6. Analysis of Remedial Alternatives for Sediments and Riverbanks

This section provides detailed descriptions and evaluations of the ten alternatives identified for addressing sediments and riverbanks (referred to as sediment alternatives).

As detailed in the CMS Proposal and 2009 Work Plan, the ten sediment alternatives that have been developed and approved by EPA for evaluation (SED 1 through SED 10) encompass a broad range of options from no action to the removal of over 2 million cubic yards of sediment and 35,000 cubic yards of riverbank soil that would take over a half century to complete. Development of the remedial alternatives focused primarily on the Rest of River reaches with the highest PCB concentrations in sediments, specifically Reaches 5 and 6 (the PSA), and to a lesser degree Reaches 7 and 8. As noted in Section 1.7 above, EPA agreed that (apart from no action) MNR is the only remedial alternative to be evaluated for the further downstream reaches (Reaches 9 through 16).

The ten sediment alternatives were summarized in Section 3.1.1 and in Table 1-1. For convenience, the alternatives are summarized again below. This summary focuses on the remediation of sediments. Note that the term "capping," when used alone, refers to engineered capping; thin-layer capping is identified separately and refers to a 6-inch sand cover to enhance natural recovery. The term "removal" refers to removal followed by capping (or, for SED 7 and SED 8, removal followed by backfilling), unless otherwise indicated. In addition, all of the alternatives involving sediment removal also include stabilization of the riverbanks in Reaches 5A and 5B with removal of bank soil where necessary, except for SED 10, which involves bank stabilization and bank soil removal in only portions of those reaches. The riverbank remediation/stabilization component of these alternatives was described in Section 3.1.4 and is not repeated in the following summary.

- SED 1 – No action in all reaches.
- SED 2 – MNR with institutional controls in all reaches.
- SED 3 – Sediment removal in Reach 5A, MNR in Reach 5B, a combination of thin-layer capping and MNR in Reach 5C, thin-layer capping in Woods Pond, and MNR for the remainder of the Rest of River.
- SED 4 – Combination of sediment removal, capping and thin-layer capping from Confluence to Woods Pond Dam. This alternative includes, in addition to the same elements as SED 3, sediment removal and thin-layer capping in Reach 5B and Woods Pond, capping in portions of Reach 5C, and thin-layer capping in portions of the backwaters.

- SED 5 – Combination of sediment removal, capping, and thin-layer capping from the Confluence to Woods Pond Dam and thin-layer capping in Rising Pond. This alternative involves the same elements as SED 4 with additional sediment removal in Reaches 5B and 5C, capping alone in a portion of Woods Pond, and thin-layer capping in Rising Pond.

- SED 6 – Combination of sediment removal, capping, and thin-layer capping from the Confluence to Woods Pond Dam, and a combination of capping and thin-layer capping in the Reach 7 impoundments and Rising Pond. This alternative involves the same elements as SED 5 with additional removal in Reach 5C and the backwaters, thin-layer capping in the Reach 7 impoundments, and a combination of capping and thin-layer capping in Rising Pond.

- SED 7 – Combination of sediment removal, capping, and thin-layer capping from the Confluence to Woods Ponds Dam, in the Reach 7 impoundments, and Rising Pond. This alternative involves the same elements as SED 6 with additional removal in Reaches 5A and 5B and backfilling rather than capping in those reaches, additional removal in the backwaters and Woods Pond, and sediment removal in portions of the Reach 7 impoundments and Rising Pond.

- SED 8 – Removal of sediments, followed by backfilling, in all areas of the main channel and backwaters of the River from the Confluence to Woods Pond Dam, in the Reach 7 impoundments, and in Rising Pond, with the depth of removal set as the depth to which PCBs above 1 mg/kg are estimated to occur (1 mg/kg depth horizon), and MNR for the remaining portions of the Rest of River.

- SED 9 – Combination of sediment removal and/or capping for the entire River from the Confluence to Woods Pond Dam, the Reach 7 impoundments, and Rising Pond, with variable depths of removal/capping.

- SED 10 – Removal of sediments to a depth of 2 feet in portions of Reach 5A that have been selected to avoid or minimize ecological harm, and removal of sediments to a depth of 2.5 feet in portions of Woods Pond that contain elevated PCB concentrations, without subsequent capping or backfilling.

Where these alternatives specify a combination of remedial technologies (e.g., removal and capping) for a specific reach or subreach, the areas where each technology would be applied were described in Section 3.1.1. Further, each alternative includes (or, in the case of SED 1, assumes) the continuation and maintenance of biota consumption advisories as necessary to limit the public's consumption of fish and other biota from the River.

Table 6-1 provides, for each sediment alternative, a summary of the removal volumes and depths and remediation areas for each reach of the river. Specifically, this table lists, for each alternative and each reach, the depth and volume of removal, acres of replacement capping or backfill in removal areas, acres of capping without prior removal, acres of thin-layer capping, and acres subject to MNR.

To evaluate the alternatives, EPA's PCB fate, transport, and bioaccumulation model was used to quantify the PCB reductions in sediment, water column, and fish predicted to result from implementation of each alternative. The use of this model in the CMS evaluations was described in detail in Section 3.2.[113] The resulting sediment and fish PCB concentrations for each alternative were compared to the relevant IMPGs in those media, using an appropriate spatial scale and type of sediment or fish concentration for the human or ecological receptor group subject to the IMPG in question. The averaging areas and other assumptions used in these comparisons were described in Section 3.5. The water column PCB concentrations predicted by the model were used for comparisons to the chemical-specific ARARs for PCBs, as described in Section 3.5.1.

Each alternative has been evaluated in detail based on nine criteria: the three General Standards and six Selection Decision Factors specified in the Permit (described in Sections 2.1 and 2.2 above). The results of these detailed evaluations are presented in Sections 6.1 through 6.10 for each of the 10 alternatives.

For the purposes of the evaluations in this section, it has been assumed that the sediment remedial alternatives would be conducted independently from the floodplain remedial alternatives. However, it would be more effective and efficient to implement any sediment remediation in conjunction with floodplain remediation. For example, the construction of access roads and staging areas would be less disruptive if sediment remediation and floodplain soil remediation were conducted at the same time. Since any selected remedy for the Rest of River will involve both a sediment remediation component and a floodplain remediation component, this Revised CMS Report presents comparative evaluations for selected combinations of sediment and floodplain alternatives (listed in Section 1.8), rather than providing separate comparative analyses for the sediment and floodplain alternatives (as in the original CMS Report). Those comparative evaluations are presented in Section 8.

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113 A separate analysis was conducted for the impoundments in the Connecticut portion of the River, as described in Section 3.2.5.

6.1 Evaluation of Sediment Alternative 1

6.1.1 Description of Alternative

SED 1 is the no action alternative. As required by the NCP, it was evaluated for all reaches of the Rest of River and provides a baseline against which other sediment alternatives can be compared. SED 1 would not include any sediment or riverbank remediation in the Rest of River area – i.e., no additional remediation beyond the remediation already conducted or planned for areas upstream of the Confluence. Rather, it would rely on those completed and ongoing upstream source control and remediation measures, along with natural recovery processes (e.g., silting over with cleaner sediments) in the Rest of River, to reduce potential exposures to PCBs in the sediments over time. It would not include any long-term monitoring to track these reductions. Upstream source control and remediation measures were described in Section 2.3 of the CMS Proposal and summarized in Section 1.4 above. These activities have included installation of NAPL collection systems at and near the former GE plant site, sediment and bank remediation activities in the Upper ½-Mile and 1½-Mile Reaches, additional remediation activities in the floodplain and former oxbow areas adjacent to the East Branch of the River, and sediment and lower bank soil remediation in the West Branch adjacent to Dorothy Amos Park (which represent the major identified PCB source in the West Branch). Ongoing and planned future activities that will result in further reductions in PCB inputs to the Rest of River include remediation of an additional area at the former GE plant site adjacent to the East Branch (known as East Street Area 2-South), remediation of Silver Lake, and remediation of the Unkamet Brook Area (including Unkamet Brook).

Although not specifically part of this alternative, it is assumed that Massachusetts and Connecticut would keep in place the existing biota consumption advisories based on PCBs, as necessary (see Section 3.8.1). The consumption advisories in Massachusetts warn against eating fish, frogs and turtles from the Housatonic River in Massachusetts, as well as eating ducks from the River between Pittsfield and Rising Pond. In Connecticut, the PCB fish consumption advisories for the Housatonic River vary by species, location, and group of potential consumers (e.g., children and pregnant women), ranging from “do not eat” (for a few species and locations) to advice to limit fish meals to one meal per month or week. (In addition, both Massachusetts and Connecticut have state-wide fish consumption advisories based on mercury levels in fish.) It is also assumed that the existing institutional controls relating to the inspection, monitoring, and maintenance of the dams and bridges on the River would continue under other authorities (as discussed in detail in Section 3.8.2). These existing requirements would ensure that any contaminated sediments or bank soils that would be contacted, removed, or released during repair, modification, replacement, or removal of those structures would be properly characterized, managed, and/or disposed of, and that any other potential adverse impacts from the work would be addressed. As also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

6.1.2 Overall Protection of Human Health and the Environment – Introduction

The first General Standard in the Permit, "Overall Protection of Human Health and the Environment," requires an evaluation of whether a remedial alternative "would provide human health and environmental protection, taking into account EPA's Human Health and Ecological Risk Assessments." As discussed in Section 2.1.1, application of this standard to a particular sediment remedial alternative relies heavily on the consideration of several other Permit criteria – notably: (a) a comparison of sediment and fish PCB concentrations predicted to result from implementation of the alternative to the human health and ecological IMPGs, which represent the levels that EPA considers to be protective of human health and ecological receptors based on the HHRA and ERA; (b) compliance with ARARs; (c) long-term effectiveness and permanence of the alternative, including long-term adverse impacts on health or the environment; and (d) short-term effectiveness. In these circumstances, the evaluation of whether SED 1 would be protective of human health and the environment is presented at the end of Section 6.1 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment. This same approach will be followed for the other sediment alternatives.

6.1.3 Control of Sources of Releases

SED 1 does not include any remediation activities within the Rest of River area. PCB levels in the water column and surface sediments would be reduced over time, due to reductions in upstream PCB inputs to the Rest of River that have already occurred and will continue as a result of the completed and remaining remediation activities upstream of the Confluence, as well as natural recovery processes within the Rest of River. For example, water column data collected from the station located immediately upstream of the Confluence (Dawes/Pomeroy Avenue) indicate that the upstream in-river and upland remediation has reduced the concentration of PCBs in the East Branch water column by a factor of three to five under both base flow and storm conditions (see Section 3 of the RFI Report [BBL and QEA, 2003] for pre-remediation data and the MIA-S for post-remediation data).[114]

[114] Annual average pre-remediation PCB concentrations at Dawes/Pomeroy (based on 1996-1998 non-stormflow monitoring data) ranged from approximately 50 to 70 nanograms per liter (ng/L, also expressed as parts per trillion). Post-remediation routine monitoring data collected in 2007 at this location (presented in the MIA-S) were considerably lower, averaging approximately 20 ng/L.

Likewise, the annual average PCB mass (or "load") entering the Rest of River from the East Branch, based on the model simulations, has exhibited a dramatic reduction due to the upstream remediation. For example, the East Branch PCB load over the first 5 years of the model projections (see Section 3.2.2.4) is 90% lower than the load over the last 5 years of the model validation period (i.e., 1999-2004; EPA 2006a). Some additional decreases in this PCB load are anticipated based on the ongoing planned remediation activities summarized in Section 6.1.1.

The existing dams along the River would continue to limit movement of the PCB-containing sediments within the impoundments behind the dams, thereby reducing the potential for transport of those PCB-containing sediments to further downstream reaches. While failure of those dams could lead to the release of the sediments impounded behind them, measures are in place under other authorities to prevent or minimize that possibility, regardless of changes in land use that may alter River transport processes and the amount of sediment transported to and within the Rest of River.

As noted in Sections 1.4 and 3.8.2, the two principal dams on the River in Massachusetts, Woods Pond Dam and Rising Pond Dam, are owned by GE and subject to the CD. GE currently monitors and maintains those dams through frequent visual inspections, with detailed inspections of the dams' structural stability on a periodic basis, and the performance of maintenance and repairs as needed. The other dammed impoundments in Massachusetts have considerably lower concentrations of PCBs in sediments as well as lower sediment volumes (which would reduce any potential impacts of dam failure). In any event, as discussed in Section 3.8.2, those dams, as well as the six dams on the River in Connecticut, are licensed and regulated by FERC, which requires maintenance and inspections of those dams as appropriate. Continuation of these activities would help ensure that the dams remain intact, minimizing the potential for any future release and transport of sediments in the impoundments behind the dams. Further, even if the owner of one of the non-GE-owned dams in Massachusetts or Connecticut did decide to remove the dam, the regulatory requirements discussed in Section 3.8.2 would ensure that any contaminated sediments are properly addressed.

The extent to which the sediment alternatives would control PCB releases was assessed using the following metrics calculated by the EPA model: (1) the mass (load) of PCBs passing Woods Pond and Rising Pond Dams and the mass of PCBs transported from the

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Similarly, pre-remediation storm event monitoring data tended to be higher than post-remediation. For example, pre-remediation concentrations collected during a September 1999 storm event ranged from approximately 50 to 1000 ng/L; by comparison, storm event samples collected during an April 2007 storm event (which had much higher flows than the September 1999 event) generally ranged from 25 to 200 ng/L.

River to the floodplain within the PSA; and (2) the ability of a flood to cause PCBs buried in the sediment to become available for exposure.

Control of the PCB mass transported within the River and to the floodplain was assessed by comparing 5-year averages calculated from model outputs over the first 5 and last 5 years of the projections, for each of the different sediment alternative projections. Five-year averages were used to minimize the effects of annual variations in flows and associated PCB transport on these comparisons. Furthermore, projection results from the first 5 years of SED 1 were used as the reference point to represent current conditions for all sediment alternatives in these comparisons.

Control of flood impacts on buried PCBs was assessed by examining predictions of erosion and subsequent changes in surface sediment PCB concentrations attributed to the extreme flow event simulated in Year 26 of the projection (see Section 3.2.2.1) as well as other large storm events included in the simulation period.

Based on EPA's model, under SED 1 the annual average PCB mass passing Woods Pond Dam is predicted to decrease by 37% over the 52-year model projection period (i.e., from 20 kilograms per year [kg/yr] to 13 kg/yr), and the annual average PCB mass passing Rising Pond Dam is predicted to decrease by 41% over the same period (i.e., from 19 kg/yr to 11 kg/yr).[115] Similarly, the annual average PCB mass transported from the River to the floodplain within Reaches 5 and 6 is predicted to decrease by 50% over the model projection period (i.e., from 12 kg/yr to 6 kg/yr).

To evaluate the effects of an extreme flow event that may expose buried sediments, temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from SED 1 over the 52-year model projection period are shown on Figure 6-1b. The model results indicate that the extreme flow event simulated in Year 26, which has a return frequency between 50 and 100 years, would not result in the exposure of buried PCBs at higher concentrations than those already present in the surface sediment prior to the event. Under SED 1, EPA's model predicts no perceptible change (e.g., less than 0.1 mg/kg) in reach-average surface sediment (top 6-inch) PCB concentrations in the PSA following the extreme event (Figure 6-1b). Similar imperceptible or small changes in reach-average surface sediment PCB concentrations were predicted in reaches downstream of the PSA (the only notable increase in sediment concentration predicted to result from the extreme event in Reaches 7 and 8 is a 0.5 mg/kg increase in Reaches 7F

[115] The total volume of water associated with these annual average PCB loads ranges from 50 to 110 billion gallons per year flowing over Woods Pond Dam and from 85 to 225 billion gallons per year flowing over Rising Pond Dam.

and 7G). While the model predicts varying extents of sediment erosion in these reaches during this event, the underlying sediments contain PCBs at concentrations similar to those of the scoured surface sediments, resulting in no perceptible changes in reach-average surface sediment PCB concentrations.

6.1.4 Compliance with Federal and State ARARs

The potential chemical-specific ARARs identified by GE for SED 1 are listed in Table S-1.a in Appendix C. Those ARARs include the federal and state water quality criteria for PCBs. The federal water quality criteria consist of a freshwater chronic aquatic life criterion of 0.014 µg/L (parts per billion) and a human health criterion of 0.000064 µg/L based on consumption of organisms or water and organisms.[116] The Massachusetts criteria are the same. The Connecticut water quality standards for PCBs include the same freshwater chronic aquatic life criterion of 0.014 µg/L. For human health protection, Connecticut has not to date revised its prior criterion of 0.00017 µg/L. That criterion does not constitute an ARAR, since it is less stringent (and less up-to-date) than the federal criterion (see 40 CFR § 300.5). However, in December 2009, CDEP proposed to revise that criterion to 0.00000056 µg/L, and that proposal is currently pending.

To evaluate whether SED 1 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by EPA's model for SED 1. As discussed in Section 3.5.1, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages (i.e., starting a new 4-day average each day) or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion, as shown in Table 6-2. Based on either averaging method, predicted water column concentrations in the Massachusetts portion of the River under SED 1 would exceed the water quality criterion 100% of the time in Reaches 5B, 5C, 6, and 7B, and on a considerable number of occasions in Reaches 5A, 7E, 7G, and 8. Thus, SED 1 would not achieve this criterion in that portion of the River, although it would do so in the Connecticut portion.

The assessment of the human health-based water quality criterion used the model-predicted annual average water column concentrations presented in Table 6-3 (in Section

[116] The human health criterion for PCBs is the same for consumption of water and organisms and for consumption of organisms only. The level for water consumption alone would be much higher. The EPA national drinking water standard for PCBs is 0.5 µg/L (40 CFR 141.61(c)). As shown below (Table 6-3), the model-predicted water column concentrations under SED 1 are below that level.

6.1.5.1 below). As shown in that table, annual average water column concentrations predicted by the model at the end of the simulation period would exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches.[117]

The ARARs based on the human consumption water quality criterion of 0.000064 µg/L should be waived on the ground that achievement of that criterion is technically impracticable, as provided in CERCLA (§ 121(d)(4)(C)) and the NCP (40 CFR § 300.430(f)(1)(ii)(C)*(3)*). There are two reasons for this: (1) that criterion is extremely low and is below the current ability to reliably measure;[118] and (2) that criterion would not be achieved by any of the sediment remedial alternatives approved by EPA for consideration, even the most extensive, in any reach in Massachusetts or in one or more of the Connecticut impoundments, as shown in Section 6.8.4 and Table 6-53.[119]

In addition, the ARARs based on the water quality criterion for freshwater aquatic life should be waived for SED 1 on the ground that compliance with that requirement "will result in greater risk to human health and the environment" than other alternatives (CERCLA § 121(d)(4)(B); 40 CFR § 300.430(f)(1)(ii)(C*)(2)*). As discussed further below, the remedial actions that would be necessary to attain that ARAR – which would involve substantial active removal and/or capping in the Rest of River – would unavoidably cause adverse short-term and long-term impacts to the environment, as described in Section 5.3 and amplified further below. Those adverse impacts would outweigh any risks to human health and the environment that would result from the exceedances of this ARAR. EPA's guidance on compliance with ARARs provides an example showing the appropriateness of such a waiver in this type of situation: "For example, attaining the ambient concentration level for PCBs spread throughout river sediment might require widespread dredging of the sediments, causing an unacceptable release of the pollutant to the water body and

[117] The water column concentrations estimated by the CT 1-D Analysis in all the Connecticut impoundments would also exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L).

[118] The preamble to EPA's NCP states that "ARARs must be measurable and attainable since their purpose is to set a standard that an actual remedy will attain" (EPA, 1990a, p. 8752); and EPA guidance on ARARs indicates where compliance with applicable standards cannot be measured due to detection limit issues, "the technical impracticability waiver should generally be invoked" (EPA, 1990b). The latter notes further that, in the absence of a reliable measurement tool, extrapolations should not be used because they "cannot be verified scientifically with any degree of certainty."

[119] For similar reasons, Connecticut's proposed water quality criterion of 0.00000056 µg/L (0.00056 ng/L) is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments. As a result, in the event that CDEP should adopt that proposed criterion as a water quality standard, it should likewise be waived as technically impracticable to attain.

damaging or disrupting the ecosystem. Waiving the ARAR for ambient PCB concentrations in the sediment would eliminate the need to conduct such harmful dredging" (EPA, 1988, p. 1-72).

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan also directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens (the latter of which would not be addressed by any alternative). The impact of SED 1 on the PCB water quality criteria in Massachusetts is discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.1.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic River in Massachusetts, is discussed in Section 6.1.6. The Housatonic River in Connecticut is listed as impaired based on the Connecticut Department of Public Health's (CDPH's) fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 1 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.1.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.1.6.1. These evaluations provide an assessment of the effect of SED 1 on the impairment listings.

Since SED 1 would not involve any remedial actions in the Rest of River area, there are no location-specific or action-specific ARARs that would apply to this alternative.

6.1.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of a remedial alternative includes an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment associated with the alternative. Each of these considerations is evaluated below for SED 1.

6.1.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk includes consideration of the extent to which and time over which the alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Under SED 1, reductions in PCB concentrations and exposure in the Rest of River area would continue to result from upstream source control and remediation measures and natural recovery processes. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the media to which receptors may be exposed – i.e., sediments in the bioavailable zone (top 6 inches), surface water, and fish (whole body and fillet-based concentrations). The fish tissue concentrations listed are for largemouth bass age classes 6-10 (or smallmouth bass in Connecticut), which are the species and age classes assumed for human consumption of fish (as described in Section 3.3.2).

Table 6-3 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 1/SED 2)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	13	9.0	36	7.3
5B	7.0	44	47	9.3
5C	20	34	37	7.4
5D (backwaters)	17	---	48	9.5
6	16	33	43	8.6
7[1]	0.4 - 5.1	14 – 28	14 - 32	2.8 - 6.4
8	2.9	13	18	3.6
CT[1]	0.04 – 0.08	0.6 – 1.3	0.4 – 0.8	0.08 – 0.2

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the predicted PCB concentrations shown in the above table have been evaluated based on the extent to which they would achieve the IMPGs, as discussed in Section 6.1.6.[120]

Temporal profiles of predicted reach-average PCB concentrations in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from SED 1 over the 52-year model projection period are shown on Figures 6-1a-c. These figures show the timeframes over which the model predicts that PCB concentrations in each medium would be reduced under SED 1. Although the model results vary by reach (and annually in the water column due to changing hydrologic inputs), PCB concentrations in all three media generally exhibit a slow, steady decline throughout the projection period due the decreases in PCB loads entering at the Confluence and natural attenuation processes. As a result, fish PCB concentrations are reduced by 40% to 60% over the projection period in both the PSA and in Reaches 7 and 8 (Figure 6-1c).[121]

PCBs would also remain in the sediments deeper than 6 inches. The extent to which a flood event could cause such buried PCBs to become available for human and ecological exposure was discussed in Section 6.1.3. As discussed in that section, model predictions indicate that flood events would not result in the exposure of buried PCBs at higher concentrations than those already present in the surface sediment prior to the event.

Under SED 1, it is presumed that biota consumption advisories would continue for an indefinite period.

6.1.5.2 Adequacy and Reliability of Alternative

Since SED 1 would not involve any remediation in the Rest of River, considerations relating to the adequacy and reliability of specific remedial technologies are not applicable. Note that natural recovery processes are documented to be occurring in certain portions of the River as evidenced by the evaluation of finely sectioned cores from Woods Pond and Rising Pond and long-term trends in fish and benthic insects – which are described in Section

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[120] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

[121] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are lowered based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 1 would also be lower, in the range from 27% to 45% in Reaches 5 and 6, and 27% to 44% in Reaches 7 and 8.

6.2.5.2. However, under SED 1, the adequacy and reliability of natural recovery processes would not be determined in the future, since no monitoring activities would be implemented.

6.1.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

Since SED 1 would not involve any remediation in the Rest of River, its implementation would not cause any long-term adverse impacts on human health or the environment. The potential effects from the continued presence of PCBs are considered under other criteria, including magnitude of residual risk, attainment of IMPGs, and overall protection of human health and the environment (Sections 6.1.5.1, 6.1.6, and 6.1.11).

6.1.6 Attainment of IMPGs

As part of the evaluation of SED 1, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in a manner consistent with the methods used in the human health and ecological risk assessments (see Section 3.5). The sections below describe the human health and ecological receptor IMPG comparisons for SED 1; Tables 6-4 through 6-9 summarize the comparisons of SED 1 model results to the IMPGs that apply to sediments and fish.

As described below, IMPGs would be achieved in some areas by the end of the 52-year model simulation period due to natural recovery processes. The predicted numbers of years required to achieve the various IMPGs are presented in Tables 6-4 through 6-9. In addition, the figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the time to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. Such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of the time to achieve the IMPGs that are not met within the 52-year model projection period are described below.

Also, as described in Section 3.2, bounding simulations have been conducted with the model (as directed by EPA) to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values. Since SED 1 does not involve remediation, the sediment residual bounding assumptions do not apply. Further, the bounding simulation conducted for SED 1 to evaluate the significance of the East Branch boundary condition assumptions indicated that the impact of changes in those assumptions on the model results is negligible. Therefore, the results of the bounding simulation for SED 1 are not included in the discussion below.

6.1.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations for SED 1 would achieve IMPG values within EPA's cancer risk range, as well as all non-cancer-based IMPGs, in all eight of the sediment direct contact exposure areas located within Reaches 5 through 8 (see Table 6-4).[122] The majority of these IMPGs are met at the onset of the model projection period, while some would be achieved over a period of approximately 10 to 40 years via natural recovery processes.

For human consumption of fish, the fish PCB concentrations predicted to result from SED 1 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve any of the IMPGs by the end of the simulation period (Table 6-5), except as follows:

- The CTE IMPGs based on a 10^{-4} cancer risk would be achieved in some of the subreaches between Woods Pond Dam and Rising Pond Dam after approximately 5 to 50 years (although the corresponding non-cancer CTE IMPGs would not be achieved).
- The RME IMPGs based on a 10^{-4} cancer risk would be achieved in all of the Connecticut impoundments, although the corresponding non-cancer RME IMPGs would generally not be achieved. In addition, the CTE IMPGs based on a 10^{-5} cancer risk would be achieved in the Connecticut impoundments at the outset of the model simulation period.[123]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 fish meals per year would

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[122] Specifically, SED 1 would achieve all direct contact IMPG values with the exception of the RME values based on a 10^{-6} cancer risk and, in areas SA 2 and SA 3, the RME values based on a 10^{-5} cancer risk (which would be slightly exceeded).

[123] In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health IMPG comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described in the text. For SED 1, this change in averaging method (and the resulting increase in concentration) does not change the IMPG assessment presented in Table 6-5, except that the 10^{-4} cancer probabilistic CTE IMPG would no longer be achieved in Reach 7B.

take >250 years in the PSA and in Reaches 7 and 8, and 170 to 230 years in the Connecticut impoundments.[124]

6.1.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average surface sediment PCB concentrations would achieve the upper-bound IMPG (10 mg/kg) within the model period in 23 of the 32 averaging areas (Table 6-6). The time required to achieve the upper-bound IMPG (when attained) ranges from <1 to 40 years. In areas where this IMPG is not achieved, extrapolation of the model results indicates that the time to achieve the upper-bound IMPG for benthic invertebrates could range between 80 and >250 years.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the upper-bound IMPG (5.6 mg/kg) in 10 of the 29 backwaters evaluated, and would also achieve the lower-bound IMPG (3.27 mg/kg) in 7 of those areas (Table 6-7). The time to achieve the IMPGs in backwaters could range between 5 and >250 years for the upper-bound IMPG and between 10 and >250 years for the lower-bound IMPG.

For fish, the model-predicted average whole-body fish PCB concentrations for SED 1 would achieve the IMPGs for warmwater fish (55 mg/kg) in all reaches, but would not achieve the IMPG for coldwater fish (14 mg/kg) in any of the eight subreaches in Reach 7 (Table 6-8). The time to achieve the warmwater fish IMPG (where it was not already met at the beginning of the model period) ranges from approximately 5 to 35 years. Estimates of the time to achieve the coldwater fish IMPG range from 90 to 180 years.

For insectivorous birds (represented by wood ducks) and piscivorous mammals (represented by mink), predicted average surface sediment PCB levels in the relevant averaging areas exceed the highest selected target sediment level (5 mg/kg) in all relevant averaging areas in Reaches 5 and 6, except for one wood duck averaging area (where achievement of that level would take approximately 50 years) (Table 6-9). Estimates of the time required to achieve these target levels range from 100 to >250 years for the

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[124] In this and subsequent sections, in order to have a consistent metric for specifying the time in which the extrapolations indicate that fish PCB levels would reach the IMPGs for unrestricted fish consumption, GE has used the lower of (a) the deterministic RME IMPG based on a 10^{-5} cancer risk or (b) the deterministic RME IMPG based on a non-cancer HI of 1. Further, as discussed in Section 3.2.1, where that extrapolated time exceeds 250 years, the time has been specified as > 250 years, because (1) that timeframe corresponds to a duration ten times as long as that used to develop the extrapolation function, and (2) the uncertainty and unreliability of the projections render meaningless any attempt to compare alternatives beyond that timeframe.

insectivorous bird levels and from approximately 200 to >250 years for the piscivorous mammal levels, based on extrapolation of the model results.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations for the relevant size ranges are greater than the IMPG of 3.27 mg/kg in all reaches (Table 6-8). Estimates of the time required to achieve this IMPG range from approximately 90 years in Reach 7H to >250 years in several of the remaining reaches, based on extrapolation of the model results.[125]

Finally, for threatened and endangered species (represented by bald eagle), the model-predicted average whole-body fish PCB concentrations for the relevant size range would achieve the IMPG (30.4 mg/kg) in all reaches (Table 6-8). The time to achieve this IMPG ranges from approximately 5 to 30 years.[126]

6.1.7 Reduction of Toxicity, Mobility, or Volume

Since SED 1 would not involve any remediation in the Rest of River, it does not include any processes that would reduce the toxicity or volume of PCBs in the sediment, and any reduction in the mobility of PCBs in that area would occur in the long term through upstream source control/remediation and naturally occurring processes (e.g., silting over with cleaner sediments). However, these reductions would not be documented via monitoring.

6.1.8 Short-Term Effectiveness

Since SED 1 would not involve any remediation in the Rest of River, it would not result in any short-term impacts.

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[125] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no change in the number of averaging areas achieving the piscivorous bird IMPG under SED 1.

[126] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 1 at the end of the simulation period are 0.04 to 0.08 mg/kg, and estimated fish PCB concentrations (whole body) in the Connecticut impoundments at the end of the projection period under SED 1 are in the range of 0.4 to 0.8 mg/kg (Table 6-3). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

6.1.9 Implementability

Since SED 1 would include no remedial action or associated activities in the Rest of River, there would be no technical or administrative implementability issues associated with this alternative.

6.1.10 Cost

There would be no cost associated with SED 1.

6.1.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.1.2, the evaluation of whether SED 1 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As noted previously, SED 1 would rely on upstream source control/remediation measures and natural recovery processes, expected to primarily involve physical processes (e.g., silting over with cleaner sediments), to reduce the concentrations of PCBs in sediments, surface water, and fish. As shown in Section 6.1.3, EPA's model predicts that, due to these processes, the PCB load in the River passing Woods Pond Dam and Rising Pond Dam would be reduced by 37% and 41%, respectively, over the course of the modeled period. Further, EPA's model predicts that, due to these processes, there would be a reduction in sediment and fish PCB concentrations over that period, as shown in Section 6.1.5.1. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 35-50 mg/kg in Reaches 5 and 6, from 30-50 mg/kg to approximately 20-30 mg/kg in the Reach 7 impoundments (i.e., Reaches 7B, 7E, and 7G), from approximately 30 mg/kg to approximately 20 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.4-0.8 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As discussed in Section 6.1.4, SED 1 would not achieve the federal and state water quality criteria, including the freshwater chronic aquatic life water quality criterion and the criterion based on human consumption of water and organisms. However, for the reasons given in that section, the latter should be waived as technically impracticable, and the former should be waived on the ground that the actions necessary to achieve that criterion would result in greater risk to the environment than alternatives that do not achieve that criterion.

Human Health Protection: As shown in Section 6.1.6.1, for direct human contact with sediments, SED 1 would achieve sediment PCB levels within EPA's cancer risk range and below the target non-cancer HI of 1 in all sediment direct contact exposure areas, with the majority of these IMPGs met at the present time. As such, SED 1 would provide human health protection from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 1 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the IMPG levels based on RME assumptions (i.e., those based on unrestricted consumption of Housatonic River fish) in any reaches (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in the Connecticut impoundments). In these circumstances, it is assumed that existing fish consumption advisories would continue to be used to protect human health from fish consumption.

Environmental Protection: As discussed in Section 6.1.6.2, the model results indicate that SED 1 would achieve fish PCB levels below the IMPGs for protection of warmwater fish and threatened and endangered species within the modeled period, but would not achieve sediment or fish IMPG levels for other ecological receptor groups in a number of averaging areas. For example, SED 1 would result in PCB levels in sediments and fish at the end of the modeled period that: (a) exceed the upper bound of the sediment IMPGs for benthic invertebrates (10 mg/kg) in about 30% of the relevant averaging areas; (b) exceed the upper bound of the sediment IMPGs for amphibians (5.6 mg/kg) in about 65% of the backwaters; (c) exceed the highest selected target sediment level (5 mg/kg) developed to assess protection of insectivorous birds and piscivorous mammals in all relevant averaging areas (except one wood duck averaging area); (d) exceed the fish IMPG for piscivorous birds (3.2 mg/kg) in all relevant reaches; and (e) exceed the coldwater fish IMPG (14 mg/kg) in all relevant reaches.

On the other hand, since SED 1 would not involve remediation in the Rest of River, it would avoid the adverse long-term and short-term environmental impacts that would result from remediation to attempt to meet the unmet IMPGs, as described in Section 5.3.

Summary: Under SED 1, human health would be protected in connection with direct contact with sediments, and human health protection related to fish consumption would be provided by the continuation of fish consumption advisories. With respect to ecological receptors, SED 1 would not achieve the IMPGs for several such receptor groups, as described above. Therefore, if one accepts EPA's conclusions in the ERA on which those IMPGs were based (as GE has been directed to do by EPA), SED 1 would not be fully protective of ecological receptors. However, as previously noted, GE disputes EPA's conclusions in the ERA and the resulting bases for these IMPGs, and believes that the harm to multiple ecological receptors that would result from remediation activities in the Rest of River would outweigh the benefit of those disruptive remediation activities.

6.2 Evaluation of Sediment Alternative 2

6.2.1 Description of Alternative

SED 2 consists of MNR with institutional controls for all reaches of the Rest of River, and would rely on upstream source control and remediation measures and natural recovery processes for reduction of PCB concentrations in surficial sediments over time. Institutional controls in the form of biota consumption advisories, including continued posting of signs along the River; would be continued to reduce the potential for human exposure to PCBs (see Section 3.8.1 for further discussion of fish consumption advisories). The existing institutional controls relating to the inspection, monitoring, and maintenance of the dams and bridges on the River would also continue under other authorities (as discussed in detail in Section 3.8.2). These existing requirements would ensure that any contaminated sediments or bank soils that would be contacted, removed, or released during repair, modification, replacement, or removal of those structures, as well as any other potential adverse impacts from the work, would be addressed. As also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

MNR is assumed to include the performance of routine monitoring activities in various reaches of the River to document changes in river conditions over time. Natural recovery processes (e.g., silting over with cleaner sediments) have been documented in portions of the Housatonic River (BBL and QEA, 2003, Sections 4.6 and 6.6) and would continue throughout the River downstream of the Confluence at varying rates due in part to the completed and planned source control and remediation measures in and adjacent to upstream reaches.

For purposes of this Revised CMS Report, it is assumed that the monitoring program would include biota, water column, and sediment monitoring. Monitoring is assumed to continue for a period of 100 years based upon EPA's direction. A summary of the monitoring program for SED 2 is presented in Table 3-22 as referenced in Section 3.8.2. Specifically, it is assumed that monitoring would include the following:

- Adult fish sampling at eight locations (four locations each in Massachusetts and Connecticut) in Years 1 through 5, 10, 15, 25, 50, 75, and 100, consisting of two species, 10 fish per species per location, with all samples submitted for PCB Aroclor and lipid content analysis;

- Quarterly water column sampling at 12 locations along the Housatonic River in Massachusetts and Connecticut for analysis of PCBs (total) and TSS in Years 1 through 5, 10, 15, 25, 50, 75, and 100; and

- Sediment sampling, consisting of the collection of 100 surface sediment samples in Massachusetts and Connecticut for PCB analysis in Years 5, 10, 15, 25, 50, 75, and 100.

Although this program has been assumed for purposes of this Revised CMS Report, the actual scope of monitoring activities would be determined during the design phase.

It is also assumed that the existing inspection, monitoring, and maintenance programs for the dams on the River would continue under other authorities, as discussed in Section 3.8.2.

6.2.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 2 would be protective of human health and the environment is presented at the end of Section 6.2 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.2.3 Control of Sources of Releases

SED 2 would not involve any remedial construction activities within the Rest of River area. As described for SED 1, PCB levels in the water column and surface sediments have been reduced, and will continue to be reduced over time, due to reductions in PCB inputs to the Rest of River as a result of the completed and remaining remediation activities upstream of the Confluence, as well as natural recovery processes within the Rest of River. As summarized in Section 6.1.3, completed upstream source control and remediation measures have already resulted in a decrease in PCB loading to the water column. Continued decreases in PCB concentrations entering the Rest of River are anticipated based on the planned activities summarized in Section 6.1.1.

Existing dams along the River would continue to limit movement of the PCB-containing sediments within the impoundments behind those dams, thereby reducing the potential for transport of those PCB-containing sediments to further downstream reaches. While failure of those dams could lead to the release of the sediments impounded behind them, the inspection, monitoring, and maintenance programs in place under other authorities, as described for SED 1 in Section 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams are properly addressed.

Modeling results (which are the same as for SED 1) indicate that, under SED 2, the average annual PCB mass passing Woods Pond Dam and Rising Pond Dam would decrease by approximately 37% and 41% respectively over EPA's model projection period, and the average annual mass of PCBs transported to the Reach 5/6 floodplain from the River would decrease by 50% over that period. Such reductions would be tracked over time via monitoring activities.

In addition, EPA's model indicates that an extreme flow event would not cause buried PCBs to be exposed at higher concentrations than those already present in surface sediment prior to the event, as discussed in Section 6.1.3.

6.2.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 2 are listed in Tables S-2.a through S-2.c in Appendix C. The potential chemical-specific ARARs, specified in Table S-2.a, include the federal and state water quality criteria for PCBs specified in Section 6.1.4. To evaluate whether SED 2 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 2. Since the model results for SED 2 are the same as those for SED 1, this comparison is the same as that described for SED 1 in Section 6.1.4 and is shown in Table 6-2. As for SED 1, the model-predicted water column concentrations would exceed these criteria in all reaches in Massachusetts (although not in Connecticut). However, for the reasons given in Section 6.1.4, these ARARs should be waived by EPA under CERCLA and the NCP on the grounds that the actions necessary to attain the aquatic life criterion would result in greater environmental risk than other alternatives (apart from SED 1) and that attainment of the human consumption criterion is not technically practicable.

For SED 2, the applicable location-specific and action-specific ARARs (and TBCs), listed in Tables S-2.b and S-2.c, relate to sampling in waterbodies, floodplains, and wetlands, as well as biota consumption advisories and requirements pertaining to dam inspection/maintenance activities and decontamination procedures. The activities performed under SED 2 would be conducted in accordance with those ARARs.

6.2.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness of SED 2 includes an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment associated with the alternative, as described below.

6.2.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 2 has included consideration of the extent to which and time over which the alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as institutional controls.

Reductions in PCB concentrations and exposure in the Rest of River area would continue to result from upstream source control and remediation measures and natural recovery processes. Table 6-3 (included in Section 6.1.5.1) shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model period in surface sediments, surface water, and fish for SED 1. Those same predictions apply to SED 2.

The temporal profiles of reach-average PCB concentrations presented on Figures 6-1a-c also apply to SED 2. These figures show temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 2 over the 52-year model projection period, as well as the timeframes over which the model predicts that SED 2 would reduce the PCB concentrations in each medium. As discussed in Section 6.1.5.1, a steady decline in PCB concentrations is predicted for most reaches in all media, due to reductions in PCB inputs from upstream and natural attenuation processes.

In addition, as with SED 1, PCBs would remain in sediments deeper than those included in Table 6-3. As noted in Section 6.2.3, flood events would not result in the exposure of buried PCBs at higher concentrations than those already present in the surface sediment.

Human exposure to PCBs in fish and other biota (e.g., fish, turtles, and ducks) would continue to be addressed through biota consumption advisories (described in Section 6.1.1) for an indefinite period. A long-term monitoring program would be implemented to evaluate the long-term effectiveness of this remedial alternative in mitigating potential human and ecological exposures to PCBs.

6.2.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 2 has included an assessment of the following factors: whether the technology used in that alternative (MNR) has been used effectively at other sites under similar conditions; reliability of OMM requirements and availability of labor and materials needed for OMM; and the potential need to replace technical components of the alternative.

Use of Technologies under Similar Conditions

MNR has been selected as part of the overall remedial approach for contaminated sediments at numerous Superfund sites (EPA, 2005d). With specific regard to PCBs, MNR with source control was the selected remedial approach for a seven-mile stretch of Twelvemile Creek and the 56,000-acre Lake Hartwell at the Sangamo-Weston Superfund Site in Pickens, SC (EPA, 1994a). MNR has been selected as a remedy component at other PCB sites. These sites include the Charleston Boat Yard, OR site (ORDEQ, 2001), the Fox River (EPA and WDNR, 2007), the Little Mississinewa River, IN (EPA, 2004d), the Wycoff/Eagle Harbor Superfund Site East Harbor, WA (EPA, 1994b), and Commencement Bay Nearshore/Tideflats (Sitcum Waterway), WA (Merritt et al., 2009). MNR was selected for these sites (or portions of sites) as it was determined that there were "ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment" and those processes were contributing to risk reduction (EPA, 2005d, p. 4-1). Based on monitoring results available for some of these sites, natural recovery when combined with source controls has been demonstrated to be effective in reducing contaminant levels in sediment and biota (e.g., shellfish), although long-term monitoring data are not yet available at most sites to document risk reductions (EPA, 2005d).

Likewise, natural recovery processes have been shown to be occurring in certain portions of the Rest of River, such as Woods Pond, Rising Pond, and the Connecticut impoundments. Many different processes aid in natural recovery and reduce risk from PCB-containing sediment. One of these processes involves a reduction in exposure levels through "a decrease in contaminant concentration levels in the near-surface sediment zone through burial or mixing-in-place with cleaner sediment" (EPA, 2005d; p. 4-2). Through the analysis of finely sectioned cores in Woods Pond and Rising Pond, there is evidence of deposition of cleaner sediments on the surface of certain portions of the ponds. In general, the temporal trends in surface sediment concentrations in Woods Pond and Rising Pond show a downward sloping regression line, at least in some portions of those ponds. As described in the RFI Report (BBL and QEA, 2003), "the PCB concentration of particles that settled in depositional areas of Woods Pond and Rising Pond have significantly decreased since the 1960s. The results for these cores, however, cannot be used to conclude that reach-wide concentrations in these impoundments have significantly decreased during this period." It is also likely that some natural recovery processes (e.g., silting over with cleaner sediments) are ongoing or will occur elsewhere in the River at varying rates due to completed and future PCB remedial measures implemented by GE and EPA in upstream areas. Moreover, as described in Section 6.2.3, the EPA model predicts that natural recovery processes will result in considerable reductions in PCB loading to the Rest of River and PCB concentrations within the Rest of River. Thus, there are conditions in portions of the Rest of River which are similar to those at sites where MNR has been selected as a remedy component.

The results of recent fish sampling provide further evidence that natural processes, together with source control and remediation efforts upstream of the Rest of River, are producing reductions in PCB concentrations in the River. In September 2008, GE conducted an additional round of sampling of adult largemouth bass at three locations in the Rest of River. This sampling involved the collection of 15 bass at Reach 5B/5C, 15 bass at Woods Pond, and 10 bass at Rising Pond, which are comparable to the numbers of largemouth bass previously sampled at these locations by EPA in 1998 and by GE in 2002. All of these fish collection efforts were conducted at the same time of year. The samples collected were submitted for analyses of the fillets and the offal for PCBs and lipids. The results are presented in Table 6-10. Comparisons of these results with the results of the samples collected in 1998 and 2002 are shown, for both fillets and reconstituted whole bodies (fillets plus offal), and on both a wet-weight and lipid-normalized basis, on Figures 6-2a and 6-2b, respectively. As indicated by those figures, the 2008 samples show a substantial reduction in PCB concentrations in the fish in Reach 5B/5C and Woods Pond compared to those measured in 1998 and 2002. This reduction is particularly pronounced in the fillets, but is also evident in the reconstituted whole body data, and can be observed for both wet-weight concentrations (Figure 6-2a) and lipid-normalized concentrations (Figure 6-2b).

The statistical significance of the observed declines in PCB concentrations in these adult fish was confirmed through a 3-way (reach, tissue preparation, and year) analysis of variance (ANOVA) performed on log-transformed lipid-normalized concentrations.[127] For both the Reach 5B/5C and Woods Pond locations, this analysis shows a significant difference in PCB concentrations, with the 2008 data being significantly lower than both the 1998 and 2002 data ($p < 0.05$). In addition, the 1998 and 2002 data were not significantly different from one another. For the Rising Pond data, based on a one-tailed Student's t-

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[127] Data were lipid-normalized in order to remove variability in concentrations due to differences in lipid content; data were log-transformed since ANOVA assumes that the distributions in each of the groups are normally distributed and previous statistical analyses of the fish data from the system indicated that the data were generally lognormally distributed (e.g., Figure D-2.1 of the RFI Report [BBL and QEA, 2003].

test, there is no statistically significant difference in concentrations between the 1998 and 2008 fish data.

It should also be noted that the adult fish data collected from Reach 5B/5C and Woods Pond in 2008 show lower PCB concentrations in those fish than the initial concentrations in EPA's model. This suggests that SED 2 may achieve lower concentrations than predicted by EPA's model, although this would need to be confirmed by future long-term fish sampling.

In addition, GE completed another round of biennial sampling of young-of-year (YOY) fish between September 29 and October 2, 2008. This sampling involved the collection of composite samples of largemouth bass, yellow perch, and bluegill/pumpkinseed at four locations in Massachusetts – New Lenox Road (HR 2), Woods Pond, Glendale Dam, and the Connecticut border (HR 6) – for analysis of PCBs and lipid content. The resulting data are presented in Table 6-11. In addition, the mean concentrations for each species and location for 2008 are shown in relation to those from prior years (1994-2006), on both wet-weight and lipid-normalized bases, in Table 6-12 and Figures 6-3a–b. The 2008 YOY data are generally consistent with the 2008 adult largemouth bass data from the PSA. While trends in YOY fish data can be confounded by year-to-year variability arising from several sources (e.g., hydrologic conditions and water temperature), the samples collected in 2008 generally show a decline in PCB concentrations from prior years and PCB levels that are among the lowest observed since the start of this program in 1994.

These data provide further support for the conclusion that source control and remediation efforts upstream of the Confluence, together with ongoing natural recovery processes within the Rest of River, have resulted in a significant reduction in PCB concentrations in the Rest of River between the Confluence and Woods Pond Dam.

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

SED 2 would include long-term monitoring of biota, water column, and sediment to evaluate the effectiveness of natural recovery processes. Such monitoring activities are considered a reliable means of tracking changes in constituent concentrations over time (EPA, 2005d). The labor and materials required to implement the long-term monitoring activities should be readily available. There would be no operation or maintenance requirements associated with implementation of SED 2.

Technical Component Replacement Requirements

Since SED 2 would not include in-river excavation/construction activities, there would be no need to replace technical components of the remedy.

6.2.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

SED 2 would not involve any remedial construction activities in the Rest of River. The monitoring activities that are part of SED 2 would not produce any long-term adverse impacts on human health or the environment. The potential effects from the continued presence of PCBs are considered under other criteria, including magnitude of residual risk, attainment of IMPGs, and overall protection of human health and the environment (Sections 6.2.5.1, 6.2.6, and 6.2.11).

6.2.6 Attainment of IMPGs

Since the model predictions for SED 2 are the same as those for SED 1, the extent to which SED 2 would achieve the IMPGs for human health and ecological protection and the time periods in which it would achieve those IMPGs are the same as those described for SED 1 in Section 6.1.6. The comparisons of SED 2 model results to the IMPGs that apply to sediments and fish are summarized in Tables 6-4 through 6-9.

6.2.7 Reduction of Toxicity, Mobility, or Volume

Since SED 2 would not include any remedial construction in the Rest of River, it would not include any processes that would reduce the toxicity or volume of PCBs in the sediment, and any reduction in the mobility of PCBs in that area would occur in the long term through upstream source control/remediation and naturally occurring processes (e.g., silting over with cleaner sediments). The reductions in PCB concentrations predicted by the model from implementation of this alternative are discussed in Section 6.2.5.1. The actual reductions would be tracked and evaluated through long-term monitoring.

6.2.8 Short-Term Effectiveness

Since SED 2 would not involve any remedial construction activities in the Rest of River, it would not result in any short-term impacts. While monitoring activities would involve the potential for exposure to PCBs by site workers involved in those activities, as well as the potential for accidents to such workers, these risks would be minimal, and would be mitigated through implementation of health and safety measures similar to those successfully applied during such activities on the River in the past.

6.2.9 Implementability

6.2.9.1 Technical Implementability

The technical implementability of SED 2 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 2 would be implemented using well-established and readily available methods for long-term monitoring of PCB concentrations in the water column, sediment and fish. Fish, water column, and sediment monitoring would be conducted using conventional equipment.

Ability To Be Implemented: As described above, SED 2 could be readily performed. There would be no construction activities performed as part of SED 2.

Reliability: The monitoring activities that would be performed under SED 2 are reliable, as shown through implementation at other sites and the Housatonic River. Monitoring activities provide data necessary to evaluate trends in fish, water column, and sediment, so as to help determine the extent to which PCB concentrations are changing over time.

Availability of Space for Support Facilities: Since there would be no construction activities associated with SED 2, no staging areas or support areas would be needed along the River. Sampling activities would require only boat or shoreline access.

Ease of Conducting Additional Corrective Measures: SED 2 does not include any construction activities; therefore, implementation of this alternative would not interfere with the performance of additional corrective measures if deemed necessary at some point in the future.

Ability to Monitor Effectiveness: The effectiveness of SED 2 would be determined over time through monitoring to document PCB concentrations in the water column, sediment, and fish in various reaches of the River. Such monitoring has been used to document changes in sediment, surface water and biota PCB concentrations, and is expected to be an effective means of tracking the effects of implementing SED 2 over time.

6.2.9.2 Administrative Implementability

The administrative implementability of SED 2 has been evaluated considering the criteria listed below.

Regulatory Requirements: Implementation of SED 2 would need to comply with the substantive requirements of applicable and appropriate regulations pertaining to the performance of this alternative (unless waived). Since SED 2 includes only monitoring activities and maintenance of institutional controls, it could be conducted in accordance with the location-specific and action-specific ARARs relating to those activities (see Section 6.2.4).

Access Agreements: It is anticipated that implementation of SED 2 would require GE to obtain permission for access as necessary to conduct monitoring and to post biota consumption advisory signs. Although many of the areas in Reach 5 are owned by the State or the City of Pittsfield (which have agreed to provide access), access agreements may be required from other landowners. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA and/or MDEP to provide assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in dissemination of information to the public and surrounding communities. In addition, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.2.10 Cost

Since SED 2 does not include excavation or construction activities, there are no anticipated capital costs. The estimated annual cost of the long-term monitoring program associated with SED 2 ranges from $33,000 to $379,000 per year depending on the extent of monitoring occurring within a given year, resulting in a total OMM cost of $5.0 M over 100 years. The long-term monitoring program costs include the performance of quarterly surface water monitoring activities, as well as collection of representative sediment and fish tissue samples at the intervals specified in Section 6.2.1 for 100 years following completion of construction. In addition, the long-term monitoring program costs include costs for the annual maintenance of institutional controls. The following summarizes the total capital and OMM costs estimated for SED 2:

SED 2	Est. Cost	Description
Total OMM Cost	$5.0 M	Costs for performance of the 100-year Long-Term Monitoring Program
Total Cost for Alternative	$5.0 M	Total cost of SED 2 in 2010 dollars

Note: $ M = millions of dollars

The total estimated present worth cost of SED 2, which was developed using a discount factor of 7% and considering an OMM period of 100 years, is approximately $1.8 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain alternative. As noted in Section 1.8, SED 2 has been combined with FP 1 for the comparative evaluations, and the estimated costs for the combination of SED 2 and FP 1 are presented in Section 8.2.9.

6.2.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.2.2, the evaluation of whether SED 2 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As noted previously, SED 2 would rely on upstream source control/remediation measures and natural recovery processes, expected to primarily involve physical processes (e.g., silting over with cleaner sediments), to reduce the concentrations of PCBs in sediments, surface water, and fish. Due to these processes, EPA's model predicts that SED 2 would result in the same reductions in PCB loading in the River and the same reductions in sediment and fish PCB concentrations as described for SED 1. However, under SED 2, these reductions would be tracked over time via monitoring.

Compliance with ARARs: As discussed in Section 6.2.4, SED 2 could be implemented to meet the action-specific and location-specific ARARs pertinent to this alternative. On the other hand, similar to SED 1, SED 2 would not achieve the federal and state water quality criteria. However, as discussed in Section 6.1.4, the criterion based on human consumption of water and organisms should be waived as technically impracticable to meet, and the freshwater chronic aquatic life criterion should be waived on the ground that the actions necessary to achieve that criterion would result in greater risk to the environment than alternatives that do not achieve that criterion.

Human Health Protection: Since the model-predicted concentrations for SED 2 are the same as those for SED 1, the ability of SED 2 to achieve the IMPGs for human health protection is the same as that discussed for SED 1 in Section 6.1.11. For direct human contact with sediments, SED 2 would achieve sediment IMPGs within EPA's cancer risk range, as well as the non-cancer-based IMPGs, in all sediment exposure areas, with the majority of these IMPGs met at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 2 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the IMPG levels based on RME assumptions (i.e., those based on unrestricted human fish consumption) in any reaches (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the associated non-cancer IMPGs, in the Connecticut impoundments). In these circumstances, SED 2 would rely on the continuation of fish consumption advisories to protect human health from fish consumption.

Environmental Protection: SED 2 would achieve the IMPGs for protection of warmwater fish and threatened and endangered species within the modeled period. However, it would not achieve sediment or fish IMPGs levels for other ecological receptor groups – namely, benthic invertebrates, amphibians, piscivorous birds, and coldwater fish – in a number of averaging areas; and it would result in sediment levels that would exceed the highest selected target sediment level (5 mg/kg) developed to assess protection of insectivorous birds and piscivorous mammals in all relevant averaging areas (except one wood duck averaging area).

On the other hand, since SED 2 would not involve remedial construction activities in the Rest of River, it would avoid the adverse long-term and short-term environmental impacts that would result from remediation to attempt to meet the unmet IMPGs, as described in Section 5.3.

Summary: SED 2 would provide human health protection in connection with direct contact with sediments and would rely on the continuation of institutional controls (fish consumption advisories) to provide human health protection from fish consumption. With respect to ecological receptors, SED 2 would not meet the IMPGs for several such receptor groups, as described above. Therefore, if one accepts EPA's conclusions in the ERA on which those IMPGs were based (as GE has been directed to do by EPA), SED 2 would not be fully protective of ecological receptors. However, as previously noted, GE disputes EPA's conclusions in the ERA and the resulting bases for these IMPGs, and believes that the harm to multiple ecological receptors that would result from further remediation activities would outweigh the benefit of those further disruptive remediation activities

6.3 Evaluation of Sediment Alternative 3

6.3.1 Description of Alternative

SED 3 would involve the removal of a total of 169,000 cy of sediments and riverbank soils – including 134,000 cy of sediment over 42 acres plus 35,000 of bank soils as part of bank stabilization over 14 linear miles of riverbank – and application of a thin-layer cap over 97 acres. Specifically, the components of SED 3 include the following:

- Reach 5A: Sediment removal in the entire reach (134,000 cy over 42 acres) followed by capping;

- Reach 5B, upstream portion of Reach 5C, and Reach 5 backwaters: MNR;

- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);

- Downstream portion of Reach 5C and Reach 6 (Woods Pond): Thin-layer capping (37 acres in Reach 5C and 60 acres in Woods Pond); and

- Reaches 7 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figure 6-4 identifies the remedial action(s) that would be taken in each reach as part of SED 3.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 3. It is estimated that SED 3 would require approximately 10 years to complete. A construction timeline for implementation of SED 3 is provided in Figure 6-5. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. However, details of the specific methods for implementation of the remedy selected would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 3 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and material and equipment staging/handling areas (staging areas) would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 3 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report include 21 staging areas, which would occupy a total of 34 acres (8.3 acres of which would be within the floodplain), and nearly 19 miles of temporary access roads covering 47 additional acres assuming a 20-foot road width (16 miles and 38 acres of which would be within the floodplain) would be constructed between the Confluence and Woods Pond Dam to support implementation of SED 3. The locations of these staging areas and access roads are shown on Figure 6-4. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: In Reach 5A, 134,000 cy of sediment covering an area of 42 acres would be removed to a depth of 2 feet, followed by placement of a 2-foot cap over the removal areas (Figure 6-4). It is assumed that the excavation would be performed in the dry with conventional mechanical excavation equipment. Similar to the approach used for the Upper ½-Mile Reach and portions of the 1½-Mile Reach of the Housatonic River, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. A water treatment system with an assumed capacity of 450 gallons per minute (gpm), located at each staging area, would be used to treat water pumped from the excavation areas. Periodic water column and air sampling would be performed during implementation.

Cap Placement: The cap installed in Reach 5A would be placed in the dry following excavation and prior to removal of the sheetpile from a removal area. The cap would be designed to limit the potential for upward migration of PCBs from the underlying sediments and to limit the potential for erosion of the cap materials. Cap materials would be transferred to the River using conventional earth-moving equipment. It is assumed that the cap would contain 12 inches of sand (which may be amended with organic material to increase the TOC content) placed over the excavated riverbed, followed by 12 inches of armor stone over the sand. The composition and size of the sand and armor stone would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to preclude the movement of cap materials during high flow events.

Thin-Layer Cap Placement: A thin-layer cap would be installed in downstream portions of Reach 5C (37 acres) and in Woods Pond (60 acres), as shown on Figure 6-4. For purposes of evaluation, it is assumed that the thin-layer cap would consist of a 6-inch layer of sand, placed via a combination of techniques including mechanical and/or hydraulic means. For purposes of modeling, the material to be used for the thin-layer cap is assumed to have similar properties to those of the underlying native material (see Section 3.1.3. However, the actual materials to be placed would be determined during design activities.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that sediments removed in the dry from Reach 5A would contain some residual water and would require further dewatering by being stockpiled at the staging areas to allow them to dewater by gravity, with stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) added as necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 3 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in those subreaches. The bank stabilization techniques that are assumed to be part of SED 3 for purposes of this Revised CMS Report were described generally in Section 3.1.4, with specific details in Appendix G. As discussed there, those techniques involve a combination of bioengineering techniques and traditional bank hardening methods (e.g., riprap), which were identified as appropriate for the various types of bank conditions in Reaches 5A and 5B. The specific bank stabilization techniques identified for SED 3 are depicted on Figures G-10 through G-17 in Appendix G. Application of these techniques would involve or be accompanied by removal of riverbank soil in a number of locations in Reaches 5A and 5B (as discussed in Appendix G), resulting in the removal of a total of 35,000 cy of bank soil.

For purposes of this Revised CMS Report, it is assumed that the riverbank stabilization/soil removal work in Reach 5A would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, and employing conventional mechanical excavation equipment. For Reach 5B, which would not be subject to any river sediment remediation under SED 3, it is assumed that the river bank stabilization/soil removal work would be performed in the wet from the top of the riverbank. For this reason, as discussed in Appendix G (Section 6), the riverbank stabilization techniques identified for Reach 5B under SED 3 have been modified from those that could be applied in the dry, some of which could not practicably be implemented below the water. Thus, the riverbank stabilization techniques described for SED 3 in Appendix G and shown on Figures G-10 through G-17 include certain modifications in Reach 5B to allow implementation in the wet.

MNR: MNR would be implemented in the remainder of the Rest of River (Reach 5B, the upper portion of Reach 5C, the Reach 5 backwaters, and Reaches 7 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue throughout the Rest of River area at varying rates, due in part to completed and planned upstream source control and remediation measures, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of the evaluations in this Revised CMS Report, it is assumed that SED 3 would include restoration of areas that are directly impacted by the sediment removal activities, the bank stabilization/removal activities, and ancillary construction activities. The restoration methods assumed for SED 3 for purposes of the evaluations in this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reach 5A and the downstream portion of Reach 5C, Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B, Section 5.3.3.3 for Woods Pond, and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 3 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 3 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2. These requirements would ensure that any contaminated sediments or bank soils that would be contacted, removed, or released during such projects would be properly addressed. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 3 would include a 5-year post-construction monitoring and maintenance program for the capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program would include elements relating to the capped areas and elements relating to the restoration components of SED 3. For purposes of this Revised CMS Report, it is assumed that the 5-year post-construction OMM program for the capped areas would include: (a) visual observations of the cap over the restored Reach 5A riverbed, supplemented with probing in areas not visually observable to confirm the presence of the cap materials; (b) collection of sediment cores for visual observation in the thin-layer cap areas in Reach 5C and Woods Pond to assess the presence of cap material; and (c) repair or replacement of cap material as needed. Note that in the thin-layer cap areas, after a period of time, the difference between the cap material and native sediment may not be visually apparent; however, the visual observations would be supplemented/enhanced through periodic core collection with PCB analysis as described below. The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 3.

A summary of the assumed long-term (100-year) OMM program for SED 3 was included in Table 3-22, referenced in Section 3.7.2 above. That program would include sampling of fish and the water column using the same program described for SED 2 in Section 6.2.1. Sampling of sediments under this long-term monitoring program would occur in Years 5, 10, 15, 25, 50, 75, and 100 following remediation, as well as after significant storm events. It is assumed that each sampling event would include collection with PCB analysis of the following:

- Approximately 75 surface sediment samples from the MNR areas;
- Approximately 10 cores with a total of 30 samples from the removal areas (one core every 4 to 5 acres, three samples per core); and
- Approximately 25 cores with a total of 25 samples from the thin-layer cap areas (one core every 4 to 5 acres, one sample per core).

Further, for the caps in Reach 5A and the thin-layer caps in Reaches 5C and Woods Pond, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.3.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 3 would be protective of human health and the environment is presented at the end of Section 6.3 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.3.3 Control of Sources of Releases

SED 3 would reduce the potential for PCB migration from certain riverbanks and sediments through removal of PCB-containing sediments (with capping) in Reach 5A, stabilization of banks in Reach 5 with removal of bank soils where necessary, and thin-layer capping in portions of Reach 5C and in Woods Pond. Implementation of these remedial activities would address approximately 139 acres of the riverbed and approximately 14 linear miles of riverbanks (7 miles on both sides), removing 169,000 cy of sediment and bank soils containing PCBs, thereby resulting in a reduction in the potential for future PCB transport within the River or onto the floodplain for potential human or ecological exposure. PCB-containing surface sediments in Reach 5A and select bank soils in Reaches 5A and 5B, which are prone to scour during high-flow events, would be removed, and the residual PCBs remaining in these areas would be contained using caps and bank stabilization techniques, respectively. In portions of Reach 5C and Woods Pond where the water is deeper and the river bottom is less prone to scour, a thin-layer cap would be placed over the existing river bottom to accelerate the natural recovery process and assist in controlling releases from the river bed.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would reduce PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams and therefore limit the potential transport of those sediments further downstream. While failure of those dams could lead to the release of sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed.

Implementation of SED 3, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain, as demonstrated by EPA's model. The annual average PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by approximately 94% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 1.3 kg/yr). Likewise, SED 3 is predicted to achieve an 87% reduction in the average PCB mass passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 2.4 kg/yr). Similarly, the annual average PCB mass transported from the River to the floodplain in Reaches 5 and 6 is predicted to decrease by 97% over the model projection period (i.e., from 12 kg/yr to 0.4 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood, which is the maximum flood during the 52-year projection period and has a return frequency between 50 and 100 years (see Section 3.2.2.1). The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-6b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 3 over the 52-year model projection period. Similar to SED 1, the model results for SED 3 indicate that, in reaches subject to MNR only (i.e., Reaches 5B, 5D, 7, and 8), the extreme flow event would not result in the exposure of buried PCBs at higher concentrations than those already present in the surface sediment prior to the event. This is supported by the minimal changes (generally less than 0.1 mg/kg) in reach-average surface sediment PCB concentrations predicted for those reaches (Figure 6-6b). Within Reach 5A, which would be capped, EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event, and consequently no change in reach-average surface sediment PCB concentrations is predicted (Figure 6-6b).[128] In reaches undergoing thin-layer capping (Reaches 5C and Woods Pond), the model predicts that those cap materials and the underlying sediments would largely remain stable during the extreme event in Year 26. The model results indicate that only limited portions of these areas (1% to 5% of the thin-layer capped areas) would experience erosion, which would result in relatively minor increases (e.g., pre-storm concentration of ~0.4 mg/kg to a post-storm concentration of ~1.3 mg/kg in Woods Pond) in reach-average surface sediment PCB concentrations (Figure 6-6b). These concentration increases are small relative to the pre-remediation levels in these reaches (30 to 35 mg/kg) such that the

128 Further evaluation of the stability of cap and thin-layer cap materials under SED 3 based on model predictions of erosion is provided in Section 6.3.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

concentrations following the extreme event still represent significant reductions relative to current levels (90% in Reach 5C and 96% in Woods Pond; Figure 6-6b). Thus, the model results indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event following implementation of SED 3.

Given that SED 3 includes remediation in Woods Pond (i.e., placement of a thin-layer cap), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. Based on EPA's model, the solids trapping efficiency of Woods Pond under SED 3 would be slightly lower relative to MNR (i.e., 15% under MNR versus 13% under SED 3). The placement of a thin-layer cap would result in a small decrease in depth, which in turn results in the small decrease in solids trapping described above.

6.3.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE for SED 3 in accordance with directions from EPA are listed in Tables S-3.a through S-3.c in Appendix C. The compliance of SED 3 with these potential ARARs is discussed below.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-3.a, include federal and state water quality criteria for PCBs. To evaluate whether SED 3 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 3. As discussed in Section 3.5.1, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages (i.e., starting a new 4-day average each day) or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, only 2 exceedances are predicted at one location within the PSA (Holmes Road) and 2 to 5 exceedances are predicted at two locations within Reaches 7 and 8. However, all of these exceedances in both the PSA and Reaches 7 and 8 consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered a single exceedance (i.e., a prolonged exceedance that spans more than a single day resulting from the use of rolling averages). This is confirmed by the block averages that indicate only a single (or no) exceedance for this alternative in these reaches. For these reasons, as discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 3 would achieve this criterion, albeit at a significant environmental cost as discussed in Sections 6.3.5.3 and 6.3.8.

By contrast, the model-predicted annual average water column concentrations (which are used for assessment of the human health-based water quality criteria and are set forth in Table 6-13 in Section 6.3.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. However, as previously discussed, the ARARs based on this criterion should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not be achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[129]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens (the latter of which would not be addressed by any alternative). The impact of SED 3 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.3.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic River in Massachusetts, is discussed in Section 6.3.6. The Housatonic River in Connecticut is listed as impaired based on the Connecticut Department of Public Health's (CDPH) fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 3 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.3.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.3.6.1.[130] These evaluations provide an assessment of the effect of SED 3 on the impairment listings.

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[129] The estimated future water column concentrations in all the Connecticut impoundments under SED 3 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[130] In addition to the comparison to the IMPGs, it is our understanding that, in developing and periodically revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-13 (in Section 6.3.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 3 would reach the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.02 to 0.04 mg/kg. This provides further insight on the effect of SED 3 on the River's impairment listing in Connecticut.

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 3 are listed in Tables S-3.b and S-3.c.[131] Review of those potential ARARs indicates that SED 3 could be designed and implemented to achieve certain of those ARARs, assuming, in some cases, that the necessary EPA determinations are obtained.[132] However, as indicated in those tables, there are a number of potential location- and action-specific ARARs that would not be met by SED 3. These include the following:

- The requirements of EPA's and the USACE regulations under Section 404 of the Clean Water Act (40 CFR Part 230, 33 CFR Parts 320-323) that there be no practicable alternative with less adverse on the aquatic ecosystem (since there are practicable sediment removal alternatives with less adverse impact – e.g., SED 10) and that a project involving the discharge of dredged or fill material (such as SED 3) not contribute to violation of state water quality standards (which are not currently met in the Housatonic River) and not cause significant adverse effects on aquatic life, aquatic ecosystems, and recreational and aesthetic values;

- The requirements of the federal Executive Orders for Wetlands Protection (E.O. 11990) and Floodplain Management (E.O. 11988) that there be no practicable alternative with less adverse impacts on wetlands and floodplains, respectively;[133]

[131] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

[132] For example, EPA's regulations under § 402 of the Clean Water Act include a requirement that discharges from water treatment facilities must be subject to effluent limitations or other conditions necessary to meet state water quality standards (40 CFR § 122.44(d)); but they exempt discharges in compliance with instructions of EPA's On-Scene Coordinator (OSC) (40 CFR § 122.3(d)). The discharges from the water treatment facilities used for dewatering removed sediments under SED 3 could not feasibly meet the state water quality standards since current water quality conditions in the Housatonic River do not meet the Massachusetts water quality criteria for PCBs (see Section 6.1.4). Hence, it is assumed that such discharges would be in compliance with the OSC's instructions. Similarly, it may be impractical for some of the temporary staging areas for PCB-containing sediments to meet certain default conditions of EPA's TSCA regulations for storage of PCB remediation waste (40 CFR § 761.65(c)(9)) – e.g., that they have systems capable of preventing flow onto those areas from a 25-year flood (although they would include appropriate flood control measures). However, the TSCA requirements could be met for those staging areas through an EPA determination that those areas meet the substantive requirements of the regulations for a risk-based approval (40 CFR § 761.61(c)); and it is assumed that, if necessary, such a determination would be made.

[133] Since these Executive Orders were not formally promulgated after notice-and-comment rulemaking, they are to be considered (TBC), rather than ARARs. However, as orders of the President, they are applicable to and binding on EPA.

- Given that Reach 5A is included in the designated Upper Housatonic ACEC, the prohibition on dredging in an ACEC under the Massachusetts Waterways Law and its regulations (310 CMR 9.40(1)(b));

- The requirements of the Massachusetts water quality certification regulations (314 CMR 9.01 – 9.08) that there be no practicable alternative with less adverse impact on the aquatic ecosystem, that a project involving dredging and the discharge of dredged or fill material not affect the Estimated Habitat of rare wildlife species listed by the State under MESA, and that such a project not cause substantial adverse impacts to conditions in surface waters;

- The requirements of the Massachusetts Wetlands Protection Act and its implementing regulations that there be no practicable alternative with less adverse impact on resource areas (310 CMR 10.53(3)(q)), that implementation of the project not affect the Estimated Habitat of state-listed rare wildlife species (310 CMR 10.59), and, if this project does not constitute a "limited project" under 310 CMR 10.53(3)(q), certain additional requirements as well (e.g., the prohibition on work that results in a loss of > 5000 square feet of bordering vegetated wetlands or impairs such wetlands within an ACEC [310 CMR 10.55(4)] and potentially the requirement to maintain a 100-foot wide area of undisturbed vegetation along the river in a Riverfront Area, subject to certain exceptions [310 CMR 10.58(4)(d)1.]); and

- The requirements of MESA and its implementing regulations (310 CMR 10.23) that the project not result in a "take" of a state-listed species.[134]

Thus, SED 3 would not meet a number of federal and state regulatory requirements relating to ecological protection (including regulations applicable to the Upper Housatonic ACEC). To the extent that these requirements constitute ARARs, they would need to be waived by EPA under CERCLA and the NCP.

In addition to the ARARs discussed above, it is possible that some of the temporary staging areas for excavated sediments and/or bank soils may not meet certain requirements that could potentially apply to those areas in the event that the excavated materials should be

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[134] The MESA evaluations in Appendix L indicate that SED 3 would involve a take of at least 23 state-listed species. The MESA regulations contain a provision authorizing the Director of the MDFW to permit a take of a state-listed species if (a) the project proponent has adequately assessed alternatives, (b) the take would not affect a significant portion of the local population of the species, and (c) a long-term Net Benefit plan for the species is developed and agreed to (321 CMR 10.23). However, as discussed in Section 5.4, this provision does not constitute an ARAR for the Rest of River remedial action.

found to constitute hazardous waste under RCRA criteria or comparable state criteria. Based on prior experience at other portions of this site (e.g., the 1½-Mile Reach and floodplain), it is not anticipated that the excavated sediments or bank soils would constitute RCRA hazardous waste.[135] However, appropriate testing of representative sediments and bank soils would be conducted, using the Toxicity Characteristic Leaching Procedure (TCLP), to confirm that result.

Further, even if some excavated materials should be found to constitute hazardous waste under RCRA, the federal RCRA requirements would not apply to staging areas within the Rest of River boundary, since those areas would be covered by EPA's Area of Contamination (AOC) policy (EPA, 1995), which excludes from the RCRA land disposal restrictions and other RCRA technical requirements the movement of wastes within an overall area that includes discrete areas of generally dispersed contamination. However, in the unlikely event that such materials were staged at areas that are located outside the Rest of River boundary and to which EPA's AOC policy would not apply, those staging areas would not meet all the substantive requirements of EPA's RCRA regulations for hazardous waste storage facilities. For example, waste pile staging areas would not be constructed with the double liner/leachate collection systems specified for new waste pile units to be used for storage of hazardous waste (40 CFR § 264.251(c)), nor would they have groundwater monitoring systems such as is required for regular hazardous waste management facilities (40 CFR Part 264, Subpart F). It would not be practical or necessary for these temporary staging facilities to be constructed and operated to comply with all the regular RCRA storage requirements (which are designed for permanent storage facilities). Accordingly, if such requirements were deemed applicable to any such staging areas, they should waived by EPA as technically impracticable to meet.

Similarly, although not anticipated, it is possible that some excavated sediments or bank soils may constitute hazardous waste under the Massachusetts hazardous waste regulations on grounds other than containing PCBs at concentrations ≥ 50 mg/kg.[136] Even

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[135] A total of over 90 samples of sediment or soil collected by EPA or GE from the 1½-Mile Reach or adjacent floodplain, were analyzed for hazardous waste characteristics by the Toxicity Characteristic Leaching Procedure (TCLP). None of these samples showed leachate levels in excess of the regulatory limits that would result in the material being classified as hazardous waste. It is expected that the sediments and soils in the Rest of River would be similar to those in and adjacent to the 1½-Mile Reach and thus would likewise not constitute hazardous waste.

[136] Although wastes with PCB concentrations ≥ 50 mg/kg are listed hazardous wastes in Massachusetts, the Massachusetts hazardous waste regulations exempt facilities that manage such wastes so long as such facilities comply with EPA's TSCA regulations (310 CMR 30.501(3)(a)), and the staging facilities would meet substantive TSCA requirements (provided that any necessary risk-based determination is obtained from EPA under those regulations). The other pertinent bases for characterizing a waste as hazardous are the same under state regulations as those under RCRA.

if they did, the Massachusetts hazardous waste regulations should not apply to the staging and dewatering of ***sediments***, provided that the sediments are temporarily stored at an "intermediate facility" (a temporary facility for sediment management) under the State's water quality certification regulations.[137] However, if excavated ***bank soils*** were found to constitute non-PCB hazardous waste (which, again, is not expected), the staging areas would not meet certain requirements of the Massachusetts hazardous waste regulations. For example, since these areas need to be located close to the River and would contain waste piles, the majority of them could not feasibly meet the requirement that waste piles used for hazardous waste storage may not be constructed within the 500-year floodplain (310 CMR 30.701(6)). In addition, depending on the locations of the staging areas, some of those areas may not meet other location standards set forth in these regulations for such waste piles (e.g., 310 CMR 30.704(3), 30.705(3) & (6)) or certain design requirements for such waste piles (e.g., that the liner must be a minimum of 4 feet above the probable high groundwater table) (310 CMR 30.641). Further, construction of groundwater monitoring systems (per 310 CMR 30.660) for these temporary staging areas is not practical. In any of these circumstances, if these requirements were deemed applicable to any particular temporary staging areas, they should be waived by EPA as technically impracticable to meet.

6.3.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 3 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.3.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 3 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 3, along with upstream source control and remediation measures and natural recovery processes, would reduce the exposure of humans and ecological

[137] The Massachusetts hazardous waste regulations exempt dredged material that is temporarily stored at an intermediate facility pursuant to 314 CMR 9.07(4) and managed under a state water quality certification and § 404 of the Clean Water Act (310 CMR 30.104(3)(f)).

receptors to PCBs in sediments, surface water, and fish in the Rest of River area. Potential exposure to sediments containing PCBs would be significantly reduced in Reach 5A due to sediment removal and capping activities, and potential exposure to PCB-containing bank soils in Reaches 5A and 5B would be reduced by the bank soil removal and stabilization. The placement of a thin-layer cap over the sediments in a portion of Reach 5C and in Woods Pond would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) for surface sediments, surface water, and fish (including both modeled whole body and calculated fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-13 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 3)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.6	1.3	0.3
5B	5.5	3.0	15	3.0
5C	3.0	4.0	9.1	1.8
5D (backwaters)	15	---	31	6.3
6	1.5	4.4	3.6	0.7
7[1]	0.40 – 4.7	2.1 – 4.1	3.6 – 11	0.7 – 2.1
8	2.7	2.3	7.9	1.6
CT[1]	0.009 – 0.02	0.1 – 0.2	0.09 – 0.2	0.02 – 0.04

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the predicted PCB concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.3.6.[138]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 3 over the 52-year model projection period are shown on Figures 6-6a-c. These figures show the timeframes over which the model predicts that PCB concentrations in each medium would be reduced under SED 3. The general pattern exhibited by these temporal profiles is one of a large reduction in PCB concentrations associated with the remediation, followed by a period of slow decline or, in some instances, a leveling off or increase to a new steady-state concentration determined by upstream PCB inputs and natural attenuation processes. In the surface sediments, this pattern is observed mainly in the remediated reaches, while most reaches exhibit this pattern for water column and fish concentrations, which illustrates how remediating upstream source areas within the Rest of River (e.g., Reach 5A) translates to reductions in PCBs in downstream areas. As a result of the remediation under SED 3, predicted fish PCB concentrations are reduced over the projection period by 87% to 99% in the remediated reaches (i.e., Reaches 5A, 5C, and 6), by 72% and 83% in Reach 5B and the Reach 5 backwaters, and by 75% to 90% in Reaches 7 and 8 (Figure 6-6c).[139]

PCBs would also remain in the sediments beneath and outside the areas addressed by SED 3. However, in Reach 5A, the cap would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the cap; and the thin-layer caps in portions of Reach 5C and in Woods Pond would provide a clean layer over the underlying PCB-containing sediments. Overall, the extent to which SED 3 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.3.3. As discussed in that section, the model results for SED 3 indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

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[138] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

[139] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are lowered based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 3 would also be lower, ranging from 83% to 98% in the remediated reaches (i.e., Reaches 5A, 5C, and 6), 63% to 77% in the remainder of the PSA, and 73% to 86% in Reaches 7 and 8.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 3 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.3.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 3 has included an assessment of the following factors: whether the technologies have been used under similar conditions; whether the combinations of technologies in the alternative have been used together effectively; general reliability and effectiveness; reliability of OMM requirements and availability of labor and materials needed for OMM; and the potential need to replace technical components of the alternative, along with a consideration of potential exposure pathways and the associated risks should the remedial action need replacement.

Use of Technologies under Similar Conditions and in Combination

As stated in EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, for remediation in "multiple water bodies or sections of water bodies with differing characteristics or uses, or different levels of contamination, project managers have found that alternatives that combine a variety of approaches are frequently the most promising" (EPA, 2005d, p. 3-2). Further, in response to variable site conditions at other sites (e.g., water depth, water velocity, sediment characteristics, etc.), a combination of technologies is often required to mitigate the potential for exposure to constituents in sediments. The 2007 report by the National Research Council (NRC) of the National Academy of Sciences on Sediment Dredging at Superfund Megasites provided a detailed evaluation of 26 environmental sediment dredging projects, each of which included at least 10,000 cy of sediment removal and had pre-dredging and post-dredging data and which collectively represented a variety of project types. That report stated that "dredging alone achieved the desired cleanup levels at only a few of the 26 dredging projects, and that capping after dredging was often necessary to achieve cleanup levels" (NRC, 2007, p. 4). It also noted that "the ability of combination remedies to lessen the adverse effects of residuals should be considered when evaluating the potential effectiveness of dredging" (NRC, 2007, p. 164), and that "some combination of dredging, capping or covering, and natural recovery will be involved at all megasites" (NRC, 2007, p. 248). As such, many sediment remedial projects have employed a combination of remedial technologies to achieve their respective remedial objectives.[140]

SED 3 includes such a combination of technologies. It includes sediment removal followed by capping using dry excavation techniques in Reach 5A, bank stabilization with removal of bank soils where necessary in Reaches 5A and 5B, thin-layer capping in a portion of Reach 5C and in Woods Pond, and MNR in the remaining areas. These remedial components have been applied in various combinations at other PCB-containing sites as described below.

Sediment removal using dry excavation techniques followed by capping (or backfilling) has been applied at sites containing PCBs under hydrologic conditions similar to those in Reach 5A (e.g., higher energy environments), albeit much different ecological conditions. For example, this approach was used at the Upper ½-Mile Reach (including the Building 68 area), the 1½-Mile Reach, and the West Branch of the Housatonic River, all which have similar conditions to Reach 5A in terms of water flow, width, and depth (ARCADIS BBL and QEA, 2007a; Weston Solutions, Inc. [Weston], 2007), though not similar ecological conditions.

In an effort to assess the precedents for a sediment remediation project with the removal volumes that would be involved in the sediment alternatives for the Rest of River, GE reviewed publicly available information on completed, ongoing, or planned dredging/removal projects, including those evaluated in the NRC (2007) report. This review identified approximately 75 completed dredging/removal projects to address various contaminants of concern. Less than 25% of these projects involved removal of volumes equivalent to or greater than the removal volume of SED 3. The sites of these projects include a mix of harbors, lakes, and rivers. None of these sites is comparable to the Rest of River, where the area targeted for remediation is long and sinuous (see Figure 6-7), includes numerous stretches with limited access, contains a largely undisturbed corridor of diverse and environmentally sensitive habitats (with numerous rare species), and is not navigable by large vessels.[141]

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140 Some examples of sites where a combination of remedial technologies was utilized include the St. Lawrence River Site (NY) (hydraulic dredging, mechanical excavation, and capping to address PCB-containing sediments; BBLES, 1996) and Fox River (WI) (sediment removal with capping, capping alone, and MNR to address PCB-containing sediments; EPA and WDNR, 2007). Moreover, MNR with institutional controls is commonly used at sites in combination with active remedial technologies, such as at Kalamazoo River (MI), Spokane River (WA), Bremerton Naval Complex (WA), Commencement Bay Nearshore/Tidal Flats (WA), and Sheboygan River (WI).

141 For example, the NRC (2007) report identified nine dredging projects with sediment removal volumes greater than 100,000 cy. These projects were conducted at Commencement Bay (WA) (2

Riverbank stabilization using a combination of traditional bank hardening methods and bioengineering techniques (as described in Section 3.1.4 and Appendix G), with removal of bank soils as necessary, has also been applied at other sites, albeit sites with different ecological conditions. In New England, this approach was used on the Turners Falls/Northfield Mountain project in Connecticut to successfully stabilize eroding banks on the Connecticut River (Franklin Regional Council of Governments [FRCOG], 2003 and 2010). The design for different segments of the riverbanks in that case included traditional hardening techniques (e.g., riprap for scour zones and toe of slope) combined with bioengineering techniques (e.g., joint planting, coir matting, geogrid lifts, brush mattresses). Similarly, bank stabilization on the White River in Vermont used a combination of rock revetment (a traditional hardening approach) in combination with bioengineering (brush layers, coir matting, live stakes) to address an erosion problem along a 300-foot section of the White River, while two other riverbank segments were stabilized using bioengineering techniques alone. Additionally, on the Little Miami River in Ohio, 30-foot high banks were stabilized by combining a riprap foundation, synthetic cellular confinement layers, natural coir fabric wrapped soil lifts, and internal geotextile reinforcement material, all combined with a comprehensive revegetation plan (Land & Water, 1999). Finally, soil layer lifts were combined with a rock toe to stabilize over a mile of eroding riverbank on the Grand River in Michigan. The soil layer lifts were planted with a variety of native species to help lock the shoreline while providing wildlife habitat (Land and Water, 2007).

Placement of a thin-layer cap, such as would be used for the lower part of Reach 5C and in Woods Pond under SED 3, was pilot tested at the Grasse River (NY), and implemented at Puget Sound Naval Shipyard (WA), Commencement Bay Nearshore/Tideflats (Middle Waterway, WA), Eagle Harbor West Site (WA) and Pier 64 (WA), and was incorporated into the Record of Decision (ROD) Amendment for the Fox River (WI) as part of a remedy which also includes sediment removal with capping, capping alone, and MNR. Thin-layer cap placement in a near-shore area at the Grasse River (NY) demonstrated a 99% reduction in surface PCB concentrations, with long-term monitoring ongoing (www.thegrasseriver.com). Water depths at the Grasse River where the thin-layer cap was placed were less than 5 feet, which is similar to portions of Reach 5C and Woods Pond where thin-layer capping would be performed.

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projects), Bayou Bonfouca (LA), Puget Sound Naval Shipyard (WA), Harbor-Island (WA), Cumberland Bay (NY), Lake Jarnsjon (Sweden), Manistique Harbor (MI), and United Heckathorn (CA). None of these projects involved sediment removal in a riverine system like that in the Rest of River; rather, they involved shipping channels, bayous, estuaries, lakes, and harbors (NRC 2007). Other large sediment removal projects, such as those at the Grand Calumet River (IN), Ashtabula River (OH), Milltown Reservoir Sediments Site (MT), and the Ottawa River (OH), likewise involved very different conditions from those in the Rest of River. See Section 6.5.5.2 for a description of the first three of these; the Ottawa River is bordered by landfills and commercial/industrial properties and is much more accessible from the water than the Rest of River (see EPA, 2009).

MNR (with institutional controls) has been in place for several years at Lake Hartwell (SC) to address PCBs in stretches of the lake and adjoining river where natural recovery processes were known or expected. Conditions at Lake Hartwell have some similarities to Reaches 7 and 8 as well as in Reaches 9 through 16, where MNR would be implemented under SED 3. Other reaches selected for MNR under SED 3 include Reach 5B, the upper portion of Reach 5C, and the Reach 5 backwaters, where PCB concentrations are higher than those observed at other sites, and conditions may differ from Lake Hartwell. However, in such areas, river conditions (i.e., slower moving depositional areas) should support the natural recovery process over time.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 3 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments.[142]

EPA has concluded that sediment excavation, capping, and MNR should be evaluated at every sediment site (EPA, 2005d). Under certain circumstances, sediment excavation can be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to contaminated sediments through removal of contaminant(s) of interest. However, there are some limitations associated with the technology, including sediment resuspension during removal and residual contamination following removal (EPA, 2005d). Placement of a cap over sediment removal areas has been used to address residual contamination. Capping is an EPA-approved technology for the effective remediation of contaminated sediments (EPA, 2005d), and has been successfully applied, either following removal or without removal, in a variety of settings, including rivers, near-shore areas, and estuaries. Various capping materials and cap placement techniques are available, and monitoring data collected for a number of projects have indicated that capping can be an effective remedy (Fredette et al., 1992; Brannon and Poindexter-Rollings, 1990; Sumeri et al., 1994).

Thin-layer capping can be effective at reducing the potential for human and/or ecological exposure to PCBs in sediment. Its greatest effectiveness has been typically demonstrated where it is not subject to high erosional forces. Assuming even low rates of natural sedimentation in the future, thin-layer capping can provide a base for sustained long-term reduction in surficial PCB concentrations. Studies have indicated that even very thin layers of new clean material placed on the sediment bed can result in a substantial reduction in

[142] This section addresses the reliability and effectiveness of these techniques to reduce PCB exposures. That is different from the overall reliability and effectiveness of the techniques to protect human and ecological receptors, which must also consider the adverse impacts from implementation of those techniques on such receptors. Those issues are evaluated separately below.

the interaction of sediment-associated contaminants with the overlying water (Talbert et al., 2001). In addition, EPA has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases" (EPA, 2005d, p. 4-13).

Certain MNR and enhanced MNR approaches have been demonstrated at aquatic sites with PCB-containing sediment (EPA, 2005d). These approaches can be applied alone or in combination with other, more active remedial technologies (e.g., removal, *in situ* containment). MNR has been selected as a component of the remedy for contaminated sediment at numerous Superfund sites (EPA, 2005d). EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d, p. 4-3). EPA has also noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d, p. 4-1). Sedimentation would be expected to be the primary natural recovery mechanism for the Rest of River, and would eliminate or reduce exposure and risk by containing the contaminants in place through the deposition of cleaner sediments on top of impacted sediments.

To further assess the reliability and effectiveness of SED 3, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability. Two metrics were used in this assessment: (1) the area predicted to remain stable (i.e., undergo limited or no erosion) for the full duration of the model projection, including the extreme (50- to 100-year) flow event simulated in Year 26;[143] and (2) the predicted impact of such erosion (if any) on reach-average 0- to 6-inch surface sediment PCB concentrations. The results of these stability assessments for SED 3 are as follows:

<u>*Caps:*</u> Under SED 3, cap would be installed in Reach 5A following removal. The cap would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 3 are predicted to be 100% stable.

<u>*Thin-Layer Caps:*</u> SED 3 includes placement of a thin-layer cap in the lower portion of Reach 5C and Woods Pond to enhance natural recovery. For the purposes of evaluating long-term effectiveness, the thin-layer cap was considered stable (and therefore reliable) when EPA's model predicted that at least 1 inch of this material would remain for the full

[143] Review of model results indicated that, in general, the most significant erosion is predicted to occur during the extreme flow event; thus, that event was a primary focus of this analysis (although other high flow events occurring within the projection period were evaluated as well).

duration of the model projection.[144] Based on this definition, the model predicts that approximately 99% of the thin-layer capped area within Reach 5C would be stable under SED 3. The remaining 1% of the area predicted to contain less than 1 inch of thin-layer cap material occurs within a single model grid cell located in a narrow part of the channel of Reach 5C. That limited erosion is predicted to occur during the extreme flow event simulated in Year 26, and would result in an increase of less than 0.5 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentrations in Reach 5C (Figure 6-6b). Similarly, EPA's model predicts that approximately 95% of the thin-layer capped area in Woods Pond would remain stable. Erosion in the remaining 5% of the Woods Pond area was predicted by the model to occur in the pond's outlet channel during the extreme flow event. However, such erosion resulted in an increase of less than 1 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 6-6b). After such increases in concentration are taken into account, the concentrations following the high flow events still represent reductions of 90% to 96% relative to current levels for both reaches where SED 3 includes a thin-layer cap (as discussed in Section 6.3.3). Since the thin-layer cap materials would largely remain in place, they would assist in controlling releases from underlying sediments and provide stability, although this is not the primary goal of thin-layer capping.

It should also be noted, however, that there is a potential for impacts to the thin-layer caps from the feeding, spawning, and/or nesting activities of "megafauna," such as carp and largemouth bass. Specifically, carp could have some influence on portions of the thin-layer caps due to foraging in sediments, uprooting of plants, and thrashing behavior during spawning; and largemouth bass could have some influence on portions of the thin-layer caps by clearing areas for nests.

<u>General Reliability and Effectiveness – Riverbank Stabilization Techniques</u>

As noted in Section 6.3.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques. Bioengineering techniques can be grouped into two basic categories: those that reduce the force of water against a riverbank by directing flow away from the banks and those that increase a bank's resistance to the erosive force of water (NRCS, 2002). Both categories have as a primary objective the control and

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[144] Because the model simulates mixing of thin-layer cap material with native sediment when the cap material erodes to less than 3 inches, there are circumstances where thin-layer capped cells increase in concentration due to such mixing and yet the 1-inch stability criterion is still met. However, model results based on a criterion of 3 inches were very similar to those for the 1-inch criteria used here, with the number of grid cells exceeding the criteria differing by only 1 or 2 cells, and only in some reaches.

prevention of bank erosion, while at the same time encouraging growth of vegetation on the bank that is consistent with the stabilization technique employed. Further, the structures used to direct flow away from a bank or to increase a bank's resistance to the force of water often will be made of natural materials such as logs, native rock, or coir fiber to attempt to provide habitat for aquatic organisms or a suitable substrate for plant growth. Controlling erosion can also be accomplished by reshaping a bank to have a reduced bank angle or by constructing a bench which can reduce the shear stress affecting the lower portion of the bank.

In areas that are subject to greater instability, such as where shear stress and channel velocities are particularly severe, bioengineering techniques are unlikely to succeed (at least by themselves), and thus traditional hardening methods (e.g., use of concrete, riprap, and gabion baskets) are necessary to prevent bank soil erosion. Bioengineering techniques and traditional hardening methods are not exclusive of each other. In areas where shear stress and channel velocities are relatively severe, bioengineering can be used in conjunction with traditional hardening methods (termed "hybrid methods") (VDCR, 2004) to provide the most effective method of bank stabilization.

While combinations of stabilization techniques can reliably stabilize riverbanks and reduce erosion, the ecological impacts of doing so must be recognized. As discussed in Section 5.3.2, these bank stabilization measures would, by design, essentially lock the existing channel in a stable state. Thus, if successful, these measures would prevent or permanently curtail the continuation of the current geomorphological processes of bank erosion and lateral channel migration, which have contributed to the current heterogeneous mix of riverbank types in Reaches 5A and 5B, including vertical and undercut banks. In addition, as also discussed in Section 5.3.2, the stabilization measures would include the elimination of mature overhanging trees on these banks and a long-term management plan to prevent the regrowth of such trees on the stabilized bank slopes, which could, through windthrow or overtopping from storm events, cause destabilization of the banks. These aspects of the bank stabilization measures would produce permanent adverse impacts on the riverbank habitat for various wildlife species, as discussed further in Section 6.3.5.3; and those impacts must be balanced against the ability of these measures to stabilize the banks in assessing the overall effectiveness of these measures.[145]

[145] The impacts of bank stabilization techniques on in-river processes such as bedload movement and water depth and velocity are also discussed in Section 6.3.5.3.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 3 would be subject to restoration, as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of adversely affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, and 5.3.3.4 for impoundments, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which could be impacted by access roads and staging areas under SED 3. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.3.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques, including periodic analytical sampling (i.e., fish, water column, and sediment sampling), visual monitoring (i.e., visual observation supplemented with sediment probing and/or coring as necessary), and maintenance of the restored riverbed and riverbanks (e.g., repair of the armor layer of the cap, repair of bank stabilization materials, etc.), would be implemented to maintain and track the long-term effectiveness of SED 3. Post-remediation sampling is commonly used (and recommended by EPA) to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks has been implemented in the Upper ½-Mile and 1½-Mile Reaches of the Housatonic River. Visual observation of capped/armored areas was also performed at the Sheboygan River to determine if the caps were still intact (BBL, 1998). Should changes in cap conditions be noted that require maintenance, labor and materials (e.g., cap material, conventional earth-moving equipment, etc.) needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although, as noted above, the restoration efforts themselves would not be expected to ever re-establish pre-remediation conditions for certain of the affected habitats and would not re-establish pre-remediation conditions of others for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 3 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur that expose the underlying sediments/bank soil, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road reconstruction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.3.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 3 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 3 and the biota that utilize those habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 3 would alter the habitat of the river areas that would be excavated or subject to thin-layer capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 3 would affect portions of the mapped Priority Habitats of 24 state-listed rare species, as described in Appendix L. The long-term impacts of SED 3 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reach 5A

SED 3 would involve sediment removal throughout the entirety of Reach 5A to a depth of 2 feet, followed by placement of a 2-foot cap over the removal areas. The long-term post-restoration impacts of such removal/capping activities on aquatic riverine habitat were described generally in Section 5.3.1.4. For Reach 5A under SED 3, these impacts would include the following:

- *Change in Substrate Type*. Placement of the cap material would change the surficial substrate from its current condition consisting mainly of sand and gravel to one consisting of armor stone. This change would result in a change in the organisms present in the sediments to those consistent with the new substrate (as discussed further below). Over time, deposition of natural sediments on top of the cap from upstream would be expected to naturally change the substrate back to a condition approximating its prior condition. This could take many years. This is particularly true in the further downstream portions of Reach 5A, since the sediment remediation and bank stabilization in the upstream portions of Reach 5A would diminish the amount of soil and sediment available to be transported into the downstream portions and thus delay the re-establishment of the pre-remediation substrate type.

- *Loss of Continuing Source of Woody Debris and Shade*. The sediment excavation activities in Reach 5A would remove woody debris from the River, which is a major component of the habitat in the riverine environment of Reach 5A. Artificial replacement of such woody debris is not practical in the long term. In addition, the riverbank stabilization activities in this reach would permanently eliminate the mature overhanging trees on those banks, as noted above, and thus result in a permanent loss of a continuing natural source of woody debris from trees along the banks. The loss of trees along the riverbanks would also result in greater exposure to wind and sun, which would increase evaporation from the water surface as well as increase water temperature.

- *Alteration of Biotic Communities*. The sediment removal and capping would destroy virtually all aquatic plants and benthic invertebrates present in the existing sediments. Recolonization of those areas would depend largely on the availability of replacement organisms and sediment from upstream. Initially, with armor stone as the surficial sediment in remediated areas, certain groups of aquatic plants and invertebrates that can thrive in such conditions would be expected to recolonize from similar upstream aquatic habitats. For aquatic vegetation, as conditions resembling the previous substrate return, recolonization of previously vegetated areas by rooted aquatic plants would be expected. However, the rate of such colonization is uncertain and would be slowed by upstream riverbed and riverbank remediation, and it is likely that invasive species would spread further into these areas and out-compete native species (as discussed further below). For the benthic invertebrates, while recolonization would occur as the substrate reverts to prior conditions, it is expected that the recolonized community would be dominated for some period of time by invertebrate taxa that are more tolerant of stress, and that the more sensitive taxa would be severely reduced and may not re-establish themselves. Over time, continued accumulation of sediments would increase the diversity of habitat, resulting in a more complex benthic invertebrate community than existed shortly after remediation; but that community is still unlikely to match the pre-remediation community in terms of composition, species diversity and richness, and relative abundance of species, at least for many years. In particular, it is doubtful whether the state-listed invertebrate species that would be destroyed by the in-stream remediation, including the triangle floater mussel and the rare dragonfly species, would ever return. (The impacts of SED 3 on state-listed species are discussed further below.)

Fish would be displaced by the sediment removal and capping activities. They would be expected to move back into the capped areas after completion of the remediation work, but their forage base is not likely to reach pre-remediation levels during the initial years. Over time, the gradual re-establishment of a healthy invertebrate community would support a more robust fish community than existed during the initial post-remediation period. However, individual species abundance would vary depending on the specific riverbed and riverbank conditions that develop over time, and the post-restoration fish community may not match the pre-remediation community for many years until the prevailing substrate conditions have been re-established.

- *High Potential for Colonization by Invasive Species*: Following remediation, once sufficient sediment returns to support aquatic vegetation, invasive species such as Eurasian watermilfoil and curly-leaf pondweed (already present in Reach 5A) and others not yet able to establish populations under current conditions are likely to immigrate and dominate in the disturbed areas. Once established, these invasive species are likely to impede the growth of native species. As discussed in Section 5.3.1.4, a sufficiently intensive invasive species control program would not be practical in a flowing riverine environment like Reach 5A.

In summary, following the remediation and restoration of Reach 5A, the physical substrate type in the River would be expected eventually to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur and the abundance of organisms and richness of the mix of species in that community are all uncertain, the return of certain specialized species (including state-listed species) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 3 would involve stabilization of the riverbanks in Reaches 5A and 5B, using the techniques described in Section 3.1.4 and Appendix G, including the removal of bank soils in a number of locations. These measures would impact a total of 7 miles of riverbank. Despite the implementation of restoration measures (as described in Section 5.3.2.3), the stabilization of these banks would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. These impacts were described in Section 5.3.2.4 and can be summarized as follows:

- *Changes in Geomorphic Processes and Associated Loss in Bank Nesting Habitat*: As previously discussed, the stabilization of riverbanks would, if successful, prevent or permanently curtail the continuation of the current geomorphic processes of bank erosion and lateral channel migration. This would result in the permanent elimination of vertical and/or undercut banks. Animals that depend on such banks would thus lose critical habitat. For example, bird species such as the kingfisher and bank swallow and several turtle species, including the state-listed wood turtle, that currently utilize the undercut or exposed vertical banks in Reaches 5A and 5B would lose their nesting or overwintering habitats. In addition, the bank stabilization would reduce the extent of sandy banks that are used by a variety of bird species that depend upon such banks for nesting.[146]

- *Changes in Bank Vegetative Characteristics and Associated Loss in Overhanging Tree/Tree Canopy Habitat*: In the numerous locations along the riverbanks in Reaches 5A and 5B that contain mature trees overhanging the River, the bank stabilization would result in a dramatic change from their current condition to conditions ranging from open, sparsely vegetated banks to those which over time would provide dense shrub growth. As discussed above, since the return of mature trees on the stabilized banks is incompatible with the objective of bank stabilization, a long-term management plan to prevent such trees from establishing on the stabilized bank slopes would be implemented. As a result, the current wooded environment that includes mature overhanging trees would never be re-established. This would produce a corresponding long-term reduction in the birds that currently use these

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[146] There would be significant constraints on the ability to reconstruct habitat features that could be used by these species, such as hibernacula for wood turtles and/or cavities or other nesting sites for bank-nesting birds. Some of the bank stabilization techniques that would be used, particularly riprap and bioengineered wall-type construction techniques, would not be suitable for such use. Further, even if such features could be created in portions of the restored banks, they may be in different locations and would not match the original configurations, which would have negative consequences for species that have strong fidelities to nesting or overwintering sites in banks with specific characteristics.

trees as perching or nesting sites, the dragonflies (including state-listed clubtail dragonfly species) that use these trees for perching during their adult stage, and the reptiles and mammals that use fallen trees and other large woody debris as shelter or resting/basking sites.

- *Loss of Slide and Burrow Habitat*: Slides and burrows of muskrat and beaver would be removed as part of the bank stabilization, and the bank areas that would be stabilized with riprap would, by design, not be conducive to the creation of new animal burrows and slides. Thus, there is likely to be an overall long-term reduction in such burrows and slides in portions of Reaches 5A and 5B.

- *Reduction in Wildlife Access Routes and Movement to and from the River*: The bank stabilization techniques would reduce access between the terrestrial and aquatic habitats required by some amphibian, reptile, and mammal species. For example, large mammals such as deer, black bears, and mink that currently access the River at certain points to drink from or cross the River would probably alter their access routes based on new riverbank slopes and construction materials, although these species would likely adapt to the post-restoration riverbank conditions within 5 to 10 years of restoration if not adversely affected by the loss of forested habitat and by the habitat fragmentation also inherent in this remedial alternative. The movement of smaller or less mobile species such as beaver, wood turtles, snapping turtles, green frogs, leopard frogs and bullfrogs, which move between the River and other wetland habitats within the currently forested floodplain, particularly in the spring and summer months, would be substantially constrained by riverbanks stabilized with riprap. However, areas subject to bioengineered techniques would be easier for these species to negotiate than would the riprap areas, and thus should not provide a significant barrier to these species' movements within about 5 to 10 years (or possibly more) after restoration.

- *Reduction in Species Richness and Diversity*: As discussed above, the bank stabilization measures would result in a loss of habitat for various species now present, including those that depend on undercut or exposed vertical banks or on mature overhanging trees. There may be an increase in utilization of the banks by certain birds and mammals that prefer an open, early successional habitat as opposed to a mature forest. Overall, however, due to the long-term loss of the species dependent on the forest and bank habitats that would be permanently lost, the stabilization would result in impoverished biodiversity on the banks compared to pre-remediation conditions.

- *Increased Potential for Colonization by Invasive Species*: As new plantings would not cover all remediated areas, additional plant species would be expected to colonize the riverbanks in some areas. At least some of these are expected to be invasive species, some of which (e.g., multi-flora rose, Japanese knotweed) are present already along portions of the riverbanks in Reaches 5A and 5B. Some of these species, such as Japanese knotweed, are extremely difficult to control. Given the extensive lengths of riverbank that would be remediated under SED 3, application of the type of labor-intensive invasive species control program that could potentially control the spread of these species would not be practical over the long term.

In summary, the bank stabilization/restoration measures described above, including bioengineering techniques, would promote the re-establishment of some aspects of current bank conditions by encouraging the growth of riparian vegetation and providing habitat or access routes for some wildlife. However, those measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to many species. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

<u>Long-Term Adverse Impacts on Habitats in Reach 5C and Woods Pond</u>

The placement of thin-layer caps in the downstream portions of Reach 5C and in the portions of Woods Pond outside the "deep hole" would also have some long-term adverse impacts, as discussed generally for these habitat types in Sections 5.3.1.4 and 5.3.3.4. The placement of these caps would bury most (if not all) of the aquatic plants and benthic invertebrates in those areas, with only the heartiest (including invasive species) potentially able to regrow or make their way through the cap, which is not desirable for maintaining biological diversity. The thin-layer caps would also change the substrate in these areas from its current condition dominated by silty sediments to one composed of sand.

Biological recovery of these areas would depend on colonization from other areas. Commonly occurring aquatic plants and macroinvertebrates from upstream areas that are not subject to remediation (i.e., Reach 5B and the upstream portions of Reach 5C) would be expected to recolonize these areas, arriving with flow into these areas. Initially, the species composition of these invertebrates and plants would differ from those currently present due to the change in substrate. Similarly, while fish would move back into the remediated areas, they would be challenged by the changed resources and would likely have an altered species composition and relative abundance, at least initially.

Eventually, as sand and organic sediments develop due to deposition from upstream, biological communities in Reach 5C and the shallower portions of Woods Pond that are consistent with those substrate conditions would be expected to develop (with possible changes in the type of shoreline vegetation due to elevation changes from the thin-layer cap, as discussed below). However, the length of time for such communities to develop, the number of organisms that may be present, and the mix of species are all uncertain; and the return of certain specialized species (such as state-listed species) is doubtful. Further, as noted above, there is a high potential for colonization by invasive species and for those species to dominate over native species, unless an active control program is sustained for many years, which would be logistically difficult and likely impractical.

In addition, in areas where the water depth is less than 12 inches deep, which may occur along the shorelines of Reach 5C and Woods Pond, if consolidation of the underlying sediment does not occur, the increase in substrate elevation due to the thin-layer cap could change the emergent vegetative characteristics of these areas and the biota dependent on them. Indeed, in areas (if any) where the thin-layer cap (or the cap plus any subsequently deposited sediments) exceeds the depth of water, existing emergent wetlands vegetation would be replaced by species more tolerant of less frequently inundated or drier conditions.

In the “deep hole” portion of Woods Pond, the placement of a thin-layer cap would not be expected to have any adverse long-term ecological impacts because there is currently no submerged aquatic vegetation in that area and the existing substrate is of low habitat quality.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 3 includes 21 staging areas covering approximately 34 acres (including 8.3 acres within the floodplain) and approximately 19 miles of temporary roadways covering an additional 47 acres (including 16 miles and 38 acres in the floodplain), as shown on Figure 6-4. The principal habitats affected by these facilities (within the boundaries of the Woodlot (2002) natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (i.e., open, mowed fields) (8.8 acres), and upland forests (2.9 acres).[147] These impacts would occur mainly in Reach 5A, with additional impacts in certain areas in the more downstream portions of the PSA to support the remediation in those portions of the PSA. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally

[147] Many of the access roads and staging areas required to complete remediation activities under SED 3 are situated outside of the PSA floodplain and not included in the Woodlot natural community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural lands) (27 acres), with additional impacts occurring in forested uplands (6 acres) and wet meadow/emergent marsh habitats (1 acre). There would be no impacts from access roads or staging areas in Reaches 7 and 8.

in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats). In summary, the long-term impacts on these habitats from access roads and staging areas under SED 3 would include the following:

- *Loss of Forested Habitat*: The construction of access roads and staging areas in currently forested areas would require the clearing and removal of all mature trees in those areas, together with the associated shrub and herbaceous communities. Assuming these areas would be replanted upon completion of their use, the plant community succession (described in Section 5.3.4.4) would be expected to take 5 to 15 years to progress to the sapling/shrub stage, 20 to 25 years to reach the young forest stage, and at least 50 to 100 years to return to a mature forest – assuming this progression is not impeded by floods or colonization by invasive species, both of which are uncertain. Thus, there would be a loss of the current type of forested habitat in these areas for at least 50 to 100 years. As a result, there would likewise be a loss of the wildlife species that depend on this habitat over at least the same period.

- *Soil Compaction:* Prolonged use of access roads or staging areas (e.g., for more than 2 to 3 years) would result in compaction of the soils in those areas. This would likely alter the water storage capacity and hydrology of these areas and would make the soils less conducive to the formation of the necessary subterranean burrows required by certain animals for overwintering, hinder or prolong the re-establishment of a native plant community, and facilitate proliferation of invasive plant species. While scarification of the soils after removal of the access roads or staging areas would reduce the adverse effects from compaction, it would not eliminate such effects.

- *Loss of Wetlands:* Where access roads are required to be constructed in wetlands, they would result in a number of long-term impacts. These would include the following (in addition to the soil compaction mentioned above): (a) changes in soil composition and chemistry, since replacement soils are unlikely to match existing organic-rich wetland soils, which have formed over many decades; (b) changes in hydrology; (c) changes in vegetative characteristics due to the changes in soil composition and hydrology; and (d) changes in the wetland wildlife community due to the foregoing changes. Over time, as floods bring back silt and organic material to these wetlands, the vegetative and wildlife communities would be expected to approach pre-remediation levels; but the time for that to occur is uncertain.

- *Habitat Fragmentation*: The construction of access roads and staging areas, particularly in forested areas and combined with the bank stabilization activities discussed above, would result in fragmentation of the existing, largely intact forested floodplain/riparian corridor in the affected areas, especially Reach 5A. Such habitat fragmentation, which would last for decades, and in some areas permanently, would displace some species and disrupt the dispersal and migratory movements of other species, such as neotropical migratory song birds and some mammals like the fisher and bobcat, that rely on the largely unfragmented forested riparian corridor to facilitate access and movement.

- *Likely Proliferation of Invasive Species:* The disturbances associated with construction of access roads and staging areas in previously intact habitats present a prime opportunity for the expansion of invasive plant species into those habitats. Active roadways in particular provide a conduit for invasive species to enter disturbed areas. Seeds or fragments can be attached to vehicles (e.g., mud on tires) and transferred into new areas. Certain invasive species such as phragmites and purple loosestrife can displace native species and alter habitat functions and are extremely difficult, if not impossible, to eradicate once established.

In short, the clearing and disturbances that would be associated with the construction and use of access roads and staging areas under SED 3 would produce a number of long-term negative impacts on the floodplain and other affected habitats in the areas where those facilities would be located. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 3 would affect portions of the Priority Habitats of 24 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 3 would involve a "take" of at least 23 of these species and would adversely affect a significant portion of the local population of at least 9 of them. The table below lists the 24 species whose Priority Habitat would be affected by SED 3, along with those for which SED 3 would result in a take and those for which SED 3 would impact a significant portion of the local population:

Table 6-14 – Impacts of SED 3 on State-Listed Species

Species with Priority Habitat Affected by SED 3	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Unlikely
Arrow clubtail	Yes	Yes
Bald eagle	Yes	No

Species with Priority Habitat Affected by SED 3	Take?	Impact on Significant Portion of Local Population?
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Unlikely
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	No
Riffle snaketail	Yes	Yes
Spine-crowned clubtail	Yes	Yes
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Possibly
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 3 would also have long-term impacts on the aesthetic features of the natural environment. The removal activities in the 42 acres of Reach 5A and the bank stabilization activities along approximately 14 linear miles of Reaches 5A and 5B banks would alter the appearance of the River during the course of those activities and for a period thereafter. Indeed, as discussed above, since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the appearance of those banks prior to remediation.

The placement of access roads and staging areas also has the potential for causing long-term impacts on the aesthetics of the floodplain. The placement of these roadways and staging areas would remove trees and vegetation, including in numerous forested areas. This would change the appearance of these areas until such time (if any) as they return to their prior state. For example, the trees in some of the affected forested areas are mature trees that are greater than 50 to 100 years in age, and the time for a replanted forest community to develop an appearance comparable to its current appearance would be generally commensurate with the age of the current community. The presence of these cleared areas would detract from the natural pre-remediation appearance of those areas until such time as the restoration plantings have matured.

The riverine, riverbank, and impoundment areas that would be subject to remediation under SED 3, along with the floodplain areas to be used for staging areas and access roads, include areas that are currently used for a variety of recreational purposes, including canoeing, fishing, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 3. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts on Fluvial Geomorphic Processes

The River's geomorphic processes that could potentially be affected by the remediation of sediments and banks under SED 3 include lateral channel migration (i.e., changes in channel pattern), changes in channel dimension (i.e., width and depth), and changes in channel profile (i.e., slope). These channel dynamics are driven by energy dissipation, which is manifested in sediment transport processes such as bank erosion, bedload transport, and deposition/erosion patterns. An evaluation has been made of the effects of the SED 3 bank stabilization and bed remediation work on such morphologic processes, as well as certain other in-river hydrologic characteristics, such as water depth and current velocities within the River, as discussed below. The in-river morphologic processes most likely to be impacted (e.g., sediment transport) are those that occur within the higher energy environments found in Reaches 5A and 5B, since Reach 5C and Woods Pond are generally lower energy environments.[148] As such, the following discussion focuses on the impacts within Reaches 5A and 5B.

Previous studies of the riverbanks in Reaches 5A and 5B indicate that portions of these areas, at times, are subject to erosion and lateral movement (as described in Section 8.8.1.9 of the RFI Report, BBL and QEA, 2003). Under SED 3, some of the sediments, as well as select soils from riverbanks along Reaches 5A and 5B, would be removed and the banks in those reaches would subsequently be stabilized using a combination of traditional hardening methods and bioengineering techniques. As discussed above, bank stabilization in Reaches 5A and 5B would prevent or permanently curtail the continuation of the current geomorphological processes of bank erosion and lateral channel migration, which have allowed for the current heterogeneous mix of riverbank types, including vertical and undercut banks. As such, it would have a permanent adverse impact on the animals that depend on such banks.

Stabilization of the banks in Reaches 5A and 5B, as well the riverbed armoring due to the placement of a cap in Reach 5A, would also reduce the sediment supply to the River, which could affect such in-river processes as transport of sediments as bedload or suspended load, point bar development, and changes in channel dimension (i.e., width and/or depth), as determined by sediment deposition/erosion patterns. From a geomorphology perspective, the reduction of sediment load to the River due to the SED 3 bank stabilization and bed armoring would theoretically result in a gradual shift in channel pattern (i.e., lateral position), profile (i.e., slope), and/or dimension (i.e., width/depth) in order to reach a new point of equilibrium. However, as discussed above, the bank stabilization work would, by definition, be designed to limit changes in channel pattern and width, and the bed armoring would be designed to limit changes in channel depth and slope that could occur through increased erosion. Moreover, any shift in channel depth or slope in Reaches 5A and 5B due to the reduction in sediment load would be further minimized by the fact that there would still be a sufficient upstream supply of sediment. Based on visual observations in the field, much of Reaches 5A and 5B appears to exhibit over-widening characteristics with lateral and transverse bar deposits of sediment, which are an indication of excess sediment supply to a river (Rosgen, 2001, 2006; Rosgen and Silvey, 1996). Thus, if Reaches 5A and 5B are in a state of excess sediment supply, some reduction in sediment load from bank stabilization and bed armoring would not have a significant negative impact on the River's long-term in-river geomorphologic processes.

[148] For example, bedload data collected from the PSA confirm that this process occurs predominantly in Reach 5A and to a much lesser extent in Reach 5B (BBL and QEA, 2003).

With regard to bedload transport, stabilization of the riverbanks would eliminate or reduce a source of larger grain size material to the River that is transported as bedload in Reaches 5A and 5B. To the extent that eroding banks slump into the River and subsequently contribute to the overall bedload in Reaches 5A and 5B, this process would be reduced following implementation of SED 3. The armor stone placed as a cap component would also have an impact on bedload transport by limiting the mobility of the bed which normally serves to dissipate energy in higher flow events. However, based on experience in the Upper ½-Mile Reach, once sediment has aggraded on top of the armor stone, bedload movement should return to current conditions, as evidenced by the aggradation of material in that reach after remediation. As discussed above, the presence of an adequate sediment supply in Reaches 5A and 5B would further limit the impacts of SED 3 remediation work on bedload transport within those reaches.

Finally, EPA's hydrodynamic and sediment transport (EFDC) model can also provide some information on how the riverbank stabilization and sediment remediation may affect long-term sediment transport processes and hydrologic characteristics within the River.[149] As discussed in Section 3.3, to evaluate the potential combined impact of the SED 3 bank stabilization and sediment removal/capping/armoring work on in-river processes (e.g., deposition/erosion patterns, water depth, velocity), results from the model simulation of SED 3 were used to assess whether or not the reduced sediment load associated with bank stabilization and bed armoring would significantly impact in-river geomorphic processes, as indicated by changes in long-term sediment deposition and erosion patterns (i.e., bed elevation change). The model-predicted bed elevation within Reach 5 under SED 3 was compared to that predicted under no action (SED 1) over spatial scales ranging from a single model grid cell to 1-mile reaches. For this comparison, differences in sediment bed elevation between these two simulations (as compared to those at the start of the simulation) were used as surrogates for changes in the hydrologic characteristics described above (i.e., water depth and velocity). Changes in bed elevation are a reasonable surrogate for water depth and velocity since, as bed elevation increases, water depth decreases and current velocity tends to increase (and vice versa).

The results of these two simulations are shown on Figure 6-8. This comparison suggests that bank stabilization and bed armoring, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas, mainly in

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[149] EPA's model was not specifically developed to analyze river geomorphology and its relatively coarse scale (e.g., one grid cell across the entire river channel in Reaches 5A and 5B) does not allow it to accurately represent processes such as differences in shear stress regime between the inner and outer portions of bends. However, it is useful for assessing relative changes in sediment deposition and erosion on larger scales (e.g., ¼ to ½ mile segments).

Reaches 5A and 5B,[150] but would have a relatively small overall impact on larger-scale bed elevation changes (e.g., over ½-mile or longer reaches) over the 52-year model projection simulation. As expected, removing the sediment loading due to bank erosion under SED 3 is predicted to result in slight decreases in net deposition, relative to SED 1 (no action, which included bank and bed erosion), within several areas of the River (mainly in Reaches 5A and 5B, as shown by bed elevations predicted for SED 3 that are lower than those predicted for SED 1 on Figure 6-8). However, given the relatively small magnitude of such differences, it is reasonable to expect that changes in water depths and velocities would also be relatively small on average. These model results indicate that the bank stabilization work under SED 3 would have a minimal effect on deposition/erosion patterns, water depths, and current velocities.

In summary, as noted above, the bank stabilization in Reaches 5A and 5B would have a significant impact on the geomorphological processes of bank erosion and lateral channel migration. However, based on the qualitative observations of geomorphologic processes and the predictions of EPA's model described above, it is not expected that the reduction in sediment load associated with riverbank stabilization and riverbed armoring in those subreaches under SED 3 would result in a large-scale, long-term impact on the in-river morphologic processes of channel dimension shifts, sediment transport, and deposition/erosion patterns, or on in-river hydrologic characteristics such as water depth and current velocity.

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 3, various restoration methods are available.[151] Restoration methods for the types of habitats that would be affected by SED 3 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, and 5.3.3.3 for impoundments such as Woods Pond, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 3.

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150 The increase in bed elevation in the lower portion of Reach 5C and Woods Pond shown on Figure 6-7 under SED 3 is primarily associated with placement of the thin-layer cap material in those reaches rather than deposition.

151 Potential measures to avoid or minimize the adverse impacts were described in Section 5.2.

6.3.6 Attainment of IMPGs

As part of the evaluation of SED 3, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 3, and those comparisons are illustrated in Tables 6-15 through 6-20.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years required to achieve the various IMPGs are presented in Tables 6-15 through 6-20.[152] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the time to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. It should be noted that such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[153]

6.3.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations for SED 3 would achieve the RME IMPGs based on a cancer risk of 10^{-5}, as well as all non-cancer-based IMPGs, in all eight of the sediment direct contact

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[152] The extent to which SED 3 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 6.1.6 above).

[153] Also, as described in Section 3.2, bounding simulations have been conducted with the model (as directed by EPA) to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values. In almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the single instance of additional IMPG attainment resulting from application of the lower-bound assumptions is noted.

exposure areas located within Reaches 5 through 8 (see Table 6-15). The majority of these IMPGs would be met prior to any active remediation.

For human consumption of fish, the average fish PCB concentrations predicted by the model after 52 years, when converted to fillet-based concentrations, would not achieve any of the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8, except the probabilistic cancer-based IMPG at a 10^{-4} risk (but not the non-cancer IMPG) in Reach 5A (Table 6-16).[154] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 3 would achieve fish PCB levels within the range of the RME-based cancer and non-cancer IMPGs within the modeled period (except for the deterministic non-cancer IMPG for children in the Bulls Bridge Dam and Lake Lillinonah impoundments).[155]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year (based on a deterministic approach and on a 10^{-5} cancer risk as well as non-cancer impacts) would take 150 to >250 years in the PSA and >250 years in Reaches 7 and 8.

6.3.6.2 Comparison to Ecological IMPGs[156]

For benthic invertebrates, predicted average surface sediment PCB concentrations would achieve the upper-bound IMPG (10 mg/kg) within the model period in all of the 32 relevant averaging areas and would also achieve the lower-bound IMPG (3 mg/kg) in 20 of those

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154 Under the CTE assumptions, SED 3 would achieve the CTE IMPGs at a cancer risk level of 10^{-4} in nearly all subreaches of Reaches 5 through 8 within approximately 10 years, although the corresponding non-cancer IMPGs would generally not be met. (Application of the lower-bound assumptions would result in attainment of the probabilistic CTE non-cancer (child) IMPG in one additional subreach in Reach 7.) Also, SED 3 would achieve the CTE IMPGs at a 10^{-5} cancer risk in Reach 5A within approximately 20 years, although the corresponding non-cancer IMPG would not always be met.

155 In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 3, this change in averaging method (and the resulting increase in concentration) would not change the IMPG assessment presented in Table 6-16, except that the non-cancer (child) probabilistic CTE IMPG would no longer be achieved in Reach 6.

156 While this section describes the extent to which SED 3 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.3.5.3 and 6.3.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.3.11.

areas (Table 6-17). Where the IMPGs would be achieved within the model period, the time required to achieve them ranges from 1 to 7 years in Reach 5A, and up to approximately 20 years in Reaches 5B, 5C and 6. For the areas where the lower-bound IMPG would not be met within the model simulation period, extrapolation of the model results indicates that this IMPG would be achieved in the majority of averaging areas within approximately 150 years.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the upper-bound IMPG (5.6 mg/kg) in 15 of the 29 backwater areas evaluated, and would also achieve the lower-bound IMPG (3.27 mg/kg) in 9 of those areas (Table 6-18). In the backwaters where the upper-bound IMPG would be achieved within the model period, the time to achieve it ranges between 5 and approximately 40 years. The estimated time to achieve the lower-bound IMPG in all backwaters varies from approximately 10 years (based on the model) to >250 years (based on the extrapolations).

For fish, the model-predicted average whole-body fish PCB concentrations for SED 3 would achieve the IMPGs for fish protection (55 and 14 mg/kg for warmwater and coldwater fish, respectively) in all reaches, except for the coldwater fish IMPG in Reach 7B (Table 6-19). In Reaches 5 and 6, the time to achieve the warmwater fish IMPG ranges from approximately <1 to 11 years. In Reaches 7 and 8, the warmwater fish IMPG is already achieved at the beginning of the model projection period, and the coldwater fish IMPG would generally be achieved in about 10 to 50 years (again excluding Reach 7B). The estimated time to achieve the coldwater fish IMPG in Reach 7B is approximately 80 years.

For insectivorous birds (represented by wood ducks) and piscivorous mammals (represented by mink), predicted average surface sediment PCB levels have been compared to the selected target sediment levels of 1, 3, and 5 mg/kg, which would allow achievement of the IMPGs for these receptors depending on the associated floodplain soil concentrations. For insectivorous birds, predicted average surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all of the Reach 5A averaging areas and below the target level of 1 mg/kg in some of those areas, but exceed all sediment target levels in nearly all of the exposure areas in Reaches 5B, 5C/5D, and 6 (Table 6-20). For piscivorous mammals, the predicted average surface sediment PCB concentration in Reaches 5A/5B exceeds the target sediment level of 1 mg/kg but is below the target sediment levels of 3 and 5 mg/kg, and the predicted surface sediment level in the Reaches 5C/5D/6 averaging area exceeds all the target levels (Table 6-20). The estimated times required to achieve the target sediment levels for insectivorous birds and piscivorous mammals are highly variable, depending on the receptor, the reach, and the target level, as shown in Table 6-19.[157]

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to osprey would achieve the IMPG of 3.2 mg/kg in Reaches 5A and 6 and four of the subreaches within Reach 7 (Table 6-19). In these reaches, the IMPG is predicted to be achieved in approximately 10 to 20 years. In the remaining reaches, extrapolated estimates of the time required to achieve the IMPG range from 60 years in Reach 7D to >250 years in Reach 7B.[158]

Finally, for threatened and endangered species (represented by bald eagle), the model-predicted average whole-body fish PCB concentrations for the relevant size range would achieve the IMPG (30.4 mg/kg) in all reaches (Table 6-19). In Reaches 5 and 6, the time to achieve that IMPG ranges from 3 to 10 years and in Reaches 7 and 8, that IMPG is already achieved at the beginning of the model projection period.[159]

6.3.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 3 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 3 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if removal activities should encounter

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157 In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 3 has been paired with FP 3. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 3, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

158 In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no change in the number of averaging areas achieving the piscivorous bird IMPG under SED 3.

159 EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 3 at the end of the simulation period are 0.009 to 0.02 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 3 are in the range of 0.09 to 0.2 mg/kg (Table 6-13). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

free NAPL, drums of liquid, or the like (which is not anticipated), these wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 3 would result in reduced mobility of PCBs in the River by removing approximately 134,000 cy of sediment containing PCBs in Reach 5A followed by capping; stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks; and placing a thin-layer cap over a total of 97 acres in portions of Reach 5C and in Woods Pond to enhance recovery processes.

Reduction of Volume: SED 3 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through removal of 134,000 cy of sediment from Reach 5A containing approximately 10,300 pounds (lbs) of PCBs. Further, 35,000 cy of bank soil containing approximately 1,600 lbs of PCBs would also be removed from Reaches 5A and 5B under this alternative.[160]

6.3.8 Short-Term Effectiveness

Consideration of the short-term effectiveness of SED 3 has included an assessment of the short-term adverse impacts of implementing SED 3 on the environment (in terms of both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Since the remedial activities associated with SED 3 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Nevertheless, SED 3 would cause substantial short-term adverse impacts in portions of the Rest of River area for its 10-year implementation period.

Impacts on the Environment – Effects Within PSA

The short-term adverse effects on the environment resulting from implementation of SED 3 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of the riverbank habitat and

[160] The mass of PCBs removed from sediment was estimated based on EPA model mass balance results. The mass of PCBs removed from banks was estimated using an estimated average bank soil PCB concentration in Reaches 5A and 5B of 17 mg/kg (calculated from riverbank sample points collected in riverbank areas specified for soil removal [see Appendix G]), and soil bulk density of 1.3 grams per cubic centimeter (g/cm^3) (BBL and QEA, 2003).

associated biota due to bank stabilization activities; and loss of floodplain habitat and disruption to the biota that reside in the floodplain due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal activities in Reach 5A (134,000 cy over 42 acres) would result in some resuspension of PCB-containing sediment in the water column due to the invasive nature of the removal operation. Resuspension to the water column outside the work area would be controlled in Reach 5A as sheetpiling would be used to contain the area during excavation/capping activities and removal activities would be performed in the dry. However, the potential exists for suspended or residual sediment containing PCBs to be released from the work area both during sheetpile installation and during a high flow event should overtopping of the sheeting occur. As a result, PCB levels in aquatic biota may increase temporarily in the vicinity of the remediation.[161]

The potential also exists during sediment and bank soil removal and related sediment/soil processing activities for airborne releases that could impact downwind communities.

Implementation of removal and capping under SED 3 would cause a loss of aquatic habitat in the 42 acres of Reach 5A where such remedial activities would occur. As discussed more generally in Section 5.3.1.2, these activities would involve or cause the following short-term ecological impacts:

- Removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates in Reach 5A, and change in surface substrate type from its current condition of sand and gravel to armor stone;

- Removal of any non-mobile or slow-moving organisms, such as aquatic plants, benthic invertebrates, reptiles, and amphibians, as well as their viable propagules (e.g., seeds, eggs), present in the sediments during the removal;

- Temporary disruption and displacement of fish in Reach 5A;

- Alteration of habitat for birds and mammals that live adjacent to the River in Reach 5A and migrate, feed, and disperse in the areas subject to remediation;

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[161] Such a temporary increase in biota PCB concentrations was noted in the results of the caged mussel monitoring performed during the Upper ½-Mile Reach Removal Action, which involved dry excavation using sheetpiling (GE, 2004b).

- Change in the character of the biotic community that would return to the area after remediation, at least initially, to a community more tolerant of the changed substrate, with likely loss of sensitive and rare species; and

- High likelihood of colonization by invasive plant species.

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate impacts on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. As discussed more generally in Section 5.3.2.2, these impacts would include the following:

- Removal of all trees, other vegetation, and woody debris from the riverbanks, with the resulting loss of shading and wind protection for the River and the loss of the wildlife that use the features (e.g., birds that use these trees as perching or nesting sites, dragonflies that use these trees for perching during their adult stage, and reptiles and mammals that use the living and dead woody vegetation for shelter or resting/basking);

- Reshaping of the banks together with installation of stabilization measures, which would eliminate the vertical and undercut banks used by various species for nesting (e.g., belted kingfishers, bank swallows) or overwintering (e.g., the state-listed wood turtle);

- Disruption of the forested riparian corridors up and down the River in Reaches 5A and 5B, resulting in the fragmentation of populations and curtailment of the dispersal and migratory movement of species that rely on these corridors;

- Elimination of muskrat and beaver slides and burrows from the banks;

- Impairment of the movements of various species (including amphibians, reptiles, and large and small mammals) between the aquatic and terrestrial habitats used by these species; and

- Increased opportunity for invasive species to move into areas where they are currently not found, particularly due to the opening of the canopy as a result of tree removal from the banks.

Thin-Layer Capping: Thin-layer capping activities in Woods Pond and part of Reach 5C would be performed by placing a thin layer of sand (assumed for this evaluation to consist of 6 inches) over 97 acres of the undisturbed native sediments. As discussed more generally in Sections 5.3.1.2 and 5.3.3.2, the placement of thin-layer caps in Reach 5C and the portions of Woods Pond outside the "deep hole" would produce the following short-term ecological impacts:

- Burial of most, if not all, of the non-mobile organisms, including aquatic plants and invertebrates, in the remediation zone, with only the heartiest (including invasive species) potentially able to regrow or make their way through the cap material (which is not desirable for maintaining biological diversity);

- Change in the existing substrate of Reach 5C and Woods Pond from its current condition dominated by silty sediments to one composed of sand, with the resulting change in the aquatic vegetation, invertebrate, and fish species that would recolonize these areas, at least initially;

- High likelihood of colonization by invasive plant species;

- In areas where the water depth in less than 12 inches, such as along the shorelines, if consolidation of the underlying sediment does not occur, a potential change in the vegetative characteristics and biota of these areas due to the change in bottom elevation – and, in areas (if any) where the thin-layer cap exceeds the depth of water, potential replacement of existing emergent vegetation by species more tolerant of less frequently inundated or drier conditions.

In the “deep hole” portion of Woods Pond, the placement of a thin-layer cap is unlikely to have any significant short-term impacts for the same reasons discussed for long-term impacts in Section 6.3.5.3.

<u>*Supporting Facilities*</u>: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the loss of the wildlife that they support. It is anticipated that SED 3 would require a total of approximately 81 acres for access roads and staging areas, with approximately 47 acres within the floodplain. The habitat types affected were identified in Section 6.3.5.3. The short-term impacts from the construction and use of these support facilities would include the following:

- Removal of all trees, shrubs, and other vegetation within the access roads and staging areas located in forested areas, with the consequent loss of cover, nesting, and feeding habitat for wildlife species that use the affected areas;

- Compaction of the soil in the areas used for access roads and staging areas, with consequent impacts on the permeability of those soils;

- Where the access roads are constructed in wetlands, loss of those wetlands and their associated wildlife;

- Habitat fragmentation that would further disrupt the movement and interactions of certain wildlife species; and

- Increase in construction and equipment traffic, which could disrupt some animals or result in mortality to certain slow-moving smaller animals.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 3.

The total calculated emissions from SED 3 would amount to approximately 39,000 tonnes of GHG emissions, with 19,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation), 1,200 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 19,000 tonnes from off-site emissions (primarily from manufacture of steel sheeting and of cement for stabilization, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent to the annual output of approximately 7,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

Implementation of SED 3 would result in some short-term impacts to the local communities in the Rest of River area. The removal/thin-layer capping activities in the River, the riverbank remediation/stabilization, and the construction of staging areas and access roads in the adjacent floodplain would cause disruption of recreational canoeing and other river-related and land-side activities in this area, together with increased noise and truck traffic. These impacts would mainly affect Reach 5A, where remediation activities are anticipated to last approximately 8 years, with lesser impacts in and adjacent to Reaches 5B, 5C, and 6, where remediation is estimated to last for approximately 2 years.

Impacts on Recreational Activities: During the period of active construction, restrictions on recreational use of the River and floodplain would be imposed in the areas in which remedial construction activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational hikers, anglers, and hunters to use those areas during construction. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment to the work areas and to remove excavated materials and deliver capping materials, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would continue for the duration of SED 3 (estimated at 10 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 13,900 truck trips to do so (1,390 truck trips per year for a 10-year remediation project). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton trucks for local hauling of such materials, an additional approximately 25,000 truck trips (2,500 truck trips per year) would be required for that purpose. The additional traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near Reach 5A, with lesser impacts in Reaches 5B and 5C, and Woods Pond.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and staging area materials following remediation. (The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal locations are evaluated as either worker risks or traffic accident risks under the relevant treatment/disposition alternatives.) This analysis indicates that the increased truck traffic associated with SED 3 would result in an estimated 1.63 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.17) with a probability of 80% of at least one such injury, and an estimated 0.08 fatalities from accidents (average annual fatality estimate of 0.008) with a probability of 7% of at least one such fatality.[162]

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[163] These

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[162] Since the analysis in Appendix N is based on statistics, it can result in an estimate of injuries or fatalities of less than 1.

[163] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

measures would consist of the ones identified in Section 5.7 above, which include the following: (a) avoidance of construction activities at nights except where necessary and minimization of such activities on weekends and holidays; (b) proper vehicle maintenance; (c) efforts to avoid travel through densely populated areas where practical; (d) where travel though populated areas is necessary, implementation of measures to ensure the safety and well-being of the impacted communities (e.g., traffic control, consultation with local public officials); (e) performance of routine air monitoring during construction activities in accordance with a project-specific community air monitoring plan; (f) use of dust control measures as needed; (g) implementation of a public information program prior to and during the construction process; and (h) implementation of engineering controls and other actions as needed on a case-by-case basis. Despite the implementation of these measures, detrimental effects of construction and short-term impacts and risks to the community in association with SED 3 implementation would be inevitable.

Risks to Remediation Workers

Implementation of SED 3 would result in health and safety risks to site workers. Implementation of SED 3 is estimated to involve 477,505 man-hours over a 10-year timeframe. Appendix N includes an analysis of potential risks to workers from implementation of the sediment alternatives. This analysis indicates that implementation of SED 3 would result in an estimated 4.43 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.46) with a probability of 99% of at least one such injury, and an estimated 0.04 worker fatalities (average annual fatality estimate of 0.004) with a probability of 4% of at least one such fatality. Engineering controls and Occupational Safety and Health Administration (OSHA) procedures designed to mitigate risks to remediation workers would be instituted.

6.3.9 Implementability

6.3.9.1 Technical Implementability

The technical implementability of SED 3 has been evaluated considering the following factors.

General Availability of Technologies: SED 3 would be implemented using well-established and available in-river remediation methods and equipment. These include conventional mechanical earthmoving equipment such as bulldozers and backhoes, support equipment such as barges for thin-layer capping, and engineering controls (e.g., sheetpiling). Land-based support areas would be constructed using commonly available construction technologies. Well-established methods and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

<u>*Ability To Be Implemented*</u>: Based on site characteristics, the technologies that are part of SED 3 would be technically implementable in the reaches where they would be applied. Sediment removal followed by capping would be implemented in Reach 5A, with current grades re-established following cap placement so that flood flows and flood storage capacity in this reach are not altered. Removal and capping would be performed in the dry. Removal and capping in the dry was used in the Upper ½-Mile Reach, using sheetpiling to divert flow and isolate portions of the River for dewatering and subsequent removal in the dry. The same dry techniques could be implemented in Reach 5A.

Thin-layer capping would be implemented in portions of Reach 5C and in Woods Pond. These are areas of generally lower velocity, which are the types of areas that are candidates for thin-layer capping. The impacts on flood storage capacity resulting from the placement of thin-layer cap material in these reaches under SED 3 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event. For the purposes of this analysis (and similar analyses conducted for the remaining sediment alternatives), an event occurring in Year 48 of the projection having a 2-year return period was selected.[164] Under SED 3, the area of floodplain within Reaches 5 and 6 predicted by the model to be inundated during this 2-year flow event was equal to that of SED 1 (817 acres). This indicates that the placement of thin-layer cap material in Reaches 5C and 6 under SED 3 would have no impact on flood storage capacity. This result was expected since the backwater effects in Woods Pond and in Reach 5C are controlled by Woods Pond Dam. Nonetheless, additional calculations would be conducted during design as appropriate.

Riverbank stabilization, including removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant river stretches.

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[164] This event was selected for two reasons. First, this event is smaller than the 10-year event, which defines the limits of the floodplain in the EPA model. Because the numerical grid does not extend past the 10-year floodplain, the model cannot be used to accurately simulate floodplain inundation for larger events. Indeed, evaluation of predicted water surface elevations during the extreme event in Year 26 of the simulation indicated that the model results did not differ appreciably among the sediment alternatives. Results from analysis of other storm events (e.g., 1-, 1.5-, and 5-year events) were similar to those for the 2-year event described here. Second, the event occurs at a time in the projection when sediment remediation within the PSA is complete for all alternatives, allowing a direct comparison of the full impact of remediation on flooding.

MNR with institutional controls would be implemented in all other reaches. Monitoring to track changes in PCB concentrations following the other SED 3 activities would be performed using readily available methods and materials, such as has been used previously in the River. The continued maintenance of biota consumption advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain necessary for implementation of SED 3 (i.e., staging areas and access roads) could readily be constructed using commonly available construction techniques.

Reliability: The remediation technologies that comprise SED 3 are considered reliable, based on a review of similar applications at other sites, including previous remediation in the Housatonic River upstream of the Confluence. The use of these technologies at other sites is described in more detail in Section 6.3.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.3.5.2 and 6.3.5.3.

Availability of Space for Support Facilities: Implementation of SED 3 would require construction of access roads and staging areas at various locations within the floodplain of the Housatonic River. As noted previously, an estimated 81 acres of space would be needed, and appear to be available to support the SED 3 activities based on a conceptual site layout (assuming that the necessary access agreements can be obtained). Development of staging and support areas would be sequenced over the approximate 10-year implementation period estimated for SED 3.

Availability of Cap/Stabilization Material: Materials required for cap construction and bank stabilization must be of suitable quality for their intended purposes. A total of approximately 232,000 cy of sand/fill/stone materials would be required for capping, thin-layer capping, and bank stabilization activities (i.e., 156,000 cy of sand/clean fill and 76,000 cy of armor stone and riprap). Adequate material sources are assumed to be locally available, based on the availability and use of similar materials for the removal actions completed in the Upper ½-Mile and 1½-Mile Reaches. An evaluation would be performed during design activities to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable subject to the same technical and logistical constraints applicable to the initial implementation of SED 3. Ease of implementation of the corrective measures would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 3 would be determined through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness as well as bank stability. Such activities have been performed on the upper portions of the Housatonic River and at other sites. Equipment and methods for this type of monitoring are readily available.

6.3.9.2 Administrative Implementability

Administrative implementability of SED 3 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 3 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 3 is provided in Tables S-3.a through S.3-c in Appendix C and summarized in Section 6.3.4.

Access Agreements: Implementation of SED 3 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although many of these areas are owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 30 to 40 other landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA’s assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 3, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.3.10 Cost

The estimated total cost to implement SED 3 is $155 M (excluding treatment/disposition costs). The estimated capital cost for implementation of SED 3 is $146 M, assumed to occur over a 10-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.0 M. The estimated annual OMM costs for SED 3 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $15,000 to $509,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $6.4 M. The following summarizes the total capital and OMM costs estimated for SED 3.

SED 3	Est. Cost	Description
Total Capital Cost	$146 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$9.4 M	Costs for performance of the OMM programs
Total Cost for Alternative	$155 M	Total cost of SED 3 in 2010 dollars

The total estimated present worth cost of SED 3, which was developed using a discount factor of 7%, a 10-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $114 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for the combination of SED 3 and FP 3 is presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.3.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.3.2, the evaluation of whether SED 3 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

<u>*General Effectiveness*</u>: As noted previously, SED 3 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 134,000 cy of PCB-containing sediments in Reach 5A and placing a cap over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy of bank soil; (c) placing a thin-layer cap over 97 acres in portions of Reach 5C and in Woods Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (d) relying on natural recovery processes (primarily physical) in other areas to contain and reduce the bioavailability of PCBs in the sediment. As shown in Section 6.3.3, this remediation, along with ongoing remedial activities upstream of the Confluence, is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 1.3 kg/yr and that passing Rising Pond Dam from 19 to 2.4 kg/yr over the course of the modeled period, and to reduce the annual PCB mass transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.4 kg/yr over that period.

Further, as shown in Section 6.3.5.1, EPA's model predicts that SED 3 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 90 mg/kg to approximately 1 mg/kg in Reach 5A, from 70-90 mg/kg to 9-15 mg/kg in Reaches 5B and 5C, from 110 mg/kg to 30 mg/kg in the Reach 5 backwaters, from 80 mg/kg to approximately 4 mg/kg in Woods Pond, from 30-60 mg/kg to 5-11 mg/kg in the Reach 7 impoundments, from 30 mg/kg to 8 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.1-0.2 mg/kg in the Connecticut impoundments.

On the other hand, SED 3 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.3.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

<u>*Compliance with ARARs*</u>: As explained in Section 6.3.4, SED 3 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 µg/L, which should be waived as technically impracticable to attain. Further, review of the potential location-specific and action-specific ARARs indicates that SED 3 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.3.6.1, accepting EPA's HHRA, SED 3 would provide protection of human health from direct contact with sediments, since it would achieve the direct contact IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 3 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (with the exception of the probabilistic RME 10^{-4} cancer IMPG in Reach 5A). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 3 would generally achieve fish PCB levels within the range of the RME IMPGs (except the deterministic non-cancer IMPG for children in two impoundments) within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls (fish consumption advisories) would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.3.6.2, the model results indicate that, by the end of the modeled period, SED 3 would achieve the IMPG levels for some ecological receptor groups. Specifically, SED 3 would achieve sediment levels within or below the IMPG range for benthic invertebrates (3 to 10 mg/kg) in all of the relevant averaging areas (as well as the lower bound of those IMPGs in 60% of those areas) and would also achieve fish PCB levels below the IMPGs for warmwater and coldwater fish and threatened and endangered species (55, 14, and 30.4 mg/kg, respectively) in all reaches, except for the coldwater fish IMPG in Reach 7B. For other receptor groups, SED 3 would achieve the IMPG levels in some areas. For amphibians, SED 3 would result in sediment PCB levels within or below the IMPG range (3.27 mg/kg to 5.6 mg/kg) in about 50% of the backwater areas and the lower-bound IMPG in 30% of those areas. For piscivorous birds, SED 3 would achieve the fish-based IMPG (3.2 mg/kg) in 6 areas (Reaches 5A and 6 and four subreaches of Reach 7) and would achieve levels close to the IMPG (within 1.2 mg/kg or less) in another 4 areas (see Table 6-19). For insectivorous birds, SED 3 would achieve the target sediment levels of 3 and 5 mg/kg in about half the averaging areas (i.e., those in Reaches 5A and 6) and the target sediment level of 1 mg/kg in 3 areas; while for piscivorous mammals, SED 3 would achieve the target sediment levels of 3 and 5 mg/kg in one of the two averaging areas, but would not achieve the target level of 1 mg/kg in either area.[165]

As discussed in Section 2.1.1, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. Under SED 3, while the IMPGs would not be achieved for some receptors and areas, the local populations of these receptors extend beyond the areas of the IMPG exceedances (i.e., to other areas of suitable habitat within the Rest of River where the IMPGs would be achieved and/or to nearby areas outside the Rest of River).[166] In these circumstances, the IMPG exceedances are not indicative of adverse effects that would prevent the maintenance of healthy local populations of these receptors, let alone negatively impact the overall wildlife community in the Rest of River area. This is supported by the fact that field surveys conducted by both EPA and GE, as well as other existing ecological information identified in Section 5.1.1, have documented the presence of numerous and diverse invertebrate, fish, amphibian, reptile, bird, and mammal species (including state-listed rare species) in the PSA despite the fact that PCBs have been present in that area for over 70 years.

On the other hand, implementation of SED 3 would cause substantial short-term adverse impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of removal and capping in Reach 5A, loss of riparian habitat in the bank stabilization areas, alteration of the habitat in the thin-layer cap areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 6.3.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 3 would result in substantial long-term and, in some cases, permanent adverse impacts on the ecosystem of the PSA. These impacts were described in Section 6.3.5.3. They include:

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165 As discussed previously, attainment of the IMPGs for insectivorous birds and piscivorous mammals depends on the combination of sediment and floodplain soil concentrations in the relevant averaging areas. Thus, attainment of the target sediment levels (1, 3, and 5 mg/kg) must be evaluated in conjunction with attainment of the corresponding target floodplain soil levels that were developed to achieve the IMPGs when associated with these sediment levels (see Section 7).

166 For example, the local amphibian population would include not only the amphibians in the backwaters evaluated as part of the sediment alternatives, but also those that inhabit the vernal pools in the PSA floodplain which are evaluated under the floodplain alternatives. As another example, the local populations of insectivorous and piscivorous birds, due to their dispersal and movement ability, extend at least throughout the PSA. Further, the local population of mink is not limited to the PSA, but extends to areas near the shoreline but outside the 1 mg/kg isopleth, as well as to tributaries of the River and to other riverine areas in the vicinity.

- Alteration of the aquatic riverine habitat in Reach 5A for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the aquatic habitats in the lower part of Reach 5C and the shallower portions of Woods Pond due to the thin-layer caps, with the additional potential that in certain shoreline areas the change in substrate elevation could result in a permanent change in the type of vegetation;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

- Fragmentation of the current, largely intact forested riparian corridors in Reach 5A and, to a lesser extent, Reach 5C, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of “overall protection” of the environment requires a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat” (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 3 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 3 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 3 would not meet the standard of providing overall protection of the environment.

6.4 Evaluation of Sediment Alternative 4

6.4.1 Description of Alternative

SED 4 would involve the removal of a total of 297,000 cy of sediment and riverbank soil (including 262,000 cy of sediment over 91 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank), engineered capping of a total of 128 acres (91 acres after removal and 37 acres without removal), and thin-layer capping of an additional 119 acres. Specifically, the components of SED 4 include the following:

- Reach 5A: Sediment removal in the entire reach (134,000 cy over 42 acres) followed by capping;

- Reach 5B: Combination of sediment removal/capping (39,000 cy over 12 acres) in the upstream portion of this reach and thin-layer capping (15 acres) in the downstream portion of this reach;

- Reach 5C: Combination of thin-layer capping (20 acres) in the upstream portion of this reach and capping (37 acres) in the downstream portion of this reach;

- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);

- Reach 5 backwaters: Thin-layer capping in certain backwaters (61 acres; depending on PCB concentrations);

- Reach 6 (Woods Pond): Combination of sediment removal (89,000 cy over 37 acres) in shallower areas (followed by capping) and thin-layer capping (23 acres) in the "deep hole"; and

- Remaining Reach 5 backwaters and Reaches 7 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figure 6-9 identifies the remedial action(s) that would be taken in each reach as part of SED 4.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 4. It is estimated that SED 4 would require approximately 15 years to complete. A construction timeline for implementation of SED 4 is provided in Figure 6-10. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. However, details of the specific methods for implementation of the remedy selected would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 4 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 4 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 23 staging areas, which would occupy a total of 37 acres (8.3 acres of which would be within the floodplain) and approximately 20 miles of access roads covering 48 additional acres assuming a 20-foot road width (16 miles and 39 acres of which would be in the floodplain) would be constructed between the Confluence and Woods Pond Dam to support implementation of SED 4. The locations of these staging areas and access roads are shown on Figure 6-9. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed in Reaches 5A, 5B, and 6, as presented below.

	Average Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 5A:	2	134,000	42
Reach 5B:	2	39,000	12
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**262,000**	**91**

The areas over which removal would occur are shown on Figure 6-9.

In Reaches 5A and 5B, it is assumed that the sediment removal would be performed in the dry with conventional mechanical excavation equipment. Similar to the approach for the Upper ½-Mile Reach and portions of the 1½-Mile Reach, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas. It is assumed that mechanical dredging in the wet using barge-mounted equipment would be implemented to accomplish the sediment removal in Woods Pond. Silt curtains would be placed downstream of excavation areas in Woods Pond in an effort to limit transport of suspended sediment. Periodic water column and air sampling would be performed during implementation.

Cap Placement: Following sediment removal, caps would be installed in the dry in Reaches 5A and 5B prior to removal of the sheetpile, and a cap would be installed in Woods Pond through the water column (Figure 6-9). A cap would also be installed through the water column in the deeper portions of Reach 5C where no excavation would be performed (Figure 6-9). Removal of debris that could interfere with the performance of the cap would be conducted prior to cap material placement. The caps would be designed to limit the potential for upward migration of the PCBs from the underlying sediments and to limit the potential for erosion of the cap materials. Cap materials would be transferred to the River using conventional earth-moving equipment. It is assumed that the caps would contain 12 inches of sand (which may be amended by organic material to increase the TOC content). To minimize the potential for cap erosion in the higher velocity reaches of the River, a 12-inch thick armor stone layer would be placed over the sand cap in Reaches 5A and 5B, and a 6-inch thick armor stone layer would be placed over the sand cap in the lower section of Reach 5C and the shallow areas of Woods Pond. The sand and armor stone composition/size would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to preclude the movement of cap materials during high flow events. Silt curtains would be used during capping in the wet in an effort to mitigate the potential for downstream transport of materials suspended in the water column.

Thin-Layer Cap Placement: Thin-layer caps would be installed in the deeper part of Reach 5B (15 acres), the shallower portion of Reach 5C having relatively lower concentrations of PCBs (20 acres), the Reach 5 backwaters with average PCB concentrations equal to or greater than 15 mg/kg (61 acres; see Section 3.1.1), and the deep areas of Woods Pond (23 acres) as shown on Figure 6-9 (total of 119 acres). For purposes of evaluation, it is assumed that the thin-layer cap would consist of a 6-inch layer of sand, and would be placed via a combination of techniques, including mechanical and/or hydraulic means. For purposes of modeling, the material to be used for the thin-layer cap is assumed to have similar properties to those of the underlying native material (see Section 3.1.3). However, the actual materials to be placed would be determined during design activities.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that the removed sediments would be dewatered through gravity dewatering in stockpiles at the staging areas. The addition of stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 4 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in these subreaches. The bank stabilization techniques that are assumed to be part of SED 4 for purposes of this Revised CMS Report, like those identified for SED 3, involve a combination of bioengineering and traditional bank hardening techniques. Those techniques are described in Section 3.1.4 and Appendix G and are depicted on Figures G-18 through G-25 in Appendix G.

For purposes of this Revised CMS Report, it is assumed that the riverbank stabilization/soil removal work in Reach 5A and the upstream portion of Reach 5B (above approximately New Lenox Road) would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, and employing conventional mechanical excavation equipment. However, since the downstream portion of Reach 5B would be subject to thin-layer capping (which would be placed in the wet), the bank stabilization/soil removal work in that portion of Reach 5B would be performed in the wet from the top of the riverbank. For this reason, as with the bank stabilization under SED 3 in Reach 5B, and as discussed in Appendix G (Section 6), the riverbank stabilization techniques identified for the downstream portion of Reach 5B under SED 4 have been modified from those that could be applied in the dry, some of which could not practicably be implemented below the water. Thus, the riverbank stabilization techniques described for SED 4 in Appendix G and shown on Figures G-18 through G-25 include certain modifications in the downstream portion of Reach 5B to allow implementation in the wet.

MNR: MNR would be implemented in the remainder of the Rest of River (portions of the Reach 5 backwaters and Reaches 7 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue throughout the Rest of River area at varying rates, due in part to the completed and planned upstream source control and remediation measures, as well as the remediation that would be conducted in the Rest of River as part of this alternative.

Restoration: For purposes of evaluation in this Revised CMS Report, it is assumed that, SED 4 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, the bank stabilization/removal activities, and ancillary construction activities. The restoration methods assumed for SED 4 for purposes of this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, and 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B; Section 5.3.3.3 for Woods Pond; Section 5.3.6.3 for the Reach 5 backwaters; and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 4 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 4 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and/or disposal of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 4 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for the capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM programs for capped areas under SED 4 would include the same elements outlined for that program under SED 3 (Section 6.3.1). The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 4.

A summary of the assumed long-term (100 year) OMM program for SED 4 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 following remediation and would include collection and PCB analysis of 50 surface sediment samples from MNR areas, approximately 23 cores (69 samples) from removal areas, approximately 10 cores (30 samples) from cap only areas, and approximately 30 cores (30 samples) from the thin-layer cap areas. Further, for the caps and thin-layer caps, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.4.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 4 would be protective of human health and the environment is presented at the end of Section 6.4 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.4.3 Control of Sources of Releases

SED 4 would reduce the potential for PCB migration from certain sediments and riverbanks. The remedial components of SED 4 would include all of the components of SED 3, with additional removal in Reach 5B and Woods Pond, capping in a portion of Reach 5C, and thin-layer capping in Reaches 5B and another portion of Reach 5C and certain Reach 5 backwaters. Implementation of these actions would address approximately 247 acres of the riverbed and approximately 14 linear miles of riverbank (7 miles on both banks), and would include removal of 297,000 cy of PCB-containing sediment and bank soils, thereby resulting in a reduction in the potential for future transport of the PCBs within the River or onto the floodplain for potential human or ecological exposure. The PCB-containing surface sediments in Reaches 5A and 5B and the shallow portion of Woods Pond, as well as select bank soils in Reaches 5A and 5B, which are susceptible to scour during high flow events, would be removed and the residual PCBs remaining in these areas would be contained using caps and bank stabilization techniques. A cap (with no excavation) would also be placed in the deeper portion of Reach 5C to isolate the underlying PCB-containing sediments from the water column. In a portion of Reaches 5B and 5C, the Reach 5 backwaters, and the deep portion of Woods Pond, which are more depositional, a thin-layer cap would be placed to accelerate the natural recovery process, and in doing so would assist in controlling releases in those areas.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would reduce PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed.

Implementation of SED 4, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain, as demonstrated by EPA's model. The annual average PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by 96% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.8 kg/yr). Similarly, SED 4 is predicted to achieve an 89% reduction in the PCB mass passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 2.1 kg/yr). Likewise, the annual average PCB mass transported from the River to the floodplain in Reaches 5 and 6 is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 12 kg/yr to 0.4 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-11b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 4 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 4 indicate that, in reaches subject to MNR only (i.e., Reaches 7 and 8), the extreme flow event would not result in the exposure of buried PCBs at higher concentrations than those already present in the sediment surface prior to the event. For the reaches that would be capped either following removal or without removal (i.e., Reach 5A, and parts of Reaches 5B, 5C, and Woods Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[167] As a result, the model predicts no change in reach-average surface sediment PCB concentrations in Reach 5A (Figure 6-11b) or in the capped portions of the other reaches. For the portions of Reaches 5B, 5C, and 5D that include thin-layer capping, the model predicts that only limited portions of these areas (<1% to 7% of the thin-layer capped portions) would experience erosion large enough to produce increases in average surface sediment PCB concentrations during storm events (Figure 6-11b). These concentration increases are small (0.2 to 0.3 mg/kg), and the concentrations following the extreme event still represent significant reductions relative to current levels (96% in Reach 5B and 99% in Reaches 5C and 5D; Figure 6-11b). No such erosion of the thin-layer cap is predicted to occur in the deep portion of Woods Pond. Thus, the model results for SED 4 indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

Given that SED 4 includes remediation in Woods Pond (a combination of sediment removal over 37 acres and thin-layer capping over 23 acres), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. The solids trapping efficiency of Woods Pond under SED 4, as predicted by EPA's model, would be unchanged relative to MNR (approximately 15% under both alternatives) for two reasons: (1) the placement of a thin-layer cap over 23 acres of the Pond would result in a small decrease in depth, which in turn results in only a small decrease in solids trapping efficiency; and (2) the 37 acres subject to removal would be restored to grade, therefore resulting in no net change in depth over this portion of the Pond.

6.4.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 4 in accordance with directions from EPA are listed in Tables S-4.a through S-4.c in Appendix C. The compliance of SED 4 with these potential ARARs is discussed below.

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167 Further evaluation of the stability of cap and thin-layer cap materials under SED 4 based on model predictions of erosion in these areas is provided in Section 6.4.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-4.a, include federal and state water quality criteria for PCBs. To evaluate whether SED 4 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 4. As discussed in Section 3.5.1, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, only 2 exceedances are predicted at two locations within the PSA (Holmes Road and Woods Pond Headwaters) and 2 to 5 exceedances are predicted at four locations within Reaches 7 and 8. However, similar to SED 3, all of these exceedances in both the PSA and Reaches 7 and 8 consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered as a single exceedance. This is confirmed by the block averages that indicate only a single (or no) exceedance for this alternative in these reaches. For these reasons, as discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 4 would achieve this criterion, albeit at a significant environmental cost as discussed in Sections 6.4.5.3 and 6.4.8.

By contrast, the model-predicted annual average water column concentrations (which are used for assessment of the human health-based water quality criteria and are presented in Table 6-21 in Section 6.4.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. However, as previously discussed, the ARARs based on this criterion should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not be achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[168]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due

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[168] The estimated future water column concentrations in all the Connecticut impoundments under SED 4 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

to PCBs and pathogens. The impact of SED 4 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.4.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic River in Massachusetts, is discussed in Section 6.4.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 4 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.4.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.4.6.1. These evaluations provide an assessment of the effect of SED 4 on the impairment listings.[169]

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 4 are listed in Tables S-4.b and S-4.c.[170] As shown in those tables, SED 4 could be designed and implemented to achieve certain of those ARARs;[171] but, as with SED 3, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 4. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations applicable to the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute

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[169] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-21 (in Section 6.4.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 4 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.01 to 0.02 mg/kg. This provides further insight on the effect of SED 4 on the River's impairment listing in Connecticut.

[170] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

[171] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132), it is assumed that EPA would make the necessary determinations allowed by the regulations.

hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain locational and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.4.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 4 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.4.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 4 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 4, along with upstream source control and remediation measures and natural recovery processes, would reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities in Reach 5A and portions of Reaches 5B, 5C, and Woods Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in portions of Reach 5B, Reach 5C, Woods Pond, and certain backwater areas would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the media to which such receptors may be exposed. This table uses the same format described in Section 6.1.5.1.

Table 6-21 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 4)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.5	1.3	0.3
5B	0.4	1.8	1.9	0.4
5C	0.4	1.6	2.1	0.4
5D (backwaters)	0.3	---	2.0	0.4
6	0.3	1.5	1.1	0.2
7[1]	0.4 – 5.0	1.0 – 1.5	2.3 – 8.2	0.5 – 1.6
8[1]	2.7	1.4	6.5	1.3
CT	0.005 – 0.01	0.07 – 0.1	0.05 – 0.1	0.01-0.02

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.4.6.[172]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 4 over the 52-year model projection period are shown on Figures 6-11a-c. These figures show the timeframes over which the model predicts that SED 4 would reduce the PCB concentrations in each medium. The general pattern exhibited by these temporal profiles is one of a large decline in PCB concentrations over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. In the surface sediments, this pattern is generally observed mainly in the reaches undergoing remediation, while patterns in downstream reaches exhibit a shallower

[172] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

trajectory, which illustrates how remediating upstream source areas within the Rest of River (e.g., Reaches 5 and 6) translate to reductions in PCBs in downstream areas. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Fish concentrations respond to the predicted changes in water column and sediments. As a result of the remediation under SED 4, predicted fish PCB concentrations are reduced over the projection period by 97% to 99% in the remediated reaches (i.e., Reaches 5 and 6) and by 79% to 96% in the other downstream reaches (Figure 6-11c).[173]

PCBs would remain in the sediments beneath and outside the areas addressed by this alternative. However, in the capped areas of Reach 5 and Woods Pond, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; and the thin-layer caps would provide a clean layer over the underlying PCB-containing sediments. Overall, the extent to which SED 4 would mitigate a flood event could cause PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.4.3. As discussed in that section, the model results for SED 4 indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 4 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.4.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 4 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

[173] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are lowered based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 4 are largely unchanged, ranging from 96% to 98% in Reaches 5 and 6 and 78% to 94% in Reaches 7 and 8.

Use of Technologies under Similar Conditions and in Combination

As discussed in Section 6.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007), and SED 4 involves such a combination. The SED 4 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology at other sites. The components include sediment removal/capping using dry excavation techniques (in Reaches 5A and 5B), bank stabilization with removal of bank soils where necessary (in Reaches 5A and 5B), mechanical dredging/capping in the wet (in Woods Pond), capping alone (in the deeper part of Reach 5C), thin-layer caps (in portions of Reaches 5B, 5C, 5D, and 6), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs, albeit with different ecological conditions.

Examples of prior use of the SED 4 technologies that are common to SED 3 were presented in Section 6.3.5.2. The additional technologies for SED 4 are mechanical removal and capping in the wet in Woods Pond and capping in Reach 5C. Mechanical dredging in the wet followed by capping and capping alone have been used at the Sheboygan River (WI; BBL, 1998) and the Grasse River (NY; www.thegrasseriver.com). Removal in the Sheboygan River was performed using a clamshell bucket, and the cap placed following excavation consisted of sand and armor stone. A cap (without excavation) was also placed over the existing riverbed using sand and armor stone. Mechanical dredging (i.e., clamshell from a barge in select areas) was performed at the Grasse River, and a 1-foot sand/topsoil cap was placed via clamshell over the removal areas. Capping alone was successfully performed through the water column at the Grasse River site using a clamshell bucket to place a cap consisting of sand, gravel, and armor stone over the existing riverbed through an average water depth of approximately 16 feet.

As discussed in Section 6.3.5.2, GE has reviewed publicly available information on approximately 75 completed dredging/removal projects with various contaminants of concern to assess the precedents for a sediment remediation project with removal volumes like those in the sediment alternatives involved here. Approximately 15% of those projects included targeted/removed volumes greater than that for SED 4. However, none of those sites involved the unique mix of ecological habitats and settings present in and along the Housatonic River.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 4 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. Similar to SED 3, these include sediment removal, capping, thin-layer capping, and MNR.

Their general reliability and effectiveness were previously discussed in Section 6.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments. However, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). As stated by EPA (2005d), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005d) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d).

To further assess the reliability and effectiveness of SED 4, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 4, the areas receiving a cap, either following sediment removal or without sediment removal, include Reach 5A, the upper portion of Reach 5B, the lower portion of Reach 5C, and the shallow portion of Woods Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 4 are predicted to be 100% stable.

Thin-Layer Caps: SED 4 includes placement of a thin-layer cap in the lower portion of Reach 5B, the upper portion of Reach 5C, several Reach 5 backwaters, and the deeper portion of Woods Pond to enhance natural recovery. As discussed in Section 6.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when at least 1 inch of material remained for the full duration of the model projection (including the extreme flow event). EPA's model predicts that approximately 93% of the thin-layer capped area within Reach 5B would remain stable under SED 4. The erosion in the remaining 7% of that area is predicted to occur in a few limited sections of the Reach 5B channel, mainly during the Year 26 extreme event. Such erosion is predicted to result in an increase in the reach-average 0- to 6-inch surface sediment PCB concentration of approximately 0.3 mg/kg (Figure 6-11b). Similarly, EPA's model predicts that approximately 95% of the thin-layer capped area in Reach 5C would remain stable, and that the erosion over the remaining 5% of the area, occurring mostly during the extreme flow event, would increase the reach-average 0- to 6-inch surface sediment PCB concentration by approximately 0.2 mg/kg (Figure 6-11b). The model simulates similar erosion of the thin-layer cap within a single grid cell in the Reach 5 backwaters (representing <1% of the thin-layer capped area) in response to storm events in Years 39 and 41 of the simulation. As a result, the Reach 5D average 0- to 6-inch surface sediment PCB concentration is predicted to increase by approximately 0.2 mg/kg (Figure 6-11b). Finally, 100% of the thin-layer cap material within the deep portion of Woods Pond is predicted to be stable. After the increases in concentration described above are taken into account, the concentrations following the high flow events still represent reductions of 96% to 99% relative to current levels for all reaches where SED 4 includes a thin-layer cap (as discussed in Section 6.4.3). Based on these results, thin-layer caps would largely remain in place and thus would assist in controlling releases from underlying sediments and provide stability, even though this is not the primary goal of thin-layer capping.

It should also be noted, however, that there is a potential for impacts to the thin-layer caps from the feeding, spawning, and/or nesting activities of "megafauna," such as carp and largemouth bass. Specifically, carp could have some influence on portions of the thin-layer caps due to foraging in sediments, uprooting of plants, and thrashing behavior during spawning; and largemouth bass could have some influence on portions of the thin-layer caps by excavating nests.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.4.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques similar to those used in SED 3. The general reliability and effectiveness of this approach were described in Section 6.3.5.2.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 4 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the adversely affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 4. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.4.5.3.)

<u>Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials</u>

A combination of OMM techniques, including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for the caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 4. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks has been implemented in the Upper ½-Mile and 1½-Mile Reaches. Visual observation of capped/armored areas was also performed at the Sheboygan River to determine if the caps were still intact (BBL, 1998). Should changes in cap condition be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for the restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats and would not re-establish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

<u>Technical Component Replacement Requirements</u>

The technologies that comprise SED 4 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road reconstruction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.4.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 4 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 4 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the river and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 4 would alter the habitat of the river areas that would be excavated and/or subject to capping or thin-layer capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 4 would affect portions of the mapped Priority Habitats of 25 state-listed species, as described in Appendix L. Since SED 4 would affect more area and would take longer to implement than SED 3, its implementation would have greater impacts than SED 3 and overall recovery would take longer and be more unreliable. The long-term impacts of SED 4 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C

SED 4 would involve sediment removal and/or capping activities in the entirety of Reach 5A and portions of Reaches 5B and 5C, and placement of a thin-layer cap over the sediments in portions of Reaches 5B and 5C. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4 and are summarized below.

The specific long-term impacts of sediment removal/capping in Reach 5A were summarized in Section 6.3.5.3 for SED 3. Those same impacts would also apply to the sediment removal/capping activities in Reach 5A and the upper portion of Reach 5B under SED 4, except that they would extend for a greater distance along the River. As noted in Section 6.3.5.3, those impacts include the following:

- The cap would cause a change in surface substrate type from sand or a combination of sand and gravel to armor stone, lasting until deposition of natural sediments from upstream changes the substrate surface back to a condition approximately its prior condition, which could take years.

- There would be a loss of a continuing source of woody debris and shade due to the permanent loss of mature trees on the riverbanks.

- The sediment removal and capping would destroy or displace the existing aquatic vegetation, benthic invertebrates, and fish. While recolonization would occur, the organisms that would initially recolonize these areas would differ from the existing organisms (e.g., would include species more tolerant of stress, including invasives) due to the changed substrate. Over time, continued accumulation of sediments would increase the diversity of habitat, resulting in more complex communities than existed shortly after remediation, but those communities are still unlikely to match the pre-remediation communities in terms of composition, species diversity and richness, and relative abundance of species, at least for many years. In particular, it is doubtful whether the state-listed species destroyed by the sediment removal/capping would ever return. (Impacts on state-listed species are discussed further below.)

- There is a high potential that the disturbed areas would be colonized by invasive species, which are impractical to control in a flowing river and thus are likely to dominate over the native species.

The long-term impacts from capping in a portion of Reach 5C would be similar to those discussed above. In addition, the placement of a cap on top of the existing substrate would change the elevation of the impoundment bottom. In certain areas with relatively shallow water, such as along the shorelines, if consolidation of the underlying sediment does not occur, the increase in substrate elevation due to the cap could change the vegetative characteristics of those areas and the biota dependent on them. Indeed, in such areas where the thickness of the cap (24 inches) (or the cap plus any subsequently deposited sediments) exceeds the depth of water, the elevation change could cause the emergent vegetation to be replaced by species more tolerant of less frequently inundated or drier conditions.

In the areas of Reaches 5B and 5C subject to installation of the thin-layer cap, the placement of that cap would likewise result in changes similar to those discussed above, with the exception that some of the more hearty plants, particularly invasive species, may survive the initial placement of the cap and that the initial post-remediation substrate would consist of sand rather than armor stone. In the long term, however, the potential for recolonization would be similar to that in other capped areas, and there would likewise be a high potential for colonization by invasive species. Further, in areas where the water depth is less than 12 inches deep, which may occur along the shorelines, if consolidation of the underlying sediment does not occur, the increase in substrate elevation due to the thin-layer cap could change the vegetative characteristics of these areas – and, in areas where the thin-layer cap exceeds the depth of water, could cause the emergent wetlands vegetation to be replaced by species more tolerant of less frequently inundated or drier conditions.

In summary, over time, following the remediation and restoration of the impacted reaches of the River, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur and the abundance of organisms and richness of the mix of species in that community are all uncertain, the return of certain specialized species (including state-listed species) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 4 would include stabilization of the riverbanks in Reaches 5A and 5B using the same techniques used for SED 3, as described in Section 3.1.4 and Appendix G, including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4, and would be the same as those summarized in Section 6.3.5.3 for SED 3. As discussed there, the bank stabilization measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Woods Pond

Under SED 4, Woods Pond would be remediated by removal/capping in the shallower parts of the Pond and placement of a thin-layer cap in the "deep hole." The removal/capping activities in the shallower parts of the Pond would have a number of long-term impacts, as described for impoundments in Section 5.3.3.4. These would include a change in the surface substrate and a consequent alteration in the biological community in the Pond. While it is anticipated that, over time, a biological community typical of such impoundments would eventually develop, the rate is unknown and the community may include changes in the mix of native species, including the loss of certain specialized native species, and would likely be dominated by invasive species, notably, water chestnut, which is already prevalent in Woods Pond.

As noted for SED 3 in Section 6.3.5.3, the placement of a thin-layer cap in the deep portion of Woods Pond would not be expected to have any adverse long-term impacts.

Long-Term Adverse Impacts on Backwaters

The placement of a thin-layer cap in portions of the backwater areas under SED 4 would be expected to have some long-term negative impacts. The long-term impacts of remediation on backwater habitats are discussed generally in Section 5.3.6.4. For the thin-layer capped areas under SED 4, these would include the following:

- Change in surface substrate type from silts or mucky organic material to sand, which would last until enough silt and organic material have been deposited through flood events to approximate current conditions – which is an uncertain time period, but could be a decade or more;
- Change in bottom elevation, assuming consolidation of the underlying sediment does not occur;
- Change in vegetative characteristics corresponding to the change in substrate type and elevation (including, in shallower areas where the thin-layer cap exceeds the depth of water, a potential change from emergent wetlands vegetation to species more tolerant of less frequently inundated or drier conditions);
- Likely proliferation of invasive species; and
- Change in the wildlife communities using the backwater until such time as the soil, hydrological, and vegetative conditions of the backwater return to conditions comparable to pre-remediation conditions – which is uncertain.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 4 includes 23 staging areas covering approximately 37 acres (including 8.3 acres within the floodplain) and approximately 20 miles of temporary roadways covering an additional 48 acres (including 16 miles and 39 acres in the floodplain), as shown on Figure 6-9. The principal habitats affected by these facilities (within the boundaries of the Woodlot (2002) natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (9.4 acres), and upland forests (2.9 acres).[174] These impacts would occur mainly in Reaches 5A and 5B, with additional

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[174] Many of the access roads and staging areas required to complete remediation activities under SED 4 are situated outside of the PSA floodplain and not included in the Woodlot natural community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural lands) (30 acres),

impacts in limited portions of Reaches 5C and 6 to support the remediation in those portions of the PSA. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats).

The long-term negative impacts anticipated from access roads and staging areas under SED 4 are comparable to those described in Section 6.3.5.3 for SED 3. As such, the summary of such impacts presented in that section also applies to SED 4. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 4 would affect portions of the Priority Habitats of 25 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 4 would involve a "take" of at least 23 of these species and would adversely affect a significant portion of the local population of at least 13 of them. The table below lists the 25 state-listed species whose Priority Habitat would be affected by SED 4, along with those for which SED 4 would result in a take and those for which SED 4 would impact a significant portion of the local population:

Table 6-22 – Impacts of SED 4 on State-Listed Species

Species with Priority Habitat Affected by SED 4	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Yes
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes

with additional impacts occurring in forested uplands (7 acres) and wet meadow/emergent marsh habitats (1 acre). There would be no impacts from access roads or staging areas in Reaches 7 and 8.

Species with Priority Habitat Affected by SED 4	Take?	Impact on Significant Portion of Local Population?
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Spine-crowned clubtail	Yes	Yes
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 4 would have long-term impacts on the aesthetic features of the natural environment. The sediment removal and capping activities throughout Reaches 5 and 6, along with the bank stabilization activities along approximately 14 linear miles of Reaches 5A and 5B banks would alter the appearance of the River over the course of those construction activities and for a period thereafter. For example, as discussed above, since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The placement of access roads and staging areas would also cause long-term impacts on the aesthetics of the floodplain. The placement of these roadways and staging areas would remove trees and vegetation, including in numerous forested areas; and this would change the appearance of those areas until such time (if ever) as they return to their prior state. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to its current appearance. The presence of these cleared areas would detract from the natural pre-remediation appearance of those areas until the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 4 include areas used for canoeing, fishing, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 4. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts on Fluvial Geomorphic Processes

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B, as well as the capping and armoring of the riverbed in those reaches, would reduce the supply of sediment to the River. The potential impacts of this reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. As discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization and riverbed armoring would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity. This conclusion would also apply to SED 4.[175]

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 4, various restoration methods are available.[176] Restoration methods for the types of habitats that would be affected by SED 4 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for impoundments such as Woods Pond, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in

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175 Similar to SED 3, model results for SED 4 suggest that bank stabilization and bed armoring, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, removing the sediment loading due to bank erosion under SED 4 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank erosion), within several areas of the River (mainly in Reaches 5A and 5B).

176 Potential measures to avoid or minimize the adverse impacts were described in Section 5.2.

Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 4.

6.4.6 Attainment of IMPGs

As part of the evaluation of SED 4, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 4, and those comparisons are illustrated in Tables 6-23 through 6-28.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-23 through 6-28.[177] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[178]

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[177] The extent to which SED 4 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

[178] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. In almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted.

6.4.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-23). Many of these IMPGs are achieved prior to the start of remediation, while the others would generally be achieved in 15 years or less.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8 (with the exception of the probabilistic RME IMPG at the 10^{-4} cancer risk level, but not the corresponding non-cancer IMPGs, in Reaches 5 and 6 and four subreaches in Reach 7) (Table 6-24).[179] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 4 would achieve fish PCB levels within the range of the RME-based cancer and non-cancer IMPGs.[180]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year (based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts) would take 160 to > 250 years in the PSA and > 250 years in Reaches 7 and 8.

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179 Application of the lower-bound assumptions results in the additional attainment of the deterministic RME IMPG based on a 10^{-4} cancer risk in Reach 6 only.

180 SED 4 would also achieve some of the CTE-based fish consumption IMPGs in Massachusetts, as well as all CTE IMPGs in Connecticut, within time periods typically ranging up to 25 years (Table 6-24). Application of the lower-bound assumptions results in the additional attainment of two CTE IMPGs – deterministic non-cancer (child) in Reach 6 and deterministic 10^{-5} cancer in Reach 7A.

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 4, this change in averaging method (and the resulting increase in concentration) would not change the IMPG assessment presented in Table 6-24, except that the non-cancer (adult) deterministic CTE IMPG would no longer be achieved in Reach 5C and the 10^{-4} cancer probabilistic RME IMPG would no longer be achieved in Reach 7E.

6.4.6.2 Comparison to Ecological IMPGs[181]

For benthic invertebrates, predicted average surface sediment concentrations would achieve the upper-bound IMPG (10 mg/kg) within the model period in all 32 averaging areas and would also achieve the lower-bound IMPG (3 mg/kg) in all areas except for a few in Reach 7 (Table 6-25). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6.

For amphibians, predicted surface sediment PCB levels in the backwaters at the end of the modeled period would achieve the upper-bound IMPG (5.6 mg/kg) in 27 of the 29 backwater areas evaluated, and would also achieve the lower-bound IMPG (3.27 mg/kg) in 21 of those areas (Table 6-26). The estimated time to achieve the IMPGs (where achieved) ranges from approximately 5 to 50 years. In the few backwater areas that would not achieve the IMPGs by the end of the modeled period, extrapolated estimates indicate that they could be achieved within various times between 60 and > 250 years.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-27). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 11 years for warmwater fish, and from 11 to 36 years for coldwater fish.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations have been compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all averaging areas, and below the 1 mg/kg target level in 10 of the 12 averaging areas (Table 6-28). The times to achieve those levels range from 1 to 30 years, but are generally less than 15 years. For piscivorous mammals, the model-predicted surface sediment concentrations are below all three of the target sediment levels (1, 3, and 5 mg/kg) in both averaging areas (Table 6-28). The times to achieve them range from approximately 10 to 15 years.

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG in 11 of the 14 modeled reaches

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[181] While this section describes the extent to which SED 4 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.4.5.3 and 6.4.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.4.11.

(Table 6-27) – i.e., all except two of the Reach 7 subreaches and Reach 8. Estimated times to achieve the IMPG in reaches where it is not already met prior to the start of the model projection range from 10 to 20 years. In reaches where the IMPG is not attained within the 52-year projection period, the extrapolated time to achieve this IMPG ranges from 80 to >250 years.[182]

Finally, for threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG (30.4 mg/kg) in all reaches (Table 6-27). Estimated times to achieve this IMPG in reaches where it is not already met prior to the start of the model projection range from 3 to 11 years.[183]

6.4.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 4 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 4 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 4 would reduce the mobility of PCBs in the River by removing approximately 262,000 cy of sediment containing PCBs in Reaches 5A, 5B, and 6 and placing a cap over those areas (total of 91 acres); stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks; and placing a cap over the deeper portion of Reach 5C (37 acres). The caps would

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[182] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in only one small change in IMPG attainment under SED 4 (i.e., the osprey IMPG would no longer be met in Reach 7G).

[183] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 4 at the end of the simulation period are 0.005 to 0.01 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 3 are in the range of 0.05 to 0.1 mg/kg (Table 6-21). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

prevent or minimize the mobility of PCB in the underlying sediments. Further, a thin-layer cap would be placed over 35 acres in portions of Reaches 5B and 5C, 61 acres in the Reach 5 backwaters, and 23 acres in a portion of Woods Pond (for a total of 119 acres) to aid in the recovery of those areas.

Reduction of Volume: SED 4 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of approximately 297,000 cy of sediments/bank soil containing approximately 16,600 lbs of PCBs.

6.4.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 4 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Given that the remedial actions under SED 4 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Nevertheless, since the extent and overall duration of remediation activities under SED 4 are greater than under SED 3, the short-term impacts would be more extensive and would occur over a longer time period in the Rest of River area.

Impacts on the Environment – Effects Within PSA

Short-term adverse impacts on the environment resulting from implementation of SED 4 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and disruption to the biota that reside in the floodplain due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal activities in Reaches 5A, 5B, and 6 (262,000 cy over 91 acres) would result in resuspension of PCB-containing sediment in the water column due to the invasive nature of the removal operation. Resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal in those areas would be conducted in the dry with sheetpile enclosing the removal areas. However, the potential exists for sediment containing PCBs to be released from the work area both during sheetpile installation and during a high flow event should overtopping of the sheeting occur. Removal activities in Reach 6 would be conducted in the wet through the use of barge-mounted mechanical excavators, with silt curtains to mitigate sediment releases to downstream reaches. In that area, some sediment containing PCBs would be released from the work area through the excavation process even though the area would be surrounded by silt curtains.[184] In addition, boat and barge traffic could resuspend sediment during the construction phase.

For this reason, sediment removal activities conducted in the wet, even with the use of silt curtains, would be expected to result in short-term increases in fish tissue PCB concentrations. For example, wet dredging conducted in the Upper Hudson River in 2009 resulted in elevated PCB concentrations in fish collected at downstream stations in September of that year (Anchor QEA and ARCADIS, 2010). Similarly, wet dredging in the Grasse River, with use of silt curtains, resulted in significantly elevated PCB levels in resident fish samples collected in the same year that dredging was performed; however, monitoring conducted one year after completion of the dredging indicated that these increases were temporary, with PCB concentrations returning to pre-dredging levels (www.thegrasseriver.com). Caged mussel monitoring results performed during the Upper ½-Mile Reach activities indicated a similar trend associated with dry excavation using sheetpiling (GE, 2004b). Based on this information, it would be expected that implementation of SED 4 would result in increases in PCB concentrations in biota, but that that increase may have limited duration, with tissue levels decreasing after completion of the work.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 4 would cause a loss of aquatic habitat in the 91 acres of Reaches 5A, 5B, and 6 where removal would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine and impoundment habitats was provided in Sections 5.3.1.2 and 5.3.3.2, respectively. The short-term impacts of removal/capping in Reach 5A under SED 3 were summarized in Section 6.3.8. The same impacts would apply under SED 4 to the removal/capping in both Reach 5A and a portion of Reach 5B; and they would also apply to the areas subject to sediment removal

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[184] For example, the recent experience of mechanical dredging of the Upper Hudson River from barges showed an overall PCB resuspension rate of 3% at least a mile downstream of the dredging operations, with a rate of approximately 4% outside areas with resuspension controls (Anchor QEA and ARCADIS, 2010). Similarly, the resuspension rates of 1.3% to 5.8% of solids were observed during pilot clamshell dredging in the Passaic River (Lower Passaic River Restoration Project Environmental Dredging Pilot Study Work Group, 2009). If 3% of the PCB mass dredged in Woods Pond under SED 4 were lost to the water column, that would equate to approximately 120 lbs of PCBs.

and capping in Woods Pond (except that the substrate would be changed from silt and organic material – rather than sand and gravel – to armor stone). These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; a disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation; and colonization by invasive plant species. Overall, the short-term adverse impacts from removal under SED 4 would affect approximately twice as much area of aquatic habitat as would occur from removal under SED 3.

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts would be largely the same as described for SED 3 in Section 6.3.8.

Capping: Capping activities in Reach 5C would be performed during low flow periods with silt curtains in place. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much less than for removal activities, since capping involves placement of clean material on undisturbed native sediment, and silt curtains would be in place to mitigate transport of cap material any resuspended sediments downstream.

Placement of a cap (without removal) as part of SED 4 would occur over 37 acres of the River, and would have immediate impacts on the aquatic communities. Those impacts were generally described in Sections 5.3.1.2, and would be largely the same as those of sediment removal followed by capping. In addition, as discussed above, in shallow areas where consolidation of the underlying sediment does not occur, placement of the cap could increase the substrate elevation such that the vegetative characteristics of the wetlands and the biota dependent on such wetlands would be changed.

Thin-Layer Capping: Thin-layer capping activities in portions of Reaches 5B and 5C, the backwaters, and Woods Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, there is little potential for thin-layer capping to resuspend PCB-containing sediments into the overlying water column.

Placement of a thin-layer cap as part of SED 4 would occur over 119 acres of the River, and would have short-term impacts on aquatic vegetation and benthic invertebrates in those areas. Immediate and near-term impacts of thin-layer capping were described in Section 5.3.1.2 for aquatic riverine habitats, 5.3.3.2 for impoundments, and 5.3.6.2 for backwaters.

These impacts were also summarized in Section 6.3.8 for the thin-layer capping in Reach 5C and Woods Pond under SED 3. These impacts would also apply to the placement of thin-layer caps in Reaches 5B and 5C and the Reach 5 backwaters under SED 4. However, placement of a thin-layer cap in the deep hole in Woods Pond is unlikely to have any significant short-term habitat impacts.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the loss of the wildlife that they support. It is anticipated that SED 4 would require a total of approximately 85 acres for access roads and staging areas (approximately 47 acres within the 10-year floodplain). The habitat types affected were identified in Section 6.4.5.3 and are the same as those that would be affected by the access roads and staging areas under SED 3. Thus, the short-term adverse impacts from the construction and use of these support facilities under SED 4 would be the same as those listed in Section 6.3.8 for the support facilities under SED 3.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 4.

The total calculated emissions from SED 4 would amount to approximately 71,000 tonnes of GHG emissions, with 29,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation), 1,700 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 40,000 tonnes from off-site emissions (primarily from manufacture of steel sheeting and of cement for stabilization, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent to the annual output of 14,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 4 would result in short-term impacts to the local communities along the River in Reaches 5 and 6. These impacts would include disruption along the River and within the floodplain due to the remediation and the construction of staging areas and access roads, as well as increased noise and truck traffic. These impacts would mainly affect the upper part of Reach 5 (Reaches 5A and 5B), where remediation activities are estimated to last for 11 years, with lesser impacts in the downstream portion of Reach 5 and Woods Pond, where the remediation is estimated to last for 4 years.

Impacts on Recreational Activities: Recreational activities in the areas that would be affected by SED 4 include fishing, canoeing, hiking, waterfowl hunting, and general recreation. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where activities are being conducted. Further, bank stabilization activities in Reach 5 would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment to the work areas, to remove excavated materials, and to deliver capping materials, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would persist for the duration of the project (estimated at 15 years). As an example, if 20-ton capacity trucks were used to transport sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 24,500 truck trips to do so (approximately 1,630 truck trips per year for a 15-year remediation project). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton trucks for local hauling of such materials, an additional approximately 48,300 truck trips (3,200 truck trip per year) would be required. The additional traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Further, noise in and near the construction zone could affect those residents and businesses located near the work areas.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives, as well as to dispose of used access road and staging area materials following completion of remediation.[185] This analysis indicates that the increased truck traffic associated with SED 4 would result in an estimated 2.42 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.17) with a probability of 91% of at least one such injury, and an estimated 0.11 fatalities from

[185] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

accidents (average annual fatality estimate of 0.0078) with a probability of 11% of at least one such fatality.

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[186] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, however, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 4 would be inevitable.

Risks to Remediation Workers

There would be health and safety risks to site workers implementing SED 4. Implementation of SED 4 is estimated to involve 730,098 man-hours over a 15-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 4 would result in an estimated 6.74 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.46) with a probability of 100% of at least one such injury,[187] and an estimated 0.07 worker fatalities (average annual fatality estimate of 0.005) with a probability of 7% of at least one such fatality). Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.4.9 Implementability

6.4.9.1 Technical Implementability

The technical implementability of SED 4 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 4 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support

[186] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

[187] In this Revised CMS Report, probabilities that are effectively 100% (i.e., greater than 99.5%) are referred to as 100%.

areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 4 were selected based on river characteristics, and would be technically implementable in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use both in higher energy river reaches such as Reach 5A and parts of Reach 5B, and in shallow, lower water velocity river reaches like those found in portions of Woods Pond. Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Woods Pond. Each technique has been used at other sites (see Section 6.4.5.2). Sediment removal and subsequent capping would be performed in a manner to cause no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Reach 5C where the water is relatively deep and the surface water velocities are low, which are suitable conditions for such capping. In addition, thin-layer capping would be applied in low velocity areas in parts of Reach 5B, Reach 5C, Reach 5 backwaters, and Woods Pond, which have suitable conditions for this technique.

The potential impacts on flood storage capacity resulting from the placement of cap materials in these reaches under SED 4 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event (using a 2-year flow event in Year 48 of the model projections, as discussed for SED 3 in Section 6.3.9.1). In Reach 5 backwaters and Woods Pond, where the backwater effects are controlled by Woods Pond Dam, impacts to flood storage capacity would not be expected as a result of cap placement. However, in Reaches 5B and 5C, there is the potential for the caps to increase water level/flood frequency. Under SED 4, the model-predicted area of inundation within Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection increased by 1% over that predicted under SED 1 (829 acres compared to 817 acres). This analysis suggests that the caps would have a limited impact on flood storage. A more refined assessment of flood storage capacity would be developed during design. If necessary, additional flood storage capacity would be obtained to accommodate placement of the caps in these reaches if this alternative were selected.

Riverbank stabilization, including removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process.

Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant river stretches.

MNR with institutional controls would be implemented in the remaining backwaters and in the reaches downstream of Woods Pond Dam. Monitoring to track changes in PCB concentrations following the SED 4 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 4 could readily be constructed using commonly available construction techniques.

Reliability: The remediation technologies that comprise SED 4 are considered reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites is described in Sections 6.3.5.2 and 6.4.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.4.5.2 and 6.4.5.3.

Availability of Space for Support Facilities: Implementation of SED 4 would require construction of access roads and staging areas at various locations within the floodplain of the River. As noted previously, an estimated 85 acres of space would be needed, and appears to be available to support the SED 4 activities (assuming that the necessary access agreements can be obtained) based on preparation of a conceptual site layout. Development of staging areas and access roads would be sequenced over the estimated 15-year implementation period.

Availability of Cap/Stabilization Material: Materials required for cap construction and bank stabilization must be of suitable quality for their intended purpose. A total of approximately 468,000 cy of sand/stone materials would be required for capping, thin-layer capping, and bank stabilization activities (313,000 cy of sand and 160,000 cy of armor stone and riprap). Adequate material sources are assumed to be locally available; however, an evaluation would be performed during design activities to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would be implementable subject to the same technical and logistical constraints applicable to the initial implementation of SED 4. Ease of implementation of the corrective measures would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 4 would be determined over time through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been performed on the upper portions of the Housatonic River and at other sites. Equipment and methods for this type of monitoring are readily available.

6.4.9.2 Administrative Implementability

The administrative implementability of SED 4 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 4 would need to comply with the substantive requirements of regulations that are designated as ARARs for performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 4 is provided in Tables S-4.a through S-4.c in Appendix C and summarized in Section 6.4.4.

Access Agreements: Implementation of SED 4 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although many of these areas are owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 30 to 40 other landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA's assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 4, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.4.10 Cost

The estimated total cost to implement SED 4 is $233 M (not including treatment/disposition costs). The estimated capital cost for implementation of SED 4 is $223 M, assumed to occur over a 15-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $30,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.0 M. The estimated annual OMM costs for SED 4 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $32,500 to $580,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $7.0 M. The following summarizes the total capital and OMM costs estimated for SED 4.

SED 4	Est. Cost	Description
Total Capital Costs	$223 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM	$10.0 M	Costs for performance of the OMM programs
Total Cost for Alternative	$233 M	Total cost of SED 4 in 2010 dollars

The total estimated present worth cost of SED 4, which was developed using a discount factor of 7%, a 15-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $147 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.4.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.4.2, the evaluation of whether SED 4 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 4 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 262,000 cy of PCB-containing sediments in portions of Reaches 5 and 6 and placing a cap over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy of bank soils; (c) placing a cap over 37 acres in the deeper part of Reach 5C where no excavation would be performed; (d) placing a thin-layer cap over 119 acres in Reaches 5B, 5C, and 6, and backwaters in Reach 5 to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 6.4.3, implementation of SED 4 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.8 kg/yr, that passing Rising Pond Dam from 19 to 2.1 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.4 kg/yr over the modeled period.

Further, as shown in Section 6.4.5.1, EPA's model predicts that SED 4 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 3-8 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 7 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.05-0.1 mg/kg in the Connecticut impoundments.

On the other hand, SED 4 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.4.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.4.4, SED 4 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 μg/L, which should be waived as technically impracticable to attain. Further, review of the potential location-specific and action specific ARARs indicates that SED 4 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.4.6.1, accepting EPA's HHRA, SED 4 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from

SED 4 in Reaches 5 through 8 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) within EPA's cancer risk range or those based on non-cancer impacts (except for the probabilistic RME 10^{-4} cancer IMPG, but not the corresponding non-cancer IMPG, in Reaches 5 and 6 and a few subreaches in Reach 7). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 4 would achieve fish PCB levels within the range of the RME IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.4.6.2, the model results indicate that, by the end of the modeled period, SED 4 would achieve the IMPG levels for some ecological receptor groups in all areas. Specifically, for benthic invertebrates, SED 4 would result in sediment PCB concentrations within or below the IMPG range (3 to 10 mg/kg) in all averaging areas, and would achieve fish PCB levels below the IMPGs for both warmwater and coldwater fish and for threatened and endangered species in all reaches. For other receptor groups, SED 4 would achieve the IMPGs in most areas. Specifically, for amphibians, SED 4 would result in sediment PCB concentrations within or below the IMPG range (3.27 to 5.6 mg/kg) in 27 of the 29 backwaters; and for piscivorous birds, SED 4 would achieve the fish-based IMPG (3.2 mg/kg) in Reaches 5, 6, and most of 7. Finally, for insectivorous birds, SED 4 would achieve the target sediment levels of 3 and 5 mg/kg in all averaging areas and the target level of 1 mg/kg in most areas; and for piscivorous mammals, SED 4 would achieve all three target sediment levels in both averaging areas.[188]

As discussed in Section 2.1.1, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against

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188 As discussed previously, attaining the target sediment levels for insectivorous birds and piscivorous mammals would allow achievement of the IMPGs for those receptors provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 7).

the other Selection Decision Factors. Although SED 4 would not achieve the ecological IMPGs for a couple of receptor groups in a few areas, those exceedances are not widespread and are generally only slightly above the IMPG levels. Given the fact that the local populations of these receptors extend through the numerous areas within the Rest of River where the IMPGs would be achieved, as well as nearby areas outside the Rest of River, these exceedances would not be expected to prevent the maintenance of healthy local populations of these receptors, let alone adversely impact the overall wildlife community in the Rest of River area. This is supported by the fact that field surveys conducted by both EPA and GE, as well as other existing ecological information identified in Section 5.1.1, have documented the presence of numerous and diverse species (including state-listed rare species) in the PSA despite the presence of PCBs in this area for over 70 years.

On the other hand, implementation of SED 4 would cause substantial short-term adverse impacts on the environment in the areas where work would be conducted (e.g., loss of aquatic habitat in areas of remediation in portions of Reaches 5 and 6, loss of riparian habitat in the bank stabilization areas, potential resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed), as discussed in Section 6.4.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 4 would result in substantial long-term and, in some cases, permanent adverse effects on the ecosystem of the PSA. These impacts were described in Section 6.4.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the shallower portions of Woods Pond and in the Reach 5 backwaters;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, "it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat" (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 4 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 4 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 4 would not meet the standard of providing overall protection of the environment.

6.5 Evaluation of Sediment Alternative 5

6.5.1 Description of Alternative

SED 5 would include the removal of a total of 412,000 cy of sediment and riverbank soil (including 377,000 cy of sediment over 126 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank), placement of a cap over a total of 186 acres including all of the removal areas and some non-removal areas, and application of a thin-layer cap over 102 acres. Specifically, the components of SED 5 include the following:

- Reach 5A: Sediment removal in the entire reach (134,000 cy over 42 acres) followed by capping;

- Reach 5B: Sediment removal in the entire reach (88,000 cy over 27 acres) followed by capping;

- Reach 5C: Combination of sediment removal/capping (66,000 cy over 20 acres) in the shallow areas and capping without sediment removal (37 acres) in the deeper areas;

- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);

- Reach 5 backwaters: Thin-layer capping (61 acres) in certain backwaters (depending on PCB concentrations);
- Reach 6 (Woods Pond): Combination of removal with capping (89,000 cy over 37 acres) in shallower areas and capping without sediment removal (23 acres) in the "deep hole";
- Reach 8 (Rising Pond): Thin-layer capping (41 acres); and
- Remaining Reach 5 backwaters, Reach 7, and Reaches 9 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 6-12a-b identify the remedial action(s) that would be taken in each reach as part of SED 5.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 5. It is estimated that SED 5 would require approximately 18 years to complete. A construction timeline for implementation of SED 5 is provided in Figure 6-13. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. Details of the specific methods for implementation of the remedy would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 5 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 5 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 25 staging areas, occupying a total of 41 acres (8 acres within the floodplain), and approximately 20 miles of access roads covering 49 additional acres assuming a 20-foot road width (16 miles and 39 acres of which would be within the floodplain) would be constructed between the Confluence and Rising Pond to support implementation of SED 5. The locations of these staging areas and access roads are shown on Figure 6-12a-b. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed in Reaches 5 and 6, as presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	2	134,000	42
Reach 5B:	2	88,000	27
Reach 5C:	2	66,000	20
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**377,000**	**126**

The areas in which removal would be conducted for the reaches listed above are shown on Figure 6-12a.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas. In Reach 5C and Woods Pond, it is assumed that removal would be performed in the wet using barge-mounted clamshell excavators. Debris removal would be conducted prior to dredging. Silt curtains would be placed downstream of excavation areas in an effort to limit transport of suspended sediment. Periodic water column and air sampling would be performed during implementation.

Cap Placement: Following sediment removal, caps would be installed in the dry in Reaches 5A and 5B prior to removal of the sheetpile, and caps would be installed in Reach 5C and Woods Pond through the water column (Figure 6-12a). Caps would also be installed through the water column in the deeper portions of Reach 5C and Woods Pond where no excavation would be performed (Figure 6-12a). Removal of debris that could interfere with the performance of the cap would be conducted prior to cap material placement. Cap materials would be transferred to the River using conventional earth-moving equipment. For purposes of this Revised CMS Report, it is assumed that, in Reach 5, the cap would consist of 12 inches of sand (which may be amended to increase the TOC content), overlain by 12 inches of stone in the removal areas, and 6 inches of armor stone where no excavation would be performed. In Woods Pond, it is assumed that the caps would consist of 12 inches of sand (which may be organically amended) overlain by 6 inches of armor stone in both the removal and non-removal areas. The composition and size of the sand and armor stone would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to limit the potential for erosion of the cap materials during high flow events. Silt curtains would be used during capping activities through the water column in an effort to limit downstream transport of suspended materials.

Thin-Layer Cap Placement: A thin-layer cap would be installed in the Reach 5 backwaters with average PCB concentrations equal to or greater than 15 mg/kg (61 acres; see Section 3.1.1) and in Rising Pond (41 acres), as shown on Figures 6-12a-b (total of 102 acres). For purposes of evaluation, it is assumed that the thin-layer cap would consist of a 6-inch layer of sand, and would be placed via a combination of techniques, including mechanical and/or hydraulic means. For purposes of modeling, the material to be used for the thin-layer cap is assumed to have similar properties to those of the underlying native material (see Section 3.1.3. However, the actual materials to be placed would be determined during design activities.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that the removed sediments would be dewatered through gravity dewatering in stockpiles at the staging areas. The addition of stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately, and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 5 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in these subreaches. The bank stabilization techniques that are assumed to be part of SED 5 for purposes of this Revised CMS Report would involve a combination of bioengineering and traditional bank hardening techniques. Those techniques are described in Section 3.1.4 and Appendix G and are depicted on Figures G-2 through G-9 in Appendix G. For purposes of this report, it is assumed that the riverbank stabilization/soil removal work in Reaches 5A and 5B would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, and would employ conventional mechanical excavation equipment.

MNR: MNR would be implemented in the remainder of the Rest of River under SED 5 (certain Reach 5 backwaters, Reach 7, and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 5, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of evaluation in this Revised CMS Report, it is assumed that SED 5 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, bank removal/stabilization activities, and ancillary construction activities. The restoration methods assumed for SED 5 for purposes of this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B; and Section 5.3.3.3 for Woods Pond and Rising Pond; Section 5.3.6.3 for the Reach 5 backwaters; and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 5 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 5 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at

concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 5 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program for capped areas under SED 5 would include the same elements outlined for that program under SED 3 (Section 6.3.1). The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 5.

A summary of the assumed long-term (100-year) OMM program for SED 5 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 following remediation and would include collection of 50 surface sediment samples from MNR areas, approximately 32 cores (96 samples) from removal areas, approximately 15 cores (45 samples) from cap-only areas, and approximately 25 cores (25 samples) from the thin-layer cap areas. Further, for the caps and thin-layer caps, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.5.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 5 would be protective of human health and the environment is presented at the end of Section 6.5 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.5.3 Control of Sources of Releases

SED 5 would reduce the potential for PCB migration from certain sediments and riverbanks. This alternative would address approximately 288 acres of the riverbed and approximately 14 linear miles of riverbank (7 miles on both banks), and would include the removal of 412,000 cy of PCB-containing sediment and bank soils. Implementing these actions would result in a reduction in the potential for future transport of the PCBs within the River and onto the floodplain for potential human or ecological exposure. The PCB-containing surface sediments in Reaches 5A, 5B, and parts of 5C and the shallow portion of the main channel in Woods Pond, some of which are susceptible to scour during high-flow events, would be removed, and the residual PCBs remaining in these areas would be contained by a cap. Similarly, the banks of Reaches 5A and 5B would be stabilized, including bank soil removal where appropriate. In portions of Reach 5C and Woods Pond where the water is deeper, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediments from the water column. In addition, in portions of the Reach 5 backwaters and Rising Pond, where sediment PCB concentrations and the potential for scour/transport are low, a thin-layer cap would be placed to accelerate the natural recovery process and to assist in controlling releases in those areas.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed. Moreover, the removal and/or capping in Woods Pond and Rising Pond under SED 5 would further mitigate the potential for downstream transport of PCBs even in the event of dam failure.

As indicated by EPA's model, implementation of SED 5, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. The annual average PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 5 is predicted to achieve a 93% reduction in the PCB mass passing

Rising Pond Dam over this same period (i.e., from 19 kg/yr to 1.3 kg/yr). Likewise, SED 5 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.3 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-14b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 5 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 5 indicate that, in reaches subject to MNR only (i.e., Reach 7), the extreme flow event would not result in the exposure of buried PCBs at concentrations higher than those already present in the surface sediment prior to the event. For the reaches that would be capped either following removal or without removal (i.e., Reaches 5A, 5B, 5C, and Woods Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[189] As a result, no change in reach-average surface sediment PCB concentrations associated with cap erosion is predicted in these reaches (Figure 6-14b). In the Reach 5 backwater areas undergoing thin-layer capping, the model predicts that the cap materials and underlying sediments also would remain stable during high flow events. Indeed, the model results indicate that only a single model grid cell (representing <1% of the thin-layer capped portion) would experience significant erosion. Such erosion is predicted to result in a small (0.2 mg/kg) increase in the reach-average surface sediment PCB concentration (Figure 6-14b). Similarly, in Rising Pond, the thin-layer cap and underlying sediments are predicted to remain in place over 93% of that impoundment during the extreme flow event. In the remaining area of Rising Pond, limited erosion resulting in a small (0.3 mg/kg) increase in the reach-average concentration is predicted to occur. These concentration increases are small, and the concentrations following the high flow events still represent significant reductions relative to current levels (99% in Reach 5D and 91% in Rising Pond; Figure 6-14b). Thus, the model results for SED 5 indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

Given that SED 5 includes remediation in Woods Pond (a combination of sediment removal over 37 acres and capping over 23 acres), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. Although there would be a net

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[189] Further evaluation of the stability of cap and thin-layer cap materials under SED 5 based on model predictions of erosion in these areas is provided in Section 6.5.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

decrease in depth as a result of the capping (without prior removal) that occurs in the deep portion of the Pond, the solids trapping efficiency of Woods Pond, as predicted by EPA's model, would be unchanged relative to MNR (approximately 15%).

6.5.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 5 in accordance with the directions from EPA are listed in Tables S-5.a through S-5.c in Appendix C. The compliance of SED 5 with these potential ARARs is discussed below.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-5.a, include federal and state water quality criteria for PCBs. To evaluate whether SED 5 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 5. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, two exceedances are predicted within the PSA (Holmes Road) and 3 to 4 exceedances are predicted at two locations within Reaches 7 and 8 (Glendale Dam and Rising Pond Dam). However, all of these exceedances in both the PSA and Reaches 7 and 8 consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered as a single exceedance. This is confirmed by the block averages that indicate only a single (or no) exceedance for this alternative in these reaches. For these reasons, as discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 5 would achieve this criterion, albeit at a significant environmental cost, as discussed in Sections 6.5.5.3 and 6.5.8.

By contrast, the model-predicted annual average water column concentrations (which are used for assessment of human health-based water quality criteria and are presented in Table 6-29 in Section 6.5.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis exceed the federal criterion in two of the four impoundments, although these estimates are highly uncertain (as discussed in Section 3.2.5). However, as previously discussed, the ARARs based on the human health consumption criterion should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not be achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[190]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 5 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.5.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.5.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 5 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.5.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.5.6.1. These evaluations provide an assessment of the effect of SED 5 on the impairment listings.[191]

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 5 are listed in Tables S-5.b and S-5.c.[192] As shown in those tables, SED 5 could be designed and

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[190] The estimated future water column concentrations in all the Connecticut impoundments under SED 5 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[191] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-29 (in Section 6.5.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 5 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.006 to 0.01 mg/kg. This provides further insight on the effect of SED 5 on the River's impairment listing in Connecticut.

[192] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

implemented to achieve certain of those ARARs;[193] but, as with SED 3 and SED 4, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 5. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations applicable to the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain locational and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.5.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 5 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.5.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 5 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 5, along with upstream source control and remediation measures and natural recovery processes, would reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities throughout Reach 5 and in Woods Pond and

[193] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132) it is assumed that EPA would make the necessary determinations allowed by the regulations.

stabilization/removal of bank soils in Reaches 5A and 5B would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in certain backwater areas and Rising Pond would reduce the surface sediment PCB concentrations in these reaches, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the media to which such receptors may be exposed). This table uses the same format described in Section 6.1.5.1.

Table 6-29 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 5)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.06	2.5	1.3	0.3
5B	0.06	1.8	1.2	0.2
5C	0.1	1.2	0.8	0.2
5D (backwaters)	0.3	---	1.8	0.4
6	0.2	1.2	0.9	0.2
7[1]	0.4 – 5.0	0.9 – 1.2	2.1 – 7.9	0.4 – 1.6
8	0.3	1.0	1.7	0.3
CT[1]	0.004 – 0.008	0.05 – 0.1	0.03 – 0.07	0.006 – 0.01

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.5.6.[194]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 5 over the 52-year model projection period are shown on Figures 6-14a-c. These figures show the timeframes over which the model predicts SED 5 would reduce the PCB concentrations in each medium. The general pattern exhibited by these temporal profiles is one of a large decline in PCB concentrations over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. In the surface sediments, this pattern is generally observed in the reaches undergoing remediation (Reaches, 5, 6, and 8), while patterns in Reach 7 and the Connecticut impoundments exhibit a shallower trajectory, which further illustrates how remediating upstream areas within the Rest of River translates to PCB reductions in downstream areas. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Predicted temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments. As a result of the remediation under SED 5, predicted fish PCB concentrations are reduced over the projection period by 95% to 99% in the remediated reaches (i.e., Reaches 5, 6 and 8) and by 84% to 97% in the other downstream reaches (Figure 6-14c).[195]

PCBs would remain in the sediments in areas beneath and outside of the areas addressed by this alternative. However, in the capped areas of Reach 5 and Woods Pond, the caps would prevent direct contact with, and effectively reduce the mobility of, PCB-containing sediments beneath the caps; and the thin-layer caps in the backwaters and Rising Pond, would provide a clean layer over the underlying PCB-containing sediments. Overall, the extent to which SED 5 would mitigate the effects of a flood event that could cause the PCB-

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194 As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

195 As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 5 in the PSA are largely unchanged at a value of 98% and are slightly lower (80% to 95%) in Reaches 7 and 8.

containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.5.3. As discussed in that section, the model results for SED 5 indicate that buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 5 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.5.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 5 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

<u>Use of Technologies under Similar Conditions and in Combination</u>

As discussed in Section 6.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007). SED 5 involves such a combination. The SED 5 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B) and wet excavation techniques (in Reaches 5C and 6), bank stabilization with removal of bank soils where necessary (in Reaches 5A and 5B), capping alone (in the deeper part of Reach 5C and Woods Pond), thin-layer capping (in the Reach 5 backwaters and Rising Pond), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs, albeit with different ecological conditions, as discussed in Sections 6.3.5.2 and 6.4.5.2.

Although the individual remedial techniques involved in SED 5 have been used at other sites, there is limited precedent for an overall sediment remediation project of the size of SED 5 (over 400,000 cy of removal). This is demonstrated by the NRC (2007) report on sediment megasites, which provided a detailed evaluation of 26 environmental sediment dredging projects that included at least 10,000 cy of sediment removal. Only two of these 26 projects included greater than 400,000 cy of removal. Those were dredging projects at Head of Hylebos and Sitcum in Commencement Bay in Washington. Moreover, these projects were completed in very different settings from the Rest of River. The Head of Hylebos and Sitcum projects included removal of sediments from large shipping channels in highly industrialized areas. The areas targeted for removal were easily accessible, and removal activities were conducted over a relatively small area. Conversely, the Rest of River has much different site characteristics that present unique challenges not encountered during the Commencement Bay projects. These characteristics include the length of the River to be addressed, the presence of ecologically sensitive areas in and surrounding the River (including a large number of rare species), the sinuous nature of the River, and lack of navigability for larger vessels. In addition, limited access and the presence of large tracts of undeveloped land, as well as some residential areas, along the River make the Rest of River very different from those other sites.

In addition to the sites discussed in the NRC (2007) report, other large removal projects have been completed or are ongoing or planned. Less than 15% of the approximately 75 completed dredging/removal projects reviewed by GE (including those in the NRC [2007] report) had removal volumes equivalent to or greater than the removal volume that would be involved in SED 5. However, conditions at those sites are also different from those in the Rest of River. Examples of other large completed projects not mentioned in the NRC (2007) report include the dredging projects conducted at the Grand Calumet River (Indiana), Ashtabula River (Ohio), and Milltown Reservoir Sediments Site (Montana). The Grand Calumet River project included removal of approximately 786,000 cy of material from a 5-mile reach of the river located in an industrialized area adjacent to U.S. Steel's facility (U.S. Steel, 2004). At the Ashtabula River, a total of approximately 630,000 cy of soft sediments were removed over approximately two miles of river in an industrialized area, with sediment removal depths ranging from approximately 16 to 21 feet (EPA, 1997b). The Milltown Reservoir Site is located at the confluence of the Clark Fork and Blackfoot Rivers, and the dredging project included the removal of approximately 3,000,000 tons (estimated at approximately 2,000,000 to 2,300,000 cy) of the most contaminated sediment behind the dam along with the dam itself (http://epa.gov/region8/superfund/mt/milltown/). The Housatonic River in the PSA differs significantly from those sites because it extends for 10 miles in a sinuous manner through a natural and biologically rich ecosystem (Figure 6-7).

Remedies selected for some other large sites include dredging of close to or more than 2,000,000 cy; these include the Hudson River (New York), the Fox River (Wisconsin), and Onondaga Lake (New York). However, these projects have not been completed,[196] and

[196] Only Phase 1 of the Hudson River project has been conducted (in 2009), involving removal of 286,000 cy of sediments. At the Fox River, approximately 541,000 cy of sediment were dredged in the first year of that project (2009) and an additional 490,000 cy had been dredged in 2010 through September 4. The remedy for Onondaga Lake is currently under development. The Record of Decision for that site (NYSDEC, 2005) specified dredging of up to 2,653,000 cy of sediment; however, the Initial Design Submittal (Parsons et al., 2009) noted, based on conservative assumptions

in any case, these sites are significantly different in environmental setting from the Rest of River. The Hudson and Fox Rivers are large, wide navigable rivers generally accessible throughout their course without the same concerns over the impacts to natural communities bounding the rivers. While there are concerns with impacting the shoreline communities in these rivers, the majority of the dredging in those rivers involves working within the navigable river, with transport to a single processing facility, rather than working from the adjacent shoreline in many instances and utilizing numerous access roads and staging areas built in the floodplain adjoining the River. Onondaga Lake is a 3,000-acre lake (4.5 miles by 1 mile) with an average water depth of 36 feet, surrounded by residential, urban, industrial, parklands, wetlands, and undeveloped areas.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 5 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. Similar to SED 3, these include sediment removal, capping, thin-layer capping, and MNR. Their general reliability and effectiveness were previously discussed in Section 6.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediment. However, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). As stated by EPA (2005d), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005d) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d).

To further assess the reliability and effectiveness of SED 5, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. The results of these stability assessments are as follows:

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regarding the extent and depth of impacted sediment and additional investigation results, that the actual sediment removal volume required to accomplish the remedial goals may range from 1,600,000 cy to 2,653,000 cy. A dredge volume of 1,900,000 cy was assumed in that design submittal.

Caps: Under SED 5, the areas receiving a cap, either following sediment removal or without sediment removal, include Reaches 5A, 5B, 5C, and Woods Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 5 are predicted to be 100% stable.

Thin-Layer Caps: SED 5 includes placement of a thin-layer cap in several Reach 5 backwaters and in Rising Pond to enhance natural recovery. As discussed in Section 6.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). In the backwaters, the model predicts that the thin-layer caps would remain stable during the simulated extreme flow event in Year 26, and that erosion causing less than 1 inch of thin-layer cap material to remain would occur within only a single grid cell during a storm event simulated in Year 29. That erosion is predicted to produce an increase of less than 0.2 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration in Reach 5D (Figure 6-14b). In Rising Pond, EPA's model predicts that approximately 93% of the thin-layer capped area within that Reach would remain stable under SED 5. The erosion occurring in the remaining 7% of that area is predicted to occur during various high flow events over Years 19 through 30 of the projection, and would result in a relatively small (< 0.3 mg/kg) change in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 6-14b).[197] After such increases in concentration are taken into account, the concentrations following the high flow events still represent reductions of 91% and 99% relative to current levels for both reaches where SED 5 includes a thin-layer cap (as discussed in Section 6.5.3). Based on these results, the model indicates that the thin-layer caps under SED 5 would largely remain in place and would thus assist in controlling releases from underlying sediments and provide stability, although this is not the primary goal of thin-layer capping.

It should also be noted, however, that there is a potential for impacts to the thin-layer caps from the feeding, spawning, and/or nesting activities of "megafauna," such as carp and largemouth bass. Specifically, carp could have some influence on portions of the thin-layer caps due to foraging in sediments, uprooting of plants, and thrashing behavior during spawning; and largemouth bass could have some influence on portions of the thin-layer caps by excavating nests.

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[197] The overall increase in Rising Pond surficial PCB concentration shown on Figure 6-13b (from 0.02 to 0.3 mg/kg over Years 19 through 25) results from a combination of erosion of thin-layer cap material in a limited number of grid cells, as well as from deposition and subsequent mixing of PCB-containing sediments from upstream areas.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.5.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques. The general reliability and effectiveness of this approach were described in Section 6.3.5.2.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 5 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the adversely affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 5. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.5.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques, including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for the caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 5. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the riverbed and restored banks has been implemented in the Upper ½-Mile and 1½-Mile Reaches and at the Sheboygan River, as further described in Section 6.4.5.2. Should changes in the riverbed or riverbanks be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for the actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1.

Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although the restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats and would not reestablish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 5 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road re-construction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.5.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 5 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 5 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 5 would alter the habitat of the River areas that would be excavated and/or subject to capping or thin-layer capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 5 would affect portions of the mapped Priority Habitats of 25 state-listed rare species, as described in Appendix L. Since SED 5 would impact more area and would take longer to implement than the previously discussed alternatives (i.e., SED 3 and SED 4), it would also more extensively alter the habitat of the River and the adjacent floodplains, and overall recovery would take even longer and be even less reliable. The long-term impacts of SED 5 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

<u>Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C</u>

SED 5 would involve sediment removal and/or capping activities in the entirety of Reaches 5A and 5B and portions of Reach 5C and placement of a cap over the sediments in the remaining portions of Reach 5C. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4 and are summarized below.

The specific long-term impacts of sediment removal/capping in Reaches 5A and 5B were summarized in Sections 6.3.5.3 and 6.4.5.3 for SED 3 and SED 4, and the specific long-term impacts of capping in a portion of Reach 5C were summarized in Section 6.4.5.3 for SED 4. Those same impacts would also result from the sediment removal/capping activities in Reaches 5A, 5B, and a portion of Reach 5C and capping in the remainder of Reach 5C, except that they would extend for the entire distance of Reach 5B and Reach 5C. As noted in Sections 6.3.5.3 and 6.4.5.3, those impacts include the following:

- The cap would cause a change in surface substrate type from sand or a combination of sand and gravel to armor stone, lasting until deposition of natural sediments from upstream changes the substrate surface back to a condition approximating its prior condition, which could take many years, particularly in the further downstream reaches due to the extensive remediation upstream of those reaches.

- There would be a loss of a continuing source of woody debris and shade due to the permanent loss of mature trees on the riverbanks. This would alter the riverine habitat, since woody debris provides structure that is important to many aquatic and semi-aquatic species, and shading limits temperature increases in the river water, which could increase aquatic plant growth and change the suitability of the habitat for temperature-dependent species.

- The sediment removal and capping would destroy or displace the existing aquatic vegetation, benthic invertebrates, and fish. While recolonization would occur, the organisms that would initially recolonize these areas would differ from the existing organisms (e.g., would include species more tolerant of stress, including invasive species) due to the changed substrate. Over time, continued accumulation of sediments would increase the diversity of habitat, resulting in more complex communities than existed shortly after remediation, but those communities are still unlikely to match the pre-remediation communities in terms of composition, species diversity and richness, and relative abundance of species, at least for many years. In particular, it is doubtful whether the state-listed species destroyed by the sediment removal/capping would ever return. (Impacts on state-listed species are discussed further below.)

- There is a high potential that the disturbed areas would be colonized by invasive species, which are impractical to control in a flowing river and thus are likely to dominate over the native species.

- Cap placement on top of the existing substrate in a portion of Reach 5C would change the elevation of the river bottom. In certain relatively shallow areas, the increase in substrate elevation resulting from the cap could change the vegetative characteristics of those areas and the biota dependent on them. For example, in areas (if any) where the cap thickness (24 inches) exceeds the water depth, the elevation change could cause the emergent vegetation to be replaced by species more tolerant of less frequently inundated or drier conditions, including invasive species.

In summary, over time, following the remediation and restoration of the impacted reaches of the River, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur is unpredictable and would be delayed, particularly in the further downstream reaches, by the extensive upstream riverbed and riverbank remediation. Moreover, the abundance of organisms and richness of the mix of species in the replaced community are uncertain, the return of certain specialized species (including state-listed species) is doubtful, and colonization by invasive species is highly probable.

<u>Long-Term Adverse Impacts on Riverbank Habitats</u>

As previously described, SED 5 would include stabilization of the riverbanks in Reaches 5A and 5B using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4, and would be similar to the impacts summarized in Section 6.3.5.3 for SED 3. As discussed there, the bank stabilization measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species, as well as causing other long-term or permanent impacts. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Impoundment Habitats in Woods Pond and Rising Pond

Under SED 5, Woods Pond would be remediated by removal/capping in the shallower parts and placement of a cap in the "deep hole," and remediation in Rising Pond would involve placement of a thin-layer cap. The long-term impacts from remediation in impoundments were described generally in Section 5.3.3.4. An assessment of such impacts to Woods Pond and Rising Pond under SED 5 is provided below.

For Woods Pond, the long-term impacts from removal/capping activities in the shallower parts of the Pond would be the same as those summarized in Section 6.4.5.3 for SED 4, and would include a change in the surface substrate and a consequent alteration in the biological community in the Pond. It is anticipated that, over time, as sand and organic sediments are deposited from upstream, a biological community typical of such impoundments would eventually develop. However, the rate of recovery is uncertain, the replaced community may include changes in the mix of native species, the return of certain specialized native species is doubtful, and the Pond would likely be dominated by invasive species such as those currently present (e.g., water chestnut). The placement of a cap in the deep portion of Woods Pond would not be expected to have any significant adverse long-term ecological impacts for the reasons discussed in Section 6.3.5.3.

The placement of a thin-layer cap in Rising Pond would have a number of long-term impacts, as it would change the surface substrate type, the bottom elevation, and thus the aquatic vegetation and the benthic invertebrate and fish community of the Pond for at least some period of time. As discussed in Section 5.3.3.4, as sediments are deposited from upstream, a biological community consistent with those conditions would be expected to develop (with possible changes in the type of vegetation present along shorelines and associated biota due to elevation changes from the thin-layer cap). Again, however, the length of time for such a community to develop and the specific species mix are uncertain, the return of certain specialized native species (including state-listed species) is doubtful, and there is a high potential for colonization by invasive species, which would likely be impractical to control over the long term. Impacts would vary from greatest in shallow areas to least in deep areas.

Long-Term Adverse Impacts on Backwaters

The placement of a thin-layer cap in portions of the backwater areas under SED 5 would be expected to have some long-term negative impacts. The long-term impacts of remediation on backwater habitats are discussed generally in Section 5.3.6.4, and those likely to result from thin-layer capping are summarized in Section 6.4.5.3 for SED 4. Those impacts would include changes in surface substrate type, bottom elevation (assuming no consolidation), vegetative characteristics (including proliferation of invasive species), and wildlife communities using the backwaters – all of which would last until such time (if any) as physical conditions of the backwaters return to pre-remediation conditions.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 5 includes 25 staging areas covering approximately 41 acres (including 8.3 acres within the floodplain) and approximately 20 miles of temporary roadways covering an additional 49 acres (including 16 miles and 39 acres in the floodplain), as shown on Figures 6-12a-b. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (9.4 acres), and upland forests (2.9 acres).[198] These impacts would occur mainly in Reaches 5A and 5B, with additional impacts in limited portions of Reaches 5C, 6, and 8 to support the remediation in those areas. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats).

The long-term negative impacts anticipated from access roads and staging areas under SED 5 are generally comparable to those described in Section 6.3.5.3 for SED 3. As such, the summary of such impacts presented in that section also applies to SED 5, except that the extent of such impacts would be somewhat greater under SED 5. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 5 would affect portions of the Priority Habitats of 25 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 5 would involve a “take” of at least 23 of these species and would adversely affect a significant portion of the local population of at least 13 of them. The table below lists the 25

[198] Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 5 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural fields and cultural grasslands) (30 acres), with additional impacts occurring in forested uplands (9 acres) and in shrub swamp, wet meadow, and emergent marsh habitats (1 acre). While there would be no impacts associated with access roads and staging area in Reach 7, approximately 2 acres of upland forest would be impacted by such facilities in Reach 8.

state-listed species whose Priority Habitat would be affected by SED 5, along with those for which SED 5 would result in a take and those for which SED 5 would impact a significant portion of the local population:

Table 6-30 – Impacts of SED 5 on State-Listed Species

Species with Priority Habitat Affected by SED 5	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Yes
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Spine-crowned clubtail	Yes	Yes
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 5 would have long-term impacts on the aesthetic features of the natural environment. The sediment removal and capping activities throughout Reaches 5 and 6, along with bank stabilization in approximately 14 linear miles (7 miles on both banks) of Reaches 5A and 5B, would alter the appearance of the River over the course of those construction activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The construction of an extensive network of roadways and staging areas on both sides of the River to support the implementation of SED 5 would also cause long-term impacts on the aesthetics of the floodplain. The placement of these roadways and staging areas would remove trees and vegetation, including in numerous forested areas. This would change the appearance of those areas until such time (if ever) that they return to their prior state. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to its current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 5 include areas used for canoeing, fishing, hiking, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 5. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts on Fluvial Geomorphic Processes

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B, as well as the capping and armoring of the riverbed in those reaches, would reduce the supply of sediment to the River. The potential impacts of this reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. As discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization and riverbed armoring would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity. This conclusion would also apply to SED 5.[199]

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 5, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 5 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for impoundments such as Woods Pond and Rising Pond, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 5.

6.5.6 Attainment of IMPGs

As part of the evaluation of SED 5, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 5, and those comparisons are shown in Tables 6-31 through 6-36.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-31 through 6-36.[200] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the

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[199] Similar to SED 3, model results for SED 5 suggest that bank stabilization and bed armoring, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, the reduction in sediment loading associated with bank and bed remediation under SED 5 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank and bed erosion), within several areas of the River (mainly in Reaches 5A and 5B).

[200] The extent to which SED 5 is predicted by the model to accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 6.1.6 above).

estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[201]

6.5.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) PCB concentrations would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-31). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods generally ranging from 2 to 25 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in any of the Massachusetts reaches (except for the IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in a few subreaches) (Table 6-32). However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 5 would achieve the RME IMPGs associated with a 10^{-5} cancer risk as well as non-cancer impacts.[202]

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[201] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 5, application of the "lower bound" assumptions in the model did not result in the attainment of any additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions. (Full comparisons between model results for the base case and lower-bound simulations are provided in Appendix K.)

[202] SED 5 would also achieve some of the CTE-based IMPGs in Massachusetts, particularly under a probabilistic analysis in Reaches 5 and 6, as well as all CTE IMPGs in Connecticut (Table 6-32).

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's sole use of largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 5, this change in averaging method (and resulting increase in concentration) would not change the IMPG assessment presented in Table 6-32, except that the non-cancer (adult) deterministic CTE IMPG would no longer be achieved in Reaches 7A and 7H and the 10^{-5} cancer probabilistic CTE IMPG would no longer be achieved in Reach 7E.

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 160 to >250 years in the PSA and >250 years in Reaches 7 and 8.

6.5.6.2 Comparison to Ecological IMPGs[203]

For benthic invertebrates, predicted average surface sediment concentrations would achieve the upper-bound IMPG (10 mg/kg) within the model period in all 32 averaging areas and would achieve the lower-bound IMPG (3 mg/kg) in all areas except for three subreaches in Reach 7 (Table 6-33). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6.

For amphibians (similar to SED 4), predicted surface sediment PCB levels in the backwaters at the end of the modeled period would achieve the upper-bound IMPG (5.6 mg/kg) in 27 of the 29 backwater areas evaluated, and would also achieve the lower-bound IMPG (3.27 mg/kg) in 21 of those areas (Table 6-34). Time to achieve the IMPGs (where achieved) generally ranges from approximately 5 to 50 years. In the backwater areas that would not achieve the IMPGs by the end of the modeled period, extrapolated estimates indicate that the IMPG would be achieved within various times between 60 and >250 years.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-35). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 14 years for warmwater fish, and from 11 to 30 years for coldwater fish.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations have been compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below the target sediment levels of 3 and 5 mg/kg in all 12 averaging areas and below the 1 mg/kg target level in 10 of those 12 areas (Table 6-36). For piscivorous mammals, the model-predicted surface sediment concentrations are below all three target sediment levels in both

[203] While this section describes the extent to which SED 5 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.5.5.3 and 6.5.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.5.11.

averaging areas (Table 6-36). For both receptor groups, the times to achieve the various target levels are highly variable, and range between 1 and 70 (extrapolated) years.[204]

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG in 13 of the 14 modeled reaches – i.e., all except Reach 7B (Table 6-35). Estimated times to achieve the IMPG in reaches where it is not already met prior to the start of the model projection range from 10 to 40 years. In Reach 7B where the IMPG is not attained within the 52-year projection period, the extrapolated time to achieve this IMPG is >250 years.[205]

Finally, for threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPG (30.4 mg/kg) in all reaches (Table 6-35). Estimated times to achieve these IMPGs (in reaches where they are not already met prior to the start of the model projection) range from 3 to 14 years.[206]

6.5.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 5 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

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[204] In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 5 has been paired with FP 4. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 5, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

[205] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in only two changes in IMPG attainment under SED 5 (i.e., the osprey IMPG would no longer be met in Reaches 7C and 7G).

[206] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 5 at the end of the simulation period are 0.004 to 0.008 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 5 are in the range of 0.03 to 0.07 mg/kg (Table 6-29). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

Reduction of Toxicity: SED 5 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 5 would reduce the mobility of PCBs in the River by removing approximately 377,000 cy of sediment containing PCBs in Reaches 5 and 6 and placing a cap over those areas, stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks, and placing a cap over the remaining sediments in Reach 5 and Woods Pond. In total, caps would be placed over approximately 42 acres in Reach 5A, 27 acres in Reach 5B, 57 acres in Reach 5C, and 60 acres in Woods Pond. These caps would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (61 acres) and in Rising Pond (41 acres) to accelerate the recovery of those areas.

Reduction of Volume: SED 5 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 412,000 cy of sediments/bank soils containing approximately 18,800 lbs of PCBs.

6.5.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 5 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Since the remedial actions under SED 5 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Nevertheless, since the extent and duration of remediation activities under SED 5 are greater than that under SED 3 and SED 4, the short-term impacts would be more extensive and would occur over a longer time period in the Rest of River.

Impacts on the Environment – Effects Within PSA

The short-term adverse impacts on the environment resulting from implementation of SED 5 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and disruption to the biota that reside in the floodplain due to the construction of supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: The sediment removal activities in Reaches 5 and 6 (377,000 cy over 126 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. Resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal activities in those areas would be conducted in the dry using sheetpile containment. However, the potential for sediment to be released from the work area exists during sheetpile installation or due to overtopping of sheeting during a high flow event. For Reach 5C and Woods Pond, activities would be conducted in the wet through use of barge-mounted mechanical excavators, with silt curtains used to mitigate sediment releases to downstream reaches. In those areas, some sediment containing PCBs would be released from the work area through the excavation process even though the area would be surrounded by silt curtains.[207] In addition, boat and barge traffic could resuspend sediment during the construction phase.

In addition, sediment removal activities, particularly when conducted in the wet (even with the use of silt curtains), would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach); and such results would likewise be expected to occur under SED 5.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 5 would cause a loss of aquatic habitat in 126 acres of Reaches 5A, 5B, 5C, and 6 where sediment removal would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine and impoundment habitats was provided in Sections 5.3.1.2 and 5.3.3.2, respectively. The short-term impacts of removal/capping in Reach 5A under SED 3 were summarized in

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[207] For example, the recent experience of mechanical dredging of the Upper Hudson River from barges showed an overall PCB resuspension rate of 3% at least a mile downstream of the dredging operations, with a rate of approximately 4% outside areas with resuspension controls (Anchor QEA and ARCADIS, 2010). Similarly, the resuspension rates of 1.3% to 5.8% of solids were observed during pilot clamshell dredging in the Passaic River (Lower Passaic River Restoration Project Environmental Dredging Pilot Study Work Group, 2009). If 3% of the PCB mass dredged in Woods Pond and Reach 5C under SED 5 were lost to the water column, that would equate to approximately 170 lbs of PCBs.

Section 6.3.8. The same impacts would apply under SED 5 to the removal areas in Reaches 5 and 6. These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; a disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation; and colonization by invasive species. Overall, the short-term adverse impacts from removal under SED 5 would affect approximately 84 more acres of aquatic habitat than SED 3 and approximately 35 more acres than SED 4.

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate adverse effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts were described for SED 3 in Section 6.3.8 and would also occur under SED 5.

Capping: Capping activities in Reaches 5C and 6 would be performed during low flow periods. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be less than during removal activities, since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place in an effort to limit transport of cap material and solids to downstream reaches.

Placement of a cap (without removal) as part of SED 5 would occur over 37 acres in Reach 5C and 23 acres in Woods Pond. In Reach 5C, the cap placement would have immediate impacts on the aquatic communities. Those impacts were generally described in Section 5.3.1.2, and would largely be the same as those of sediment removal followed by capping In addition, in shallow shoreline areas where the cap thickness would approach or exceed the water depth and consolidation of the underlying sediment does not occur, the increase in substrate elevation resulting from the cap could change the vegetative characteristics of these riverine wetlands and the biota dependent on them. In Woods Pond, placement of the cap in the "deep hole" area would bury plants and invertebrates, if any, present at the time of placement, and would cause a temporary disruption and displacement of fish in and near that area, as well as of birds and mammals that feed on those fish.

Thin-Layer Capping: Thin-layer capping activities in the Reach 5 backwaters and Rising Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, there is little potential for thin-layer capping to resuspend PCB-containing sediments into the overlying water column.

Placement of a thin-layer cap as part of SED 5 would occur over 102 acres of the River, and would have short-term impacts on aquatic vegetation and benthic invertebrates in those areas. Immediate and near-term impacts of thin-layer capping were described in Sections 5.3.3.2 for impoundments and 5.3.6.2 for backwaters. These impacts were also summarized in Section 6.3.8 for the thin-layer capping in Reach 5C and Woods Pond under SED 3. Similar impacts would occur from the placement of thin-layer caps in the Reach 5 backwaters and Rising Pond under SED 5.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of the habitats in those areas and the loss of the wildlife that they support. It is anticipated that SED 5 would require a total of approximately 90 acres for access roads and staging areas (approximately 48 acres within the 10-year floodplain). The principal habitat types affected were identified in Section 6.5.5.3; they include floodplain forests, shrub and shallow emergent wetlands, disturbed upland habitats such as agricultural fields and cultural grasslands, and upland forests. The short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 5 would be largely the same as those described in Section 6.3.8 for the support facilities under SED 3, except that the total acreage affected would be greater under SED 5.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 5.

The total calculated emissions from SED 5 would amount to approximately 93,000 tonnes of GHG emissions, with 38,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation), 2,300 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 53,000 tonnes from off-site emissions (primarily from manufacture of steel sheeting and of cement for stabilization, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent to the annual output of 18,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 5 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 5, these impacts would primarily affect portions of Reaches 5 and 6 for an estimated 18 years, with impacts to Rising Pond occurring over 1 year.

Impacts on Recreational Activities: Recreational activities in the areas that would be affected by SED 5 include fishing, canoeing, hiking, waterfowl hunting, and general recreation. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment and capping/stabilization materials to the work areas and to remove excavated materials from those areas, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 5 (approximately 18 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 34,000 truck trips to do so (1,890 truck trips per year for a 18-year implementation period). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 63,500 truck trips (3,530 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter period, near Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and

staging area materials following remediation.[208] This analysis indicates that the increased truck traffic associated with SED 5 would result in an estimated 2.97 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.16) with a probability of 95% of at least one such injury, and an estimated 0.14 fatalities from accidents (average fatality estimate of 0.0076) with a probability of 13% of at least one such fatality.

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[209] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, however, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 5 would be inevitable.

Risks to Remediation Workers

There would be health and safety risks to site workers implementing SED 5. Implementation of SED 5 is estimated to involve 892,927 man-hours over an 18-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 5 would result in an estimated 8.23 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.45) with a probability of 100% of at least one such injury, and an estimated 0.09 worker fatalities (average annual fatality estimate of 0.005) with a probability of 9% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.5.9 Implementability

6.5.9.1 Technical Implementability

The technical implementability of SED 5 has been evaluated considering the factors identified below.

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[208] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal locations are evaluated under the relevant treatment/disposition alternatives.

[209] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

General Availability of Technologies: SED 5 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 5 would be technically implementable in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use both in higher energy river reaches such as Reach 5A and parts of Reach 5B, and in shallow, lower water velocity river reaches like those found in portions of Reach 5C and Woods Pond. Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Reach 5C and Woods Pond. Each technique has been used at other locations (see Section 6.4.5.2). Sediment removal and subsequent capping would be performed in a manner to cause no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Reach 5C and Woods Pond where the water is relatively deep, which are suitable conditions for such capping. In addition, thin-layer capping to enhance the ongoing natural recovery process would be applied in low velocity areas with shallow water depths – i.e., Reach 5 backwaters and Rising Pond – which have suitable conditions for this technique.

The potential impacts on flood storage capacity resulting from the placement of cap materials in these reaches under SED 5 were assessed by comparing EPA model predictions of the area of floodplain within Reaches 5 and 6 inundated during a high flow event to that predicted under SED 1 during the same event (using a 2-year flow event in Year 48 of the model projections, as discussed for SED 3 in Section 6.3.9.1). In Reach 5 backwaters, Woods Pond, and Rising Pond, the backwater effects are controlled by the dams and thus no flood storage capacity impacts are expected. In Reach 5C, the potential would exist for the cap to increase water level/flood frequency. Under SED 5, the model-predicted area of inundation within the floodplain of Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection increased by 1% over that predicted under SED 1 (827 acres compared to 817 acres). This analysis suggests that the cap would have a limited impact on flood storage. A more refined assessment of floodplain storage would be developed during design. If necessary, additional flood storage capacity would be obtained to accommodate placement of caps if this alternative were selected.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process.

Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant river stretches.

MNR with institutional controls would be implemented in the downstream reaches. Monitoring to track changes in PCB concentrations following the SED 5 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 5 could readily be constructed using commonly available construction techniques.

Reliability: The remediation technologies that comprise SED 5 are considered reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.3.5.2, 6.4.5.2, and 6.5.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.5.5.2 and 6.5.5.3.

Availability of Space for Support Facilities: Implementation of SED 5 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 90 acres of space would be needed, and appear to be available to support SED 5 activities based on the conceptual site layout (assuming that the necessary access agreements can be obtained). Development of staging areas and access roads would be sequenced and constructed appropriately over the approximate 18-year implementation period.

Availability of Cap/Stabilization Materials: Materials required for cap construction and bank stabilization must be of suitable quality for their intended purposes. A total of approximately 624,000 cy of sand/fill/stone materials would required for capping, thin-layer capping, and bank stabilization activities (i.e., 378,000 cy of sand/clean fill and 246,000 cy of armor stone and riprap). For purposes of this Revised CMS Report, adequate material sources are assumed to be available, although their proximity to the site is uncertain. An evaluation would be required during design activities to confirm material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 5. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 5 would be determined over time through long-term monitoring to document reductions in PCB concentrations in the water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness as well as bank stability. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.5.9.2 Administrative Implementability

The administrative implementability of SED 5 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 5 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 5 is provided in Tables S-5.a through S.5-c in Appendix C and summarized in Section 6.5.4.

Access Agreements: Implementation of SED 5 would require GE to obtain access permission from the owners of properties in Reaches 5 and 6 where remedial work or ancillary facilities would be necessary to carry out the alternative. Although many of these areas are owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 30 to 40 other landowners. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA’s assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 5, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.5.10 Cost

The estimated total cost for implementation of SED 5 is $285 M (not including treatment/disposition costs). The estimated capital cost is $274 M, assumed to occur over an 18-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.1 M. The estimated annual OMM costs for SED 5 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction on a reach-specific basis. The estimated costs for the long-term program range from approximately $32,500 to $635,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $7.5 M. The following summarizes the total capital and OMM costs estimated for SED 5.

SED 5	Est. Cost	Description
Total Capital	$274 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM	$10.6 M	Costs for performance of the OMM programs
Total Cost for Alternative	$285 M	Total cost of SED 5 in 2010 dollars

The total estimated present worth cost of SED 5, which was developed using a discount factor of 7%, an 18-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $164 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soil. The estimated costs for the combination of SED 5 and FP 4 are presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.5.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.5.2, the evaluation of whether SED 5 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 5 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 377,000 cy of PCB-containing sediments in Reaches 5 and 6 and placing a cap over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B to address erosion of PCB-containing bank soil, including removal of 35,000 cy of bank soil; (c) placing a cap over 60 acres in the deeper parts of Reaches 5C and 6 where no excavation would be performed; (d) placing a thin-layer cap over 102 acres in the Reach 5 backwaters and in Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 6.5.3, implementation of SED 5 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.6 kg/yr, that passing Rising Pond Dam from 19 to 1.3 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.3 kg/yr over the modeled period.

Further, as discussed in Section 6.5.5.1, EPA's model predicts that implementation of SED 5 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 3-8 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 2 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.03-0.07 mg/kg in the Connecticut impoundments.

On the other hand, SED 5 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.5.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.5.4, SED 5 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 µg/L, which should be waived as technically impracticable to attain. Review of the potential location-specific and action-specific ARARs indicates that SED 5 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.5.6.1, accepting EPA's HHRA, SED 5 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from

SED 5 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a few areas). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 5 would achieve fish PCB levels within the range of the RME IMPGs in all impoundments within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.5.6.2, the model results indicate that, by the end of the modeled period, SED 5 would achieve the IMPG levels for some ecological receptor groups. Specifically, SED 5 would result in sediment PCB concentrations within or below the IMPG range for benthic invertebrates (3 mg/kg to 10 mg/kg) in all averaging areas, and would achieve fish PCB levels below the IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) and for threatened and endangered species (30.4 mg/kg) in all reaches. For other receptor groups, SED 5 would achieve the IMPG in the great majority of areas. Specifically, for amphibians, SED 5 would result in sediment PCB concentrations within or below the IMPG range (3.27 mg/kg to 5.6 mg/kg) in nearly all (27 of 29) of the backwaters; and for piscivorous birds, SED 5 would achieve the fish-based IMPG (3.2 mg/kg) in all reaches except one subreach of Reach 7. For insectivorous birds, SED 5 would achieve the target sediment levels of 3 and 5 mg/kg in all averaging areas and the target level of 1 mg/kg in 10 of the 12 areas; and for piscivorous mammals, SED 5 would achieve all three target sediment levels in both averaging areas.[210]

As discussed in Section 2.1.1, attainment of IMPGs, as one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. Although SED 5 would not achieve the ecological

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[210] As discussed previously, attaining the target sediment levels for insectivorous birds and piscivorous mammals would allow achievement of the IMPGs for these receptors provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 7).

IMPGs for a couple of receptor groups in a few areas, those exceedances are limited in area and are only slightly above the IMPG levels. Given the fact that the local populations of these receptors extend through the numerous areas within the Rest of River where the IMPGs would be achieved, as well as nearby areas outside the Rest of River, these exceedances would not be expected to prevent the maintenance of healthy local populations of these receptors, let alone adversely impact the overall wildlife community in the Rest of River area. This is supported by the fact that field surveys conducted by both EPA and GE, as well as other existing ecological information identified in Section 5.1.1, have documented the presence of numerous and diverse species (including state-listed rare species) in the PSA despite the presence of PCBs in this area for over 70 years.

On the other hand, implementation of SED 5 would cause substantial short-term and long-term adverse impacts on the environment, including the animal groups that the IMPGs are designed to protect. The short-term impacts would include loss of the existing aquatic habitat in Reaches 5 and 6, loss of riparian habitat in the bank stabilization areas, resuspension of PCB-containing sediments during removal, and loss of floodplain habitat in areas where supporting facilities are constructed – all as discussed in Section 4.5.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 5 would result in substantial long-term and, in some cases, permanent adverse effects on the ecosystem. These impacts were described in Section 6.5.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the Reach 5 backwaters, the shallower portions of Woods Pond, and Rising Pond;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of “overall protection” of the environment requires a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat” (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 5 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 5 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 5 would not meet the standard of providing overall protection of the environment.

6.6 Evaluation of Sediment Alternative 6

6.6.1 Description of Alternative

SED 6 would include the removal of a total of 556,000 cy of sediment and riverbank soil (including 521,000 cy of sediment over 178 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank), engineered capping of a total of 223 acres of river bottom including all removal areas and some non-removal areas, and thin-layer capping of an additional 112 acres. Specifically, the components of SED 6 include the following:

- Reach 5A: Sediment removal in the entire reach (134,000 cy over 42 acres), followed by capping;

- Reach 5B: Sediment removal in the entire reach (88,000 cy over 27 acres), followed by capping;

- Reach 5C: Sediment removal in the entire reach (186,000 cy over 57 acres), followed by capping;

- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);

- Reach 5 backwaters: Combination of removal with capping in areas with surface PCB concentrations greater than 50 mg/kg (24,000 cy over 15 acres) and thin-layer capping in areas with surface PCB concentrations between 1 and 50 mg/kg (55 acres);

- Reach 6 (Woods Pond): Combination of removal with capping (89,000 cy over 37 acres) in shallower areas and capping without sediment removal (23 acres) in the "deep hole";

- Reach 7 impoundments: Thin-layer capping (38 acres);

- Reach 8 (Rising Pond): Combination of capping without sediment removal (22 acres) in the "deep" portion of the Pond and thin-layer capping (19 acres) in the remaining "shallow" areas; and

- Reach 7 (channel) and Reaches 9 through 16: MNR

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 6-15a-b identify the remedial action(s) that would be taken in each reach as part of SED 6. Either capping or backfilling would be conducted following removal in the Reach 5 backwaters based on the PCB concentrations remaining following removal; this would be determined during design. However, for purposes of this Revised CMS Report, it is conservatively assumed that capping would be conducted in the backwater areas.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 6. It is estimated that SED 6 would require approximately 21 years to complete. A construction timeline for implementation of SED 6 is provided in Figure 6-16. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. Details of the specific methods for implementation of the remedy would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 6 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 6 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 26 staging areas, occupying a total of 48 acres (10 acres within the floodplain), and approximately 21 miles of access roads covering 50 additional acres assuming a 20-foot road width (16 miles and 40 acres in the floodplain) would be constructed between the Confluence and Rising Pond to support implementation of SED 6. The locations of these staging areas and access roads are shown on Figure 6-15a-b. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed in Reaches 5 and 6, as presented below.

	Average Removal Depth (feet)	**Removal Volume (cy)**	**Acreage**
Reach 5A:	2	134,000	42
Reach 5B:	2	88,000	27
Reach 5C:	2	186,000	57
Reach 5 backwaters:	1	24,000	15
Reach 6 (Woods Pond):	1.5	89,000	37
Totals:		**521,000**	**178**

The areas over which removal would be conducted for the reaches listed above are shown on Figure 6-15a.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas. In Reaches 5C, the Reach 5 backwaters, and Reach 6, it is assumed that the removal would be performed using hydraulic dredging. In these areas, debris removal would be conducted prior to dredging, and silt curtains would be placed downstream of dredging areas in an effort to limit transport of suspended sediment. Periodic water column and air monitoring would be performed during implementation.

Cap Placement: Following excavation, caps would be installed in the dry in Reaches 5A and 5B prior to removal of the sheetpile, and caps would be installed in Reach 5C, Reach 5 backwaters, and the shallow portion of Woods Pond through the water column (see Figure 6-15a). Caps would also be installed through the water column in the deeper portions of Woods Pond and Rising Pond without prior sediment excavation. Removal of debris that could interfere with the performance of the cap would be conducted prior to cap material placement. Cap materials would be transferred to the River using conventional earth-moving equipment.

For those areas where sediment removal is performed, the existing bathymetry would be maintained through construction of caps with a thickness similar to the removal depths. For purposes of this Revised CMS Report, it has been assumed that in the Reach 5 subreaches where sediment removal occurs, the caps would consist of 12 inches of sand (which may be amended by organic material to increase the TOC content), overlain by an armor stone layer of 12 inches to bring the riverbed to the pre-removal elevation. In the areas of Woods Pond where removal would occur, the pre-removal depths would be achieved through placement of a cap consisting of 12 inches of sand and 6 inches of armor stone. In the backwater areas, the pre-removal elevation would be achieved with a 12-inch stable sand layer (which may include some stone mixed in and may be amended by organic material), but no additional armor stone layer. In the deeper portions of Woods Pond and Rising Pond where caps would be installed without prior sediment excavation, the cap would consist of 12 inches of sand and 6 inches of armor stone. It should be noted that the composition and thickness of the sand layer and armor stone layer (where applicable) would be determined during design, and would be selected to limit the potential for migration of PCBs from underlying sediments and to resist erosion during high flows). Silt curtains would be used during capping in the wet in an effort to limit downstream transport of suspended materials in the water column, and water column sampling would be performed.

Thin-Layer Cap Placement: In the Reach 5 backwaters, following removal of sediments in the top foot with PCB concentrations over 50 mg/kg, a thin-layer cap would be installed over all remaining areas where PCB concentrations in the top foot exceed 1 mg/kg (55 acres). A thin-layer cap would also be installed in the Reach 7 impoundments (38 acres) and the shallow portion of Rising Pond (19 acres), as shown on Figures 6-15a-b. For purposes of evaluation, it is assumed that the thin-layer cap would consist of a 6-inch layer of sand. The thin-layer cap would be placed via a combination of techniques, including mechanical and/or hydraulic means. For purposes of modeling, the material to be used for the thin-layer cap is assumed to have similar properties to those of the underlying native material (see Section 3.1.3). However, the actual materials to be placed would be determined during design activities.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling at the staging areas for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed by hydraulic dredging. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 6 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in these subreaches. The bank stabilization techniques assumed to be part of SED 6 for purposes of this Revised CMS Report are the same as those identified for SED 5, involving a combination of bioengineering and traditional bank hardening techniques. Those techniques are described in Section 3.1.4 and Appendix G and are depicted on Figures G-2 through G-9 in Appendix G. For purposes of this report, it is assumed that the riverbank stabilization/soil removal work in Reaches 5A and 5B would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, employing conventional mechanical excavation equipment.

MNR: MNR would be implemented in the remainder of the Rest of River under SED 6 (i.e., the Reach 7 channel and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 6, due in part to the completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of the evaluations in this Revised CMS Report, it is assumed that SED 6 would include restoration of areas that are directly impacted by the removal and/or capping activities, the bank removal/stabilization activities, and ancillary construction activities. The restoration methods assumed for SED 6 for purposes of this Revised CMS Report include the include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B; Section 5.3.3.3 for Woods Pond, the Reach 7 impoundments, and Rising Pond; Section 5.3.6.3 for the Reach 5 backwaters; and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 6 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 6 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 6 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for the capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program for capped areas under SED 6 would include the same elements outlined for that program under SED 3 (Section 6.3.1). The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 6.

A summary of the assumed long-term (100-year) OMM program for SED 6 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 following remediation and would include collection of 50 surface sediment samples from the MNR areas, approximately 45 cores (135 samples) from the removal areas, approximately 11 cores (33 samples) from the cap-only areas, and approximately 25 cores (25 samples) from the thin-layer cap areas. Further, for the caps and thin-layer caps, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.6.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 6 would be protective of human health and the environment is presented at the end of Section 6.6 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.6.3 Control of Sources of Releases

SED 6 would reduce the potential for future PCB migration from certain sediments and riverbanks. This alternative would address approximately 335 acres of the riverbed and approximately 14 linear miles of riverbank (7 miles on both banks), and would include the removal of 556,000 cy of sediment and bank soils containing PCBs, thereby resulting in a reduction of the potential for future transport of the PCBs within the River and onto the floodplain for potential human or ecological exposure. Specifically, SED 6 would result in the removal of 1.5 to 2 feet of sediments throughout of all Reach 5 and the shallow portion of Woods Pond, and removal of sediments with PCB concentrations greater than 50 mg/kg in the top foot in the backwaters. PCBs remaining in these areas would be contained by a cap. The banks of Reaches 5A and 5B would be addressed through bank stabilization techniques, including bank soil removal where appropriate. In the deeper portions of Woods Pond and Rising Pond, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediment from the water column. In addition, in portions of the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond, a thin-layer cap would be placed to accelerate the natural recovery process and assist in controlling releases from those areas.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place for the dams under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed. Moreover, the removal and/or capping in the impoundments under SED 6 would further mitigate the potential for downstream transport of PCBs even in the event of dam failure.

As indicated by EPA's model, implementation of SED 6, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual average PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 6 is predicted to achieve a 95% reduction in the PCB mass passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 1.0 kg/yr). Likewise, SED 6 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.3 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-17b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 6 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 6 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme flow event would not result in the exposure of buried PCBs at concentrations higher than those already present in the sediment surface prior to the event. For the reaches that would be capped either following removal or without removal (i.e., Reaches 5A, 5B, 5C, Woods Pond, and portions of the backwaters and Rising Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[211] As a result, no change in reach-average surface sediment PCB concentrations associated with cap erosion is predicted for these areas (e.g., Figure 6-17b). In the portions of the Reach 5 backwaters and Rising Pond that would undergo thin-layer capping under SED 6, the model predicts that the cap materials and underlying sediments also would largely remain stable during high flow events. Indeed, the model results indicate that only a few model grid cells (representing 1% to 3% of the thin-layer capped portions) would experience significant erosion in these reaches. Such erosion is predicted to produce small (0.1 mg/kg) increases in the reach-average surface sediment PCB concentrations, resulting in levels that are still 99% lower than pre-remediation levels in Reaches 5D and 8 (Figure 6-17b). Similarly, in the Reach 7 impoundments, the model predicts that the thin-layer cap materials and underlying sediments would generally remain stable during the high flow events. Portions of these areas (11% to 21% of the thin-layer capped portions of Reaches 7B, 7E, and 7G) would experience erosion large enough to produce increases in average surface sediment PCB concentrations (Figure 6-17b), although no such erosion was predicted for Reach 7C. These predicted concentration increases are moderate (0.6 mg/kg to 1.0 mg/kg) relative to the pre-remediation levels (2 mg/kg to 6 mg/kg) such that the concentrations following the erosion are still predicted to be 70% (Reach 7E) to 82% (Reach 7B) lower than current levels (Figure 6-17b), with no such increase predicted in Reach 7C. Overall, the model results for SED 6 indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

Given that SED 6 includes remediation in Woods Pond (a combination of sediment removal over 37 acres and capping over 23 acres), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. Similar to SED 3, SED 4, and SED 5, although there would be a net decrease in the depth of the Pond as a result of the capping (without prior removal) that occurs in the deep portion of the Pond, the solids trapping efficiency of Woods Pond under SED 6, as predicted by EPA's model, would be unchanged relative to MNR (approximately 15%).

6.6.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 6 in accordance with the directions from EPA are listed in Tables S-6.a through S-6.c in Appendix C. The compliance of SED 6 with these potential ARARs is discussed below.

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[211] Further evaluation of the stability of cap and thin-layer cap materials under SED 6 based on model predictions of erosion in these areas is provided in Section 6.6.5.2. The results of this stability analysis (i.e., percentages of cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-6.a, include the federal and state water quality criteria for PCBs. To evaluate whether SED 6 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 6. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, two exceedances are predicted within the PSA (Holmes Road). However, these exceedances consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered as a single exceedance. This is confirmed by the block averages that indicate no exceedances for this alternative in these reaches. For such reasons, as discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 6 would achieve this criterion, albeit at a significant environmental cost, as discussed in Sections 6.6.5.3 and 6.6.8.

By contrast, the model-predicted annual average water column concentrations (which are used for assessment of human health-based water quality criteria and are presented in Table 6-37 in Section 6.6.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis exceed the federal criterion in two of the four impoundments, although these estimates are highly uncertain (see Section 3.2.5). However, as previously discussed, the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not be achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[212]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both

[212] The estimated future water column concentrations in all the Connecticut impoundments under SED 6 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 6 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.6.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.6.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 6 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.6.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.6.6.1. These evaluations provide an assessment of the effect of SED 6 on the impairment listings.[213]

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 6 are listed in Tables S-6.b and S-6.c.[214] As shown in those tables, SED 6 could be designed and implemented to achieve certain of those ARARs;[215] but, as with SED 3, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 6. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations relating to the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

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213 In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-37 (in Section 6.6.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 6 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.004 to 0.009 mg/kg. This provides further insight on the effect of SED 6 on the River's impairment listing in Connecticut.

214 For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

215 For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132) it is assumed that EPA would make the necessary determinations allowed by the regulations.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain location and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.6.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 6 has included an evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.6.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 6 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure, such as engineering and institutional controls.

Implementation of SED 6, along with upstream source control and remediation measures and natural recovery processes, would reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities throughout Reach 5 and in Woods Pond and Rising Pond and the stabilization/removal of bank soils in Reaches 5A and 5B would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap over the sediments in certain Reach 5 backwaters, the Reach 7 impoundments, and the shallow areas of Rising Pond would reduce the surface sediment PCB concentrations in these areas, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-37 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 6)

Reach	Average Surface Sediment (0-6”) (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)
5A	0.06	2.5	1.3	0.3
5B	0.06	1.9	1.1	0.2
5C	0.2	1.3	0.8	0.2
5D (backwaters)	0.2	---	1.8	0.4
6	0.2	1.2	0.9	0.2
7[1]	0.09 – 1.4	0.8 – 1.1	1.0 – 3.5	0.2 – 0.7
8	0.1	0.9	1.1	0.2
CT[1]	0.003 – 0.006	0.04 – 0.09	0.02 – 0.05	0.004 – 0.009

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.6.6.[216]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 6 over the 52-year model projection period are shown on Figures 6-17a-c. These figures show the timeframes over which the model predicts SED 6 would reduce the PCB concentrations in each medium. The general patterns exhibited by these temporal profiles is one of a large reduction in PCB concentrations within remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8) over the period of active remediation, followed by a period of smaller decline or, in some instances, a leveling off or increase to a concentration which is in steady-state with upstream loadings and natural attenuation processes. Sediment PCB concentrations in the Connecticut impoundments exhibit a

[216] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

shallower temporal trajectory, reflecting the influence of upstream remediation on these downstream sediments. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, the water column temporal changes generally follow those of the sediments. Moreover, temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments and result in a 90% to 99% reduction in predicted fish PCB concentrations in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), a 93% to 97% reduction in the channel sections of Reach 7, and a 97% reduction in the Connecticut impoundments over the projection period (Figure 6-17c).[217]

PCBs would also remain in the sediments beneath and outside of the areas addressed by this alternative. However, in the capped areas, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; and the thin-layer caps would provide a clean layer over the underlying PCB-containing sediments. Overall, the extent to which SED 6 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.6.3. As discussed in that section, the model results for SED 6 indicate that, in most areas, buried sediments containing PCBs would not become exposed to any significant extent during an extreme flow event.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 6 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.6.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 6 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

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[217] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 6 in the remediated reaches (Reaches 5, 6, 7 impoundments, and 8) and the unremediated Reach 7 channel are only slightly lower, ranging from 93% to 99% in the remediated reaches and 91% to 96% in the Reach 7 channel, respectively.

Use of Technologies under Similar Conditions and in Combination

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007). SED 6 involves such a combination. The SED 6 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B), sediment removal using hydraulic dredging (in Reaches 5C, the Reach 5 backwaters, and Reach 6), bank stabilization with removal of bank soils where necessary (in Reaches 5A and 5B), capping all the removal areas and some non-removal areas (in the deeper parts of Woods Pond and Rising Pond), thin-layer capping (in the Reach 7 impoundments and shallow areas of Rising Pond), and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs, as discussed under SED 3 and SED 4 in Sections 6.3.5.2 and 6.4.5.2, albeit sites with different ecological conditions.

In addition to the remedial technologies that are common to SED 3 and SED 4, SED 6 includes hydraulic dredging for areas downstream of Reach 5B. Similar to mechanical excavation, hydraulic dredging is a remedial technique commonly used at contaminated sediment sites (EPA, 2005d). For example, hydraulic dredging was used for removal of sediments in the main channel (average water depth of 16 feet) at the Grasse River (www.thegrasseriver.com), and also at the St. Lawrence River (BBLES, 1996).

Although the individual remedial techniques involved in SED 6 have been used at other sites, there is very limited precedent for an overall sediment remediation project of the size of SED 6 (over 550,000 cy of removal),[218] and the sites at which such projects have been conducted or are ongoing or planned have very different conditions from those in the Rest of River. This is demonstrated in Section 6.5.5.2 above.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 6 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These include sediment removal, capping, thin-layer capping, and MNR. Their general reliability and effectiveness were previously discussed in Section 6.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be

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[218] Less than 10% of the approximately 75 completed dredging/removal projects reviewed by GE had removal volumes equivalent to or greater than the removal volume that would be involved in SED 6.

effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments, although there are some limitations associated with this technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). As stated by EPA (2005d), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005d) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d).

To further assess the reliability and effectiveness of SED 6, model predictions of erosion in areas receiving a cap or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 6, the areas receiving a cap, either following sediment removal or without sediment removal, include Reaches 5A, 5B, 5C, portions of the backwaters in Reach 5, Woods Pond, and the deep section of Rising Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 6 are predicted to be 100% stable.

Thin-Layer Caps: SED 6 includes placement of a thin-layer cap to enhance natural recovery in portions of the backwaters in Reach 5, in the impoundments within Reach 7, and in the shallow portion of Rising Pond. As discussed in Section 6.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). In the Reach 5 backwaters, the model predicts that the thin-layer cap would be stable over 99% of the area. In the remaining 1% of the area, erosion causing less than 1 inch of thin-layer cap material to remain is predicted to occur within a limited number of grid cells in response to storm events simulated in Years 16 and 20. This limited erosion is predicted to produce an increase of approximately 0.1 mg/kg in the reach-average 0- to 6-inch sediment PCB concentration in Reach 5D (Figure 6-17b). In the Reach 7 impoundments, the model predicts that approximately 79% to 100% of the thin-layer capped areas would be stable under SED 6. The remaining areas, comprising 11% to 21% of certain impoundments (Reaches 7B, 7E, and 7G), are predicted to contain less than 1 inch of thin-layer cap material during the simulation. That erosion is predicted to occur primarily during the extreme flow event simulated in Year 26, but also to a lesser extent during other events simulated prior to and after Year 26. Such erosion is predicted to cause increases in the reach-average 0- to 6-inch surface sediment PCB concentrations in those three impoundments ranging from 0.6 mg/kg in Reach 7E to approximately 1.0 mg/kg in Reach 7G (Figure 6-17b). In the shallow area of Rising Pond, EPA's model predicts that approximately 97% of the thin-layer capped area would remain stable. Erosion in the remaining 3% of the area (corresponding to a single model grid cell) was predicted to occur over various high flow events simulated in Years 26 through 31 and to result in an increase of approximately 0.1 mg/kg in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 6-17b).[219] After such increases in concentration are taken into account, the predicted concentrations following the high flow events still represent reductions, relative to current levels, of 99% in the Reach 5 backwaters and Rising Pond and 70% to 82% in the Reach 7 impoundments having predicted erosion (Reaches 7B, 7E, and 7G), with no erosion-related increase in Reach 7C (see Section 6.6.3). Based on these results, the model indicates that the thin-layer caps under SED 6 would largely remain in place and would thus assist in controlling releases from underlying sediments and provide stability, although this is not the primary goal of thin-layer capping.

It should also be noted, however, that there is a potential for impacts to the thin-layer caps from the feeding, spawning, and/or nesting activities of "megafauna," such as carp and largemouth bass. Specifically, carp could have some influence on portions of the thin-layer caps due to foraging in sediments, uprooting of plants, and thrashing behavior during spawning; and largemouth bass could have some influence on portions of the thin-layer caps by excavating nests.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.6.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques. The general reliability and effectiveness of this approach were described in Section 6.3.5.2.

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[219] The overall increases in the Reach 7 impoundment and Reach 8 surficial sediment PCB concentrations shown on Figure 6-17b result not only from erosion of thin-layer cap material in limited areas, but also from deposition and subsequent mixing of PCB-containing sediment originating from areas upstream.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 6 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the adversely affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 6. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.6.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques, including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the restored riverbed and riverbanks, would be implemented to maintain and track the long-term effectiveness of SED 6. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping components of the remedy have remained stable and in place (see Section 6.4.5.2). Should changes in the riverbed or riverbank be noted that require maintenance, labor and materials (e.g., cap material, conventional earth-moving equipment, etc.) needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although the restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats, and would not reestablish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 6 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road re-construction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.6.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 6 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 6 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 6 would alter the habitat of the River areas that would be excavated and/or subject to capping or thin-layer capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 6 would affect portions of the mapped Priority Habitats of 30 state-listed rare species, as described in Appendix L. Since SED 6 would impact more area and would take longer to implement than the previously discussed alternatives (i.e., SED 3 through SED 5), it would have more extensive adverse impacts than those alternatives, and overall recovery would take longer and be more unreliable. The long-term impacts of SED 6 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C

SED 6 would involve sediment removal and/or capping activities in the entirety of Reaches 5A, 5B, and 5C. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4 and are summarized below.

The specific long-term impacts of sediment removal/capping in Reaches 5A, 5B, and 5C were summarized in Sections 6.3.5.3, 6.4.5.3, and 6.5.5.3 for SED 3 through SED 5, respectively. Those same impacts would result from the sediment removal/capping activities in Reaches 5A, 5B, and 5C, except that they would extend for the entire distance of Reach 5C (instead of just a portion of it). As noted in those sections, the impacts include the following:

- The cap would cause a change in surface substrate type from sand or a combination of sand and gravel to armor stone, lasting until deposition of natural sediments from upstream changes the substrate surface back to a condition approximately its prior condition, which could take many years, particularly in the further downstream reaches due to the extensive remediation upstream of those reaches.

- There would be a loss of a continuing source of woody debris and shade due to the permanent loss of mature trees on the riverbanks. This would alter the riverine habitat, since woody debris provides structure that is important to many aquatic and semi-aquatic species, and shading limits temperature increases in the river water, which could increase aquatic plant growth and change the suitability of the habitat for temperature-dependent species.

- The sediment removal and capping would destroy or displace the existing aquatic vegetation, benthic invertebrates, and fish. While recolonization would occur, the organisms that would initially recolonize these areas would differ from the existing organisms (e.g., would include species more tolerant of stress, including invasives) due to the changed substrate. Over time, continued accumulation of sediments would increase the diversity of habitat, resulting in more complex communities than existed shortly after remediation, but those communities are still unlikely to match the pre-remediation communities in terms of composition, species diversity and richness, and relative abundance of species, at least for many years. In particular, it is doubtful whether the state-listed species destroyed by the sediment removal/capping would ever return. (Impacts on state-listed species are discussed further below.)

- There is a high potential that the disturbed areas would be colonized by invasive species, which are impractical to control in a flowing river and thus are likely to dominate over the native species.

In summary, over time, following the remediation and restoration of the impacted reaches of the River, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur is highly uncertain and would be delayed, particularly in the further downstream reaches, by the extensive upstream riverbed and riverbank remediation. Moreover, the abundance of organisms and richness of the mix of species in the replaced community are also uncertain, the return of certain specialized species (including state-listed species) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 6 would include stabilization of the riverbanks in Reaches 5A and 5B using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4, and would be similar to the impacts summarized in Section 6.3.5.3 for SED 3. As discussed there, the bank stabilization measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species, as well as causing other long-term or permanent impacts. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Impoundment Habitats

Under SED 6, Woods Pond would be remediated by removal/capping in the shallower parts and placement of a cap in the “deep hole,” the Reach 7 impoundments would receive thin-layer caps, and Rising Pond would be subject to placement of a cap without removal in the deeper part of the Pond and thin-layer capping in the remainder of the Pond. The long-term adverse impacts of remediation in impoundments are described generally in Section 5.3.3.4 and include:

- For Woods Pond, the long-term impacts would be the same as those summarized in Section 6.5.5.3 for SED 5.

- For the Reach 7 impoundments and the portion of Rising Pond subject to a thin-layer cap, the long-term impacts from placement of the thin-layer cap would be the same as those summarized in Section 6.5.5.3 for placement of such a cap in Rising Pond.

- For the deeper portion of Rising Pond that would be capped with an engineering cap without removal, the capping would alter the surface substrate and thus change the biological community in that area. It is anticipated that, over time, as sediments are deposited from upstream, a biological community typical of such impoundments would eventually develop; but the rate of such a recovery and the community that might be present are unknown. In addition, there is a high potential for proliferation of invasive plant species.

Long-Term Adverse Impacts on Backwaters

The Reach 5 backwaters would be subject to a combination of removal/capping and thin-layer capping under SED 6. The long-term impacts of such remediation on backwater habitats are discussed generally in Section 5.3.6.4. They would include the following:

- Change in surface substrate type from silts or mucky organic material to sand, which would last until enough silt and organic material have been deposited through flood events to approximate current conditions – which is an uncertain time period, but could be a decade or more;

- Change in vegetative characteristics corresponding to the change in substrate type and elevation (including, in shallower areas where the thin-layer cap exceeds the depth of water, a potential change from emergent wetlands vegetation to species more tolerant of less frequently inundated or drier conditions);

- Likely proliferation of invasive species; and

- Change in the wildlife communities using the backwaters until such time as the soil, hydrological, and vegetative conditions of the backwaters return to conditions comparable to pre-remediation conditions – which is uncertain.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 6 includes 26 staging areas covering approximately 48 acres (including 10 acres within the floodplain) and approximately 21 miles of temporary roadways covering an additional 50 acres (including 16 miles and 40 acres in the floodplain), as shown on Figures 6-15a-b. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (9.4 acres), and upland forests

(2.6 acres).[220] These impacts would occur mainly in Reaches 5A and 5B, with additional impacts in limited portions of Reaches 5C, 6, 7, and 8 to support the remediation in those areas. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats).

The long-term negative impacts anticipated from access roads and staging areas under SED 6 are generally comparable to those described in Section 6.3.5.3 for SED 3, except that they would affect a greater area (98 acres vs. 81 acres under SED 3) and would last longer. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 6 would affect portions of the Priority Habitats of 30 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 6 would involve a “take” of at least 27 of these species and would adversely affect a significant portion of the local population of at least 13 of them. The table below lists the 30 state-listed species whose Priority Habitat would be affected by SED 6, along with those for which SED 6 would result in a take and those for which SED 6 would impact a significant portion of the local population:

Table 6-38 – Impacts of SED 6 on State-Listed Species

Species with Priority Habitat Affected by SED 6	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Yes
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely

220 Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 6 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural fields and cultural grasslands) (30 acres), with additional impacts occurring in forested uplands (11 acres) and in wet meadow and emergent marsh habitats (1 acre). Impacts associated with access roads and staging areas in Reach 7 would be minimal (approximately 0.3 acre of upland forest); however, approximately 9 acres of habitat would be impacted by such facilities in Reach 8 (6 acres of upland forest, 2 acres of wetland habitats, and 1 acre of disturbed upland).

Species with Priority Habitat Affected by SED 6	Take?	Impact on Significant Portion of Local Population?
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Creeper	Yes	No
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Longnose sucker	Yes	No
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Skillet clubtail	Yes	No
Spine-crowned clubtail	Yes	Yes
Stygian shadowdragon	Yes	No
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
White adder's-mouth	No	No
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 6 would have long-term impacts on the aesthetic features of the natural environment. The sediment removal and capping throughout Reaches 5 and 6, along with the bank stabilization activities along approximately 14 linear miles (7 miles on both banks) of Reaches 5A and 5B, would alter the appearance of the River over the course of those construction activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The construction of access roads and staging areas would also cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, including in numerous forested areas. This would change the appearance of these areas until such time (if ever) that they return to their prior state. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to its current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 6 include areas used for canoeing, fishing, hiking, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 6. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

<u>Long-Term Impacts to Fluvial Geomorphic Processes</u>

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B, as well as the capping and armoring of the riverbed in those reaches, would reduce the supply of sediment to the River. The potential impacts of this reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. As discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization and riverbed armoring would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity. This conclusion would also apply to SED 6.[221]

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 6, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 6 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for the impoundments, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 6.

6.6.6 Attainment of IMPGs

As part of the evaluation of SED 6, average PCB concentrations in surface sediment and fish predicted by the model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 6, and those comparisons are shown in Tables 6-39 through 6-44.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve each IMPG within a particular averaging area are presented in Tables 6-39 through 6-44.[222] In addition, figures in Appendix K show temporal

[221] Similar to SED 3, model results for SED 6 suggest that bank stabilization and bed armoring, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, the reduction in sediment loading associated with bank and bed remediation under SED 6 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank and bed erosion), within several areas of the River (mainly in Reaches 5A and 5B).

[222] The extent to which SED 6 is predicted to accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 6.1.6 above).

profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve those IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[223]

6.6.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-39). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from 2 to 20 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8 (except for the IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in some subreaches) (Table 6-40).[224] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 6 would achieve the RME IMPGs associated with a 10^{-5} cancer risk as well as non-cancer impacts.[225]

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[223] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. In all cases but one, application of the “lower bound” assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the “base case” assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the “base case” model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted. (Full comparisons between model results for the base case and lower-bound simulations are provided in Appendix K.)

[224] Application of the lower-bound model assumptions results in the attainment of two additional RME IMPGs (the probabilistic RME IMPG based on non-cancer impacts to adults in Reach 6 and the deterministic RME IMPG based on a 10^{-4} cancer risk in Reach 7C).

[225] SED 6 would also achieve certain of the CTE-based IMPGs in Reaches 5 through 8 (particularly under a probabilistic analysis and generally within 10 to 30 years), as well as all CTE IMPGs in Connecticut (Table 6-40). Application of the lower-bound model assumptions would have the same

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 140 to >250 years in the PSA and 180 to >250 years in Reaches 7 and 8.

6.6.6.2 Comparison to Ecological IMPGs[226]

For benthic invertebrates, predicted average surface sediment concentrations would achieve the lower-bound IMPG (3 mg/kg) in all averaging areas within the model period (Table 6-41). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6, and within that same timeframe in the portions of Reach 7 and 8 where the levels are not below the range at the beginning of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower-bound IMPG (3.27 mg/kg) and the upper-bound IMPG (5.6 mg/kg) in all 85 acres of backwaters evaluated (Table 6-42). The estimated times to achieve these IMPGs in the backwaters range from approximately 2 to 15 years, which correspond to the times in which remediation occurs within these areas.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-43). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 15 years for warmwater fish, and approximately 20 years for coldwater fish.

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results except that it would result in the attainment of one additional CTE IMPG (the deterministic CTE IMPG based on non-cancer impacts to children in Reach 7C).

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 6, this change in averaging method (and the resulting increase in concentration) results in only a few small changes in the IMPG attainment presented in Table 6-40, primarily in a few subreaches in Reach 7. Specifically, SED 6 would no longer achieve certain of the CTE IMPGs in Reaches 7B and 7D.

226 While this section describes the extent to which SED 6 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.6.5.3 and 6.6.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.6.11

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For insectivorous birds, the predicted surface sediment concentrations are below all three target sediment levels in all 12 averaging areas (Table 6-44). Likewise, for piscivorous mammals, the model-predicted surface sediment concentrations are below those target sediment levels in both averaging areas (Table 6-44). For both receptor groups, the estimated times to achieve the various target levels are variable, and range from 1 to 20 years, with the time required to reach the 1 mg/kg level generally corresponding to the time when a majority of the sediments within a given averaging area have been remediated.[227]

For piscivorous birds (represented by osprey) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches (Table 6-43).[228] Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from approximately 10 to 20 years for piscivorous birds and 5 to 15 years for threatened and endangered species.[229]

6.6.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 6 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

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[227] In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 6 has been paired with FP 4. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 6, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

[228] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no changes in attainment of the piscivorous bird IMPG under SED 6.

[229] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 6 at the end of the simulation period are 0.003 to 0.006 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 6 are in the range of 0.02 to 0.05 mg/kg (Table 6-37). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

Reduction of Toxicity: SED 6 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 6 would reduce the mobility of PCBs in the River by removing approximately 521,000 cy of sediment containing PCBs in Reaches 5 and 6 and placing a cap over those areas, stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks, and placing a cap over certain additional sediments in the Reach 5 backwaters, Woods Pond, and Rising Pond. In total, caps would be placed over approximately 223 acres (42 acres in Reach 5A, 27 acres in Reach 5B, 57 acres in Reach 5C, 15 acres in the Reach 5 backwaters, 60 acres in Woods Pond, and 22 acres in Rising Pond). These caps would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (55 acres), the Reach 7 impoundments (38 acres), and in Rising Pond (19 acres) – for a total of 112 acres – to aid in the recovery of those areas.

Reduction of Volume: SED 6 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 556,000 cy of sediments/bank soils containing approximately 22,800 lbs of PCBs.

6.6.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 6 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Since the remedial actions under SED 6 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Even so, since the extent and duration of remediation activities under SED 6 are greater than those under the alternatives discussed thus far, the short-term impacts would be more extensive and would occur over a longer time period in the Rest of River.

Impacts on the Environment – Effects Within PSA

The short-term adverse impacts on the environment resulting from implementation of SED 6 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and disruption to the biota which reside in the floodplain due to the construction of supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal in Reaches 5 and 6 (521,000 cy over 178 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. As discussed under SED 4 (Section 6.4.8), resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B, as removal activities in those areas would be conducted using sheetpile enclosing the removal areas. However, the potential exists for sediment containing PCBs to be released from the work area both during sheetpile installation and during a high-flow event should overtopping of the sheeting occur. For Reach 5C, the Reach 5 backwaters, and Woods Pond, activities would be conducted in the wet using hydraulic dredging, with silt curtains used to mitigate sediment release to downstream reaches. In these cases, sediment containing PCBs would be released from the work area through the dredging process even though the area would be surrounded by silt curtains.[230] In addition, boat and barge traffic could resuspend sediment during the construction phase.

For this reason, sediment removal activities, particularly when conducted in the wet (even with the use of silt curtains), would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach); and such results would likewise be expected to occur under SED 6.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 6 would cause a loss of aquatic habitat over approximately 178 acres of River in Reaches 5A, 5B, 5C, the Reach 5 backwaters, and Reach 6 where sediment removal with capping would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine, impoundment, and

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[230] For example, an overall PCB resuspension rate of 3% was noted during hydraulic dredging in the Grasse River (Connolly et al., 2007), and pilot hydraulic dredging in the Fox River showed a 2.2% resuspension rate (USGS, 2000). If 3% of the PCB mass dredged in Reach 5C, Reach 5 backwaters, and Woods Pond under SED 6 were lost to the water column, that would equate to approximately 290 lbs of PCBs.

backwater habitats was provided in Sections 5.3.1.2, 5.3.3.2, and 5.3.6.2, respectively. The short-term impacts of removal/capping in Reach 5A, which were summarized in Section 6.3.8 for SED 3, would occur in the removal areas in Reaches 5 and 6 under SED 6. These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments at the time of the removal; a disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation; and colonization by invasive species. Overall, the short-term adverse impacts from removal under SED 6 would affect more area of aquatic habitat than would occur from removal under the alternatives discussed above (e.g., 52 acres more than SED 5).

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate adverse effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts were described for SED 3 in Section 6.3.8 and would also occur under SED 6.

Capping: Capping activities in the deeper portions of Woods Pond and Rising Pond would be performed during low flow periods. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much lower than that due to removal activities, since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place in an effort to mitigate transport of cap material and any resuspended sediments to downstream reaches.

Placement of the caps (without removal) as part of SED 6 would occur over 45 acres in these impoundments. As noted in Section 5.3.3.2, the short-term habitat impacts of capping in impoundments would be generally similar to those of sediment removal followed by capping. In this case, since the caps would be placed in the deep portions of these impoundments where biotic diversity is limited, these short-term negative impacts would be expected to be less significant that they would be in shallower portions of the impoundments.

Thin-Layer Capping: Thin-layer capping activities in portions of the Reach 5 backwaters, the Reach 7 impoundments, and Rising Pond would be performed by placement of a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, the potential for thin-layer capping to resuspend PCB-containing sediments into the overlying water column is considered minimal.

Placement of a thin-layer cap as part of SED 6 would occur over 112 acres of River, and would have short-term impacts on aquatic vegetation and benthic invertebrates in those areas. Immediate and near-term impacts of thin-layer capping were described generally in Sections 5.3.3.2 for impoundments and 5.3.6.2 for backwaters. These impacts were also summarized in Section 6.3.8 for the thin-layer capping in Reach 5C and Woods Pond under SED 3. Similar impacts would occur from the placement of thin-layer caps in the Reach 5 backwaters, the Reach 7 impoundments, and Rising Pond under SED 6.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitats in those areas and the loss of the wildlife that they would support. It is anticipated that SED 6 would require a total of approximately 98 acres for access roads and staging areas (approximately 50 acres within the 10-year floodplain). The principal habitat types affected were identified in Section 6.6.5.3 and include floodplain forests, shrub and shallow emergent wetlands, disturbed upland habitats, and upland forests. The short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 6 would be similar to those described in Section 6.3.8 for the support facilities under SED 3, except that the total acreage affected would be greater and more widespread under SED 6.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 6.

The total calculated emissions from SED 6 would amount to approximately 130,000 tonnes of GHG emissions, with 56,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation), 3,500 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 72,000 tonnes from off-site emissions (primarily from manufacture of steel sheeting and of cement for stabilization, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent to the annual output of 24,900 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 6 would result in short-term adverse impacts to the local communities in the Rest of River area. These short-term effects would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 6, these impacts would affect portions of Reaches 5 and 6 for an estimated 19 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over 2 years.

Impacts on Recreational Activities: Recreational activities in the areas of Reaches 5 and 6 that would be affected by SED 6 include fishing, canoeing, hiking, dirt biking/ATVing, waterfowl hunting, and general recreation. Recreational activities in Reaches 7 and 8 include fishing and canoeing. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver capping/stabilization materials and equipment to the work areas and to remove excavated material, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 6 (approximately 21 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 45,800 truck trips to do so (2,180 truck trips per year for a 21-year implementation period). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 73,500 truck trips (3,500 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter time period, near Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and staging area materials following completion of remediation.[231] This analysis indicates that

[231] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

the increased truck traffic associated with SED 6 would result in an estimated 3.40 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.16) with a probability of 97% of at least one such injury, and an estimated 0.16 fatalities from accidents (average fatality estimate of 0.0077) with a probability of 15% of at least one such fatality.

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[232] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, however, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 6 would be inevitable.

Risks to Remediation Workers

There would be health and safety risks to site workers implementing SED 6. Implementation of SED 6 is estimated to involve 976,834 man-hours over a 21-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 6 would result in an estimated 9.02 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.44) with a probability of 100% of at least one such injury, and an estimated 0.10 worker fatalities (average annual fatality estimate of 0.005) with a probability of 9% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.6.9 Implementability

6.6.9.1 Technical Implementability

The technical implementability of SED 6 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 6 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further,

[232] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 6 would be technically implementable in the reaches where they would be applied. Sediment removal followed by capping is a functional remedy for use in the various types of environments where it would be applied in SED 6 (e.g., high energy river reaches, shallow areas with lower velocity, etc.). Sediment removal would be performed in the dry in Reaches 5A and 5B, and in the wet in Reach 5C, the Reach 5 backwaters, and Woods Pond. Both techniques have been used in other locations, as noted in Sections 6.4.5.2 and 6.6.5.2. Since the current river bathymetry would be maintained in those areas where sediment removal and subsequent capping are performed, there would be no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Woods Pond and Rising Pond where the water is relatively deep, which are suitable conditions for such capping. Since the backwater effects in Woods Pond and Rising Pond are controlled by the dams, impacts to flood storage capacity would not be expected as a result of cap placement. The model-predicted area of inundation within the floodplain of Reaches 5 and 6 during the 2-year flow event in Year 48 of the projection (as discussed in Section 6.3.9.1) was similar to that predicted under SED 1. This would be evaluated in more detail during design as necessary.

Thin-layer capping to enhance natural recovery processes would be implemented in lower velocity areas – i.e., portions of Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond – which have suitable conditions for this technology. Similar to the capping described above, there would no impacts to flood storage capacity as a result of thin-layer capping in these areas, as these areas are controlled by backwater effects from the dams along the River.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant River stretches.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and would likely decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 6 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 6 could readily be constructed using commonly available construction techniques.

Although the technologies needed to implement SED 6 are generally available and suitable, the 21-year period required to implement this alternative introduces other complications and uncertainties (in addition to those described above). It is difficult to contract for a remedial project over that length of time, given the possibility of changes in equipment and techniques and the possibility that contracting firms will not remain available throughout that long a time period. It is also difficult to predict the availability of large quantities of backfill and capping materials that far into the future. In addition, depending on the treatment or disposition alternative selected (see Section 9), the availability of landfill capacity or treatment capabilities could also affect the ability to implement such a long-term dredging project.

Reliability: The remediation technologies that comprise SED 6 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.3.5.2, 6.4.5.2, 6.5.5.2, and 6.6.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.6.5.2 and 6.6.5.3.

Availability of Space for Support Facilities: Implementation of SED 6 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, an estimated 98 acres of space would be needed, and appear to be available to support the SED 6 activities based on the conceptual site layout (assuming that the necessary access agreements can be obtained). Development of access roads and staging areas would be sequenced over the approximate 21-year implementation period.

Availability of Cap/Stabilization Materials: Materials required for cap and thin-layer cap placement and bank stabilization must be of suitable quality for their intended purposes. Approximately 723,000 cy of sand/fill/stone materials would be required for capping, thin-layer capping, and bank stabilization activities (i.e., 444,000 cy of sand/clean fill and 279,000 cy of armor stone and riprap). Locating suitable sources for this volume of such materials would be challenging. For purposes of this Revised CMS Report, adequate material sources are assumed to be available, although their proximity to the site is uncertain and obtaining needed quantities might require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 6. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 6 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.6.9.2 Administrative Implementability

The administrative implementability of SED 6 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 6 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 6 is provided in Tables S-6.a through S.6-c in Appendix C and summarized in Section 6.6.4.

Access Agreements: Implementation of SED 6 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although much of the area in Reach 5 is owned by the State or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from up to approximately 45 to 55 other landowners to implement SED 6. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA's assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 6, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.6.10 Cost

The total estimated cost of implementing SED 6 is $363 M (not including treatment/disposition costs). The estimated total capital cost is $351 M, assumed to occur over a 21-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.2 M. The estimated annual OMM costs for SED 6 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $32,500 to $723,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $8.4 M. The following summarizes the total capital and OMM costs estimated for SED 6.

SED 6	Est. Cost	Description
Total Capital Cost	$351 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$11.6 M	Costs for performance of the OMM programs
Total Cost for Alternative	$363 M	Total cost of SED 6 in 2010 dollars

The total estimated present worth cost of SED 6, which was developed using a discount factor of 7%, a 21-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $191 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for the combination of SED 6 and FP 4 are presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.6.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.6.2, the evaluation of whether SED 6 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 6 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 521,000 cy of PCB-containing sediments in Reaches 5 and 6 and placing a cap over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy of bank soil; (c) placing a cap over 45 acres in the deeper portions of Reaches 6 and 8 where no excavation would be performed; (d) placing a thin-layer cap over 112 acres in the Reach 5 backwaters, the Reach 7 impoundments, and the shallow portion of Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 6.6.3, implementation of SED 6 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.6 kg/yr, that passing Rising Pond Dam from 19 to 1.0 kg/yr, and transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.3 kg/yr over the modeled period.

Further, as shown in Section 6.6.5.1, EPA's model predicts that implementation of SED 6, like the previously discussed removal alternatives, would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 1-2 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.02-0.05 mg/kg in the Connecticut impoundments.

However, SED 6 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.6.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.4.4, SED 6 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 μg/L, which should be waived as technically impracticable to attain. Review of the potential location-specific and action-specific ARARs indicates that SED 6 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.6.6.1, accepting EPA's HHRA, SED 6 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-5} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 6 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a few areas). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 6 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all impoundments within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.6.6.2, the model results indicate that, by the end of the modeled period, SED 6 would achieve the IMPG levels for all ecological receptor groups and areas. SED 6 would result in sediment PCB concentrations within or below the IMPG range for benthic invertebrates (3-10 mg/kg) in all averaging areas and below both the lower and upper bounds of the IMPG range for amphibians (3.27 mg/kg to 5.6 mg/kg) in all backwater areas. In addition, SED 6 would achieve fish PCB levels below the fish-based IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg), for piscivorous birds (3.2 mg/kg) and for threatened and endangered species (30.4 mg/kg) in all reaches. For insectivorous birds and piscivorous mammals, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below the target sediment levels of 1, 3, and 5 mg/kg in all averaging areas.[233]

However, as discussed in Section 2.1.1, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. In this case, implementation of SED 6 would cause substantial short-term and long-term adverse impacts on the plants and animals within Rest of River area, including the receptor groups that the IMPGs are designed to protect. The short-term impacts would include loss of the existing aquatic habitat in Reach 5, Woods Pond, the Reach 7 impoundments, and Rising Pond; loss of riparian habitat in the bank stabilization areas; resuspension of PCB-containing sediments during removal; and loss of floodplain habitat in areas where supporting facilities are constructed – all as discussed in Section 6.6.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 6 would result in substantial permanent or at least long-term adverse effects on the ecosystem. These impacts were described in Section 6.6.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the Reach 5 backwaters, the shallower portions of Woods Pond, the Reach 7 impoundments, and Rising Pond;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

[233] As discussed previously, attaining the target sediment levels for these receptor groups would allow achievement of the IMPGs provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 7).

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of “overall protection” of the environment requires a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat” (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 6 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 6 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 6 would not meet the standard of providing overall protection of the environment.

6.7 Evaluation of Sediment Alternative 7

6.7.1 Description of Alternative

SED 7 would involve the removal of a total of 805,000 cy of sediment and riverbank soil (including 770,000 cy of sediment over 219 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank), placement of an engineered cap or backfill over a total of 264 acres of river bottom including all the removal areas and some non-removal areas, and thin-layer capping over an additional 72 acres. Specifically, the components of SED 7 include the following:

- Reach 5A: Sediment removal in the entire reach (218,000 cy over 42 acres), followed by backfilling;

- Reach 5B: Sediment removal in the entire reach (109,000 cy over 27 acres), followed by backfilling;

- Reach 5C: Sediment removal in the entire reach (186,000 cy over 57 acres), followed by capping;

- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);

- Reach 5 backwaters: Combination of sediment removal with capping in areas with surface PCB concentrations greater than 10 mg/kg (51,000 cy over 32 acres) and thin-layer capping in areas with surface PCB concentrations between 1 and 10 mg/kg (39 acres);

- Reach 6 (Woods Pond): Combination of sediment removal with capping (148,000 cy over 37 acres) in the shallower areas and capping without sediment removal (23 acres) in the "deep hole";

- Reach 7 impoundments: Combination of sediment removal with capping in areas with surface PCB concentrations greater than 3 mg/kg (43,000 cy over 18 acres) and thin-layer capping in the remaining areas (20 acres);

- Reach 8 (Rising Pond): Combination of sediment removal with capping in shallow areas with surface PCB concentrations greater than 3 mg/kg (15,000 cy over 6 acres), thin-layer capping in the remaining shallow areas (13 acres), and capping in the deep area without sediment removal (22 acres); and

- Reaches 7 (channel), and 9 through 16: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 6-18a-b identify the remedial action(s) that would be taken in each reach as part of SED 7. Either capping or backfilling would be conducted following removal in the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond considering the PCB concentrations remaining following removal, as determined during design. However, for purposes of this Revised CMS Report, it has been conservatively assumed that capping would be conducted for these three areas.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 7. It is estimated that SED 7 would require approximately 26 years to complete. A construction timeline for implementation of SED 7 is provided in Figure 6-19. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. Details of the specific methods for implementation of the remedy would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 7 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 7 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 26 staging areas, occupying a total of 48 acres (10 acres within the floodplain), and approximately 20 miles of access roads covering 50 additional acres assuming a 20-foot road width (16 miles and 40 acres in the floodplain) would be constructed between the Confluence and Rising Pond to support implementation of SED 7. The locations of these staging areas and access roads are shown on Figure 6-18a-b. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed throughout the reaches of the River as presented below.

	Average Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 5A:	3-3.5	218,000	42
Reach 5B:	2.5	109,000	27
Reach 5C:	2	186,000	57
Reach 5 backwaters:	1	51,000	32
Reach 6 (Woods Pond):	2.5	148,000	37
Reach 7 impoundments:	1.5	43,000	18
Reach 8 (Rising Pond):	1.5	15,000	6
Totals:		**770,000**	**219**

The areas over which removal would be conducted for the reaches listed above are shown on Figures 6-18a-b.

It is assumed that the excavations in Reaches 5A and 5B would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. It is assumed that the removal in Reach 5C, the Reach 5 backwaters, Reach 6, and Reach 8 would be performed using hydraulic dredging, and that removal in the Reach 7 impoundments would be performed in the wet using barge-mounted mechanical clamshell excavators. In these areas, debris removal would be conducted prior to dredging, and silt curtains would be placed downstream of excavation activities in an effort to limit transport of suspended sediment. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas. Periodic water column and air monitoring would be performed during implementation.

Cap/Backfill Placement: Following excavation, backfill would be placed in the dry in Reaches 5A and 5B prior to removal of the sheetpile. Backfill (rather than caps) would be placed in these reaches because removal to the depths specified would remove most of the PCB-containing sediments in these reaches. Caps would be installed through the water column following excavation in Reach 5C and in certain areas in the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond (see Figures 6-18a-b). Caps would also be installed through the water column in the deeper portions of Woods Pond and Rising Pond without prior sediment excavation. Removal of debris that would interfere with the performance of the cap would be conducted prior to cap material placement. Backfill and cap materials would be transferred to the River using conventional earth-moving equipment.

It is assumed for purposes of this Revised CMS Report that, in Reaches 5A and 5B, backfill would include placement of sand and gravel such that the riverbed would be returned to its pre-removal elevation. For purposes of evaluation, it is assumed that the caps to be placed following removal in Reach 5C, Woods Pond, the Reach 7 impoundments and Rising Pond would consist of a minimum of 12 inches of sand (which may be amended by organic material to increase the TOC content), overlain by an armor stone layer of 6 to 12 inches, to bring the riverbed to the pre-removal elevation. In the backwaters, the cap would consist of a 12-inch stable sand layer (which may include some stone mixed in and may be amended by organic material), but no additional armor stone layer. In the deeper portions of Woods Pond and Rising Pond where caps would be installed without prior sediment excavation, the cap would consist of 12 inches of sand and 6 inches of armor stone. The composition and size of the sand and armor stone (when applied) would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to preclude the movement of cap materials during high flow events. Silt curtains would be used during capping and backfilling in the wet in an effort to limit downstream transport of suspended materials, and water column monitoring would be performed.

Thin-Layer Cap Placement: A thin-layer cap would be installed in the Reach 5 backwaters where PCB concentrations exceed 1 mg/kg (39 acres), portions of the Reach 7 impoundments (20 acres), and the shallow portion of Rising Pond (13 acres), as shown on Figures 6-18a-b. For purposes of evaluation, it is assumed that the thin-layer cap would consist of a 6-inch layer of sand. The thin-layer cap would be placed via a combination of techniques, including potentially mechanical and/or hydraulic means. Note that for purposes of modeling, the material to be used for the thin-layer cap is assumed to have similar properties to those of the underlying native material (see Section 3.1.3); however, the actual materials to be placed would be determined during design activities.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling at the staging areas for materials removed in the dry or by barge-mounted mechanical equipment and mechanical dewatering using a plate and frame filter press for materials removed by hydraulic dredging. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 7 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in these subreaches. The bank stabilization techniques assumed to be part of SED 7 for purposes of this Revised CMS Report are the same as those identified for SED 5, involving a combination of bioengineering and traditional bank hardening techniques. Those techniques are described in Section 3.1.4 and Appendix G and are depicted on Figures G-2 through G-9 in Appendix G. For purposes of this report, it is assumed that the riverbank stabilization/soil removal work in Reaches 5A and 5B would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, employing conventional mechanical excavation equipment.

MNR: MNR would be implemented in the remainder of the Rest of River under SED 7 (i.e., Reach 7 channel and Reaches 9 through 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 7, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of evaluation in this Revised CMS Report, it is assumed that SED 7 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, the bank removal/stabilization activities, and the ancillary construction activities. The restoration methods assumed for SED 7 for purposes of this Revised CMS Report include the include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B; Section 5.3.3.3 for Woods Pond, Reach 7 impoundments, and Rising Pond; Section 5.3.6.3 for the Reach 5 backwaters; and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 7 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 7 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at

concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 7 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for the capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program for capped areas under SED 7 would include the same elements outlined for that program under SED 3 in Section 6.3.1. The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 7.

A summary of the assumed long-term (100-year) OMM program for SED 7 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 and would include collection of 50 surface sediment samples from the MNR areas, approximately 55 cores (165 samples) from the removal areas, approximately 11 cores (33 samples) from the cap-only areas, and approximately 18 cores (18 samples) from the thin-layer cap areas. Further, for the caps and thin-layer caps, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.7.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 7 would be protective of human health and the environment is presented at the end of Section 6.7 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.7.3 Control of Sources of Releases

SED 7 would reduce the potential for future PCB migration from certain sediments and riverbanks. This alternative would include the removal of 805,000 cy of sediment and bank soils containing PCBs. This removal would address approximately 336 acres of riverbed and approximately 14 linear miles of riverbank (7 miles on both banks). Specifically, SED 7 would result in removal of 2 to 3.5 feet of sediments throughout all of Reach 5 and the shallow portion of Woods Pond, removal of sediments with PCB concentrations greater than 10 mg/kg in the top foot in the backwaters, and removal of sediments with PCB concentrations greater than 3 mg/kg in the top 1.5 feet in the Reach 7 impoundments and shallow portion of Rising Pond. PCBs remaining in these areas would be contained either by a cap designed to withstand erosion during high flows or by backfill in areas where most PCB-containing sediments would be removed. The banks of Reaches 5A and 5B would be addressed through bank stabilization techniques, including removal of bank soil where appropriate. In deeper portions of Woods Pond and Rising Pond, a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediment from the water column. In addition, in portions of the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond, where sediment PCB concentrations are lower, a thin-layer cap would be placed over the existing River bottom to accelerate the reduction in PCB concentrations in surface sediments due to the natural recovery process and assist in controlling releases from those areas.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize the possibility of dam failure. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed. Moreover, the removal and/or capping in the impoundments under SED 7 would further mitigate the potential for downstream transport of PCBs even in the event of dam failure.

As indicated by EPA's model, implementation of SED 7, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual PCB mass passing Woods Pond

Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 7 is predicted to achieve a 95% reduction in the PCB mass passing Rising Pond Dam over the same period (i.e., from 19 kg/yr to 0.9 kg/yr). Likewise, SED 7 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.2 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-20b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 7 over the 55-year model projection period. Similar to the other alternatives, the model results for SED 7 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme flow event would not result in the exposure of buried PCBs at concentrations higher than those already present in the sediment surface prior to the event. For the reaches that would be capped either following removal or without removal (i.e., Reach 5C, Woods Pond, and portions of the backwaters, Reach 7 impoundments, and Rising Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[234] As a result, no change in reach-average surface sediment PCB concentrations associated with cap erosion is predicted for these areas (e.g., Figure 6-20b). In Reaches 5A and 5B, where backfill would be placed following removal, the model results indicate that the backfill would be stable, with the exception of a small portion of Reach 5A (representing 3% of the area). Erosion of backfill in that portion of Reach 5A is predicted to produce an increase in the reach-average surface sediment concentration of 0.3 mg/kg (Figure 6-20b). In the portions of the Reach 5 backwaters and Rising Pond undergoing thin-layer capping, the model predicts that the cap materials and underlying sediments would remain stable, as evidenced by the lack of a change in average surface sediment PCB concentrations in Reaches 5D and 8 (Figure 6-20b). In the small portions of the Reach 7 impoundments receiving a thin-layer cap, the cap materials and underlying sediments would mostly remain stable during high flow events. The model results indicate that six or fewer model grid cells in the reaches subject to thin-layer capping (representing 14% to 43% of those areas in Reaches 7B, 7E, and 7G) would experience erosion large enough to produce increases in average surface sediment PCB concentrations (Figure 6-20b), with no such erosion or predicted increase in concentration for Reach 7C. However, the concentration increases are generally small (0.2 to 0.8 mg/kg), and the concentrations

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[234] Further evaluation of the stability of cap, thin-layer cap, and backfill materials under SED 7 based on model predictions of erosion in these areas is provided in Section 6.7.5.2. The results of this stability analysis (i.e., percentages of backfill/cap/thin-layer cap areas that are stable) are cited in the remainder of this discussion.

following the erosion events are still 82% (Reach 7B) to 87% (Reach 7G) lower than current levels (Figure 6-20b). Overall, the model results for SED 7 indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

Given that SED 7 includes remediation in Woods Pond (a combination of sediment removal over 37 acres and capping over 23 acres, the same as SED 5 and SED 6), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. Similar to SED 5 and SED 6, although there would be a net decrease in depth as a result of the capping (without prior removal) that occurs in the deep portion of the Pond under SED 7, the solids trapping efficiency of Woods Pond, as predicted by EPA's model, would be unchanged relative to MNR (approximately 15%).

6.7.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 7 in accordance with the directions from EPA are listed in Tables S-7.a through S-7.c in Appendix C. The compliance of SED 7 with these potential ARARs is discussed below

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-7.a, include the federal and state water quality criteria for PCBs. To evaluate whether SED 7 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 7. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, a total of 13 exceedances are predicted within the PSA (10 at Holmes Road and 3 at New Lenox Road). These exceedances consist of consecutive 4-day averages resulting from a number of high-flow events over the three-year evaluation period. Using block averages, SED 7 shows two exceedances at Holmes Road and one at New Lenox Road. For reasons discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 7 would not achieve this criterion due to the two exceedances (one more than allowed) at Holmes Road.

The model-predicted annual average water column concentrations (which are used for assessment of human health-based water quality criteria and are presented in Table 6-45 in

Section 6.7.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations estimated by the Connecticut 1-D Analysis exceed the federal criterion in two of the four impoundments, although these estimates are highly uncertain (see Section 3.2.5). However, as discussed previously, the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not be achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[235]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 7 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.7.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.7.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 7 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.7.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.7.6.1. These evaluations provide an assessment of the effect of SED 7 on the impairment listings.[236]

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[235] The estimated future water column concentrations in all the Connecticut impoundments under SED 7 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[236] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-45 (in Section 6.7.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 7 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 55-year projection period, resulting in average fillet levels of 0.004 to 0.009 mg/kg. This provides further insight on the effect of SED 7 on the River's impairment listing in Connecticut.

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 7 are listed in Tables S-7.b and S-7.c.[237] As shown in those tables, SED 7 could be designed and implemented to achieve certain of the ARARs that would be pertinent to this alternative;[238] but, as with SED 3, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 7. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations relating to the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain location and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.7.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 7 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.7.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 7 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available

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[237] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

[238] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132) it is assumed that EPA would make the necessary determinations allowed by the regulations.

for such exposure, and other aspects of the alternative that would reduce potential exposure such as engineering and institutional controls.

Implementation of SED 7, along with upstream source control and remediation measures and natural recovery processes, would reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and/or capping activities throughout Reach 5 and in Woods Pond and Rising Pond and the stabilization/removal of bank soils in Reaches 5A and 5B would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a thin-layer cap in certain Reach 5 backwaters, Reach 7 impoundments, and shallow areas of Rising Pond would reduce the surface sediment PCB concentrations in these areas, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 55) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-45 – Modeled PCB Concentrations at End of 55-Year Projection Period (SED 7)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.1	2.9	1.5	0.3
5B	0.06	1.9	1.2	0.3
5C	0.2	1.5	0.9	0.2
5D (backwaters)	0.2	---	1.9	0.4
6	0.2	1.4	1.0	0.2
7[1]	0.06 – 1.1	1.0 – 1.2	1.0 – 3.7	0.2 – 0.8
8	0.03	1.1	1.0	0.2
CT[1]	0.003 – 0.006	0.05 – 0.1	0.02 – 0.05	0.004 – 0.009

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.7.6.[239]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 7 over the 55-year model projection period are shown on Figures 6-20a-c. These figures show the timeframes over which SED 7 would reduce the PCB concentrations in each medium. Similar to the other sediment alternatives, the general pattern exhibited by these temporal profiles is one of a large decline in PCB concentrations within remediated reaches (Reaches 5, 6, Reach 7 impoundments, and 8) over the remediation period, followed by a period of smaller decline, or in some instances, a small increase, until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. However, due to the extended remediation period associated with the larger volume of sediments subject to remediation under SED 7, this period of decline is longer than that predicted for SED 3 to SED 6. While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with increased PCB transport during the Year 26 extreme flow event and sediment resuspension during remediation, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations reflect the predicted changes in water column and sediments. As a result of the remediation under SED 7, predicted fish PCB concentrations are reduced over the projection period by 91% to 99% in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), by 93% to 97% in the channel sections of Reach 7, and by 97% in the Connecticut impoundments (Figure 6-20c).[240]

PCBs would remain in the sediments beneath and outside the area addressed by this alternative. However, in the capped areas, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps; in the backfilled areas the majority of the PCBs would be removed; and the thin-layer caps would provide a clean layer over the underlying PCB-containing sediments. Overall, the extent to

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[239] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

[240] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 7 in the remediated reaches (Reaches 5, 6, the Reach 7 impoundments, and Reach 8) and the unremediated Reach 7 channel are only slightly lower, ranging from 94% to 98% and 90% to 95%, respectively.

which SED 7 would mitigate the effects of a flood event that could cause the PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.7.3. As discussed in that section, the model results for SED 7 indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 7 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.7.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 7 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed in Section 6.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007). SED 7 involves such a combination. The SED 7 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology at other sites. These components include sediment removal using dry excavation techniques (in Reaches 5A and 5B), sediment removal using hydraulic dredging techniques (in Reaches 5C, the Reach 5 backwaters, Reach 6, and Reach 8), sediment removal using mechanical dredging techniques (in the Reach 7 impoundments), bank stabilization with removal of bank soils where necessary (in Reaches 5A and 5B), capping or backfilling all the removal areas and capping some non-removal areas (in the deeper parts of Woods Pond and Rising Pond), thin-layer capping (in portions of the Reach 5 backwaters, Reach 7 impoundments, and Reach 8), and MNR (in the remaining areas). These remedial techniques have been applied alone and in various combinations at a number of sites containing PCBs, as discussed in Sections 6.3.5.2, 6.4.5.2, and 6.6.5.2.

An additional component of SED 7 is placement of backfill following removal activities in Reaches 5A and 5B. Placement of backfill following removal has been part of the remedial efforts at Ruck Pond (WI; BBL, 1995) following mechanical removal in the dry, and at the Christina River (Newport, DE) and Bayou Bonfouca (LA) sites following mechanical dredging in the wet (to address metals and PAHs, respectively; Malcolm Pirnie, Inc. and

TAMS Consultants, Inc., 2004). Backfill would be placed via the same methods and equipment used for capping.

Although the individual remedial techniques involved in SED 7 have been used at other sites, there is very limited precedent for an overall sediment remediation project of the size of SED 7 (over 800,000 cy of removal),[241] and the sites at which such projects have been conducted or are ongoing or planned have very different conditions from those in the Rest of River. This is demonstrated in Section 6.5.5.2 above. Given the magnitude of, and estimated time needed to complete, SED 7, complications would likely arise during implementation that have not been noted at other, smaller, completed projects (e.g., even greater restoration difficulties, a higher likelihood of, and greater potential impacts from releases during implementation) and which could compromise the long-term reliability and effectiveness of SED 7.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 7 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These include sediment removal, capping, backfilling (after removal), thin-layer capping, and MNR. The general reliability and effectiveness of all these technologies, except backfilling, were previously discussed in Section 6.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments, although there are some limitations associated with this technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). EPA (2005d) has acknowledged that placement of backfill material as needed or as appropriate can be a component of dredging and excavation. As noted by EPA (2005d), capping is also a viable and effective approach for remediating impacted sediments. Regarding thin-layer capping, EPA (2005d) has acknowledged that placement of a thin layer "of clean sediment may accelerate natural recovery in some cases." Finally, EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d).

[241] Only one of the approximately 75 completed dredging/removal projects reviewed by GE had a removal volume greater than the removal volume that would be involved in SED 7 (Milltown Reservoir Site in Montana, with removal of approximately 2.0 to 2.3 million cy; see Section 6.5.5.2).

To further assess the reliability and effectiveness of SED 7, model predictions of erosion in areas receiving a cap, backfill, or a thin-layer cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. The results of these stability assessments are as follows:

Caps: Under SED 7, the areas receiving a cap, either following sediment removal or without sediment removal, include Reach 5C, portions of backwaters in Reach 5, Woods Pond, portions of the Reach 7 impoundments, and portions of Rising Pond. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 7 are predicted to be 100% stable.

Backfill: SED 7 includes removal with subsequent backfilling in Reaches 5A and 5B. For the purposes of assessing stability of backfill, which would be placed at a thickness of 2 feet or more following removal, the backfill was considered stable when at least 50% of the material remained for the full duration of the model projection (including the extreme flow event). The model predicts that backfill material following removal in SED 7 would largely remain stable, as it would be stable over 97% of the surface area in Reach 5A and 100% of the backfilled area in Reach 5B. The erosion over the remaining 3% of backfilled area within Reach 5A is predicted to occur in response to the Year 26 extreme event in an isolated area near the bend in the River at Holmes Road. Such erosion is predicted to result in small increases (less than 0.3 mg/kg) in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 6-20b).

Thin-Layer Caps: SED 7 includes placement of a thin-layer cap in portions of backwaters in Reach 5, and in portions of the Reach 7 impoundments and shallow areas of Rising Pond. As discussed in Section 6.3.5.2, the long-term effectiveness of the thin-layer cap was evaluated by considering it stable (and therefore reliable) when EPA's model predicts that at least 1 inch of material would remain for the full duration of the model projection (including the extreme flow event). For the Reach 5 backwaters, EPA's model predicts that the thin-layer cap would be stable over 99% of that area. A single model grid cell representing approximately 1% of the thin-layer capped area within the backwaters would experience erosion in response to a storm event simulated in Year 20. Such erosion, however, is predicted to produce no appreciable increase (less than 0.1 mg/kg) in the reach-average surface sediment PCB concentration in Reach 5D (Figure 6-20b). In the Reach 7 impoundments, the model predicts that approximately 57% to 100% of the thin-layer capped areas would be stable under SED 7. Erosion of the thin-layer cap material in the remaining areas, comprising 14% to 43% of the thin-layer capped portions of three of the four Reach 7 impoundments, is limited to a few model grid cells in each impoundment (i.e., 6, 3, and 2 grid cells in Reaches 7B, 7E, and 7G, respectively), with no such erosion predicted for Reach 7C. Where erosion is predicted, it would occur mainly during the extreme flow event simulated in Year 26, with high flow events in other years (e.g., Years 20, 32, and 51) contributing to a lesser extent. Such erosion is predicted to cause increases in the reach-average 0- to 6-inch surface sediment PCB concentrations in those impoundments ranging from 0.2 mg/kg in Reach 7E to approximately 0.8 mg/kg in Reach 7G (Figure 6-20b).[242] In shallow portions of Rising Pond, EPA's model predicts that 100% of the thin-layer capped area would remain stable. After the increases in concentration described above are taken into account, the concentrations following the high flow events still represent reductions, relative to current levels, of 99% or more in the Reach 5 backwaters, Reach 7C, and Rising Pond and 82% to 87% in Reaches 7B, 7E, and 7G (as discussed in Section 6.7.3). Based on these results, the model indicates that the thin-layer caps under SED 7 would largely remain in place and would thus assist in controlling releases from underlying sediments and provide stability, although this is not the primary goal of thin-layer capping.

It should also be noted, however, that there is a potential for impacts to the thin-layer caps from the feeding, spawning, and/or nesting activities of "megafauna," such as carp and largemouth bass. Specifically, carp could have some influence on portions of the thin-layer caps due to foraging in sediments, uprooting of plants, and thrashing behavior during spawning; and largemouth bass could have some influence on portions of the thin-layer caps by excavating nests.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.7.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques. The general reliability and effectiveness of this approach were described in Section 6.3.5.2.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 7 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the adversely affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for

[242] Additional increases in the Reach 7 impoundment surficial sediment PCB concentrations shown on Figure 6-20b result from deposition and subsequent mixing of PCB-containing sediment originating from areas upstream.

impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 7. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.7.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques – including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the capped areas and riverbanks – would be implemented to maintain and track the long-term effectiveness of SED 7. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping components of the remedy have remained in place. Should changes in the capped riverbed or the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although the restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats, and would not reestablish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 7 were selected for application in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road re-construction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.7.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 7 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 7 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 7 would alter the habitat of the River areas that would be excavated and/or subject to capping or thin-layer capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 7 would affect portions of the mapped Priority Habitats of 30 state-listed rare species, as described in Appendix L. Since SED 7 would impact more areas and would take longer to implement than previously discussed alternatives (i.e., SED 3 through SED 6), it would cause greater adverse impacts to the habitat of the River and the adjacent floodplain areas, and recovery would take longer and would be more unreliable. The long-term impacts of SED 7 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C

SED 7 would involve sediment removal and/or capping activities in the entirety of Reaches 5A, 5B, and 5C. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4. The specific impacts of SED 7 on these habitats would be the same as those of SED 6, as described in Section 6.6.5.3. In summary, over time, due to deposition of sediments from upstream, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur is highly uncertain and would be delayed, particularly in the further downstream reaches, by the extensive upstream riverbed and riverbank remediation. Moreover, the abundance of organisms and richness of the mix of species in the replaced community are also uncertain, the return of certain specialized species (including state-listed species destroyed by the sediment removal/capping) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 7 would include stabilization of the riverbanks in Reaches 5A and 5B using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4, and would be similar to the impacts summarized in Section 6.3.5.3 for SED 3. As discussed there, the bank stabilization measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species, as well as causing other long-term or permanent impacts. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Impoundment Habitats

Under SED 7, Woods Pond, the Reach 7 impoundments, and Rising Pond would all be subject to combinations of sediment removal/capping and capping alone and/or thin-layer capping. The long-term impacts of such remediation techniques on impoundments are discussed generally in Section 5.3.3.4. They include a change in the surface substrate and a consequent alteration of the biological community in the impoundments. As previously discussed, it is anticipated that, over time, as sediments are deposited from upstream, a biological community typical of such impoundments would eventually develop. However, the length of time for such a community to develop is uncertain, especially given the extent of upstream remediation; and the resulting community may include changes in the mix of native species, the return of certain specialized native species (including state-listed species) is doubtful, and the impoundments would likely be dominated by invasive species such as those currently present. In Woods Pond, these impacts would be expected in the shallower portions; the placement of a cap in the “deep hole” of that Pond would not be expected to have any significant adverse long-term ecological impacts for the reasons given in Section 6.3.5.3.

Long-Term Adverse Impacts on Backwaters

As in SED 6, the Reach 5 backwaters would be subject to a combination of removal/capping and thin-layer capping under SED 7. The long-term impacts of such remediation on backwater habitats are discussed generally in Section 5.3.6.4. Those likely to occur in the backwaters under SED 7 would be the same as summarized for SED 6 in Section 6.6.5.3.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 7 includes 26 staging areas covering approximately 48 acres (including 10 acres within the floodplain) and approximately 20 miles of temporary roadways covering an additional 50 acres (including 16 miles and 40 acres in the floodplain), as shown on Figures 6-18a-b. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (9.4 acres), and upland forests (2.6 acres).[243] These impacts would occur mainly in Reaches 5A and 5B, with additional impacts in limited portions of Reaches 5C, 6, 7, and 8 to support the remediation in those portions. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats).

The long-term negative impacts anticipated from access roads and staging areas under SED 7 are the same as those for SED 6. As discussed for the latter, those impacts are generally comparable to those described in Section 6.3.5.3 for SED 3, except that they would affect a greater acreage and would last longer. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 7 would affect portions of the Priority Habitats of 30 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 7 would involve a "take" of at least 27 of these species and would adversely affect a significant portion of the local population of at least 13 of them. The table below lists the 30 state-listed species whose Priority Habitat would be affected by SED 7, along with those for

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[243] Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 7 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural fields and cultural grasslands) (30 acres), with additional impacts occurring in forested uplands (11 acres) and in wet meadow and emergent marsh habitats (1 acre). Impacts associated with access and staging in Reach 7 would be minimal (approximately 0.3 acre of upland forest); however, approximately 9 acres of habitat would be impacted by such facilities in Reach 8 (6 acres of upland forest, 2 acres of wetland habitats, and 1 acre of disturbed upland).

which SED 7 would result in a take and those for which SED 7 would impact a significant portion of the local population:

Table 6-46 – Impacts of SED 7 on State-Listed Species

Species with Priority Habitat Affected by SED 7	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Yes
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Creeper	Yes	No
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray’s sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Longnose sucker	Yes	No
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Skillet clubtail	Yes	No
Spine-crowned clubtail	Yes	Yes
Stygian shadowdragon	Yes	No
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
White adder’s-mouth	No	No

Species with Priority Habitat Affected by SED 7	Take?	Impact on Significant Portion of Local Population?
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 7 would have long-term impacts on the aesthetic features of the natural environment. The sediment removal and capping in Reaches 5 and 6, along with bank stabilization in approximately 14 linear miles (7 miles on both banks) of Reaches 5A and 5B, would alter the appearance of the River over the course of these activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The construction of access roads and staging areas on both sides of the River to support implementation of SED 7 would also cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, including in numerous forested areas. This would change the appearance of those areas until such time (if ever) that they return to their prior state. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to its current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 7 include areas used for canoeing, fishing, hiking, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 7. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts to Fluvial Geomorphic Processes

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B would reduce the supply of sediment to the River. (SED 7 would not involve armoring of the riverbed in Reaches 5A and 5B, as SED 3 through SED 6 would do.) The potential impacts of such a reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. For similar reasons to those discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity.[244]

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 7, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 7 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for the impoundments, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 7.

6.7.6 Attainment of IMPGs

As part of the evaluation of SED 7, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 55-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 7, and those comparisons are shown in Tables 6-47 through 6-52.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other

[244] Model results for SED 7 suggest that bank stabilization, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on the on larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, removing the sediment loading due to bank erosion under SED 7 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank erosion), within several areas of the River (mainly in Reaches 5A and 5B).

IMPGs would be achieved at some point within the 55-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-47 through 6-52.[245] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 55-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 55-year model projection period are described below.[246]

6.7.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve the RME IMPGs based on a 10^{-5} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-47). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from approximately 5 to 20 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 55, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8 (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in some subreaches) (Table 6-48).[247] However, in the Connecticut impoundments, the CT 1-

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[245] The extent to which SED 7 is predicted to accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 6.1.6 above).

[246] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 7, in almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted. (Full comparisons between model results for the base case and lower bound simulations are provided in Appendix K.)

[247] Application of the lower-bound model assumptions results in three additional instances of attainment of the RME IMPGs in the Massachusetts reaches (the probabilistic RME IMPG based on non-cancer impacts to adults in Reach 6 and the deterministic RME IMPG based on a 10^{-4} cancer risk in Reaches 7C and 8).

D Analysis indicates that SED 7 would achieve the RME IMPGs associated with a 10^{-5} cancer risk as well as non-cancer impacts.[248]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 140 to >250 years in the PSA, 160 to >250 years in Reach 7, and 250 years in Reach 8.

6.7.6.2 Comparison to Ecological IMPGs[249]

For benthic invertebrates, predicted average surface sediment concentrations would achieve both the lower and upper bounds of the IMPG range (3 to 10 mg/kg) in all averaging areas within the model period (Table 6-49). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6, and within that same timeframe in the portions of Reach 7 and 8 where the levels are not below the range at the beginning of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower-bound IMPG (3.27 mg/kg) and the upper-bound IMPG (5.6 mg/kg) in all of the of backwaters evaluated (Table 6-50). Times to achieve the lower-bound IMPGs generally range from 2 to 20 years, which correspond to the times in which remediation occurs within these areas.

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[248] SED 7 would also achieve many of the CTE-based IMPGs in certain subreaches of Reaches 5 through 8, as well as all CTE IMPGs in Connecticut. Application of the lower-bound model assumptions results in two additional instances of attainment of the CTE IMPGs (i.e., attainment of the deterministic CTE IMPG based on non-cancer impacts to children in Reaches 7C and 8).

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 7, this change in averaging method (and the resulting increase in concentration) results in a few changes in the IMPG attainment presented in Table 6-48 – notably, that SED 7 would no longer achieve the RME 10^{-4} cancer IMPG in Reaches 7C and 8 and the non-cancer CTE IMPGs in Reaches 7A, 7C, and 8.

[249] While this section describes the extent to which SED 7 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.7.5.3 and 6.7.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.7.11.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-51). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 20 years for warmwater fish, and approximately 10 to 25 years for coldwater fish.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For both receptor groups, the predicted surface sediment concentrations are below all three of the target sediment levels evaluated in all averaging areas (Table 6-52), with times to achieve these target levels generally ranging between 2 and 20 years.

For piscivorous birds (represented by osprey) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches (Table 6-51).[250] Estimated times to achieve these IMPGs range between 10 and 30 years for piscivorous birds and between 5 and 20 years for threatened and endangered species.[251]

6.7.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 7 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 7 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like

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[250] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no changes in attainment of the piscivorous bird IMPG under SED 7.

[251] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 7 at the end of the simulation period are 0.003 to 0.006 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 7 are in the range of 0.02 to 0.05 mg/kg (Table 6-45). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 7 would reduce the mobility of PCBs in the River by removing approximately 770,000 cy of sediment containing PCBs in Reaches 5 through 8 and placing a cap (or backfill) over those areas, stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks, and placing a cap over certain additional sediments in Woods Pond and Rising Pond. In total, caps or backfill would be placed over approximately 264 acres (42 in Reach 5A, 27 in Reach 5B, 57 in Reach 5C, 32 in Reach 5 backwaters, 60 in Woods Pond, 18 in the Reach 7 impoundments, and 28 in Rising Pond). These caps and backfill would prevent or minimize the mobility of PCBs in the underlying sediments. In addition, a thin-layer cap would be placed over portions of the Reach 5 backwater areas (39 acres), Reach 7 impoundments (20 acres), and in Rising Pond (13 acres) – for a total of 72 acres – to accelerate the recovery of those areas.

Reduction of Volume: SED 7 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 805,000 cy of sediments/bank soils containing approximately 32,200 lbs of PCBs.

6.7.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 7 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Given that the remedial actions under SED 7 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Even so, since the extent and duration of remediation activities under SED 7 are greater than those of the alternatives discussed thus far, the short-term impacts would be more widespread and occur over a longer time period in the Rest of River area.

Impacts on the Environment – Effects Within PSA

The short-term effects on the environment resulting from implementation of SED 7 would include potential impacts to the water column, air, and biota in the Rest of River area during excavation, capping, backfilling, and thin-layer capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal (with backfilling/capping activities) in Reaches 5, 6, 7, and 8 (770,000 cy over 219 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. As discussed under prior alternatives, resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B as removal activities in those reaches would be conducted in the dry using sheetpile containment. However, the potential exists for suspended or residual sediment containing PCBs to be released during sheetpile installation or due to overtopping of the sheetpiles during a high flow event. For Reach 5C, the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond, activities would be conducted in the wet using hydraulic dredging or barge-mounted mechanical clamshell excavators, with silt curtains used to mitigate sediment release to downstream reaches. In these areas, some sediment containing PCBs would be released from the work area through the dredging/excavation process even though the areas would be surrounded by silt curtains.[252] In addition, boat and barge traffic could resuspend sediment during the construction phase.

For this reason, sediment removal activities, particularly when conducted in the wet (even with the use of silt curtains), would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach); and such results would likewise be expected to occur under SED 7.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 7 would cause a loss of aquatic habitat over approximately 219 acres of River in Reaches 5A, 5B, and 5C, the Reach 5 backwaters, Woods Pond, the

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[252] As discussed above, mechanical and hydraulic dredging projects at other sites have shown significant rates of resuspension. For example, the recent experience of mechanical dredging of the Upper Hudson River from barges showed an overall PCB resuspension rate of 3% at least a mile downstream of the dredging operations, with a rate of approximately 4% outside areas with resuspension controls (Anchor QEA and ARCADIS, 2010). This is similar to the resuspension rates of 3% during hydraulic dredging in the Grasse River (Connolly et al., 2007), 2.2% during pilot hydraulic dredging in the Fox River (USGS, 2000), and 1.3% to 5.8% of solids during pilot clamshell dredging in the Passaic River (Lower Passaic River Restoration Project Environmental Dredging Pilot Study Work Group, 2009). If 3% of the PCB mass dredged in Reach 5C, the Reach 5 backwaters, Reach 6, Reach 7, and Reach 8 under SED 7 were lost to the water column, that would equate to approximately 435 lbs of PCBs.

Reach 7 impoundments, and Rising Pond where sediment removal would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine, impoundment, and backwater habitats was provided in Sections 5.3.1.2, 5.3.3.2, and 5.3.6.2, respectively. The short-term impacts of removal/capping in Reach 5A under SED 3 were summarized in Section 6.3.8; these same impacts would apply under SED 7 to the removal areas in Reaches 5 through 8. These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; a temporary disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation; and colonization by invasive plant species. Overall, the short-term adverse impacts from removal under SED 7 would affect more area of aquatic habitat than would occur from removal under the alternatives discussed above (e.g., 41 more acres than SED 6).

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate adverse effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts were described for SED 3 in Section 6.3.8 and would also occur under SED 7.

Capping: Capping activities in the deeper portions of Woods Pond and Rising Pond would be performed during lower flow conditions. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment is anticipated to be much less than in connection with removal activities since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place in an effort to mitigate transport of suspended solids to downstream reaches.

Placement of the caps (without removal) as part of SED 7 would occur over the same 45 acres of these impoundments as under SED 6, and would have similar impacts on the aquatic communities. As noted in Section 5.3.3.2, the impacts of capping in impoundments would be similar to those of sediment removal followed by capping. In this case, since the caps would be placed in the deep portions of these impoundments where biotic diversity is limited, short-term conditions resulting from the capping (e.g., higher suspended sediment loads, burial with sediment) are not anticipated to have a significant adverse ecological impact.

Thin-Layer Capping: Thin-layer capping activities in the Reach 5 backwaters, Reach 7 impoundments, and Rising Pond would consist of placing a thin layer of sand over the undisturbed native sediment. Based on data collected during the Silver Lake capping pilot study, there is little potential for thin-layer capping to resuspend PCB-containing sediments into the overlying water column.

Placement of a thin-layer cap as part of SED 7 would occur over 72 acres of River, and would have a short-term impact on aquatic vegetation and benthic invertebrates in those areas. Immediate and near-term impacts of thin-layer capping were described in Section 5.3.3.2 for impoundments and 5.3.6.2 for backwaters. These impacts were also summarized in Section 6.3.8 for the thin-layer capping in Reach 5C and Woods Pond under SED 3. Similar impacts would occur from the placement of thin-layer caps in the Reach 5 backwaters, the Reach 7 impoundments, and Rising Pond under SED 7.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the loss of the wildlife that they support. The supporting structures required for SED 7 and the habitat impacts from them would be that same as those for SED 6 (Section 6.6.8). As with SED 6, it is anticipated that SED 7 would require a total of approximately 98 acres for access roads and staging areas (approximately 50 acres within the 10-year floodplain). As described in Section 6.7.5.3, the principal habitat types affected include floodplain forests, shrub and shallow emergent wetlands, disturbed upland habitats, and upland forests. The short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 7 would be largely the same as those described in Section 6.3.8 for the support facilities under SED 3, except that the total acreage affected would be much greater and more widespread under SED 7.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal and capping or backfilling and related ancillary activities during the implementation of SED 7.

The total calculated emissions from SED 7 would amount to approximately 170,000 tonnes of GHG emissions, with 65,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and associated mulch decay/sequestration of removed vegetation associated with tree removal), 4,500 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 99,000 tonnes from off-site emissions (primarily from manufacture of cement for stabilization and of steel sheeting, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent to the annual output of 33,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 7 would result in short-term impacts to the local communities in the Rest of River area. These short-term adverse impacts would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 7, these impacts would affect portions of Reaches 5 and 6 for an estimated 22 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over 3 years.

Impacts on Recreational Activities: Recreational activities in the areas of Reaches 5 and 6 that would be affected by SED 7 include fishing, canoeing, hiking, dirt biking/ATVing, waterfowl hunting, and general recreation. Recreational activities in Reaches 7 and 8 include fishing and canoeing. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment and capping, backfill, and bank stabilization materials to the work areas and to remove excavated materials from the work areas, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 7 (approximately 26 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 66,500 truck trips to do so (2,560 truck trips per year for a 26-year implementation period). Additional truck trips would be necessary to transport capping, backfill, and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 102,000 truck trips (3,920 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near the work areas (i.e., between the Confluence and Woods Pond and, for a shorter time period, near the Reach 7 impoundments and Rising Pond).

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and

staging area materials following completion of remediation.[253] This analysis indicates that the increased truck traffic associated with SED 7 would result in an estimated 4.23 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.16) with a probability of 99% of at least one such injury, and an estimated 0.20 fatalities from accidents (average fatality estimate of 0.0076) with a probability of 18% of at least one such fatality.

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[254] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, however, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 7 would be inevitable.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing SED 7. Implementation of SED 7 is estimated to involve 1,205,082 man-hours over a 26-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 7 would result in an estimated 11.1 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.43) with a probability of 100% of at least one such injury, and an estimated 0.12 worker fatalities (average annual fatality estimate of 0.005) with a probability of 12% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.7.9 Implementability

6.7.9.1 Technical Implementability

The technical implementability of SED 7 has been evaluated considering the factors identified below.

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[253] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

[254] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

General Availability of Technologies: SED 7 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 7 would be technically implementable in the reaches where they would be applied. Sediment removal followed by backfilling or capping would be implemented throughout Reach 5 and in portions of the Reach 5 backwaters, Woods Pond, Reach 7 impoundments, and Rising Pond. Sediment removal with subsequent backfilling would be performed in the dry in Reaches 5A and 5B. Removal in the dry was used in parts of the 1½-Mile Reach of the Housatonic River. Sediment removal in the wet would be performed in areas downstream of Reach 5B, using hydraulic or mechanical dredging techniques, depending on the sediment volumes, composition, and water depths. Removal in the wet (both mechanical and hydraulic) with capping has also been used at other sites, as noted in Sections 6.4.5.2 and 6.6.5.2. Since the current river bathymetry would be maintained in those areas where sediment removal and subsequent backfilling/capping are performed, there would be no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of Woods Pond and Rising Pond where the water is relatively deep, which are suitable conditions for such capping. Since the backwater effects in Woods Pond and Rising Pond are controlled by the dams, impacts to flood storage capacity would not be expected as a result of cap placement. This would be evaluated during design as necessary.

Thin-layer capping to enhance natural recovery processes would be implemented in lower velocity areas – i.e., portions of the Reach 5 backwaters, the Reach 7 impoundments, and the shallow portion of Rising Pond – which have suitable conditions for application of this technology. Similar to the capping described above, there would no impacts to flood storage capacity as a result of thin-layer capping in these areas, as these areas are controlled by backwater effects from the dams along the River.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant river stretches.

MNR with institutional controls would be implemented in the downstream reaches, where PCB concentrations are already low and would likely decrease further following remediation in the upstream reaches. Monitoring to track changes in PCB concentrations following the SED 7 remedial activities would be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 7 could readily be constructed using commonly available construction techniques.

Although the technologies needed to implement SED 7 are generally available and suitable, the 26-year period required to implement this alternative introduces other complications and uncertainties (in addition to those described above). It is difficult to contract for a remedial project for that length of time, given the possibility of changes in equipment and techniques and the possibility that contracting firms will not remain available throughout that long a time period. It is also difficult to predict the availability of large quantities of backfill and capping materials that far into the future. In addition, depending on the treatment or disposition alternative selected (see Section 9), the availability of landfill capacity or treatment capabilities could also affect the ability to implement such a long-term dredging project.

Reliability: The remediation technologies that comprise SED 7 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.3.5.2, 6.4.5.2, 6.5.5.2, and 6.6.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.7.5.2 and 6.7.5.3.

Availability of Space for Support Facilities: Implementation of SED 7 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, approximately 98 acres of space (assuming that the necessary access agreements can be obtained) would be needed, and appear to be available to support the SED 7 activities based on preparation of a conceptual site layout. Development of access roads and staging areas would be sequenced and constructed appropriately over the approximate 25-year implementation period for SED 7.

Availability of Cap/Backfill/Stabilization Materials: Materials required for cap/backfill placement and bank stabilization must be of suitable quality for their intended purposes. Approximately 1,017,000 cy of sand/fill/stone materials would be required for capping, backfilling, thin-layer capping, and bank stabilization activities (i.e., 624,000 cy of sand/clean fill and 393,000 cy of armor stone and riprap). Locating suitable sources for this volume of such materials would be challenging, and predicting the availability of suitable material over length of time required to implement this alternative (26 years) introduces additional complications and uncertainties. For purposes of this Revised CMS Report, adequate material sources are assumed to be available, although obtaining needed quantities may require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 7. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 7 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.7.9.2 Administrative Implementability

The administrative implementability of SED 7 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 7 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 7 is provided in Tables S-7.a through S.7-c in Appendix C and summarized in Section 6.7.4.

Access Agreements: Implementation of SED 7 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although much of the area in Reach 5 is owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 45 to 55 other landowners to implement SED 7. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA's assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 7, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.7.10 Cost

The estimated total cost for implementation of SED 7 is $420 M (not including treatment or disposition). The estimated capital cost is $409 M, assumed to occur over a 26-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed and riverbanks, thin-layer cap areas, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.1 M. The estimated annual OMM costs for SED 7 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $32,500 to $700,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $8.3 M. The following summarizes the total capital and OMM costs estimated for SED 7.

SED 7	Est. Cost	Description
Total Capital Cost	$409 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$11.4 M	Costs for performance of the OMM programs
Total Cost for Alternative	$420 M	Total cost of SED 7 in 2010 dollars

The total estimated present worth cost of SED 7, which was developed using a discount factor of 7%, a 25-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $191 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain remediation or the costs of pertinent treatment/disposition alternatives for removed sediments/bank soils. The estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.7.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.7.2, the evaluation of whether SED 7 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 7 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 770,000 cy of PCB-containing sediments in Reaches 5, 6, and the Reach 7 impoundments and placing a cap/backfill over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy of bank soil; (c) placing a cap over 42 acres in the deeper parts of Reaches 6 and 8 where no excavation would be performed; (d) placing a thin-layer cap over 72 acres in the Reach 5 backwaters, Reach 7 impoundments, and the shallow portion of Rising Pond to reduce exposure concentrations and accelerate the process of natural recovery; and (e) relying on natural recovery processes in other areas. As shown in Section 6.7.3, implementation of SED 7 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.6 kg/yr, that passing Rising Pond Dam from 19 to 0,9 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.2 kg/yr over the modeled period.

Further, as shown in Section 6.7.5.1, EPA's model predicts that implementation of SED 7 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 1-2 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.02-0.05 mg/kg in the Connecticut impoundments.

On the other hand, SED 7 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.7.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.7.4, review of the chemical-specific ARARs indicates that SED 7 would not achieve the freshwater aquatic life water quality criterion of 0.014 µg/L or the human health water quality criterion of 0.000064 µg/L, although the latter should be waived as technically impracticable to attain. Review of the potential location-specific and action-specific ARARs indicates that SED 7 could be designed and implemented to meet certain of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.7.6.1, accepting EPA's HHRA, for direct human contact with sediments, SED 7 would achieve IMPG levels based on a 10^{-5} (and, in most cases, 10^{-6}) cancer risk, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. As such, SED 7 would protect human health from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 7 at the end of the 55-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in a limited number of areas). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 7 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and all non-cancer IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.7.6.2, the model results indicate that, by the end of the 55-year modeled period, SED 7 would achieve the IMPG levels for all ecological receptor groups and areas. Specifically, SED 7 would result in sediment PCB concentrations below both the lower and upper bounds of the IMPG range for benthic invertebrates (3 to 10 mg/kg) in all averaging areas and below both the lower and upper bounds of the IMPG range for amphibians (3.27 to 5.6 mg/kg) in all backwater areas. In addition, SED 7 would achieve fish PCB levels below the IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg), for piscivorous birds (3.2 mg/kg), and for threatened and endangered species (30.4 mg/kg) in all reaches. For insectivorous birds and piscivorous mammals, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below all 3 target sediment levels (1, 3, and 5 mg/kg) in all averaging areas.[255]

However, as discussed in Section 2.1.1, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. In this case, implementation of SED 7 would cause substantial short-term and long-term adverse impacts on the plants and animals within Rest of River area, including the receptor groups that the IMPGs are designed to protect. The short-term impacts would include loss of the current aquatic habitat in Reach 5, Woods Pond, the Reach 7 impoundments, and Rising Pond; loss of riparian habitat in the bank stabilization areas; resuspension of PCB-containing sediments during removal; and loss of floodplain habitat in areas where supporting facilities are constructed – all as discussed in Section 6.7.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 7 would result in substantial long-term and, in some cases, permanent adverse effects on the ecosystem. These impacts were described in Section 6.7.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the Reach 5 backwaters, the shallower portions of Woods Pond, the Reach 7 impoundments, and Rising Pond;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

[255] As discussed previously, attaining the target sediment levels for these receptor groups would allow achievement of the IMPGs provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 7).

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, "it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat" (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 7 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 7 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 7 would not meet the standard of providing overall protection of the environment.

6.8 Evaluation of Sediment Alternative 8

6.8.1 Description of Alternative

SED 8 would include the removal of a total of 2,287,000 cy of sediment and riverbank soil, including 2,252,000 cy of sediment over 351 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank. Sediment removal would be performed in Reaches 5A, 5B, and 5C, the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond to the 1 mg/kg depth horizon, as further described in Section 3.1.1, and would be followed by backfilling to grade. MNR would be included for the remaining portions of the River (Reach 7 channel and Reaches 9 through 16). Additionally, the riverbanks along 7 miles on both sides of the River in Reaches 5A and 5B, comprising 14 linear miles, would be stabilized, and 35,000 cy of bank soil would be removed in connection with that stabilization. Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figures 6-21a-b identify the remedial action(s) that would be taken in each reach as part of SED 8.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 8. It is estimated that SED 8 would require approximately 52 years to complete. A construction timeline for implementation of SED 8 is provided in Figure 6-22. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (i.e., removal, backfill, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods are provided in this description for purposes of the evaluations in this Revised CMS Report. Details of the specific methods for implementation of the remedy would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 8 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging area, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 8 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that approximately 26 staging areas, which would occupy a total of 51 acres (10 acres within the floodplain), and approximately 20 miles of access roads covering 50 additional acres assuming a 20-foot road width (16 miles and 40 acres in the floodplain) would be constructed between the Confluence and Rising Pond to support the implementation of SED 8. The locations of these staging areas and access roads are shown on Figure 6-21a-b. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed throughout the above-identified reaches of the River to the 1 mg/kg depth horizon. A summary of removal by reach, based on existing PCB data, is presented below.

	Average Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 5A:	4	268,000	42
Reach 5B:	3.5	153,000	27
Reach 5C:	3	279,000	57
Reach 5 backwaters:	2 to 3	388,000	86
Reach 6 (Woods Pond):	6	575,000	60
Reach 7 impoundments:	2	121,000	38
Reach 8 (Rising Pond):	7	468,000	41
Totals:		**2,252,000**	**351**

The areas over which removal would occur are shown on Figures 6-21a-b.

In Reaches 5A and 5B, it is assumed that the excavations would be performed in the dry with conventional mechanical excavation equipment. Once the excavation depths are achieved, stable backfill would be placed over removal areas. In these reaches, sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of sediment. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. In the remaining reaches, it is assumed that removal would be performed using hydraulic dredging, with placement of a stable backfill following completion of removal activities. Debris removal would be conducted prior to dredging. In these reaches, silt curtains would be placed downstream of excavation activities in an effort to limit transport of suspended sediment. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas. Periodic water column and air monitoring would be performed during implementation.

Placement of Backfill: Backfill would be placed following excavation in all removal areas (see Figures 6-21a-b). Backfill materials would be transferred to the River using conventional earth-moving equipment. For purposes of this Revised CMS Report, it is assumed that the backfill would consist of an adequate thickness of sand and gravel to return the riverbed to its pre-removal elevation. Silt curtains would be used during backfilling (except in areas where backfilling would be conducted in the dry with the sheetpiles still in place) in an effort to limit downstream transport of suspended materials, and water column monitoring would be performed.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that a combination of dewatering alternatives would be used, including gravity dewatering through stockpiling at the staging areas for materials removed in the dry and mechanical dewatering using a plate and frame filter press for materials removed by hydraulic dredging. It is also assumed that Geotubes would also be used to dewater sediments hydraulically dredged from the Reach 7 impoundments. Since there is limited space available for construction of staging areas in Reach 7, use of Geotubes would reduce the size requirement for these operations in this area. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat the water pumped from the removal areas being excavated in the dry, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 8 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from the banks in these subreaches. The bank stabilization techniques that are assumed to be part of SED 8 for purposes of this Revised CMS Report are the same as those identified for SED 5, involving a combination of bioengineering and traditional bank hardening techniques. Those techniques are described in Section 3.1.4 and Appendix G and are depicted on Figures G-2 through G-9 in Appendix G. For purposes of this report, it is assumed that the riverbank stabilization/soil removal work in Reaches 5A and 5B would be performed in the dry, within the same sheetpiled cells used for the removal/backfilling of the adjacent sediments, employing conventional mechanical excavation equipment.

MNR: MNR would be implemented in the remainder of the Rest of River under SED 8 (i.e., Reach 7 channel and Reaches 9 through 16). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 8, due in part to completed and planned source control and remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of evaluation in the Revised CMS Report, it is assumed that SED 8 would include restoration of the areas that are directly impacted by removal and backfilling, bank stabilization, and ancillary construction activities. The restoration methods assumed for SED 8 for purposes of this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B; Section 5.3.3.3 for Woods Pond, the Reach 7 impoundments, and Rising Pond; Section 5.3.6.3 for the Reach 5 backwaters;

and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 8 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 8 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 8 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for the restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM programs for SED 8 would include repair or replacement of backfill material as needed. The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 8.

A summary of the assumed long-term (100-year) OMM program for SED 8 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 and would include collection of 100 surface sediment samples from the MNR and removal/backfill areas. In addition, maintenance activities would be implemented, as necessary.

6.8.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 8 would be protective of human health and the environment is presented at the end of Section 6.8 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.8.3 Control of Sources of Releases

SED 8 would reduce the potential for future PCB migration from certain sediments and riverbanks. This alternative would include removal of sediments from Reaches 5A, 5B, and 5C, the Reach 5 backwaters, Reach 6, the Reach 7 impoundments, and Reach 8 to the estimated 1 mg/kg depth horizon, followed by backfilling, and stabilization of riverbanks in Reaches 5A and 5B. These actions would address approximately 351 acres of the riverbed and 14 linear miles of riverbank (7 miles on both banks), removing 2,287,000 cy of sediment and bank soils containing PCBs, thereby resulting in a reduction of the potential transport of PCBs within the River and onto the floodplain for potential human or ecological exposure.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit the potential movement of any PCB-containing sediments that would be left behind in the impoundments, buried under feet of backfill. As noted above, the inspection, monitoring, and maintenance programs and regulatory requirements in place for these dams under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize the possibility of dam failure. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed. Moreover, the sediment removal in the impoundments under SED 8 would further mitigate the potential for downstream transport of PCBs even in the event of dam failure.

As indicated by EPA's model, implementation of SED 8, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the average annual PCB mass passing Woods Pond Dam at the end of the 81-year model projection period is predicted to decrease by 98% from that calculated at the beginning of that period (i.e., from 20 kg/yr to 0.4 kg/yr). Similarly, SED 8 is predicted to achieve a 97% reduction in the annual average PCB mass passing Rising Pond Dam over that same period (i.e., from 19 kg/yr to 0.6 kg/yr). Likewise, SED 8 is predicted to result in a 99% reduction in the annual average mass of

PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.1 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-23b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 8 over the 81-year model projection period. Similar to the alternatives discussed above, the model results for SED 8 indicate that, in reaches subject to MNR only (i.e., Reach 7 channel sections), the extreme flow event would not result in the exposure of buried PCBs at concentrations higher than those already present at the sediment surface prior to the event. In the remaining areas, where backfill would be placed following removal to the 1 mg/kg depth horizon, the EPA model predicts that the backfill and underlying sediments containing PCBs (to the extent such sediments exist given the deep removal depths for this alternative) would be largely be stable during high flow events.[256] In nearly all reaches, no observable change in surface sediment PCB concentrations is predicted during the extreme event under SED 8 (Figure 6-23b). The only exceptions are a small portion of Reach 5A (representing 2% of that reach's area) and limited areas within two of the Reach 7 impoundments. In the case of Reach 5A, erosion of backfill in that one section is predicted to produce an increase in the reach-average 0- to 6-inch sediment concentration of 0.2 mg/kg (Figure 6-23b). For the two Reach 7 impoundments (Reaches 7E and 7G), erosion to a depth exceeding 50% of the backfill depth is predicted to occur in limited portions of those reaches (17% and 4%, respectively), but that erosion is not deep enough to expose buried PCBs. Overall, the model results for SED 8 indicate that buried sediments containing PCBs (at concentrations below 1 mg/kg) generally would not become exposed during an extreme flow event, due in part to the deep removal under that alternative.

Given that SED 8 includes remediation in Woods Pond (i.e., sediment removal over the full 60-acre Pond), the effect of that remediation on the solids trapping efficiency of Woods Pond has also been evaluated. Based on EPA's model, the solids trapping efficiency of Woods Pond under SED 8 would be unchanged relative to MNR (i.e., approximately 15%) since the removal that would occur under this alternative would be followed by replacement with backfill to original grade.

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[256] Further evaluation of the stability of backfill materials under SED 8 based on model predictions of erosion in these areas is provided in Section 6.8.5.2. The results of this stability analysis (i.e., percentages of backfill areas that are stable) are cited in the remainder of this discussion.

6.8.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 8 in accordance with the directions from EPA are listed in Tables S-8.a through S-8.c in Appendix C. The compliance of SED 8 with these potential ARARs is discussed below.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-8.a, include the federal and state water quality criteria for PCBs. To evaluate whether SED 8 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 8. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day “block” averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, four exceedances are predicted within the PSA (at Holmes Road). However, these exceedances consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered as a single exceedance. This is confirmed by the block averages which indicate only a single exceedance for this alternative in this reach and no exceedances in other reaches. For such reasons, as discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 8 would achieve this criterion, albeit at a significant environmental cost, as discussed in Sections 6.8.5.3 and 6.8.8.

By contrast, the model-predicted annual average water column concentrations (which are used for assessment of human health-based water quality criteria and are presented in Table 6-53 in Section 6.8.5.1) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations predicted by the CT 1-D Analysis exceed the federal criterion in one of the four impoundments, although these estimates are highly uncertain (see Section 3.2.5). However, as discussed previously, the ARARs based on the human health consumption criteria should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including the fact that even SED 8 (the most extensive removal alternative) would not achieve this criterion in any reach in Massachusetts and in at least one Connecticut impoundment.[257]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 8 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.8.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.8.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 8 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.8.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.8.6.1. These evaluations provide an assessment of the effect of SED 8 on the impairment listings.[258]

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 8 are listed in Tables S-8.b and S-8.c.[259] As shown in those tables, SED 8 could be designed and

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[257] The estimated future water column concentrations in all the Connecticut impoundments under SED 8 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[258] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-53 (in Section 6.8.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 8 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 81-year projection period, resulting in average fillet levels of 0.003 to 0.007 mg/kg. This provides further insight on the effect of SED 8 on the River's impairment listing in Connecticut.

[259] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

implemented to achieve certain of the ARARs;[260] but, as with SED 3, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 8. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations regarding the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain location and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.8.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 8 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.8.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 8 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative to reduce potential exposure such as engineering and institutional controls.

Implementation of SED 8, along with upstream source control and remediation measures and natural recovery processes, would reduce the exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The extensive sediment removal and backfilling throughout Reaches 5 through 8 and the stabilization/removal of the bank soils in Reaches 5A and 5B would result in a significant

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[260] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132) it is assumed that EPA would make the necessary determinations allowed by the regulations.

reduction in the potential for exposure to PCBs in these areas. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 81) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-53 – Modeled PCB Concentrations at End of 81-Year Projection Period (SED 8)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.09	1.8	0.9	0.2
5B	0.05	1.2	0.8	0.2
5C	0.1	0.9	0.6	0.1
5D (backwaters)	0.1	---	1.4	0.3
6	0.2	0.9	0.6	0.1
7[1]	0.01 – 0.9	0.7 – 0.8	0.5 – 3.2	0.1 – 0.6
8	0.07	0.8	0.9	0.2
CT[1]	0.002 – 0.005	0.04 – 0.08	0.02 – 0.04	0.003 – 0.007

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within each of the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.8.6.[261]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 8 over the 81-year model projection period are shown on Figure 6-23a-c. These figures show the timeframes over which the model predicts SED 8 would

[261] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

reduce the PCB concentrations in each medium. Similar to the other sediment alternatives, general pattern exhibited by these temporal profiles is one of a large decline in PCB concentrations over the remediation period within remediated reaches (Reaches 5, 6, 7 impoundments, and 8), followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. However, due to the extended remediation period associated with SED 8, this period of decline is much longer than that predicted for the other sediment alternatives. While water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with sediment resuspension during remediation and the flood event occurring within Year 26, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations follow the same general pattern, reflecting the predicted changes in water column and sediments. As a result of the remediation under SED 8, predicted fish PCB concentrations are reduced over the 81-year projection period by 92% to 99% in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), by 94% to 97% in channel sections of Reach 7, and by 98% in the Connecticut impoundments (Figure 6-23c).[262]

SED 8 would involve little or no residual risk of exposure to PCBs in buried sediments in removal areas since PCBs would be removed to the 1 mg/kg depth horizon in Reaches 5 and 6, the Reach 7 impoundments, and Reach 8; and placement of backfill (ranging from 2 to 7 feet in thickness) would prevent direct contact with, and reduce the mobility of, any potential PCB-containing sediments beneath the backfill. Overall, the extent to which SED 8 would mitigate the effects of a flood event that could cause PCB-containing sediments that have been buried by backfill and/or natural processes to become available for human and ecological exposure was discussed in Section 6.8.3. As discussed in that section, the model results for SED 8 indicate that buried sediments containing PCBs would generally not become exposed during an extreme flow.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 8 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative.

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262 As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 8 in the remediated reaches (Reaches 5, 6, 7 impoundments, and 8) and the unremediated Reach 7 channel are only slightly lower than those discussed in the text, ranging from 97% to 99% and 92% to 96%, respectively.

6.8.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 8 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

Use of Technologies under Similar Conditions and in Combination

As discussed in Section 6.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007). SED 8 involves such a combination. The SED 8 remedy components include sediment removal using dry excavation techniques (in Reaches 5A and 5B) and hydraulic dredging techniques (in Reaches 5C, the Reach 5 backwaters, Reach 6, the Reach 7 impoundments, and Reach 8) with backfill placed following removal, as well as bank stabilization and removal of bank soils where necessary (in Reaches 5A and 5B) and MNR (in the remaining areas). These remedial techniques have been applied at a number of sites containing PCBs, albeit sites with different ecological conditions, as discussed in Sections 6.3.5.2, 6.4.5.2, and 6.6.5.2.

However, no completed environmental remediation projects have been identified where an extensive sediment removal and backfilling project like SED 8 (the removal of over 2 million cy of PCB-containing sediments to depths ranging up to 7 feet in a riverine setting over a period of more than 50 years) was completed. Only one of the completed environmental dredging projects identified in GE's review of remedies, as discussed in Section 6.5.5.2 above, had a magnitude comparable to that of SED 8 (the Milltown Reservoir Site in Montana, where an estimated 2.0 to 2.3 million cy of sediments were removed), and that site is very different from the Rest of River.[263] Given the magnitude and estimated time needed to complete SED 8, complications could arise during implementation that have not been noted at other, smaller, completed projects (e.g., even greater restoration difficulties, a higher likelihood of, and greater potential impacts from releases during implementation) and which could compromise the long-term reliability and effectiveness of SED 8.

SED 8 also includes the use of Geotubes in the Reach 7 impoundments as a potential dewatering technique. Geotubes have been pilot tested at the Grasse River (NY; www.thegrasseriver.com) and used successfully in Little Lake Butte des Morts (Fox River,

[263] Although large-scale dredging remedies involving more than or approaching 2 million cy have been selected for the Hudson River, Fox River, and Onondaga Lake sites, those remedies have not been completed. In any event, those sites are significantly different in environmental setting from the Rest of River, as discussed in Section 6.5.5.2 above.

WI; www.dnr.wi.gov) and Ashtabula River (Ohio; http://www.clu-in.org) for sediments that were hydraulically dredged.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 8 utilizes sediment removal and backfill to reduce exposure of humans and ecological receptors to PCBs in sediments. The general reliability and effectiveness of these techniques were previously discussed in Section 6.3.5.2. As noted in that section, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments. However, there are some limitations associated with the technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). EPA (2005d) has stated that placement of backfill material as needed or as appropriate can be a component of dredging and excavation, and is sometimes necessary to address residual contamination. Further, EPA has recognized that “deeper contaminated sediment that is not currently bioavailable or bioaccessible, and that analyses have shown to be stable to a reasonable degree, do not necessarily contribute to site risks” (EPA, 2005d, p. 7-3). As such, removal of sediment to the depths targeted under SED 8 would not result in a greater reduction in potential exposure to PCB-containing sediments than lesser removal followed by placement of a cap.

To further assess the reliability and effectiveness of SED 8, model predictions of erosion in areas receiving backfill were evaluated to assess the stability of this material, using the same metrics described for this analysis in Section 6.3.5.2. SED 8 includes removal to the 1 mg/kg PCB depth horizon with subsequent backfilling in all portions of Reach 5, Woods Pond, the Reach 7 impoundments, and Rising Pond. As discussed in Section 6.7.5.2, the backfill was considered stable when at least 50% of the material remained for the full duration of the model projection (including the extreme flow event). Within the PSA, the model predicts that the backfill material would be stable over 98% of the surface area in Reach 5A and over 100% of the backfilled areas in Reaches 5B, 5C, the backwaters, and Woods Pond. The erosion over the remaining 2% of backfilled area within Reach 5A is predicted to occur in response to the Year 26 extreme event in an isolated area near the bend in the River at Holmes Road. Such erosion is predicted to result in small increases (less than 0.3 mg/kg) in the reach-average 0- to 6-inch surface sediment PCB concentration (Figure 6-23b). Within Reaches 7 and 8, the model predicts that 100% of the backfilled area would remain stable in Reaches 7B and 7C, and in Rising Pond, and that the backfill would be stable in 83% of the area in Reach 7E and 96% of the area in Reach 7G. Within the remaining backfilled areas of Reaches 7E and 7G, the model predicts erosion in a limited number of grid cells (4 and 1, respectively) during high flow events simulated at various times in Years 46 through 79 of the projection. However, such erosion is predicted to produce no appreciable change (<0.1 mg/kg) in reach-average surface sediment PCB concentrations within those impoundments (Figure 6-23b). Overall, this analysis indicates that the areas receiving backfill following removal in SED 8 would largely remain stable.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.8.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques. The general reliability and effectiveness of this approach were described in Section 6.3.5.2.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 8 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 8. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.8.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

Given the extensive amount of removal associated with SED 8, the monitoring and maintenance program would be limited in scope and extent. This program would include visual observations of the restored riverbed and riverbanks, as well as post-remediation sampling and analysis of fish, water column, and sediment. These are considered reliable techniques for monitoring the effectiveness of this alternative (EPA, 2005d). Should changes in the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1.

Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although the restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats and would not reestablish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

Given the extensive amount of removal associated with SED 8, the need to replace technical components of the remedy would be limited to the banks remediated in Reaches 5A and 5B and possibly portions of the floodplain affected by access roads and staging areas. If erosion should occur in such areas, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road re-construction would likely pose minimal risks to humans and ecological receptors that use/inhabit the nearby floodplain. However, redesign/replacement of large areas of the restored banks or floodplain could require more extensive disturbance of the adjacent floodplains to support access.

6.8.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 8 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 8 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 8 would alter the habitat of the River areas that would be excavated and backfilled, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 8 would affect portions of the mapped Priority Habitats of 30 state-listed rare species, as described in Appendix L. Implementation of SED 8 would involve a much greater areal extent of remediation than all other alternatives and would take much longer (e.g., twice as long as SED 7). As such, it would have greater adverse impacts than the other alternatives and recovery would take longer and be more unreliable. The long-term impacts of SED 8 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C

SED 8 would involve sediment removal (followed by backfilling) in the entirety of Reaches 5A, 5B, and 5C to the 1 mg/kg depth horizon. The long-term post-restoration impacts of removal activities on aquatic riverine habitat were described generally in Section 5.3.1.4. The specific impacts of SED 8 on these habitats would be the same as those of SED 6, as described in Section 6.6.5.3, although the sediment removal would be deeper and the removal activities would thus take much longer. In summary, over time, due to deposition of sediments from upstream, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to be present. However, the length of time for that to occur is highly uncertain and unreliable and would be delayed, particularly in the further downstream reaches, due to the extensive upstream riverbed and riverbank remediation. Moreover, the abundance of organisms and richness of the mix of species in the replaced community are also uncertain, the return of certain specialized species (including state-listed species destroyed by the sediment removal) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 8 would include stabilization of the riverbanks in Reaches 5A and 5B using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4, and would be similar to the impacts summarized in Section 6.3.5.3 for SED 3. As discussed there, the bank stabilization measures would result in a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species, as well as causing other long-term or permanent impacts. Therefore, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Impoundment Habitats

SED 8 would include sediment removal (followed by backfilling) throughout Woods Pond, the Reach 7 impoundments, and Rising Pond. These activities would have a number of long-term impacts, as described for impoundments generally in Section 5.3.3.4. Those impacts include a change in the surface substrate and a consequent alteration in the biological community in the impoundments. As previously discussed, it is anticipated that, over time, as sediments are deposited from upstream, a biological community typical of such impoundments would eventually develop. However, the length of time for such a community to develop is uncertain and would be affected by the extent of upstream remediation – which would be extensive under SED 8, especially throughout the PSA. Moreover, the community that develops may include changes in the mix of native species, the return of certain specialized native species (including state-listed species) is doubtful, and the impoundments would likely be dominated by invasive species such as those currently present. In Woods Pond, these impacts would be expected in the shallower portions; the removal/capping in the “deep hole” of that Pond would not be expected to have any significant adverse long-term ecological impacts for the reasons given in Section 6.3.5.3.

Long-Term Adverse Impacts on Backwaters

The sediment removal in the backwater areas under SED 8 would also have long-term negative impacts. The long-term impacts of remediation on backwater habitats are discussed generally in Section 5.3.6.4. It is anticipated that natural deposition of organic detritus from upstream sources would eventually provide the base necessary for a developed vegetative community and associated biota. However, under SED 8, given the spatial extent (86 acres) and duration (10 years) of the backwater remediation, as well as the extensive and lengthy remediation of upstream areas, the time required to develop a sufficient organic base to support emergent species would be lengthy and unpredictable. In addition, the abundance of organisms and mix of species that would return to the backwaters are uncertain, the return of certain specialized species (including state-listed species) is doubtful, and there is a high likelihood of domination by invasive species. In fact, under SED 8, due to the spatial extent and duration of the backwater remediation, local subpopulations of less mobile organisms such as reptiles and amphibians would likely be permanently displaced from these backwater areas.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 8 includes 26 staging areas covering approximately 51 acres (including 10 acres within the floodplain) and approximately 20 miles of temporary roadways covering an additional 50 acres (including 16 miles and 40 acres in the floodplain), as shown on Figures 6-21a-b. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (23 acres), shrub and shallow emergent wetlands (12 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (9.4 acres), and upland forests

(2.6 acres).[264] These impacts would occur mainly in Reaches 5A and 5B, with additional impacts in limited portions of Reaches 5C, 6, 7, and 8 to support the remediation in those portions. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats).

The long-term negative impacts anticipated from access roads and staging areas under SED 8 are generally comparable to those summarized in Section 6.3.5.3 for SED 3, except that they would adversely affect a greater acreage (total of 101 acres) and would last longer. At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 8 would affect portions of the Priority Habitats of 30 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 8 would involve a "take" of at least 27 of these species and would adversely affect a significant portion of the local population of at least 13 of them. The table below lists the 30 state-listed species whose Priority Habitat would be affected by SED 8, along with those for which SED 8 would result in a take and those for which SED 8 would impact a significant portion of the local population:

Table 6-54 – Impacts of SED 8 on State-Listed Species

Species with Priority Habitat Affected by SED 8	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Yes
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely

[264] Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 8 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural fields and cultural grasslands) (30 acres), with additional impacts occurring in forested uplands (11 acres) and in wet meadow and emergent marsh habitats (1 acre). Impacts associated with access roads and staging areas in Reach 7 would be minimal (approximately 0.3 acre of upland forest); however, approximately 12 acres of habitat would be impacted by such facilities in Reach 8 (9 acres of upland forest, 2 acres of wetland habitats, and 1 acre of disturbed upland).

Species with Priority Habitat Affected by SED 8	Take?	Impact on Significant Portion of Local Population?
Black maple	Yes	Unlikely
Bristly buttercup	Yes	Possibly
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Creeper	Yes	No
Crooked-stem aster	Yes	No
Foxtail sedge	Yes	Possibly
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Possibly
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Longnose sucker	Yes	No
Mustard white	Yes	Possibly
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Skillet clubtail	Yes	No
Spine-crowned clubtail	Yes	Yes
Stygian shadowdragon	Yes	No
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
White adder's-mouth	No	No
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

Long-Term Impacts on Aesthetics and Recreational Use

SED 8 would have long-term impacts on the aesthetic features of the natural environment. The removal activities (followed by backfilling) in 351 acres of Reaches 5 through 8, as well as bank stabilization along approximately 14 linear miles (7 miles on both banks) Reaches 5A and 5B, would significantly alter the appearance of the River over the course of those activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The construction of network of access roads and staging areas on both sides of the River to support implementation of SED 8 would also cause long-term impacts on the aesthetics of the floodplain. As discussed for prior alternatives, the placement of roadways and staging areas would remove trees and vegetation, including in numerous forested areas. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. Since SED 8 would take the longest time to complete of all the sediment alternatives, its implementation would result in the longest length of time that roads would be in place. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to their current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 8 include areas used for canoeing, fishing, hiking, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 8. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

<u>Long-Term Impacts to Fluvial Geomorphic Processes</u>

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B would reduce the supply of sediment to the River. (SED 8 would not involve armoring of the riverbed in Reaches 5A and 5B, as SED 3 through SED 6 would do.) The potential impacts of such a reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. For reasons similar to those discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity.[265]

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 8, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 8 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for the impoundments, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, because of the timeframe and spatial extent of SED 8, the success of these measures is even more unlikely than for the alternatives discussed above.

6.8.6 Attainment of IMPGs

As part of the evaluation of SED 8, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 81-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 8, and those comparisons are shown in Tables 6-55 through 6-60.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-55 through 6-60.[266] In addition, figures in Appendix K show temporal profiles of model-simulated PCB

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[265] Model results for SED 8 suggest that bank stabilization, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, removing the sediment loading due to bank erosion under SED 8 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank erosion), within several areas of the River (mainly in Reaches 5A and 5B).

[266] The extent to which SED 8 is predicted to accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 6.1.6 above).

concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 81-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 81-year model projection period are described below.[267]

6.8.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations would achieve the RME IMPGs based on a 10^{-6} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-55). Some of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from 5 to 50 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 81, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8 (with the exception of the RME IMPGs based on a 10^{-4} cancer risk under the probabilistic analysis in all reaches, and under the deterministic analysis in some reaches, but not the corresponding non-cancer IMPGs) (Table 6-56).[268] In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 8 would achieve the RME IMPGs associated with a cancer risk level of 10^{-5} (or lower) as well as non-cancer impacts.[269]

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[267] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 8, in almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted. (Full comparisons between model results for the base case and lower bound simulations are provided in Appendix K.)

[268] Application of the lower-bound model assumptions results in the attainment of one additional RME IMPG – the probabilistic non-cancer IMPG for adults in Reach 6.

[269] Similar to SED 7, SED 8 would also achieve many of the CTE-based IMPGs in certain of the Massachusetts subreaches, as well as all CTE IMPGs in Connecticut. Application of the lower-bound model assumptions results in the attainment of one additional CTE IMPG (the deterministic non-cancer IMPG for children in Reach 7E).

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 180 to >250 years in the PSA and 200 to >250 years in Reaches 7 and 8.

6.8.6.2 Comparison to Ecological IMPGs[270]

For benthic invertebrates, predicted average surface sediment concentrations would achieve both the lower and upper bounds of the IMPG range (3 to 10 mg/kg) in all averaging areas within the model period (Table 6-57). These levels would generally be achieved immediately following completion of remediation in Reaches 5 and 6, and within that same timeframe in the portions of Reaches 7 and 8 where the levels are not below the range at the onset of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower and upper bounds of the IMPG range (3.27 to 5.6 mg/kg) in all of the backwaters evaluated (Table 6-58). Times to achieve the lower-bound IMPGs generally range from 3 to 30 years, which correspond to the times in which remediation occurs within these areas.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-59). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from 3 to 25 years for warmwater fish and approximately 30 to 40 years for coldwater fish.

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 8, this change in averaging method (and the resulting increase in concentration) results in several changes in the IMPG attainment presented in Table 6-56 – notably, that SED 8 would no longer achieve certain of the RME IMPGs and CTE IMPGs in Reach 7.

[270] While this section describes the extent to which SED 8 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.8.5.3 and 6.8.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.8.11.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For both receptor groups, the predicted surface sediment concentrations are below all three of the target sediment levels evaluated in all averaging areas (Table 6-60), with times to achieve these target levels generally ranging between 2 and 40 years.[271]

For piscivorous birds (represented by osprey) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches (Table 6-59).[272] Estimated times to achieve these IMPGs range between 10 and 50 years for piscivorous birds and 5 and 20 years for threatened and endangered species.[273]

6.8.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 8 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 8 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

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[271] In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 8 has been paired with FP 7. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 8, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

[272] In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no changes in attainment of the piscivorous bird IMPG under SED 8.

[273] EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 8 at the end of the simulation period are 0.002 to 0.005 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 8 are in the range of 0.02 to 0.04 mg/kg (Table 6-53). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

Reduction of Mobility: SED 8 would reduce the mobility of PCBs in the River by removing approximately 2,252,000 cy of sediment containing PCBs in Reaches 5 through 8 and placing backfill over all the removal areas, and by stabilizing the banks in Reaches 5A and 5B, including the removal of approximately 35,000 cy of PCB-containing soils from those banks. In total, SED 8 would remove approximately 351 acres of sediments (42 acres in Reach 5A, 27 acres in Reach 5B, 57 acres in Reach 5C, 86 acres in the Reach 5 backwaters, 60 acres in Woods Pond, 27 acres in the Reach 7 impoundments, and 41 acres in Rising Pond).

Reduction of Volume: SED 8 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 2,287,000 cy of sediments/bank soils containing approximately 55,200 lbs of PCBs.

6.8.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 8 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Given that the remedial actions under SED 8 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Even so, since the extent and duration of remediation activities under SED 8 are greater than those under all previous alternatives, the short-term impacts would be the most widespread of all alternatives and would occur over the longest period of time in various portions of the Rest of River area.

Impacts on the Environment – Effects Within PSA

The short-term adverse impacts on the environment resulting from implementation of SED 8 would include: potential impacts to the water column, air, and biota in the Rest of River area during dredging and backfilling activities, alteration/destruction of benthic habitat in the areas subject to those activities, alteration of riverbank habitat and associated biota due to bank stabilization activities, and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal with Backfilling: Sediment removal with backfilling activities in Reaches 5, 6, 7, and 8 (2,252,000 cy over 351 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. As discussed in Section 6.4.8, resuspension to the water column outside the work area would be controlled in Reaches 5A and 5B as removal activities in those reaches would be conducted using sheetpile enclosing the removal/backfill areas. However, the potential exists for suspended or residual sediment containing PCBs to be released from the work area both during sheetpile installation and during a high-flow event should overtopping of the sheeting occur. For Reach 5C, the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond, activities would be conducted in the wet using hydraulic dredging, with silt curtains used to mitigate sediment release to downstream reaches. In these areas, some sediment containing PCBs would be released from the work area through the dredging/excavation process even though the area would be surrounded by silt curtains.[274] In addition, boat and barge traffic could resuspend sediment during the construction phase.

In addition, sediment removal activities, particularly when conducted in the wet (even with the use of silt curtains), would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach). Such results would likewise be expected to occur under SED 8 and would last for a substantial period of time given the long duration of this alternative.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 8 would cause a loss of aquatic habitat in Reaches 5 through 8 (except in the channel in Reach 7) where sediment removal with backfilling would occur. It is estimated that these adverse impacts would occur over approximately 351 acres along approximately 13 miles of River. Since this alternative would include complete removal of all aquatic main channel and backwater areas between the Confluence and Woods Pond Dam and select locations between Woods Pond Dam and Rising Pond Dam, the short-term loss of aquatic habitat would be comprehensive and would last for an extended period of time. A general discussion of the immediate and near-term impacts of sediment removal and capping/backfilling in aquatic riverine, impoundment, and backwater habitats was provided in Sections 5.3.1.2, 5.3.3.2, and 5.3.6.2, respectively. These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used

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[274] For example, as previously noted, an overall PCB resuspension rate of 3% was noted during hydraulic dredging in the Grasse River (Connolly et al., 2007), and pilot hydraulic dredging in the Fox River showed a 2.2% resuspension rate (USGS, 2000). If 3% of the PCB mass dredged in Reaches 5C, 5 backwaters, 6, 7, and 8 under SED 8 were lost to the water column, that would equate to approximately 975 lbs of PCBs.

as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and other aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and disperse in areas subject to remediation; and colonization by invasive plant species. Overall, the short-term adverse impacts of SED 8 would affect more area of aquatic habitat than would occur from sediment removal under the alternatives discussed above (including 132 more acres than SED 7).

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate adverse effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts were described for SED 3 in Section 6.3.8 and would also occur under SED 8.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the wildlife that they support. The supporting structures required for SED 8 are similar to those for SED 6 and SED 7 (see Sections 4.6.8 and 4.7.8), although would affect a somewhat greater total acreage. It is anticipated that SED 8 would require a total of approximately 101 acres for access roads and staging areas (approximately 50 acres within the 10-year floodplain). As described in Section 6.8.5.3, the principal habitat types affected include floodplain forests, shrub and shallow emergent wetlands, disturbed upland habitats, and upland forests. The short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 8 would be largely the same as those described in Section 6.3.8 for the support facilities under SED 3, except that the total acreage affected would be greater and more widespread under SED 8 and the effects would last longer due to the longer duration of SED 8.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/backfilling and related ancillary activities during the implementation of SED 8.

The total calculated emissions from SED 8 would amount to approximately 470,000 tonnes of GHG emissions, with 180,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation associated with tree removal), 10,000 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 280,000 tonnes from off-site emissions (most of which are associated with manufacture of cement for stabilization and of steel sheeting, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent the annual output of 90,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 8 would result in major short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the construction of access areas and roads, disruption of recreational canoeing and other River-related and land-side activities, and increased noise and truck traffic.

Impacts on Recreational Activities: Recreational activities in the areas that would be affected by SED 8 include fishing, canoeing, hiking, dirt biking/ATVing, waterfowl hunting, and general recreation. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, angler, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area. Under SED 8, these impacts would affect portions of Reaches 5 and 6 for an estimated 39 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over approximately 13 years.

Increase in Truck Traffic: Due to the need to deliver backfill and bank stabilization materials and equipment to the work areas and to remove excavated material from those areas, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 8 (over 50 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas, it would take approximately 189,000 truck trips to do so (3,630 truck trips per year for a 52-year implementation period). Additional truck trips would be necessary to transport backfill and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 218,300 truck trips (4,200 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located along the River.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and staging area materials following completion of remediation.[275] This analysis indicates that the increased truck traffic associated with SED 8 would result in an estimated 7.76 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.15) with a probability of 100% of at least one such injury, and an estimated 0.36 fatalities from accidents (average fatality estimate of 0.007) with a probability of 30% of at least one such fatality.

Potential Measures to Avoid, Minimize or Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[276] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, however, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 8 would be inevitable.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing SED 8. Implementation of SED 8 is estimated to involve 2,403,424 man-hours over a 52-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 8 would result in an estimated 22.2 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.43) with a probability of 100% of at least one such injury, and an estimated 0.28 worker fatalities (average annual fatality estimate of 0.005) with a probability of 24% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.8.9 Implementability

6.8.9.1 Technical Implementability

The technical implementability of SED 8 has been evaluated considering the factors identified below.

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[275] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

[276] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

General Availability of Technologies: SED 8 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 8 would be technically implementable in the reaches where they would be applied. Sediment removal followed by backfilling would be implemented in all river reaches. Sediment removal/backfilling would be performed in the dry in Reaches 5A and 5B and hydraulically in the wet in other reaches. As previously discussed, these techniques have been used at other sites. However, given the length of time required to implement SED 8 (52 years) and, in some reaches, the depths which would be dredged, complications are likely to be encountered during implementation. For example, dredging to depths up to 6 and 7 feet in Woods Pond and Rising Pond would likely require some stabilization measures for the riverbanks to avoid sloughing and bank slope failure.

Since the current river bathymetry is assumed to be maintained in those areas where sediment removal and subsequent backfilling are performed, there would be no net loss of flood storage capacity.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant River stretches.

MNR with institutional controls would be implemented in the downstream reaches. Monitoring to track changes in PCB concentrations following the SED 8 remedial activities could be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 8 could readily be constructed using commonly available construction techniques.

Although the technologies needed to implement SED 8 are generally available and suitable, the 52-year period required to implement this alternative introduces other complications and uncertainties (in addition to those described above). It is difficult to contract for a remedial project for that length of time, given the possibility of changes in equipment and techniques, and the possibility that contracting firms will not remain available throughout that long a time period. It is also difficult to predict the availability of large quantities of backfill and capping materials that far into the future. In addition, depending on the treatment or disposition alternative selected (see Section 9), the availability of landfill capacity or treatment capabilities could also affect the ability to implement such a long-term dredging project.

Reliability: The remediation technologies that comprise SED 8 are individually reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.4.5.2, 6.5.5.2, 6.6.5.2, and 6.7.5.2. While it is possible to remove sediment at depths of to 7 feet below the riverbed, these sediments are buried below many feet of stable sediments and are currently therefore not available for human and ecological exposure. It should also be noted that, due to the absence of any precedent for an environmental dredging project of the magnitude and duration of SED 8 and the complications described above, the overall reliability of implementing this alternative is unknown. Additionally, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.8.5.2 and 6.8.5.3.

Availability of Space for Support Facilities: Implementation of SED 8 would require construction of access roads and staging areas at various locations within the floodplain. As noted previously, an estimated 101 acres of space (assuming that the necessary access agreements can be obtained) would be needed, and appear to be available to support the SED 8 activities based on preparation of a conceptual site layout. Development of access roads and staging areas would be sequenced over the approximate 52-year duration of SED 8.

Availability of Backfill and Stabilization Materials: Materials required for backfill placement and bank stabilization must be of suitable quality for their intended purposes. Approximately 2,236,000 cy of clean sand, fill, gravel, and stone would be required for backfilling and bank stabilization. Due to the large volume of material required, it is anticipated that adequate material sources would be difficult to locate, and predicting the availability of suitable material over length of time required to implement this alternative (52 years from initiation of construction) introduces additional complications and uncertainties. For purposes of this Revised CMS Report, it is assumed that necessary quantities would be available. However, obtaining the needed quantities, if feasible, would likely require long travel distances. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed for bank maintenance or to conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 8. It is assumed that no corrective measures would be conducted for the areas covered with backfill. Ease of implementation would be directly related to the extent of the additional corrective measures (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 8 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic visual observations of the riverbed and restored riverbanks would allow for an evaluation of those components of the remedy. Such activities have been successfully performed on the upper portions of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.8.9.2 Administrative Implementability

The administrative implementability of SED 8 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 8 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 8 is provided in Tables S-8.a through S.8-c in Appendix C and summarized in Section 6.8.4.

Access Agreements: Implementation of SED 8 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although the many of the areas in Reach 5 are owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 45 to 55 other landowners to implement SED 8. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA’s assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 8, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.8.10 Cost

The estimated total cost to implement SED 8 is $745 M (not including treatment or disposition of removed materials). The estimated total capital cost is $734 M, assumed to occur over a 52-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed (visual observations only), riverbanks, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $3.2M. The estimated annual OMM costs for SED 8 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $32,500 to $617,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $7.7 M. The following summarizes the total capital and OMM costs estimated for SED 8.

SED 8	Est. Cost	Description
Total Capital Cost	$734 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$10.9 M	Costs for performance of the OMM programs
Total Cost for Alternative	$745 M	Total cost of SED 8 in 2010 dollars

The total estimated present worth cost of SED 8, which was developed using a discount factor of 7%, a 52-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $223 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of any associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for the combination of SED 8 and FP 7 are presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.8.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.8.2, the evaluation of whether SED 8 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 8 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 2,252,000 cy of PCB-containing sediments to the 1 mg/kg depth horizon in Reaches 5 through 8 (except in the Reach 7 channel) and placing backfill over the underlying sediments; and (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy of bank soil. As shown in Section 6.8.3, implementation of SED 8 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.4 kg/yr, that passing Rising Pond Dam from 19 to 0.6 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.1 kg/yr over the modeled period.

Further, as shown in Section 6.8.5.1, EPA's model predicts that SED 8 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, that model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 0.5-1 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.02-0.04 mg/kg in the Connecticut impoundments.

On the other hand, SED 8 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.8.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.8.4, SED 8 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 µg/L, which should be waived as technically impracticable to attain. Review of the potential location-specific and action-specific ARARs indicates that SED 8 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.8.6.1, accepting EPA's HHRA, for direct human contact with sediments, SED 8 would achieve IMPG levels based on a 10^{-6} cancer risk, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. As such, SED 8 would protect human health from direct contact with sediments. For human consumption of fish, the fish PCB concentrations predicted to result from SED 8 at the end of the 81-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in several areas). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 8 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and all non-cancer IMPGs within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.8.6.2, the model results indicate that, by the end of the 81-year modeled period, SED 8 would achieve the sediment and fish IMPG levels for all ecological receptor groups and areas. The estimated time to achieve these ecological IMPGs in all averaging areas is approximately 50 years.

As discussed in Section 2.1.1, however, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. In this case, implementation of SED 8 would have substantial short-term and long-term adverse environmental impacts, including on the receptor groups that the IMPGs are designed to protect. The short-term impacts would include loss of the current aquatic habitat throughout Reaches 5 through 8 (except for the Reach 7 channel); loss of riparian habitat in the bank stabilization areas; resuspension of PCB-containing sediments during removal; and loss of floodplain habitat in areas where supporting facilities are constructed – all as discussed in Section 6.8.8. Even more significantly, despite the implementation of restoration measures, implementation of SED 8 would result in substantial long-term and, in some cases, permanent adverse effects on the ecosystem. These impacts were described in Section 6.8.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the Reach 5 backwaters, the shallower portions of Woods Pond, the Reach 7 impoundments, and Rising Pond;

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of “overall protection” of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat” (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 8 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 8 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 8 would not meet the standard of providing overall protection of the environment.

6.9 Evaluation of Sediment Alternative 9

6.9.1 Description of Alternative

SED 9 is a sediment remediation alternative that was identified and described by EPA. It would involve the removal of a total of 921,000 cy of sediment and riverbank soil, including 886,000 cy of sediment over 333 acres plus 35,000 cy of bank soil as part of bank stabilization over 14 linear miles of riverbank. A total of 336 acres would be capped (333 acres after removal and 3 acres without removal). Specifically, the elements of SED 9 include the following:

- Reach 5A: Sediment removal in the entire reach (134,000 cy over 42 acres), followed by capping;
- Reach 5B: Sediment removal in the entire reach (88,000 cy over 27 acres), followed by capping;
- Reach 5C: Sediment removal in the entire reach (156,000 cy over 57 acres), followed by capping;
- Riverbanks in Reaches 5A and 5B: Bank stabilization (14 linear miles, comprising both banks along 7 miles of River) and removal of bank soils where necessary as part of the stabilization (35,000 cy);
- Reach 5 backwaters: Combination of sediment removal with capping (109,000 cy over 68 acres) and capping without removal (3 acres);
- Reach 6 (Woods Pond): Sediment removal (244,000 cy over 60 acres), followed by capping;
- Reach 7 impoundments (Reaches 7B, 7C, 7E, 7G): Sediment removal (84,000 cy over 38 acres), followed by capping;
- Reach 8 (Rising Pond): Sediment removal (71,000 cy over 41 acres), followed by capping; and
- Reach 7 (Channel) and Reaches 9 through 16: MNR.

Figures 6-24a-b identifies the remedial action(s) that would be taken in each reach as part of SED 9. This alternative differs from all of the sediment removal alternatives discussed above in that, under SED 9, at EPA's direction: (a) all sediment removal and capping work, including in Reaches 5A and 5B, would be performed in the "wet" by equipment operating within the River (either on the river bottom or on barges); and (b) removal of the sediments in the Reach 5 backwaters and Reaches 6, 7, and 8 would be performed concurrently with removal activities in the Reach 5 channel, but capping in those reaches would be delayed, where necessary, until after all the removal/capping activities in Reach 5 have been completed.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 9. Based on production rates and other inputs and assumptions specified by EPA, it is estimated that SED 9 would require approximately 14 years to complete. A construction timeline for implementation of SED 9 is provided in

Figure 6-25. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline. It also shows the activities that would be performed concurrently – namely, that the removal and capping activities in the Reach 5 backwaters and the removal activities in Reaches 6, 7, and 8 would be conducted while removal/capping activities in Reaches 5B and 5C are ongoing, to be followed by capping in Reaches 6, 7, and 8 after all removal/capping activities in the upstream reaches are completed.[277]

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. Details of the specific methods for implementation of the remedy would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 9 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging areas, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 9 have been selected, considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Since all sediment removal work under SED 9 would be performed by equipment operating within the River, this alternative would minimize the need for access roads along the riverbanks. Locations for staging areas and the access roads that would still be needed were selected based on accessibility, existing

[277] For comparison with the other sediment removal alternatives, GE has also estimated the timeline for completion of SED 9 in the event that this concurrent remediation approach mandated by EPA were not followed and that, instead, the sequencing of remediation activities followed the same approach used for the other alternatives, in which the removal and capping activities in Reaches 6, 7, and 8 are conducted after the completion of the removal/capping activities in Reach 5. Under that alternate sequencing, but still using the production rates required by EPA, it is estimated that SED 9 would require 18 years to complete, as shown by the alternate construction timeline presented in Figure 6-26.

land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 20 staging areas, occupying a total of 43 acres (5 acres within the floodplain), and approximately 5 miles of access roads covering 12 additional acres assuming a 20-foot road width (1.9 miles and 4.7 acres in the floodplain) would be constructed between the Confluence and Rising Pond to support implementation of SED 9. The locations of these staging areas and access roads are shown on Figures 6-24a-b. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: Sediment removal would be performed in Reaches 5, 6, 7 and 8 as presented below. As discussed in Section 3.1.1, the removal volumes in the Reach 7 impoundments and Rising Pond have been based on an analysis of shear stress, with areas having higher shear stress subject to removal to a depth of 1.5 feet and areas if lower shear stress subject to removal of 1 foot. The shear stress analysis is presented in Appendix F and shows that approximately 34 acres of these impoundments have high shear stress and 45 acres have low shear stress, leading to the removal volumes presented below for these impoundments.

As also discussed in Section 3.1.1, EPA's January 15, 2010 conditional approval letter for the 2009 Work Plan stated that the removal depths in the Reach 5 backwaters and Reaches 6, 7, and 8 should be increased to account for estimated sedimentation during the period between removal and capping. However, the construction schedule presented on Figure 6-25 shows that the backwater remediation, including capping, would be completed at the same time as the remediation in the Reach 5 channel, leaving no time delay between the sediment removal and capping in those backwaters. For the downstream impoundments (Woods Pond, the Reach 7 impoundments, and Rising Pond), an analysis presented in Appendix F shows that, during the periods when those areas would be uncovered under the schedule presented in Figure 6-25, the amount of sediment deposited in them would be less than one inch in thickness in five of the six impoundments and approximately 1.5 inches in the remaining impoundment (the Glendale Dam Impoundment). These thicknesses are within the anticipated accuracy and allowable dredge depth tolerances of current environmental dredging equipment. Moreover, it is likely that the accumulated sediments would consolidate once the relatively dense capping material (e.g., sand, gravel and armor stone) is placed on the river bottom, which would further offset any additional accumulation of sediments during the uncovered period. In these circumstances, it is not necessary to increase the base removal depths in these areas under SED 9 to account for sedimentation between removal and capping.

Based on these considerations, the removal volumes for SED 9 are as follows:

	Removal Depth (feet)	Removal Volume (cy)	Acreage
Reach 5A:	2	134,000	42
Reach 5B:	2	88,000	27
Reach 5C:	1.5 – 2	156,000	57
Reach 5 backwaters:	1	109,000	68
Reach 6 (Woods Pond):	1 – 3.5	244,000	60
Reach 7 impoundments:	1 – 1.5	84,000	38
Reach 8 (Rising Pond):	1 – 1.5	71,000	41
Totals:		**886,000**	**333**

The areas over which removal would be conducted for the reaches listed above are shown on Figures 6-24a-b.

As noted above, EPA has specified that all sediment removal work in SED 9, including in Reaches 5A and 5B, must be performed in the wet by equipment operating within the river channel. In Reach 5A, average water depths (i.e., typically less than 3 to 4 feet) make the use of barges infeasible. As a result, it is assumed that sediment removal in that subreach would be performed by excavation and transport equipment operating from the channel bottom while water continues to flow in the River. In discussions relating to GE's dispute regarding the production and resuspension rates for sediment removal in Reach 5A under SED 9 and in its response to GE's Statement of Position on that dispute (attached to EPA's June 10, 2010 decision on the dispute), EPA suggested a sediment excavation/capping approach that would involve the following components: (a) constructing an elevated roadway in the River (as operations proceed from upstream to downstream) which could consist of backfill that would subsequently be used as capping material; (b) installing turnarounds on the roadway as necessary to allow two-way traffic; (c) using that roadway to conduct sediment excavation, followed shortly by capping, as operations proceed; and (d) using transport equipment (such as a "crawler carrier") that has a rotating cab so that traveling in reverse is not necessary. While the feasibility of this approach is unproven and many of the details are uncertain, GE has assumed for purposes of the evaluations in this Revised CMS Report that the sediment removal and capping in Reach 5A under SED 9 would involve components such as those suggested by EPA. Under this approach, silt curtains would be placed downstream of excavation activities in an effort to limit transport of suspended sediment. In the event that SED 9 were selected, the specific method for conducting sediment removal and capping from within the river channel in Reach 5A would be evaluated and developed during design.

For the purposes of this assessment, it is assumed that sediment removal in Reach 5B and the Reach 7 impoundments would be performed using barge-mounted mechanical clamshell excavators, and that sediment removal in Reaches 5C, the Reach 5 backwaters, Reach 6, and Reach 8 would be performed using hydraulic dredging. In these areas, debris removal would be conducted prior to dredging, and silt curtains would be placed downstream of excavation activities to limit transport of suspended sediment.

As noted above and shown on Figures 6-24a-b, sediment removal in Reaches 6, 7, and 8 would be conducted while removal activities in Reaches 5B and 5C are still ongoing, although those impoundments would not be capped until after completion of all the removal/capping activities in Reach 5C.

Periodic water column and air monitoring would be performed during implementation of all removal operations.

<u>Cap Design and Placement</u>: Following sediment removal, caps would be installed through the water column in Reaches 5A, 5B, and 5C and in the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond (see Figures 6-24a-b). In Reach 5A, the caps would be installed by equipment operating from a road built on the river bottom as described above; and in the other reaches, the caps would be installed by equipment operating from barges. Caps would also be installed though the water column in the deeper portions of the Reach 5 backwaters (i.e., where the water depth is greater than 4 feet) without prior sediment excavation. Removal of debris that could interfere with the performance of the cap would be conducted prior to cap material placement. Cap materials would be transferred to the River using conventional earth-moving equipment.

It is assumed that the caps to be placed following removal in Reaches 5A and 5B would consist of 12 inches of sand (which may be amended by organic material to increase the TOC content), overlain by an armor stone layer of12 inches, to bring the riverbed to the pre-removal elevation. In Reach 5C, the caps to be placed following removal would consist of 12 inches of sand overlain by an armor stone layer of 6 to 12 inches to bring the riverbed back to the pre-removal grade. In the backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond, at EPA's request, the caps would consist of 6 inches of an active, or sorptive, layer (e.g., organic material) and a 6-inch habitat/bioturbation layer – with the modification that, in areas of high shear stress in the Reach 7 impoundments and Rising Pond, the cap would consist of a 6-inch active layer, a 6-inch sand layer, and a 6-inch armor stone layer. The cap in the backwaters, the Reach 7 impoundments, and Rising Pond would bring the riverbed to the pre-removal elevation. The cap in Woods Pond would bring the riverbed to the pre-removal elevation in the deeper portions of the Pond, but in the shallow areas excavations would be greater than the cap thickness, resulting in an increase in water depth after cap placement. As noted above, the capping in Woods Pond, the

Reach 7 impoundments, and Rising Pond would be delayed until all removal/capping activities in the Reach 5 channel have been completed.

The composition and size of the materials used for the caps would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to preclude the movement of cap materials during high flow events. For the purposes of this assessment, it has been assumed that the 6-inch active layer would be composed of 50% sand and 50% topsoil – a ratio of topsoil to sand that would be anticipated to provide more than adequate sorptive capacity to retard the migration of PCBs through the cap layer. Silt curtains would be used during capping activities through the water column in an effort to limit downstream transport of suspended materials, and water column monitoring would be performed.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary. For purposes of this Revised CMS Report, it is assumed that a combination of dewatering alternatives would be used, including gravity dewatering via stockpiling at the staging areas for materials removed from Reach 5A or by barge-mounted mechanical equipment and mechanical dewatering using a plate and frame filter press for materials removed by hydraulic dredging. The addition of stabilization agents (e.g., other dry sediments, excavated soil, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately, and are discussed in Section 9. A water treatment system would be used to treat any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 9 would include the stabilization of the riverbanks on both sides of the River in Reaches 5A and 5B, including the removal of 35,000 cy of soil from these subreaches. The bank stabilization techniques that are assumed to be part of SED 9 for purposes of this Revised CMS Report, like those identified for SED 3 through SED 8, would involve a combination of bioengineering and traditional bank hardening techniques. However, since they would be implemented while flowing water is present in the River, the techniques identified have been modified (similar to those identified for SED 3 in Reach 5B and for SED 4 in the downstream portion of Reach 5B) from those that could be applied in the dry, some of which could not practicably be implemented below the water.[278] The modified bank stabilization techniques for SED 9 are described in Section 3.1.4 and Appendix G and are depicted on Figures G-26 through G-33 in Appendix G.

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[278] For example, construction of certain stabilization structures from within the flowing channel is impractical. The presence of flowing water decreases visibility of in-water work and is inherently more dangerous. Additionally, shaping of sands and fine sediments (such as in constructing a point bar) is not practical in the wet, as the substrate would wash away and not hold form. As a result, those

For purposes of this report, it is assumed that the riverbank stabilization/soil removal work in Reach 5A would be performed on both sides of the River using equipment operating in the wet from the elevated roadway on the river bottom, as described above for the sediment removal/capping activities. The bank stabilization/soil removal work in Reach 5B would be performed in the wet from barges.

MNR: MNR would be implemented in the remainder of the Rest of River (channel portions of Reach 7, as well as the river stretches downstream of Reach 8). As discussed previously, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue at varying rates in the areas where MNR would be implemented under SED 9, due in part to completed and planned remediation conducted upstream of the Rest of River, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of evaluation in this Revised CMS Report, it is assumed that SED 9 would include restoration of areas that are directly impacted by the sediment removal and/or capping activities, bank removal/stabilization activities, and ancillary construction activities. The restoration methods assumed for SED 9 for purposes of this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reaches 5A, 5B, 5C; Section 5.3.2.3 for the riverbanks in Reaches 5A and 5B (with modifications to eliminate measures that cannot practically be implemented under submerged conditions); Section 5.3.3.3 for Woods Pond, Reach 7 impoundments, and Rising Pond; Section 5.3.6.3 for the Reach 5 backwaters; and the other restoration methods subsections in Section 5.3 for the floodplain habitats disturbed by access roads and staging areas. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 9 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 9 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at

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techniques that would require work below the normal water line and those that would require placement of sands and fine grading have been modified for SED 9.

concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 9 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program for capped areas under SED 9 would include the same elements outlined for that program under SED 3 (Section 6.3.1). The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 9.

A summary of the assumed long-term (100-year) OMM program for SED 9 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 and would include collection for PCB analysis of 50 surface sediment samples from MNR areas, approximately 84 cores (252 samples) from removal areas, and 2 cores (6 samples) from the cap-only areas in the backwaters. Further, for the caps, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of those caps would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.9.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 9 would be protective of human health and the environment is presented at the end of Section 6.9 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.9.3 Control of Sources of Releases

Implementation of SED 9 would reduce the potential for future PCB migration from certain river sediments and riverbanks. This alternative would address approximately 336 acres of the riverbed and approximately 14 linear miles of riverbank (7 miles on both banks), and would include the removal of 921,000 of sediment and bank soils containing PCBs.

SED 9 would reduce the potential for future transport of PCBs within the River and onto the floodplain for human or ecological exposure. Specifically, SED 9 would result in removal of 1 to 3.5 feet of sediments throughout Reaches 5A through 5C, the majority of the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond. PCBs remaining in these areas would be contained by a cap designed to withstand erosion during high flows. The banks of Reaches 5A and 5B would be addressed through bank stabilization techniques, including removal of bank soil where appropriate. In the limited deeper portions of the Reach 5 backwaters (with water depth greater than 4 feet), a cap would be placed over the existing river bottom to isolate the underlying PCB-containing sediment from the water column.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize the possibility of dam failure. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly characterized, managed, and/or disposed of. Moreover, under SED 9, Woods Pond, the Reach 7 impoundments, and Rising Pond would be subject to removal and capping, which would further mitigate the potential for PCB transport downstream even in the event of dam failure.

As indicated by EPA's model, implementation of SED 9, in combination with upstream source control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain. For example, the annual PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by 97% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 0.6 kg/yr). Similarly, SED 9 is predicted to achieve a 96% reduction in the PCB mass passing Rising

Pond Dam over the same period (i.e., from 19 kg/yr to 0.8 kg/yr). Likewise, SED 9 is predicted to result in a 98% reduction in the annual average mass of PCBs transported from the River to the floodplain within Reaches 5 and 6 over the modeled period (i.e., from 12 kg/yr to 0.2 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-27b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 9 over the 52-year model projection period. Similar to the other alternatives, the model results for SED 9 indicate that, in reaches subject to MNR only (i.e., the Reach 7 channel sections), the extreme flow event would not result in the exposure of buried PCBs at concentrations higher than those already present in the sediment surface prior to the event. For the reaches that would be capped following removal with a cap system that includes an armor stone layer (i.e., Reaches 5A, 5B 5C, and high shear stress portions of the Reach 7 impoundments and Rising Pond), EPA's model predicts that, given the cap's armor layer, buried sediments would not be exposed during the extreme storm event.[279] As a result, no change in reach-average surface sediment PCB concentrations associated with cap erosion is predicted for these areas (e.g., Figure 6-27b). In reaches where the cap, as specified by EPA, would include a 6-inch active layer overlain by as 6-inch habitat/bioturbation layer (i.e., Reach 5 backwater areas, Woods Pond, and the low shear stress areas of the Reach 7 impoundments and Rising Pond as defined in Appendix F), the model results (based on the assumptions described in Section 3.4) indicate that the habitat/bioturbation layer would be stable, with the exception of some limited areas in Reaches 7B, 7G, and Rising Pond. The model results indicate that a few grid cells in each of these reaches (2 to 5 cells, representing 3% to 31% of the portions of these reaches receiving such a cap) would experience erosion large enough to completely erode the 6-inch habitat/bioturbation layer during high flow events in Years 20-30 of the simulation, with the most significant of such erosion occurring during the Year 26 extreme event. The concentration increases associated with such erosion are 0.1 to 0.2 mg/kg, and the concentrations following the erosion events are 95% (Rising Pond) to 97% (Reach 7B) lower than current levels (Figure 6-27b). Overall, the model results for SED 9 indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

The remediation in Woods Pond under SED 9 would involve the installation of caps of varying thicknesses after sediment removal. In the deeper portion of the Pond (23 acres),

[279] Further evaluation of the stability of cap materials under SED 9 based on model predictions of erosion in these areas is provided in Section 6.9.5.2. The results of this stability analysis (i.e., percentages of cap areas that are predicted to be stable) are cited in the remainder of this discussion.

the cap would be installed to the pre-removal grade; but in the shallower portions (37 acres), a one-foot cap would be installed after removal of 3.5 feet of sediment, resulting in a net 2.5-foot increase in water depth. In these circumstances, the effect of that remediation on the trapping efficiency of solids in Woods Pond has been evaluated. As a result of the net increase in depth in the shallow portion of the Pond, the solids trapping efficiency of Woods Pond, as predicted by EPA's model, would increase by approximately 10% relative to MNR (from 15% under MNR to 26% under SED 9).

6.9.4 Compliance with Federal and State ARARs

The potential ARARs identified by GE for SED 9 in accordance with the directions from EPA are listed in Tables S-9.a through S-9.c in Appendix C. The compliance of SED 9 with these potential ARARs is discussed below.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-9.a, include the federal and state water quality criteria for PCBs. To evaluate whether SED 9 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 9. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Using 4-day rolling averages, two exceedances are predicted within the PSA (both at Holmes Road). These exceedances consist of consecutive 4-day averages resulting from a single high-flow event, and thus could be considered as a single exceedance. This is confirmed by the block averages, which indicate no exceedances for this alternative in these reaches. For reasons discussed in Section 3.5.1, assessment of achievement of this criterion has been based on the 4-day averages computed by the block averaging method. Under that approach, SED 9 would achieve this criterion, albeit at a significant environmental cost, as discussed in Sections 6.9.5.3 and 6.9.8.

The model-predicted annual average water column concentrations (which are used for assessment of human health-based water quality criteria and are presented in Table 6-61 in Section 6.9.5.1 below) exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches in Massachusetts. For the Connecticut impoundments, the water column concentrations estimated by the CT 1-D Analysis exceed the federal criterion in one of the four impoundments, although these estimates are highly uncertain (see Section 3.2.5). However, as discussed previously, the

ARARs based on the human health consumption criterion should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not by achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[280]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 9 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.9.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.9.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 9 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.9.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.9.6.1. These evaluations provide an assessment of the effect of SED 9 on the impairment listings.[281]

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[280] The estimated future water column concentrations in all the Connecticut impoundments under SED 9 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[281] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-61 (in Section 6.9.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 9 would meet the CDPH's unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.004 to 0.009 mg/kg. This provides further insight on the effect of SED 9 on the River's impairment listing in Connecticut.

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 9 are listed in Tables S-9.b and S-9.c.[282] As shown in those tables, SED 9 could be designed and implemented to achieve certain of the ARARs;[283] but, as with SED 3, there are a number of potential location-specific and action-specific ARARs that would not be met by SED 9. These are the same potential ARARs as described in Section 6.3.4 for SED 3 and include a number of federal and state regulatory requirements relating to ecological protection (including regulations regarding the protection of the Upper Housatonic ACEC). To the extent that these requirements would constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain location and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.9.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 9 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.9.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 9 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs available for such exposure, and other aspects of the alternative that would reduce potential exposure such as engineering and institutional controls.

[282] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

[283] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132) it is assumed that EPA would make the necessary determinations allowed by the regulations.

Implementation of SED 9, along with upstream source control and remediation measures and natural recovery processes, would reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and capping activities throughout Reaches 5 through 8 and the stabilization/removal of the bank soils in Reaches 5A and 5B would result in a significant reduction in the potential for exposure to PCBs in these areas. The placement of a cap (without removal) in certain Reach 5 backwaters would likewise reduce the surface sediment PCB concentrations in these areas, thereby reducing potential human and ecological exposures. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-61 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 9)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	0.2	2.5	1.6	0.3
5B	0.1	2.1	1.4	0.3
5C	0.2	1.4	0.9	0.2
5D (backwaters)	0.2	---	2.0	0.4
6	0.1	1.2	0.8	0.2
7[1]	0.01 – 0.9	0.8 – 1.1	1.0 – 3.7	0.2 – 0.7
8	0.2	0.9	1.2	0.2
CT[1]	0.003 – 0.006	0.04 – 0.09	0.02 – 0.05	0.004 – 0.009

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.9.6.[284]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets, resulting from the implementation of SED 9 over the 52-year model projection period are shown on Figures 6-27a-c. These figures show the timeframes over which the model predicts SED 9 would reduce the PCB concentrations in each medium. Similar to the other sediment alternatives, the general pattern exhibited by these temporal profiles is one of a large decline in PCB concentrations over the remediation period, followed by a period of smaller decline, or in some instances, a small increase until concentrations reach a steady-state with prevailing upstream loads and natural attenuation processes. However, unlike the other sediment alternatives, SED 9 shows a temporary increase in sediment concentrations in a few of the downstream impoundments (Reaches 7B and 7G and Rising Pond) for the period between completion of removal and subsequent capping activities under the scheduling approach specified by EPA for this alternative. Most notably, reach-average surface sediment concentrations in Rising Pond are predicted to increase from a pre-remediation average of approximately 3 mg/kg to about 9 mg/kg after completion of removal, and to remain at this level for approximately 3 years, until the cap is placed in this impoundment, resulting in concentrations less than 0.1 mg/kg. This increase is due to exposure of sediments with higher PCB concentrations at depth (as compared to those at the pre-removal surface). For this same reason, a slight decrease (less than 0.5 mg/kg) in the reach-average surface concentration is predicted for the Reach 7C impoundment during the period between removal and capping.

While the water column patterns exhibit significant year-to-year variability, including short-term increases in PCB concentration associated with sediment resuspension during remediation and with increased PCB transport during the Year 26 extreme flow event, most water column temporal changes follow those of the sediments. Temporal patterns in fish PCB concentrations generally reflect the predicted changes in water column and sediments. However, predicted fish concentrations in nearly all reaches increase for the first few years of the simulation and remain elevated for approximately 5 years as a result of the PCB releases associated with the performance of removal activities in the wet in Reaches 5A and 5B, as specified by EPA for this alternative. Over a longer timeframe, the remediation under SED 9 is predicted to reduce fish PCB concentrations over the projection period by

[284] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

96% to 99% in the remediated reaches (i.e., Reaches 5, 6, 7 impoundments, and 8), by 93% to 97% in the channel sections of Reach 7, and by 98% in the Connecticut impoundments (Figure 6-27c).[285]

PCBs would remain in the sediments beneath and outside the area addressed by this alternative. However, in the capped areas, the caps would prevent direct contact with, and effectively reduce the mobility of, the PCB-containing sediments beneath the caps. Overall, the extent to which SED 9 would mitigate the effects of a flood event that could cause PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.9.3. As discussed in that section, the model results for SED 9 indicate that, in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 9 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.9.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 9 has included an assessment of the use of technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

<u>Use of Technologies under Similar Conditions and in Combination</u>

As discussed previously, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments (e.g., EPA, 2005d; NRC, 2007). SED 9 involves such a combination. The SED 9 remedy components include sediment removal in the wet using mechanical excavation and transport equipment operating from a roadway constructed on the channel bottom (Reach 5A), sediment removal using mechanical dredging techniques (Reaches 5B and 7 impoundments), sediment removal

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[285] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 9 in the remediated reaches (Reaches 5, 6, 7 impoundments, and 8) and in the unremediated Reach 7 channel are similar to or slightly lower than those discussed in the text, ranging from 96% to 99% and 90% to 95%, respectively.

using hydraulic dredging techniques (Reaches 5C, 5 backwaters, 6, and 8), bank stabilization with removal of bank soils where necessary (in Reaches 5A and 5B), capping all the removal areas and capping some non-removal areas (in the deeper parts of the backwaters), and MNR (in the remaining areas). Most of these remedial techniques have been applied alone and in various combinations at a number of sites containing PCBs, as discussed for prior alternatives in Sections 6.3.5.2, 6.4.5.2, and 6.6.5.2.

However, SED 9 includes certain components that were not included in the sediment alternatives discussed above. The most notable is the performance of sediment removal, capping, and bank stabilization activities in Reach 5A in the wet, using excavation and transport equipment operating from the channel while water continues to flow in the River, as required by EPA. As noted above, this approach is assumed to involve the construction of a roadway on the channel bottom and the other components suggested by EPA, as described in Section 6.9.1. GE is unaware of any precedent for this approach indicating its feasibility on the scale that would be involved in SED 9. Further, there are many limitations of the components suggested by EPA that would make that technique unworkable and/or incapable of achieving the production and resuspension rates directed by EPA. These are discussed is Section 6.9.9.1 below.

In addition, SED 9 would involve the use of an active, or sorptive, layer in the cap for the backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond. Placement of such an active layer (e.g., granular activated carbon) has been demonstrated as part of the Grasse River (NY) Activated Carbon Pilot Study (www.thegrasseriver.com); however, the active layer was not placed as part of a cap but rather was directly applied to the surface sediments within the Grasse River pilot area. The use of granular activated carbon has also been demonstrated at the Hunter's Point Pilot Study (CA) via the amendment of the *in situ* sediments (Luthy et al., 2009); see discussion of this field demonstration project in Appendix A. Reactive capping was also demonstrated in the Anacostia River (Washington, DC) using a series of cells with different materials and designs (Reible et al., 2004). In general, the use of an active layer to remediate PCB-containing sediments has been limited to smaller-scale applications than would be involved under SED 9.

There are also no known precedents for the suggested timing and order of operation for SED 9 as GE is not aware of any other ongoing or completed projects where downstream capping has been deferred by more than one construction season following removal activities.

Finally, on an overall basis, based on its review of dredging/removal projects, GE identified only one completed environmental dredging project with a removal volume exceeding the magnitude of SED 9 (approximately 920,000 cy of removal). That project was conducted at the Milltown Reservoir Sediments Site in Montana and involved the removal of approximately 2.0 to 2.3 million cy of sediments behind a dam along with the dam itself. In addition, as discussed in Section 6.5.5.2, there have been a handful of completed dredging projects with removal volumes between 400,000 and 800,000 cy. However, as also discussed in that section, all of these sites have very different conditions from those in the Rest of River. Similarly, the sites where larger dredging or capping remedies have been selected but not completed (e.g., the Hudson and Fox Rivers and Onondaga Lake) are significantly different in environmental setting from the Rest of River, as also discussed in Section 6.5.5.2.

In short, given the unprecedented components and magnitude of SED 9, complications could arise during implementation that have not been encountered at other projects and that could compromise the long-term reliability and effectiveness of SED 9.

<u>General Reliability and Effectiveness – Sediment Remediation Techniques</u>

With the exception of the untested sediment remediation and bank stabilization approach suggested by EPA for Reach 5A, SED 9 would otherwise utilize sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These include sediment removal, capping, and MNR. The general reliability and effectiveness of these technologies were previously discussed in Section 6.3.5.2. However, given the lack of precedent for the sediment removal/capping technique suggested by EPA for Reach 5A, as well as the engineering limitations discussed in Section 6.9.9.1 below, the feasibility, reliability, and effectiveness of that technique are at best unknown, and the technique may not be workable.

With respect specifically to the caps, as with the alternatives discussed above, model predictions of erosion in areas receiving a cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. Under SED 9, the areas receiving a cap system that includes an armor stone layer following sediment removal include Reaches 5A, 5B, and 5C, and high shear stress portions of the Reach 7 impoundments and Rising Pond (as specified in Appendix F). Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving an armored cap under SED 9 are predicted to be 100% stable. SED 9 also includes areas where the cap, as specified by EPA, would consist of a 6-inch active layer overlain by as 6-inch habitat/bioturbation layer placed either following removal (in Reach 5 backwater areas shallower than 4 feet, Woods Pond, and the low shear stress areas of the Reach 7 impoundments and Rising Pond) or without removal (in the Reach 5 backwater areas deeper than 4 feet). For the purposes of assessing stability of such a configuration, the cap was considered stable when at least 50% of the total placed thickness remained for the full duration of the model projection (i.e., such that no erosion of the active layer would occur). The model predicts that these caps would largely remain stable, as they would be stable over 69% to 100% of the surface area in the reaches receiving such caps. The areas in the Reach 5 backwaters and Woods Pond receiving these caps are predicted to be 100% stable. Within the portions of the two Reach 7 impoundments (Reach 7B and 7G) and Rising Pond receiving such a cap, the erosion over the remaining 3% to 31% of capped areas (corresponding to 2 to 5 model grid cells in these reaches) is predicted to occur in response to high flow events occurring in Years 20-30 of the simulation. Such erosion is predicted to result in minimal increases (0.2 mg/kg or less) in the reach-average 0- to 6-inch surface sediment PCB concentration in these reaches (Figure 6-27b). After the increases in concentration described above are taken into account, the concentrations following the high flow events still represent reductions, relative to current levels, of 96% to 97% in Reaches 7B and 7G and 95% in Rising Pond (as discussed in Section 6.9.3). Based on these results, the model indicates that the caps containing an active layer overlain by a habitat/bioturbation layer, as specified by EPA, under SED 9 would largely remain in place.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted in Section 6.9.1 and discussed in Section 3.1.4 and Appendix G, the riverbanks in Reaches 5A and 5B would be stabilized using a modified combination of bioengineering and hard engineering techniques that can be implemented under submerged conditions, including greater use of hard engineering measures such as riprap than in the previously discussed alternatives. The general reliability and effectiveness of this stabilization approach were described in Section 6.3.5.2. Again, however, the novel approach suggested by EPA (described in Section 6.9.1) for installing these stabilization measures on both banks in Reach 5A from a roadway within the flowing river channel is unproven and may not be workable.

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 9 would be subject to restoration as discussed in the restoration methods subsections in Section 5.3. However, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the affected habitats. These constraints and the consequent likelihood of restoration success are discussed in Sections 5.3.1.4 for aquatic riverine habitats, 5.3.2.4 for riverbanks, 5.3.3.4 for impoundments, and 5.3.6.4 for backwaters, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 9. For the reasons discussed in those sections, these restoration methods would not be expected to re-establish pre-remediation conditions for some of these habitats for many decades and would likely never do so for other habitats. As such, these restoration methods would not be fully effective or reliable in returning these habitats to their pre-remediation state. (These issues are discussed further in Section 6.9.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques – including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the capped areas and riverbanks – would be implemented to maintain and track the long-term effectiveness of SED 9. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping components of the remedy have remained in place. Should changes in the capped riverbed or the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts (although the restoration efforts themselves would not be expected to re-establish pre-remediation conditions for certain of the affected habitats and would not reestablish pre-remediation conditions of other habitats for many decades). The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 9 would be applied in areas of the River where site conditions are expected to support long-term reliability with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Small-scale repairs not requiring access road re-construction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain. However, redesign/replacement of larger remedy components could require more extensive disturbance of the river bottom, banks, and/or the adjacent floodplains to support access.

6.9.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 9 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 9 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 9 would alter the habitat of the aquatic areas that would be excavated and/or subject to capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 9 would affect portions of the mapped Priority Habitats of 30 state-listed rare species, as described in Appendix L. Due to the widespread areas affected by SED 9, it would have an extensive negative impact on the habitats of the River and the adjacent floodplains. The long-term impacts of SED 9 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Adverse Impacts on Aquatic Riverine Habitat in Reaches 5A, 5B, and 5C

SED 9 would involve sediment removal and/or capping activities in the entirety of Reaches 5A, 5B, and 5C. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4. The specific impacts of SED 9 on these habitats would be the same as those of SED 6, SED 7, and SED 8, as described (for SED 6) in Section 6.6.5.3. In summary, over time, due to deposition of sediments from upstream, the physical substrate type would be expected to approximate its prior condition, and a biotic community consistent with that substrate type would be expected to develop. However, the length of time for that to occur is highly uncertain and unreliable and would be delayed, particularly in the further downstream reaches, due to the extensive upstream riverbed and riverbank remediation. Further, the abundance of organisms and richness of the mix of species in the new biotic communities are also uncertain, the return of certain specialized species (including state-listed species) is doubtful, and colonization by invasive species is highly probable.

Long-Term Adverse Impacts on Riverbank Habitats

As previously described, SED 9 would include stabilization of the riverbanks in Reaches 5A and 5B using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. Those stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. Those impacts were described in Section 5.3.2.4 and would be similar to the impacts summarized in Section 6.3.5.3 for SED 3, including a permanent loss of the vertical and cut banks and the mature overhanging trees that are critical to some species. In addition, as discussed above, the bank stabilization techniques identified for implementation in the dry have been modified for SED 9 to eliminate bioengineering measures that cannot practically be performed under water; and that modified approach involves a greater use of hard engineering techniques, such as riprap, than would be used under alternatives where the stabilization work would be performed in the dry. This would result in a reduced amount of densely vegetated bank under SED 9 compared to those alternatives. Consequently, habitat suitability for riverbank species that forage, rest, burrow, hibernate, or nest in the sediments or vegetation along the banks would be further diminished under SED 9 compared to those alternatives. This riprap would also result in a long-term reduction in the density and vigor of shrub growth, further reducing habitat value. Overall, for these reasons, as well as those discussed previously for SED 3, it is not expected that the riverbanks in Reaches 5A and 5B would ever return to their current condition and level of function.

Long-Term Adverse Impacts on Impoundment Habitats

SED 9 would include sediment removal/capping throughout Woods Pond, the Reach 7 impoundments, and Rising Pond. The long-term impacts of such activities on impoundments generally were discussed in Section 5.3.3.4. Under SED 9, the caps used in these impoundments would include a 6-inch habitat/bioturbation layer that attempts to mimic existing substrate conditions by placing high-organic materials on top of the sorptive layer. The use of this layer would increase the potential for the return of aquatic plants and invertebrates that utilize this type of substrate. However, given the extensive disturbances that would occur throughout these impoundments, there would still be long-term adverse impacts (except in the “deep hole” of Woods Pond, where, as noted above, no significant long-term adverse impacts would be expected). While the use of the habitat/bioturbation layer may help to hasten the development of a biological community typical of such impoundments, the length of time for such a community to develop remains uncertain, particularly given the extensive remediation under SED 9. Moreover, the delay between removal and capping in these impoundments would cause two separate disturbances – one for removal and another, 2-3 years later, for capping – which would further prolong the adverse impacts and delay any recovery. Further, the community that ultimately develops in these impoundments may include changes in the mix of native species, and the return of certain specialized native species (including state-listed species) is doubtful. Finally, it is expected that invasive aquatic plant species such as those currently present would return to these impoundments. However, in the shallower portions of Woods Pond, the sediment removal and the increase in water depth resulting from removal of 3.5 feet of sediments followed by placement of a one-foot cap would aid in limiting the proliferation of invasive species, at least for several years.

Long-Term Adverse Impacts on Backwaters

Removal/capping throughout the backwater areas under SED 9 would also have long-term negative impacts. The long-term impacts of remediation on backwater habitats are discussed generally in Section 5.3.6.4. As with the impoundments, the use of a 6-inch habitat/bioturbation layer in the backwater caps under SED 9 would increase the potential for the return of conditions comparable to pre-remediation conditions in terms of substrate, hydrology, and vegetative characteristics. However, given the extensive disturbances throughout these backwater areas, there would remain considerable uncertainties regarding the extent and timing of the return of such conditions. During that uncertain period, the wildlife communities using the backwaters would be adversely affected. Moreover, as with the other habitat types, the abundance of organisms and mix of species that would return to the backwaters are uncertain, the return of certain specialized species (including state-listed species) is doubtful, and there is a high likelihood of domination by invasive species.

Long-Term Adverse Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 9 includes 20 staging areas covering approximately 43 acres (including 5 acres within the floodplain) and approximately 5 miles of temporary roadways covering an additional 12 acres (including 1.9 miles and 4.7 acres in the floodplain), as shown on Figures 6-24a-b. Since the sediment removal/capping and bank stabilization work under SED 9 would all be performed from within the River, this alternative would require fewer access roads than the removal alternatives discussed above. Nevertheless, some such access roads would be needed, as would staging areas. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (2.8 acres), shrub and shallow emergent wetlands (1.5 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (3.0 acres), and upland forests (0.4 acres).[286] These impacts would occur

[286] Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 9 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas

mainly in Reaches 5A and 5B, with additional impacts in limited portions of Reaches 5C, 6, 7, and 8 to support the remediation in those portions. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats). At a minimum, these impacts would be expected to last for decades, and the extent and timing of the return of the affected habitats to pre-remediation conditions are uncertain.

Long-Term Impacts on State-Listed Species

As noted above, SED 9 would affect portions of the Priority Habitats of 30 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 9 would involve a "take" of at least 26 of these species and would adversely affect a significant portion of the local population of at least 12 of them. The table below lists the 30 state-listed species whose Priority Habitat would be affected by SED 9, along with those for which SED 9 would result in a take and those for which SED 9 would impact a significant portion of the local population:

Table 6-62 – Impacts of SED 9 on State-Listed Species

Species with Priority Habitat Affected by SED 9	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	Likely
Arrow clubtail	Yes	Yes
Bald eagle	Yes	Unlikely
Black maple	Yes	Unlikely
Bristly buttercup	Yes	No
Brook snaketail	Yes	Yes
Bur oak	Yes	No
Common moorhen	Yes	Yes
Creeper	Yes	No

(e.g., agricultural fields and cultural grasslands) (24 acres), with additional impacts occurring in forested uplands (11 acres) and in wet meadow and emergent marsh habitats (1 acre). Impacts associated with access roads and staging areas in Reach 7 would be minimal (approximately 0.3 acre of upland forest); however, approximately 12 acres of habitat would be impacted by such facilities in Reach 8 (9 acres of upland forest, 2 acres of wetland habitats, and 1 acre of disturbed upland).

Species with Priority Habitat Affected by SED 9	Take?	Impact on Significant Portion of Local Population?
Crooked-stem aster	Unlikely	No
Foxtail sedge	Yes	Unlikely
Gray's sedge	Possibly	No
Hairy wild rye	Yes	Unlikely
Intermediate spike-sedge	Yes	Yes
Jefferson salamander	No	No
Longnose sucker	Yes	No
Mustard white	Yes	Unlikely
Narrow-leaved spring beauty	Yes	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	Yes
Riffle snaketail	Yes	Yes
Skillet clubtail	Yes	No
Spine-crowned clubtail	Yes	Yes
Stygian shadowdragon	Yes	No
Triangle floater	Yes	Yes
Wapato	Yes	Yes
Water shrew	Yes	Yes
White adder's-mouth	No	No
Wood turtle	Yes	Yes
Zebra clubtail	Yes	Yes

<u>Long-Term Impacts on Aesthetics and Recreational Use</u>

SED 9 would have long-term impacts on the aesthetic features of the natural environment. The sediment removal and capping activities in Reaches 5 through 8, as well as bank stabilization along approximately 7 miles of both banks of Reaches 5A and 5B, would alter the appearance of the River during the course of those activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of the banks would never resemble the banks' appearance prior to remediation.

The construction of access roads and staging areas to support implementation of SED 9 would also cause long-term impacts on the aesthetics of the floodplain. Although SED 9 would involve fewer access roads than prior alternatives, the placement of those roadways, as well as the staging areas, would remove trees and vegetation, including in some forested areas. This would change the appearance of these areas until such time (if ever) that they return to their prior state. The length of time that the appearance of the floodplain in these in these areas would be changed depends on the length of time that the roads and staging areas remain, along with additional time for these areas to return to a natural appearance. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for a replanted forest community to develop an appearance comparable to their current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 9 include areas used for canoeing, fishing, hiking, waterfowl hunting, hiking, and general recreation. These recreational activities would be disrupted by the implementation of SED 9. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts to Fluvial Geomorphic Processes

In addition to reducing or preventing bank erosion and lateral channel migration, the stabilization of the banks in Reaches 5A and 5B, as well as the capping and armoring of the riverbed in those reaches, would reduce the supply of sediment to the River. The potential impacts of this reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. As discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization and riverbed armoring would not be expected to result in a large-scale, long-term impact on these river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity. This conclusion would also apply to SED 9.[287]

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[287] Similar to SED 3, model results for SED 9 suggest that bank stabilization and bed armoring, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on larger-scale bed elevation change over the 26-year simulation relative to SED 1 (no action). As expected, the reduction in sediment loading associated with bank and bed remediation under SED 9 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank and bed erosion), within several areas of the River (mainly in Reaches 5A and 5B).

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 9, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 9 are described in Sections 5.3.1.3 for aquatic riverine habitat, 5.3.2.3 for the riverbanks, 5.3.3.3 for impoundments such as Woods Pond, and 5.3.6.3 for backwaters, and in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas. However, as discussed above, implementation of these restoration methods would not prevent long-term impacts from the remedial construction activities in SED 9.

6.9.6 Attainment of IMPGs

As part of the evaluation of SED 9, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 9, and those comparisons are shown in Tables 6-63 through 6-68.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-63 through 6-68.[288] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain.

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[288] The extent to which SED 9 would accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[289]

6.9.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations under SED 9 would achieve the RME IMPGs based on a 10^{-6} cancer risk and a non-cancer HI of 1 in all eight sediment exposure areas (Table 6-63). Many of these IMPGs are achieved prior to the start of the remediation, while the others would be achieved in time periods ranging from approximately 5 to 15 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model in Year 52, when converted to fillet-based concentrations, would not achieve the fish consumption IMPGs based on RME assumptions in Reaches 5 through 8 (except for the RME IMPGs based on a 10^{-4} cancer risk, but not the corresponding non-cancer IMPGs, in some subreaches) (Table 6-64).[290] However, in the Connecticut impoundments, the CT 1-D Analysis indicates that SED 9 would achieve the RME IMPGs associated with a cancer risk level of 10^{-5} as well as non-cancer impacts.[291]

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[289] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 9, in almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted. (Full comparisons between model results for the base case and lower bound simulations are provided in Appendix K.)

[290] Application of the lower-bound model assumptions results in four additional instances of attainment of the RME IMPGs in the Massachusetts reaches (the probabilistic RME IMPG based on non-cancer impacts to adults in Reach 6 and the deterministic RME IMPG based on a 10^{-4} cancer risk in Reaches 7B, 7C, and 7E).

[291] SED 9 would also achieve many of the CTE-based IMPGs in certain of the subreaches of Reaches 5 through 8, as well as all CTE IMPGs in Connecticut. Application of the lower-bound model assumptions results in five additional instances of attainment of the CTE IMPGs (i.e., attainment of the deterministic CTE IMPG based on non-cancer impacts to children in Reaches 7B, 7C, and 7E and adults in Reach 7F, and the probabilistic CTE IMPG based on non-cancer impacts to children in Reach 7D).

In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 meals per year, based on a deterministic approach and a 10^{-5} cancer risk as well as non-cancer impacts, would take 140 to >250 years in the PSA, 170 to >250 years in Reach 7, and >250 years in Reach 8.

6.9.6.2 Comparison to Ecological IMPGs[292]

For benthic invertebrates, predicted average surface sediment concentrations would achieve both the lower and upper bounds of the IMPG range (3 to 10 mg/kg) in all averaging areas within the model period (Table 6-65). These levels would generally be achieved immediately following completion of remediation where the levels are not below the range at the onset of the projection period.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve both the lower and upper bounds of the IMPG range (3.27 to 5.6 mg/kg) in all of the backwaters evaluated (Table 6-66). Times to achieve the lower-bound IMPGs generally range from 1 to 10 years.

For fish, the model-predicted average whole-body fish PCB concentrations would achieve the applicable IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg) in all reaches (Table 6-67). Estimated times to achieve these IMPGs in reaches where they are not already met prior to the start of the model projection range from approximately 5 to 10 years for warmwater fish and approximately 10 to 15 years for coldwater fish.

For insectivorous birds (represented by wood duck) and piscivorous mammals (represented by mink), the model-predicted surface sediment concentrations were compared to selected target sediment levels of 1, 3, and 5 mg/kg, as discussed previously. For both receptor groups, the predicted surface sediment concentrations are below all three of the target

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comparisons described above. For SED 9, this change in averaging method (and the resulting increase in concentration) results in a few changes in the IMPG attainment presented in Table 6-64 – notably, that SED 9 would no longer achieve the probabilistic RME 10^{-6} cancer IMPG in one Connecticut impoundment (Lake Lillinonah), and the deterministic CTE non-cancer (adult) IMPG in Reach 7A).

292 While this section describes the extent to which SED 9 would achieve the IMPGs for ecological receptors, it is also critical to consider the adverse impacts from implementation of that alternative on the ecological receptors that the IMPGs are designed to protect, as discussed in Sections 6.9.5.3 and 6.9.8, and to balance those impacts against the residual risks of PCBs in determining overall environmental protectiveness, as discussed in Section 6.9.11.

sediment levels evaluated in all averaging areas (Table 6-68), with times to achieve these target levels generally ranging between 1 and 10 years.[293]

For piscivorous birds (represented by osprey) and threatened and endangered species (represented by the bald eagle), the model-predicted average whole-body fish PCB concentrations would achieve the applicable receptor IMPGs in all reaches (Table 6-67).[294] Estimated times to achieve these IMPGs range between 10 and 15 years for piscivorous birds and between 5 and 10 years for threatened and endangered species.[295]

6.9.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 9 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 9 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 9 would reduce the mobility of PCBs in the River by removing approximately 886,000 cy of sediment containing PCBs in Reaches 5 through 8 and placing a cap over those areas. SED 9 would also include stabilizing the banks in Reaches 5A and 5B, including the removal of 35,000 cy of PCB-containing soils from those banks, and

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293 In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 9 has been paired with FP 8. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 9, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

294 In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no changes in attainment of the piscivorous bird IMPG under SED 9.

295 EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 9 at the end of the simulation period are 0.003 to 0.006 mg/kg, and estimated fish PCB levels (whole body) in the Connecticut impoundments at the end of the projection period under SED 9 are in the range of 0.02 to 0.05 mg/kg (Table 6-61). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

placing a cap over certain additional sediments in the Reach 5 backwaters. In total, caps would be placed over approximately 336 acres (42 in Reach 5A, 27 in Reach 5B, 57 in Reach 5C, 71 in Reach 5 backwaters, 60 in Woods Pond, 38 in the Reach 7 impoundments, and 41 in Rising Pond). These caps would prevent or minimize the mobility of PCBs in the underlying sediments.

Reduction of Volume: SED 9 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of approximately 921,000 cy of sediments/bank soils containing approximately 31,100 lbs of PCBs.

6.9.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 9 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term adverse impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Since the remedial actions under SED 9 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas. Nevertheless, given the extent and duration of remediation activities under SED 9, the short-term impacts would be widespread and occur over about a decade and a half in the Rest of River area.

Impacts on the Environment – Effects Within PSA

The short-term adverse effects on the environment resulting from implementation of SED 9 would include: potential impacts to the water column, air, and biota in the Rest of River area during excavation and capping activities; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal (with capping activities) in Reaches 5, 6, 7, and 8 (886,000 cy over 333 acres) would result in resuspension of PCB-containing sediment due to the invasive nature of removal operations. In Reach 5A, the performance of removal by equipment operating on the river bottom while water is flowing in the River would be conducive to resuspension, both due to the higher water velocities in Reach 5A compared to downstream reaches and due to the operation of removal equipment in a flowing river. Even using the elevated roadway technique suggested by EPA (as described in Section

6.9.1), there remains a high potential for resuspension of PCB-containing sediments due to the bank soil disturbances in building access ramps on the banks, as well as the dredging equipment that would have to be used. Under the approach suggested by EPA, use of a clamshell bucket that fully closes, such as can be used on barge-mounted dredges, would not be feasible, since such equipment is limited with respect to the weight that can be effectively picked up when the bucket is fully extended, and thus would not have a sufficient reach for use in Reach 5A under SED 9. As a result, it would be necessary to use a long-reach excavator with an open bucket, which would increase the release of dredged material into the water.[296] In the downstream reaches, the performance of dredging using barge-mounted mechanical or hydraulic dredges would likewise cause resuspension, even though the areas would be surrounded by silt curtains.[297] In addition, boat and barge traffic could resuspend sediment during the remedial construction activities.

For these reasons, the sediment removal activities (even with the use of silt curtains) would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River), and would be expected under SED 9.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 9 would cause a loss of aquatic habitat over approximately 333 acres of River in Reaches 5A, 5B, and 5C, the Reach 5 backwaters, Woods Pond, the Reach 7 impoundments, and Rising Pond where sediment removal would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine, impoundment, and backwater habitats was provided in Sections 5.3.1.2, 5.3.3.2, and 5.3.6.2, respectively. These impacts include removal of the natural bed material, debris, and aquatic vegetation which are used as habitat by both fish and benthic

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[296] Palermo et al. (2008, p.160) reported that backhoe excavators had resuspension rates that were 2 to 3 times those of clamshell dredges.

[297] For example, as previously noted, the recent Phase 1 mechanical dredging of the Upper Hudson River from barges showed an overall PCB resuspension rate of 3% at least a mile downstream of the dredging operations, with a rate of approximately 4% outside areas with resuspension controls (Anchor QEA and ARCADIS, 2010); and resuspension rates of 1.3% to 5.8% of solids were observed during pilot clamshell dredging in the Passaic River (Lower Passaic River Restoration Project Environmental Dredging Pilot Study Work Group, 2009). For hydraulic dredging, resuspension rates of 3% and 2.2% were reported during hydraulic dredging in the Grasse River (Connolly et al., 2007) and pilot hydraulic dredging in the Fox River (USGS, 2000), respectively. Overall, if 3% of the PCB mass dredged in Reaches 5C, 5 backwaters, 6, 7, and 8 were lost to the water column during the removal operations under SED 9, that would equate to approximately 540 lbs of PCBs.

invertebrates; direct loss of benthic invertebrates and aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; disruption and displacement of fish; and alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation. Overall, the short-term adverse impacts from removal under SED 9 would affect significantly more area of aquatic habitat than would occur from sediment removals under SED 3 through SED 7 and almost as much as would occur under SED 8.

Bank Stabilization: Bank stabilization activities in Reaches 5A and 5B would have immediate adverse effects on the riparian corridor bordering the River, which provides habitat that is unique to its position on the landscape. These impacts were described for SED 3 in Section 6.3.8 and would also occur under SED 9. In addition, since all of the bank stabilization work under SED 9 would be conducted in the wet, requiring a greater use of hard stabilization techniques such as riprap than under alternatives where the stabilization would be performed in the dry, it would further reduce the amount of suitable bank habitat for species that rely on soft banks for nesting or resting, further limit wildlife movement between aquatic and terrestrial habitats, and reduce the density and diversity of herbaceous and shrub plant species on the banks.

Capping: Capping activities in the Reach 5 backwaters would be performed during lower flow conditions. While resuspension is possible due to capping activities, the potential for resuspension of PCB-containing sediment during capping is anticipated to be much less than during removal activities since capping would involve placing clean material on undisturbed native sediment, and silt curtains would be in place in an effort to limit transport of solids to downstream reaches.

Placement of the caps (without removal) as part of SED 9 would occur over the 3 acres of backwaters that would not be subject to removal. This capping, while limited in extent, would extend the short-term adverse impacts from the sediment removal followed by capping in the rest of the backwaters, so that those impacts would affect all of the backwaters.

Supporting Facilities: Construction of access roads and staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the loss of the wildlife that they support. The number and acreage of staging areas required for SED 9 are similar to those for SED 3 and SED 4 (Sections 6.3.8 and 6.4.8). However, the total length and associated acreage of access roads required for SED 9 are much lower than for any of the preceding alternatives, since all remediation work, including in Reaches 5A and 5B, would be conducted from within the River, thus limiting the need for access roads along the banks. It is anticipated that SED 9 would require a total of approximately 55 acres for access roads and staging areas (approximately 10 acres within the 10-year floodplain).

The principal habitat types affected were identified in Section 6.9.5.3 and include floodplain forests, shrub and shallow emergent wetlands, disturbed upland habitats, and upland forests. The short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 9 would be the same as those listed in Section 6.3.8 for the support facilities under SED 3, with the exception that the impacts associated with temporary access road construction would be more limited.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 9.

The total calculated emissions from SED 9 would amount to approximately 180,000 tonnes of GHG emissions, with 66,000 tonnes resulting from direct emissions (primarily from construction activities, transportation, and mulch decay/sequestration of removed vegetation), 3,800 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 110,000 tonnes from off-site emissions (primarily from manufacture of cement for stabilization and from diesel refining). The total GHG emissions estimated for this alternative are equivalent the annual output of 34,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 9 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 9, these impacts would affect portions of Reaches 5 and 6 for an estimated 11 years, with impacts to the Reach 7 impoundments and Rising Pond occurring over 6 years (with some overlapping of these periods).

Impacts on Recreational Activities: Recreational activities in the areas of Reaches 5 and 6 that would be affected by SED 9 include fishing, canoeing, hiking, dirt biking/ATVing, waterfowl hunting, and general recreation. Recreational activities in Reaches 7 and 8 include fishing and canoeing. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, hunters, and other recreational users would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those areas during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment and capping/stabilization materials to the work areas and to remove excavated materials from the work areas, truck traffic in the area would increase substantially over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 9 (approximately 14 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 76,000 truck trips to do so (5,430 truck trips per year for a 14-year implementation period). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 66,500 additional truck trips (4,750 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near the work areas.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and staging area materials following completion of remediation.[298] This analysis indicates that the increased truck traffic associated with SED 9 would result in an estimated 4.64 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.35) with a probability of 99% of at least one such injury, and an estimated 0.22 fatalities from accidents (average fatality estimate of 0.02) with a probability of 20% of at least one such fatality.

[298] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

Potential Measures to Avoid, Minimize of Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[299] These measures would consist of the ones identified in Section 5.7 and summarized in Section 6.3.8 above. Despite the implementation of these measures, detrimental effects of construction and short-term impacts and risks associated with implementation of SED 9 would be inevitable.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing SED 9. Implementation of SED 9 is estimated to involve 912,433 man-hours over a 14-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 9 would result in an estimated 8.48 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.63) with a probability of 100% of at least one such injury, and an estimated 0.11 worker fatalities (average annual fatality estimate of 0.008) with a probability of 10% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.9.9 Implementability

6.9.9.1 Technical Implementability

The technical implementability of SED 9 has been evaluated considering the factors identified below.

General Availability of Technologies: SED 9 would be implemented using some well-established and available in-river remediation methods and equipment, except in Reach 5A, where the removal/capping/bank remediation technique assumed for this evaluation in accordance with EPA's suggestions is unproven, as discussed in Section 6.9.5.2 above. The land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

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[299] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

Ability To Be Implemented: GE is unaware of any precedent for the assumed removal/capping/bank remediation technique for Reach 5A (described in Section 6.9.1) that would indicate its feasibility on the scale involved in SED 9. Further, assuming use of the components of this technique suggested by EPA, there are many apparent limitations of those components that would make this technique unworkable and/or incapable of achieving the production and resuspension rates directed by EPA. For example, if crawler carriers are used to move excavated sediment and cap materials, they have capacity and speed limitations. Although the heaped capacity of the crawler carrier is 8 cy, its capacity when carrying wet sediments would be much less, probably about 4 cy, due to the aqueous nature of the sediments and the potential for spillage in the River and when going up the access ramps if it were full. Further, the crawler carrier would need to operate in low gear in the river, which would be approximately 2.8 mph. In addition, as noted in Section 6.9.8, use of a clamshell bucket that fully closes, such as can be used on barge-mounted dredges, would not be feasible under this approach because of its limited reach due to weight limitations when the bucket is fully extended. Instead, a long-reach excavator with an open bucket would have to be used, which would increase the release of dredged material into the water. Moreover, if the roadway is built along one bank of the river, even that type of long-reach excavator would not be able to reach across the channel in approximately half of the areas subject to this approach.[300]

The remaining technologies and process options that are part of SED 9 would be technically implementable in the reaches where they would be applied. In the areas downstream of Reach 5A, sediment removal in the wet followed by capping would be implemented using barge-mounted mechanical or hydraulic dredging techniques, depending on the sediment volumes, composition, and water depths. Removal in the wet (both mechanical and hydraulic) with capping has also been used at other sites, as noted in Sections 6.4.5.2 and 6.6.5.2. Since the current river bathymetry would be maintained in those areas where sediment removal and subsequent capping are performed, there would be no net loss of flood storage capacity.

Capping without prior removal would be implemented in portions of the Reach 5 backwaters where the water is greater than 4 feet deep (approximately 3 acres). Since the backwater effects are controlled by the dams, and the area of capping without prior removal is limited

[300] The effective reach of a long-reach excavator of the type that could be used for this application in Reach 5A is 50 to 60 feet. Such an excavator would not be able to reach the sediments and banks on the opposite side from the road in portions of Reach 5A where the width of the River exceeds approximately 75 feet (taking into account the width of the road). Review of 152 transects across the River in Reach 5A indicates that, at approximately half of those transects (79), the distance from the edge of water along one bank to the top of bank on the other side is greater than 75 feet.

to 3 acres, impacts to flood storage capacity would not be expected as a result of cap placement. This would be evaluated during design as necessary.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed in Reaches 5A and 5B. Conceptual stabilization techniques were described in Sections 3.1.4 and 6.9.1 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in the relevant river stretches.

MNR with institutional controls would be implemented in the downstream reaches. Monitoring to track changes in PCB concentrations following the SED 9 remedial activities could be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 9 could readily be constructed using commonly available construction techniques. As discussed above, efforts would be made to construct these facilities to avoid wetlands and other sensitive habitats where practicable.

Reliability: Apart from the removal/capping/bank remediation technique for Reach 5A (discussed above), the other remediation technologies that comprise SED 9 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.3.5.2, 6.4.5.2, 6.5.5.2, and 6.6.5.2. However, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, as discussed in Sections 6.9.5.2 and 6.9.5.3.

Availability of Space for Support Facilities: Implementation of SED 9 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, approximately 55 acres of space would be needed, and appear to be available to support the SED 9 activities based on preparation of a conceptual site layout (assuming that the necessary access agreements can be obtained). Development of access roads and staging areas would be sequenced and constructed appropriately over the implementation period for SED 9.

Availability of Cap/Stabilization Materials: Materials required for cap placement and bank stabilization must be of suitable quality for their intended purposes. Approximately 601,000 cy of sand/stone materials would be required for capping and stabilization activities (including 379,000 cy of sand and 222,000 cy of armor stone and riprap). For purposes of this Revised CMS Report, adequate material sources are assumed to be available, although their proximity to the site is uncertain. An evaluation would be required during design activities to determine material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 9. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 9 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.9.9.2 Administrative Implementability

The administrative implementability of SED 9 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 9 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 9 is provided in Tables S-9.a through S.9-c in Appendix C and summarized in Section 6.9.4.

Access Agreements: Implementation of SED 9 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although many of the areas in Reach 5 are owned by the Commonwealth or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 40 to 50 other landowners to implement SED 9. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA's assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 9, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.9.10 Cost

The estimated total cost to implement SED 9 is $337 M (not including treatment or disposition of removed materials). The estimated total capital cost is $326 M, assumed to occur over a 14-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed (visual observations only), riverbanks, and restored staging areas and access roads; these costs range from $15,000 to $375,000 per year (depending on which reach is being monitored), resulting in a total cost of $2.4 M. The estimated annual OMM costs for SED 9 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately $32,500 to $769,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of $8.7 M. The following summarizes the total capital and OMM costs estimated for SED 9.

SED 9	Est. Cost	Description
Total Capital Cost	$326 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$11.1 M	Costs for performance of the OMM programs
Total Cost for Alternative	$337 M	Total cost of SED 9 in 2010 dollars

The total estimated present worth cost of SED 9, which was developed using a discount factor of 7%, a 14-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $214 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for the combination of SED 9 and FP 8 are presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.9.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.9.2, the evaluation of whether SED 9 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

General Effectiveness: As discussed previously, SED 9, if feasible, would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 886,000 cy of PCB-containing sediments in Reaches 5 and 6, the Reach 7 impoundments, and Rising Pond along with placing a cap over the underlying sediments; (b) stabilizing the riverbanks in Reaches 5A and 5B, including removal of 35,000 cy; (c) placing a cap over 3 acres in the Reach 5 backwaters where no excavation would be performed; and (d) relying on natural recovery processes in other areas. As shown in Section 6.9.3, implementation of SED 9 is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 0.6 kg/yr, that passing Rising Pond Dam from 19 to 0.8 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 0.2 kg/yr over the modeled period.

Further, as shown in Section 6.9.5.1, EPA's model predicts that implementation of SED 9 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 1-2 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 1 mg/kg in the Reach 7 impoundments, from 30 mg/kg to approximately 1 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.02-0.05 mg/kg in the Connecticut impoundments.

On the other hand, SED 9 would have substantial long-term negative impacts on many species, including the likely loss of some sensitive species from portions of the PSA, as discussed in Section 6.5.5.3, and would thus actually increase the risks to biota in the Rest of River as a result of habitat loss.

Compliance with ARARs: As explained in Section 6.9.4, review of the chemical-specific ARARs indicates that SED 9 would achieve the chemical-specific ARARs except for the water quality criterion of 0.000064 μg/L, which should be waived as technically impracticable to attain. Further, review of the potential location-specific and action-specific

ARARs indicates that SED 9 could be designed and implemented to meet many of those ARARs, but that a number of federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As discussed in Section 6.9.6.1, accepting EPA's HHRA, SED 9 would provide protection of human health from direct contact with sediments, since it would achieve IMPG levels based on a 10^{-6} cancer risk or lower, as well as all non-cancer IMPGs, in all sediment exposure areas, with the majority of those levels achieved at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 9 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the RME-based IMPGs (i.e., those based on unrestricted consumption of Housatonic River fish) in Reaches 5 through 8 (except for the RME 10^{-4} cancer IMPG, but not the non-cancer IMPGs, in some areas). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 9 would achieve the RME fish consumption IMPGs based on a 10^{-5} cancer risk and non-cancer impacts in all impoundments within the modeled period. Where the levels for unrestricted fish consumption are not achieved, institutional controls – specifically, fish consumption advisories – would continue to be utilized to provide human health protection from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.9.6.2, the model results indicate that, by the end of the modeled period, SED 9 would achieve the IMPG levels for all ecological receptor groups and areas. Specifically, SED 9 would result in sediment PCB concentrations within or below the IMPG range for benthic invertebrates (3 to 10 mg/kg) in all averaging areas and below both the lower and upper bounds of the IMPG range for amphibians (3.27 mg/kg to 5.6 mg/kg) in all backwater areas. In addition, SED 9 would achieve fish PCB levels below the IMPGs for both warmwater and coldwater fish (55 and 14 mg/kg), for piscivorous birds (3.2 mg/kg), and for threatened and endangered species (30.4 mg/kg) in all reaches. For insectivorous birds and piscivorous mammals, predicted sediment PCB concentrations in the relevant averaging areas in Reaches 5 and 6 are below the target sediment levels of 1, 3, and 5 mg/kg in all averaging areas.[301] For piscivorous birds, the predicted whole body fish PCB concentrations would achieve the IMPG (3.2 mg/kg) in all reaches.

As discussed in Section 2.1.1, however, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. In this case, implementation of SED 9 would cause substantial short-term and long-term adverse environmental impacts, including on the wildlife receptor groups that the IMPGs are designed to protect. The short-term impacts would include loss of the current aquatic habitat throughout Reaches 5 through 8 (except for the Reach 7 channel); loss of riparian habitat in the bank stabilization areas; resuspension of PCB-containing sediments during removal; and loss of floodplain habitat in areas where supporting facilities are constructed – all as discussed in Section 6.9.8. These adverse impacts would be more widespread than those of any of the other alternatives except SED 8. Even more significantly, despite the implementation of restoration measures, implementation of SED 9 would result in substantial long-term and, in some cases, permanent adverse effects on the ecosystem. These impacts were described in Section 6.9.5.3. They include:

- Alteration of the aquatic riverine habitat in Reaches 5A, 5B, and 5C for an uncertain length of time, with the result that the re-establishment of the current abundance of organisms and mix of species is also uncertain, the return of certain specialized and rare species is doubtful, and there would likely be an increase in invasive species;

- Similar impacts in the Reach 5 backwaters, the shallower portions of Woods Pond, the Reach 7 impoundments, and Rising Pond (except that invasive species may be reduced in Woods Pond, at least temporarily, due to the sediment removal and increased water depth);

- The permanent loss of mature overhanging trees on the riverbanks and of vertical and undercut banks in Reaches 5A and 5B, with the consequent loss of the wildlife species that depend on those habitat features, as well as a reduction in animal slides and burrows on the banks and access routes for wildlife movement to and from the River;

- Long-term impacts in the areas that would be cleared for access roads and staging areas, including loss of trees and, in some areas, wetlands, as well as changes in the

[301] As discussed previously, attaining the target sediment levels for these receptor groups would allow achievement of the IMPGs provided that the average floodplain soil concentrations in the same averaging areas are below the associated target floodplain soil levels (see Section 7).

soil stratigraphy and composition – all of which would, at a minimum, last for decades, with the extent and timing of recovery to pre-remediation conditions uncertain; and

- Fragmentation of the current, largely intact forested riparian corridors in the PSA, with the consequent loss of connectivity among habitats and disruption of the wildlife that depend on those corridors.

As noted above, the standard of "overall protection" of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, "it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat" (EPA, 2005d, p. 6-6). Based on such balancing, due to the substantial adverse ecological impacts summarized above, SED 9 would have a net negative ecological effect and thus would not provide overall protection of the environment.

Summary: Based on the foregoing considerations, SED 9 would meet the standard of providing overall protection of human health. However, given the long-term harm to the unique ecosystem of the PSA that would result from its implementation, SED 9 would not meet the standard of providing overall protection of the environment.

6.10 Evaluation of Sediment Alternative 10

6.10.1 Description of Alternative

SED 10 would involve the removal of a total of approximately 242,000 cy of sediment and riverbank soil, including 235,000 cy of sediments from approximately 62 acres of the River and 6,700 cy of bank soils as part of bank stabilization on 1.6 linear miles of riverbank. A total of 20 acres would be capped after removal. Specifically, the components of SED 10 include the following:

- Reach 5A: Sediment removal (66,000 cy over 20 acres), followed by capping, in areas determined based on ecological criteria described in the 2009 Work Plan;

- Riverbanks in Reaches 5A and 5B: Bank stabilization adjacent to certain of the sediment removal areas in Reach 5A and areas in Reach 5B determined based on ecological criteria described in the 2009 Work Plan (total of 1.6 linear miles), with removal of bank soils where necessary as part of the stabilization (6,700 cy);

- Reach 6 (Woods Pond): Sediment removal (169,000 cy over 42 acres) in areas with PCB concentrations generally greater than 13 mg/kg in the top 6 inches; and

- Remainder of Rest of River: MNR.

Remediation would proceed from upstream to downstream to minimize the potential for recontamination of remediated areas. Figure 6-28 identifies the remedial action(s) that would be taken in each reach as part of SED 10.

As described in the 2009 Work Plan, SED 10 was developed to minimize the harm caused by sediment remediation to the ecology of the Rest of River area, particularly the PSA. The criteria used for selection of locations for sediment removal, bank stabilization, and related access roads and staging areas included the following:

- Targeting areas with a high concentration of PCBs in sediment for removal;
- Meeting EPA's acceptable cancer risk range and a non-cancer Hazard Index of 1 for direct contact with sediments in all sediment exposure areas;
- Avoiding areas with a high density of faunal and floral species of concern;
- Avoiding or minimizing the disturbance of vertical riverbanks and the application of engineered stabilization techniques to riverbanks;
- Avoiding habitat fragmentation to the maximum extent possible; and
- Otherwise minimizing and mitigating the effect of removal-related activities.

A flowchart showing how these criteria were applied to select sediment and riverbank areas for remediation under SED 10 is provided as Figure 6-29.

The following summarizes the general remedial approach (and associated assumptions) related to implementation of SED 10. It is estimated that SED 10 would require approximately 5 years to complete. A construction timeline for implementation of SED 10 is provided in Figure 6-30. As described in Section 3.1.6.4, this timeline presents a general representation of the main components of the reach-specific remedial activities (e.g., removal, capping, bank stabilization, etc.), and illustrates the respective contributions of each activity to the overall implementation timeline, as well as the extent of activities that would be performed concurrently.

Information on equipment, processes, and methods is provided in this description for purposes of the evaluations in this Revised CMS Report. However, details of the specific methods for implementation of the remedy selected would be developed during design based on engineering considerations and site conditions. In addition, various options would be considered in an effort to avoid, minimize, or mitigate the adverse ecological impacts from implementation of the selected alternative. A preliminary assessment of such options has been conducted and incorporated into SED 10 for purposes of evaluation, including alternate riverbank stabilization techniques, siting options for access roads and staging area, timing and sequencing of the work, and use of BMPs (all as discussed in Section 5.2) and potential restoration methods (as discussed in Section 5.3). However, once a remedy is selected, such options and procedures would be assessed further during design.

Site Preparation: Prior to implementation of remedial activities, access roads and material and equipment staging areas would be constructed to support implementation of this alternative. Grubbing and clearing of vegetation would be necessary, and appropriate erosion and sedimentation controls would be put in place prior to construction. Locations of the staging areas and access roads for SED 10 were selected considering site conditions (e.g., topography, habitat type, presence of residential areas, etc.) observed through site visits and aerial photographs, in an effort to minimize impacts on sensitive habitats and local communities to the extent practical (see Section 5.2.2). Areas were specifically selected based on accessibility, existing land use, habitat type, and location relative to the floodplain. An effort was made, where practical, to avoid sensitive habitats (e.g., forested floodplain areas, vernal pools, other wetlands) and heavily populated areas, and to utilize existing infrastructure. The conceptual plans developed for this Revised CMS Report indicate that 7 staging areas, which would occupy a total of 15 acres (3.3 acres of which would be within the floodplain), and nearly 5 miles of temporary access roads covering 11 additional acres assuming a 20-foot road width (3.5 miles and 8.5 acres of which would be within the floodplain) would be constructed between the Confluence and Woods Pond Dam to support implementation of SED 10. The locations of these staging areas and access roads are shown on Figure 6-28. Further evaluations of the locations for staging areas, access roads, and other supporting infrastructure would be conducted during design.

Sediment Removal: In Reach 5A, 66,000 cy of sediment covering an area of 20 acres would be removed to a depth of 2 feet, followed by placement of a 2-foot cap over the removal areas (Figure 6-28). It is assumed that the excavation would be performed in the dry with conventional mechanical excavation equipment. Sheetpiled cells would be established in the River to facilitate removal activities and limit downstream transport of PCBs. The design and construction of the sheetpile system would incorporate site-specific conditions to determine the appropriate sheet lengths, sheeting configuration, gauge, and depth of embedment, as described in Section 3.1.2.1. A water treatment system with an assumed capacity of 450 gpm, located at each staging area, would be used to treat water pumped from the excavation areas.

In Woods Pond, the sediments in the top 2.5 feet in portions of the Pond that have been shown by sampling to contain PCB concentrations generally greater than 13 mg/kg in the top 6 inches would be removed. This would involve the removal of approximately 169,000 cy of sediments from an area of approximately 42 acres within Woods Pond. It is assumed that this removal would be performed in the wet, using barge-mounted clamshell excavators, with silt curtains placed around the excavation areas. Periodic water column and air sampling would be performed during implementation.

Cap Placement: Following sediment removal, a cap would be installed in the dry in Reach 5A prior to removal of the sheetpile from a removal area. Cap materials would be transported to the River using conventional earth-moving equipment. It is assumed that the cap would contain 12 inches of sand (which may be amended with organic material to increase the TOC content) placed over the excavated riverbed, followed by 12 inches of armor stone over the sand. The composition and size of the sand and armor stone would be selected during design to limit the potential for migration of PCBs from the underlying sediments and to preclude the movement of cap materials during high flow events.

In Woods Pond, to allow an increase in the water depth in the excavated area, no cap or backfill materials would be placed in the excavated areas. The resulting post-excavation surface sediment PCB concentrations in those areas are presented in Section 3.2.4.2.

Sediment Dewatering and Handling: Sediment dewatering operations would be performed as necessary in the staging areas. For purposes of this Revised CMS Report, it is assumed that gravity dewatering via stockpiling at the staging areas would be used both for sediments removed in the dry from Reach 5A and for sediments removed mechanically in the wet from Woods Pond. The addition of stabilization agents (e.g., other dry sediments, excavated soils, Portland cement) may be necessary prior to treatment and/or disposal (see Section 3.1.5 and Figure 3-1). Treatment/disposition alternatives have been evaluated separately and are discussed in Section 9. A water treatment system would be used to treat water pumped from the excavation areas, as well as any decant water collected from excavated materials in the staging areas.

Bank Stabilization/Soil Removal: SED 10 would include stabilization of select riverbanks in areas along the River in Reach 5A (adjacent to certain sediment removal areas) and in Reach 5B, including the removal of 6,700 cy of soil from the banks in these subreaches. The areas targeted for stabilization were selected based on criteria developed to avoid or minimize the harm to sensitive habitats. The bank stabilization techniques that are assumed to be part of SED 10 for purposes of this Revised CMS Report were described generally in Section 3.1.4, with specific details in Appendix G. They include a combination of bioengineering and hard stabilization techniques. As shown in Appendix G (Section 8), this partial or intermittent bank stabilization approach is a standard practice recognized by various guidance documents, and can be effective in stabilizing riverbanks provided that the potential impacts of the stabilization measures on proximate non-stabilized riverbank areas upstream and downstream of the stabilized banks are evaluated and addressed if necessary. In this case, as also discussed in Appendix G, an evaluation was performed of the potential impacts of the bank stabilization measures in the areas originally identified for bank stabilization under SED 10 in the 2009 Work Plan on the proximate banks not subject to such measures, and the bank stabilization measures were revised to address such potential impacts. The resulting bank stabilization techniques for SED 10 are depicted on Figures G-34 through G-40 in Appendix G.

For purposes of this Revised CMS Report, it is assumed that the riverbank stabilization/soil removal work in Reach 5A would be performed in the dry, within the same sheetpiled cells used for the removal/capping of the adjacent sediments, employing conventional mechanical excavation equipment. For Reach 5B, it is assumed that the riverbank stabilization/soil removal work would be performed in the wet from the top of the riverbank, since sediment remediation would not be performed in this reach.

MNR: MNR would be implemented in the remainder of the Rest of River (Reaches 5B, 5C, 5D, and 7 though 16). As previously discussed, natural recovery processes have been documented in portions of the Housatonic River and would be expected to continue throughout the Rest of River area at varying rates, due in part to completed and planned upstream source control and remediation measures, as well as the remediation that would be conducted as part of this alternative.

Restoration: For purposes of the evaluations in this Revised CMS Report, it is assumed that SED 10 would include restoration of areas that are directly impacted by the sediment removal activities, the bank removal/stabilization activities, and ancillary construction activities. The restoration methods assumed for SED 10 for purposes of this Revised CMS Report include the conceptual methods described in Section 5.3.1.3 for the aquatic riverine habitat in Reach 5A and in Section 5.3.2.3 for the stabilized riverbanks in Reaches 5A and 5B, with appropriate modifications to reflect the intermittent sediment removals in Reach 5A and the intermittent bank stabilization in Reaches 5A and 5B. Since no capping or backfilling would be performed in Woods Pond, no active restoration measures would be implemented there following sediment removal. For the floodplain habitats disturbed by access roads and staging areas, the assumed restoration measures would consist of the conceptual restoration methods outlined in Section 5.3 for those habitat types. It is further assumed that a more specific and detailed restoration plan would be developed during design.

Institutional Controls: SED 10 would include the continued maintenance of biota consumption advisories, as appropriate, to limit the public's consumption of fish and other biota from the River (see Section 3.8.1 for further discussion of fish consumption advisories). With respect to institutional controls for the management of sediment or soil in connection with future maintenance, repair, construction, or removal projects for dams or bridges on the River, SED 10 would rely primarily on existing regulatory requirements, as discussed in detail in Section 3.8.2, which would ensure the proper characterization, management, and disposition of such materials. However, as also noted in Section 3.8.2, GE would agree that, to the extent that the handling or disposition of these materials would involve the incurrence of additional costs attributable solely to the presence of PCBs at concentrations that would require special handling or disposition, GE would consider reimbursing the owner for those incremental costs.

Long-Term OMM: Once implemented, it is assumed that SED 10 would include, for each reach involved, a 5-year post-construction monitoring and maintenance program for capping and restoration components and a long-term (100-year) monitoring and maintenance program.

The assumed 5-year post-construction OMM program for capped areas under SED 10 would include the same elements outlined for that program under SED 3 (Section 6.3.1), to the extent relevant to SED 10. Specifically, the assumed 5-year program for the capped areas would include visual observations of the caps, supplemented with probing in armor stone areas, and repair or replacement of cap material as needed. The assumed elements of the OMM program for the restoration efforts would consist of the elements detailed in Section 3.7.1, which are assumed to be performed for a 5-year period after completion of installation of the particular restoration measures for SED 10.

A summary of the assumed long-term (100-year) OMM program for SED 10 was included in Table 3-22, referenced in Section 3.7.2. That program would include sampling of fish and the water column using the same program outlined for SED 2 in Section 6.2.1. It is also assumed to include a sediment sampling program, which would occur in Years 5, 10, 15, 25, 50, 75, and 100 and would include the collection for PCB analysis of 50 surface sediment samples from MNR areas and approximately 5 cores (15 samples) from removal areas. Further, following the initial 5-year inspection period described above, it is assumed that additional visual inspections of the Reach 5A cap would be conducted in the above-listed years, to the extent that cap material can be distinguished from the underlying native sediments. In addition, maintenance activities would be implemented, as necessary.

6.10.2 Overall Protection of Human Health and the Environment – Introduction

As discussed in Section 6.1.2, the evaluation of whether a sediment remedial alternative would provide overall human health and environmental protection relies heavily on the evaluations under several other Permit criteria – notably: (a) a comparison to IMPGs; (b) compliance with ARARs; (c) long-term effectiveness and permanence (including long-term adverse impacts); and (d) short-term effectiveness. For that reason, the evaluation of whether SED 10 would be protective of human health and the environment is presented at the end of Section 6.10 so that it can take account of the evaluations under those other criteria, as well as other aspects of the alternative and other factors relevant to the protection of health and the environment.

6.10.3 Control of Sources of Releases

Implementation of SED 10 would reduce the potential for future PCB migration from certain river sediments and riverbanks. This alternative would address approximately 62 acres of the riverbed and approximately 1.6 linear miles of riverbank, and would include the removal of approximately 242,000 cy of sediment and bank soils containing PCB, thereby resulting in a reduction in the potential for future PCB transport within the River and onto the floodplain for potential human or ecological exposure. Specifically, SED 10 would result in removal of 2 feet of sediments in parts of Reach 5A and 2.5 feet of sediments in 42 acres of Woods Pond. PCBs remaining in the areas of Reach 5A subject to removal would be contained by a cap designed to withstand erosion during high flows. Select banks in Reaches 5A and 5B would be addressed through bank stabilization techniques, with bank soil removal where appropriate.

As discussed in Sections 6.1.3 and 6.2.3, the remaining remediation activities to be conducted upstream of the Confluence would further reduce the PCBs entering the Rest of River; and those activities along with natural recovery processes within the Rest of River would further reduce the PCBs in the water column and surface sediments in the Rest of River. Additionally, the existing dams along the River would continue to limit movement of PCB-containing sediments within the impoundments behind the dams, thereby further reducing the potential transport of those sediments downstream. While failure of those dams could lead to the release of PCB-containing sediments impounded behind them, the inspection, monitoring, and maintenance programs and regulatory requirements in place under other authorities, as described in Sections 3.8.2 and 6.1.3, would prevent or minimize that possibility. Further, in the event of a dam repair, modification, or removal project, the regulatory requirements described in Section 3.8.2 would ensure that any contaminated sediments behind the dams would be properly addressed. Moreover, under SED 10, the removal of sediments in Woods Pond with PCB concentrations generally exceeding 13 mg/kg in the surface would further mitigate the potential for downstream transport of PCBs even in the event of dam failure.

Implementation of SED 10, in combination with upstream source reduction and control, would reduce the mass of PCBs transported within the River to downstream reaches and to the floodplain, as demonstrated by EPA's model. The annual average PCB mass passing Woods Pond Dam at the end of the model projection is predicted to decrease by approximately 62% from that calculated at the beginning of the model projection period (i.e., from 20 kg/yr to 7.6 kg/yr). Likewise, SED 10 is predicted to achieve a 62% reduction in the average PCB mass passing Rising Pond Dam over this same period (i.e., from 19 kg/yr to 7.3 kg/yr). Similarly, the annual average PCB mass transported from the River to the floodplain in Reaches 5 and 6 is predicted to decrease by 68% over the model projection period (i.e., from 12 kg/yr to 3.9 kg/yr).

The effects of an extreme flow event were examined using the Year 26 flood. The impact of this flood on surface sediment PCB concentrations can be seen on Figure 6-31b, which shows temporal profiles of model-predicted reach-average PCB concentrations in surface sediments resulting from the implementation of SED 10 over the 52-year model projection period. Similar to SED 3, the model results for SED 10 indicate that, in reaches subject to MNR only (i.e., Reaches 5B, 5C, 5D, 7, and 8), the extreme flow event would not result in the exposure of buried PCBs at higher concentrations than those already present in the surface sediment prior to the event . This is supported by the minimal changes (generally less than 0.1 mg/kg) in reach-average surface sediment PCB concentrations predicted for those reaches (Figure 6-31b). Within Reach 5A (which involves a combination of removal/capping and MNR), EPA's model also predicts that buried sediments would not be exposed during the extreme storm event, and consequently no change in reach-average surface sediment PCB concentrations is predicted (Figure 6-31b).[302]

As noted above, the remediation in Woods Pond under SED 10 would involve sediment removal without a replacement cap or backfill. The model predictions for Woods Pond under this scenario demonstrate that the simulated large flood events would not result in any increases in reach-average surface PCB concentrations in the Pond, thus indicating that such flood events would not cause buried sediments with higher concentrations of PCBs to become exposed in these areas.[303]

In addition, since the Woods Pond remediation under SED 10 would result in a 2.5-foot increase in water depth over 42 acres, the effect of that remediation on the solids trapping efficiency of Woods Pond has been evaluated. As a result of the increase in depth in the shallow portion of the Pond, the solids trapping efficiency of Woods Pond, as predicted by

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[302] Further evaluation of the stability of cap materials under SED 10 based on model predictions of erosion is provided in Section 6.10.5.2. In addition, that section provides an evaluation of the extent to which the intermittent sediment and riverbank remediation in Reach 5A could result in PCB transport from areas that would not be subject to PCB removal or stabilization to the remediated river portions. That evaluation shows, based on simulations using EPA's model, that any such impact would not reverse or significantly impede the substantial reductions in reach-average surface sediment PCB concentration that would result from the implementation of SED 10.

[303] As discussed further in Section 6.10.5.2, the model predictions also show that any PCB input from unremediated areas upstream of and within Woods Pond would not reverse or significantly impede the significant reductions in PCB concentrations within Woods Pond resulting from SED 10.

EPA's model, would increase by nearly 10% relative to MNR (from 15% under MNR to 24% under SED 10).

6.10.4 Compliance with Federal and State ARARs

The potential chemical-specific, location-specific, and action-specific ARARs identified by GE for SED 10 in accordance with the directions from EPA are listed in Tables S-10.a through S-10.c in Appendix C. The compliance of SED 10 with these potential ARARs is discussed below.

Chemical-Specific ARARs – Water Quality Criteria

The potential chemical-specific ARARs, set forth in Table S-10.a, include the federal and state water quality criteria for PCBs. To evaluate whether SED 10 would achieve those criteria, GE reviewed the water column PCB concentrations predicted by the model for SED 10. As discussed in Section 3.5.1 and summarized in Section 6.3.4, the freshwater chronic aquatic life criterion of 0.014 µg/L (14 ng/L) is based on a 4-day average not to be exceeded more than once every 3 years. Since it is unclear whether the 4-day averages to be used in comparing water quality data to this criterion are to be calculated as rolling averages or 4-day "block" averages, 4-day averages have been computed both ways and compared to the criterion here, as shown in Table 6-2. Based on both averaging methods, predicted water column concentrations in the Massachusetts portion of the River under SED 10 exceed the water quality criterion nearly 100% of the time in Reaches 5B and 5C, and on a considerable number of occasions in Reaches 5A, 6, 7, and 8. Thus, SED 10 would not achieve this criterion in the Massachusetts portion of the River, although it would do so in the Connecticut impoundments.

However, for the same reasons discussed in Section 6.1.4, the ARARs based on this criterion should be waived for SED 10 on the ground that compliance with that requirement "will result in greater risk to human health and the environment" than other alternatives (CERCLA § 121(d)(4)(B); 40 CFR § 300.430(f)(1)(ii)(C*)(2)*). As discussed in prior sections, the remedial actions that would be necessary to attain that ARAR – e.g., those incorporated in alternatives SED 3 through SED 9 – would unavoidably cause substantial adverse short-term and long-term harm to the environment. As also discussed in the prior sections evaluating those alternatives, those adverse impacts would outweigh any risks to human health and the environment that would result from the exceedances of this ARAR. EPA's guidance on compliance with ARARs provides an example showing the appropriateness of such a waiver in this type of situation: "For example, attaining the ambient concentration level for PCBs spread throughout river sediment might require widespread dredging of the sediments, causing an unacceptable release of the pollutant to the water body and damaging or disrupting the ecosystem. Waiving the ARAR for ambient PCB concentrations in the sediment would eliminate the need to conduct such harmful dredging" (EPA, 1988, p. 1-72).

The assessment of the ARARs based on the human health-based water quality criterion has used the model-predicted annual average water column concentrations presented in Table 6-69 (in Section 6.10.5.1 below). As shown by that table, the predicted annual average water column concentrations under SED 10 exceed the federal and Massachusetts human health consumption criterion of 0.000064 µg/L (0.064 ng/L) in all reaches. However, as discussed previously, the ARARs based on this criterion should be waived on the ground that achievement of those ARARs is technically impracticable for the reasons given in Section 6.1.4, including that they could not by achieved by any remedial alternative in any reach in Massachusetts or in one or more of the Connecticut impoundments.[304]

EPA's January 15, 2010 conditional approval letter for GE's 2009 Work Plan directed GE to discuss the effect of each alternative on the current listing of the Housatonic River in both Massachusetts and Connecticut as an impaired waterbody under Section 303(d) of the federal Clean Water Act. The Housatonic River in Massachusetts is listed as impaired due to PCBs and pathogens. The impact of SED 10 on the PCB water quality criteria in Massachusetts was discussed above; its impact on PCB levels in surface sediments, surface water, and fish tissue in Massachusetts is discussed in Section 6.10.5.1; and its impact on attainment of the relevant IMPGs, including the IMPGs based on the unrestricted human consumption of fish from the Housatonic in Massachusetts, is discussed in Section 6.10.6. The Housatonic River in Connecticut is listed as impaired based on the CDPH's fish consumption advisory for PCBs for portions of the River in Connecticut (as well as based on the presence of e-coli bacteria in some river segments). The impact of SED 10 on fish PCB levels in the Connecticut impoundments is discussed in Section 6.10.5.1, and its impact on attainment of the IMPGs based on human fish consumption in the Connecticut impoundments is discussed in Section 6.10.6.1. These evaluations provide an assessment of the effect of SED 10 on the impairment listings.[305]

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[304] The estimated future water column concentrations in all the Connecticut impoundments under SED 10 exceed the proposed Connecticut consumption criterion of 0.00000056 µg/L (0.00056 ng/L). As noted in Section 6.1.4, that proposed criterion is below the level of reliable measurement and would not be achieved by any remedial alternative in any of the Connecticut impoundments, and thus its attainment would also be technically impracticable.

[305] In addition to the comparison to the IMPGs, as noted above, it is our understanding that, in developing and revising its fish consumption advisory, the CDPH utilizes as guidance a risk-based protocol that specifies unlimited fish consumption at PCB levels < 0.1 mg/kg, one meal per week at 0.1 - 0.2 mg/kg, one meal per month at 0.21- 1.0 mg/kg, etc., and "do not eat" at levels above 1.9 mg/kg. As shown in Table 6-69 (in Section 6.10.5.1 below), use of the CT 1-D Analysis, while highly uncertain, indicates that implementation of SED 10 would meet or reach the boundary of the CDPH's

Location-Specific and Action-Specific ARARs

The potential location-specific and action-specific ARARs identified for SED 10 are listed in Tables S-10.b and S-10.c.[306] Review of those potential ARARs indicates that SED 10 could be designed and implemented to achieve certain of the ARARs.[307] Note, in particular, that, unlike SED 3 through SED 9, SED 10 would meet the regulatory provisions that require that there be no practicable alternative with less adverse impact on the aquatic ecosystem, wetlands, or other types of resource areas, because GE has not identified any sediment remediation alternative (apart from MNR) with less adverse impact than SED 10. Nevertheless, as indicated in Tables S10.b and S-10.c, there are still certain federal and state regulatory requirements relating to ecological protection (including regulations regarding the protection of the Upper Housatonic ACEC) that would not be met by SED 10. These requirements, which are fewer than under any other sediment removal alternative, include the following:

- The requirement of EPA's and the U.S. Army Corps of Engineers' regulations under Section 404 of the Clean Water Act that a project involving the discharge of dredged or fill material (such as SED 10) not contribute to violation of state water quality standards (which are not currently met in the Housatonic River);
- The prohibition on dredging in an ACEC under the Massachusetts Waterways Law and its regulations (310 CMR 9.40(1)(b));
- The requirement of the Massachusetts water quality certification regulations (314 CMR 9.01 – 9.08) that a project involving dredging and the discharge of dredged or fill material not affect the Estimated Habitat of rare wildlife species listed by the State under MESA;
- The requirements of the Massachusetts Wetlands Protection Act and its implementing regulations that implementation of the project not affect the Estimated Habitat of state-listed rare wildlife species (310 CMR 10.59) and, if this project does not constitute a

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unlimited fish consumption criterion of < 0.1 mg/kg by the end of the EPA model's 52-year projection period, resulting in average fillet levels of 0.05 to 0.1 mg/kg. This provides further insight on the effect of SED 10 on the River's impairment listing in Connecticut.

[306] For the reasons discussed in Section 2.1.3, a number of these regulatory requirements do not constitute ARARs for the Rest of River remedial action, but are listed in these tables as potential ARARs per EPA's direction.

[307] For some of these requirements, as discussed for SED 3 in Section 6.3.4 (footnote 132), it is assumed that EPA would make the necessary determinations allowed by the regulations.

"limited project" under 310 CMR 10.53(3)(q)), certain additional requirements as well (e.g., the prohibition on work that results in a loss of > 5000 square feet of bordering vegetated wetlands or impairs such wetlands within an ACEC [310 CMR 10.55(4)] and potentially the requirement to maintain a 100-foot wide area of undisturbed vegetation along the river in a Riverfront Area, subject to certain exceptions [310 CMR 10.58(4)(d)1.]); and

- The requirements of MESA and its implementing regulations (310 CMR 10.23) that the project not result in a "take" of a state-listed species.[308]

To the extent that these requirements constitute ARARs, they would need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

In addition, for the same reasons discussed for SED 3 in Section 6.3.4, it is possible that, in the unlikely event that excavated sediments or bank soils under SED 10 should be found to constitute hazardous waste under RCRA or comparable state criteria (which is not anticipated) and that the temporary staging areas for the handling of those sediments and soils are subject to federal and/or state hazardous waste regulations, the staging areas may not meet certain location and/or technical requirements for the storage of hazardous waste. In that unlikely event, as also discussed in Section 6.3.4, those requirements should be waived by EPA as technically impracticable to meet.

6.10.5 Long-Term Reliability and Effectiveness

The assessment of long-term reliability and effectiveness for SED 10 has included evaluation of the magnitude of residual risk, the adequacy and reliability of the alternative, and any potential long-term adverse impacts on human health or the environment, as described below.

6.10.5.1 Magnitude of Residual Risk

The assessment of the magnitude of residual risk associated with implementation of SED 10 has included consideration of the extent to which and time over which this alternative would reduce potential exposure to PCBs, estimated concentrations of remaining PCBs

[308] The MESA evaluations in Appendix L indicate that SED 10 would involve a take of 17 state-listed species. As discussed in Section 5.4, the provision of the MESA regulations that authorizes the Director of the MDFW to permit a take of such species under certain conditions does not constitute an ARAR for the Rest of River remedial action.

available for such exposure, and other aspects of the alternative that would reduce potential exposure such as engineering and institutional controls.

Implementation of SED 10, along with upstream source control and remediation measures and natural recovery processes, would reduce the potential exposure of humans and ecological receptors to PCBs in sediments, surface water, and fish in the Rest of River area. The sediment removal and capping activities in select portions of Reach 5A, stabilization/removal of select bank soils in Reaches 5A and 5B, and sediment removal in Woods Pond would result in a significant reduction in the potential for exposure to PCBs in these areas. The following table shows, by reach, the average PCB concentrations predicted by EPA's model to be present at the end of the model simulation period (Year 52) in the surface sediments, surface water, and fish (including both whole body and fillet-based concentrations). This table uses the same format described in Section 6.1.5.1.

Table 6-69 – Modeled PCB Concentrations at End of 52-Year Projection Period (SED 10)

Reach	Average Surface Sediment (0-6") (mg/kg)	Average Surface Water (ng/L)	Average Fish (whole body) (mg/kg)	Average Fish (fillet) (mg/kg)[2]
5A	6.7	5.5	21	4.2
5B	6.6	24	33	6.6
5C	19	21	29	5.8
5D (backwaters)	17	--	55	11
6	3.7	20	19	3.7
7[1]	0.4 – 5.0	8 – 17	10 – 22	1.9 - 4.4
8	2.8	7.9	14	2.7
CT[1]	0.03 – 0.05	0.4 – 0.8	0.3 – 0.5	0.05 – 0.1

Notes:

1. Values shown as ranges in Reach 7 and CT represent the range of modeled PCB concentrations at the end of the projection within the Reach 7 subreaches, and the range of concentrations indicated by the CT 1-D Analysis for the four Connecticut impoundments.
2. Fish fillet concentrations were calculated by dividing the modeled whole-body fish PCB concentrations by a factor of 5, as directed by EPA.

The potential residual risks to human and ecological receptors from the concentrations shown in the above table have been evaluated in the context of the extent to which they would achieve the IMPGs, as discussed in Section 6.10.6.[309]

Temporal profiles of reach-average PCB concentrations predicted in surface sediments, annual average surface water, whole body fish, and fish fillets resulting from the implementation of SED 10 over the 52-year model projection period are shown on Figures 6-31a-c. These figures show the timeframes over which the model predicts PCB concentrations in each medium would be reduced under SED 10. The general pattern exhibited by these temporal profiles is one of a large reduction in PCB concentrations associated with the remediation, followed by a period of slow decline or, in some instances, a leveling off or increase to a new steady-state concentration determined by upstream PCB inputs and natural attenuation processes. In the surface sediments, this pattern is observed mainly in the remediated reaches, while most reaches exhibit this pattern for water column and fish concentrations, which illustrates how remediating portions of the upstream area in the Rest of River (Reach 5A) translates to reductions in PCBs in downstream areas. As a result of the remediation under SED 10, predicted fish PCB concentrations are reduced over the projection period by approximately 77% in both of the remediated reaches (Reach 5A and Woods Pond) and by 50% to 75% in the other reaches (Figure 6-31c). [310]

PCBs would also remain in the sediments beneath the capped portions of Reach 5A and in the surface and subsurface sediments in other portions of the River. However, in the capped portions of Reach 5A, the cap would prevent direct contact with, and effectively reduce the mobility of, PCB-containing sediments beneath the cap. Natural recovery through silting-over would occur in the rest of Reach 5A and in the other reaches. Overall, the extent to which SED 10 would mitigate the effects of a flood event that could cause PCB-containing sediments that have been contained by a cap or buried due to natural processes to become available for human and ecological exposure was discussed in Section 6.10.3. As discussed in that section, the model results for SED 10 indicate that in most areas, buried sediments containing PCBs would not become exposed to a significant extent during an extreme flow event.

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[309] As discussed in Section 1.2, GE does not agree with many of the EPA assumptions and inputs on which the IMPGs are based and thus does not agree that exceedances of those IMPGs are indicative of a risk to human health or the environment.

[310] As discussed in Appendix I (prepared in response to EPA's General Comment 17 on the CMS Report), if initial conditions in fish are reset based on post-East Branch remediation PCB concentrations, predicted percent reductions in fish concentrations under SED 10 range from 66% to 68% in the remediated reaches (i.e., Reaches 5A and 6) and 37% to 62% in the remaining reaches in the PSA and downstream.

In addition, potential human exposure to PCBs in fish and other biota would be reduced during and after implementation of SED 10 through biota consumption advisories. Also, a long-term monitoring program would be implemented to assess the continued effectiveness of this remedial alternative to mitigate potential human and ecological exposures to PCBs.

6.10.5.2 Adequacy and Reliability of Alternative

Evaluation of the adequacy and reliability of SED 10 has included an assessment of the use of the technologies under similar conditions and in combination, general reliability and effectiveness, reliability of OMM and availability of OMM labor and materials, and technical component replacement requirements, as discussed below.

<u>Use of Technologies under Similar Conditions and in Combination</u>

As discussed in Section 6.3.5.2, a combination of remedial technologies is often necessary to mitigate potential exposure to constituents in sediments. For example, EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* states that, for remediation in "multiple water bodies or sections of water bodies with differing characteristics or uses, or different levels of contamination, project managers have found that alternatives that combine a variety of approaches are frequently the most promising" (EPA, 2005d, p. 3-2). Similarly, the National Research Council's 2007 report on Sediment Dredging at Superfund Megasites stated that "some combination of dredging, capping or covering, and natural recovery will be involved at all megasites" (NRC, 2007, p. 248). SED 10 involves such a combination. The SED 10 remedy components were selected for application in various reaches of the River based in part on the study and application of each technology at other sites. These components include sediment removal using dry excavation techniques (in portions of Reach 5A), sediment removal using mechanical dredging techniques (in Woods Pond), and bank stabilization with removal of bank soils where necessary (in select areas of Reaches 5A and 5B), capping over the removal areas (in Reach 5A), and MNR (in the remaining areas). These remedial techniques have been applied alone and in various combinations at a number of sites containing PCBs, albeit sites with different ecological conditions, as discussed in Sections 6.3.5.2 and 6.4.5.2.[311]

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[311] Approximately 15% of the approximately 75 completed dredging/removal projects reviewed by GE had removal volumes equivalent to or greater than the removal volume of SED 10.

General Reliability and Effectiveness – Sediment Remediation Techniques

SED 10 utilizes sediment remediation technologies that have been shown to be reliable and effective in reducing exposure of humans and ecological receptors to PCBs in sediments. These include sediment removal, followed by capping in portions of Reach 5A and without capping in Woods Pond, and MNR. As previously discussed in Section 6.3.5.2, under certain circumstances, dredging and excavation have been shown to be effective and reliable in reducing the long-term potential for exposure of human and ecological receptors to PCB-containing sediments, although there are some limitations associated with this technology (e.g., sediment resuspension, residual contamination) (EPA, 2005d). As noted by EPA (2005d), capping is also a viable and effective approach for remediating impacted sediments. Finally, EPA has stated that MNR should "receive detailed consideration" where site conditions are conducive to such a remedy (EPA, 2005d). In addition, EPA has noted that many contaminants that remain in sediment are not easily transformed or destroyed, and that for this reason, "risk reduction due to natural burial through sedimentation is more common and can be an acceptable sediment management option" (EPA, 2005d).

To further assess the reliability and effectiveness of SED 10, model predictions of erosion in areas receiving a cap were evaluated to assess cap stability, using the same metrics described for this analysis in Section 6.3.5.2. Under SED 10, a cap would be installed in the portions of Reach 5A subject to removal. Those caps would be designed to resist erosion by including an appropriately sized armor layer. The model inputs for areas receiving a cap were specified accordingly, as discussed in Section 3.2.4.5. Thus, the areas receiving a cap under SED 10 are predicted to be 100% stable.

In its January 15, 2010 conditional approval letter for the 2009 Work Plan, EPA directed GE to evaluate the implications of the intermittent sediment and riverbank remediation approach in Reach 5A under SED 10 (in which certain segments would be remediated and others would be left undisturbed) in terms of the potential for recontamination of the remediated portions of the River due to transport of PCBs from the unremediated portions. The model simulations implicitly account for any such recontamination. The objective of SED 10 is not to achieve specific concentrations in specific portions of the River, but to achieve overall reductions in the average PCB concentrations over the entire Reach 5A, as well as downstream, while also minimizing the adverse impacts to the aquatic riverine and riverbank habitats in the River. The intermittent sediment and riverbank remediation in Reach 5A would accomplish that objective by substantially reducing the average PCB concentrations in the surface sediment, water, and fish in Reach 5A and downstream (as shown by the model results discussed in Section 6.10.5.1 above) while minimizing the adverse ecological impacts from the remediation (as shown in Sections 6.10.5.3 and 6.10.8 below). For example, on a reach-average basis, sediment PCB concentrations in Reach 5A, as shown by Figure 6-31b, are predicted to decrease from approximately 20 mg/kg to approximately 9 mg/kg immediately following remediation, followed by a continued additional decline to approximately 7 mg/kg by the end of the 52-year simulation. Based on these results, EPA's model predicts that any recontamination of remediated areas would not result in increases in reach-average sediment PCB concentrations within Reach 5A.[312] Similarly, the predicted reach-average sediment concentrations in the downstream portions of Reach 5 (i.e., Reaches 5B, 5C, and 5D) exhibit consistent declines throughout the model simulation (and no increases that would be indicative of PCB releases from unremediated portions of Reach 5A). The declines in these downstream areas result in endpoint concentrations that are approximately 30% to 50% lower than levels at the beginning of the simulation.

In the same conditional approval letter, EPA also directed GE to address the implications of sediment removal without capping or backfilling in Woods Pond for the long-term efficacy of SED 10. EPA stated specifically that GE should address implications of the fact that, under SED 10, the surface sediment in Woods Pond would continue to contain PCBs in most areas and would continue to receive PCBs transported from unremediated portions of the upstream reaches. The portion of Woods Pond to be remediated under SED 10 was selected on the basis that it contains sediments with the highest PCB concentrations within the Pond (i.e., concentrations greater than 13 mg/kg). As with Reach 5A, the objective of this remediation was to achieve a significant reduction in the average PCB concentrations in the Pond. The effectiveness of this remediation in producing such long-term reductions can be evaluated through EPA's model, which implicitly simulates the transport of PCBs from unremediated portions of the upstream reaches. The model results demonstrate that, although the Pond would receive PCBs from unremediated portions of the upstream reaches, sediment and fish concentrations in the Pond stay low and continue to decline after completion of remediation (see Section 6.10.5.1). As shown by Figure 6-31b, the predicted reach-average sediment PCB concentrations within Woods Pond are reduced from approximately 40 mg/kg to 7 mg/kg immediately after remediation. After that initial decline, concentrations within Woods Pond are predicted to continue declining, with no evidence of increases associated with recontamination from upstream areas, to a concentration of approximately 4 mg/kg at the end of the simulation, which represents a

[312] On smaller spatial scales, the model does predict that concentrations in remediated areas would increase following remediation, but only by small amounts such that significant reductions would still be achieved relative to current levels. Indeed, in the portions of Reach 5A that would be remediated under SED 10, the model results for the corresponding spatial bins (i.e., the ¼- to ½-mile reaches designated by EPA) show an initial decline to levels less than 0.1 mg/kg immediately after remediation, followed by increases in concentration associated with deposition of PCB-containing sediments over the next several years. These increases are approximately 2 mg/kg in one such spatial bin and 1 mg/kg in all others, such that even after these increases are taken into account, the sediment concentrations within the remediated spatial bins are 85% to 97% (93% on average) lower than the pre-remediation concentrations.

decrease of approximately 90% relative to current levels. Figure 6-31c shows that fish concentrations within Woods Pond exhibit a similar trend. These model results indicate that SED 10 would achieve significant reductions in PCB concentrations within Woods Pond, and that those reductions would not be reversed by recontamination from unremediated areas upstream of the Pond.

General Reliability and Effectiveness – Riverbank Stabilization Techniques

As noted above, portions of the riverbanks in Reaches 5A and 5B would be stabilized using a combination of bioengineering techniques and hard engineering techniques, as noted in Section 6.10.1 and described in Section 3.1.4 and Appendix G. The techniques identified for SED 10 would be expected to be effective in stabilizing the banks, while also reducing the adverse ecological impacts of bank stabilization compared to stabilizing the banks throughout Reaches 5A and 5B. As discussed in Section 8 of Appendix G, bank stabilization measures are often applied to only portions of the banks along a given stretch of river. Bioengineering techniques in particular are conducive to, and typically involve, this partial or intermittent bank stabilization approach. This is an effective method of controlling erosion and stabilizing the banks provided that any impacts of such intermittent bank stabilization measures on the adjacent portions of the banks that would not be stabilized are considered and addressed if necessary. In the case of SED 10, as noted in Section 6.10.1, the impacts of the bank stabilization measures in the areas originally identified for bank stabilization in the 2009 Work Plan on the proximate banks that would not be stabilized banks have been evaluated. As discussed in Section 8 of Appendix G, this evaluation indicated that, in most areas, the bank stabilization measures would not exacerbate erosion on the proximate upstream and downstream banks. However, in some areas, the bank stabilization measures have been extended to avoid or minimize adverse impacts on the adjacent non-stabilized banks. The resulting bank stabilization approach would thus be expected to be reliable and effective.[313]

General Reliability and Effectiveness – Restoration Techniques

It is assumed for this Revised CMS Report that the areas affected by SED 10 would be subject to restoration (except for the dredged area in Woods Pond, for which such measures would be unnecessary), as discussed in the restoration methods subsections in Section 5.3. As previously discussed, there are significant constraints on the ability of restoration methods to re-establish the pre-remediation conditions and functions of the affected habitats. These constraints and the consequent likelihood of restoration success

313 The impacts of this intermittent bank stabilization approach on potential recontamination from the unremediated banks were discussed above.

are discussed in Sections 5.3.1.4 for aquatic riverine habitats and 5.3.2.4 for riverbanks, and in Sections 5.3.4.4, 5.3.5.4, and 5.3.8.4 for forested floodplain habitats, shrub and shallow emergent wetlands, and upland habitats, which would be impacted by access roads and staging areas under SED 10. Those constraints, however, would have less influence on restoration success, or at least less overall impact on the ecosystem of the PSA, due to the limited areas selected for remediation under SED 10 and the criteria used in selecting the areas that would be disturbed (as described above) in an effort to minimize ecological impacts. Thus, while the restoration methods may not be fully effective or reliable in returning some of the limited removal areas to their pre-remediation conditions, the likelihood of effective restoration is higher under SED 10 than under SED 3 through SED 9. (These issues are discussed further in Section 6.10.5.3.)

Reliability of Operation, Monitoring, and Maintenance Requirements/Availability of Labor and Materials

A combination of OMM techniques – including periodic analytical sampling (for fish, water column, and sediment), visual monitoring (for caps and restored banks, supplemented with sediment probing and/or coring as necessary), and maintenance of the capped areas and riverbanks – would be implemented to maintain and track the long-term effectiveness of SED 10. Post-remediation sampling is commonly used to monitor the effectiveness of completed sediment removal and capping remedies (EPA, 2005d). Visual observation of the sediment cap and restored banks is considered a reliable means of verifying that the capping and stabilization components of the remedy have remained in place. Should changes in the capped riverbed or the riverbank be noted that require maintenance, labor and materials needed to perform repairs are expected to be readily available.

In addition, a monitoring and maintenance program would be implemented for actively restored areas to confirm planting survival and areal coverage and to determine whether replaced in-river structures (if any) are intact. This program is outlined in Section 3.7.1. Such monitoring is considered a reliable means of tracking the progress of the restoration efforts. The necessary labor and equipment for such a program are expected to be readily available.

Technical Component Replacement Requirements

The technologies that comprise SED 10 were selected for application in areas of the River where site conditions are expected to support long-term reliability and effectiveness with minimal maintenance requirements. However, if erosion of cap and/or bank stabilization materials should occur, an assessment would be conducted to determine the need for and methods of repair. Depending on the timing and location of the repair, access roads and staging areas may need to be temporarily constructed in the nearby floodplain. Periodic small-scale repairs not requiring access road reconstruction would likely pose minimal risks to humans and ecological receptors that use/inhabit the disturbed river bottom and nearby floodplain.

6.10.5.3 Potential Long-Term Adverse Impacts on Human Health or the Environment

The evaluation of potential long-term adverse impacts of SED 10 on human health or the environment has included identification and evaluation of potentially affected populations, long-term adverse impacts on the various habitats that would be affected by SED 10 and the biota that use the affected habitats, impacts on the aesthetics and recreational use of the River and floodplain, impacts on banks and bedload movement, and potentially available measures that may be employed to mitigate these impacts.

Potentially Affected Populations

Implementation of SED 10 would alter the habitat of the river areas that would be excavated and/or subject to capping, the riverbanks that would be stabilized, and the adjacent floodplain areas used for access roads and staging areas. These habitat alterations would affect people using these areas and the fish and wildlife in these areas. In particular, SED 10 would affect portions of the mapped Priority Habitats of 20 state-listed rare species, as described in Appendix L. The long-term impacts of SED 10 on the affected habitats and the plants and animals that use those habitats, as well as the long-term impacts on the aesthetics and recreational use of the affected habitats by people, are discussed below.

Long-Term Impacts on Aquatic Riverine Habitat in Reach 5A

SED 10 would involve sediment removal/capping activities in portions of Reach 5A. The long-term post-restoration impacts of such activities on aquatic riverine habitat were described generally in Section 5.3.1.4 and are summarized in Section 6.3.5.3 for SED 3. Those impacts would include a change in surface substrate type from sand or a combination of sand and gravel to armor stone, along with associated alterations in the aquatic vegetation (where present), benthic invertebrates, and fish in the area. Those impacts would be expected to last at least until deposition of natural sediments from upstream changes the substrate surface back to a condition approximating its prior condition and a biotic community consistent with that substrate type recolonizes the areas. As discussed previously, under remedial alternatives involving removal and/or capping of an entire reach, that time period is uncertain and could last for many years; and the biotic community that develops may differ from the pre-remediation community in terms of the abundance of organisms, the mix of species, and the presence of any specialized species (including state-listed species) and would likely be dominated by invasive species. However, under SED 10, the sediment removal/capping would take place only in limited, intermittent segments of Reach 5A (as shown on Figure 6-28), selected based on the criteria discussed above to minimize the ecological harm from the remediation. Since significant stretches of Reach 5A would remain undisturbed, they would serve as a source of native sediments for transport and deposition into the remediated segments, and as a source and refuge for aquatic species to aid in the recolonization process after remediation is completed. Thus, populations of aquatic plants, invertebrates, and fish from upstream (as well as fish from undisturbed downstream areas) would be able to move into the newly restored areas and begin recolonization. Moreover, while there would still be a threat of colonization by invasive species, such as those already present in Reach 5A, it would be less than would be the case with more extensive stretches of disturbed aquatic habitat. In these circumstances, over the long term, there is a reasonably high potential for recolonization and re-establishment of pre-remediation conditions and functions in Reach 5A under SED 10.

Long-Term Impacts on Riverbank Habitats

As previously described, SED 10 would include stabilization of the riverbanks in Reach 5A (adjacent to removal areas) and Reach 5B in select areas using techniques described in Section 3.1.4 and Appendix G and including bank soil removal in a number of locations. These stabilization measures would produce a number of long-term and permanent adverse impacts on the riverbank habitat in these reaches. As described in Sections 5.3.2.4 and 6.3.5.3, those impacts would include the permanent loss of the vertical and undercut banks and mature overhanging trees that are critical to some species, as well as long-term reductions in slide and burrow habitat and wildlife access routes between terrestrial and aquatic habitats for some species, especially in the areas stabilized with riprap. However, the intermittent nature of the bank stabilization measures in SED 10 would limit the extent of these impacts and thus minimize the overall adverse habitat impacts on the riverbanks in Reaches 5A and 5B.

Long-Term Impacts on Woods Pond

Under SED 10, Woods Pond would be remediated by removal of the top 2.5 feet of sediments in portions of the Pond, without subsequent capping or backfilling. While the sediment removal actions would remove any living organisms present in the sediments, aquatic plants, benthic invertebrates, fish, and other aquatic organisms (e.g., amphibians, reptiles) from upstream would be expected to readily recolonize areas of the Pond where the modified water depth would allow, since the reaches upstream of the Pond (Reaches 5B and 5C) would remain undisturbed and thus would be a source of those organisms and since the substrate of the Pond itself would not be altered by a cap. The remediation would alter the Pond by increasing the water depth by 2.5 feet in the removal area. Given the existing, relatively shallow water depth in these areas, it is unlikely that this increase in water depth would appreciably reduce the extent of the photic zone. In areas within the photic zone, there is a high potential for the return of invasive species, especially water chestnut, which is currently prevalent in the shallow areas of Woods Pond. However, the sediment removal and the increase in water depth would aid in limiting the proliferation of invasive species at least for several years.

Long-Term Habitat Impacts of Supporting Facilities

The conceptual layout design for SED 10 includes 7 staging areas covering approximately 15 acres (including 3.3 acres within the floodplain) and approximately 5 miles of temporary roadways covering an additional 11 acres (including 3.5 miles and 8.5 acres in the floodplain), as shown on Figure 6-28. The principal habitats affected by these facilities (within the boundaries of the Woodlot [2002] natural community mapping) are floodplain forests (6.0 acres), shrub and shallow emergent wetlands (2.2 acres), disturbed upland habitats such as agricultural fields and cultural grasslands (2.8 acres), and upland forests (0.5 acres).[314] These impacts would occur mainly in Reaches 5A and 5B, with additional limited impacts in Reach 6 to support the remediation there. Despite the implementation of restoration methods for these habitats, as described in the pertinent restoration methods subsections of Section 5.3, these habitats would experience long-term adverse impacts. The long-term post-restoration impacts on these types of habitats were described generally in Sections 5.3.4.4 (for floodplain forests), 5.3.5.3 (for shrub and shallow emergent wetlands), and 5.3.8.4 (for upland habitats). However, since the extent of these supporting facilities would be substantially less than under any of the other sediment removal alternatives (e.g., affecting 54 acres less than SED 3, the next smallest alternative), the extent of the long-term impacts from those facilities would also be less; and thus SED 10 would not be expected to cause widespread long-term harm within the PSA.

Long-Term Impacts on State-Listed Species

As noted above, SED 10 would affect portions of the Priority Habitats of 20 state-listed species. As discussed in the MESA assessments in Appendix L, it is anticipated that SED 10 would involve a "take" of 17 of these species and would adversely affect a significant portion of the local population of at least one of them. The table below lists the 20 state-

[314] Many of the access roads and staging areas required to complete remediation activities in Reaches 5 and 6 under SED 10 are situated outside of the PSA floodplain and not included in the Woodlot habitat community mapping. Based on review of information from MassGIS and aerial photography, it appears most of these facilities would be located in existing disturbed upland areas (e.g., agricultural fields and cultural grasslands) (8 acres), with additional impacts occurring in forested uplands (5 acres). Impacts associated with access roads and staging areas in Reach 7 would be minimal (approximately 0.3 acre of upland forest), and there would be no impacts from such facilities in Reach 8.

listed species whose Priority Habitat would be affected by SED 10, along with those for which SED 10 would result in a take and those for which SED 10 would or could impact a significant portion of the local population:

Table 6-70 – Impacts of SED 10 on State-Listed Species

Species with Priority Habitat Affected by SED 10	Take?	Impact on Significant Portion of Local Population?
American bittern	Yes	No
Arrow clubtail	Yes	No
Black maple	Unlikely	No
Bristly buttercup	Yes	No
Brook snaketail	Yes	No
Bur oak	Yes	No
Common moorhen	Yes	No
Foxtail sedge	Yes	No
Hairy wild rye	Unlikely	No
Intermediate spike-sedge	Yes	No
Mustard white	Yes	No
Narrow-leaved spring beauty	Unlikely	No
Ostrich fern borer moth	Yes	No
Rapids clubtail	Yes	No
Riffle snaketail	Yes	No
Spine-crowned clubtail	Yes	Likely
Triangle floater	Yes	Yes
Wapato	Yes	No
Wood turtle	Yes	Unlikely
Zebra clubtail	Yes	No

Long-Term Impacts on Aesthetics and Recreational Use

SED 10 would have some long-term impacts on the aesthetic features of the natural environment. The removal and capping activities in portions of Reach 5A, bank stabilization on approximately 1.6 linear miles of riverbank in Reaches 5A and 5B, and removal in Woods Pond would alter the appearance of the River during the course of those activities and for a period thereafter. Since the bank stabilization efforts would result in the permanent loss of mature overhanging trees on the stabilized banks, they would permanently change the vegetative community on those banks to a more open, exposed community, and thus the natural appearance of those banks would never resemble their current appearance. Further, the construction of access roads and staging areas to support implementation of SED 10 would also cause long-term impacts on the aesthetics of the floodplain. The construction of such facilities would remove trees and vegetation, including in forested areas. This would change the appearance of these areas until such time that they return to their prior state. As discussed previously, where mature trees are cut down, it would take at least 50 to 100 years for the replanted community to develop an appearance comparable to its current appearance. The presence of these cleared areas would detract from the natural pre-remediation of those areas until such time as the restoration plantings have matured. However, the areas that would be affected by implementation of SED 10 are small relative to the overall PSA, and thus the remediation would be less detrimental to the overall aesthetics of the PSA than any other sediment removal alternative in the long term.

In addition to their aesthetic value, the areas that would be subject to remediation under SED 10 include areas used for canoeing, fishing, hiking, and waterfowl hunting. These recreational activities would be disrupted by the implementation of SED 10. These disruptions would last not only during the remediation period, but until the areas have sufficiently recovered to support such uses.

Long-Term Impacts to Fluvial Geomorphic Processes

In addition to the impacts on bank erosion and lateral channel migration (discussed above), the partial stabilization of the banks in Reaches 5A and 5B, as well as the partial capping of sediment bed in those reaches, would reduce the supply of sediment to the River. The reduction in sediment load is expected to be relatively minor in comparison to the overall sediment load within the river system due to upstream sources as well as sediment input from non-stabilized banks and bed sediment. The potential impacts of such a reduction in sediment supply on geomorphological processes within the River, such as sediment transport, deposition/erosion patterns, and changes in channel width, depth, and slope, as well as on water depth and current velocities in the River, were described for SED 3 in Section 6.3.5.3. As discussed there, based on geomorphological considerations and modeling, the reduction in sediment load associated with riverbank stabilization and riverbed armoring would not be expected to result in a large-scale, long-term impact on these in-river morphologic processes or on in-river hydrologic characteristics such as water depth and current velocity. SED 10 would affect considerably less of both the riverbanks and riverbed than SED 3. The conclusion for SED 3 therefore applies even more to SED 10.[315]

Armoring of the riverbed would also have little effect on geomorphic processes occurring in the River. The armor stone would not affect sediment transport in the River as the river geometry would not be changed. Boundary conditions such as sediment supply, discharge, channel geometry, and roughness are the primary factors affecting geomorphic processes, and these attributes would not be greatly affected by the SED 10 remediation.

The intermittent nature of the sediment remediation in Reaches 5A and 5B under SED 10 would have the potential for small-scale, localized changes in in-river geomorphic processes, but no significant changes in those processes would be expected. Specifically, increases in near-bed and bank shear stress might arise in areas where the channel transitions between its natural state and engineered sections, depending on differences in effective roughness. However, it is unlikely that such a situation would occur because the equivalent roughness (e.g., based on observed heights of natural sand dunes that develop in these reaches) is likely not very different from the roughness that would result from a stabilized section of the channel as considered for SED 10 (e.g., based on assumed sizes of armor materials). Additionally, the stabilization under SED 10 would be designed to minimize abrupt changes in roughness in these alternating sections. Finally, any small localized areas of erosion that did occur as a result of the intermittent channel remediation under SED 10 would be evaluated under the monitoring program and remedial repairs developed if necessary.

Potential Measures to Mitigate Long-Term Adverse Impacts

In an effort to mitigate the long-term adverse impacts caused by the implementation of SED 10, various restoration methods are available (measures to avoid or minimize adverse impacts were described in Section 5.2). Restoration methods for the types of habitats that would be affected by SED 10 are described in Sections 5.3.1.3 for aquatic riverine habitat and 5.3.2.3 for the riverbanks, with appropriate modifications for the intermittent sediment removals in Reach 5A and intermittent bank stabilization in Reaches 5A and 5B. They

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315 Similar to SED 3, model results for SED 10 suggest that the partial bank stabilization and bed armoring included under this alternative, as represented by EPA's model, would produce some relatively large changes in bed elevation in some discrete localized areas (mainly in Reaches 5A and 5B), but would have a relatively small overall impact on the larger-scale bed elevation changes over the 26-year simulation relative to SED 1 (no action). As expected, the reduction in sediment loading due to partial bank and bed remediation under SED 10 is predicted to result in slight decreases in net deposition, relative to SED 1 (which included bank and bed erosion), within several areas of the River (mainly in Reaches 5A and 5B).

would also include the conceptual restoration methods outlined in the other pertinent restoration methods subsections in Section 5.3 for the habitats that would be affected by access roads and staging areas.

6.10.6 Attainment of IMPGs

As part of the evaluation of SED 10, average PCB concentrations in surface sediment and fish predicted by EPA's model at the end of the 52-year projection period have been compared to applicable IMPGs. For these comparisons, model-predicted sediment and fish PCB concentrations were averaged in the manner discussed in Section 3.5. The sections below describe the human health and ecological receptor IMPG comparisons for SED 10, and those comparisons are shown in Tables 6-71 through 6-76.

As described below, PCB concentrations in some areas are sufficiently low that certain IMPGs would be achieved prior to any active remediation of sediments, while some other IMPGs would be achieved at some point within the 52-year model simulation period, and other IMPGs would not be met (if at all) for many years after the modeled period. The numbers of years needed to achieve the IMPGs are presented in Tables 6-71 through 6-76.[316] In addition, figures in Appendix K show temporal profiles of model-simulated PCB concentrations for each of the IMPG comparisons described in this section (including the estimated time to achieve each IMPG). Where certain IMPGs would not be achieved by the end of the model projection period, the number of years to achieve the IMPGs has been estimated by extrapolating the model projection results beyond the 52-year simulation period, as directed by EPA, using the extrapolation method described in Section 3.2.1. As previously noted, such extrapolation produces estimates that are highly uncertain. Nonetheless, the extrapolated estimates of time to achieve the IMPGs that are not met within the 52-year model projection period are described below.[317]

[316] The extent to which SED 10 is predicted to accelerate attainment of the IMPGs relative to natural processes can be seen by comparing these tables to the comparable tables for SED 1 (see Section 4.1.6 above).

[317] Also, as described in Section 3.2, bounding simulations have been conducted with the model to evaluate the significance of various assumptions regarding the East Branch PCB boundary condition and sediment residual values, as directed by EPA. For SED 10, in almost all cases, application of the "lower bound" assumptions in the model did not result in the attainment of additional IMPGs, beyond those attained using the "base case" assumptions, for the receptors/averaging areas described below. Therefore, the discussion below focuses on IMPG attainment resulting from the application of the "base case" model assumptions; however, the few instances of additional IMPG attainment resulting from application of the lower-bound assumptions are noted. (Full comparisons between model results for the base case and lower bound simulations are provided in Appendix K.)

6.10.6.1 Comparison to Human Health-Based IMPGs

For human direct contact with sediments, the average predicted surface sediment (0- to 6-inch) concentrations for SED 10 would achieve RME IMPG values within EPA's cancer risk range, as well as all non-cancer-based IMPGs, in all eight of the sediment direct contact exposure areas in Reaches 5 through 8 (Table 6-71).[318] The majority of these IMPGs would be met prior to any active remediation, while the others would be achieved over a period of approximately 2 to 35 years.

For human consumption of fish, the average fish PCB concentrations predicted by the model after 52 years, when converted to fillet-based concentrations, would not achieve any of the IMPGs in Reaches 5 through 8 by the end of the simulation period, except that the CTE IMPGs based on a 10^{-4} cancer risk would be achieved in Reach 5A and Woods Pond and in all subreaches between Woods Pond and Rising Pond Dams (although the corresponding CTE IMPGs based on non-cancer impacts would not be achieved) (Table 6-72). In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 10 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all of those impoundments, and would achieve some of the non-cancer IMPGs in some of the impoundments (Table 6-72).[319]

Extrapolation of the model results beyond the model period indicates that achievement of the RME-based IMPGs for unrestricted fish consumption of 50 fish meals per year (based on the deterministic approach and on a 10^{-5} cancer risk as well as non-cancer impacts) would take >250 years in the PSA and in Reaches 7 and 8, and 160 to 245 years in the Connecticut impoundments.

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318 Specifically, SED 10 would achieve all direct contact IMPG values with the exception of the RME values based on a 10^{-6} cancer risk and, in area SA 2, the RME value based on a 10^{-5} cancer risk for adults (which would be slightly exceeded).

319 In Specific Comment 38 on the CMS Report, EPA directed GE to include a discussion of the sensitivity of the model to GE's use of only largemouth bass in the "blended fish" calculations used for human health risk comparisons. To assess this sensitivity, the method used by EPA in the HHRA to calculate a "blended" fish concentration was adapted for use with the species simulated by EPA's FCM (as discussed in Appendix I). Application of this revised "blended" fish averaging method to FCM outputs results in PCB concentrations that are on average 5% higher than those used in the comparisons described above. For SED 10, this change in averaging method (and the resulting increase in concentration) results in only two small changes in the IMPG attainment presented in Table 6-72. Specifically, SED 10 would no longer achieve the probabilistic RME non-cancer (child) IMPG and the probabilistic CTE 10^{-4} cancer IMPG in one Connecticut impoundment (Lake Zoar).

6.10.6.2 Comparison to Ecological IMPGs

For benthic invertebrates, predicted average surface sediment PCB concentrations would achieve the upper-bound IMPG (10 mg/kg) within the model period in 27 of the 32 averaging areas, and would also achieve the lower-bound IMPG (3 mg/kg) in 11of those areas (Table 6-73). The time required to achieve the upper-bound IMPG (when attained) ranges from <1 to 50 years; however, in areas where this IMPG is not achieved, extrapolation of the model results indicates that time to achieve the upper-bound IMPG for benthic invertebrates could range between 100 and >250 years.

For amphibians, predicted surface sediment PCB levels in the backwater areas at the end of the modeled period would achieve the upper-bound IMPG (5.6 mg/kg) in 13 of the 29 backwaters evaluated, and would also achieve the lower-bound IMPG (3.27 mg/kg) in 7 of those areas (Table 6-74). Time to achieve the IMPGs in backwaters varies between 5 and >250 (extrapolated) years for the upper-bound IMPG and between 10 and >250 (extrapolated) years for the lower-bound IMPG.

For fish, the model-predicted average whole-body fish PCB concentrations for SED 10 would achieve the IMPGs for warmwater fish (55 mg/kg) in all reaches, but would not achieve the IMPG for coldwater fish (14 mg/kg) in any of the eight subreaches in Reach 7 (Table 6-75). Time to achieve the warmwater fish IMPG (where it was not already met at the beginning of the model period) ranges from approximately 5 to 35 years. Estimates of the time to achieve the coldwater fish IMPG range from 60 to 170 (extrapolated) years.

For insectivorous birds (represented by wood ducks) and piscivorous mammals (represented by mink), predicted average surface sediment PCB levels in the relevant averaging areas exceed the highest selected target sediment level (5 mg/kg) in all relevant averaging areas in Reaches 5 and 6, except for two wood duck averaging areas (where achievement in those areas would take approximately 5 to 30 years) (Table 6-76). Extrapolated estimates of the time required to achieve these target levels range from 70 to >250 years for the insectivorous bird levels and from approximately 110 to >250 years for the piscivorous mammal levels.[320]

For piscivorous birds (represented by osprey), the model-predicted average whole-body fish PCB concentrations for the size ranges relevant to this receptor are greater than the IMPG

[320] In the evaluation of combined sediment and floodplain alternatives presented in Section 8, SED 10 has been paired with FP 9. The evaluation of that combination of alternatives in Section 8.2.5.2 has assessed the attainment of the IMPGs for insectivorous birds and piscivorous mammals based on the actual sediment concentrations achieved under SED 10, thus avoiding the need to consider the pre-determined target sediment levels of 1, 3, and 5 mg/kg (see also Section 2.2.2.3).

of 3.27 mg/kg in all reaches (Table 6-75). Extrapolated estimates of the time required to achieve this IMPG range from approximately 80 to >250 years.[321]

Finally, for threatened and endangered species (represented by bald eagle), the model-predicted average whole-body fish PCB concentrations for the relevant size range would achieve the IMPG (30.4 mg/kg) in all reaches (Table 6-75). Time to achieve this IMPG ranges from approximately 5 to 35 years.[322]

6.10.7 Reduction of Toxicity, Mobility, or Volume

The degree to which SED 10 would reduce the toxicity, mobility, or volume of PCBs is discussed below.

Reduction of Toxicity: SED 10 does not include any treatment processes that would reduce the toxicity of the PCBs in the sediment. However, if free NAPL, drums of liquid, or the like should be encountered (which is not anticipated), those wastes would be segregated and sent off-site for treatment and disposal.

Reduction of Mobility: SED 10 would reduce the mobility of PCBs in the River by removing approximately 235,000 cy of sediment containing PCBs in Reach 5A (followed by capping) and in Woods Pond and by stabilizing portions of the banks in Reaches 5A and 5B, including the removal of 6,700 cy of PCB-containing bank soils. In total, a cap would be placed over approximately 20 acres of Reach 5A. This cap would prevent or minimize the mobility of PCBs in the underlying sediments.

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321 In Specific Comment 60 on the CMS Report, EPA noted that it disagrees with GE's assignment of feeding preferences for osprey, and provided an alternate parameterization for the osprey diet. As discussed in Appendix I), use of the method proposed by EPA would result in simulated fish tissue concentrations that are approximately 16% higher than those calculated by GE and used in the comparisons described herein. However, as shown in Appendix I, this increase in predicted fish tissue concentrations would result in no change in the number of averaging areas achieving the piscivorous bird IMPG under SED 10.

322 EPA's conditional approval letter of January 15, 2010 for GE's 2009 Work Plan also directed GE to consider the impact of each alternative on ecological receptors, including threatened and endangered species, in Connecticut. Estimated surface sediment PCB concentrations in the Connecticut portion of the River under SED 10 at the end of the simulation period are 0.03 to 0.05 mg/kg, and estimated fish PCB concentrations (whole body) in the Connecticut impoundments at the end of the projection period under SED 10 are in the range of 0.3 to 0.5 mg/kg (Table 6-69). All of these sediment and fish concentrations are well below the IMPGs for ecological receptors (including threatened and endangered species).

Reduction of Volume: SED 10 would reduce the volume of sediment containing PCBs and the mass of PCBs present in the River through the removal of a total of 241,700 cy of sediments/bank soils containing approximately 10,600 lbs of PCBs.

6.10.8 Short-Term Effectiveness

Evaluation of the short-term effectiveness of SED 10 has included consideration of the short-term adverse impacts of implementing this alternative on the environment (considering both ecological effects and increases in GHG emissions), on the local communities (as well as communities along transport routes), and on the workers involved in the remedial activities. Short-term adverse impacts are those that would occur during and immediately after the performance of the remedial activities in a given area. Since the remedial actions under SED 10 would be spread out over the overall remedial action period and area, the short-term impacts would not last for the entire duration of the project in all affected areas.

Impacts on the Environment – Effects Within PSA

The short-term adverse impacts on the environment resulting from implementation of SED 10 would include potential impacts to the water column, air, and biota in the Rest of River area during excavation and capping; alteration/destruction of benthic habitat in the areas subject to those activities; alteration of riverbank habitat and associated biota due to bank stabilization activities; and loss of floodplain habitat and biota due to construction of the supporting facilities. Short-term impacts specifically associated with each remedial component are described below.

Sediment Removal: Sediment removal in Reaches 5A and 6 (235,000 cy over 62 acres) would result in some resuspension of PCB-containing sediment due to the invasive nature of removal operations. Resuspension to the water column outside the work area would be controlled in Reach 5A as removal activities in those reaches would be conducted in the dry using sheetpile containment. However, the potential exists for suspended or residual sediment containing PCBs to be released during sheetpile installation or due to overtopping of the sheetpiles during a high flow event. For Woods Pond, activities would be conducted via mechanical dredging in the wet with silt curtains used to mitigate sediment release to downstream reaches. In these areas, some sediment containing PCBs would be released from the work area through the dredging/excavation process even though the areas would be surrounded by silt curtains.[323] In addition, boat and barge traffic could resuspend sediment during the construction phase.

In addition, sediment removal activities, particularly when conducted in the wet (even with the use of silt curtains), would be expected to result in short-term increases in PCB concentrations in biota downstream of the removal work areas. As described in Section 6.4.8, such increases have been noted at other sites where dredging in the wet has occurred (e.g., Upper Hudson River and Grasse River) and even where excavation in the dry has been conducted (e.g., Upper ½-Mile Reach); and such results would likewise be expected to occur under SED 10.

The potential also exists during sediment and bank soil removal and related processing activities for airborne releases that could impact downwind communities.

Implementation of SED 10 would cause a loss of aquatic habitat over approximately 20 acres of the River in Reach 5A where sediment removal would occur. A general discussion of the immediate and near-term impacts of sediment removal and capping in aquatic riverine habitats was provided in Section 5.3.1.2, and the short-term impacts of removal/capping in Reach 5A were summarized for SED 3 in Section 6.3.8. These impacts include removal of the natural bed material, woody debris, and aquatic vegetation which are used as habitat by both fish and benthic invertebrates; direct loss of benthic invertebrates and aquatic organisms (e.g., reptiles and amphibians) residing in the sediments during the removal; disruption and displacement of fish; alteration of habitat for birds and mammals that live adjacent to the River and feed and disperse in areas subject to remediation; and colonization by invasive plant species. However, under SED 10, these impacts would occur in a considerably smaller extent of aquatic riverine habitat than under all previously discussed sediment removal alternatives, since SED 10 would affect much less of that habitat (e.g., 22 acres less than SED 3, the next smallest alternative).

SED 10 would also cause a short-term loss of aquatic habitat over at least 42 acres in Woods Pond where sediment removal would occur. A general discussion of the immediate and near-term impacts of sediment removal in such impoundments was provided in Section 5.3.3.2. For SED 10, these impacts would include removal of the current structural habitat, aquatic vegetation, and any viable organisms present in the sediments subject to removal, a well as disruption and displacement of fish and other mobile animals in and near the removal areas and of birds and mammals that feed on those organisms.

[323] Examples of other sites where mechanical dredging has caused resuspension, generally on the order of 3%, were provided in prior sections. If 3% of the PCB mass dredged in Woods Pond under SED 10 were lost to the water column, that would equate to approximately 135 lbs of PCBs.

Bank Stabilization: Bank stabilization activities in the portions of Reaches 5A and 5B subject to such activities would have immediate effects on the riparian corridor bordering the River. Those impacts were described generally in Section 5.3.2.2 and summarized for SED 3 in Section 6.3.8. However, under SED 10, these impacts would be much more limited in extent than under SED 3 through SED 9, since SED 10 would involve bank stabilization over only a total of 1.6 linear miles of banks versus 14 linear miles under those prior alternatives.

Supporting Facilities: Construction of access roads staging areas in the floodplain and other areas near the River would result in the loss of habitat in those areas and the wildlife that they support. It is anticipated that SED 10 would require a total of approximately 26 acres for access roads and staging areas (approximately 12 acres within the 10-year floodplain). The habitat types affected were identified in Section 6.3.5.3; they are the same as those that would be affected by such facilities under SED 3 except that they would cover a smaller area. (For comparison, the facilities required for SED 3 would affect a total of 81 acres, with 47 in the floodplain.) Thus, the short-term adverse impacts on these habitats from the construction and use of access roads and staging areas under SED 10 would be generally the same as those listed in Section 6.3.8 for the support facilities under SED 3, except that they would occur in substantially fewer areas. In particular, any habitat fragmentation resulting from SED 10 would be much less severe than that from SED 3 or any of the other sediment removal alternatives.

Carbon Footprint – GHG Emissions

As described in Section 5.6 and Appendix M, an estimate has been developed of the carbon footprint composed of GHG emissions anticipated to occur through sediment removal/capping and related ancillary activities during the implementation of SED 10.

The total calculated emissions from SED 10 would amount to approximately 37,000 tonnes of GHG emissions, with 9,300 tonnes resulting from direct emissions (primarily from construction activities and transportation), 900 tonnes from indirect emissions (associated with electricity for water treatment), and the remaining 27,000 tonnes from off-site emissions (primarily from manufacture of steel sheeting and of cement for stabilization, as well as diesel refining). The total GHG emissions estimated for this alternative are equivalent the annual output of 7,000 passenger vehicles.

Impacts on Local Communities and Communities Along Transport Routes

SED 10 would result in short-term impacts to the local communities in the Rest of River area. These short-term effects would include disruption of recreational canoeing and other river-related and land-side activities along the River and within the floodplain due to the remediation and the construction of access roads and staging areas, as well as increased noise and truck traffic. Under SED 10, these impacts would affect portions of Reach 5 and 6 for an estimated 5 years.

Impacts on Recreational Activities: As noted above, recreational activities in the areas that would be affected by SED 10 include fishing, canoeing, hiking, and waterfowl hunting. During the period of remedial construction, restrictions on such recreational uses of the River and floodplain would be imposed in the areas in which remediation-related activities are taking place. Due to safety considerations, boaters, hikers, anglers, and hunters would not be able to use the River or floodplain in the areas where such activities are being conducted. Further, bank stabilization activities in portions of Reaches 5A and 5B would remove the ability of recreational anglers, hunters, and hikers to use those bank portions during construction. Aesthetically, the presence of the heavy construction equipment and cleared or disturbed areas would detract from the visually undisturbed nature of the area.

Increase in Truck Traffic: Due to the need to deliver equipment and capping/stabilization materials to the work areas and to remove excavated materials from the work areas, truck traffic in the area would increase over current conditions. It is expected that this increased truck traffic would persist for the duration of SED 10 (approximately 5 years). As an example, if 20-ton capacity trucks were used to transport excavated sediments and bank soils from the staging areas to the disposal or treatment facilities, it would take approximately 19,900 truck trips to do so (1,990 truck trips per year for a 5-year implementation period). Additional truck trips would be necessary to transport capping and stabilization materials (sand and stone), as well as materials for the construction of staging areas and access roads, to the site. Assuming the use of 16-ton capacity trucks for local hauling of such materials, approximately 9,200 additional truck trips (1,840 truck trips per year) would be required for that purpose. The increased traffic would increase noise levels and emissions of vehicle/equipment exhaust and nuisance dust to the air. Noise in and near the construction zone could affect those residents and businesses located near the work areas.

The additional truck traffic would also increase the risk of traffic accidents along transport routes. Appendix N includes an analysis of potential risks from the increased off-site truck traffic that would be associated with the sediment remedial alternatives. This analysis focuses on the increased truck traffic that would be necessary to transport clean materials to the site for implementation of the alternatives and to dispose of used access road and

staging area materials following completion of remediation.[324] This analysis indicates that the increased truck traffic associated with SED 10 would result in an estimated 0.89 non-fatal injuries due to accidents (average annual non-fatality injury estimate of 0.17) with a probability of 59% of at least one such injury, and an estimated 0.04 fatalities from accidents (average fatality estimate of 0.008) with a probability of 4% of at least one such fatality.

Potential Measures to Avoid, Minimize of Mitigate Short-Term Community Impacts

A number of measures would be employed in an effort to avoid, minimize, and mitigate potential detrimental effects of construction activities on the affected communities.[325] These measures would consist of the ones identified in Section 5.7 above. Despite the implementation of these measures, some detrimental effects of construction and short-term impacts and risks associated with implementation of SED 10 would be inevitable.

Risks to Remediation Workers

There would be potential health and safety risks to site workers implementing SED 10. Implementation of SED 10 is estimated to involve 242,568 man-hours over a 5-year timeframe. The analysis in Appendix N of potential risks to workers from implementation of the sediment alternatives indicates that implementation of SED 10 would result in an estimated 2.24 non-fatal injuries to workers (average annual non-fatality injury estimate of 0.44) with a probability of 89% of at least one such injury, and an estimated 0.02 worker fatalities (average annual fatality estimate of 0.005) with a probability of 2% of at least one such fatality. Engineering controls and OSHA procedures designed to mitigate risks to remediation workers would be instituted.

6.10.9 Implementability

6.10.9.1 Technical Implementability

The technical implementability of SED 10 has been evaluated considering the factors identified below.

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[324] The risks from transport of excavated materials to the staging areas are evaluated as part of risks to workers, discussed below; and the risks from transport of such materials from the staging areas to treatment or disposal facilities are evaluated under the relevant treatment/disposition alternatives.

[325] The measures considered to avoid or minimize adverse short-term ecological effects were described in Section 5.2.

General Availability of Technologies: SED 10 would be implemented using well-established and available in-river remediation methods and equipment. Similarly, land-based support areas would be constructed using commonly available construction technologies. Further, well-established and readily available equipment would also be used to monitor the remedial alternative both during and following implementation.

Ability To Be Implemented: The technologies and process options that are part of SED 10 would be technically implementable in the reaches where they would be applied. Sediment removal with subsequent capping would be performed in the dry in portions of Reach 5A. Removal in the dry was used in the Upper ½-Mile Reach and the 1½-Mile Reach of the Housatonic River, and the same techniques could be used in Reach 5A. Sediment removal in the wet would be performed in Woods Pond using mechanical dredging techniques. Removal in the wet has also been used at other sites, as noted in Section 6.4.5.2. Given the capping to current grade in Reach 5A and the deepening in Woods Pond, there would be no loss of flood storage capacity.

Riverbank stabilization, including the removal of bank soils where necessary, would be performed on portions of the banks in Reaches 5A and 5B. Conceptual stabilization techniques were described in Section 3.1.4 and Appendix G, but the actual stabilization techniques that would be used if this alternative were selected would be determined through the detailed design process. Those techniques would be designed to avoid any significant net reduction in flood storage capacity in any relevant river stretches.

MNR with institutional controls would be implemented in all other reaches. Monitoring to track changes in PCB concentrations following the SED 10 remedial activities could be performed using readily available methods and materials, such as have been used previously in the River. Similarly, the continued maintenance of biota consumption of advisories would be expected to use similar techniques to those used previously.

Support facilities in the floodplain area necessary for implementation of SED 10 could readily be constructed using commonly available construction techniques.

Reliability: The remediation technologies that comprise SED 10 are reliable, as shown through implementation at other sites and in portions of the Housatonic River upstream of the Confluence. The use of these technologies at other sites was described in Sections 6.3.5.2 and 6.4.5.2. However, as discussed in Sections 6.10.5.2 and 6.10.5.3, the habitat restoration technologies for some of the affected habitats cannot be considered reliable in terms of their ability to re-establish the pre-remediation conditions and functions of those habitats, although this should be less of a problem for SED 10 than for the other sediment removal alternatives due to the lesser extent of the disturbances.

Availability of Space for Support Facilities: Implementation of SED 10 would require construction of access roads and staging areas at various locations within the floodplain. As noted above, approximately 26 acres of space (assuming that the necessary access agreements can be obtained) would be needed, and appear to be available to support the SED 10 activities based on preparation of a conceptual site layout (assuming that the necessary access agreements can be obtained). Development of access roads and staging areas would be sequenced and constructed appropriately over the approximate 5-year implementation period for SED 10.

Availability of Cap/Stabilization Materials: Materials required for cap placement and bank stabilization must be of suitable quality for their intended purposes. Approximately 69,600 cy of sand/fill/stone materials would be required for capping and bank stabilization activities (i.e., 34,700 cy of sand/clean fill and 34,900 cy of armor stone and riprap). For purposes of this Revised CMS Report, adequate material sources are assumed to be locally available, based on the availability and use of similar materials for the removal actions completed in the Upper ½-Mile and 1½-Mile Reaches. An evaluation would be performed during design to confirm suitable material availability.

Ease of Conducting Additional Corrective Measures: Future corrective measures, if needed to perform cap or bank maintenance or conduct additional remediation, would likely be implementable, subject to the same technical and logistical constraints applicable to the initial implementation of SED 10. Ease of implementation would be directly related to the extent of the additional corrective measure (i.e., area and/or volume to be addressed) and the ease of access (i.e., location of target area and proximity of access areas).

Ability to Monitor Effectiveness: The effectiveness of SED 10 would be determined over time through long-term monitoring to document reductions in PCB concentrations in water column, sediment, and fish tissue in various reaches of the River. Periodic monitoring (i.e., visual observation and sampling) of the capped sediments and restored riverbanks would allow for an evaluation of cap integrity and effectiveness, as well as bank stability. Such activities have been successfully performed on the upper portion of the Housatonic River and at other sites previously. Equipment and methods for this type of monitoring are readily available.

6.10.9.2 Administrative Implementability

The administrative implementability of SED 10 has been evaluated in consideration of regulatory requirements, the need for access agreements, and coordination with governmental agencies.

Regulatory Requirements: Implementation of SED 10 would need to comply with the substantive requirements of regulations that are designated as ARARs for the performance of the remedial action (unless waived). An evaluation of compliance with potential ARARs for SED 10 is provided in Tables S-10.a through S.10-c in Appendix C and summarized in Section 6.10.4.

Access Agreements: Implementation of SED 10 would require GE to obtain access permission from the owners of properties that include riverbank or floodplain areas where remedial work or ancillary facilities would be necessary to carry out the alternative. Although many of these areas are owned by the State or the City of Pittsfield (which have agreed to provide access), it is anticipated that access agreements may be required from approximately 20 to 25 other landowners to implement SED 10. Obtaining such access agreements could be problematic in some cases. If GE should be unable to obtain access agreements with particular property owners, GE would request EPA's assistance.

Coordination with Agencies: Implementation of biota consumption advisories would require coordination with state public health departments and/or other appropriate agencies in the dissemination of information to the public and surrounding communities regarding those advisories. In addition, obtaining access to state-owned lands would require coordination with the state agencies that own that land. Finally, both prior to and during implementation of SED 10, GE would need to coordinate with EPA, as well as state and local agencies, to provide as-needed support with public/community outreach programs.

6.10.10 Cost

The estimated total cost to implement SED 10 is \$82 M (not including treatment or disposition of removed materials). The estimated total capital cost is \$73.5 M, assumed to occur over a 5-year construction period. Estimated annual OMM costs include costs for a 5-year inspection and maintenance program for the restored riverbed (visual observations only), riverbanks, and restored staging areas and access roads; these costs range from \$15,000 to \$375,000 per year (depending on which reach is being monitored), resulting in a total cost of \$2.9 M. The estimated annual OMM costs for SED 10 also include implementation of a long-term water, sediment, and fish monitoring program, as well as implementation of institutional controls, for a period of 100 years following completion of construction activities on a reach-specific basis. The estimated costs for this long-term program range from approximately \$32,500 to \$447,000 per year (depending on the extent of monitoring occurring within a given year), resulting in a total cost of \$5.8 M. The following summarizes the total capital and OMM costs estimated for SED 10.

SED 10	Est. Cost	Description
Total Capital Cost	$73.5 M	Costs for engineering, labor, equipment, and materials associated with implementation
Total OMM Cost	$8.7 M	Costs for performance of the OMM programs
Total Cost for Alternative	$82 M	Total cost of SED 10 in 2010 dollars

The total estimated present worth cost of SED 10, which was developed using a discount factor of 7%, a 5-year construction period, and an OMM period of 100 years on a reach-specific basis, is approximately $68 M. More detailed cost estimate information and assumptions for each of the sediment alternatives are included in Appendix Q.

These costs do not include the costs of associated floodplain remediation or the costs of treatment/disposition of removed sediments/bank soils. The estimated costs for the combination of SED 10 and FP 9 are presented in Section 8.2.9, and the estimated costs for combinations of sediment remediation and treatment/disposition alternatives are presented in Section 10.

6.10.11 Overall Protection of Human Health and the Environment – Conclusions

As explained in Section 6.10.2, the evaluation of whether SED 10 would provide overall protection of human health and the environment draws upon the evaluations under several other Permit criteria, discussed in prior sections, as well as other factors relevant to the protection of health and the environment. The key considerations relevant to this criterion are discussed below.

<u>*General Effectiveness*</u>: As discussed previously, SED 10 would result in a reduction in the potential for exposure of human and ecological receptors to PCBs in sediments, surface water, and fish by: (a) permanently removing 235,000 cy of PCB-containing sediments in Reaches 5A and 6 and placing a cap over the underlying sediments in the Reach 5A removal areas; (b) stabilizing select riverbanks in Reaches 5A and 5B, including removal of 6,700 cy; and (c) relying on natural recovery processes in other areas. As shown in Section 6.10.3, implementation of SED 10, along with ongoing remedial activities upstream of the Confluence, is predicted to reduce the annual PCB mass in the River passing Woods Pond Dam from 20 to 7.6 kg/yr, that passing Rising Pond Dam from 19 to 7.3 kg/yr, and that transported from the River to the floodplain in Reaches 5 and 6 from 12 to 3.9 kg/yr over the modeled period.

Further, as shown in Section 6.10.5.1, EPA's model predicts that implementation of SED 10 would result in a substantial permanent reduction in sediment and fish PCB concentrations. For example, the model predicts that the fish PCB concentrations (whole body) would be reduced over the modeled period from 70-110 mg/kg to approximately 20-55 mg/kg in Reaches 5 and 6, from 30-60 mg/kg to approximately 15-20 mg/kg in the Reach 7 impoundments, from 30 mg/kg to 14 mg/kg in Rising Pond, and from 1-2 mg/kg to 0.3-0.5 mg/kg in the Connecticut impoundments.

Compliance with ARARs: As explained in Section 6.10.4, review of the chemical-specific ARARs indicates that SED 7 would not achieve the freshwater aquatic life water quality criterion of 0.014 µg/L or the human health water quality criterion of 0.000064 µg/L. However, as also discussed in that section, the latter should be waived as technically impracticable, and the former should be waived on the ground that the actions necessary to achieve that criterion would result in greater risk to the environment than alternatives that do not achieve that criterion. Review of the potential location-specific and action-specific ARARs indicates that SED 10 could be designed and implemented to meet most of those ARARs, but that some federal and state regulatory requirements would not be met. As a result, to the extent that those requirements constitute ARARs, they would also need to be waived by EPA as technically impracticable (or on some other ground) under CERCLA and the NCP.

Human Health Protection: As shown in Section 6.10.6.1, accepting EPA's HHRA, SED 10 would provide protection of human health from direct contact with sediments, since it would achieve sediment PCB levels within EPA's cancer risk range and below the target non-cancer HI of 1 in all sediment direct contact exposure areas, with the majority of these IMPGs met at the present time. For human consumption of fish, the fish PCB concentrations predicted to result from SED 10 at the end of the 52-year simulation period, when converted to fillet-based concentrations, would not achieve the IMPG levels based on RME assumptions (i.e., those based on unrestricted consumption of Housatonic River fish) in any reaches in Massachusetts. In the Connecticut impoundments, the CT 1-D Analysis indicates that SED 10 would achieve the RME IMPGs based on a 10^{-4} cancer risk in all of those impoundments within the model period, and would achieve some of the non-cancer IMPGs in some of the impoundments. Where the levels for unrestricted fish consumption are not achieved, institutional controls – i.e., fish consumption advisories – would continue to be used to protect human health from fish consumption.

Environmental Protection: As EPA guidance makes clear, the standard of "overall protection" of the environment requires a balancing of the short-term and long-term adverse ecological impacts of the alternatives with the residual risks (EPA, 1990a, 1997a, 1999, 2005d). Thus, in assessing achievement of that standard, it is essential that any asserted risks of PCBs be weighed against the adverse ecological impacts from implementation of the remedial alternatives.

As discussed in Section 6.1.6.2, the model results indicate that SED 10 would achieve the IMPG levels for some ecological receptor groups. Specifically, SED 10 would achieve fish PCB levels below the IMPGs for protection of warmwater fish and threatened and endangered species within the modeled period. For other receptor groups, SED 10 would achieve the IMPG levels in some areas. Specifically, SED 10 would result in PCB levels in sediments at the end of the modeled period that: (a) are within or below the IMPG range for benthic invertebrates (3 to 10 mg/kg) in 27 of the 32 averaging areas, and (b) are within or below the IMPG range for amphibians (3.27 to 5.6 mg/kg) in 13 of the 29 backwaters. The fish levels predicted for SED 10 exceed the coldwater fish IMPG (14 mg/kg) and the fish IMPG for piscivorous birds (3.2 mg/kg) in all relevant reaches, and the predicted sediment levels exceed the highest selected target sediment level (5 mg/kg) developed to assess protection of insectivorous birds and piscivorous mammals in all relevant averaging areas (except two wood duck averaging areas).

As discussed in Section 2.1.1, attainment of IMPGs, as only one of the Selection Decision Factors under the Permit, is not determinative of whether an alternative would provide overall protection of the environment, but rather is a consideration to be balanced against the other Selection Decision Factors. Under SED 10, while the IMPGs would not be achieved for some receptors and areas, the local populations of these receptors extend beyond the areas of the IMPG exceedances (i.e., to other areas of suitable habitat within the Rest of River where the IMPGs would be achieved and/or to nearby areas outside the Rest of River), as discussed previously. In these circumstances, the IMPG exceedances are not indicative of adverse effects that would prevent the maintenance of healthy local populations of these receptors, let alone negatively impact the overall wildlife community in the Rest of River area. This is supported by the fact that field surveys conducted by both EPA and GE, as well as other existing ecological information identified in Section 5.1.1, have documented the presence of numerous and diverse invertebrate, fish, amphibian, reptile, bird, and mammal species (including state-listed rare species) in the PSA despite the fact that PCBs have been present in that area for over 70 years.

More significantly, while SED 10 would have some adverse ecological impacts, it would minimize the severe and widespread short-term, long-term, and, in some cases, permanent adverse ecological impacts that would result from more extensive remediation to achieve additional IMPGs. Those impacts were described in the evaluation sections on SED 3 through SED 9. As noted above, the standard of “overall protection” of the environment includes a balancing of the short-term and long-term ecological impacts of the alternatives with the residual risks. In particular, “it is important to determine whether the loss of a contaminated habitat is a greater impact than the benefit of providing a new, modified but less contaminated habitat” (EPA, 2005d, p. 6-6). Based on such balancing, SED 10 would provide overall protection of the environment, since it would (a) reduce the PCB exposure levels of ecological receptors and provide additional protection from the PCB effects found in the ERA, while at the same time (b) minimizing the severe ecological harm from remediation to achieve additional IMPGs and causing the least amount of environmental damage of any of the sediment removal alternatives.

Summary: Based on the foregoing considerations, SED 10 would meet the standard of providing overall protection of human health and the environment.

Section 6 Tables

Table 6-1. Summary of volume calculations, removal depths and areas by subreach for all SED alternatives.

Alternative		River Reach																	
		5A	5B	5A/B Banks	5C (Upper Section)	5C (Lower Section)	5 Backwaters (Small)	5 Backwaters (Large)	Woods Pond (Shallow)	Woods Pond (Deep Hole)	7A, D, F, H (Reach 7 Channel)	7B (Columbia Mill Dam Imp.)	7C (Former Eagle Mill Dam Imp.)	7E (Willow Mill Dam Imp.)	7G (Glendale Dam Imp.)	Rising Pond (Shallow)	Rising Pond (Deep)	9 to 17	Total
SED 1	**Approach**	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	No action	
	Criteria	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Removal depth	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Replacement engr. cap (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Thin Layer Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	MNR (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
SED 2	**Approach**	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	
	Criteria	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Removal depth	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Replacement engr. cap (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Thin Layer Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	MNR (acres)	42	27	---	20	37	18	68	37	23	164	10	8	8	12	19	22	---	**515**
SED 3	**Approach**	Removal	MNR	Stabilization	MNR	TLC Only	MNR	MNR	TLC Only	TLC Only	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	
	Criteria	Full reach	---	Operational	---	Full reach	---	---	Full reach	Full reach	---	---	---	---	---	---	---	---	
	Removal depth	2-ft	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	134,000	---	35,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**169,000**
	Replacement engr. cap (acres)	42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**42**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Thin Layer Cap only area (acres)	---	---	---	---	37	---	---	37	23	---	---	---	---	---	---	---	---	**97**
	MNR (acres)	---	27	---	20	---	18	68	---	---	164	10	8	8	12	19	22	---	**376**
SED 4	**Approach**	Removal	Removal/TLC Only	Stabilization	TLC Only	EC Only	TLC Only/MNR	TLC Only/MNR	Removal	TLC Only	MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	
	Criteria	Full reach	Velocity/depth	Operational	Full reach	Full reach	PCBs: 15 ppm [1]	PCBs: 15 ppm [1]	Full reach	Full reach	---	---	---	---	---	---	---	---	
	Removal depth	2-ft	2-ft	---	---	---	---	---	1.5-ft	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	134,000	39,000	35,000	---	---	---	---	89,000	---	---	---	---	---	---	---	---	---	**297,000**
	Replacement engr. cap (acres)	42	12	---	---	---	---	---	37	---	---	---	---	---	---	---	---	---	**91**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	37	---	---	---	---	---	---	---	---	---	---	---	---	**37**
	Thin Layer Cap only area (acres)	---	15	---	20	---	7	54	---	23	---	---	---	---	---	---	---	---	**119**
	MNR (acres)	---	---	---	---	---	11	14	---	---	164	10	8	8	12	19	22	---	**268**
SED 5	**Approach**	Removal	Removal	Stabilization	Removal	EC Only	TLC Only/MNR	TLC Only/MNR	Removal	EC Only	MNR	MNR	MNR	MNR	MNR	TLC Only	TLC Only	MNR	
	Criteria	Full reach	Full reach	Operational	Full reach	Full reach	PCBs: 15 ppm [1]	PCBs: 15 ppm [1]	Full reach	Full reach	---	---	---	---	---	Full reach	Full reach	---	
	Removal depth	2-ft	2-ft	---	2-ft	---	---	---	1.5-ft	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	134,000	88,000	35,000	66,000	---	---	---	89,000	---	---	---	---	---	---	---	---	---	**412,000**
	Replacement engr. cap (acres)	42	27	---	20	---	---	---	37	---	---	---	---	---	---	---	---	---	**126**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	37	---	---	---	23	---	---	---	---	---	---	---	---	**60**
	Thin Layer Cap only area (acres)	---	---	---	---	---	7	54	---	---	---	---	---	---	---	19	22	---	**102**
	MNR (acres)	---	---	---	---	---	11	14	---	---	164	10	8	8	12	---	---	---	**227**
SED 6	**Approach**	Removal	Removal	Stabilization	Removal	Removal	Removal/TLC Only	Removal/TLC Only	Removal	EC Only	MNR	TLC Only	TLC Only	TLC Only	TLC Only	TLC Only	EC Only	MNR	
	Criteria	Full reach	Full reach	Operational	Full reach	Full reach	PCBs: 50 ppm / 1 ppm [2]	PCBs: 50 ppm / 1 ppm [2]	Full reach	Full reach	---	Full reach	Full reach	Full reach	Full reach	Full reach	Full reach	---	
	Removal depth	2-ft	2-ft	---	2-ft	2-ft	1-ft	1-ft	1.5-ft	---	---	---	---	---	---	---	---	---	
	Removal volume (cy)	134,000	88,000	35,000	66,000	120,000	1,000	23,000	89,000	---	---	---	---	---	---	---	---	---	**556,000**
	Replacement engr. cap (acres)	42	27	---	20	37	1	14	37	---	---	---	---	---	---	---	---	---	**178**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	23	---	---	---	---	---	---	22	---	**45**
	Thin Layer Cap only area (acres)	---	---	---	---	---	14	41	---	---	---	10	8	8	12	19	---	---	**112**
	MNR (acres)	---	---	---	---	---	3	13	---	---	164	---	---	---	---	---	---	---	**180**
SED 7	**Approach**	Removal	Removal	Stabilization	Removal	Removal	Removal/TLC Only	Removal/TLC Only	Removal	EC Only	MNR	Removal/TLC Only	Removal/TLC Only	Removal/TLC Only	Removal/TLC Only	Removal/TLC Only	EC Only	MNR	
	Criteria	Full reach	Full reach	Operational	Full reach	Full reach	PCBs: 10 ppm / 1 ppm [3]	PCBs: 10 ppm / 1 ppm [3]	Full reach	Full reach	---	PCBs: 3 ppm [4]	PCBs: 3 ppm [4]	PCBs: 3 ppm [4]	PCBs: 3 ppm [4]	PCBs: 3 ppm [4]	Full reach	---	
	Removal depth	3 to 3.5-ft	2.5-ft	---	2-ft	2-ft	1-ft	1-ft	2.5-ft	---	---	1.5-ft	1.5-ft	1.5-ft	1.5-ft	1.5-ft	---	---	
	Removal volume (cy)	218,000	109,000	35,000	66,000	120,000	5,000	46,000	148,000	---	---	12,000	7,000	9,000	15,000	15,000	---	---	**805,000**
	Replacement engr. cap (acres)	---	---	---	20	37	3	29	37	---	---	5	3	4	6	6	---	---	**150**
	Replacement backfill (acres)	42	27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**69**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	23	---	---	---	---	---	---	22	---	**45**
	Thin Layer Cap only area (acres)	---	---	---	---	---	12	27	---	---	---	5	5	4	6	13	---	---	**72**
	MNR (acres)	---	---	---	---	---	3	12	---	---	164	---	---	---	---	---	---	---	**179**
SED 8	**Approach**	Removal	Removal	Stabilization	Removal	Removal	Removal	Removal	Removal	Removal	MNR	Removal	Removal	Removal	Removal	Removal	Removal	MNR	
	Criteria	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Operational	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	---	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	Full reach, to 1 ppm horizon	---	
	Removal depth	4-ft	3.5-ft	---	3-ft	3-ft	2-ft	3-ft	6-ft	6-ft	---	2-ft	2-ft	2-ft	2-ft	7-ft	7-ft	---	
	Removal volume (cy)	268,000	153,000	35,000	99,000	180,000	57,000	331,000	355,000	220,000	---	32,000	25,000	25,000	39,000	217,000	251,000	---	**2,287,000**
	Replacement engr. cap (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Replacement backfill (acres)	42	27	---	20	37	18	68	37	23	---	10	8	8	12	19	22	---	**351**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	Thin Layer Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**---**
	MNR (acres)	---	---	---	---	---	---	---	---	---	164	---	---	---	---	---	---	---	**164**

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Table 6-1. Summary of volume calculations, removal depths and areas by subreach for all SED alternatives.

Alternative		River Reach																	
		5A	5B	5A/B Banks	5C (Upper Section)	5C (Lower Section)	5 Backwaters (Small)	5 Backwaters (Large)	Woods Pond (Shallow)	Woods Pond (Deep Hole)	7A, D, F, H (Reach 7 Channel)	7B (Columbia Mill Dam Imp.)	7C (Former Eagle Mill Dam Imp.)	7E (Willow Mill Dam Imp.)	7G (Glendale Dam Imp.)	Rising Pond (Shallow)	Rising Pond (Deep)	9 to 17	Total
SED 9	**Approach**	Removal	Removal	Stabilization	Removal	Removal	Removal/EC Only[5]	Removal/EC Only[5]	Removal[5]	Removal[5]	MNR	Removal[5]	Removal[5]	Removal[5]	Removal[5]	Removal[5]		MNR	
	Criteria	Full reach	Full reach	Operational	Full reach	Full reach	PCBs: 1 ppm / water depth[6]	PCBs: 1 ppm / water depth[6]	Full reach	Full reach	---	Full reach / shear stress[7]	Full reach / shear stress[7]	Full reach / shear stress[7]	Full reach / shear stress[7]	Full reach / shear stress[7]		---	
	Removal depth	2-ft	2-ft	---	2-ft	1.5-ft	1-ft	3-ft	3.5-ft	1-ft	---	1 to 1.5-ft	1 to 1.5-ft	1 to 1.5-ft	1 to 1.5-ft	1 to 1.5-ft		---	
	Removal volume (cy)	134,000	88,000	35,000	66,000	90,000	23,000	86,000	207,000	37,000	---	22,000	19,000	19,000	24,000	71,000		---	**921,000**
	Replacement engr. cap (acres)	42	27	---	20	37	14	54	37	23	---	10	8	8	12	41		---	**333**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	1	2	---	---	---	---	---	---	---	---		---	**3**
	Thin Layer Cap only area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		---	**---**
	MNR (acres)	---	---	---	---	---	3	12	---	---	164	---	---	---	---	---		---	**179**
SED 10	**Approach**	Removal	MNR	Stabilization	MNR	MNR	MNR	MNR	Removal		MNR	MNR	MNR	MNR	MNR	MNR	MNR	MNR	
	Criteria	Minimize ecological harm[8]	---	Minimize ecological harm[8]	---	---	---	---	PCBs: generally >13 ppm		---	---	---	---	---	---	---	---	
	Removal depth	2-ft	---	---	---	---	---	---	2.5-ft		---	---	---	---	---	---	---	---	
	Removal volume (cy)	66,000	---	6,700	---	---	---	---	169,000		---	---	---	---	---	---	---	---	**241,700**
	Replacement engr. cap (acres)	20	---	---	---	---	---	---	---		---	---	---	---	---	---	---	---	**20**
	Replacement backfill (acres)	---	---	---	---	---	---	---	---		---	---	---	---	---	---	---	---	**---**
	Engineered Cap only area (acres)	---	---	---	---	---	---	---	---		---	---	---	---	---	---	---	---	**---**
	Thin Layer Cap only area (acres)	---	---	---	---	---	---	---	---		---	---	---	---	---	---	---	---	**---**
	MNR (acres)	---	27	---	20	37	18	68	---		164	10	8	8	12	19	22	---	**413**

Notes:

[1] For backwaters in SED 4 and SED 5, thin layer capping occurs for entire backwaters with average PCBs > 15 ppm; delineation based on model-predicted 0-6" sediment PCBs at the end of validation.

[2] For backwaters in SED 6, removal occurs in areas > 50 ppm, TLC only in areas <50 and >1 ppm; delineation based on 0-12" Theissen Polygons; volumes and areas are approximate due to limited data coverage.

[3] For backwaters in SED 7, removal occurs in areas > 10 ppm, TLC only in areas <10 and >1 ppm; delineation based on 0-12" Theissen Polygons; volumes and areas are approximate due to limited data coverage.

[4] For Reach 7 impoundments and Rising Pond shallow area in SED 7, removal occurs in areas > 3 ppm, with TLC only in the rest; delineation based on 0-12" Theissen Polygons; volumes and areas are approximate due to limited data coverage.

[5] Engineered cap in backwaters and replacement cap in Woods Pond, Reach 7 impoundments, and Rising Pond for SED 9 contains an active or sorptive layer.

[6] For backwaters in SED 9, removal occurs in areas with PCBs > 1 ppm and water depth less than 4 feet, and EC only occurs in areas with PCBs > 1 ppm water depths greater than 4 feet; delineation based on 0-12" Theissen Polygons; volumes and areas are approximate due to limited data coverage.

[7] For the Reach 7 impoundments and Reach 8 in SED 9, 1-ft removal occurs in areas of low shear stress, and 1.5-ft removal occurs in areas of high shear stress (see Appendix F for analysis and delineation of high and low shear stress areas).

[8] Criteria for selection of sediment remediation areas in Reach 5A and bank stabilization areas in Reaches 5A & 5B for SED 10 are described in Section 6.10.1 and Figure 6-29.

Abbreviations: Monitored Natural Recovery (MNR); Thin-layer Cap (TLC); Engineered Cap (EC)

Table 6-2. Summary of predicted exceedances of freshwater chronic aquatic life criterion for SED alternatives.

Reach	Reach (Location)	Number of Predicted Exceedances in Last 3 Years of Model Projection (Rolling Average)								
		SED 1/2	SED 3	SED 4	SED 5	SED 6	SED 7	SED 8	SED 9	SED 10
PSA	5A (Holmes Road)	126	2	2	2	2	10	4	2	33
	5B (New Lenox Road)	1095	0	0	0	0	3	0	0	1095
	5C (WP Headwaters)	1095	0	2	0	0	0	0	0	1069
	6 (Woods Pond Dam)	1095	0	0	0	0	0	0	0	875
Reaches 7/8	7B (Columbia Mill Dam)	1095	0	2	0	0	0	0	0	853
	7E (Willow Mill Dam)	587	0	3	0	0	0	0	0	75
	7G (Glendale Dam)	284	2	3	3	0	0	0	0	51
	8 (Rising Pond Dam)	226	5	5	4	0	0	0	0	49
CT	Bulls Bridge	0	0	0	0	0	0	0	0	0
	Lake Lillinonah	0	0	0	0	0	0	0	0	0
	Lake Zoar	0	0	0	0	0	0	0	0	0
	Lake Housatonic	0	0	0	0	0	0	0	0	0
Reach	**Reach (Location)**	**Number of Predicted Exceedances in Last 3 Years of Model Projection (Block Average)**								
		SED 1/2	**SED 3**	**SED 4**	**SED 5**	**SED 6**	**SED 7**	**SED 8**	**SED 9**	**SED 10**
PSA	5A (Holmes Road)	29	0	0	0	0	2	1	0	8
	5B (New Lenox Road)	274	0	0	0	0	1	0	0	274
	5C (WP Headwaters)	274	0	1	0	0	0	0	0	266
	6 (Woods Pond Dam)	274	0	0	0	0	0	0	0	217
Reaches 7/8	7B (Columbia Mill Dam)	274	0	1	0	0	0	0	0	213
	7E (Willow Mill Dam)	150	0	1	0	0	0	0	0	18
	7G (Glendale Dam)	72	1	1	1	0	0	0	0	13
	8 (Rising Pond Dam)	60	1	1	1	0	0	0	0	11
CT	Bulls Bridge	0	0	0	0	0	0	0	0	0
	Lake Lillinonah	0	0	0	0	0	0	0	0	0
	Lake Zoar	0	0	0	0	0	0	0	0	0
	Lake Housatonic	0	0	0	0	0	0	0	0	0

Table 6-4. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					12	16	23	3.4	4.2	1.2	7.6	3.0
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*> 250*	*> 250*	*243*	*0*	*0*	*0*	*220*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*22*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*34*	*> 250*	*> 250*
			10^{-5} Cancer	13	*35*	*86*	*120*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*30*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-5. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 1 / SED 2), including the time to achieve in years (in italics).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					7.3	9.3	7.4	9.5	8.6	6.4	5.7	6.3	5.5	4.1	3.2	3.5	2.8	3.6	0.2	0.1	0.08	0.08
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250
			10^{-5} Cancer	0.019	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	230	200	170	167
			10^{-4} Cancer	0.19	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	31	26	6	5
			Non-Cancer -- Child	0.026	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	203	173	143	140
			Non-Cancer -- Adult	0.062	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	128	98	68	65
		CTE	10^{-6} Cancer	0.049	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	148	119	89	85
			10^{-5} Cancer	0.49	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	231	> 250	214	> 250	0	0	0	0
			10^{-4} Cancer	4.9	82	123	98	136	132	78	69	78	64	34	9	10	7	10	0	0	0	0
			Non-Cancer -- Child	0.19	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	31	26	6	5
			Non-Cancer -- Adult	0.43	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	244	> 250	226	> 250	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250
			10^{-5} Cancer	0.064	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	125	96	66	62
			10^{-4} Cancer	0.64	240	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	232	205	243	188	233	0	0	0	0
			Non-Cancer -- Child	0.059	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	132	103	73	69
			Non-Cancer -- Adult	0.12	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	71	26	6	5
		CTE (50th percentile)	10^{-6} Cancer	0.057	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	135	106	75	72
			10^{-5} Cancer	0.57	249	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	243	216	> 250	199	246	0	0	0	0
			10^{-4} Cancer	5.7	71	107	81	122	113	63	52	62	38	11	7	8	4	7	0	0	0	0
			Non-Cancer -- Child	0.71	232	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	222	195	231	178	222	0	0	0	0
			Non-Cancer -- Adult	1.5	174	> 250	226	249	> 250	192	201	202	206	149	122	145	106	141	0	0	0	0

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(grey) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-6. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range 3	IMPG (mg/kg) Upper End of Range 10
5A	R5A_01	**1.9**	*46*	*1*
	R5A_02	**3.7**	*63*	*20*
	R5A_03	**6.4**	*67*	*40*
	R5A_04	**29**	*> 250*	*> 250*
	R5A_05	**13**	*199*	*78*
	R5A_06	**7.7**	*IT*	*12*
	R5A_07	**15**	*244*	*98*
	R5A_08	**17**	*> 250*	*133*
	R5A_09	**9.9**	*> 250*	*39*
	R5A_10	**16**	*> 250*	*> 250*
	R5A_11	**18**	*> 250*	*> 250*
5B	R5B_01	**9.6**	*> 250*	*28*
	R5B_02	**8.5**	*IT*	*0*
	R5B_03	**4.7**	*204*	*0*
	R5B_04	**5.7**	*248*	*0*
	R5B_05	**5.6**	*115*	*0*
5C	R5C_01	**7.2**	*> 250*	*0*
	R5C_02	**8.0**	*> 250*	*8*
	R5C_03	**4.9**	*120*	*0*
	R5C_04	**6.1**	*132*	*8*
	R5C_05	**37**	*> 250*	*> 250*
	R5C_06	**29**	*> 250*	*194*
6	Woods Pond	**16**	*210*	*97*
7A		**0.43**	*0*	*0*
7B		**4.2**	*> 250*	*0*
7C		**4.1**	*> 250*	*0*
7D		**1.4**	*0*	*0*
7E		**1.2**	*0*	*0*
7F		**0.74**	*0*	*0*
7G		**5.1**	*194*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**2.9**	*21*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue shading) = model prediction is lower than the IMPG

(no shading) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

IT = Increasing trend in model extrapolation; no time-to-achieve estimated.

Table 6-7. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range 3.27	IMPG (mg/kg) Upper End of Range 5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**5.7**	*113*	*54*
	BWS_02	1.8	**5.9**	*109*	*57*
	BWS_03	1.9	**3.0**	*48*	*31*
	BWS_04	0.30	**23**	*> 250*	*> 250*
	BWS_06	0.56	**2.2**	*30*	*12*
	BWS_07	0.12	**5.4**	*> 250*	*4*
	BWS_08	0.35	**37**	*> 250*	*> 250*
	BWS_09	0.28	**19**	*> 250*	*> 250*
	BWS_10	1.5	**16**	*> 250*	*> 250*
	BWS_11	0.11	**2.1**	*10*	*5*
	BWS_12	1.7	**6.1**	*109*	*61*
	BWS_13	0.37	**10**	*> 250*	*> 250*
	BWS_14	0.57	**8.8**	*> 250*	*213*
	BWS_15	0.90	**8.9**	*167*	*107*
	BWS_16	1.0	**3.2**	*52*	*23*
	BWS_17	0.58	**2.4**	*32*	*6*
	BWS_18	0.84	**2.3**	*32*	*12*
	BWS_19	0.99	**20**	*> 250*	*> 250*
	BWS_20	1.3	**5.8**	*95*	*55*
Large Backwaters (> 2 acres)	BWL_01	2.1	**11**	*180*	*124*
	BWL_02	5.5	**5.7**	*97*	*54*
	BWL_03	2.4	**3.6**	*58*	*25*
	BWL_04	2.1	**4.4**	*81*	*32*
	BWL_05	12	**14**	*200*	*146*
	BWL_07	22	**20**	*> 250*	*> 250*
	BWL_08	4.1	**13**	*> 250*	*183*
	BWL_09	7.0	**15**	*> 250*	*228*
	BWL_10	6.4	**13**	*> 250*	*223*
	BWL_11	4.6	**2.3**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(shaded) = model prediction is lower than the IMPG

(unshaded) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-8. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**
Fish protection			**28**	**36**	**29**	**36**	**34**	**25**	**22**	**24**	**21**	**16**	**13**	**14**	**11**	**14**
Coldwater fish protection - trout below PSA								**49**	**44**	**49**	**42**	**32**	**25**	**27**	**22**	
Threatened and endangered species (represented by bald eagle)			**25**	**23**	**24**	**19**	**18**	**9.2**	**16**	**11**	**10**	**6.5**	**5.5**	**7.0**	**4.4**	**7.7**
Piscivorous birds (represented by osprey)			**21**	**22**	**23**	**21**	**22**	**11**	**16**	**12**	**11**	**7.4**	**6.1**	**7.3**	**5.0**	**7.8**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*5*	*8*	*0*	*36*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*173*	*179*	*181*	*183*	*130*	*104*	*123*	*89*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*31*	*9*	*24*	*25*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*211*	*> 250*	*> 250*	*244*	*> 250*	*173*	*> 250*	*203*	*244*	*133*	*119*	*171*	*94*	*156*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

= model prediction is lower than the IMPG

= model prediction exceeds the IMPG

= IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-9. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 1 / SED 2), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	**3**	**5**
Reach 5A	KM 1	**4.3**	*129*	*72*	*48*
	KM 2	**11**	*199*	*131*	*100*
	KM 3	**13**	*> 250*	*> 250*	*> 250*
	KM 4	**15**	*> 250*	*> 250*	*> 250*
	KM 5	**19**	*> 250*	*> 250*	*> 250*
Reach 5B	KM 6	**9.7**	*> 250*	*> 250*	*179*
	KM 7	**6.3**	*IT*	*IT*	*IT*
	KM 8	**7.3**	*> 250*	*180*	*106*
Reaches 5C/5D	KM 9	**7.0**	*> 250*	*186*	*105*
	KM 10	**18**	*> 250*	*> 250*	*> 250*
	KM 11	**20**	*> 250*	*> 250*	*> 250*
Reach 6	KM 12	**19**	*> 250*	*231*	*181*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	**3**	**5**
Reaches 5A/5B	**11**	*> 250*	*> 250*	*197*
Reaches 5C/5D/6	**17**	*> 250*	*> 250*	*213*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue shading) = model prediction is lower than the target value

(no shading) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

IT = Increasing trend in model extrapolation; no time-to-achieve estimated.

Table 6-10 - 2008 Housatonic River Adult Largemouth Bass Sampling PCB and % Lipids Data

Revised CMS Report, Housatonic River - Rest of River
General Electric Company - Pittsfield, MA

Parameter Sample ID: / Date Collected:	5B/C-LMB-1 09/03/08	5B/C-LMB-2 09/03/08	5B/C-LMB-3 09/03/08	5B/C-LMB-4 09/03/08	5B/C-LMB-5 09/03/08	5B/C-LMB-6 09/03/08	5B/C-LMB-7 09/03/08	5B/C-LMB-8 09/03/08	5B/C-LMB-9 09/03/08	5B/C-LMB-10 09/03/08
PCB Congeners										
Total PCB Congeners-offal	63	120	110	120	34	15	14	50	63	54
Total PCB Congeners-fillet	4.2	4.5	9.5	5.3	1.2	1.3	1.5	5.1	8.9	9.3
Conventionals										
%Lipids-offal	5.6	7.0	5.6	8.8	4.9	2.3	3.9	5.6	7.6	7.3
%Lipids-fillet	0.49	0.81	1.1	0.52	1.1	0.48	1.1	0.85	1.6	2.8

Parameter Sample ID: / Date Collected:	5B/C-LMB-11 09/04/08	5B/C-LMB-12 09/04/08	5B/C-LMB-13 09/04/08	5B/C-LMB-14 09/04/08	5B/C-LMB-15 09/04/08	WP-LMB-1 09/04/08	WP-LMB-2 09/04/08	WP-LMB-3 09/04/08	WP-LMB-4 09/04/08	WP-LMB-5 09/04/08
PCB Congeners										
Total PCB Congeners-offal	73	74	48	30	110	79	59	54	54	79
Total PCB Congeners-fillet	3.2	8.0	1.8	3.1	9.5	4.7	1.2	1.3	0.56	2.3
Conventionals										
%Lipids-offal	4.6	3.3	3.8	5.6	6.3	4.5	3.3	3.0	2.8	4.2
%Lipids-fillet	0.46	0.70	0.29	1.6	0.93	0.37	0.12	0.097	0.050	0.14

Parameter Sample ID: / Date Collected:	WP-LMB-6 09/04/08	WP-LMB-7 09/04/08	WP-LMB-8 09/04/08	WP-LMB-9 09/04/08	WP-LMB-10 09/04/08	WP-LMB-11 09/04/08	WP-LMB-12 09/04/08	WP-LMB-13 09/04/08	WP-LMB-14 09/04/08	WP-LMB-15 09/04/08
PCB Congeners										
Total PCB Congeners-offal	53	65	62	35	67	63	39	150	74	39
Total PCB Congeners-fillet	1.5	0.52	0.53	2.5 J	0.78	0.89	0.39	1.5	1.5	0.76
Conventionals										
%Lipids-offal	4.1	1.8	4.8	2.8	3.4	2.3	2.5	3.9	4.6	3.5
%Lipids-fillet	0.12	0.069	0.092	0.44	0.16	0.10	0.098	0.095	0.25	0.11

Parameter Sample ID: / Date Collected:	RP-LMB-1 09/04/08	RP-LMB-2 09/04/08	RP-LMB-3 09/04/08	RP-LMB-4 09/04/08	RP-LMB-5 09/04/08	RP-LMB-6 09/04/08	RP-LMB-7 09/04/08	RP-LMB-8 09/04/08	RP-LMB-9 09/04/08	RP-LMB-10 09/05/08
PCB Congeners										
Total PCB Congeners-offal	26	34	31	46	37	56	49	23	52	70
Total PCB Congeners-fillet	5.4	2.3	1.9	1.2	2.7	3.0	9.3	4.0	1.1	2.2
Conventionals										
%Lipids-offal	4.1	4.6	3.3	4.2	3.8	1.3	5.1	3.8	2.6	3.4
%Lipids-fillet	0.91	0.37	0.41	0.26	0.23	0.26	0.16	1.1	0.26	0.24

Notes:
1. Samples were collected by ARCADIS, and submitted to Northeast Analytical, Inc. for analysis of PCBs and % Lipids.
2. Samples have been validated as per Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP), General Electric Company, Pittsfield, Massachusetts, ARCADIS (approved March 15, 2007 and re-submitted March 30, 2007).
3. Total PCB Congeners results are presented in parts per million, ppm.
4. Sample ID prefix represents associated river reach (5B/C - reach 5B/C; WP - Woods Pond; RP - Rising Pond).

Data Qualifiers:

J - Indicates that the associated numerical value is an estimated concentration.

Table 6-11 - 2008 Housatonic River YOY Sample Results

Revised CMS Report, Housatonic River - Rest of River
General Electric Company - Pittsfield, MA

Sample ID	Date Collected	Fish Species	1016 -1221, -1232 - 1242, -1248 (mg/kg)	Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)	Total PCB (mg/kg)	Percent Lipid (%)
HR2							
HR2-LB-183	9/29/2008	LB	ND(5.0)	6.8	12	18.8	2.6
HR2-LB-184	9/29/2008	LB	ND(2.5)	3.7	7.3	11	2.4
HR2-LB-185	9/29/2008	LB	ND(5.0)	6.8	13	19.8	2.7
HR2-LB-186	9/29/2008	LB	ND(5.0)	6.5	12	18.5	2.8
HR2-LB-187	9/29/2008	LB	ND(5.0)	5.8	11	16.8	2.7
HR2-LB-188	9/29/2008	LB	ND(5.0)	5.4	10	15.4	2.5
HR2-LB-189	9/29/2008	LB	ND(5.0)	5.8	11	16.8	2.9
HR2-YP-190	9/29/2008	YP	ND(5.0)	5.9	11	16.9	2.8
HR2-YP-191	9/29/2008	YP	ND(6.7)	8.0	18	26	2.0
HR2-YP-192	9/29/2008	YP	ND(3.3)	5.5	9.7	15.2	2.4
HR2-YP-193	9/29/2008	YP	ND(3.3)	4.7	8.7	13.4	2.1
HR2-YP-194	9/29/2008	YP	ND(3.3)	4.8	9.0	13.8	1.7
HR2-YP-195	9/29/2008	YP	ND(5.0)	6.0	11	17	2.1
HR2-YP-196	9/29/2008	YP	ND(5.0)	ND(5.0)	9.0	9	1.8
HR2-BG-197	9/29/2008	BG	ND(2.0)	3.0	4.5	7.5	3.0
HR2-BG-198	9/29/2008	BG	ND(2.0)	3.3	5.3	8.6	3.0
HR2-BG-199	9/29/2008	BG	ND(2.0)	3.4	5.3	8.7	2.8
HR2-BG-200	9/30/2008	BG	ND(2.0)	2.9	4.6	7.5	2.6
HR2-BG-264	10/2/2008	BG	ND(1.8)	3.4	5.6	9	3.6
HR2-BG-265	10/2/2008	BG	ND(2.0)	3.2	5.5	8.7	3.3
HR2-BG-266	10/2/2008	BG	ND(1.7)	2.8	4.6	7.4	3.3
Woods Pond							
WP-LB-201	9/30/2008	LB	ND(5.0)	8.1	13	21.1	1.8
WP-LB-202	9/30/2008	LB	ND(5.0)	5.8	9.8	15.6	2.3
WP-LB-203	9/30/2008	LB	ND(5.0)	7.8	13	20.8	2.1
WP-LB-204	9/30/2008	LB	ND(5.0)	6.3	10	16.3	1.9
WP-LB-205	9/30/2008	LB	ND(5.0)	9.2	16	25.2	2.0
WP-LB-206	9/30/2008	LB	ND(5.0)	9.3	16	25.3	1.8
WP-LB-207	9/30/2008	LB	ND(5.0)	9.1	14	23.1	2.0
WP-YP-208	9/30/2008	YP	ND(2.5)	4.6	7.6	12.2	1.9
WP-YP-209	9/30/2008	YP	ND(5.0)	6.4	11	17.4	2.5
WP-YP-210	9/30/2008	YP	ND(5.0)	14	23	37	2.8
WP-YP-211	9/30/2008	YP	ND(5.0)	7.3	12	19.3	2.7
WP-YP-212	9/30/2008	YP	ND(5.0)	6.7	11	17.7	2.6
WP-YP-213	9/30/2008	YP	ND(5.0)	7.2	12	19.2	2.8
WP-YP-214	9/30/2008	YP	ND(5.0)	6.2	9.8	16	2.6
WP-BG-215	9/30/2008	BG	ND(3.3)	4.9	7.6	12.5	2.8
WP-BG-216	9/30/2008	BG	ND(2.5)	4.9	7.7	12.6	2.8
WP-BG-217	9/30/2008	BG	ND(3.3)	5.0	7.5	12.5	2.8
WP-BG-218	9/30/2008	BG	ND(3.3)	6.1	9.5	15.6	3.7
WP-BG-219	9/30/2008	BG	ND(1.3)	3.7	5.7	9.4	2.3
WP-BG-220	9/30/2008	BG	ND(1.3)	3.9	6.0	9.9	2.0
WP-BG-221	9/30/2008	BG	ND(3.3)	5.3	8.1	13.4	2.8

Table 6-11 - 2008 Housatonic River YOY Sample Results

Revised CMS Report, Housatonic River - Rest of River
General Electric Company - Pittsfield, MA

Sample ID	Date Collected	Fish Species	1016 -1221, -1232 - 1242, -1248 (mg/kg)	Aroclor-1254 (mg/kg)	Aroclor-1260 (mg/kg)	Total PCB (mg/kg)	Percent Lipid (%)
Glendale Dam							
GD-LB-243	10/1/2008	LB	ND(1.5)	2.2	4.4	6.6	2.5
GD-LB-244	10/1/2008	LB	ND(1.5)	2.3	4.1	6.4	2.3
GD-LB-245	10/1/2008	LB	ND(1.5)	2.0	3.4	5.4	2.6
GD-LB-246	10/1/2008	LB	ND(1.5)	1.7	3.0	4.7	2.3
GD-LB-247	10/1/2008	LB	ND(1.5)	1.7	2.8	4.5	2.5
GD-LB-248	10/1/2008	LB	ND(1.5)	1.9	3.2	5.1	2.5
GD-LB-249	10/1/2008	LB	ND(1.5)	2.5	4.8	7.3	2.6
GD-YP-250	10/1/2008	YP	ND(1.5)	2.4	4.2	6.6	2.1
GD-YP-251	10/1/2008	YP	ND(1.5)	2.8	4.5	7.3	2.4
GD-YP-252	10/1/2008	YP	ND(1.5)	2.3	3.9	6.2	2.4
GD-YP-253	10/1/2008	YP	ND(1.5)	1.9	3.4	5.3	1.7
GD-YP-254	10/1/2008	YP	ND(1.5)	2.3	3.8	6.1	2.4
GD-YP-255	10/1/2008	YP	R	4.3J	6.9J	11.2J	3.0
GD-YP-256	10/1/2008	YP	ND(1.5)	2.7	4.7	7.4	3.2
GD-BG-257	10/1/2008	BG	ND(1.0)	1.4	1.7	3.1	2.7
GD-BG-258	10/1/2008	BG	ND(1.0)	1.5	1.6	3.1	2.9
GD-BG-259	10/1/2008	BG	ND(1.4)	1.6	1.8	3.4	2.8
GD-BG-260	10/1/2008	BG	ND(1.0)	1.5	1.6	3.1	3.2
GD-BG-261	10/1/2008	BG	ND(1.1)	1.6	1.7	3.3	2.8
GD-BG-262	10/1/2008	BG	ND(1.0)	1.3	1.3	2.6	2.4
GD-BG-263	10/1/2008	BG	ND(1.0)	1.5	1.6	3.1	2.6
HR6							
HR6-LB-222	9/30/2008	LB	ND(0.33)	0.40	0.74	1.14	1.0
HR6-LB-223	9/30/2008	LB	ND(0.51)	0.84	1.7	2.54	2.6
HR6-LB-224	9/30/2008	LB	ND(1.1)	ND(1.1)	2.1	2.1	3.0
HR6-LB-225	9/30/2008	LB	ND(0.50)	0.74	1.3	2.04	2.4
HR6-LB-226	9/30/2008	LB	ND(0.52)	0.74	1.3	2.04	3.2
HR6-LB-227	9/30/2008	LB	ND(0.50)	0.80	1.4	2.2	3.0
HR6-LB-228	9/30/2008	LB	ND(0.37)	0.79	1.6	2.39	2.9
HR6-YP-229	9/30/2008	YP	ND(0.66)	1.1	2.1	3.2	2.3
HR6-YP-230	9/30/2008	YP	ND(1.0)	ND(1.0)	1.9	1.9	1.9
HR6-YP-231	9/30/2008	YP	ND(1.0)	ND(1.0)	1.9	1.9	2.0
HR6-YP-232	9/30/2008	YP	ND(1.0)	1.1	2.0	3.1	2.0
HR6-YP-233	9/30/2008	YP	ND(1.0)	ND(1.0)	1.9	1.9	2.1
HR6-YP-234	9/30/2008	YP	ND(1.0)	1.2	2.2	3.4	2.3
HR6-YP-235	9/30/2008	YP	ND(1.0)	1.0	1.9	2.9	2.3
HR6-BG-236	9/30/2008	BG	ND(0.68)	1.0	1.9	2.9	4.4
HR6-BG-237	9/30/2008	BG	ND(0.39)	0.78	1.4	2.18	3.4
HR6-BG-238	9/30/2008	BG	ND(0.40)	0.84	1.5	2.34	3.6
HR6-BG-239	9/30/2008	BG	ND(0.32)	0.69	1.2	1.89	3.7
HR6-BG-240	9/30/2008	BG	ND(0.34)	0.89	1.6	2.49	3.9
HR6-BG-241	9/30/2008	BG	ND(0.33)	0.82	1.5	2.32	3.3
HR6-BG-242	9/30/2008	BG	ND(0.31)	0.81	1.4	2.21	3.5

Notes:
1. Samples were collected by ARCADIS and submitted to Pace Analytical Services, Inc. for analysis of PCBs and % Lipids.
2. Samples have been validated as per Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP), General Electric Company, Pittsfield, Massachusetts, ARCADIS (approved March 15, 2007 and resubmitted March 30, 2007).
3. ND - Analyte was not detected. The number in parentheses is the associated detection limit.

Data Qualifiers:
J - Indicates that the associated numerical value is an estimated concentration.
R - Data was rejected due to a deficiency in the data generation process.

Units:
mg/kg - milligram per kilogram (ppm - parts per million)

Species:
LB - Largemouth bass
YP - Yellow perch
BG - Bluegill

Table 6-12 - Comparison of Mean Total and Mean Lipid-Normalized PCB Concentrations in YOY Fish Tissue [1]

Revised CMS Report, Housatonic River - Rest of River
General Electric Company - Pittsfield, MA

Location / Species / Year	n	Lipid (%)	Total PCB [2,3,4] (mg/kg)	Lipid-Normalized PCB [3] (mg/kg-lipid)
HR2				
Largemouth Bass [5]				
1994	7	2.8 (0.2)	32 (3.6)	1158 (108)
1996	7	2.9 (0.3)	28 (5.4)	956 (152)
1998	7	3.0 (0.2)	19 (1.1)	651 (72)
2000	7	3.0 (1.0)	32 (6.2)	1168 (389)
2002	7	3.6 (0.2)	21 (1.6)	594 (64)
2004	7	3.2 (0.3)	20 (5.3)	615 (185)
2006	5	2.5 (0.5)	21 (2.6)	869 (138)
2008	7	2.7 (0.2)	17 (2.9)	628 (94)
Yellow Perch				
1994	7	2.5 (0.1)	25 (1.6)	999 (88)
1996	7	3.2 (0.2)	27 (4.0)	848 (83)
1998	7	2.8 (0.2)	26 (4.2)	939 (217)
2000	7	2.8 (0.3)	33 (3.1)	1193 (66)
2002	4	2.3 (0.5)	25 (1.8)	1118 (177)
2004	7	2.6 (0.2)	31 (3.7)	1189 (88)
2006	0	---- ----	---- ----	---- ----
2008	7	2.1 (0.4)	16 (5.2)	757 (264)
Bluegill/Pumpkinseed [6]				
1994	7	3.8 (0.5)	25 (1.4)	665 (77)
1996	7	3.5 (0.2)	29 (1.3)	839 (63)
1998	7	3.1 (0.2)	21 (8.6)	698 (309)
2000	7	4.2 (0.3)	33 (4.6)	792 (106)
2002	7	3.0 (0.4)	13 (3.6)	442 (75)
2004	7	4.0 (0.3)	19 (2.7)	464 (61)
2006	7	2.9 (0.2)	13 (1.4)	443 (31)
2008	7	3.1 (0.3)	8.2 (0.7)	268 (29)
WOODS POND				
Largemouth Bass				
1994	7	2.1 (0.5)	23 (8.1)	1178 (444)
1996	7	3.2 (0.2)	22 (2.0)	690 (63)
1998	7	2.5 (0.3)	32 (4.6)	1323 (200)
2000	7	2.6 (0.2)	24 (2.4)	910 (73)
2002	7	2.7 (0.2)	17 (1.3)	626 (37)
2004	7	3.3 (0.4)	31 (3.9)	928 (75)
2006	7	2.5 (0.3)	32 (2.7)	1295 (252)
2008	7	2.0 (0.2)	21 (3.9)	1074 (249)
Yellow Perch				
1994	7	2.6 (0.7)	38 (9.3)	1836 (1574)
1996	7	4.4 (0.4)	29 (3.1)	662 (23)
1998	7	2.4 (0.2)	29 (4.4)	1235 (226)
2000	7	3.3 (0.3)	30 (2.0)	934 (104)
2002	2	2.3 (0.1)	14 (2.8)	598 (98)
2004	7	3.4 (0.1)	29 (2.8)	842 (67)
2006	7	2.8 (0.3)	25 (2.4)	903 (106)
2008	7	2.6 (0.3)	20 (7.9)	765 (248)
Bluegill/Pumpkinseed [6]				
1994	7	2.8 (1.0)	17 (6.4)	601 (37)
1996	7	3.9 (0.4)	22 (2.3)	563 (79)
1998	7	2.8 (0.4)	17 (2.1)	622 (178)
2000	7	4.6 (0.2)	28 (3.3)	601 (64)
2002	7	4.5 (0.3)	15 (1.5)	329 (43)
2004	7	3.4 (0.2)	17 (1.0)	497 (20)
2006	7	3.7 (0.2)	18 (1.4)	499 (46)
2008	7	2.7 (0.5)	12 (2.1)	450 (30)

Table 6-12 - Comparison of Mean Total and Mean Lipid-Normalized PCB Concentrations in YOY Fish Tissue [1]

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General Electric Company - Pittsfield, MA

Location / Species / Year	n	Lipid (%)	Total PCB [2,3,4] (mg/kg)	Lipid-Normalized PCB [3] (mg/kg-lipid)
GLENDALE DAM [7]				
Largemouth Bass				
1996	7	3.0 (0.2)	7.9 (0.9)	265 (29)
1998	7	2.7 (0.2)	5.2 (1.3)	198 (58)
2000	7	3.9 (0.2)	16 (1.0)	402 (36)
2002	7	2.9 (0.3)	3.5 (0.3)	121 (8)
2004	7	3.4 (0.1)	6.8 (0.7)	198 (25)
2006	7	2.6 (0.2)	6.1 (0.8)	234 (26)
2008	7	2.5 (0.1)	5.7 (1.1)	231 (42)
Yellow Perch				
1996	7	3.4 (0.3)	11 (1.7)	323 (37)
1998	7	2.8 (0.3)	11 (1.4)	382 (43)
2000	7	3.2 (0.2)	15 (1.0)	461 (25)
2002	0	---- ----	---- ----	---- ----
2004	7	3.3 (0.5)	14 (4.7)	403 (112)
2006	0	---- ----	---- ----	---- ----
2008	7	2.5 (0.5)	7.2 (1.9)	292 (48)
Bluegill/Pumpkinseed [6]				
1996	7	4.1 (0.2)	8.4 (1.2)	205 (23)
1998	8	2.7 (1.0)	2.5 (0.3)	115 (79)
2000	7	4.9 (0.5)	16 (2.1)	317 (36)
2002	7	3.8 (0.4)	3.2 (0.7)	83 (13)
2004	7	4.7 (0.4)	6.0 (0.2)	128 (8)
2006	7	3.7 (1.2)	5.6 (2.3)	149 (16)
2008	7	2.8 (0.2)	3.1 (0.3)	112 (9)
HR6				
Largemouth Bass				
1994	7	3.2 (0.2)	4.3 (0.5)	136 (20)
1996	7	3.6 (0.3)	3.4 (0.3)	95 (8)
1998	7	3.0 (0.3)	2.5 (0.4)	83 (17)
2000	7	3.2 (0.3)	3.4 (0.6)	108 (24)
2002	7	2.9 (0.1)	1.9 (0.1)	66 (5)
2004	7	3.1 (0.3)	2.6 (0.8)	84 (32)
2006	7	3.2 (1.2)	2.8 (1.2)	85 (22)
2008	7	2.6 (0.7)	2.1 (0.4)	84 (17)
Yellow Perch				
1994	7	2.9 (0.2)	4.5 (0.2)	158 (13)
1996	7	2.6 (0.2)	3.3 (0.2)	128 (20)
1998	7	2.5 (0.2)	3.2 (0.7)	131 (34)
2000	7	2.7 (0.2)	4.1 (0.6)	153 (18)
2002	4	2.4 (0.4)	2.5 (0.2)	102 (14)
2004	7	2.5 (0.2)	4.4 (0.7)	179 (29)
2006	7	2.7 (0.4)	3.1 (1.4)	115 (46)
2008	7	2.1 (0.2)	2.6 (0.7)	122 (27)
Bluegill/Pumpkinseed [6]				
1994	7	4.2 (0.4)	3.5 (0.5)	83 (10)
1996	7	3.7 (0.2)	1.5 (0.6)	41 (15)
1998	5	3.8 (0.6)	2.1 (0.7)	55 (11)
2000	8	3.9 (0.3)	3.9 (0.6)	106 (19)
2002	7	3.0 (0.6)	1.9 (0.2)	66 (14)
2004	7	3.7 (0.3)	2.9 (0.9)	77 (21)
2006	7	3.4 (0.2)	3.0 (0.6)	89 (15)
2008	7	3.7 (0.4)	2.3 (0.3)	63 (6)

Table 6-12 - Comparison of Mean Total and Mean Lipid-Normalized PCB Concentrations in YOY Fish Tissue [1]

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General Electric Company - Pittsfield, MA

Notes:

[1] Arithmetic mean concentrations (and standard deviation) for whole-body composite samples. Means (and standard deviations) were calculated from sample results. Most samples were comprised of 5 to 15 fish.

[2] Total PCBs represented by Aroclors 1254 and 1260.

[3] Mean total PCB and lipid-normalized PCB concentrations reported on a wet-weight basis.

[4] Data have been reviewed and qualified following protocols contained in the Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP), General Electric Company, Pittsfield, Massachusetts, ARCADIS (approved March 15, 2007 and resubmitted March 30, 2007).

[5] Seven largemouth bass samples from HR2 were submitted for analysis in 2006, but two of the samples were rejected during data validation, and as such, only five sample results are reported.

[6] Pumpkinseed were collected as a substitute species for bluegill when bluegill were not available.

[7] Glendale Dam was not sampled in 1994.

n = number of samples

mg/kg = milligram per kilogram (ppm - parts per million)

mg/kg - lipid = Total PCB divided by percent lipid times 100 (ppm - parts per million).

---- = no fish collected (the fish species was not available at the time of collection).

Table 6-15. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					1.6	8.7	1.7	3.2	4.1	1.2	7.0	2.9
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*7*	*129*	*10*	*0*	*0*	*0*	*> 250*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*9*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*96*	*> 250*	*92*	*> 250*	*> 250*	*34*	*> 250*	*> 250*
			10^{-5} Cancer	13	*2*	*11*	*10*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*9*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-16. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 3), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.25	**3.0**	**1.8**	**6.3**	**0.71**	**1.3**	**2.1**	**1.8**	**1.4**	**1.0**	**0.82**	**1.3**	**0.72**	**1.6**	**0.04**	**0.03**	**0.02**	**0.02**
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	237	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	244	222	199	197
			10^{-5} Cancer	0.019	149	> 250	> 250	195	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	94	72	49	46
			10^{-4} Cancer	0.19	62	> 250	207	138	> 250	233	> 250	> 250	> 250	154	195	> 250	219	> 250	11	9	6	5
			Non-Cancer -- Child	0.026	137	> 250	> 250	187	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	74	52	34	27
			Non-Cancer -- Adult	0.062	105	> 250	> 250	165	> 250	> 250	> 250	> 250	> 250	224	> 250	> 250	> 250	> 250	22	17	12	12
		CTE	10^{-6} Cancer	0.049	113	> 250	> 250	171	> 250	> 250	> 250	> 250	> 250	239	> 250	> 250	> 250	> 250	37	23	17	17
			10^{-5} Cancer	0.49	22	241	142	115	134	142	> 250	234	174	96	102	196	99	231	0	0	0	0
			10^{-4} Cancer	4.9	8	12	10	58	11	9	9	10	9	9	8	8	7	8	0	0	0	0
			Non-Cancer -- Child	0.19	62	> 250	207	138	> 250	233	> 250	> 250	> 250	154	195	> 250	219	> 250	11	9	6	5
			Non-Cancer -- Adult	0.43	26	> 250	151	118	161	155	> 250	> 250	189	104	114	216	116	> 250	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	191	> 250	> 250	221	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	165	143	120	117
			10^{-5} Cancer	0.064	103	> 250	> 250	165	> 250	> 250	> 250	> 250	> 250	222	> 250	> 250	> 250	> 250	22	17	12	12
			10^{-4} Cancer	0.64	15	213	123	108	79	117	232	197	142	79	75	156	66	190	0	0	0	0
			Non-Cancer -- Child	0.059	106	> 250	> 250	167	> 250	> 250	> 250	> 250	> 250	227	> 250	> 250	> 250	> 250	26	19	14	13
			Non-Cancer -- Adult	0.12	80	> 250	239	149	> 250	> 250	> 250	> 250	> 250	183	240	> 250	> 250	> 250	11	9	6	5
		CTE (50th percentile)	10^{-6} Cancer	0.057	108	> 250	> 250	167	> 250	> 250	> 250	> 250	> 250	229	> 250	> 250	> 250	> 250	26	19	14	13
			10^{-5} Cancer	0.57	18	225	131	111	103	128	250	213	155	86	87	173	80	208	0	0	0	0
			10^{-4} Cancer	5.7	7	11	10	54	11	9	9	9	9	8	7	7	5	7	0	0	0	0
			Non-Cancer -- Child	0.71	14	202	116	105	53	107	217	182	129	73	65	140	52	174	0	0	0	0
			Non-Cancer -- Adult	1.5	11	124	65	87	14	26	103	76	38	23	19	34	15	58	0	0	0	0

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(grey) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-17. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.18**	*1*	*1*
	R5A_03	**0.12**	*2*	*2*
	R5A_04	**0.071**	*2*	*2*
	R5A_05	**0.032**	*2*	*2*
	R5A_06	**0.043**	*3*	*2*
	R5A_07	**0.062**	*3*	*3*
	R5A_08	**0.028**	*4*	*4*
	R5A_09	**0.022**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.023**	*7*	*7*
5B	R5B_01	**9.1**	*> 250*	*21*
	R5B_02	**5.3**	*125*	*0*
	R5B_03	**3.2**	*61*	*0*
	R5B_04	**4.4**	*112*	*0*
	R5B_05	**3.9**	*80*	*0*
5C	R5C_01	**5.8**	*118*	*0*
	R5C_02	**6.4**	*148*	*6*
	R5C_03	**3.2**	*58*	*0*
	R5C_04	**4.4**	*79*	*6*
	R5C_05	**1.8**	*8*	*8*
	R5C_06	**1.5**	*9*	*9*
6	Woods Pond	**1.5**	*10*	*10*
7A		**0.41**	*0*	*0*
7B		**3.9**	*174*	*0*
7C		**4.0**	*> 250*	*0*
7D		**0.92**	*0*	*0*
7E		**1.2**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**4.7**	*190*	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**2.7**	*25*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(shaded) = model prediction is lower than the IMPG

(unshaded) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-18. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.2**	*72*	*32*
	BWS_02	1.8	**5.0**	*99*	*38*
	BWS_03	1.9	**1.8**	*38*	*28*
	BWS_04	0.30	**22**	*> 250*	*> 250*
	BWS_06	0.56	**0.26**	*17*	*10*
	BWS_07	0.12	**5.4**	*> 250*	*4*
	BWS_08	0.35	**37**	*> 250*	*> 250*
	BWS_09	0.28	**19**	*> 250*	*> 250*
	BWS_10	1.5	**15**	*> 250*	*> 250*
	BWS_11	0.11	**0.14**	*7*	*5*
	BWS_12	1.7	**4.7**	*76*	*42*
	BWS_13	0.37	**9.2**	*> 250*	*> 250*
	BWS_14	0.57	**8.1**	*> 250*	*143*
	BWS_15	0.90	**6.7**	*116*	*69*
	BWS_16	1.0	**1.2**	*30*	*17*
	BWS_17	0.58	**0.44**	*14*	*5*
	BWS_18	0.84	**0.29**	*19*	*11*
	BWS_19	0.99	**20**	*> 250*	*> 250*
	BWS_20	1.3	**4.4**	*74*	*36*
Large Backwaters (> 2 acres)	BWL_01	2.1	**11**	*166*	*115*
	BWL_02	5.5	**4.2**	*66*	*35*
	BWL_03	2.4	**2.2**	*37*	*16*
	BWL_04	2.1	**2.4**	*38*	*26*
	BWL_05	12	**12**	*147*	*108*
	BWL_07	22	**19**	*> 250*	*225*
	BWL_08	4.1	**11**	*207*	*140*
	BWL_09	7.0	**14**	*239*	*170*
	BWL_10	6.4	**12**	*> 250*	*189*
	BWL_11	4.6	**2.3**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue cell) = model prediction is lower than the IMPG

(white cell) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-19. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 3), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection			**0.98**	**12**	**7.0**	**24**	**2.8**	**4.8**	**8.2**	**6.7**	**5.2**	**3.9**	**3.1**	**4.8**	**2.8**	**6.0**
Coldwater fish protection - trout below PSA								**9.6**	**16**	**13**	**10**	**7.7**	**6.3**	**9.7**	**5.5**	
Threatened and endangered species (represented by bald eagle)			**0.45**	**13**	**7.7**	**15**	**1.6**	**2.3**	**9.5**	**4.7**	**3.6**	**2.2**	**1.9**	**3.8**	**1.5**	**4.9**
Piscivorous birds (represented by osprey)			**0.55**	**11**	**7.0**	**15**	**1.9**	**2.4**	**8.4**	**4.4**	**3.4**	**2.2**	**1.9**	**3.5**	**1.5**	**4.4**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*18*	*77*	*51*	*22*	*18*	*14*	*21*	*12*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*10*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*202*	*114*	*96*	*13*	*18*	*> 250*	*130*	*64*	*22*	*17*	*68*	*12*	*115*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(gray) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-20. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 3), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.20**	*2*	*2*	*1*
	KM 2	**1.8**	*110*	*26*	*6*
	KM 3	**1.7**	*130*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.023**	*7*	*7*	*7*
Reach 5B	KM 6	**7.4**	*> 250*	*203*	*117*
	KM 7	**4.2**	*244*	*96*	*28*
	KM 8	**5.8**	*242*	*123*	*68*
Reaches 5C/5D	KM 9	**5.4**	*222*	*112*	*61*
	KM 10	**7.2**	*222*	*128*	*84*
	KM 11	**12**	*> 250*	*244*	*173*
Reach 6	KM 12	**1.8**	*190*	*10*	*10*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**2.9**	*188*	*45*	*8*
Reaches 5C/5D/6	**6.2**	*> 250*	*141*	*79*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the target value

(white) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-23. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.071	0.45	0.22	3.2	4.1	1.3	7.6	2.9
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*7*	*12*	*15*	*0*	*0*	*0*	*241*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*12*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*9*	*12*	*15*	*> 250*	*> 250*	*26*	*> 250*	*> 250*
			10^{-5} Cancer	13	*2*	*11*	*14*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*12*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

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Table 6-24. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 4), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					0.26	**0.39**	**0.42**	**0.40**	**0.23**	**0.50**	**1.6**	**1.1**	**0.84**	**0.62**	**0.52**	**1.1**	**0.46**	**1.3**	**0.02**	**0.01**	**0.01**	**0.01**
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*188*	*169*	*149*	*146*
			10^{-5} Cancer	0.019	*158*	*> 250*	*> 250*	*> 250*	*206*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*57*	*51*	*34*	*33*
			10^{-4} Cancer	0.19	*64*	*101*	*121*	*187*	*61*	*200*	*> 250*	*> 250*	*> 250*	*206*	*193*	*> 250*	*213*	*> 250*	*11*	*8*	*4*	*4*
			Non-Cancer -- Child	0.026	*146*	*239*	*> 250*	*> 250*	*186*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*37*	*26*	*21*	*21*
			Non-Cancer -- Adult	0.062	*110*	*179*	*218*	*> 250*	*132*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*19*	*17*	*11*	*11*
		CTE	10^{-6} Cancer	0.049	*120*	*195*	*238*	*> 250*	*147*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*22*	*19*	*17*	*17*
			10^{-5} Cancer	0.49	*22*	*18*	*17*	*19*	*20*	*57*	*> 250*	*> 250*	*158*	*83*	*61*	*218*	*37*	*> 250*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	4.9	*8*	*10*	*11*	*14*	*15*	*10*	*10*	*10*	*9*	*7*	*6*	*6*	*5*	*6*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	*64*	*101*	*121*	*187*	*61*	*200*	*> 250*	*> 250*	*> 250*	*206*	*193*	*> 250*	*213*	*> 250*	*11*	*8*	*4*	*4*
			Non-Cancer -- Adult	0.43	*26*	*22*	*17*	*22*	*20*	*77*	*> 250*	*> 250*	*184*	*100*	*79*	*246*	*65*	*> 250*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	*203*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*119*	*100*	*80*	*77*
			10^{-5} Cancer	0.064	*109*	*176*	*215*	*> 250*	*130*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*19*	*17*	*11*	*11*
			10^{-4} Cancer	0.64	*15*	*16*	*16*	*18*	*19*	*22*	*> 250*	*226*	*107*	*50*	*25*	*160*	*21*	*198*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	*112*	*182*	*222*	*> 250*	*135*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*20*	*18*	*16*	*16*
			Non-Cancer -- Adult	0.12	*83*	*133*	*161*	*> 250*	*90*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*11*	*8*	*4*	*4*
		CTE (50th percentile)	10^{-6} Cancer	0.057	*113*	*184*	*225*	*> 250*	*137*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*20*	*18*	*16*	*16*
			10^{-5} Cancer	0.57	*18*	*16*	*16*	*18*	*19*	*24*	*> 250*	*> 250*	*129*	*63*	*38*	*185*	*22*	*222*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	5.7	*7*	*10*	*11*	*14*	*14*	*9*	*9*	*9*	*8*	*6*	*5*	*5*	*3*	*5*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*15*	*16*	*17*	*19*	*21*	*> 250*	*194*	*86*	*36*	*21*	*138*	*20*	*177*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	*13*	*14*	*16*	*17*	*18*	*74*	*20*	*19*	*18*	*17*	*19*	*17*	*33*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

= model prediction is lower than the IMPG

= model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-25. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.14**	*2*	*2*
	R5A_04	**0.072**	*2*	*2*
	R5A_05	**0.033**	*2*	*2*
	R5A_06	**0.048**	*3*	*2*
	R5A_07	**0.075**	*3*	*3*
	R5A_08	**0.023**	*4*	*4*
	R5A_09	**0.022**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.026**	*7*	*7*
5B	R5B_01	**0.044**	*9*	*8*
	R5B_02	**0.061**	*10*	*0*
	R5B_03	**1.1**	*10*	*0*
	R5B_04	**0.35**	*10*	*0*
	R5B_05	**0.54**	*10*	*0*
5C	R5C_01	**1.5**	*11*	*0*
	R5C_02	**0.11**	*11*	*6*
	R5C_03	**1.1**	*11*	*0*
	R5C_04	**0.11**	*11*	*6*
	R5C_05	**0.14**	*12*	*11*
	R5C_06	**0.16**	*13*	*12*
6	Woods Pond	**0.25**	*15*	*14*
7A		**0.41**	*0*	*0*
7B		**4.0**	*188*	*0*
7C		**4.0**	*> 250*	*0*
7D		**0.94**	*0*	*0*
7E		**1.3**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**5.0**	*204*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**2.7**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-26. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.1**	*70*	*32*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.087**	*3*	*3*
	BWS_06	0.56	**0.22**	*16*	*10*
	BWS_07	0.12	**5.4**	*> 250*	*4*
	BWS_08	0.35	**0.064**	*11*	*11*
	BWS_09	0.28	**0.11**	*11*	*11*
	BWS_10	1.5	**0.094**	*11*	*11*
	BWS_11	0.11	**0.18**	*7*	*5*
	BWS_12	1.7	**4.1**	*65*	*37*
	BWS_13	0.37	**8.9**	*> 250*	*> 250*
	BWS_14	0.57	**7.9**	*> 250*	*140*
	BWS_15	0.90	**5.5**	*86*	*51*
	BWS_16	1.0	**0.76**	*26*	*17*
	BWS_17	0.58	**0.35**	*14*	*5*
	BWS_18	0.84	**0.21**	*20*	*10*
	BWS_19	0.99	**0.089**	*11*	*11*
	BWS_20	1.3	**4.0**	*65*	*35*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.11**	*8*	*8*
	BWL_02	5.5	**3.7**	*57*	*32*
	BWL_03	2.4	**1.9**	*33*	*16*
	BWL_04	2.1	**1.8**	*32*	*25*
	BWL_05	12	**0.23**	*11*	*11*
	BWL_07	22	**0.20**	*12*	*12*
	BWL_08	4.1	**1.4**	*12*	*12*
	BWL_09	7.0	**0.20**	*12*	*12*
	BWL_10	6.4	**0.15**	*12*	*12*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

[blue] = model prediction is lower than the IMPG

[white] = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-27. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 4), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection			**0.99**	**1.5**	**1.6**	**1.6**	**0.89**	**1.9**	**6.3**	**4.2**	**3.2**	**2.3**	**2.0**	**4.0**	**1.8**	**5.0**
Coldwater fish protection - trout below PSA								**3.8**	**13**	**8.5**	**6.5**	**4.7**	**4.0**	**8.0**	**3.5**	
Threatened and endangered species (represented by bald eagle)			**0.45**	**1.1**	**1.6**	**0.76**	**0.42**	**1.3**	**8.9**	**3.8**	**3.0**	**1.7**	**1.5**	**3.6**	**1.2**	**4.4**
Piscivorous birds (represented by osprey)			**0.55**	**1.0**	**1.5**	**0.89**	**0.56**	**1.2**	**7.6**	**3.3**	**2.6**	**1.6**	**1.4**	**3.2**	**1.1**	**3.9**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*17*	*36*	*19*	*18*	*17*	*16*	*17*	*11*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*11*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*14*	*15*	*17*	*17*	*> 250*	*75*	*19*	*17*	*16*	*21*	*11*	*105*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(grey) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-28. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 4), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.21**	*2*	*1*	*1*
	KM 2	**0.80**	*32*	*3*	*3*
	KM 3	**0.059**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.024**	*7*	*7*	*7*
Reach 5B	KM 6	**0.054**	*9*	*9*	*8*
	KM 7	**0.56**	*10*	*10*	*10*
	KM 8	**1.8**	*89*	*13*	*11*
Reaches 5C/5D	KM 9	**1.7**	*86*	*17*	*11*
	KM 10	**0.17**	*12*	*11*	*11*
	KM 11	**0.42**	*12*	*12*	*12*
Reach 6	KM 12	**0.23**	*15*	*15*	*14*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.49**	*11*	*9*	*7*
Reaches 5C/5D/6	**0.54**	*15*	*14*	*14*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the target value

(white) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-31. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					0.057	**0.20**	**0.21**	**3.2**	**4.1**	**1.3**	**7.5**	**0.29**
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*7*	*15*	*18*	*0*	*0*	*0*	*234*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*9*	*15*	*18*	*> 250*	*> 250*	*26*	*> 250*	*18*
			10^{-5} Cancer	13	*2*	*14*	*17*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*15*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-32. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 5), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.26	0.23	0.17	0.36	0.18	0.42	1.6	1.0	0.79	0.57	0.49	1.0	0.43	0.34	0.01	0.009	0.006	0.006
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	249	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	126	113	99	97
			10^{-5} Cancer	0.019	156	159	159	> 250	187	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	40	33	25	25
			10^{-4} Cancer	0.19	64	59	44	> 250	50	138	> 250	> 250	> 250	173	165	> 250	174	> 250	11	8	4	4
			Non-Cancer -- Child	0.026	144	146	143	> 250	168	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	27	24	22	22
			Non-Cancer -- Adult	0.062	109	108	100	> 250	116	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	21	19	15	11
		CTE	10^{-6} Cancer	0.049	118	118	111	> 250	130	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	22	21	19	19
			10^{-5} Cancer	0.49	22	18	20	21	22	36	> 250	227	124	69	51	193	34	23	0	0	0	0
			10^{-4} Cancer	4.9	8	10	14	17	18	10	10	10	9	7	6	6	5	6	0	0	0	0
			Non-Cancer -- Child	0.19	64	59	44	> 250	50	138	> 250	> 250	> 250	173	165	> 250	174	> 250	11	8	4	4
			Non-Cancer -- Adult	0.43	26	21	20	22	23	48	> 250	> 250	144	84	68	218	51	24	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	200	207	213	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	64	51	50
			10^{-5} Cancer	0.064	108	106	98	> 250	114	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	21	19	15	11
			10^{-4} Cancer	0.64	15	16	19	21	22	24	> 250	166	83	38	25	142	23	22	0	0	0	0
			Non-Cancer -- Child	0.059	111	110	102	> 250	119	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	21	20	18	18
			Non-Cancer -- Adult	0.12	82	79	67	> 250	75	188	> 250	> 250	> 250	223	219	> 250	242	> 250	11	8	4	4
		CTE (50th percentile)	10^{-6} Cancer	0.057	112	111	104	> 250	121	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	21	20	18	18
			10^{-5} Cancer	0.57	18	17	19	21	22	25	> 250	192	101	52	36	164	24	23	0	0	0	0
			10^{-4} Cancer	5.7	7	10	11	17	17	9	9	9	8	6	5	5	3	5	0	0	0	0
			Non-Cancer -- Child	0.71	14	16	19	20	22	24	238	141	68	27	24	122	22	22	0	0	0	0
			Non-Cancer -- Adult	1.5	11	14	18	19	20	21	63	23	22	21	20	21	19	20	0	0	0	0

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(gray) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-33. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.13**	*2*	*2*
	R5A_04	**0.071**	*2*	*2*
	R5A_05	**0.033**	*2*	*2*
	R5A_06	**0.044**	*3*	*2*
	R5A_07	**0.075**	*3*	*3*
	R5A_08	**0.024**	*4*	*4*
	R5A_09	**0.021**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.026**	*7*	*7*
5B	R5B_01	**0.043**	*9*	*8*
	R5B_02	**0.055**	*10*	*0*
	R5B_03	**0.058**	*10*	*0*
	R5B_04	**0.089**	*11*	*0*
	R5B_05	**0.075**	*12*	*0*
5C	R5C_01	**0.083**	*13*	*0*
	R5C_02	**0.12**	*13*	*6*
	R5C_03	**0.098**	*14*	*0*
	R5C_04	**0.11**	*14*	*6*
	R5C_05	**0.13**	*14*	*14*
	R5C_06	**0.17**	*15*	*15*
6	Woods Pond	**0.24**	*18*	*17*
7A		**0.41**	*0*	*0*
7B		**4.0**	*190*	*0*
7C		**4.0**	*> 250*	*0*
7D		**0.94**	*0*	*0*
7E		**1.3**	*0*	*0*
7F		**0.61**	*0*	*0*
7G		**5.0**	*200*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**0.35**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-34. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range	IMPG (mg/kg) Upper End of Range
				3.27	**5.6**
Small Backwaters (< 2 acres)	BWS_01	1.9	**4.1**	*70*	*32*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.087**	*3*	*3*
	BWS_06	0.56	**0.24**	*17*	*10*
	BWS_07	0.12	**5.4**	*> 250*	*4*
	BWS_08	0.35	**0.060**	*12*	*12*
	BWS_09	0.28	**0.098**	*13*	*13*
	BWS_10	1.5	**0.078**	*13*	*13*
	BWS_11	0.11	**0.12**	*7*	*5*
	BWS_12	1.7	**4.2**	*67*	*38*
	BWS_13	0.37	**8.9**	*> 250*	*> 250*
	BWS_14	0.57	**7.8**	*> 250*	*130*
	BWS_15	0.90	**5.6**	*86*	*52*
	BWS_16	1.0	**0.77**	*27*	*17*
	BWS_17	0.58	**0.27**	*15*	*5*
	BWS_18	0.84	**0.24**	*20*	*10*
	BWS_19	0.99	**0.074**	*14*	*14*
	BWS_20	1.3	**4.1**	*67*	*36*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.11**	*8*	*8*
	BWL_02	5.5	**3.9**	*60*	*32*
	BWL_03	2.4	**1.8**	*33*	*16*
	BWL_04	2.1	**1.9**	*34*	*26*
	BWL_05	12	**0.22**	*14*	*14*
	BWL_07	22	**0.17**	*15*	*15*
	BWL_08	4.1	**1.3**	*15*	*15*
	BWL_09	7.0	**0.16**	*15*	*15*
	BWL_10	6.4	**0.13**	*15*	*15*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-35. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 5), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection			**1.0**	**0.89**	**0.65**	**1.4**	**0.70**	**1.6**	**6.1**	**4.0**	**3.0**	**2.2**	**1.9**	**3.9**	**1.6**	**1.3**
Coldwater fish protection - trout below PSA								**3.2**	**12**	**7.9**	**6.0**	**4.4**	**3.7**	**7.8**	**3.3**	
Threatened and endangered species (represented by bald eagle)			**0.46**	**0.40**	**0.37**	**0.67**	**0.34**	**1.2**	**8.8**	**3.7**	**2.9**	**1.7**	**1.4**	**3.6**	**1.1**	**0.79**
Piscivorous birds (represented by osprey)			**0.56**	**0.44**	**0.41**	**0.79**	**0.45**	**1.1**	**7.5**	**3.2**	**2.5**	**1.5**	**1.3**	**3.1**	**1.1**	**0.78**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*20*	*30*	*21*	*20*	*20*	*19*	*19*	*11*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*17*	*18*	*19*	*20*	*> 250*	*41*	*22*	*19*	*18*	*22*	*11*	*19*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(gray) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

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Table 6-36. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 5), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.20**	*2*	*1*	*1*
	KM 2	**0.80**	*32*	*3*	*3*
	KM 3	**0.058**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.024**	*7*	*7*	*7*
Reach 5B	KM 6	**0.053**	*9*	*9*	*8*
	KM 7	**0.16**	*11*	*10*	*10*
	KM 8	**1.2**	*61*	*13*	*13*
Reaches 5C/5D	KM 9	**1.4**	*70*	*18*	*14*
	KM 10	**0.17**	*14*	*14*	*14*
	KM 11	**0.40**	*15*	*15*	*15*
Reach 6	KM 12	**0.21**	*18*	*17*	*17*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.40**	*12*	*9*	*7*
Reaches 5C/5D/6	**0.42**	*18*	*17*	*16*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue cell) = model prediction is lower than the target value

(white cell) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-39. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.054	0.17	0.24	1.2	0.10	0.44	2.1	0.095
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*7*	*15*	*18*	*0*	*0*	*0*	*20*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*16*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*9*	*16*	*19*	*19*	*19*	*20*	*> 250*	*21*
			10^{-5} Cancer	13	*2*	*14*	*17*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*16*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue cell) = model prediction is lower than the IMPG
(white cell) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-40. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 6), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.26	0.22	0.16	0.35	0.17	0.40	0.41	0.20	0.70	0.34	0.45	0.40	0.39	0.22	0.009	0.006	0.005	0.004
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	*230*	*235*	*242*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*91*	*82*	*73*	*72*
			10^{-5} Cancer	0.019	*146*	*145*	*143*	*> 250*	*170*	*> 250*	*> 250*	*181*	*> 250*	*213*	*> 250*	*> 250*	*> 250*	*> 250*	*36*	*31*	*26*	*26*
			10^{-4} Cancer	0.19	*62*	*56*	*44*	*> 250*	*48*	*112*	*> 250*	*53*	*210*	*83*	*128*	*154*	*139*	*65*	*18*	*9*	*6*	*5*
			Non-Cancer -- Child	0.026	*134*	*133*	*129*	*> 250*	*153*	*> 250*	*> 250*	*164*	*> 250*	*195*	*> 250*	*> 250*	*> 250*	*> 250*	*28*	*25*	*23*	*23*
			Non-Cancer -- Adult	0.062	*103*	*99*	*92*	*> 250*	*106*	*207*	*> 250*	*116*	*> 250*	*146*	*228*	*> 250*	*> 250*	*177*	*22*	*20*	*19*	*19*
		CTE	10^{-6} Cancer	0.049	*111*	*109*	*102*	*> 250*	*119*	*227*	*> 250*	*129*	*> 250*	*159*	*249*	*> 250*	*> 250*	*200*	*23*	*22*	*20*	*20*
			10^{-5} Cancer	0.49	*22*	*18*	*20*	*21*	*23*	*33*	*23*	*24*	*94*	*24*	*41*	*24*	*26*	*25*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	4.9	*8*	*10*	*14*	*17*	*19*	*10*	*10*	*10*	*10*	*9*	*8*	*8*	*7*	*8*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	*62*	*56*	*44*	*> 250*	*48*	*112*	*> 250*	*53*	*210*	*83*	*128*	*154*	*139*	*65*	*18*	*9*	*6*	*5*
			Non-Cancer -- Adult	0.43	*26*	*20*	*21*	*22*	*24*	*41*	*23*	*24*	*110*	*24*	*55*	*24*	*37*	*25*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	*186*	*188*	*190*	*> 250*	*229*	*> 250*	*> 250*	*242*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*59*	*51*	*38*	*37*
			10^{-5} Cancer	0.064	*102*	*98*	*91*	*> 250*	*105*	*205*	*> 250*	*114*	*> 250*	*144*	*225*	*> 250*	*> 250*	*173*	*22*	*20*	*19*	*19*
			10^{-4} Cancer	0.64	*15*	*16*	*20*	*21*	*23*	*24*	*23*	*23*	*62*	*23*	*26*	*23*	*23*	*24*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	*105*	*101*	*94*	*> 250*	*109*	*211*	*> 250*	*118*	*> 250*	*149*	*232*	*> 250*	*> 250*	*181*	*22*	*21*	*20*	*19*
			Non-Cancer -- Adult	0.12	*79*	*74*	*63*	*> 250*	*71*	*151*	*> 250*	*79*	*> 250*	*109*	*169*	*218*	*196*	*111*	*18*	*9*	*6*	*5*
		CTE (50th percentile)	10^{-6} Cancer	0.057	*106*	*103*	*96*	*> 250*	*111*	*214*	*> 250*	*120*	*> 250*	*151*	*235*	*> 250*	*> 250*	*185*	*22*	*21*	*20*	*19*
			10^{-5} Cancer	0.57	*18*	*17*	*20*	*21*	*23*	*25*	*23*	*24*	*76*	*23*	*32*	*24*	*24*	*24*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	5.7	*7*	*10*	*11*	*17*	*19*	*9*	*9*	*9*	*9*	*8*	*7*	*7*	*5*	*7*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*14*	*16*	*19*	*21*	*23*	*24*	*22*	*23*	*51*	*23*	*24*	*23*	*23*	*24*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*11*	*14*	*18*	*19*	*21*	*22*	*21*	*22*	*22*	*21*	*21*	*21*	*20*	*22*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

= model prediction is lower than the IMPG

= model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-41. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.33**	*1*	*1*
	R5A_02	**0.17**	*1*	*1*
	R5A_03	**0.14**	*2*	*2*
	R5A_04	**0.070**	*2*	*2*
	R5A_05	**0.032**	*2*	*2*
	R5A_06	**0.045**	*3*	*2*
	R5A_07	**0.063**	*3*	*3*
	R5A_08	**0.023**	*4*	*4*
	R5A_09	**0.021**	*4*	*4*
	R5A_10	**0.020**	*6*	*5*
	R5A_11	**0.022**	*7*	*7*
5B	R5B_01	**0.035**	*9*	*8*
	R5B_02	**0.042**	*10*	*0*
	R5B_03	**0.060**	*10*	*0*
	R5B_04	**0.090**	*11*	*0*
	R5B_05	**0.072**	*12*	*0*
5C	R5C_01	**0.081**	*13*	*0*
	R5C_02	**0.12**	*13*	*6*
	R5C_03	**0.10**	*13*	*0*
	R5C_04	**0.12**	*14*	*6*
	R5C_05	**0.19**	*14*	*14*
	R5C_06	**0.25**	*16*	*16*
6	Woods Pond	**0.21**	*18*	*18*
7A		**0.41**	*0*	*0*
7B		**0.92**	*19*	*0*
7C		**0.092**	*19*	*0*
7D		**0.90**	*0*	*0*
7E		**0.44**	*0*	*0*
7F		**0.59**	*0*	*0*
7G		**1.4**	*20*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**0.13**	*20*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue)	= model prediction is lower than the IMPG
(white)	= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-42. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.18**	*2*	*2*
	BWS_02	1.8	**0.14**	*3*	*3*
	BWS_03	1.9	**0.20**	*3*	*3*
	BWS_04	0.30	**0.12**	*3*	*3*
	BWS_06	0.56	**0.18**	*10*	*10*
	BWS_07	0.12	**0.030**	*10*	*4*
	BWS_08	0.35	**0.061**	*12*	*12*
	BWS_09	0.28	**0.098**	*13*	*13*
	BWS_10	1.5	**0.080**	*13*	*13*
	BWS_11	0.11	**0.13**	*7*	*5*
	BWS_12	1.7	**0.11**	*13*	*13*
	BWS_13	0.37	**0.11**	*13*	*13*
	BWS_14	0.57	**0.049**	*13*	*13*
	BWS_15	0.90	**0.10**	*13*	*13*
	BWS_16	1.0	**0.094**	*14*	*14*
	BWS_17	0.58	**0.11**	*14*	*5*
	BWS_18	0.84	**0.10**	*14*	*10*
	BWS_19	0.99	**0.072**	*14*	*14*
	BWS_20	1.3	**0.11**	*15*	*15*
Large Backwaters (> 2 acres)	BWL_01	2.1	**1.5**	*8*	*8*
	BWL_02	5.5	**0.11**	*12*	*12*
	BWL_03	2.4	**0.096**	*13*	*13*
	BWL_04	2.1	**0.12**	*14*	*14*
	BWL_05	12	**0.25**	*14*	*14*
	BWL_07	22	**0.18**	*15*	*15*
	BWL_08	4.1	**0.19**	*15*	*15*
	BWL_09	7.0	**0.24**	*16*	*15*
	BWL_10	6.4	**0.18**	*16*	*16*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue)	= model prediction is lower than the IMPG
(white)	= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-43. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 6), including the time to achieve in years (*in italics*).

Ecological Receptor	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
	Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
Fish protection	**0.99**	**0.86**	**0.63**	**1.4**	**0.68**	**1.5**	**1.6**	**0.77**	**2.7**	**1.3**	**1.7**	**1.5**	**1.5**	**0.84**
Coldwater fish protection - trout below PSA						**3.0**	**3.2**	**1.5**	**5.4**	**2.6**	**3.4**	**3.0**	**3.0**	
Threatened and endangered species (represented by bald eagle)	**0.45**	**0.38**	**0.38**	**0.62**	**0.32**	**1.1**	**1.9**	**0.32**	**2.7**	**0.81**	**1.4**	**1.1**	**1.1**	**0.41**
Piscivorous birds (represented by osprey)	**0.55**	**0.42**	**0.41**	**0.77**	**0.43**	**1.1**	**1.7**	**0.36**	**2.3**	**0.79**	**1.2**	**1.1**	**1.0**	**0.43**

Ecological Receptor	Tissue Type	IMPG (mg/kg)	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*15*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Fish protection	Coldwater fish tissue (whole body) - Trout Below PSA	14						*21*	*20*	*21*	*21*	*20*	*20*	*20*	*19*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*4*	*5*	*7*	*14*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*10*	*12*	*17*	*18*	*20*	*20*	*20*	*20*	*21*	*19*	*20*	*20*	*19*	*21*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(grey) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-44. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 6), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.21**	*2*	*1*	*1*
	KM 2	**0.093**	*3*	*3*	*2*
	KM 3	**0.058**	*4*	*4*	*4*
	KM 4	**0.020**	*6*	*6*	*6*
	KM 5	**0.023**	*7*	*7*	*7*
Reach 5B	KM 6	**0.31**	*9*	*9*	*8*
	KM 7	**0.065**	*11*	*10*	*10*
	KM 8	**0.085**	*13*	*12*	*12*
Reaches 5C/5D	KM 9	**0.10**	*14*	*13*	*13*
	KM 10	**0.19**	*14*	*14*	*14*
	KM 11	**0.20**	*16*	*16*	*15*
Reach 6	KM 12	**0.22**	*19*	*18*	*18*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.11**	*12*	*9*	*7*
Reaches 5C/5D/6	**0.19**	*18*	*18*	*17*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the target value

(white) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-47. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.084	0.16	0.23	0.24	0.052	0.29	1.8	0.032
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*8*	*18*	*22*	*0*	*0*	*0*	*25*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*19*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*11*	*19*	*23*	*23*	*24*	*23*	*IT*	*26*
			10^{-5} Cancer	13	*3*	*17*	*21*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*19*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 55-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
SA 1: Confluence to New Lenox Road
SA 2: New Lenox Road to Woods Pond Headwaters
SA 3: Woods Pond (6-meters from waters edge)
SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
SA 7: Glendale Dam impoundment (6-meters from waters edge)
SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report
IT = Increasing trend in model extrapolation; no time-to-achieve estimated.

Table 6-48. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 7), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.29	0.25	0.18	0.39	0.19	0.42	0.23	0.20	0.75	0.33	0.46	0.35	0.40	0.20	0.009	0.006	0.005	0.004
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	205	220	233	>250	>250	>250	>250	>250	>250	>250	>250	>250	>250	>250	98	88	78	77
			10^{-5} Cancer	0.019	136	141	142	>250	182	>250	186	157	>250	>250	>250	>250	>250	247	38	34	31	31
			10^{-4} Cancer	0.19	66	63	52	154	53	113	63	56	233	99	143	125	159	55	11	9	5	4
			Non-Cancer -- Child	0.026	126	131	130	>250	165	>250	169	143	>250	>250	>250	>250	>250	221	33	30	28	27
			Non-Cancer -- Adult	0.062	100	101	95	>250	116	197	123	105	>250	204	>250	>250	>250	149	26	24	13	12
		CTE	10^{-6} Cancer	0.049	107	109	104	>250	129	215	135	115	>250	226	>250	>250	>250	168	28	26	24	24
			10^{-5} Cancer	0.49	23	20	23	25	27	39	31	32	108	32	46	31	33	30	0	0	0	0
			10^{-4} Cancer	4.9	9	12	15	20	23	11	11	11	10	8	7	7	5	7	0	0	0	0
			Non-Cancer -- Child	0.19	66	63	52	154	53	113	63	56	233	99	143	125	159	55	11	9	5	4
			Non-Cancer -- Adult	0.43	39	21	24	26	27	51	32	33	125	34	60	33	38	31	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	169	179	185	>250	243	>250	243	205	>250	>250	>250	>250	>250	>250	63	52	41	40
			10^{-5} Cancer	0.064	99	100	94	>250	114	195	121	104	>250	201	>250	>250	>250	146	26	24	13	12
			10^{-4} Cancer	0.64	15	18	23	24	26	34	27	30	73	30	32	29	30	29	0	0	0	0
			Non-Cancer -- Child	0.059	101	103	97	>250	119	201	126	107	>250	209	>250	>250	>250	153	27	25	15	14
			Non-Cancer -- Adult	0.12	80	78	69	217	79	148	88	76	>250	142	190	188	226	94	11	9	5	4
		CTE (50th percentile)	10^{-6} Cancer	0.057	102	104	98	>250	121	204	127	109	>250	212	>250	>250	>250	156	27	25	15	14
			10^{-5} Cancer	0.57	18	19	23	24	27	35	30	31	88	31	35	30	31	30	0	0	0	0
			10^{-4} Cancer	5.7	8	11	12	20	22	10	10	10	9	7	5	6	3	5	0	0	0	0
			Non-Cancer -- Child	0.71	14	18	22	24	26	33	27	30	59	29	30	29	29	29	0	0	0	0
			Non-Cancer -- Adult	1.5	12	16	21	23	25	25	25	26	27	26	25	26	25	27	0	0	0	0

Notes

[1] Model endpoint concentrations after 55-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(gray) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-49. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.17**	*1*	*1*
	R5A_02	**0.11**	*1*	*1*
	R5A_03	**0.37**	*27*	*2*
	R5A_04	**0.83**	*3*	*2*
	R5A_05	**0.14**	*3*	*3*
	R5A_06	**0.067**	*4*	*3*
	R5A_07	**0.055**	*5*	*4*
	R5A_08	**0.026**	*5*	*5*
	R5A_09	**0.046**	*6*	*6*
	R5A_10	**0.028**	*7*	*7*
	R5A_11	**0.029**	*9*	*8*
5B	R5B_01	**0.034**	*11*	*10*
	R5B_02	**0.041**	*12*	*0*
	R5B_03	**0.066**	*12*	*0*
	R5B_04	**0.092**	*13*	*0*
	R5B_05	**0.069**	*14*	*0*
5C	R5C_01	**0.082**	*16*	*0*
	R5C_02	**0.12**	*16*	*6*
	R5C_03	**0.10**	*16*	*0*
	R5C_04	**0.12**	*17*	*7*
	R5C_05	**0.19**	*17*	*17*
	R5C_06	**0.21**	*19*	*19*
6	Woods Pond	**0.22**	*22*	*21*
7A		**0.41**	*0*	*0*
7B		**0.22**	*23*	*0*
7C		**0.062**	*24*	*0*
7D		**0.93**	*0*	*0*
7E		**0.29**	*0*	*0*
7F		**0.60**	*0*	*0*
7G		**1.1**	*25*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**0.031**	*17*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 55-year projection

IMPG = interim media protection goal

Key

[blue] = model prediction is lower than the IMPG

[white] = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-50. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.36**	*2*	*2*
	BWS_02	1.8	**0.29**	*3*	*3*
	BWS_03	1.9	**0.25**	*4*	*4*
	BWS_04	0.30	**0.24**	*4*	*4*
	BWS_06	0.56	**0.19**	*12*	*10*
	BWS_07	0.12	**0.027**	*12*	*4*
	BWS_08	0.35	**0.26**	*15*	*15*
	BWS_09	0.28	**0.17**	*16*	*16*
	BWS_10	1.5	**0.33**	*16*	*16*
	BWS_11	0.11	**0.13**	*7*	*5*
	BWS_12	1.7	**0.13**	*16*	*16*
	BWS_13	0.37	**0.17**	*16*	*16*
	BWS_14	0.57	**0.13**	*16*	*16*
	BWS_15	0.90	**0.14**	*16*	*16*
	BWS_16	1.0	**0.098**	*17*	*17*
	BWS_17	0.58	**0.11**	*16*	*5*
	BWS_18	0.84	**0.10**	*17*	*11*
	BWS_19	0.99	**0.15**	*17*	*17*
	BWS_20	1.3	**0.12**	*18*	*17*
Large Backwaters (> 2 acres)	BWL_01	2.1	**1.6**	*10*	*10*
	BWL_02	5.5	**0.16**	*15*	*15*
	BWL_03	2.4	**0.11**	*16*	*16*
	BWL_04	2.1	**0.19**	*16*	*16*
	BWL_05	12	**0.19**	*17*	*17*
	BWL_07	22	**0.21**	*18*	*18*
	BWL_08	4.1	**0.22**	*18*	*18*
	BWL_09	7.0	**0.19**	*19*	*19*
	BWL_10	6.4	**0.20**	*19*	*19*
	BWL_11	4.6	**0.024**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 55-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-51. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 7), including the time to achieve in years (*in italics*).

Ecological Receptor	Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection	**1.1**	**0.96**	**0.70**	**1.5**	**0.77**	**1.6**	**0.90**	**0.78**	**2.9**	**1.3**	**1.8**	**1.4**	**1.5**	**0.78**
Coldwater fish protection - trout below PSA						**3.2**	**1.8**	**1.6**	**5.8**	**2.6**	**3.6**	**2.7**	**3.1**	
Threatened and endangered species (represented by bald eagle)	**0.51**	**0.42**	**0.40**	**0.67**	**0.36**	**1.2**	**0.77**	**0.32**	**2.9**	**0.72**	**1.4**	**0.98**	**1.1**	**0.32**
Piscivorous birds (represented by osprey)	**0.63**	**0.47**	**0.44**	**0.84**	**0.49**	**1.1**	**0.74**	**0.37**	**2.5**	**0.73**	**1.3**	**0.92**	**1.0**	**0.36**

Ecological Receptor	Tissue Type	IMPG (mg/kg)	Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*5*	*0*	*18*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*24*	*24*	*25*	*26*	*25*	*14*	*25*	*12*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*4*	*6*	*8*	*17*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*11*	*14*	*20*	*21*	*24*	*23*	*24*	*25*	*29*	*24*	*24*	*25*	*12*	*26*

Notes

[1] Model endpoint concentrations after 55-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(gray) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-52. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 7), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.12**	*2*	*2*	*2*
	KM 2	**0.42**	*34*	*3*	*3*
	KM 3	**0.071**	*5*	*5*	*5*
	KM 4	**0.033**	*8*	*7*	*7*
	KM 5	**0.032**	*9*	*9*	*9*
Reach 5B	KM 6	**0.32**	*11*	*11*	*11*
	KM 7	**0.067**	*13*	*12*	*12*
	KM 8	**0.11**	*16*	*15*	*15*
Reaches 5C/5D	KM 9	**0.13**	*16*	*16*	*16*
	KM 10	**0.17**	*17*	*17*	*17*
	KM 11	**0.19**	*19*	*19*	*19*
Reach 6	KM 12	**0.22**	*22*	*22*	*22*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.14**	*14*	*11*	*9*
Reaches 5C/5D/6	**0.19**	*22*	*21*	*20*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 55-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

= model prediction is lower than the target value

= model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-55. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					0.076	0.10	0.17	0.038	0.044	0.014	0.055	0.072
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*10*	*25*	*37*	*0*	*0*	*0*	*42*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*21*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*13*	*27*	*38*	*40*	*41*	*34*	*42*	*48*
			10^{-5} Cancer	13	*3*	*23*	*29*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*27*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 81-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-56. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 8), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																		
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.17	0.15	0.11	0.29	0.13	0.34	0.10	0.12	0.63	0.18	0.38	0.15	0.35	0.17	0.006	0.005	0.004	0.003
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*116*	*106*	*96*	*94*
			10^{-5} Cancer	0.019	*188*	*186*	*179*	*> 250*	*193*	*> 250*	*205*	*200*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*60*	*57*	*56*	*56*
			10^{-4} Cancer	0.19	*74*	*70*	*48*	*117*	*51*	*166*	*46*	*52*	*> 250*	*64*	*182*	*52*	*226*	*63*	*15*	*11*	*7*	*6*
			Non-Cancer -- Child	0.026	*172*	*170*	*161*	*> 250*	*174*	*> 250*	*181*	*180*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*56*	*55*	*54*	*41*
			Non-Cancer -- Adult	0.062	*129*	*125*	*111*	*> 250*	*122*	*> 250*	*116*	*123*	*> 250*	*174*	*> 250*	*176*	*> 250*	*204*	*34*	*31*	*17*	*17*
		CTE	10^{-6} Cancer	0.049	*141*	*137*	*125*	*> 250*	*136*	*> 250*	*134*	*138*	*> 250*	*197*	*> 250*	*203*	*> 250*	*234*	*54*	*36*	*31*	*31*
			10^{-5} Cancer	0.49	*23*	*21*	*32*	*31*	*42*	*44*	*43*	*45*	*127*	*45*	*48*	*46*	*47*	*53*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	4.9	*10*	*14*	*17*	*27*	*37*	*12*	*12*	*13*	*12*	*11*	*10*	*11*	*8*	*11*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.19	*74*	*70*	*48*	*117*	*51*	*166*	*46*	*52*	*> 250*	*64*	*182*	*52*	*226*	*63*	*15*	*11*	*7*	*6*
			Non-Cancer -- Adult	0.43	*39*	*23*	*32*	*32*	*42*	*48*	*43*	*45*	*153*	*45*	*61*	*47*	*48*	*54*	*0*	*0*	*0*	*0*
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	*242*	*242*	*241*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*79*	*68*	*62*	*62*
			10^{-5} Cancer	0.064	*127*	*123*	*110*	*> 250*	*120*	*> 250*	*114*	*121*	*> 250*	*171*	*> 250*	*172*	*> 250*	*200*	*34*	*31*	*17*	*17*
			10^{-4} Cancer	0.64	*17*	*20*	*31*	*31*	*41*	*43*	*43*	*44*	*76*	*44*	*45*	*45*	*46*	*53*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.059	*131*	*128*	*114*	*> 250*	*125*	*> 250*	*120*	*126*	*> 250*	*179*	*> 250*	*182*	*> 250*	*210*	*39*	*32*	*26*	*22*
			Non-Cancer -- Adult	0.12	*96*	*91*	*76*	*173*	*82*	*234*	*70*	*82*	*> 250*	*110*	*> 250*	*101*	*> 250*	*120*	*15*	*11*	*7*	*6*
		CTE (50th percentile)	10^{-6} Cancer	0.057	*133*	*129*	*116*	*> 250*	*127*	*> 250*	*122*	*128*	*> 250*	*182*	*> 250*	*186*	*> 250*	*215*	*39*	*32*	*26*	*22*
			10^{-5} Cancer	0.57	*18*	*21*	*31*	*31*	*41*	*43*	*43*	*44*	*98*	*44*	*46*	*46*	*46*	*53*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	5.7	*9*	*13*	*14*	*27*	*37*	*11*	*11*	*12*	*11*	*10*	*8*	*9*	*7*	*9*	*0*	*0*	*0*	*0*
			Non-Cancer -- Child	0.71	*16*	*20*	*31*	*31*	*41*	*42*	*42*	*44*	*60*	*44*	*44*	*45*	*45*	*52*	*0*	*0*	*0*	*0*
			Non-Cancer -- Adult	1.5	*13*	*18*	*28*	*29*	*40*	*39*	*41*	*42*	*42*	*40*	*33*	*42*	*32*	*50*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 81-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(gray) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-57. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range	IMPG (mg/kg) Upper End of Range
			3	10
5A	R5A_01	**0.11**	*1*	*1*
	R5A_02	**0.084**	*1*	*1*
	R5A_03	**0.23**	*2*	*2*
	R5A_04	**0.37**	*3*	*3*
	R5A_05	**0.067**	*3*	*3*
	R5A_06	**0.28**	*4*	*3*
	R5A_07	**0.070**	*6*	*5*
	R5A_08	**0.021**	*6*	*6*
	R5A_09	**0.027**	*7*	*7*
	R5A_10	**0.022**	*9*	*8*
	R5A_11	**0.026**	*11*	*10*
5B	R5B_01	**0.030**	*13*	*12*
	R5B_02	**0.038**	*14*	*0*
	R5B_03	**0.050**	*15*	*0*
	R5B_04	**0.11**	*15*	*0*
	R5B_05	**0.057**	*16*	*0*
5C	R5C_01	**0.077**	*19*	*0*
	R5C_02	**0.090**	*20*	*7*
	R5C_03	**0.086**	*21*	*0*
	R5C_04	**0.088**	*22*	*7*
	R5C_05	**0.14**	*24*	*23*
	R5C_06	**0.15**	*28*	*27*
6	Woods Pond	**0.16**	*37*	*33*
7A		**0.41**	*0*	*0*
7B		**0.044**	*39*	*0*
7C		**0.048**	*40*	*0*
7D		**0.87**	*0*	*0*
7E		**0.014**	*0*	*0*
7F		**0.55**	*0*	*0*
7G		**0.044**	*42*	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**0.070**	*26*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 81-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-58. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.20**	*3*	*3*
	BWS_02	1.8	**0.16**	*4*	*4*
	BWS_03	1.9	**0.18**	*5*	*5*
	BWS_04	0.30	**0.19**	*5*	*5*
	BWS_06	0.56	**0.13**	*14*	*11*
	BWS_07	0.12	**0.11**	*14*	*14*
	BWS_08	0.35	**0.29**	*18*	*18*
	BWS_09	0.28	**0.21**	*18*	*18*
	BWS_10	1.5	**0.27**	*19*	*19*
	BWS_11	0.11	**0.093**	*8*	*5*
	BWS_12	1.7	**0.10**	*20*	*20*
	BWS_13	0.37	**0.10**	*20*	*20*
	BWS_14	0.57	**0.20**	*20*	*20*
	BWS_15	0.90	**0.12**	*21*	*21*
	BWS_16	1.0	**0.12**	*21*	*18*
	BWS_17	0.58	**0.088**	*16*	*6*
	BWS_18	0.84	**0.074**	*19*	*11*
	BWS_19	0.99	**0.11**	*23*	*23*
	BWS_20	1.3	**0.12**	*24*	*24*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.15**	*12*	*12*
	BWL_02	5.5	**0.14**	*17*	*17*
	BWL_03	2.4	**0.10**	*19*	*18*
	BWL_04	2.1	**0.14**	*21*	*21*
	BWL_05	12	**0.11**	*23*	*23*
	BWL_07	22	**0.11**	*25*	*25*
	BWL_08	4.1	**0.10**	*26*	*26*
	BWL_09	7.0	**0.10**	*26*	*26*
	BWL_10	6.4	**0.16**	*27*	*27*
	BWL_11	4.6	**0.022**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 81-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-59. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 8), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Fish protection			**0.68**	**0.58**	**0.43**	**1.1**	**0.50**	**1.3**	**0.40**	**0.47**	**2.5**	**0.71**	**1.5**	**0.60**	**1.3**	**0.67**
Coldwater fish protection - trout below PSA								**2.6**	**0.81**	**0.95**	**4.9**	**1.4**	**3.0**	**1.2**	**2.7**	
Threatened and endangered species (represented by bald eagle)			**0.31**	**0.28**	**0.26**	**0.49**	**0.24**	**1.1**	**0.24**	**0.20**	**2.5**	**0.27**	**1.2**	**0.24**	**1.0**	**0.32**
Piscivorous birds (represented by osprey)			**0.38**	**0.30**	**0.28**	**0.62**	**0.32**	**0.97**	**0.26**	**0.23**	**2.2**	**0.32**	**1.1**	**0.28**	**0.95**	**0.34**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*6*	*0*	*24*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*34*	*40*	*41*	*41*	*33*	*31*	*33*	*30*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*5*	*6*	*8*	*21*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*12*	*17*	*28*	*28*	*39*	*34*	*40*	*41*	*42*	*36*	*31*	*42*	*29*	*49*

Notes

[1] Model endpoint concentrations after 81-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(gray) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-60. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 8), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.089**	*2*	*2*	*2*
	KM 2	**0.36**	*36*	*4*	*3*
	KM 3	**0.063**	*6*	*6*	*6*
	KM 4	**0.024**	*9*	*9*	*9*
	KM 5	**0.028**	*11*	*11*	*11*
Reach 5B	KM 6	**0.051**	*13*	*13*	*13*
	KM 7	**0.062**	*15*	*15*	*14*
	KM 8	**0.095**	*19*	*18*	*17*
Reaches 5C/5D	KM 9	**0.11**	*21*	*20*	*20*
	KM 10	**0.11**	*24*	*24*	*23*
	KM 11	**0.11**	*27*	*26*	*26*
Reach 6	KM 12	**0.16**	*38*	*36*	*35*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.087**	*17*	*13*	*11*
Reaches 5C/5D/6	**0.13**	*37*	*33*	*29*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 81-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the target value

(white) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-63. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 9), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	**SA 2**	**SA 3**	**SA 4**	**SA 5**	**SA 6**	**SA 7**	**SA 8**
					0.16	**0.16**	**0.15**	**0.18**	**0.021**	**0.013**	**0.35**	**0.17**
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*4*	*9*	*11*	*11*	*0*	*0*	*13*	*14*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*7*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*6*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*5*	*10*	*12*	*12*	*12*	*13*	*13*	*14*
			10^{-5} Cancer	13	*2*	*8*	*10*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*8*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
SA 1: Confluence to New Lenox Road
SA 2: New Lenox Road to Woods Pond Headwaters
SA 3: Woods Pond (6-meters from waters edge)
SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
SA 7: Glendale Dam impoundment (6-meters from waters edge)
SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

(blue) = model prediction is lower than the IMPG
(white) = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-64. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 9), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																		
					Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8	BBD	LL	LZ	LH
					0.31	0.27	0.18	0.41	0.16	0.42	0.21	0.20	0.75	0.22	0.45	0.22	0.39	0.24	0.009	0.006	0.004	0.004
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	234	232	229	IT	231	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	101	90	78	77
			10^{-5} Cancer	0.019	151	148	139	IT	138	> 250	> 250	171	> 250	209	> 250	> 250	> 250	> 250	34	26	23	22
			10^{-4} Cancer	0.19	68	63	51	IT	44	120	60	52	> 250	61	140	63	147	72	13	11	9	8
			Non-Cancer -- Child	0.026	140	136	127	IT	125	> 250	245	155	> 250	189	> 250	232	> 250	> 250	25	21	18	18
			Non-Cancer -- Adult	0.062	109	104	93	IT	89	219	164	110	> 250	133	> 250	158	> 250	182	16	15	13	13
		CTE	10^{-6} Cancer	0.049	117	113	102	IT	99	240	186	122	> 250	148	> 250	178	> 250	205	19	17	15	15
			10^{-5} Cancer	0.49	35	22	15	16	16	37	16	17	114	17	39	17	22	19	0	0	0	0
			10^{-4} Cancer	4.9	8	9	10	12	12	11	11	12	11	11	10	10	9	11	0	0	0	0
			Non-Cancer -- Child	0.19	68	63	51	IT	44	120	60	52	> 250	61	140	63	147	72	13	11	9	8
			Non-Cancer -- Adult	0.43	38	34	16	24	17	48	16	18	134	17	56	18	35	19	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	190	188	181	IT	182	> 250	> 250	228	> 250	> 250	> 250	> 250	> 250	> 250	60	50	36	35
			10^{-5} Cancer	0.064	108	103	91	IT	88	216	162	108	> 250	131	251	155	> 250	179	16	15	13	13
			10^{-4} Cancer	0.64	19	15	14	15	16	120	15	16	74	16	21	16	16	18	0	0	0	0
			Non-Cancer -- Child	0.059	111	106	94	IT	91	223	169	112	> 250	136	> 250	162	> 250	187	17	16	14	14
			Non-Cancer -- Adult	0.12	85	80	67	IT	62	161	103	76	> 250	91	187	102	210	117	13	11	9	8
		CTE (50th percentile)	10^{-6} Cancer	0.057	112	107	96	IT	93	226	172	114	> 250	138	> 250	165	> 250	190	17	16	14	14
			10^{-5} Cancer	0.57	23	18	14	15	16	25	16	17	91	16	30	17	17	18	0	0	0	0
			10^{-4} Cancer	5.7	7	9	9	11	11	11	11	11	11	10	9	9	8	10	0	0	0	0
			Non-Cancer -- Child	0.71	16	14	14	15	15	17	15	16	58	15	17	16	16	18	0	0	0	0
			Non-Cancer -- Adult	1.5	10	11	12	13	14	14	14	14	15	14	14	14	13	16	0	0	0	0

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

(blue) = model prediction is lower than the IMPG

(grey) = model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-65. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 9), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
			Lower End of Range	Upper End of Range
			3	10
5A	R5A_01	**0.31**	*1*	*1*
	R5A_02	**0.20**	*1*	*1*
	R5A_03	**0.21**	*1*	*1*
	R5A_04	**0.29**	*1*	*1*
	R5A_05	**0.26**	*1*	*1*
	R5A_06	**0.13**	*2*	*1*
	R5A_07	**0.22**	*2*	*2*
	R5A_08	**0.18**	*2*	*2*
	R5A_09	**0.11**	*3*	*2*
	R5A_10	**0.19**	*3*	*3*
	R5A_11	**0.15**	*4*	*4*
5B	R5B_01	**0.083**	*5*	*4*
	R5B_02	**0.073**	*5*	*0*
	R5B_03	**0.077**	*5*	*0*
	R5B_04	**0.13**	*6*	*0*
	R5B_05	**0.10**	*6*	*0*
5C	R5C_01	**0.085**	*7*	*2*
	R5C_02	**0.13**	*7*	*7*
	R5C_03	**0.11**	*8*	*0*
	R5C_04	**0.13**	*8*	*8*
	R5C_05	**0.18**	*8*	*8*
	R5C_06	**0.19**	*10*	*10*
6	Woods Pond	**0.13**	*11*	*11*
7A		**0.41**	*0*	*0*
7B		**0.17**	*12*	*0*
7C		**0.027**	*12*	*0*
7D		**0.95**	*0*	*0*
7E		**0.0134**	*0*	*0*
7F		**0.60**	*0*	*0*
7G		**0.233**	*13*	*0*
7H		**0.39**	*0*	*0*
8	Rising Pond	**0.20**	*14*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue)	= model prediction is lower than the IMPG
(white)	= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-66. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 9), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range 3.27	IMPG (mg/kg) Upper End of Range 5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**0.21**	*1*	*1*
	BWS_02	1.8	**0.21**	*2*	*2*
	BWS_03	1.9	**0.24**	*2*	*2*
	BWS_04	0.30	**0.22**	*2*	*2*
	BWS_06	0.56	**0.19**	*5*	*5*
	BWS_07	0.12	**0.11**	*5*	*5*
	BWS_08	0.35	**0.26**	*7*	*7*
	BWS_09	0.28	**0.23**	*7*	*7*
	BWS_10	1.5	**0.38**	*7*	*7*
	BWS_11	0.11	**0.13**	*7*	*5*
	BWS_12	1.7	**0.14**	*7*	*7*
	BWS_13	0.37	**0.098**	*7*	*7*
	BWS_14	0.57	**0.14**	*7*	*7*
	BWS_15	0.90	**0.16**	*7*	*7*
	BWS_16	1.0	**0.14**	*8*	*8*
	BWS_17	0.58	**0.13**	*8*	*6*
	BWS_18	0.84	**0.11**	*8*	*8*
	BWS_19	0.99	**0.15**	*8*	*8*
	BWS_20	1.3	**0.14**	*8*	*8*
Large Backwaters (> 2 acres)	BWL_01	2.1	**0.18**	*4*	*4*
	BWL_02	5.5	**0.17**	*6*	*6*
	BWL_03	2.4	**0.14**	*7*	*7*
	BWL_04	2.1	**0.15**	*8*	*8*
	BWL_05	12	**0.19**	*8*	*8*
	BWL_07	22	**0.22**	*9*	*9*
	BWL_08	4.1	**0.18**	*9*	*9*
	BWL_09	7.0	**0.18**	*10*	*9*
	BWL_10	6.4	**0.21**	*10*	*10*
	BWL_11	4.6	**0.023**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-67. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 9), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Warmwater fish protection			**1.2**	**1.1**	**0.71**	**1.6**	**0.64**	**1.6**	**0.82**	**0.75**	**2.9**	**0.84**	**1.7**	**0.84**	**1.5**	**0.91**
Coldwater fish protection - trout below PSA								**3.2**	**1.6**	**1.5**	**5.7**	**1.7**	**3.5**	**1.7**	**2.9**	
Threatened and endangered species (represented by bald eagle)			**0.65**	**0.49**	**0.40**	**0.66**	**0.28**	**1.2**	**0.63**	**0.28**	**2.9**	**0.31**	**1.4**	**0.39**	**1.1**	**0.47**
Piscivorous birds (represented by osprey)			**0.71**	**0.54**	**0.44**	**0.83**	**0.40**	**1.1**	**0.63**	**0.33**	**2.4**	**0.36**	**1.2**	**0.42**	**1.0**	**0.49**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*4*	*6*	*6*	*9*	*7*	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*13*	*13*	*14*	*14*	*13*	*13*	*13*	*12*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*5*	*7*	*8*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*9*	*10*	*11*	*12*	*13*	*13*	*13*	*13*	*15*	*12*	*12*	*13*	*12*	*15*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(grey) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-68. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 9), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**0.24**	*1*	*1*	*1*
	KM 2	**0.22**	*2*	*2*	*1*
	KM 3	**0.17**	*2*	*2*	*2*
	KM 4	**0.17**	*3*	*3*	*3*
	KM 5	**0.16**	*4*	*4*	*4*
Reach 5B	KM 6	**0.11**	*5*	*5*	*5*
	KM 7	**0.092**	*6*	*5*	*5*
	KM 8	**0.12**	*7*	*7*	*7*
Reaches 5C/5D	KM 9	**0.14**	*8*	*7*	*7*
	KM 10	**0.17**	*8*	*8*	*8*
	KM 11	**0.18**	*10*	*10*	*9*
Reach 6	KM 12	**0.16**	*12*	*11*	*11*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**0.16**	*6*	*5*	*4*
Reaches 5C/5D/6	**0.16**	*11*	*11*	*10*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(blue)	= model prediction is lower than the target value
(white)	= model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-71. Sediment IMPGs for human direct contact compared to projected sediment PCBs (SED 10), including the time to achieve in years (*in italics*).

Risk Category	Receptor	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average 0-6" Sediment PCB Concentration (mg/kg)[1]							
					SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	SA 8
					7.0	16	11	3.4	4.1	1.2	7.6	3.0
Human Direct Contact	Older Child	RME	10^{-6} Cancer	4.5	*153*	*> 250*	*140*	*0*	*0*	*0*	*52*	*0*
			10^{-5} Cancer	45	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	453	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	31	*0*	*0*	*5*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	36	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	365	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	3645	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	125	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Adult	RME	10^{-6} Cancer	1.3	*> 250*	*> 250*	*> 250*	*> 250*	*> 250*	*37*	*> 250*	*> 250*
			10^{-5} Cancer	13	*2*	*83*	*37*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	135	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	40	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
		CTE	10^{-6} Cancer	28	*0*	*0*	*5*	*0*	*0*	*0*	*0*	*0*
			10^{-5} Cancer	280	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			10^{-4} Cancer	2800	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
			Non-Cancer	152	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Notes

[1] Model endpoint concentrations after 52-year projection
CTE = central tendency exposure
RME = reasonable maximum exposure
IMPG = interim media protection goal
SA = EPA Risk Assessment Sediment Exposure Areas
- SA 1: Confluence to New Lenox Road
- SA 2: New Lenox Road to Woods Pond Headwaters
- SA 3: Woods Pond (6-meters from waters edge)
- SA 4: Columbia Mill Dam impoundment (6-meters from waters edge)
- SA 5: Former Eagle Mill Dam impoundment (6-meters from waters edge)
- SA 6: Willow Mill Dam impoundment (6-meters from waters edge)
- SA 7: Glendale Dam impoundment (6-meters from waters edge)
- SA 8: Rising Pond impoundment (6-meters from waters edge)

Key

[blue box] = model prediction is lower than the IMPG
[white box] = model prediction exceeds the IMPG
<value> = time to achieve predicted by the model
<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-72. IMPGs for human consumption of fish tissue compared to projected fillet-based fish PCBs (SED 10), including the time to achieve in years (*in italics*).

Tissue Type	Assessment Type	Exposure Assumptions	Risk Level	IMPG (mg/kg)	Average Fish Tissue (Fillet) PCB Concentration (mg/kg) [1]																	
					Reach 5A	**Reach 5B**	**Reach 5C**	**Reach 5D**	**Reach 6**	**Reach 7A**	**Reach 7B**	**Reach 7C**	**Reach 7D**	**Reach 7E**	**Reach 7F**	**Reach 7G**	**Reach 7H**	**Reach 8**	**BBD**	**LL**	**LZ**	**LH**
					4.2	**6.6**	**5.8**	**11**	**3.7**	**4.2**	**4.2**	**4.4**	**3.7**	**2.8**	**2.2**	**2.6**	**1.9**	**2.7**	**0.1**	**0.08**	**0.05**	**0.05**
Bass Fillets	Deterministic	RME	10^{-6} Cancer	0.0019	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250
			10^{-5} Cancer	0.019	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	246	207	167	162
			10^{-4} Cancer	0.19	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	17	9	6	4
			Non-Cancer -- Child	0.026	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	210	171	131	126
			Non-Cancer -- Adult	0.062	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	111	72	27	26
		CTE	10^{-6} Cancer	0.049	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	138	99	58	54
			10^{-5} Cancer	0.49	205	> 250	> 250	> 250	209	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	0	0	0	0
			10^{-4} Cancer	4.9	36	81	69	108	25	26	26	36	11	9	8	8	6	8	0	0	0	0
			Non-Cancer -- Child	0.19	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	17	9	6	4
			Non-Cancer -- Adult	0.43	214	> 250	> 250	> 250	219	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	0	0	0	0
	Probabilistic	RME (5th percentile)	10^{-6} Cancer	0.0064	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250
			10^{-5} Cancer	0.064	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	107	68	27	26
			10^{-4} Cancer	0.64	186	> 250	> 250	239	189	235	> 250	> 250	> 250	224	> 250	> 250	> 250	> 250	0	0	0	0
			Non-Cancer -- Child	0.059	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	116	77	41	37
			Non-Cancer -- Adult	0.12	> 250	> 250	500	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	17	9	6	4
		CTE (50th percentile)	10^{-6} Cancer	0.057	> 250	> 250	> 250	> 250	198	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	120	81	41	37
			10^{-5} Cancer	0.57	194	> 250	> 250	341	52	246	> 250	> 250	> 250	> 250	> 250	> 250	> 250	> 250	0	0	0	0
			10^{-4} Cancer	5.7	26	65	54	122	10	11	11	12	9	8	7	7	3	6	0	0	0	0
			Non-Cancer -- Child	0.71	179	> 250	> 250	320	180	225	> 250	> 250	> 250	212	236	> 250	> 250	> 250	0	0	0	0
			Non-Cancer -- Adult	1.5	125	203	193	249	122	152	193	177	180	124	113	158	99	182	0	0	0	0

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average); whole body concentrations divided by a factor of 5.0 to convert to fillet basis

CTE = central tendency exposure

RME = reasonable maximum exposure

BBD: Bulls Bridge Dam Impoundment

LL: Lake Lillinonah

LZ: Lake Zoar

LH: Lake Housatonic

Key

= model prediction is lower than the IMPG

= model prediction is lower than the cancer IMPG, but is not lower than the corresponding non-cancer IMPGs

= model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-73. Sediment IMPGs for benthic invertebrates compared to projected sediment PCBs (SED 10), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg) Lower End of Range	IMPG (mg/kg) Upper End of Range
			3	10
5A	R5A_01	**3.3**	*IT*	*2*
	R5A_02	**0.92**	*1*	*1*
	R5A_03	**4.8**	*59*	*36*
	R5A_04	**27**	*>250*	*>250*
	R5A_05	**1.1**	*1*	*1*
	R5A_06	**2.3**	*2*	*1*
	R5A_07	**0.77**	*2*	*2*
	R5A_08	**14**	*245*	*98*
	R5A_09	**9.9**	*>250*	*51*
	R5A_10	**17**	*IT*	*IT*
	R5A_11	**0.95**	*4*	*3*
5B	R5B_01	**9.8**	*>250*	*45*
	R5B_02	**6.9**	*IT*	*0*
	R5B_03	**4.4**	*244*	*0*
	R5B_04	**5.3**	*245*	*0*
	R5B_05	**5.2**	*105*	*0*
5C	R5C_01	**7.1**	*>250*	*1*
	R5C_02	**7.8**	*>250*	*10*
	R5C_03	**4.4**	*103*	*0*
	R5C_04	**5.7**	*123*	*9*
	R5C_05	**37**	*>250*	*>250*
	R5C_06	**27**	*>250*	*171*
6	Woods Pond	**3.7**	*73*	*5*
7A		**0.42**	*0*	*0*
7B		**4.1**	*>250*	*0*
7C		**4.1**	*>250*	*0*
7D		**1.2**	*0*	*0*
7E		**1.2**	*0*	*0*
7F		**0.69**	*0*	*0*
7G		**5.1**	*192*	*0*
7H		**0.40**	*0*	*0*
8	Rising Pond	**2.8**	*26*	*0*

Notes

[1] Exposure areas in Reach 5 represent EPA spatial bins (1/4 to 1/2-mile segments as defined in EPA's Model Validation Report)

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(shaded) = model prediction is lower than the IMPG

(unshaded) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

IT = Increasing trend in model extrapolation; no time-to-achieve estimated.

Table 6-74. Backwater sediment IMPGs for amphibians compared to projected sediment PCBs (SED 10), including the time to achieve in years (*in italics*).

Reach	Exposure Area[1]	Area (acres)	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	IMPG (mg/kg)	
				Lower End of Range	Upper End of Range
				3.27	5.6
Small Backwaters (< 2 acres)	BWS_01	1.9	**5.6**	*114*	*52*
	BWS_02	1.8	**5.6**	*124*	*52*
	BWS_03	1.9	**2.4**	*41*	*30*
	BWS_04	0.30	**22**	*> 250*	*> 250*
	BWS_06	0.56	**1.3**	*20*	*11*
	BWS_07	0.12	**5.4**	*> 250*	*13*
	BWS_08	0.35	**37**	*> 250*	*> 250*
	BWS_09	0.28	**20**	*> 250*	*> 250*
	BWS_10	1.5	**16**	*> 250*	*> 250*
	BWS_11	0.11	**1.3**	*8*	*5*
	BWS_12	1.7	**6.0**	*107*	*59*
	BWS_13	0.37	**10**	*> 250*	*> 250*
	BWS_14	0.57	**9.0**	*> 250*	*> 250*
	BWS_15	0.90	**9.2**	*201*	*124*
	BWS_16	1.0	**2.8**	*46*	*22*
	BWS_17	0.58	**1.6**	*19*	*6*
	BWS_18	0.84	**1.4**	*22*	*11*
	BWS_19	0.99	**21**	*> 250*	*> 250*
	BWS_20	1.3	**6.4**	*130*	*68*
Large Backwaters (> 2 acres)	BWL_01	2.1	**11**	*177*	*123*
	BWL_02	5.5	**5.2**	*87*	*48*
	BWL_03	2.4	**3.3**	*53*	*22*
	BWL_04	2.1	**3.8**	*66*	*31*
	BWL_05	12	**14**	*202*	*147*
	BWL_07	22	**20**	*> 250*	*> 250*
	BWL_08	4.1	**14**	*> 250*	*> 250*
	BWL_09	7.0	**15**	*> 250*	*227*
	BWL_10	6.4	**13**	*> 250*	*226*
	BWL_11	4.6	**2.3**	*0*	*0*

Notes

[1] Exposure areas represent individual backwaters

[2] Model endpoint concentrations after 52-year projection

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-75. IMPGs for fish protection, and consumption of fish and invertebrates by ecological receptors compared to projected biota tissue PCBs (SED 10), including the time to achieve in years (*in italics*).

Ecological Receptor			Average Whole Body Fish Tissue PCB Concentration (mg/kg) [1]													
			Reach 5A	Reach 5B	Reach 5C	Reach 5D	Reach 6	Reach 7A	Reach 7B	Reach 7C	Reach 7D	Reach 7E	Reach 7F	Reach 7G	Reach 7H	Reach 8
Warmwater fish protection			**16**	**25**	**22**	**41**	**14**	**16**	**16**	**17**	**14**	**11**	**8.5**	**9.9**	**7.4**	**10**
Coldwater fish protection - trout below PSA								**32**	**32**	**33**	**29**	**22**	**17**	**20**	**15**	
Threatened and endangered species (represented by bald eagle)			**13**	**19**	**21**	**21**	**6.8**	**6.2**	**13**	**8.2**	**7.4**	**4.6**	**3.9**	**5.7**	**3.2**	**6.4**
Piscivorous birds (represented by osprey)			**11**	**17**	**20**	**24**	**9.1**	**7.2**	**13**	**8.6**	**7.7**	**5.1**	**4.2**	**5.7**	**3.5**	**6.3**
Ecological Receptor	**Tissue Type**	**IMPG (mg/kg)**														
Fish protection	Warmwater fish tissue (whole body)	55	*3*	*4*	*0*	*36*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Coldwater fish tissue (whole body) - Trout Below PSA	14						*137*	*174*	*159*	*159*	*104*	*83*	*122*	*61*	
Threatened and endangered species (represented by bald eagle)	Fish tissue (whole body)	30.41	*3*	*4*	*7*	*35*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Piscivorous birds (represented by osprey)	Fish tissue (whole body)	3.2	*173*	*> 250*	*> 250*	*199*	*146*	*150*	*> 250*	*210*	*248*	*112*	*103*	*189*	*78*	*243*

Notes

[1] Model endpoint concentrations after 52-year projection (autumn average)

IMPG = interim media protection goal

Key

(blue) = model prediction is lower than the IMPG

(white) = model prediction exceeds the IMPG

(gray) = IMPG not applicable

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

Table 6-76. Sediment IMPGs for insectivorous birds and piscivorous mammals compared to projected sediment PCBs (SED 10), including the time to achieve in years (*in italics*).

Insectivorous Birds (wood duck)

Reach	Exposure Area[1]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
			1	3	5
Reach 5A	KM 1	**2.8**	*165*	*49*	*26*
	KM 2	**7.1**	*140*	*91*	*68*
	KM 3	**7.9**	*> 250*	*> 250*	*206*
	KM 4	**15**	*IT*	*IT*	*IT*
	KM 5	**0.74**	*4*	*3*	*3*
Reach 5B	KM 6	**8.3**	*> 250*	*> 250*	*159*
	KM 7	**5.5**	*> 250*	*> 250*	*134*
	KM 8	**7.0**	*> 250*	*169*	*98*
Reaches 5C/5D	KM 9	**6.7**	*> 250*	*183*	*101*
	KM 10	**18**	*> 250*	*> 250*	*> 250*
	KM 11	**20**	*> 250*	*> 250*	*> 250*
Reach 6	KM 12	**8.5**	*> 250*	*156*	*105*

Pisciviorous Mammals (mink)

Exposure Area[4]	Average 0-6" Sediment PCB Concentration (mg/kg)[2]	Sediment Target Level (mg/kg)[3]		
		1	3	5
Reaches 5A/5B	**6.9**	*> 250*	*199*	*109*
Reaches 5C/5D/6	**13**	*> 250*	*> 250*	*195*

Notes

[1] Exposure areas for wood ducks represent approximate 1 kilometer segments of the river channel

[2] Model endpoint concentrations after 52-year projection

[3] Sediment target levels have corresponding floodplain soil IMPGs due to mixture of aquatic and terrestrial diets for these receptors

[4] Exposure areas represent entire river reach

IMPG = interim media protection goal

Key

(shaded) = model prediction is lower than the target value

(unshaded) = model prediction exceeds the target value

<value> = time to achieve predicted by the model

<value> = time to achieve based on highly uncertain extrapolation of the model results as described in Section 3.2.1 of the Revised CMS Report

IT = Increasing trend in model extrapolation; no time-to-achieve estimated.

Section 6 Figures

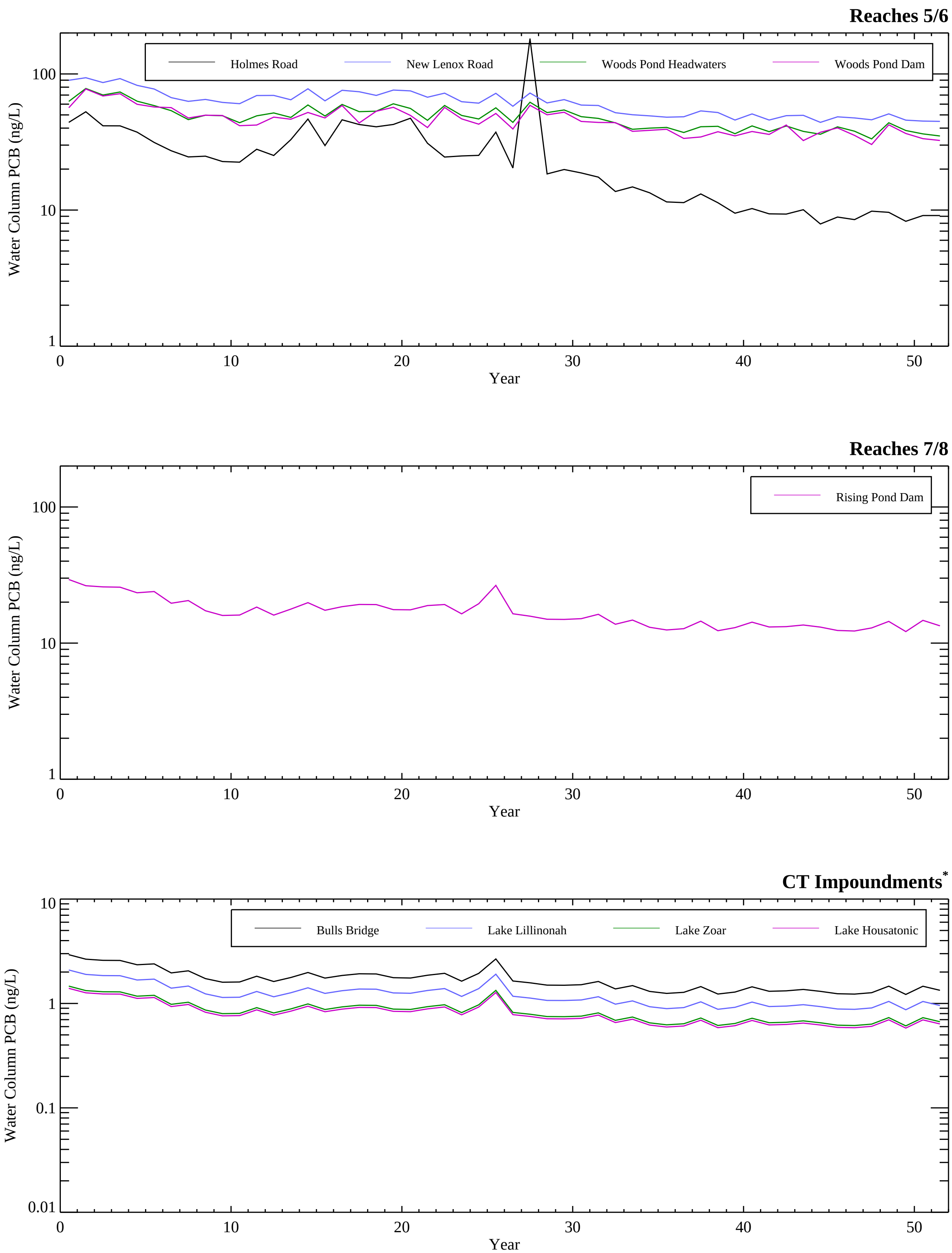

Figure 6-1a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 1 / SED 2.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\bins
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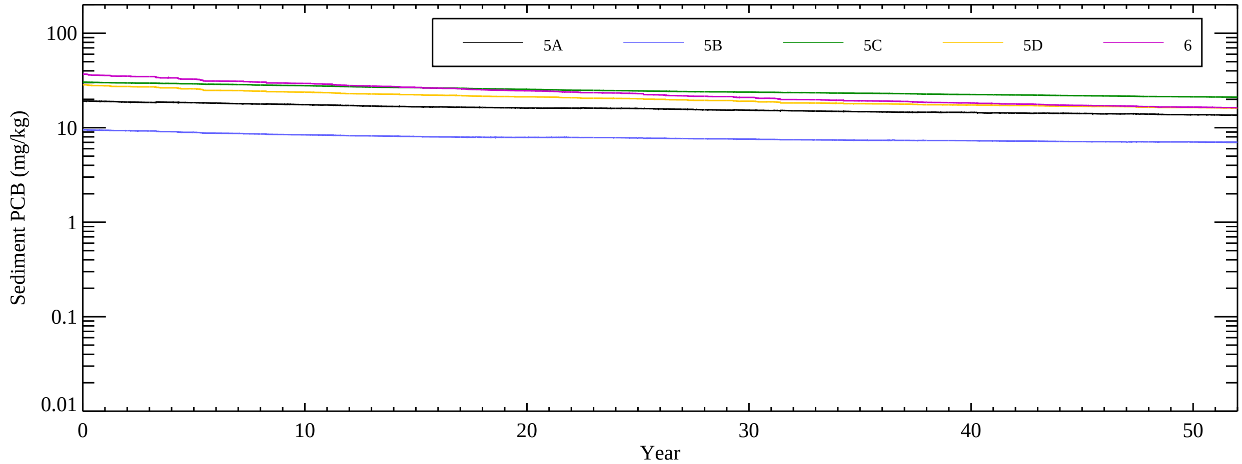
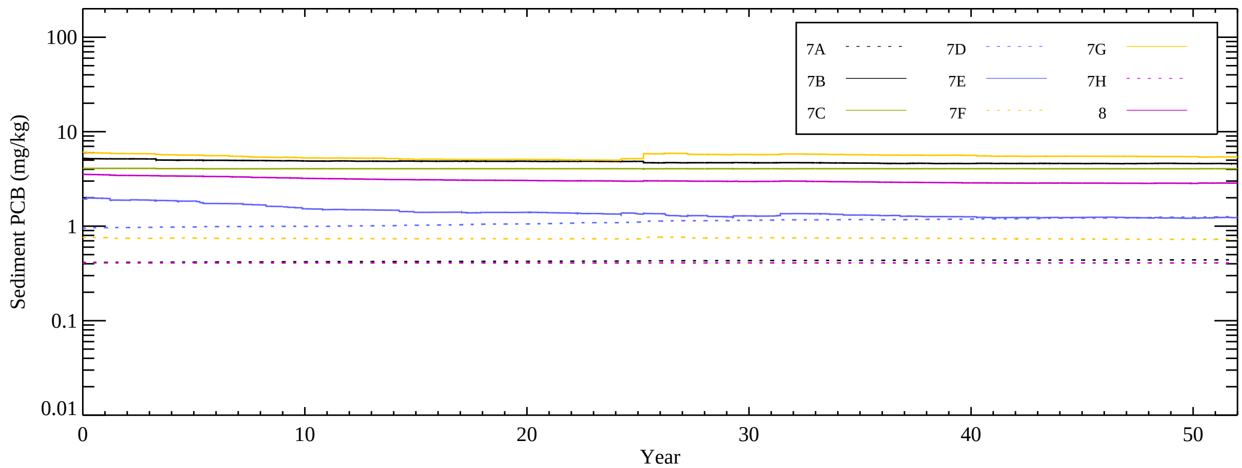
Reaches 5/6



Reaches 7/8



CT Impoundments[*]

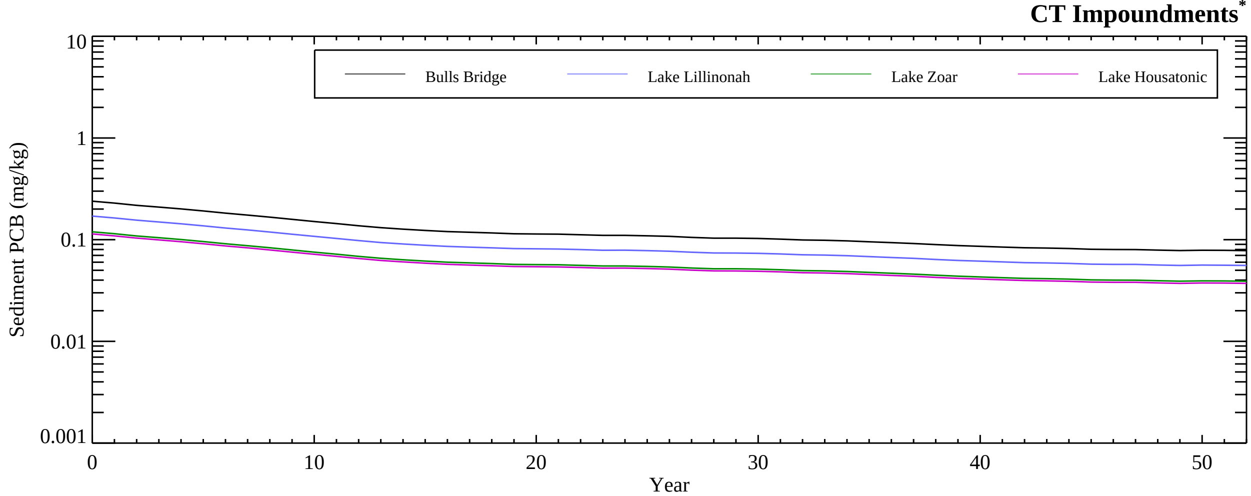


Figure 6-1b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 1 / SED 2.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED1CMSBS_0712-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED1CMSBS_0712-28\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED01_0712-28_base

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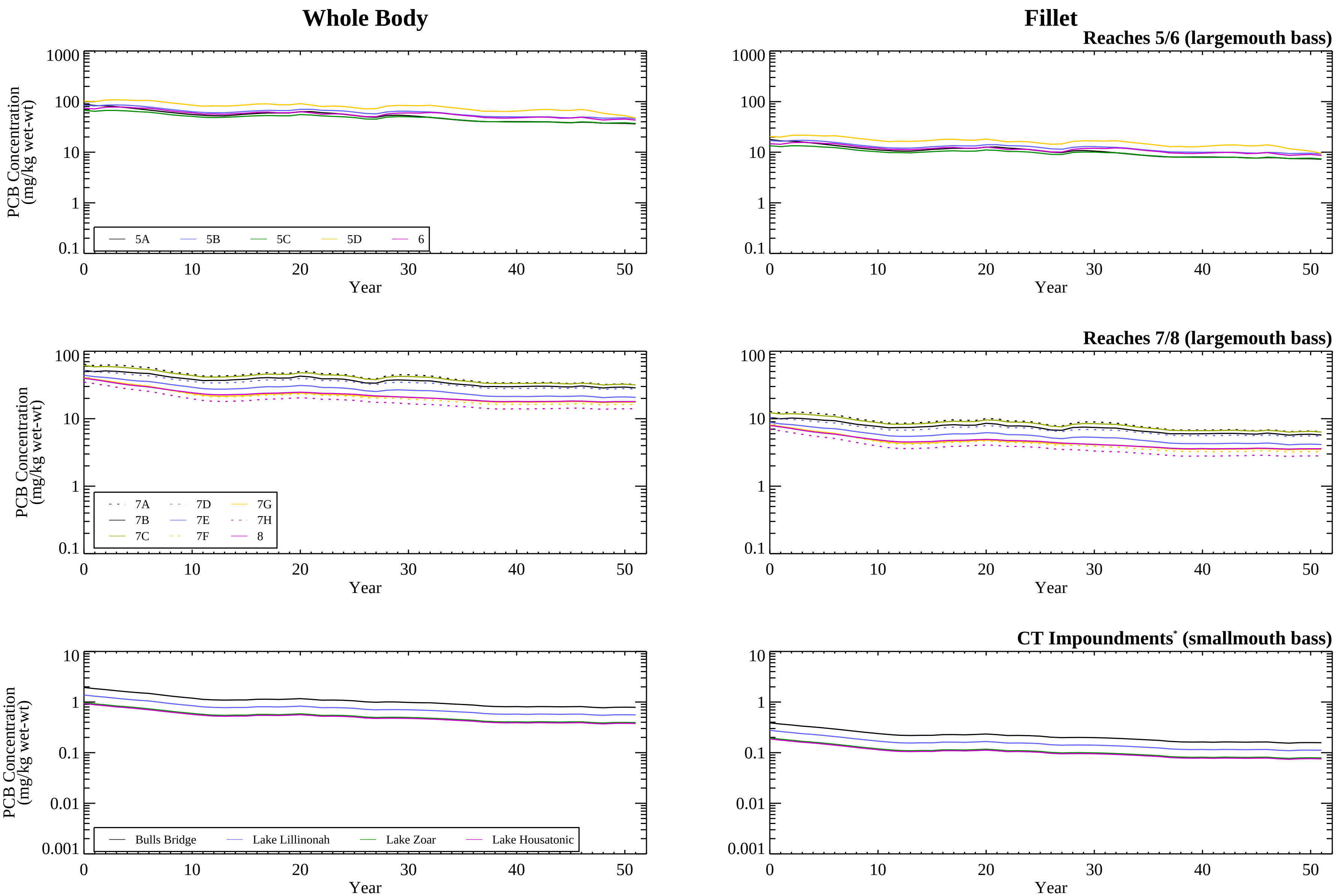

Figure 6-1c. Average PCB concentration in gamefish by subreach under SED 1 / SED2.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

DR - H:\GENcms\DOCUMENTS\reports\Revised_CMS_Report\Figures\Section 6\cms_alternatives_PSA_CT.pro
Wed Oct 06 09:20:13 2010

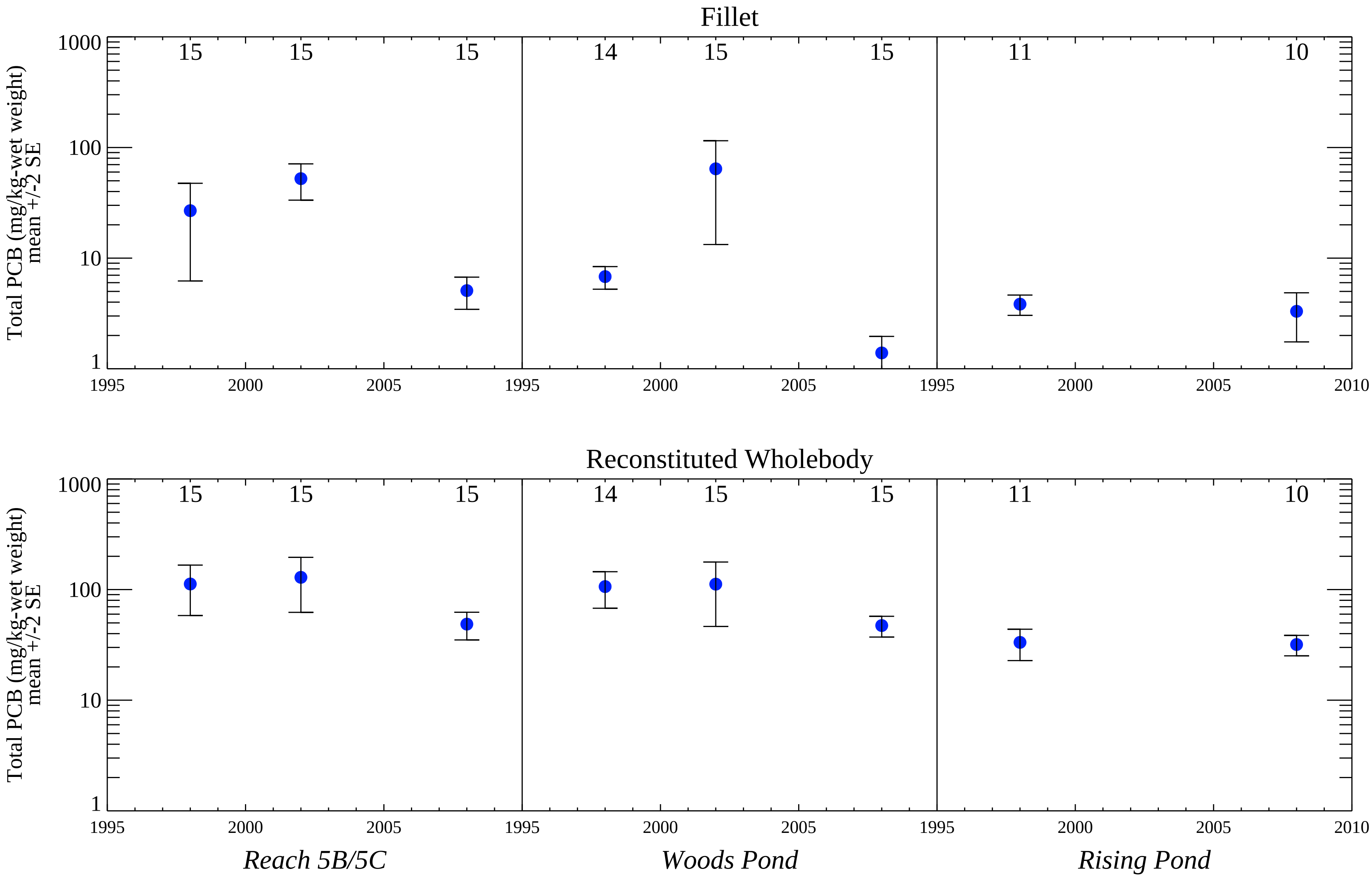

Figure 6-2a. Temporal and spatial trends in PCB concentrations of adult largemouth bass from the Housatonic River (wet weight).
Data: GE,EPA; mean (sum of aroclors or congeners) +/- 2SE, total number of samples for each group posted at top of each panel.
GE Splits were averaged. The re-analyzed fish sample extract (WP-ADULT-LB-13 F-RE) was averaged with its original result.

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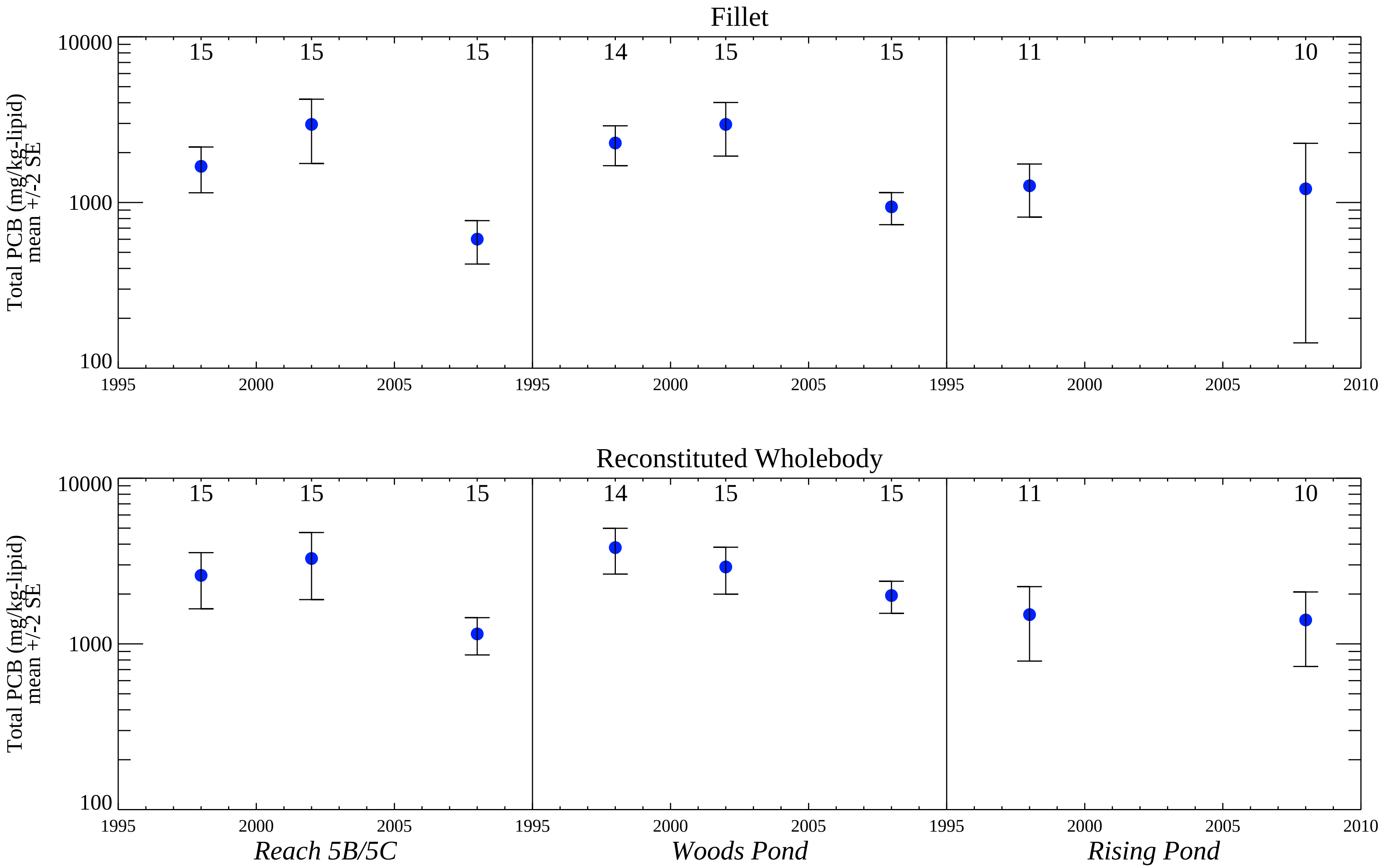

Figure 6-2b. Temporal and spatial trends in PCB concentrations of adult largemouth bass from the Housatonic River (lipid-normalized)

Data: GE,EPA; mean (sum of aroclors or congeners) +/- 2SE, total number of samples for each group posted at top of each panel.
GE Splits were averaged. The re-analyzed fish sample extract (WP-ADULT-LB-13 F-RE) was averaged with its original result.

DR - H:\GENcms\DOCUMENTS\reports\Revised_CMS_Report\Figures\Section 6\LMB_spatial_temporal_incl_2008_data_and_1998_2002_lipid_normalized.pro
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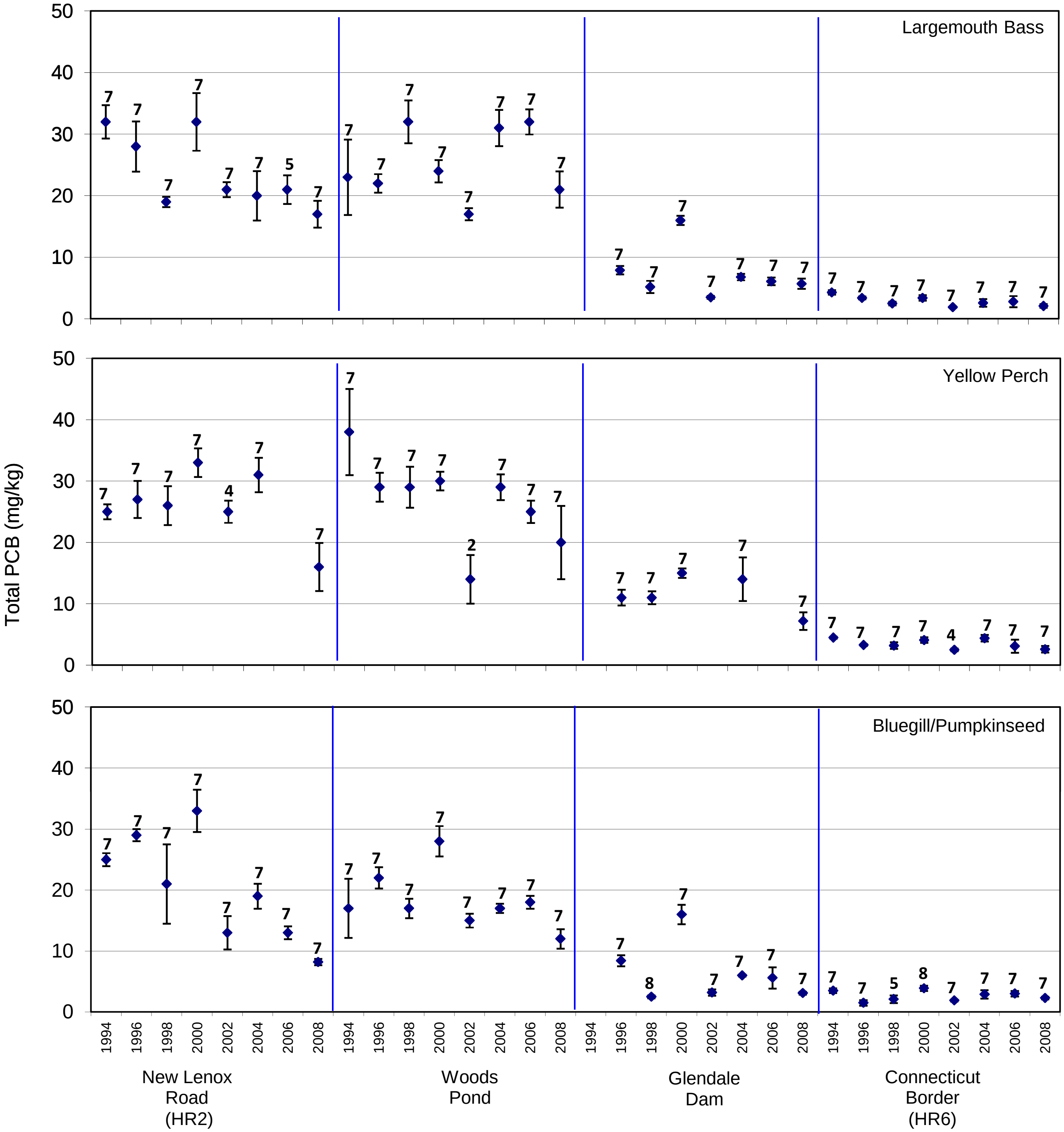
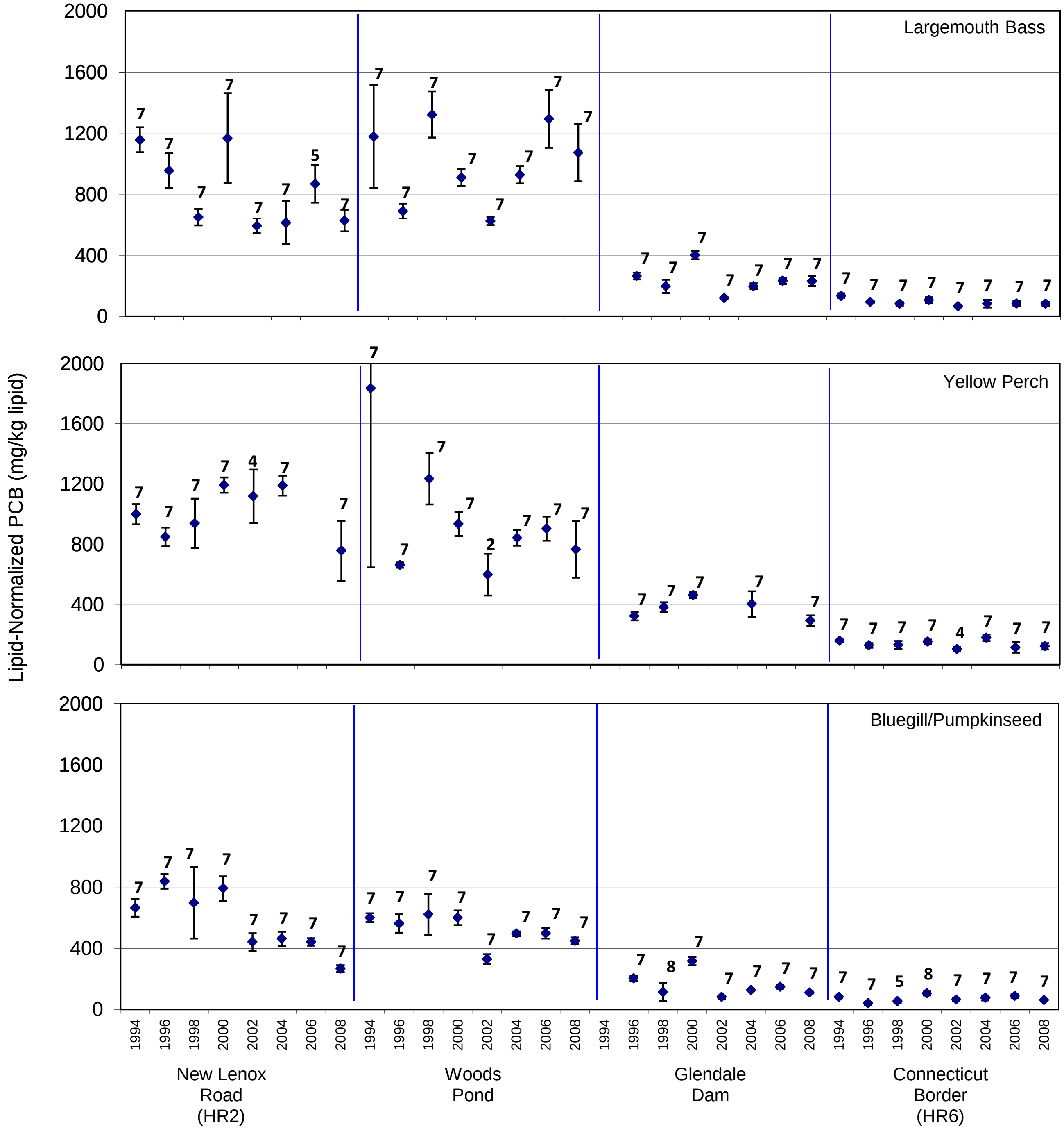


General Electric Company
Housatonic River
Revised CMS Report

TEMPORAL AND SPATIAL DISTRIBUTION OF MEAN PCB LEVELS IN YOUNG-OF-YEAR FISH TISSUE (WET-WEIGHT)

FIGURE 6-3a

Notes:
1. PCB - polychlorinated biphenyl
2. mg/kg = milligram/kilogram
3. Presents all young-of-year data collected by ARCADIS in 1994, 1996, 1998, 2000, 2002, 2004, 2006 and 2008.
4. Arithmetic means. Error bars represent +/- 2 standard errors. Number of samples is indicated.



Notes:
1. PCB - polychlorinated biphenyl
2. mg/kg-lipid = milligram/kilogram-lipid
3. Presents all young-of-year data collected by ARCADIS in 1994, 1996, 1998, 2000, 2002, 2004, 2006 and 2008.
4. Arithmetic means. Error bars represent +/- 2 standard errors.
5. Lipid-normalized mean concentration determined by dividing the total PCB concentration (in mg/kg) for each sample in the data set by the sample's associated lipid content (in kg/lipid/kg wet-weight) multiplied by 100, and calculating the arithmetic mean of those values.

General Electric Company
Housatonic River
Revised CMS Report

TEMPORAL AND SPATIAL DISTRIBUTION OF MEAN PCB LEVELS IN YOUNG-OF-YEAR FISH TISSUE (LIPID-NORMALIZED)

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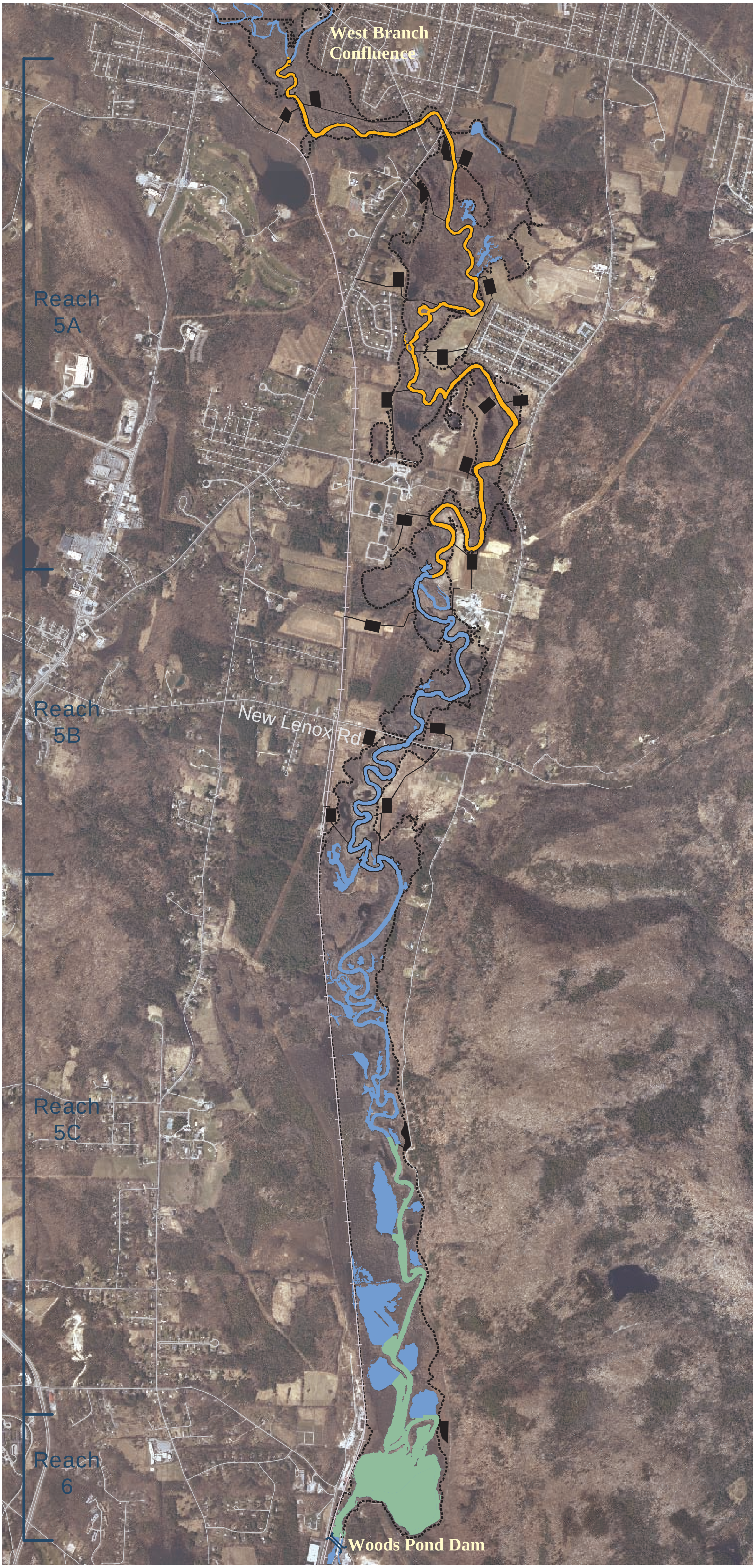
FIGURE 6-3b



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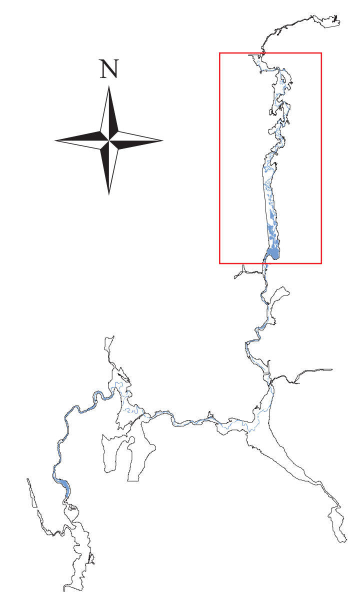

SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 2 ft
- Thin-layer Capping
- Access Road/ Staging Area

SED 3 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-4.

Sediment Alternative 3 (SED 3) in Reaches 5 and 6.

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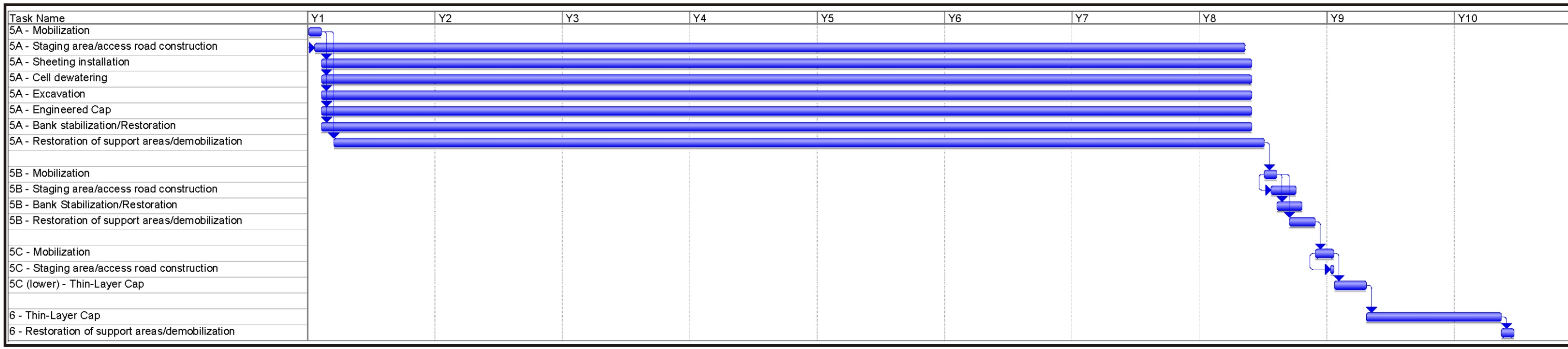

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, capping, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. Y = Year .

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CONSTRUCTION TIMELINE FOR SED 3

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FIGURE
6-5

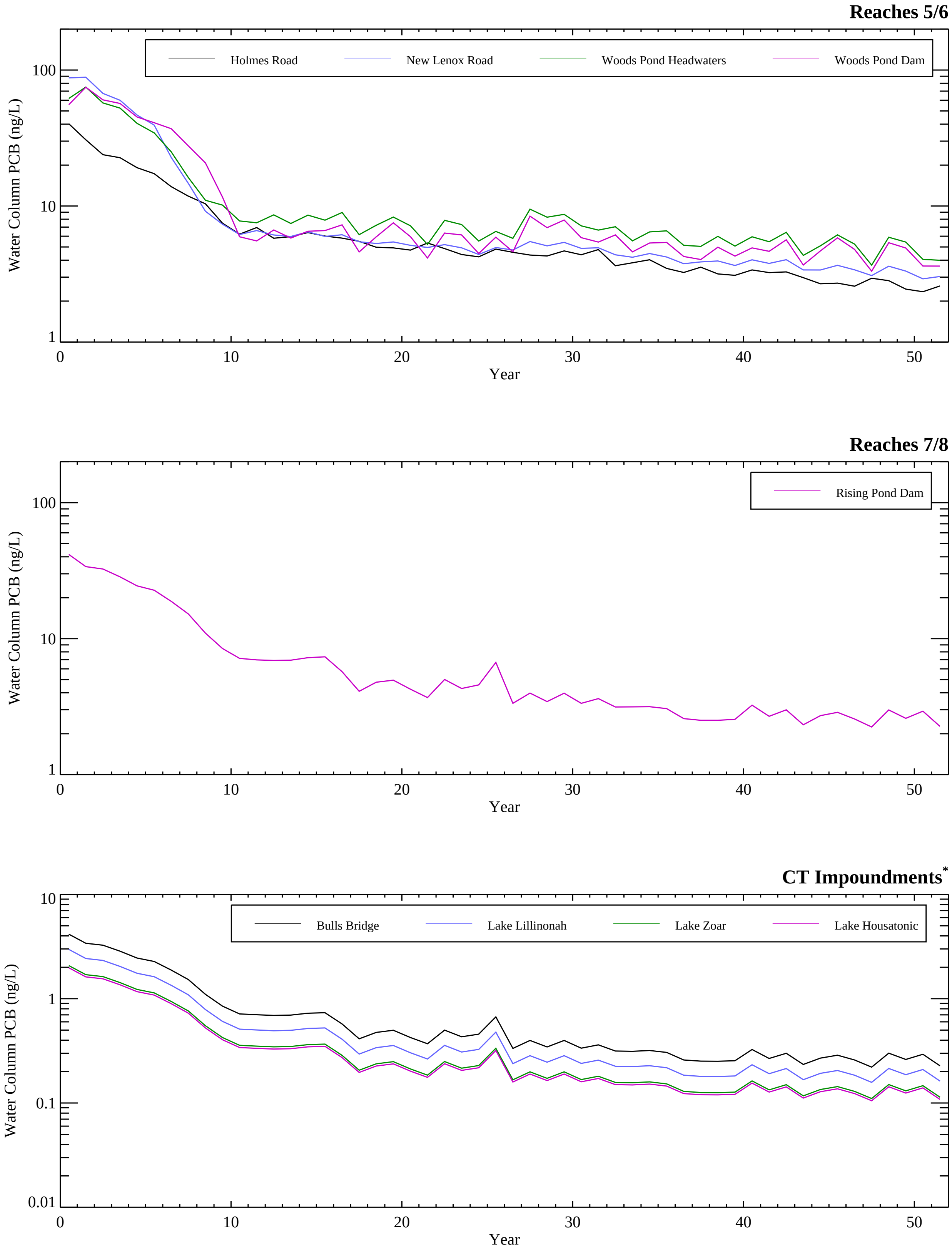

Figure 6-6a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 3.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-29_base\wchem_total

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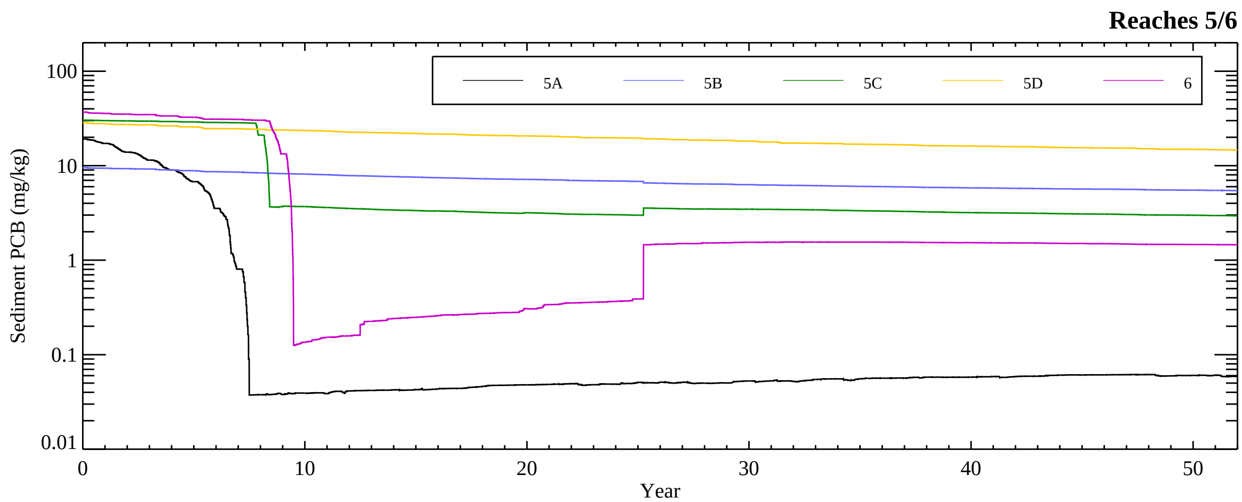

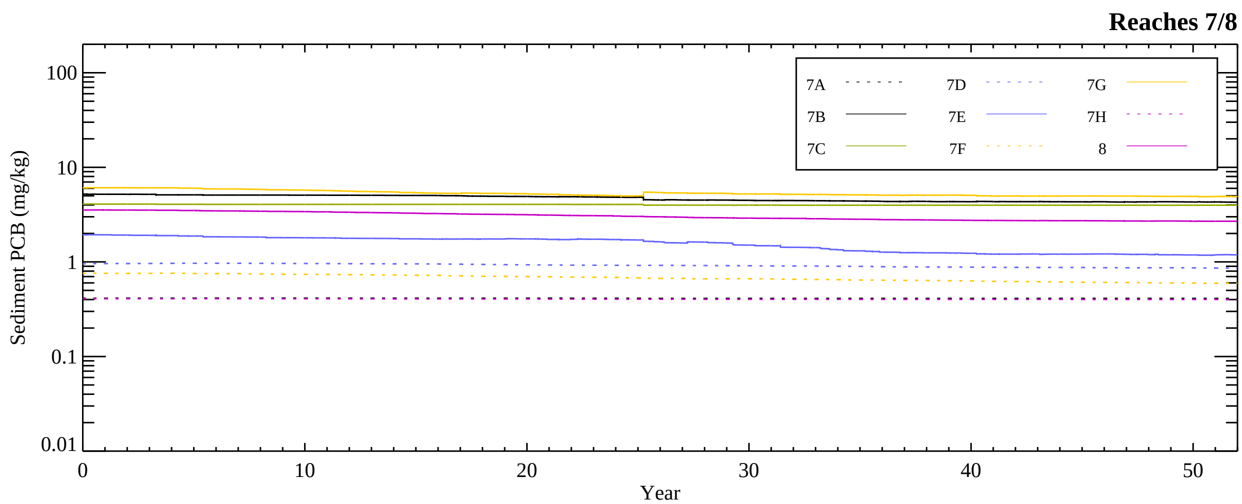

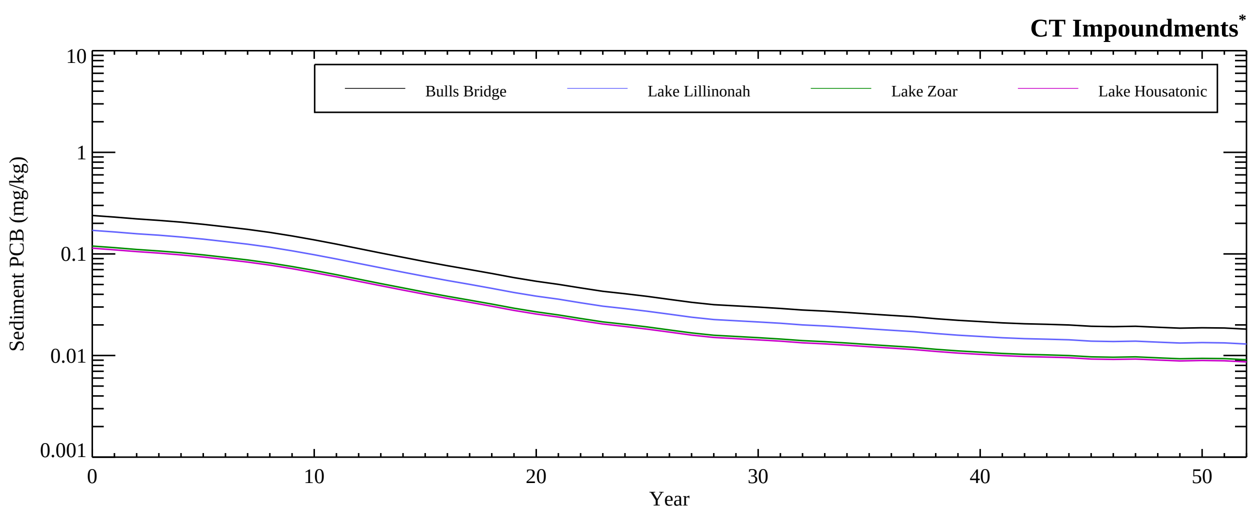

Figure 6-6b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 3.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED3CMSBS_0712-13\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED3CMSBS_0712-29\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED03_0712-29_base

wk/if/rrm - H:\GENcms\MODEL\EPA_EFDC\Post_Processors\Summary\Temporal_bedPCBs_100830_fig6.pro
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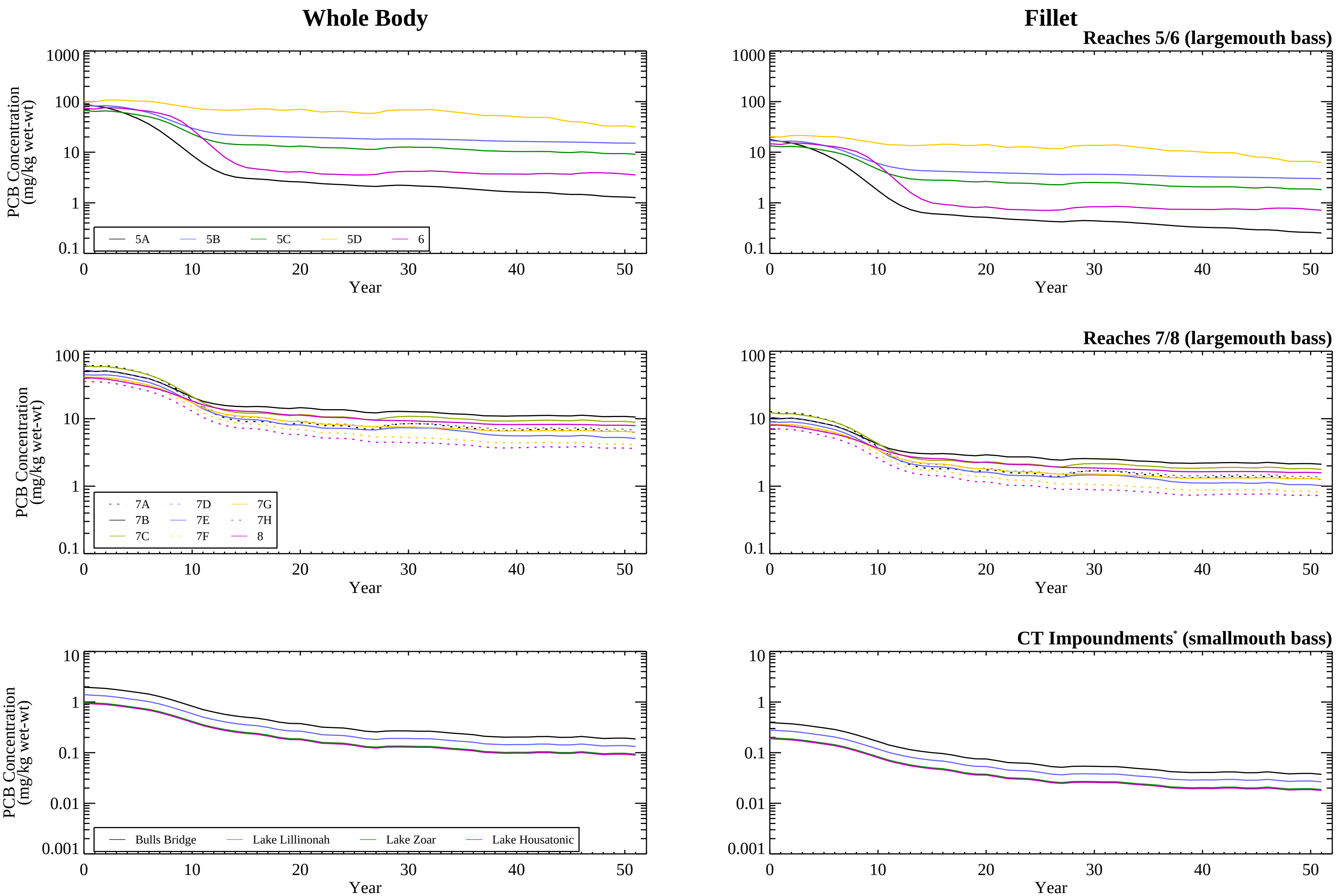

Figure 6-6c. Average PCB concentration in gamefish by subreach under SED 3.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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PITTSFIELD, MASSACHUSETTS

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AERIAL IMAGE OF HOUSATONIC RIVER PRIMARY STUDY AREA DOWNSTREAM OF NEW LENOX ROAD

ARCADIS

FIGURE

6-7

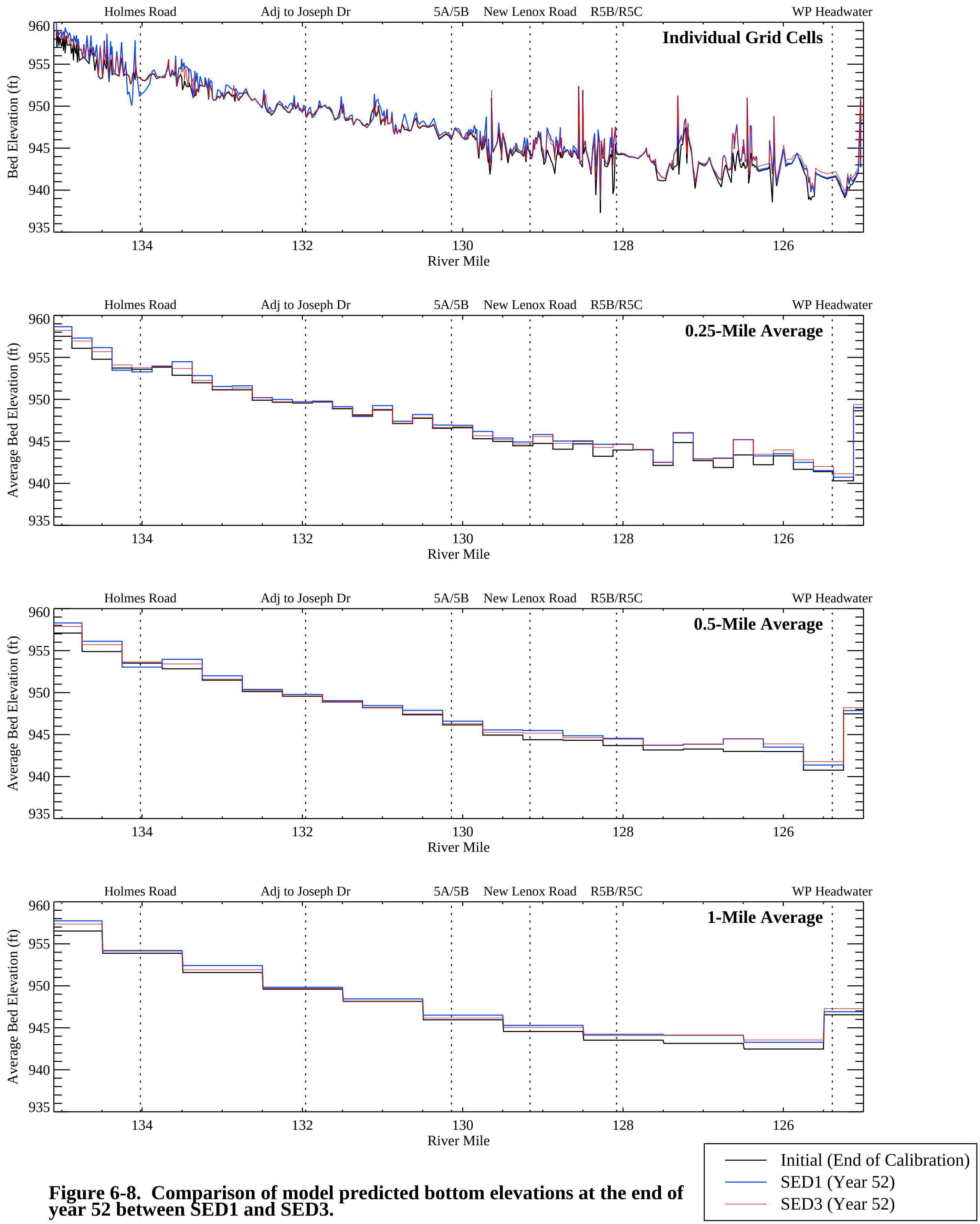

Figure 6-8. Comparison of model predicted bottom elevations at the end of year 52 between SED1 and SED3.

SED1: Z:\GENcms\MODEL\EPA_EFDC\Results\R56\Proj_R56_SED1CMSBS_0712-01\Run_2056\DXDY.INP.RESTART
SED3: Z:\GENcms\MODEL\EPA_EFDC\Results\R56\Proj_R56_SED3CMSBS_0712-13\Run_2056\DXDY.INP.RESTART

wk - Z:\GENcms\MODEL\analysis\Comp_elevation_change_SEDs\Comp_BathyChange_v2.pro
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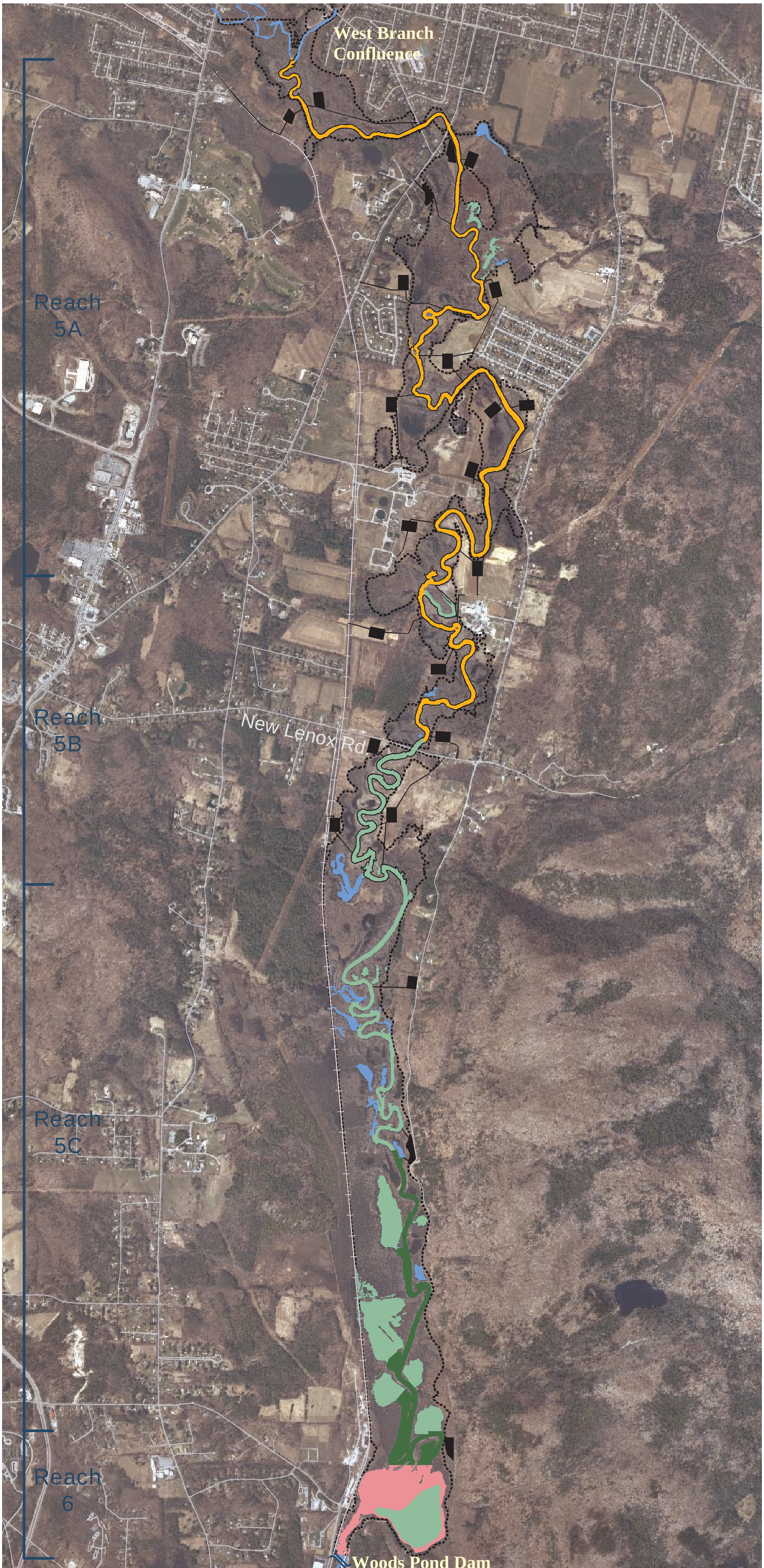

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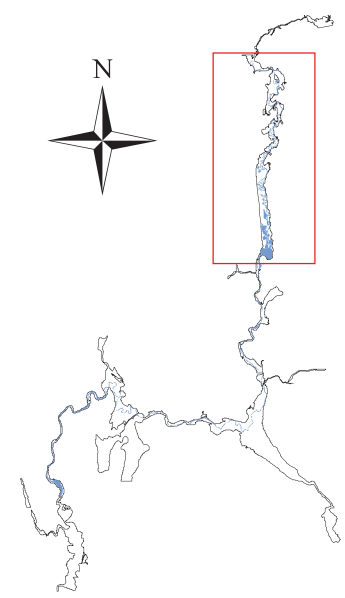

SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1.5 ft
- Removal of Top 2 ft
- Engineered Capping Only
- Thin Layer Capping
- Access Road/ Staging Area

SED 4 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-9.

Sediment Alternative 4 (SED 4) in Reaches 5 and 6.

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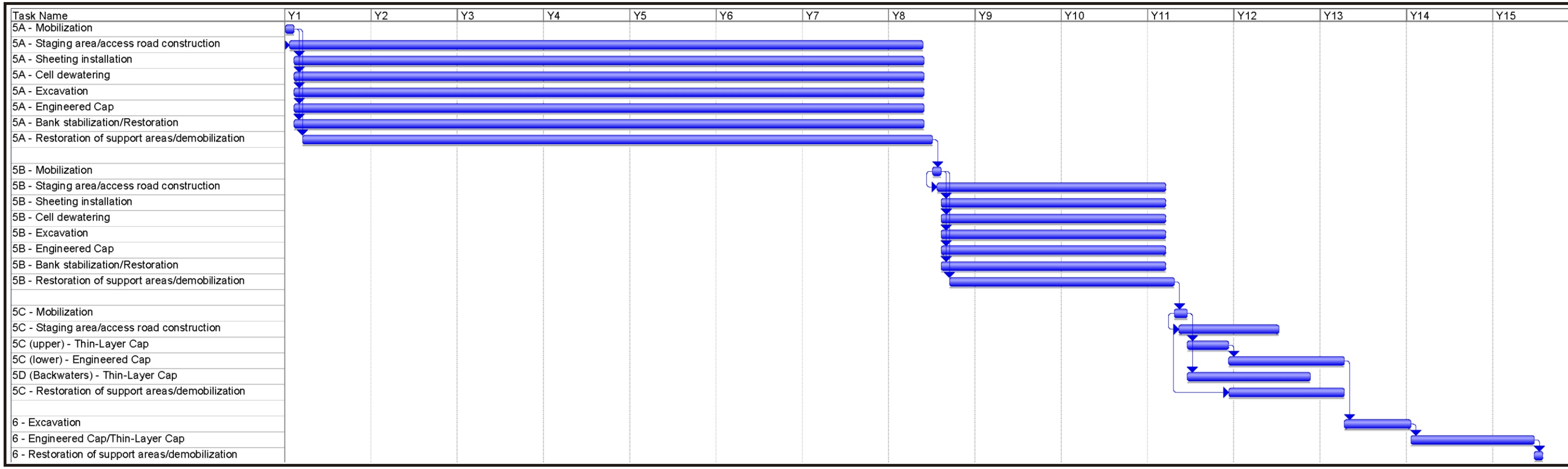

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, capping, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. Y = Year.

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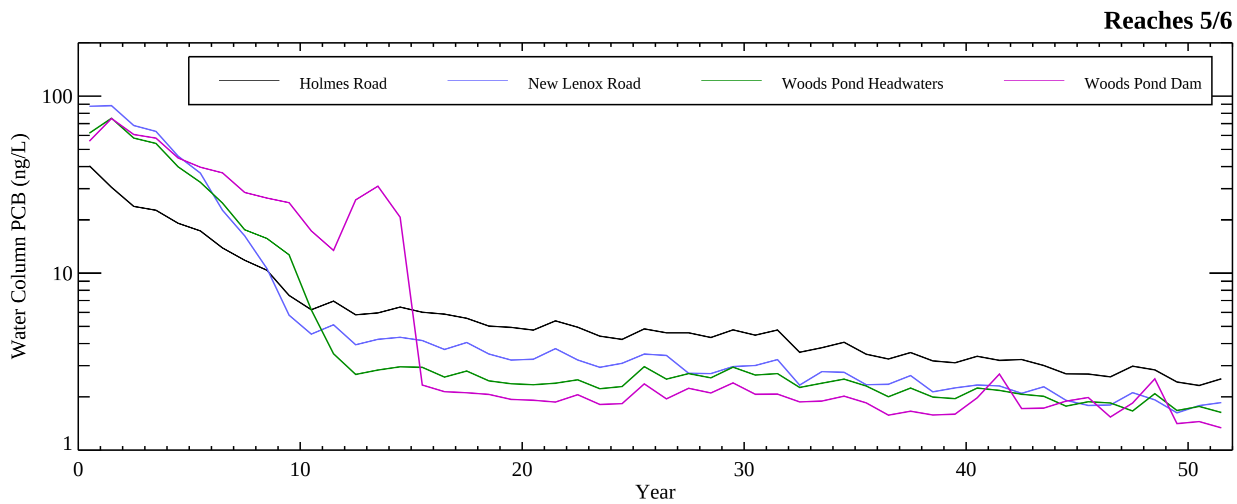
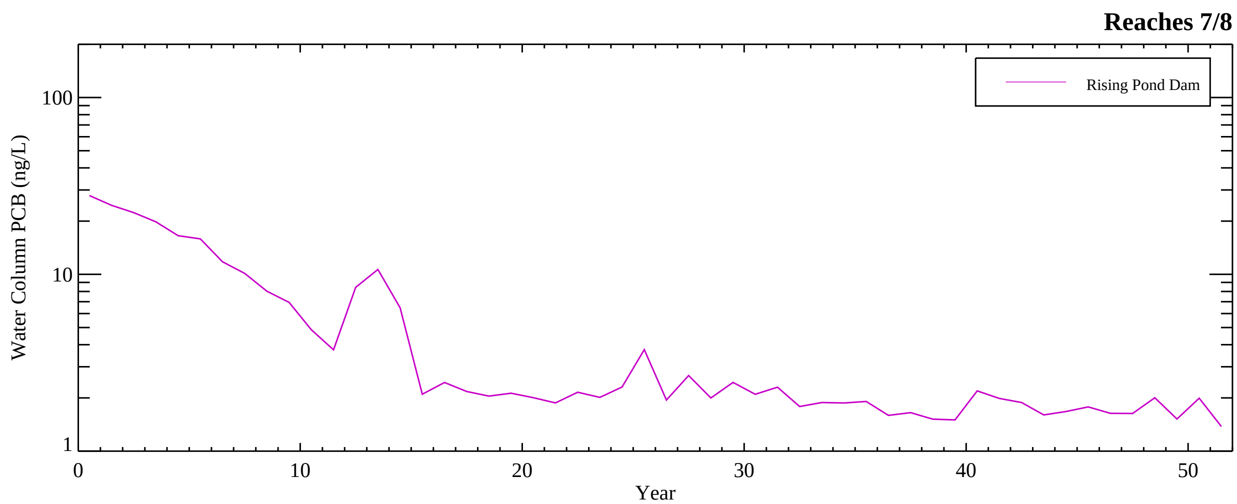
CONSTRUCTION TIMELINE FOR SED 4

ARCADIS

FIGURE
6-10





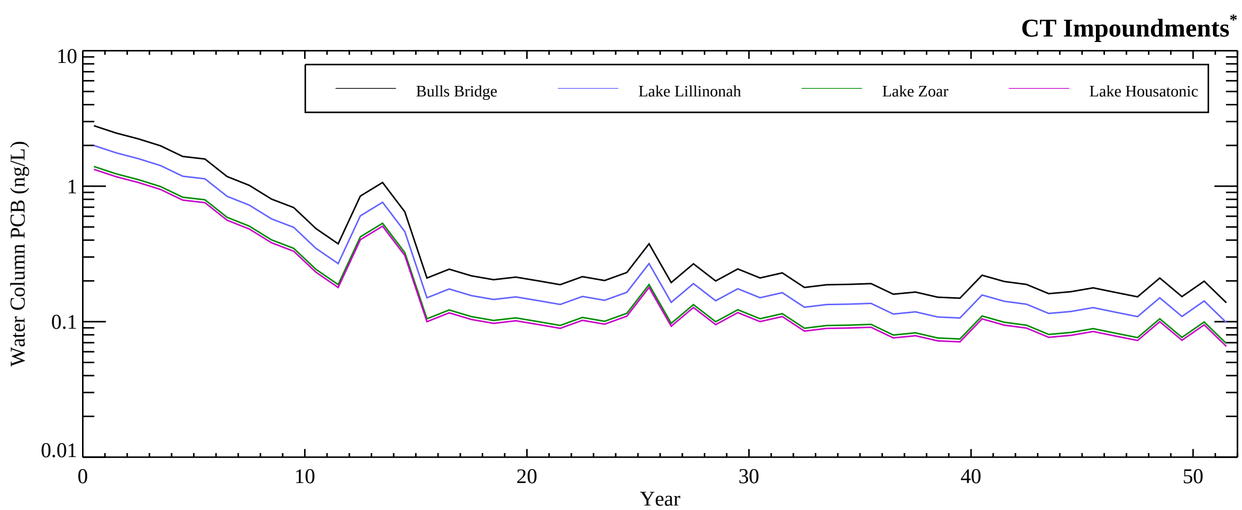


Figure 6-11a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 4.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-01_base\wchem_total

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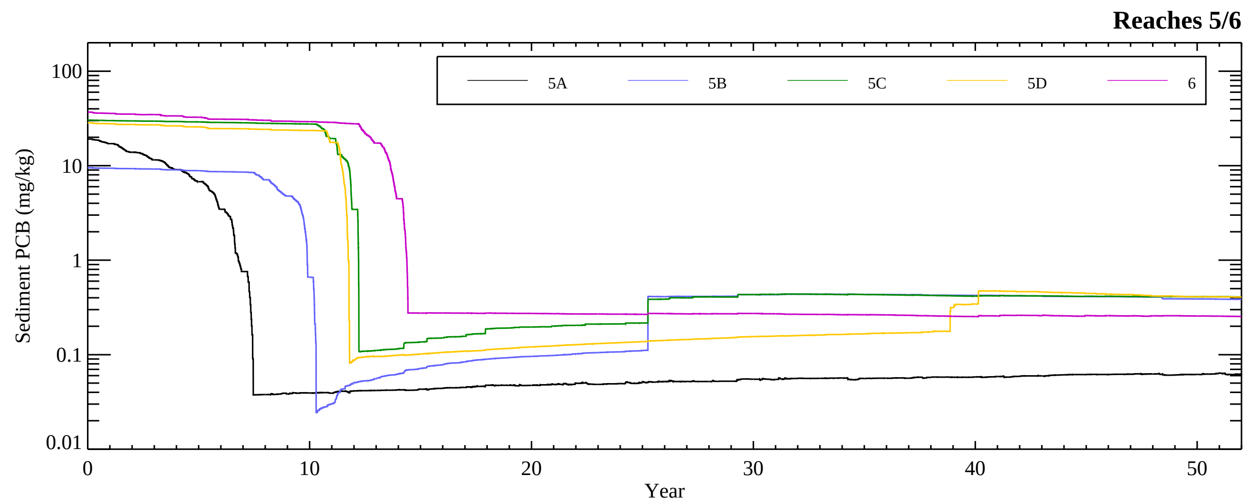

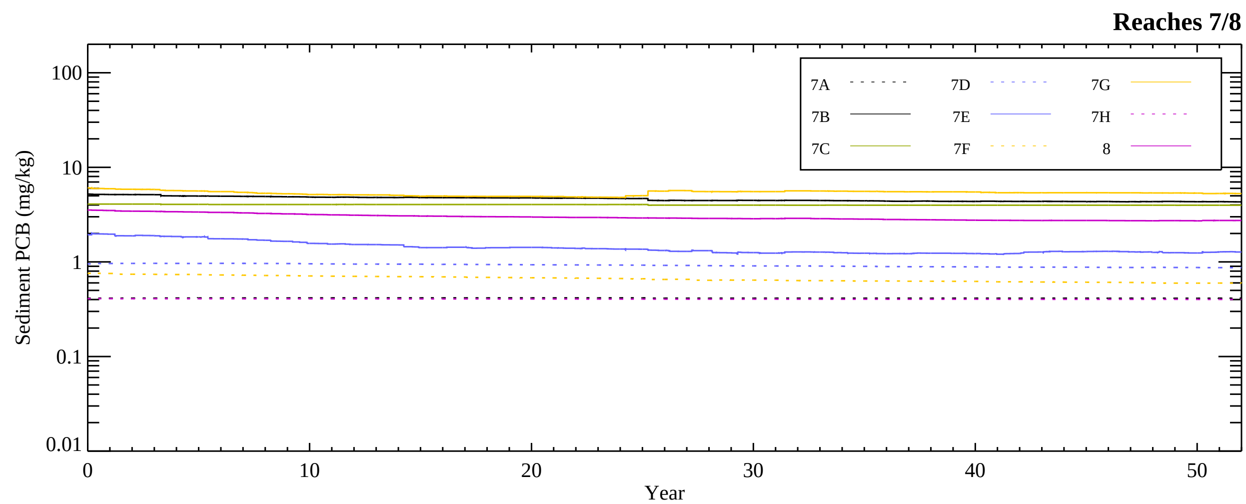

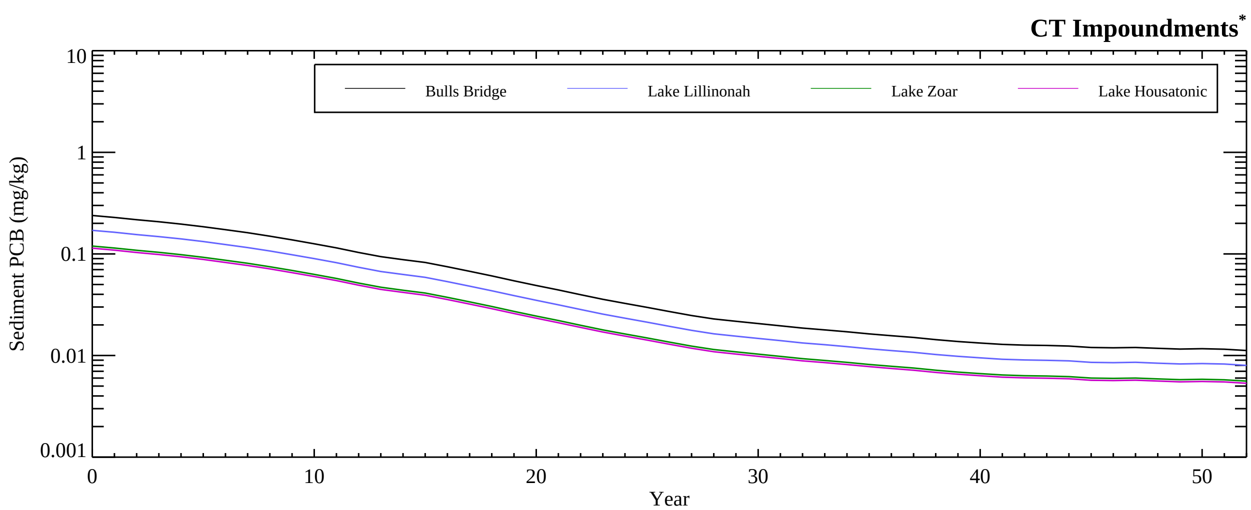

Figure 6-11b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 4.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED4CMSBS_0801-01\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED4CMSBS_0802-01\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED04_0802-01_base

wk/if/rrm - H:\GENcms\MODEL\EPA_EFDC\Post_Processors\Summary\Temporal_bedPCBs_100830_fig6.pro
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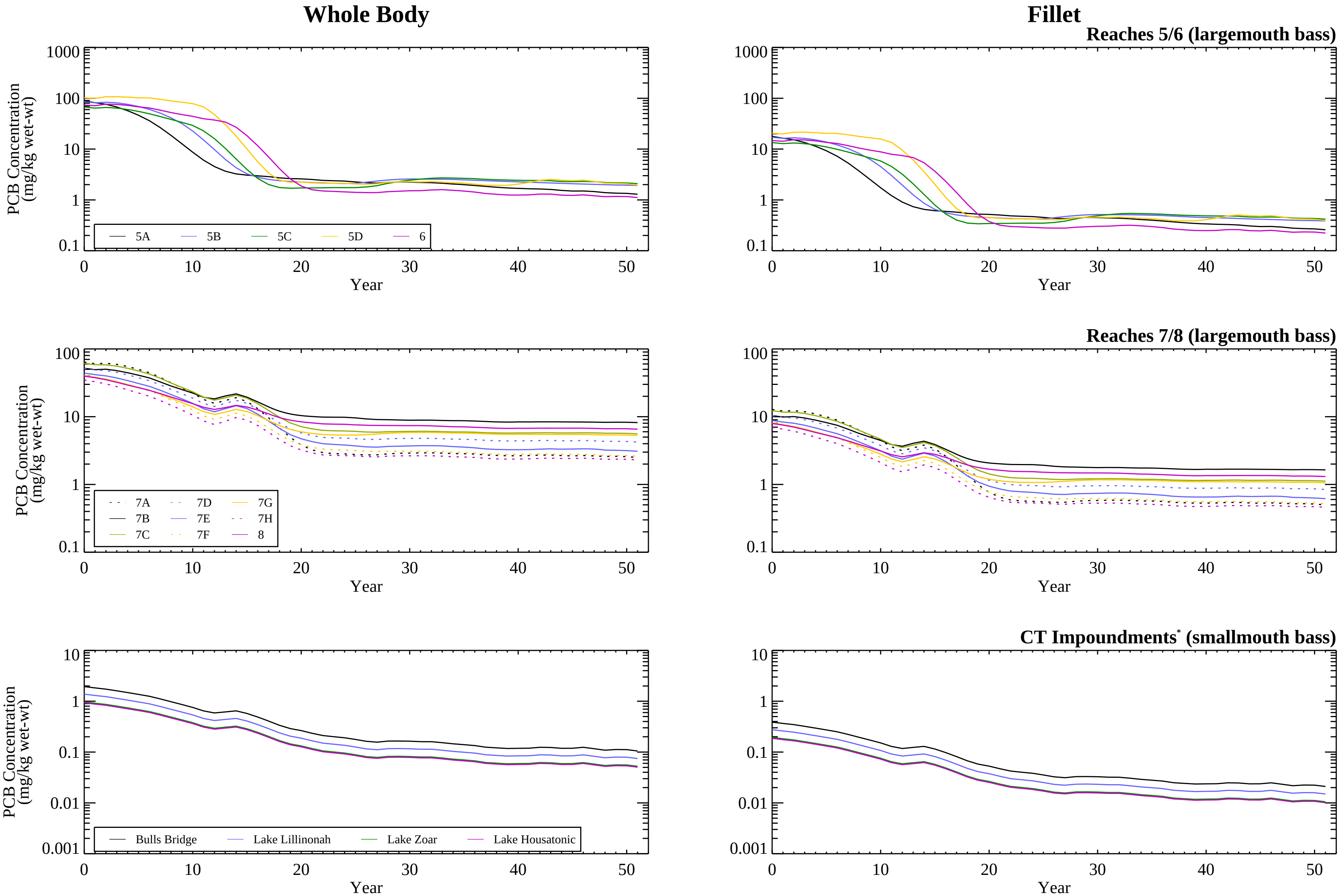

Figure 6-11c. Average PCB concentration in gamefish by subreach under SED 4.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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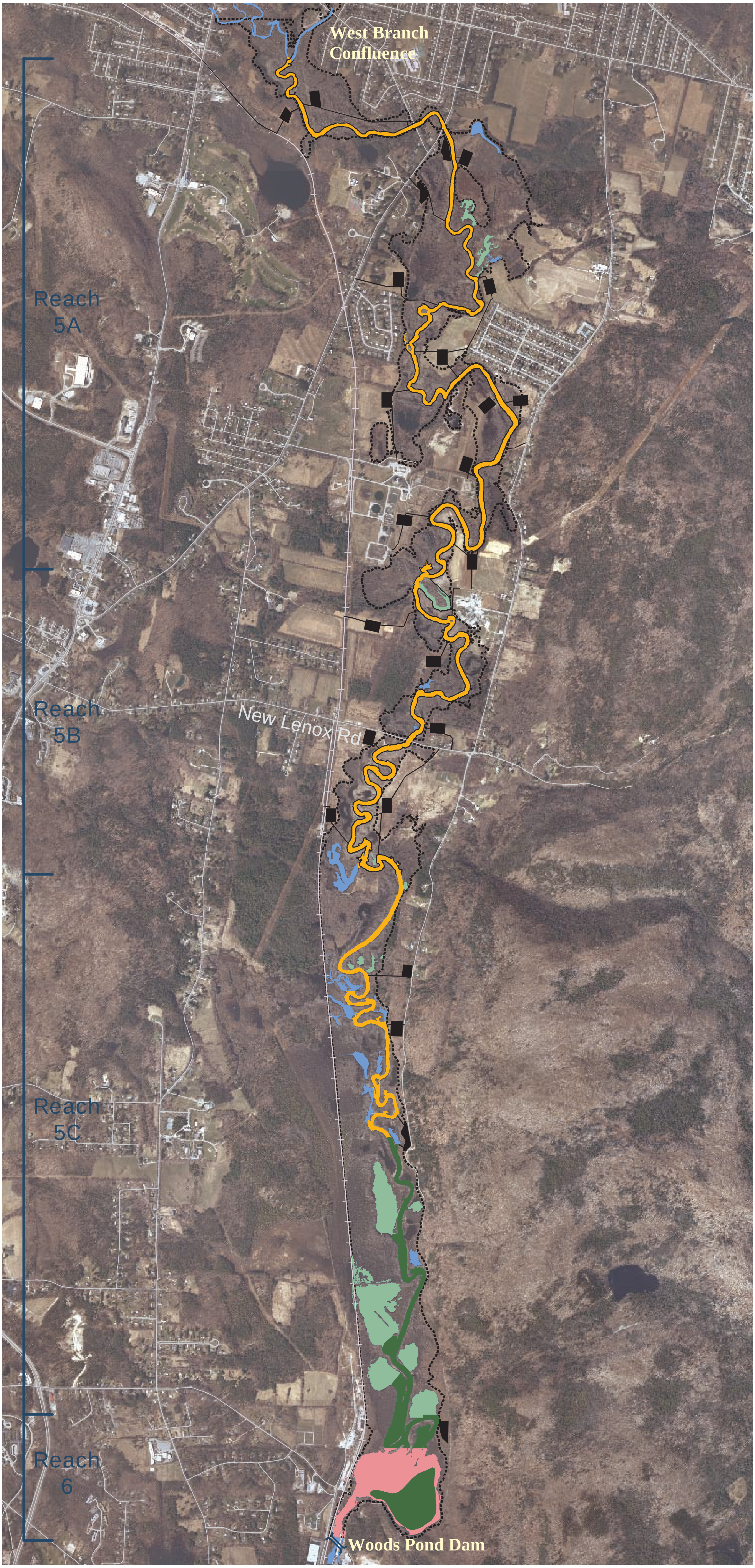

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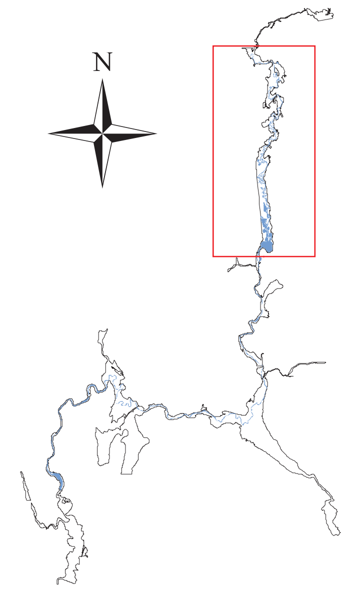

SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1.5 ft
- Removal of Top 2 ft
- Engineered Capping Only
- Thin-layer Capping
- Access Road/ Staging Area

SED 5 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-12a.

Sediment Alternative 5 (SED 5) in Reaches 5 and 6.

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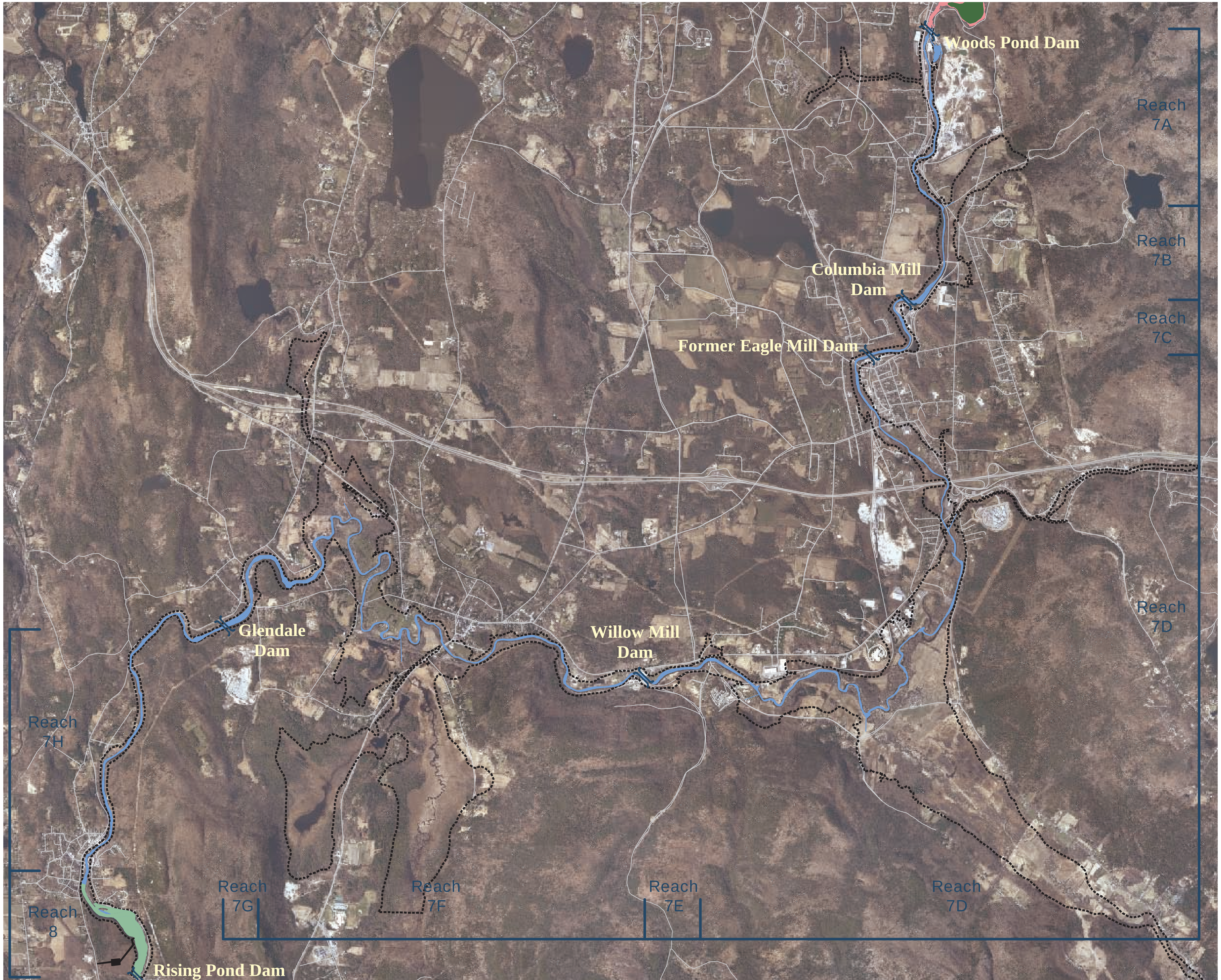

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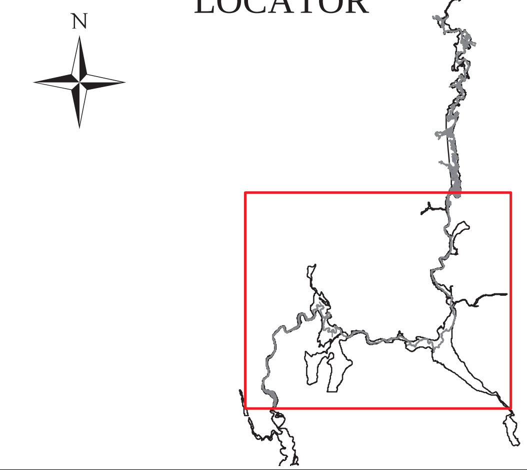

SCALE

0 0.5 1 2 Miles

LEGEND

Basemap Information

- Housatonic River
- 100-yr Floodplain
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1.5 ft
- Engineered Capping Only
- Thin-layer Capping

Access Road/ Staging Area

Figure 6-12b.
Sediment Alternative 5 (SED 5) in Reaches 7 and 8.

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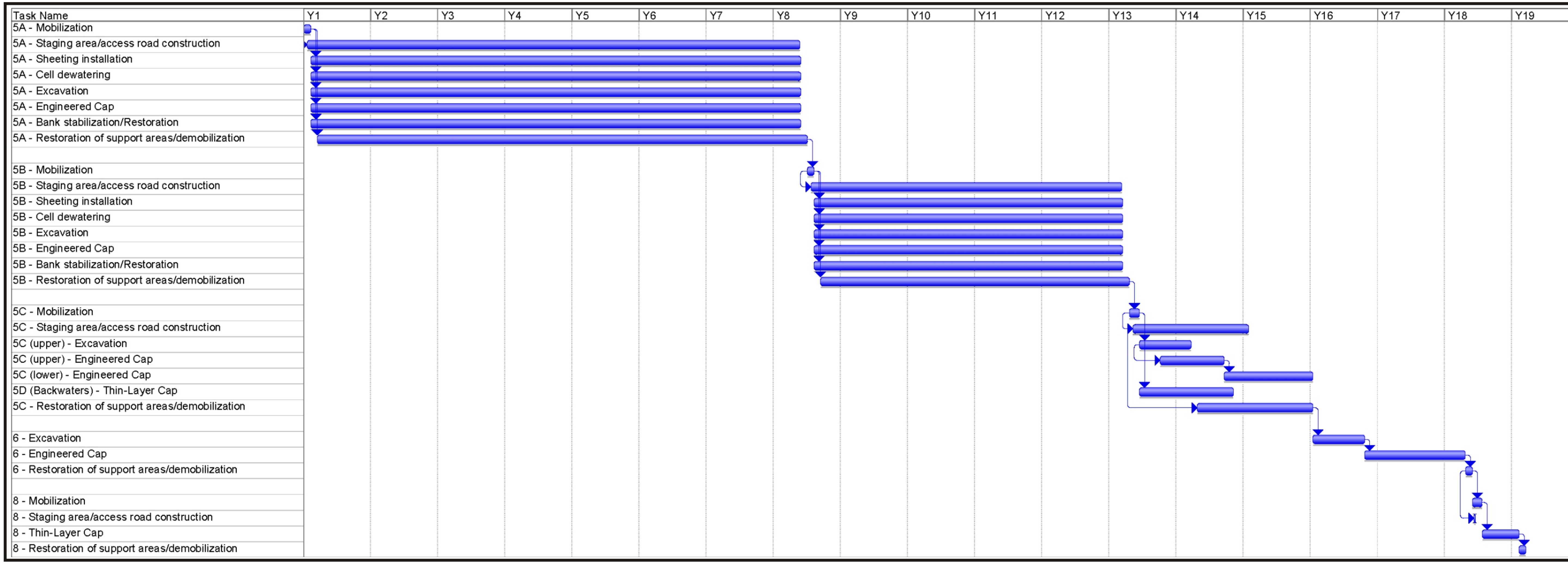

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, capping, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. Y = Year.

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CONSTRUCTION TIMELINE FOR SED 5

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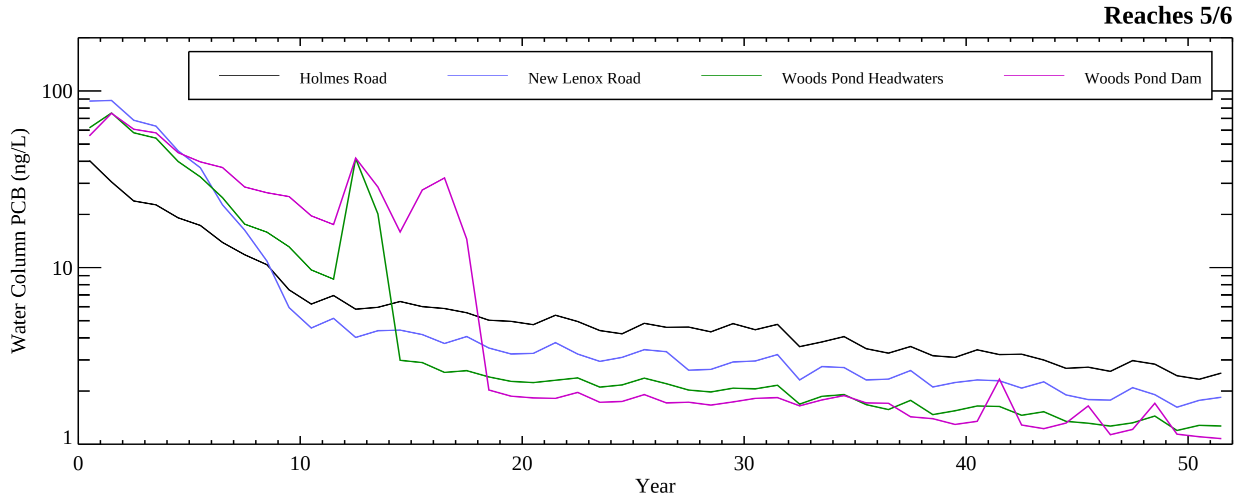
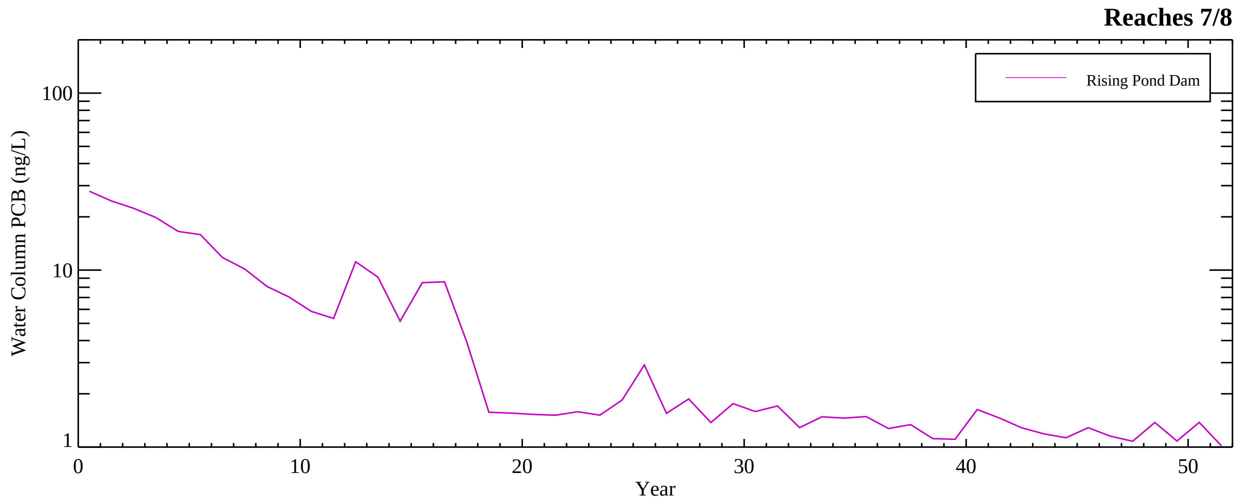
FIGURE
6-13

10/04/2010 SYRACUSE-NY-141ENV-DJHOWES
C:/B0030929/0002/00001/CDR/30929J19.CDR





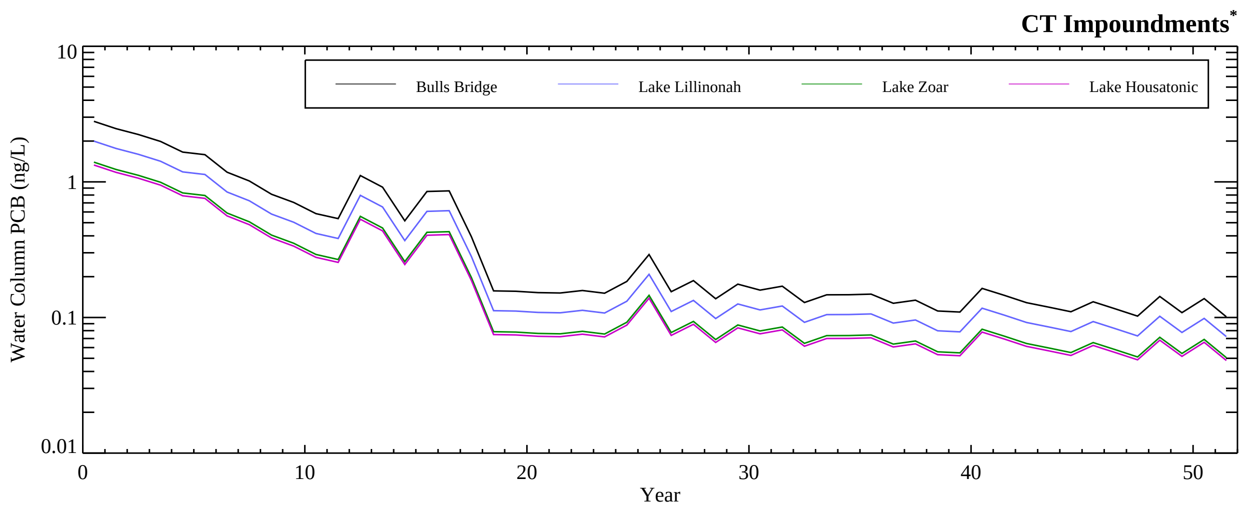


Figure 6-14a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 5.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED5CMSBS_0801-02\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED5CMSBS_0802-02\bins
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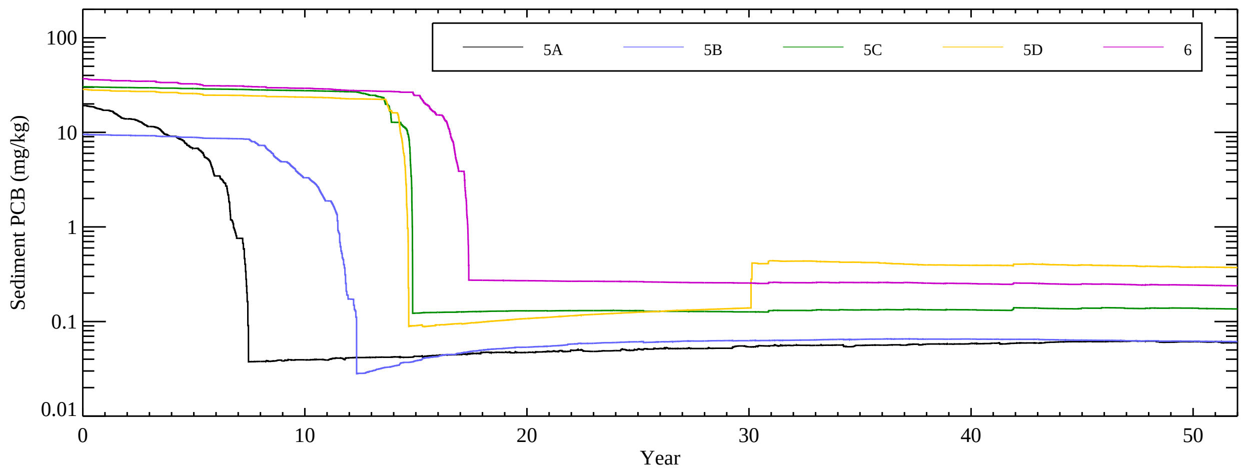
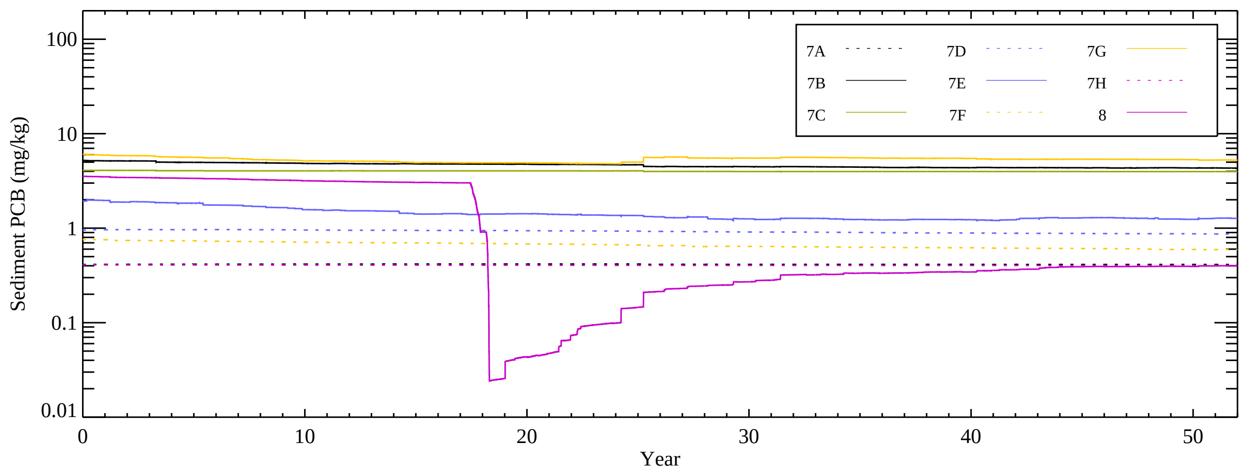
Reaches 5/6



Reaches 7/8



CT Impoundments*

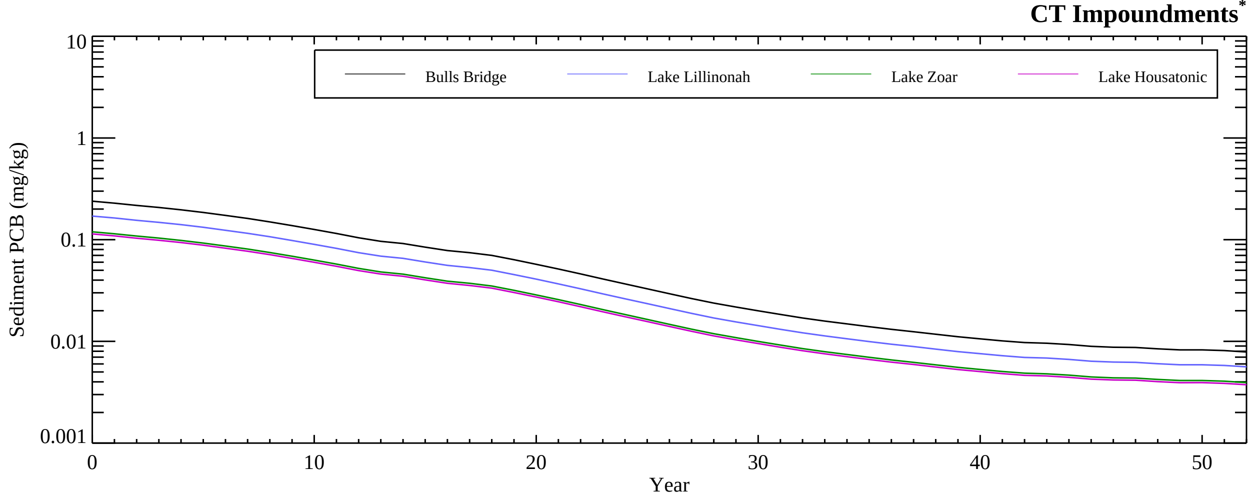


Figure 6-14b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 5.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED5CMSBS_0801-02\bins
Reaches 7/8 - \\TENMILE\EFDC_Output\r78\CMS\Proj_R78_SED5CMSBS_0802-02\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED05_0802-02_base

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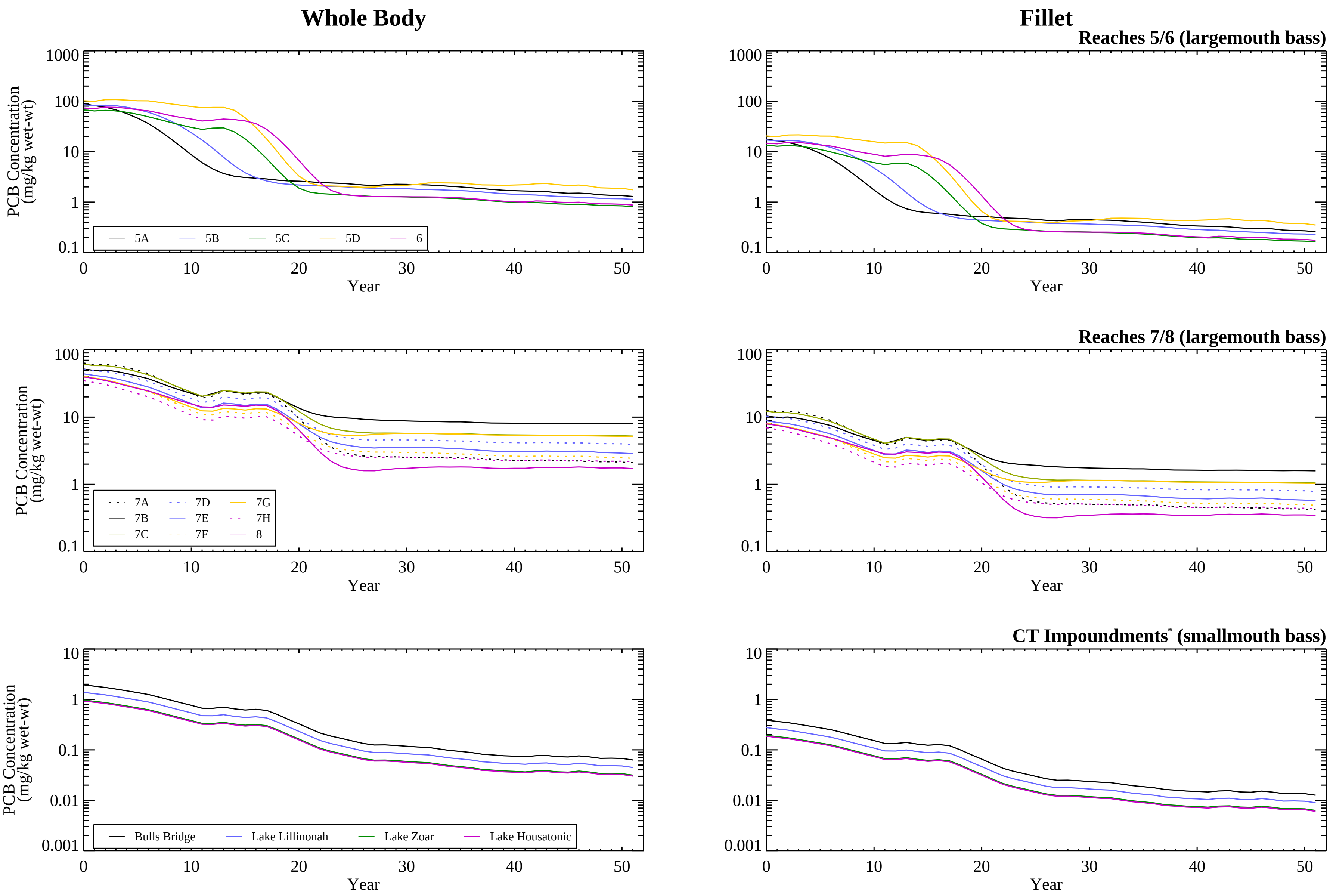

Figure 6-14c. Average PCB concentration in gamefish by subreach under SED 5.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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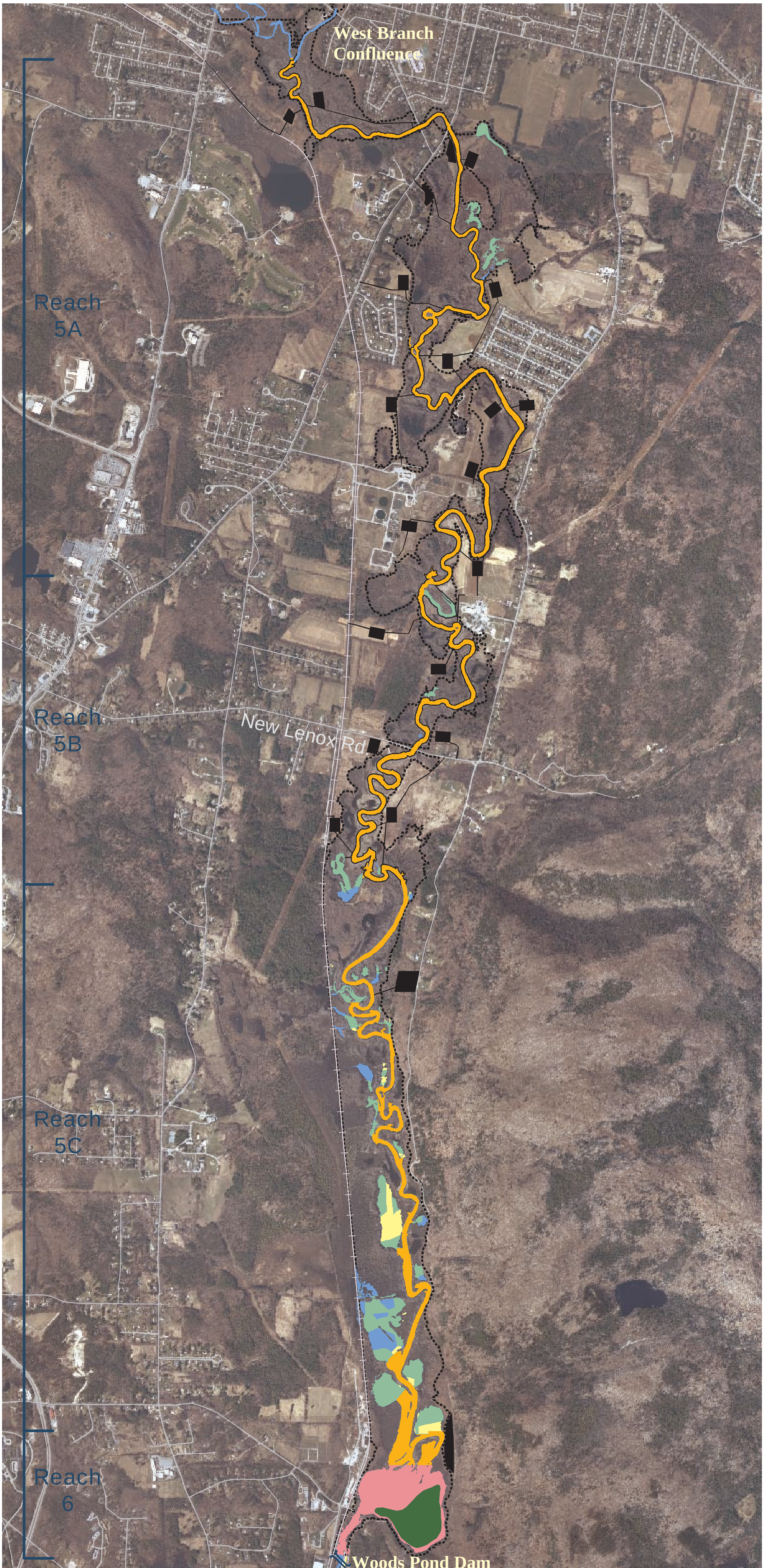

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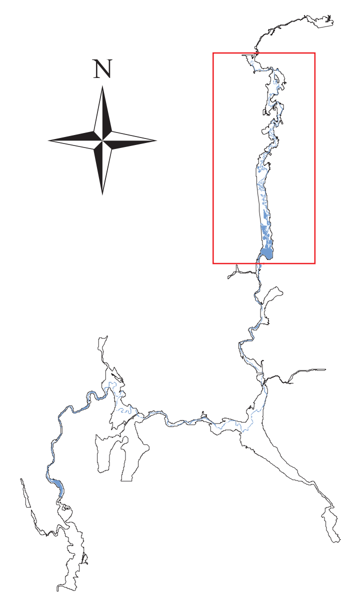

SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1 ft
- Removal of Top 1.5 ft
- Removal of Top 2 ft
- Engineered Capping Only
- Thin-layer Capping
- Access Road/ Staging Area

SED 6 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-15a.

Sediment Alternative 6 (SED 6) in Reaches 5 and 6.

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LOCATOR

N

SCALE

0 0.5 1 2 Miles

LEGEND

Basemap Information

Housatonic River

100-yr Floodplain

Housatonic Railroad

Major Road

Dam

Remediation Information

Sediment Remediation Type

Removal of Top 1 ft

Removal of Top 1.5 ft

Engineered Capping Only

Thin-layer Capping

Access Road/ Staging Area

Figure 6-15b.
Sediment Alternative 6 (SED 6) in Reaches 7 and 8.

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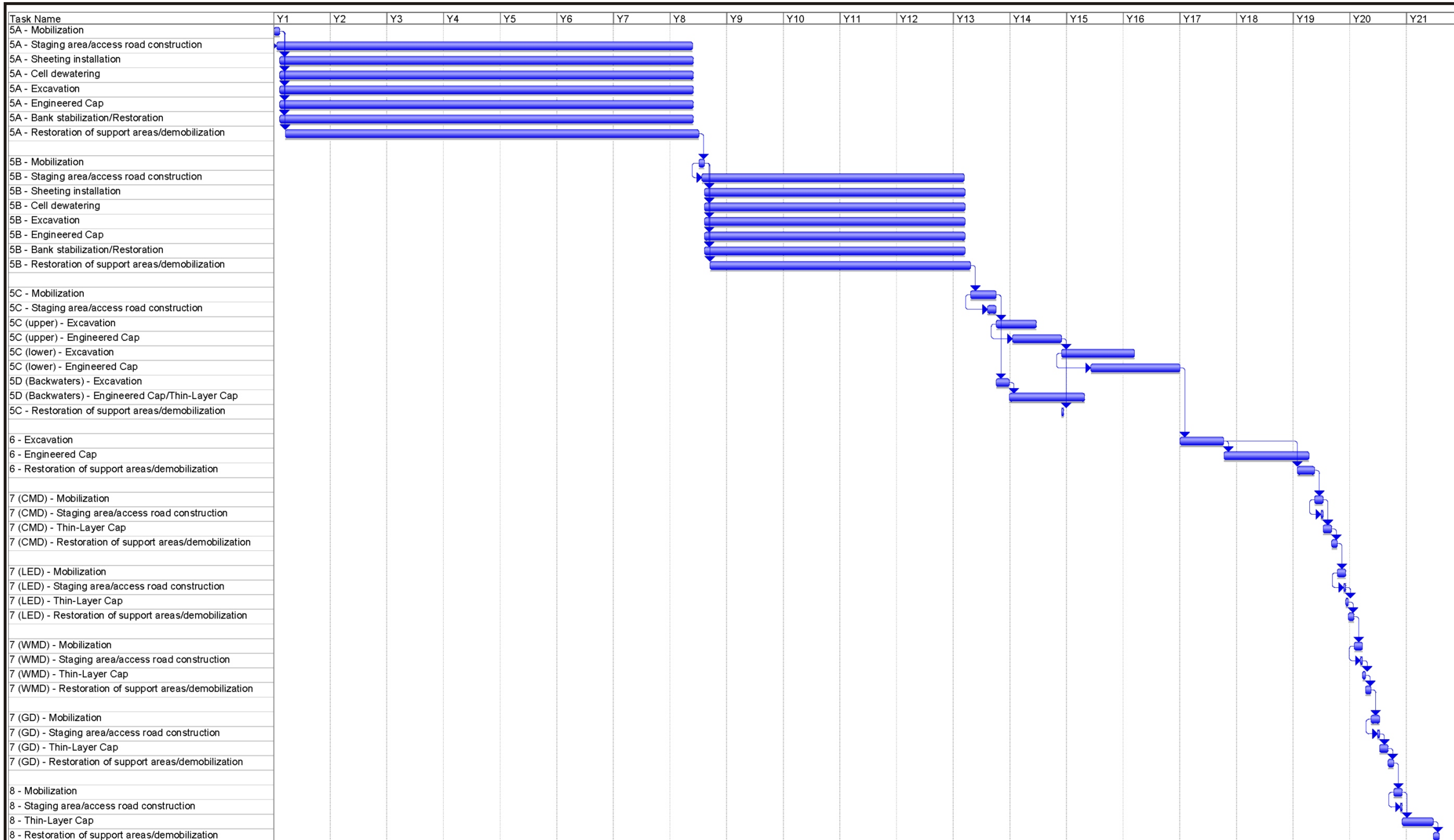

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, capping, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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PITTSFIELD, MASSACHUSETTS

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CONSTRUCTION TIMELINE FOR SED 6

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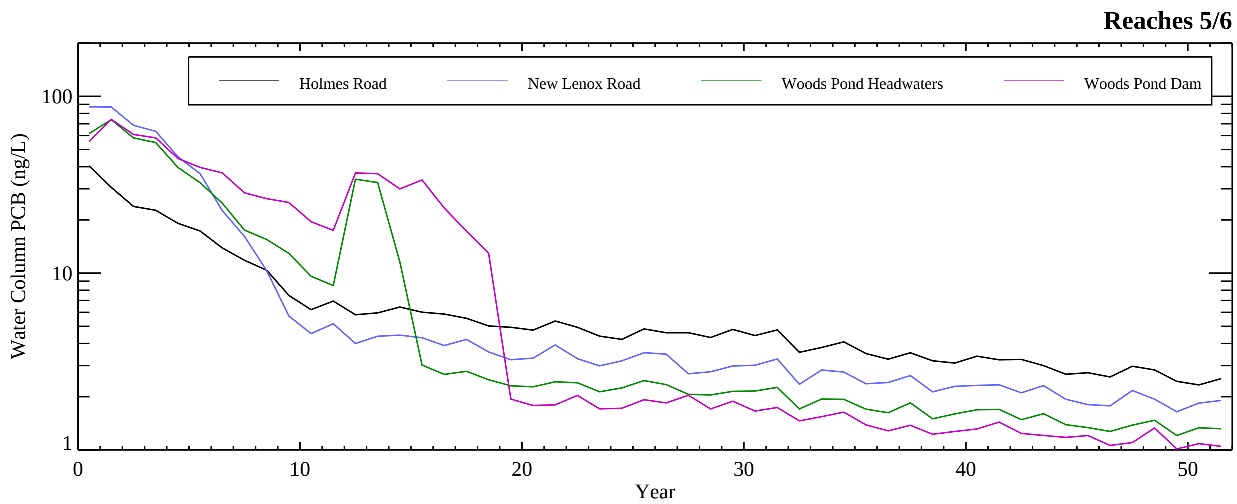
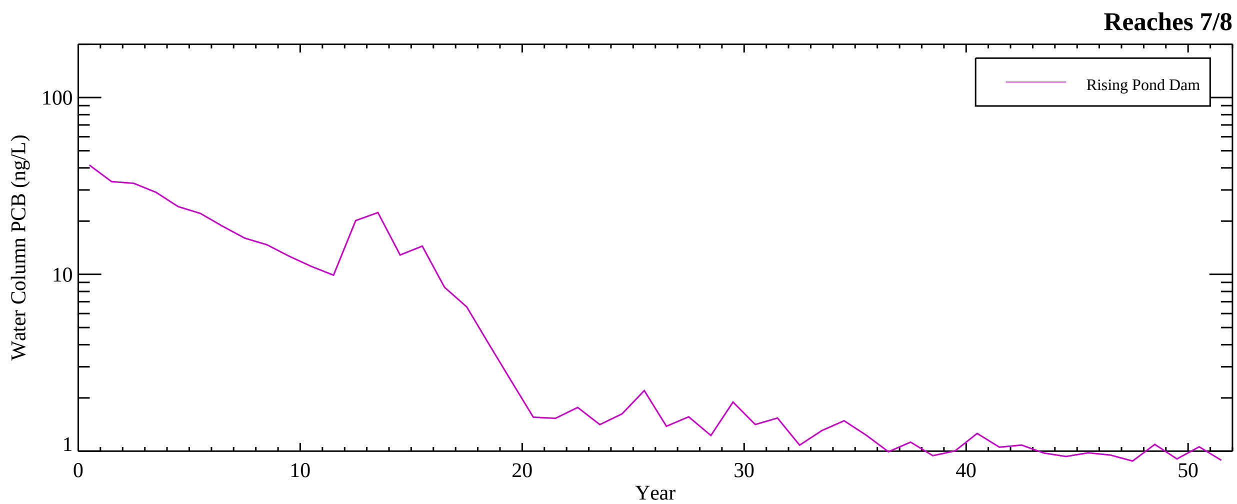
FIGURE
6-16





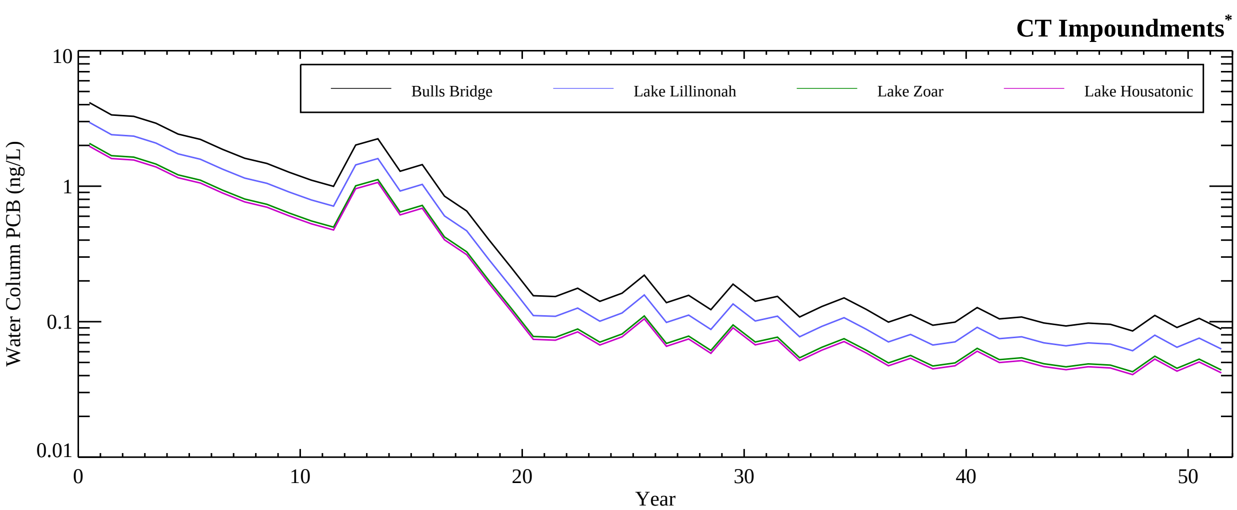


Figure 6-17a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 6.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED6CMSBS_0810-05\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0810-05_base\wchem_total

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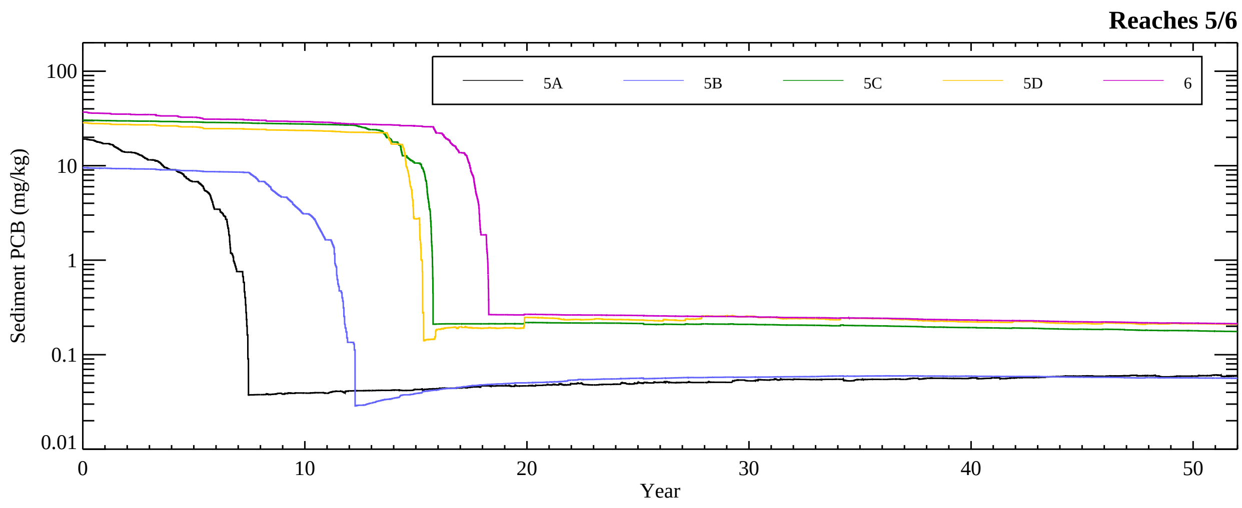

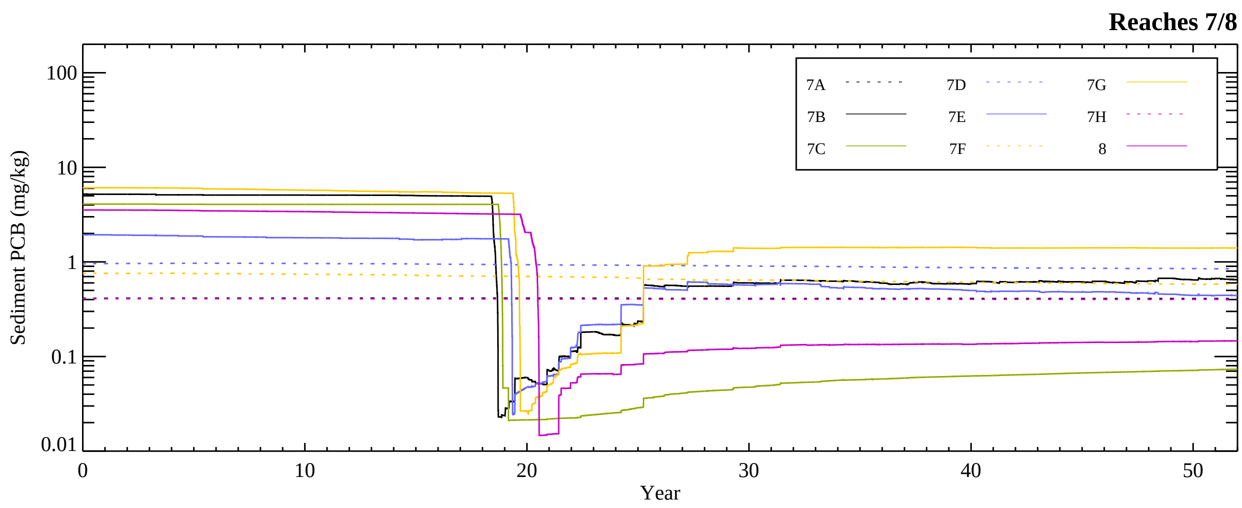

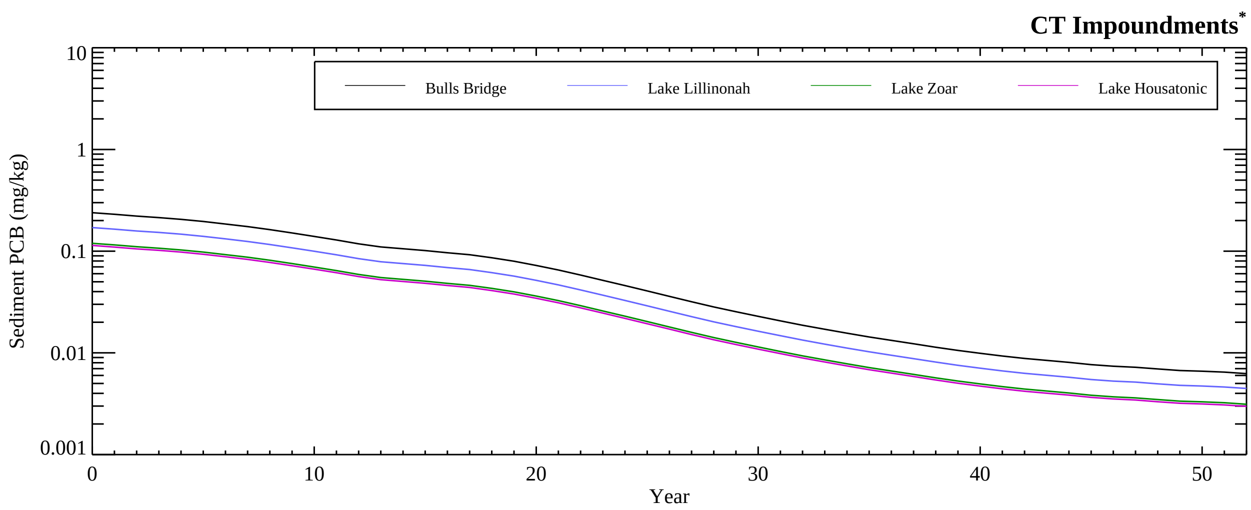

Figure 6-17b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 6.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED6CMSBS_0712-16\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED6CMSBS_0810-05\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED06_0810-05_base

wk/if/rrm - H:\GENcms\MODEL\EPA_EFDC\Post_Processors\Summary\Temporal_bedPCBs_100830_fig6.pro
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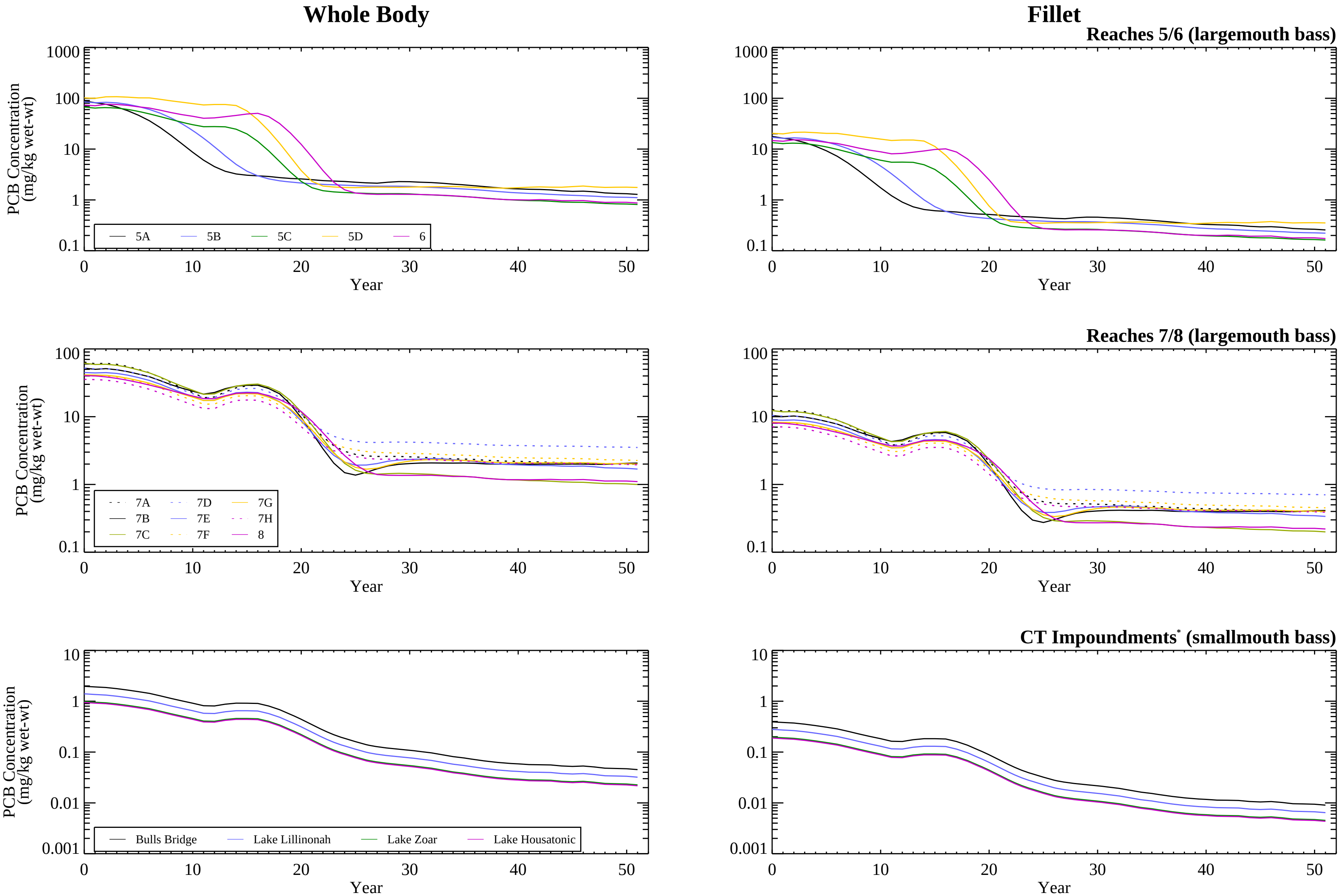

Figure 6-17c. Average PCB concentration in gamefish by subreach under SED 6.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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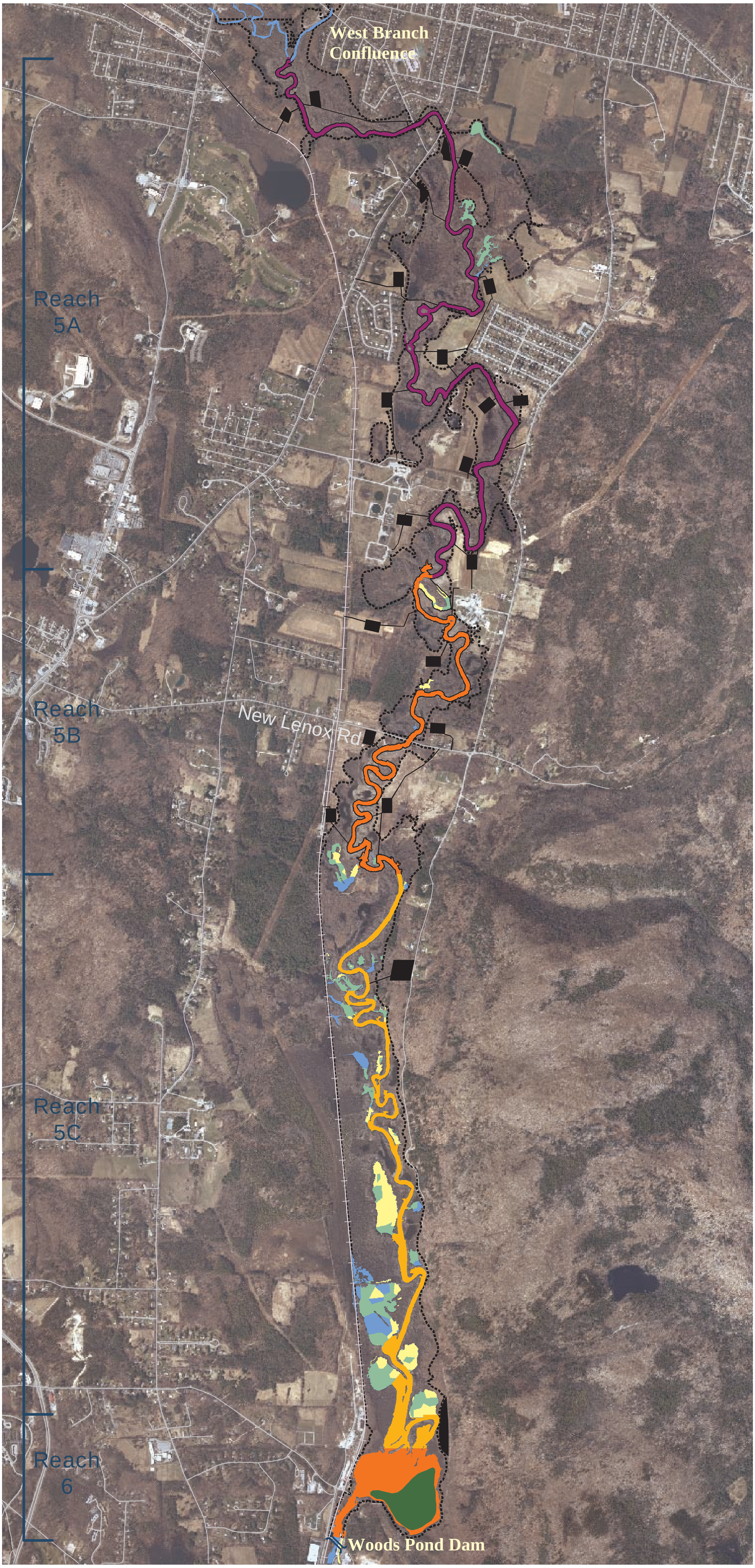
Wed Oct 06 10:37:08 2010



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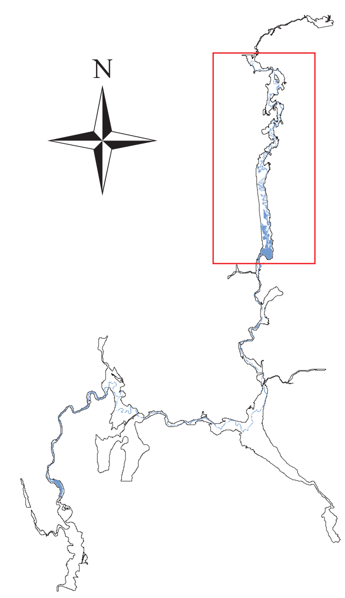

SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1 ft
- Removal of Top 1.5 ft
- Removal of Top 2 ft
- Removal of Top 2.5 ft
- Removal of Top 3.0-3.5 ft
- Thin-layer Capping
- Engineered Capping Only
- Access Road/ Staging Area

SED 7 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-18a.

Sediment Alternative 7 (SED 7) in Reaches 5 and 6.

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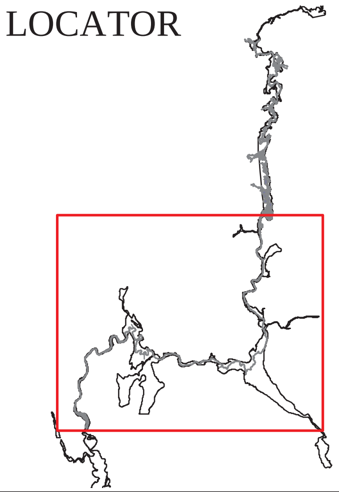
LOCATOR

N



SCALE

0 0.5 1 2 Miles

LEGEND

Basemap Information

- Housatonic River
- 100-yr Floodplain
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1 ft
- Removal of Top 1.5 ft
- Removal of Top 2.5 ft
- Thin-layer Capping
- Engineered Capping Only

Access Road/ Staging Area

Figure 6-18b.
Sediment Alternative 7 (SED 7) in Reaches 7 and 8.

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GENcms 430

OCTOBER 2010

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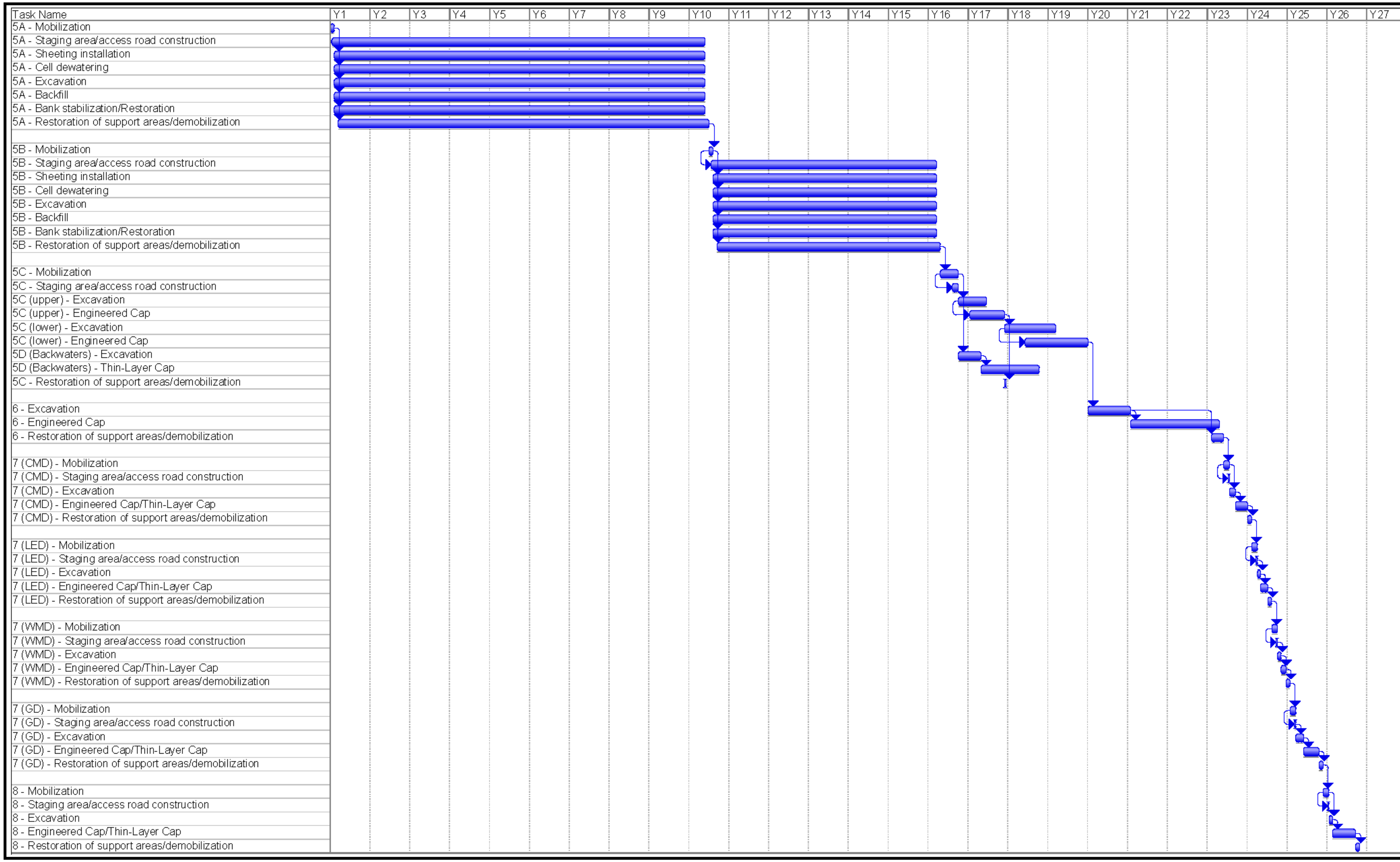

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping/backfilling, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, backfill, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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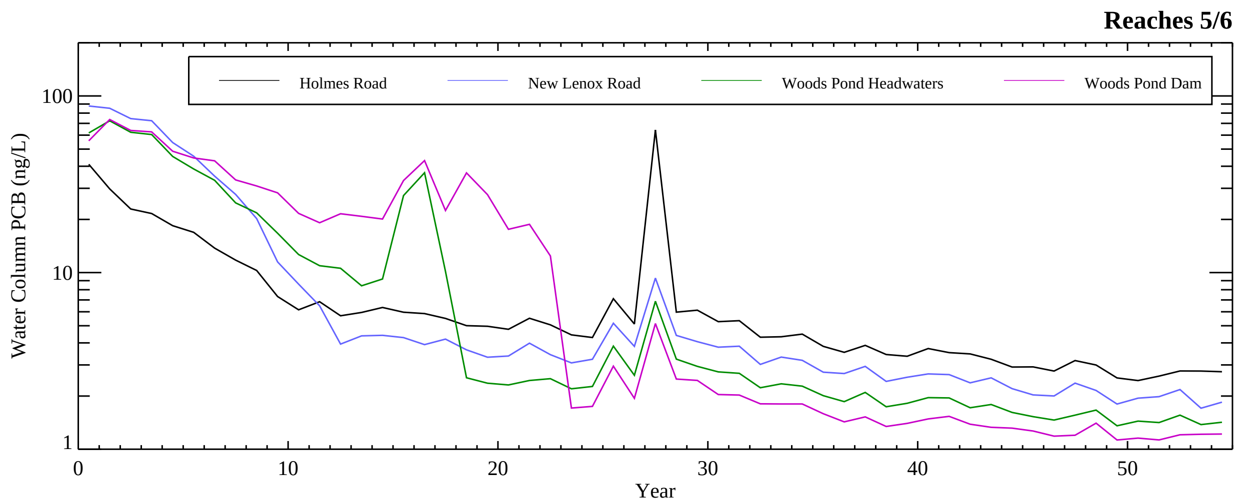
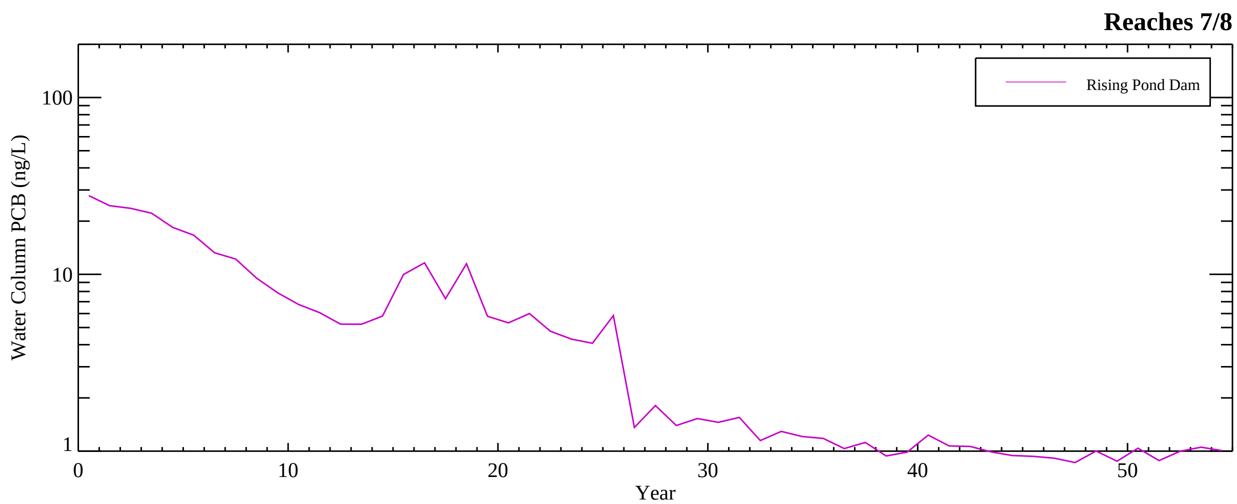
CONSTRUCTION TIMELINE FOR SED 7

ARCADIS

FIGURE
6-19

10/11/2010 SYRACUSE-NY-141ENV-DJHOWES, LJPOSENAUER
C:/B0030929/0002/00001/CDR/30929J21.CDR





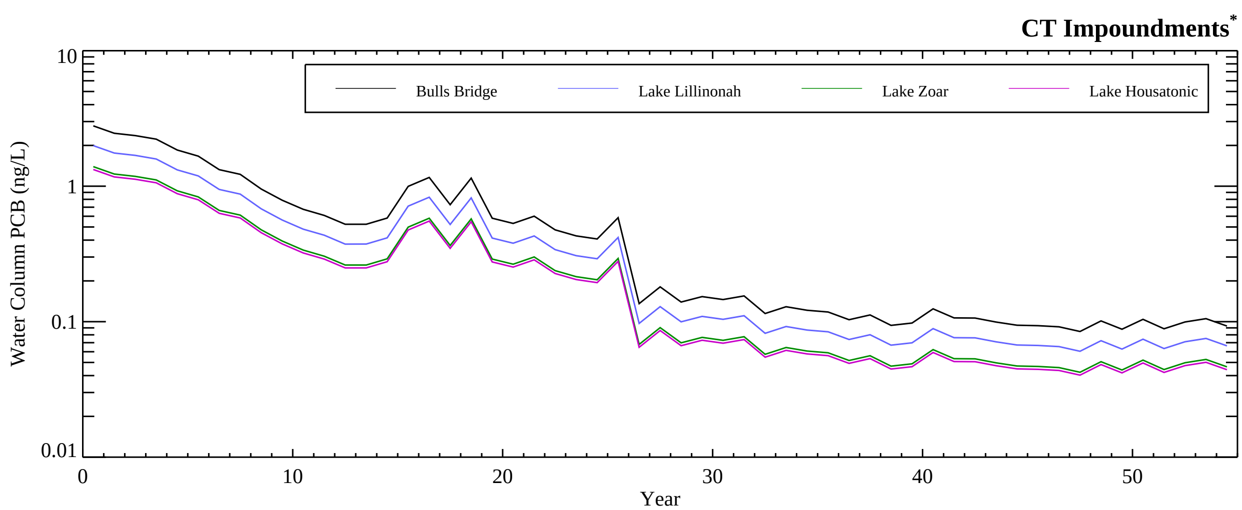


Figure 6-20a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 7.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED7CMSBS_0810-01\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED7CMSBS_0810-15\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0810-15_base\wchem_total

wk/if/rrm - H:\GENcms\MODEL\EPA_EFDC\Post_Processors\Summary\Temporal_wcPCBs_100830_fig6.pro
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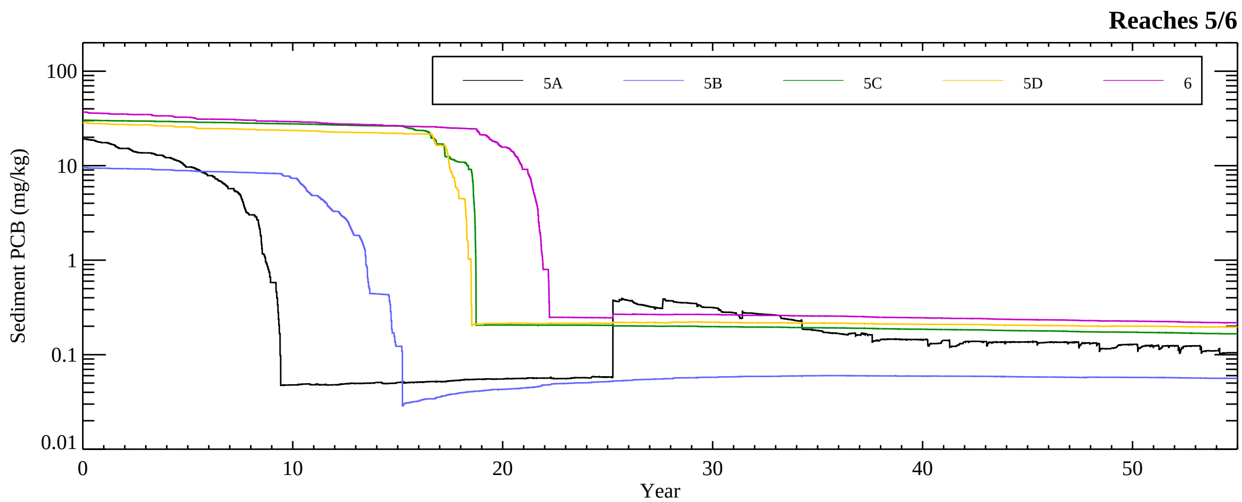

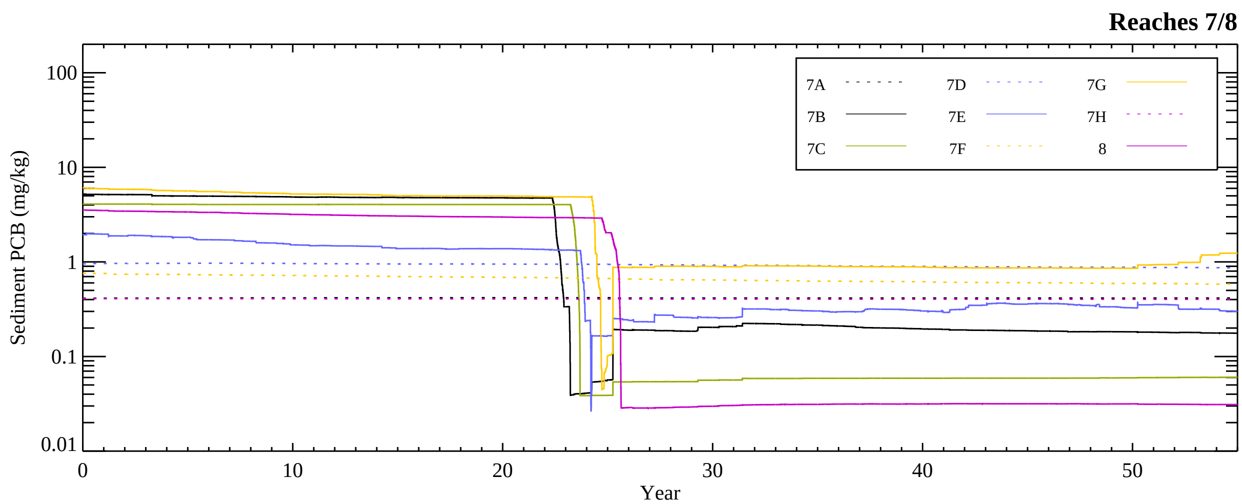

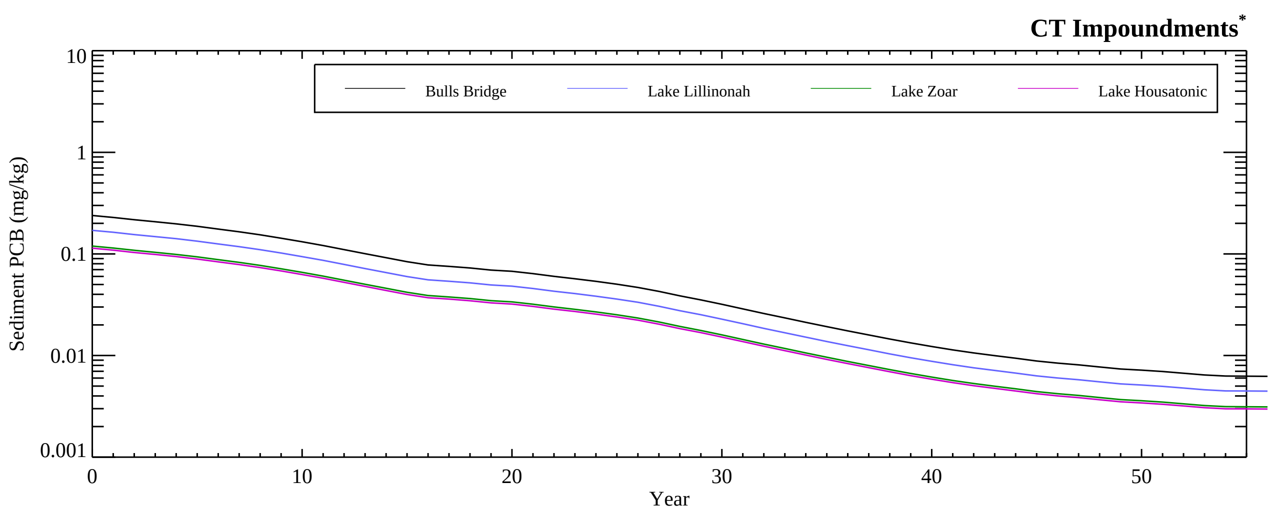

Figure 6-20b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 7.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED7CMSBS_0810-01\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED7CMSBS_0810-15\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED07_0810-15_base

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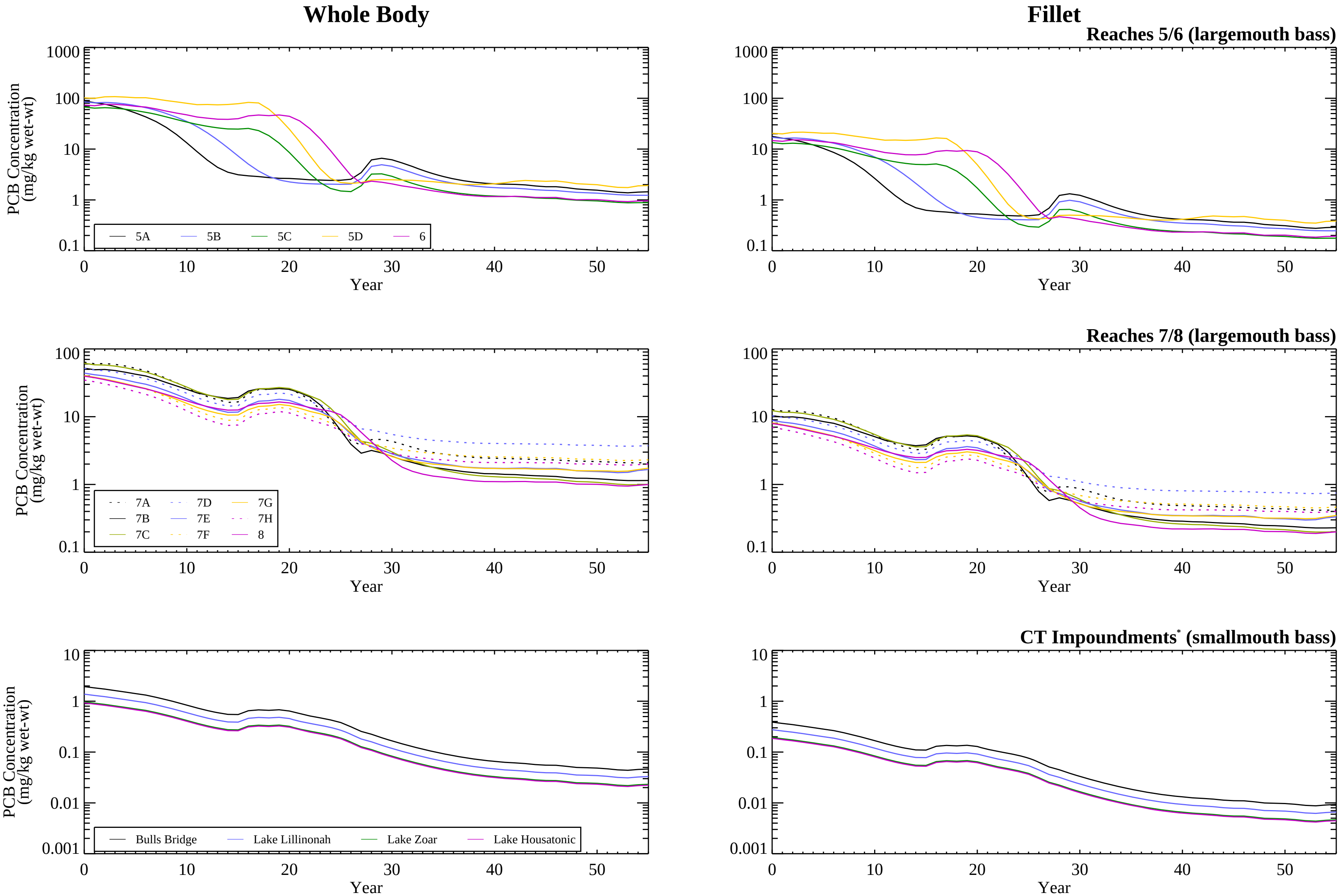
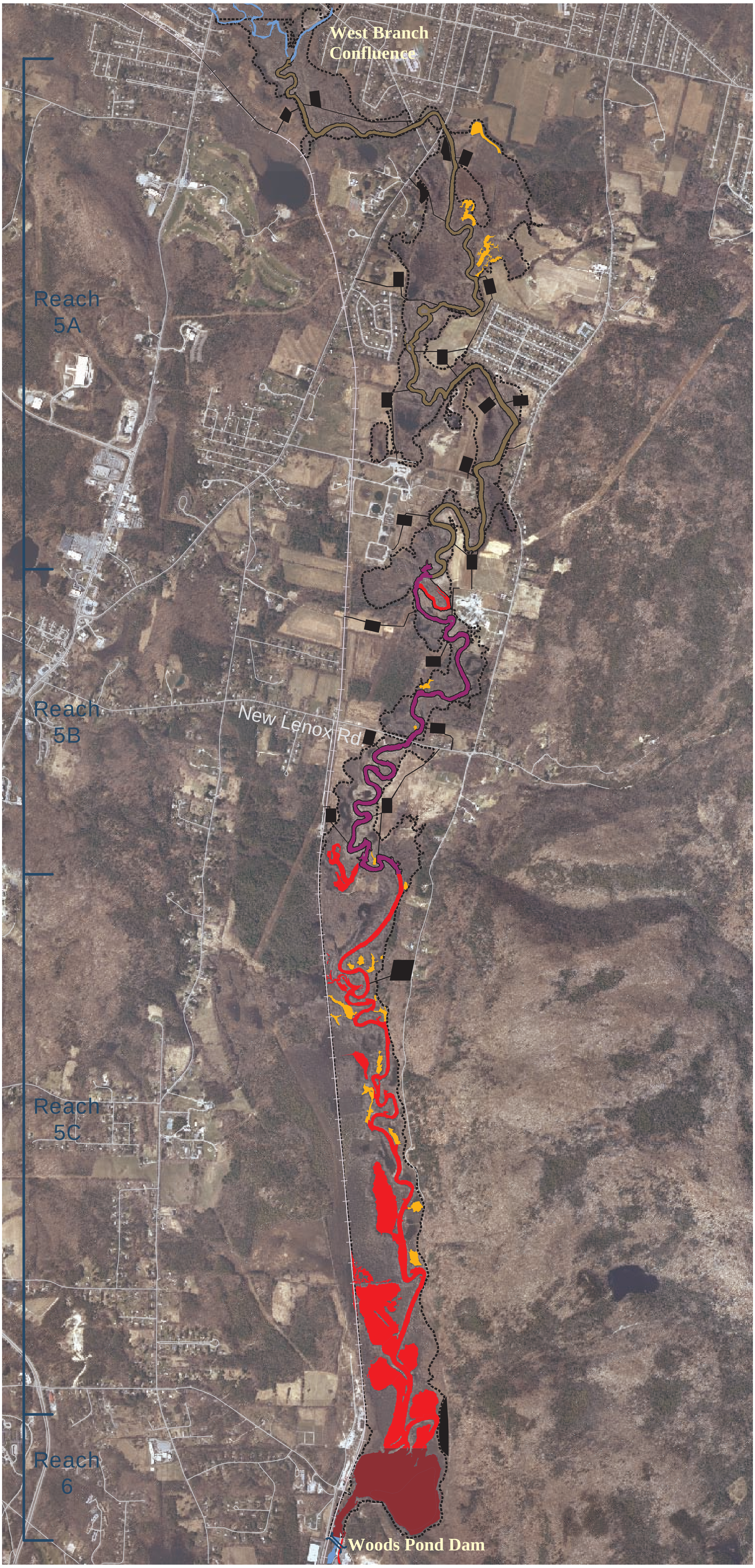


Figure 6-20c. Average PCB concentration in gamefish by subreach under SED 7.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*



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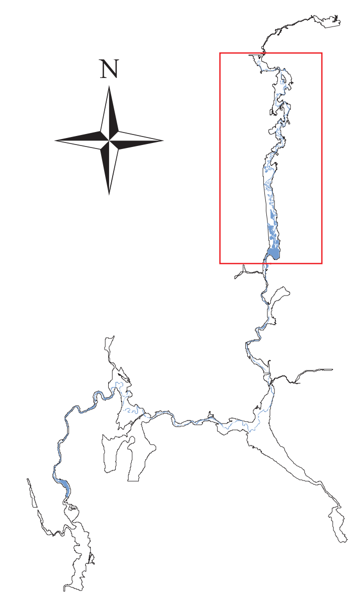

SCALE

0 0.25 0.5
Miles

LEGEND

Basemap Information

Housatonic River

1 mg/kg PCB Isopleth

Housatonic Railroad

Major Road

Dam

Remediation Information

Sediment Remediation Type

Removal of Top 2 ft

Removal of Top 3 ft

Removal of Top 3.5 ft

Removal of Top 4 ft

Removal of Top 6 ft

Access Road/
Staging Area

SED 8 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-21a.

Sediment Alternative 8 (SED 8) in Reaches 5 and 6.

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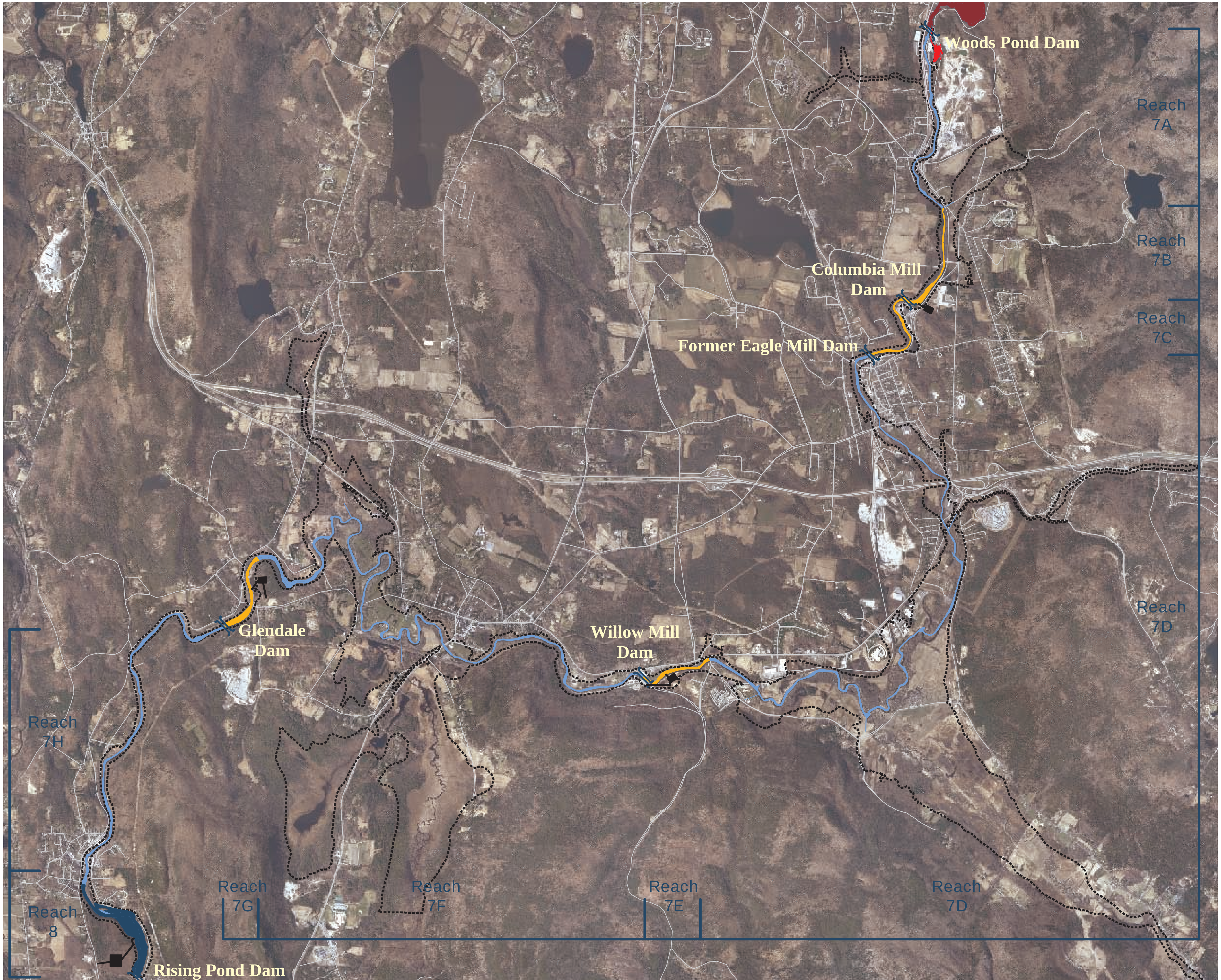

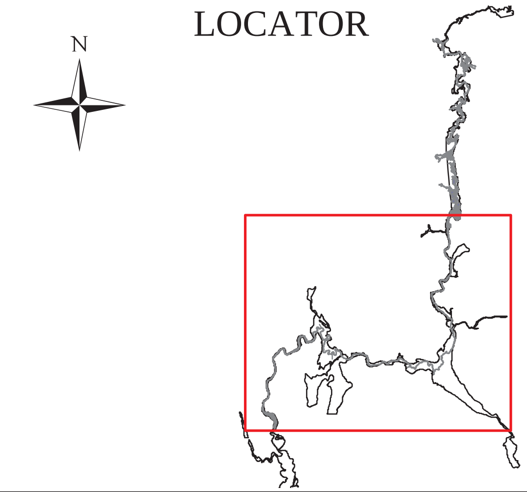

SCALE

0 0.5 1 2 Miles

LEGEND

Basemap Information

- Housatonic River
- 100-yr Floodplain
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 2 ft
- Removal of Top 3 ft
- Removal of Top 6 ft
- Removal of Top 7 ft

Access Road/ Staging Area

Figure 6-21b. Sediment Alternative 8 (SED 8) in Reaches 7 and 8.

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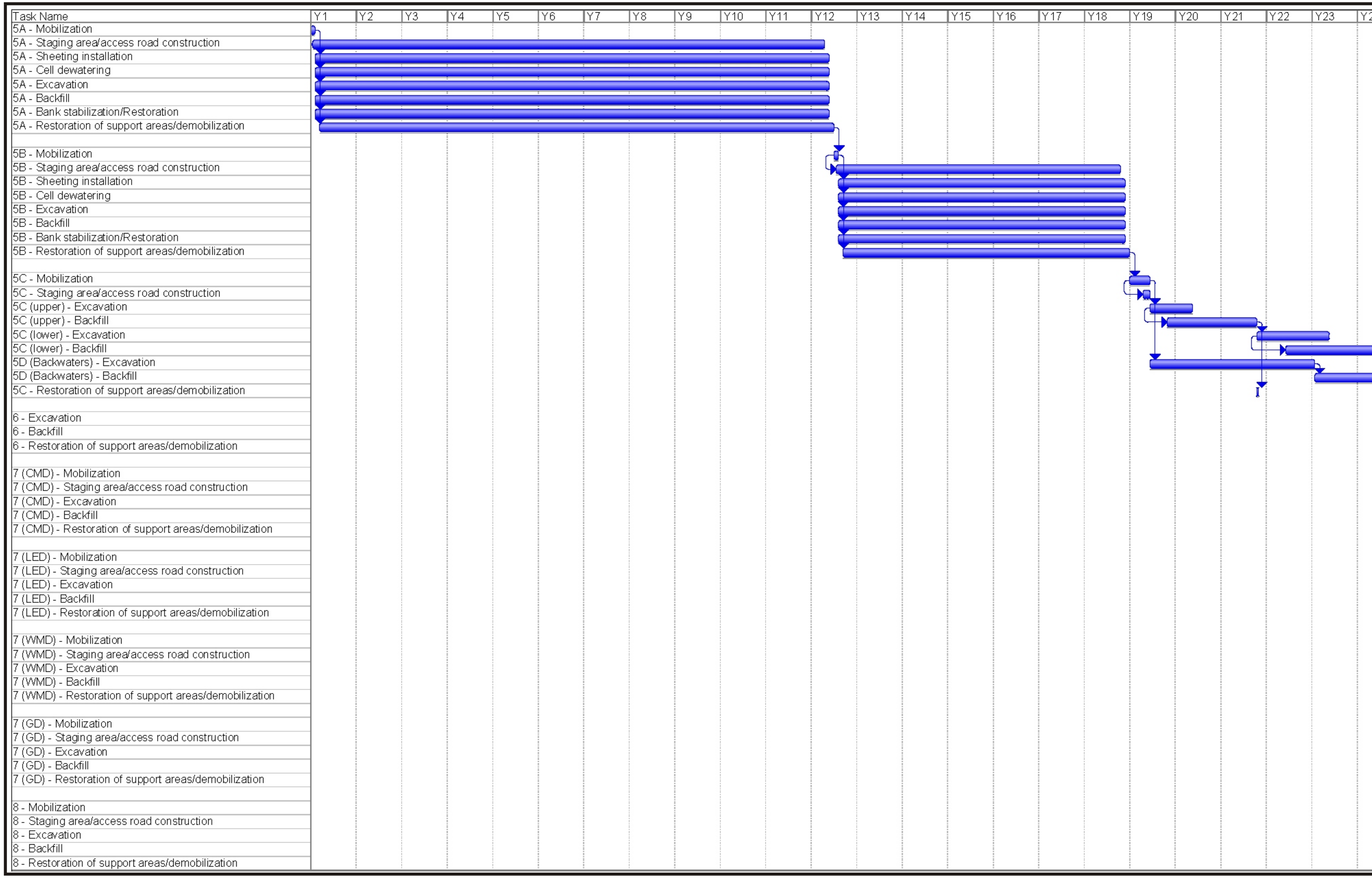

See Figure 6-22b for Continued Schedule

NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, backfilling, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, backfill, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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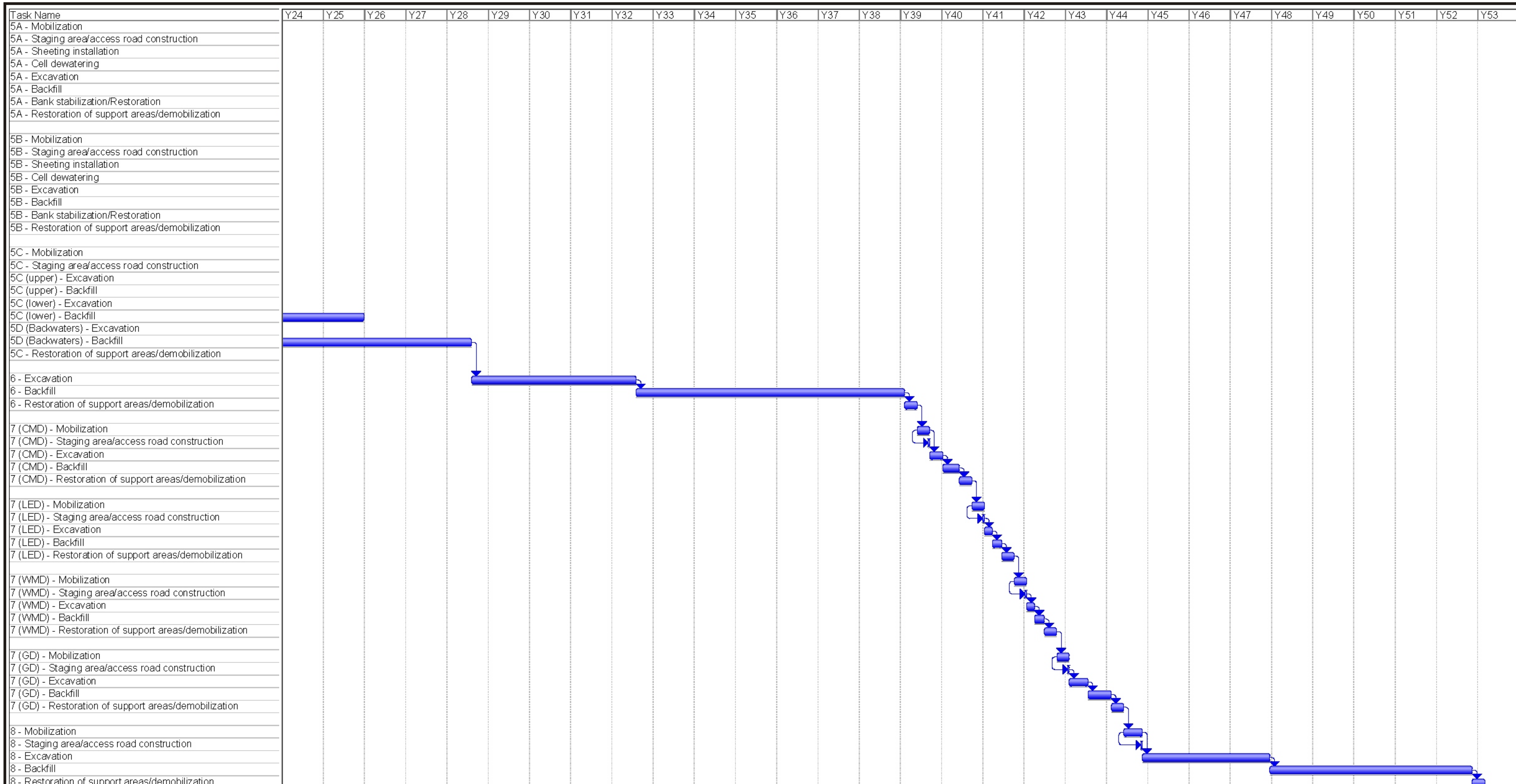
REVISED CMS REPORT

CONSTRUCTION TIMELINE FOR SED 8

ARCADIS

FIGURE

6-22a



NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, backfilling, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, backfill, and bank stabilization/restoration activities. However, as there are a total of 176 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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CONSTRUCTION TIMELINE FOR SED 8

ARCADIS

FIGURE
6-22b

10/08/2010 SYRACUSE-NY-141ENV-DJHOWES
C:/B0030929/0002/00001/CDR/30929J38.CDR

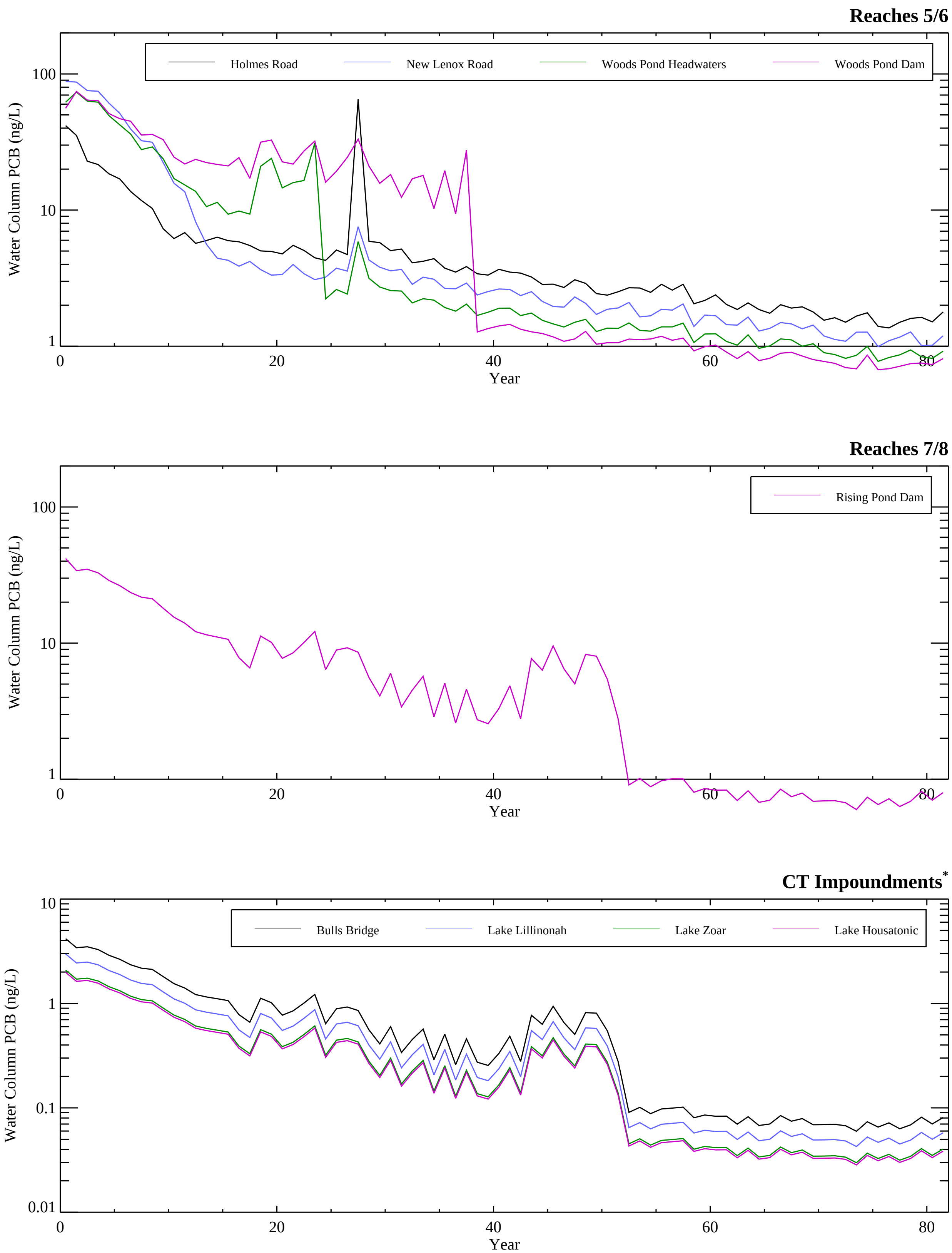

Figure 6-23a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 8.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED8CMSBS_0810-07\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0810-07_base\wchem_total

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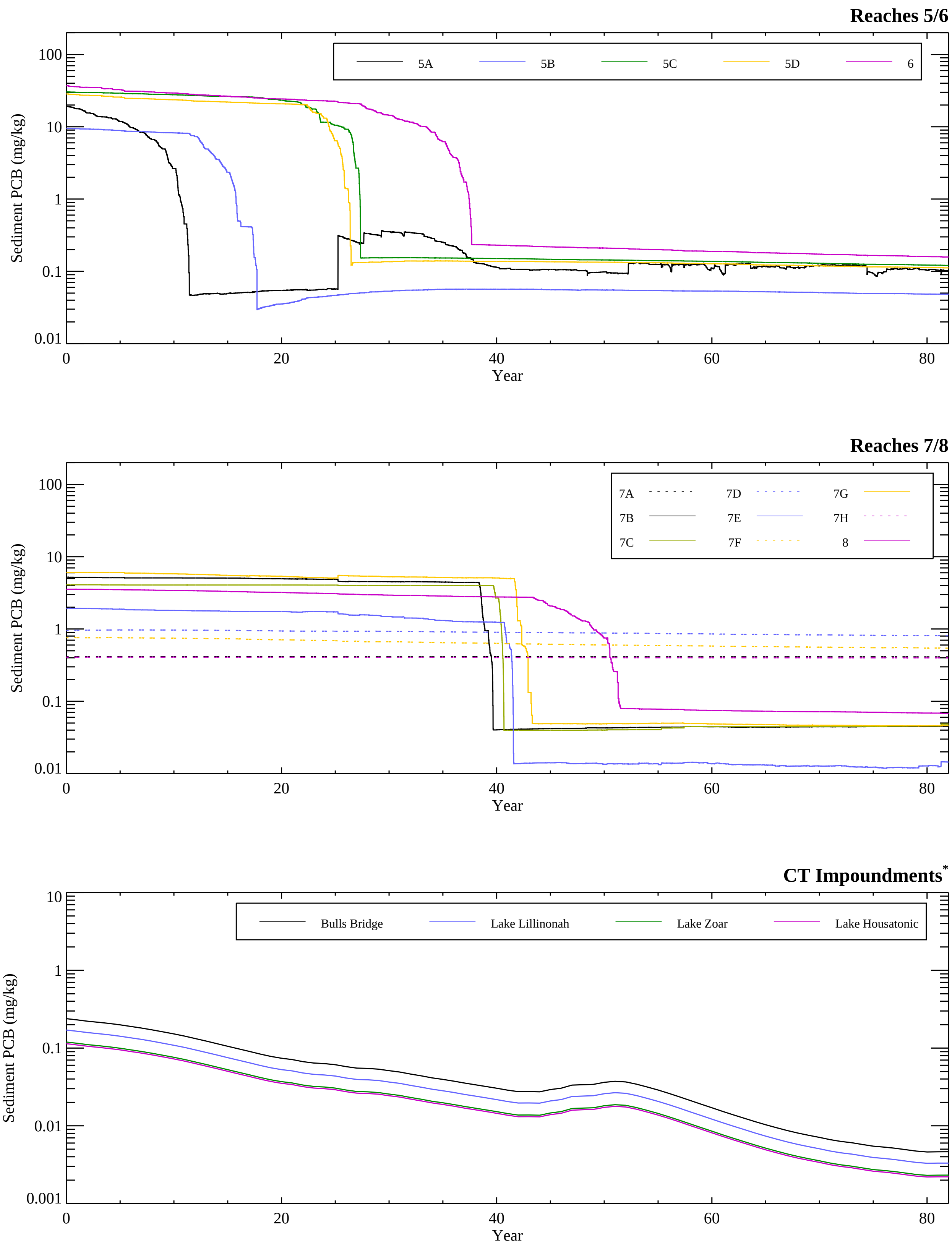

Figure 6-23b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 8.

[*] Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.
Model Results:
Reaches 5/6 - \\TENMILE\EFDC_Output\r56\CMS\Proj_R56_SED8CMSBS_0712-18\bins
Reaches 7/8 - \\Nas-01-9a-c0\EFDC_Output\r78\CMS\Proj_R78_SED8CMSBS_0810-07\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED08_0810-07_base

wk/if/rrm - H:\GENcms\MODEL\EPA_EFDC\Post_Processors\Summary\Temporal_bedPCBs_100830_fig6.pro
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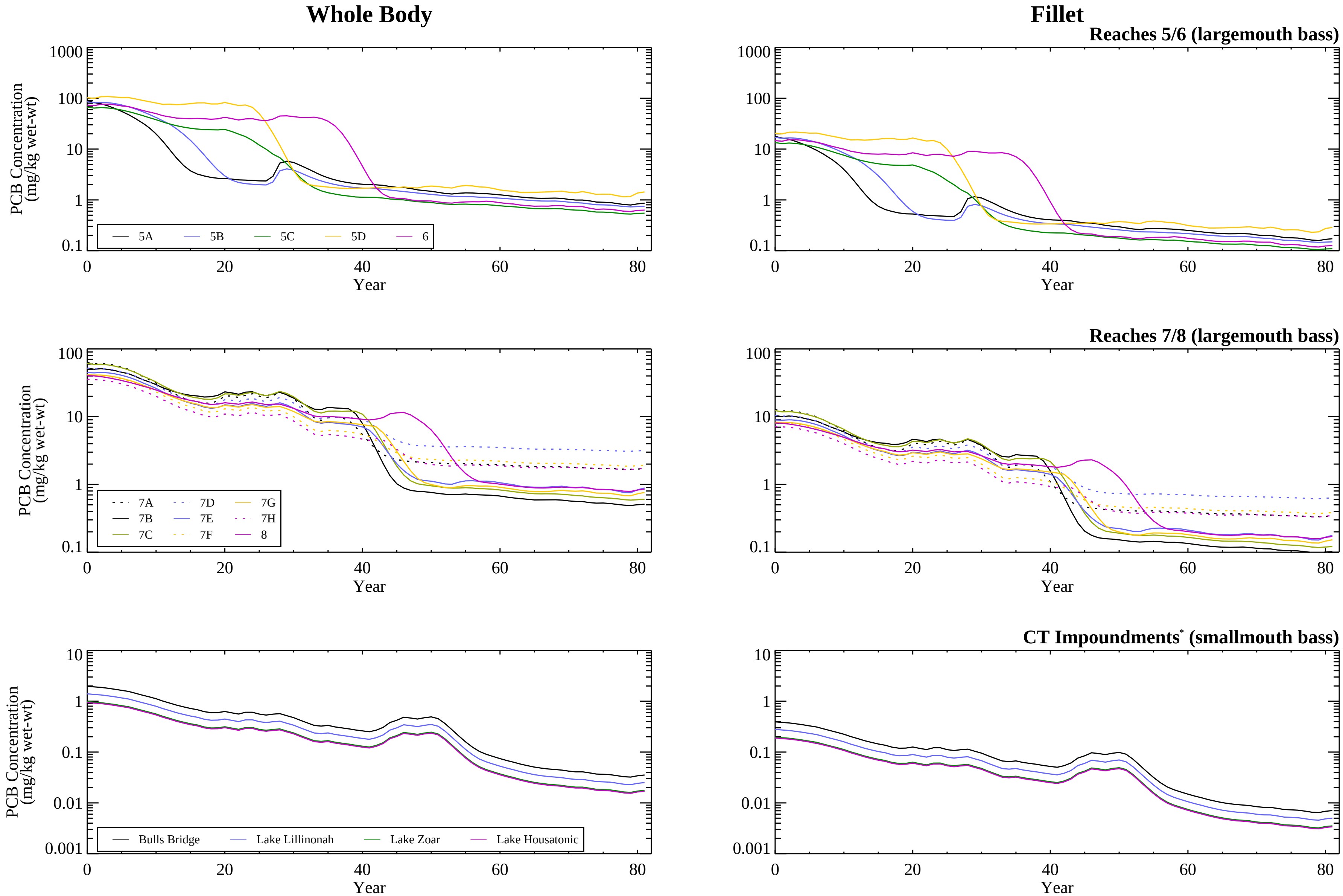

Figure 6-23c. Average PCB concentration in gamefish by subreach under SED 8.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

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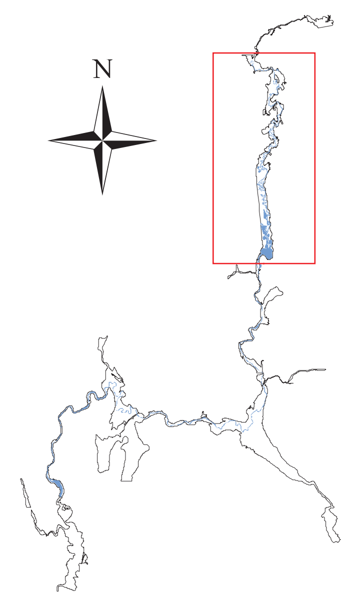
Wed Oct 06 11:17:17 2010

LOCATOR



SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1 ft
- Removal of Top 1.5 ft
- Removal of Top 2 ft
- Removal of Top 3.5 ft
- Engineered Capping

- Access Road/ Staging Area

SED 9 includes bank removal/stabilization for Reaches 5A and 5B.

Figure 6-24a.

Sediment Alternative 9 (SED 9) in Reaches 5 and 6.

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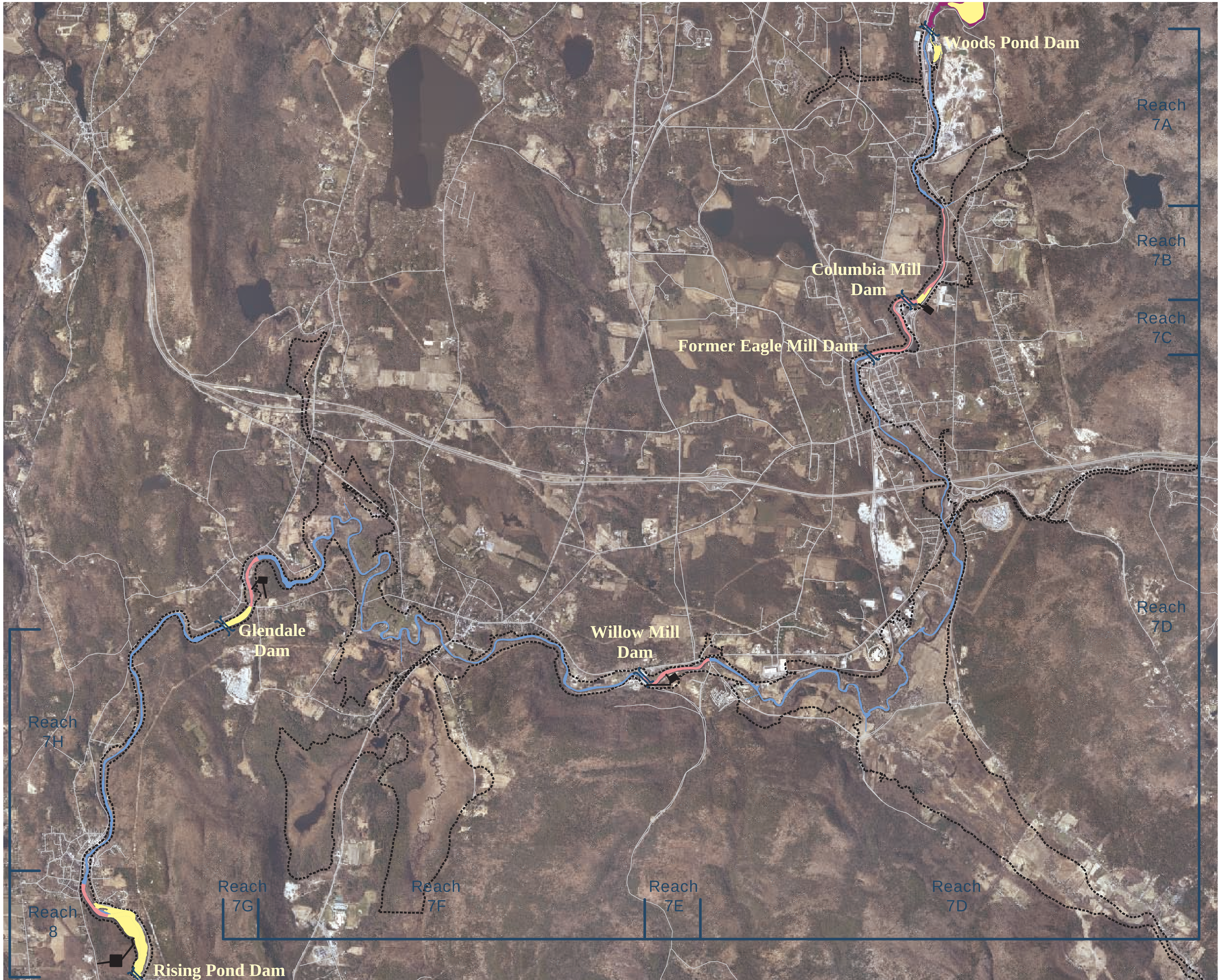

LOCATOR

N

SCALE

0 0.5 1 2 Miles

LEGEND

Basemap Information

- Housatonic River
- 100-yr Floodplain
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Removal of Top 1 ft
- Removal of Top 1.5 ft
- Removal of Top 3.5 ft
- Engineered Capping

Access Road/ Staging Area

Figure 6-24b. Sediment Alternative 9 (SED 9) in Reaches 7 and 8.

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OCTOBER 2010

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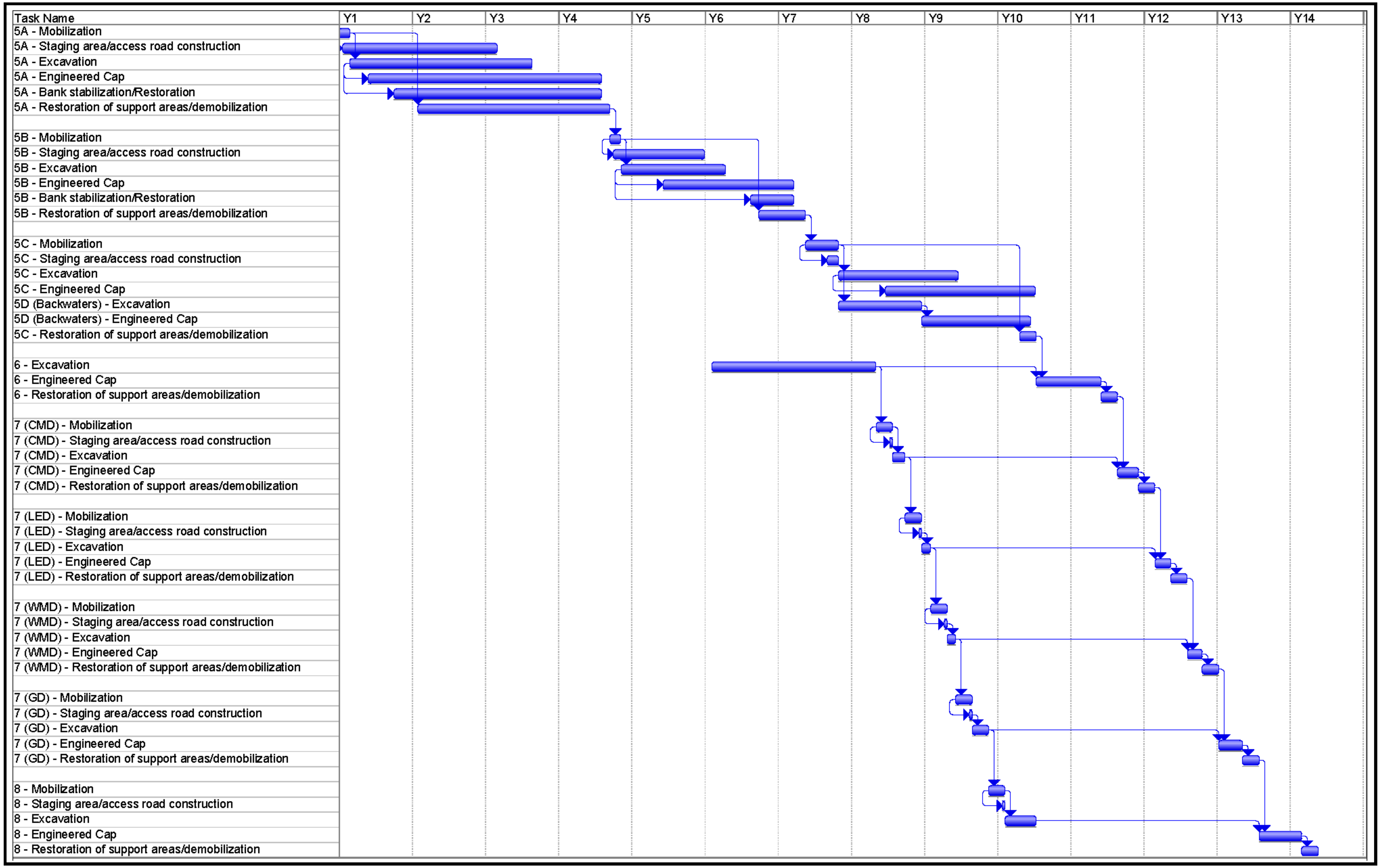

NOTES:

1.The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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PITTSFIELD, MASSACHUSETTS

REVISED CMS REPORT

CONSTRUCTION TIMELINE FOR SED 9

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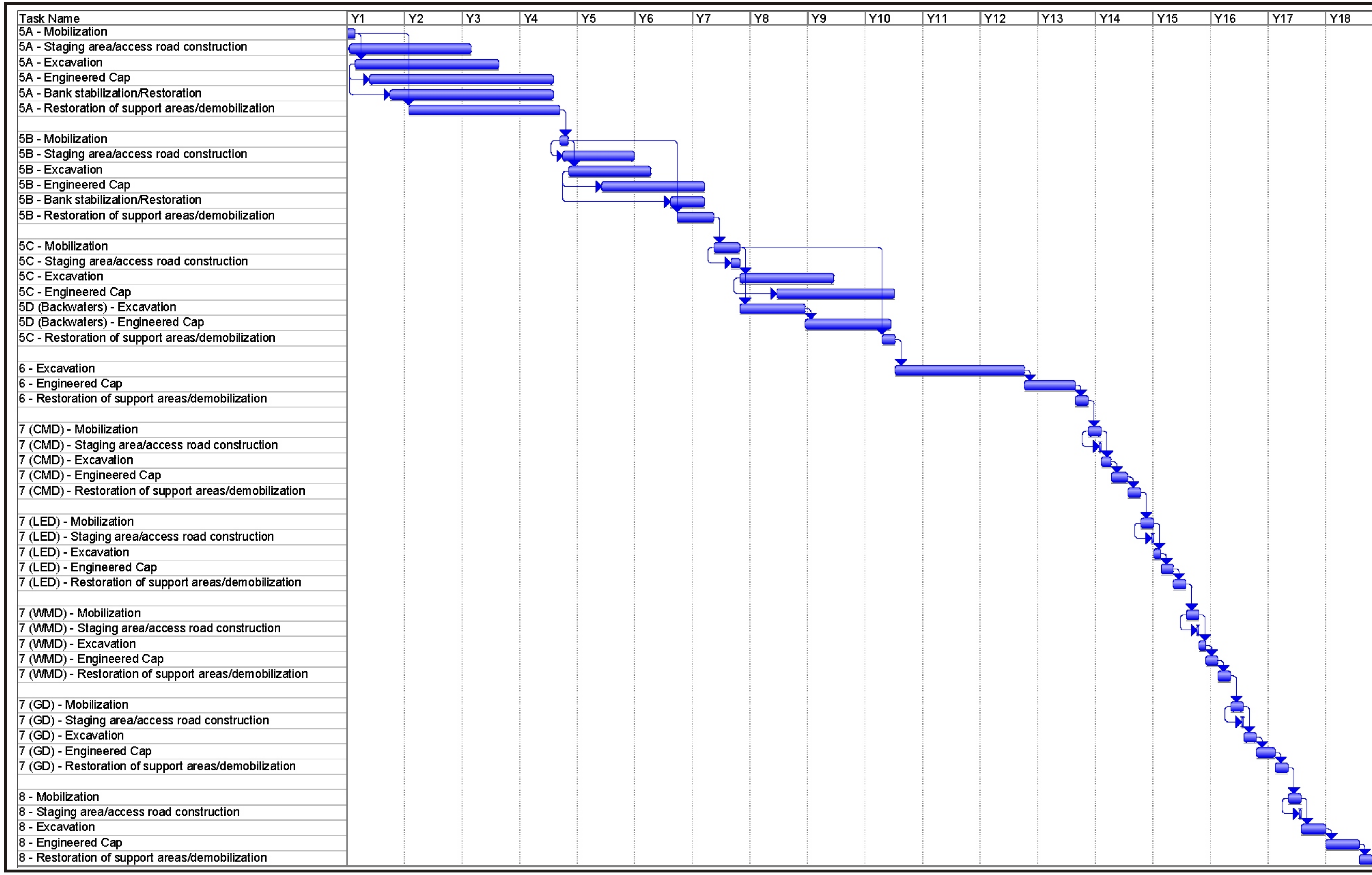
FIGURE
6-25

10/11/2010 SYRACUSE-NY-141ENV-DJHOWES, LJPOSENAUER
C:/B0030929/0002/00001/CDR/30929J23.CDR



NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years.

2. CMD = Columbia Mill Dam; LED = Lee/Eagle Dam; WMD = Willow Mill Dam; GD = Glendale Dam; Y = Year.

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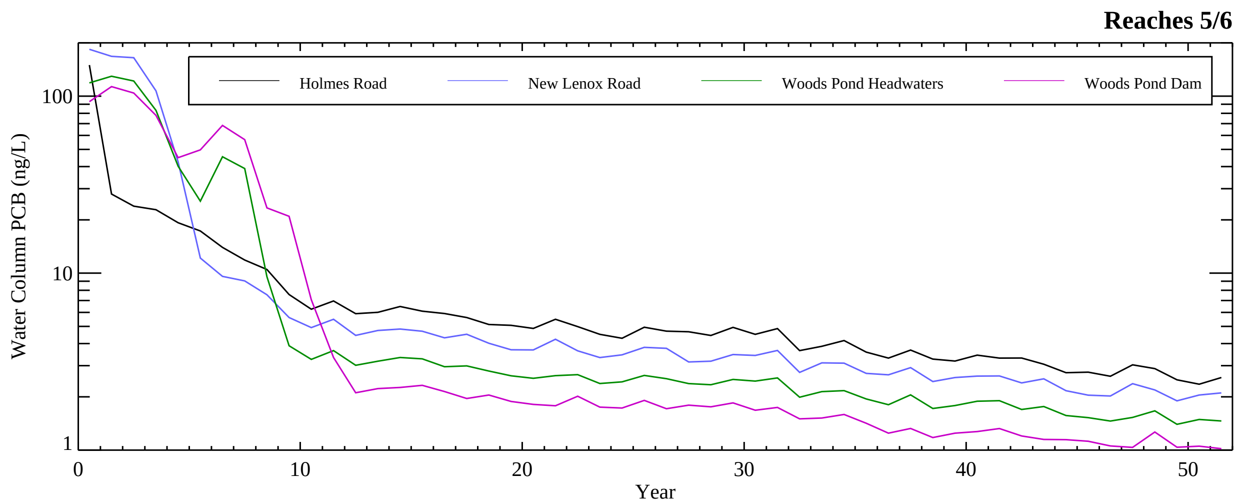
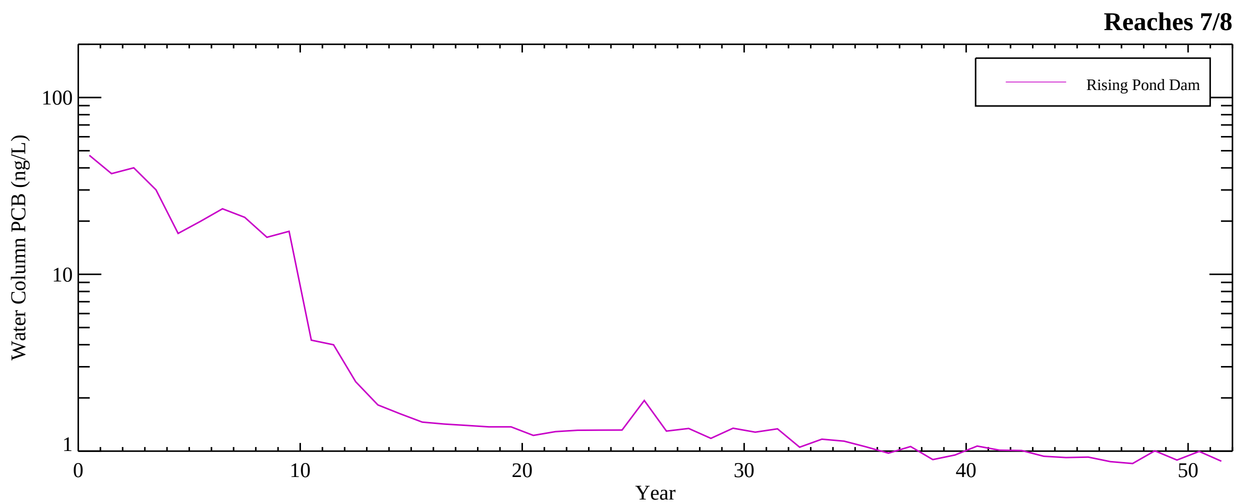
ALTERNATE CONSTRUCTION TIMELINE FOR SED 9

ARCADIS

FIGURE
6-26

09/22/2010 SYRACUSE-NY-141ENV-DJHOWES
C:/B0030929/0002/00001/CDR/30929J24.CDR





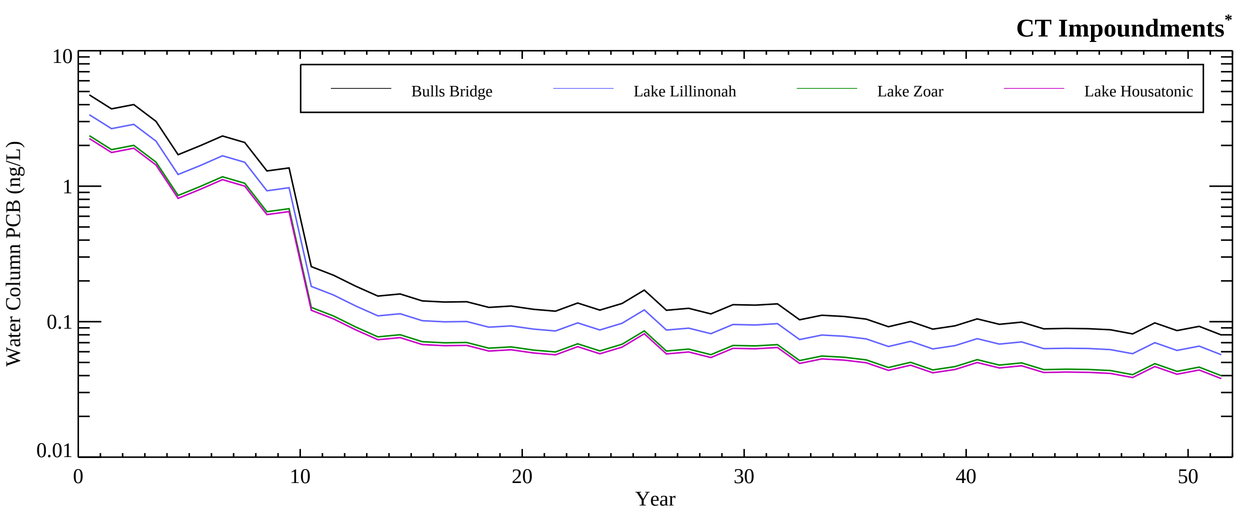


Figure 6-27a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 9.

* *Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
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Reaches 7/8 - \\helios\D_Drive\Jobs\GENcms\MODEL\EFDC_OUTPUT\r78\CMS\Proj_R78_SED9CMSBS_1008-01\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED09_1007-1_base\wchem_total

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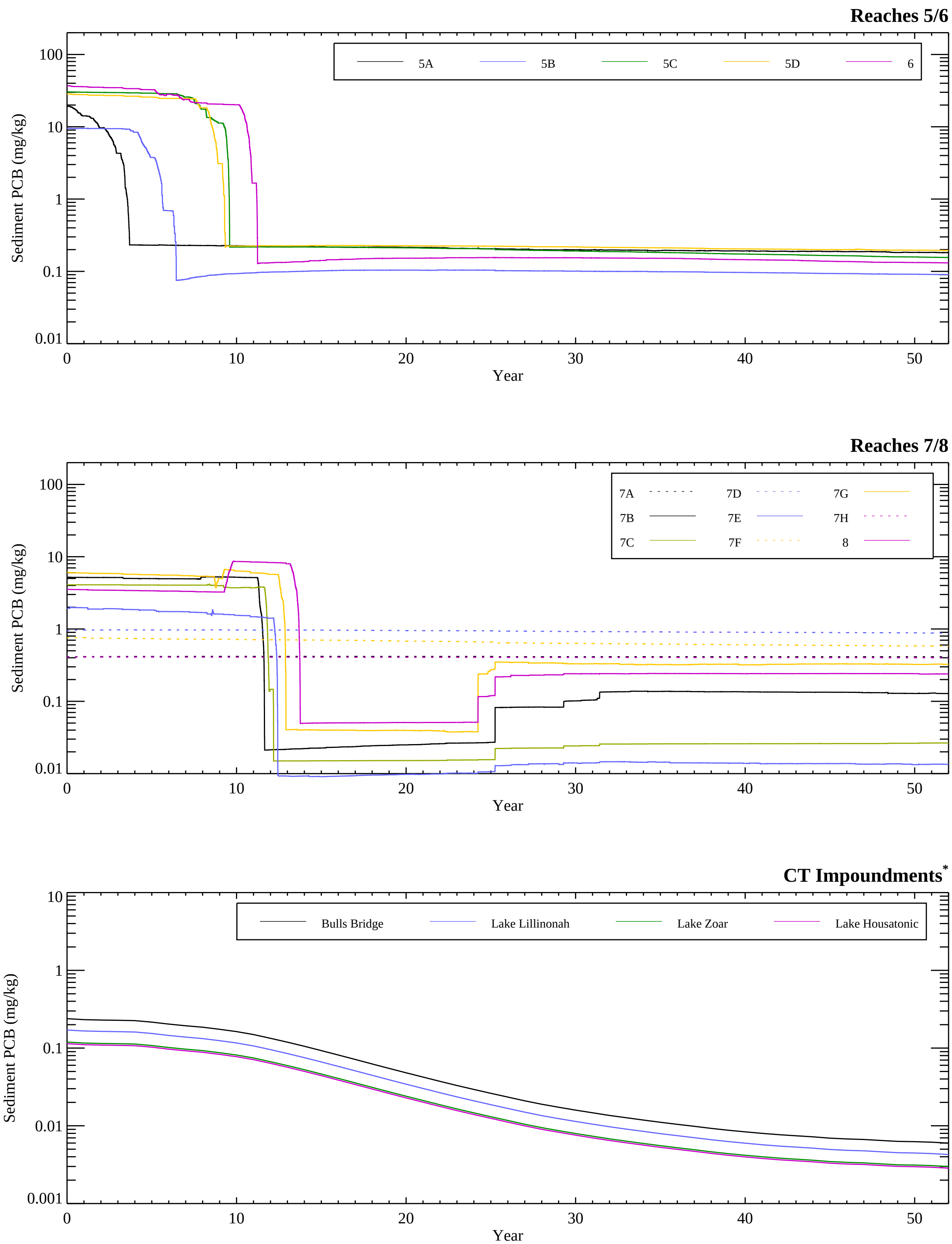

Figure 6-27b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 9.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
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Reaches 7/8 - \\helios\D_Drive\Jobs\GENcms\MODEL\EFDC_OUTPUT\r78\CMS\Proj_R78_SED9CMSBS_1008-01\bins
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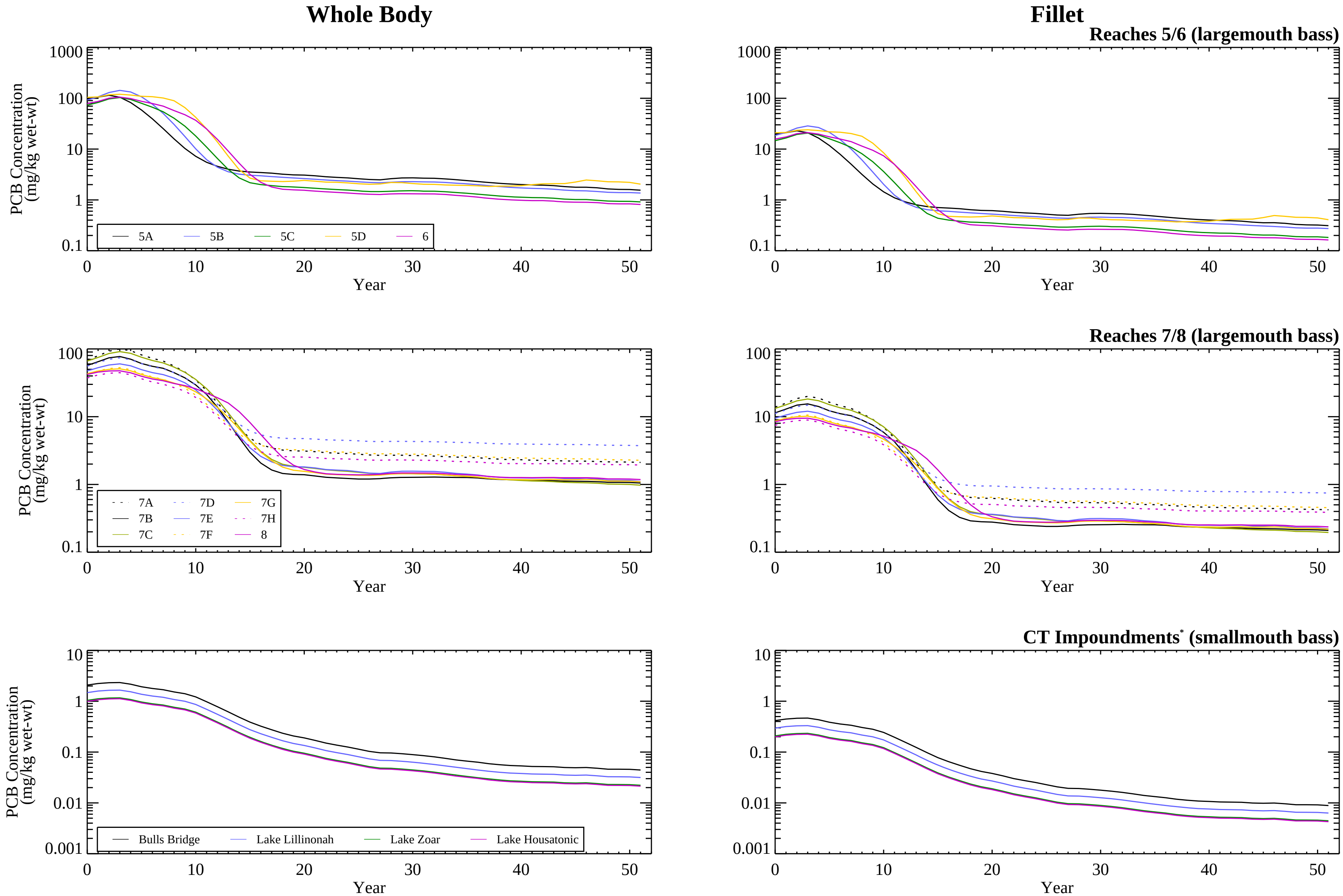
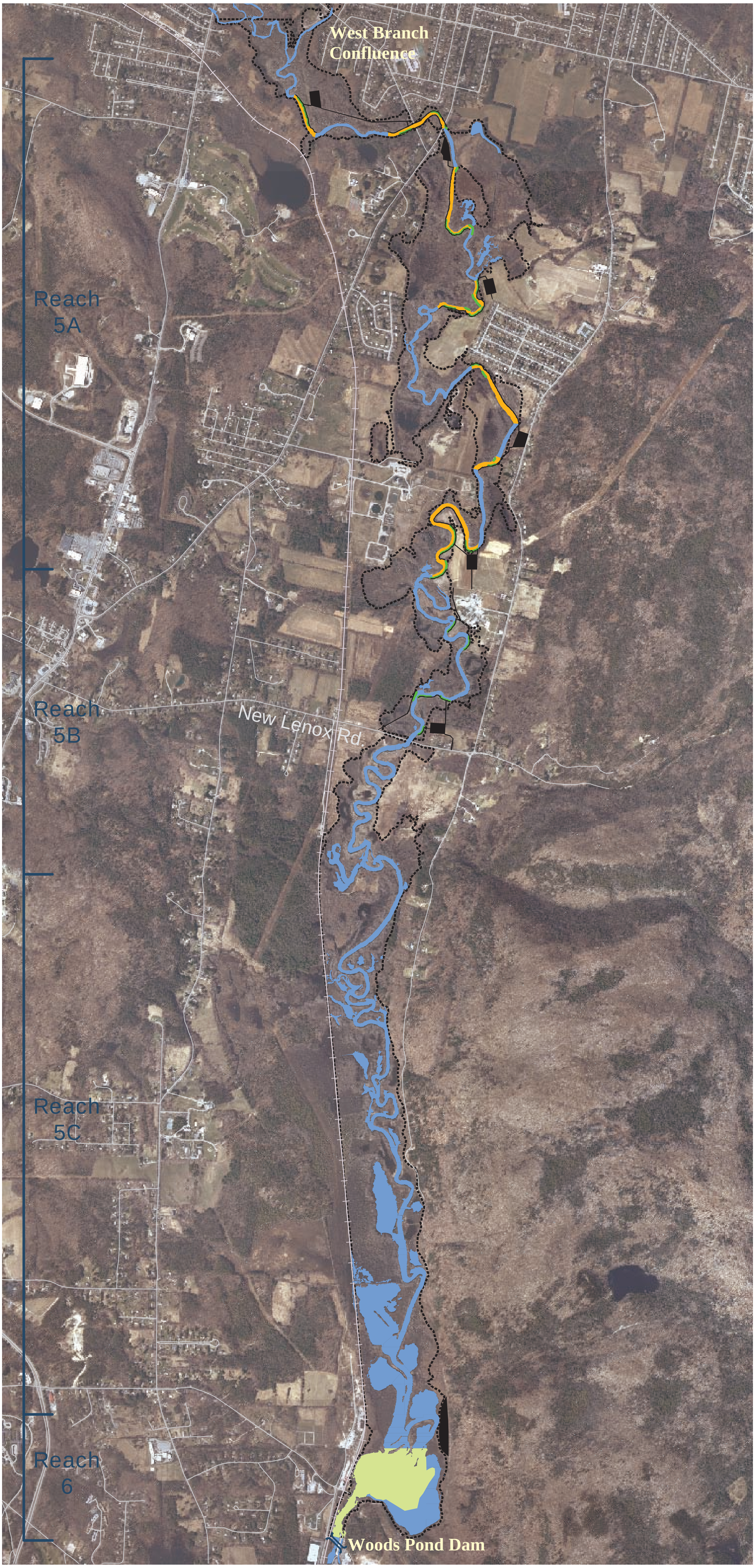
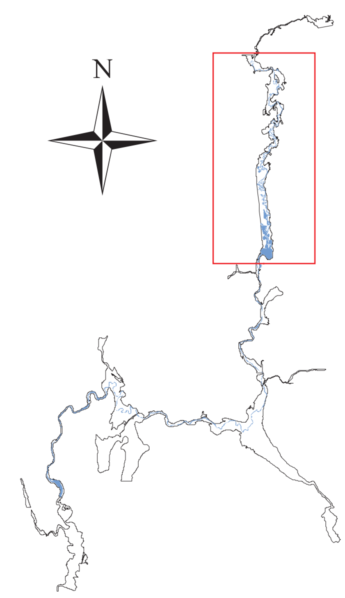


Figure 6-27c. Average PCB concentration in gamefish by subreach under SED 9.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*



LOCATOR



SCALE

0 0.25 0.5 Miles

LEGEND

Basemap Information

- Housatonic River
- 1 mg/kg PCB Isopleth
- Housatonic Railroad
- Major Road
- Dam

Remediation Information

Sediment Remediation Type

- Bank Remediation
- Removal of Top 2 ft
- Removal of Top 2.5 ft
- Access Road/ Staging Area

Figure 6-28.

Sediment Alternative 10 (SED 10) in Reaches 5 and 6.

ARCADIS

ANCHOR QEA

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BSS - H:\GENcms\DOCUMENTS\reports\Revised_CMS_Report\Figures\Section 6\sed_removals_R56_revised.mxd

10/08/2010 SYRACUSE-NY-141ENV-DJHOWES
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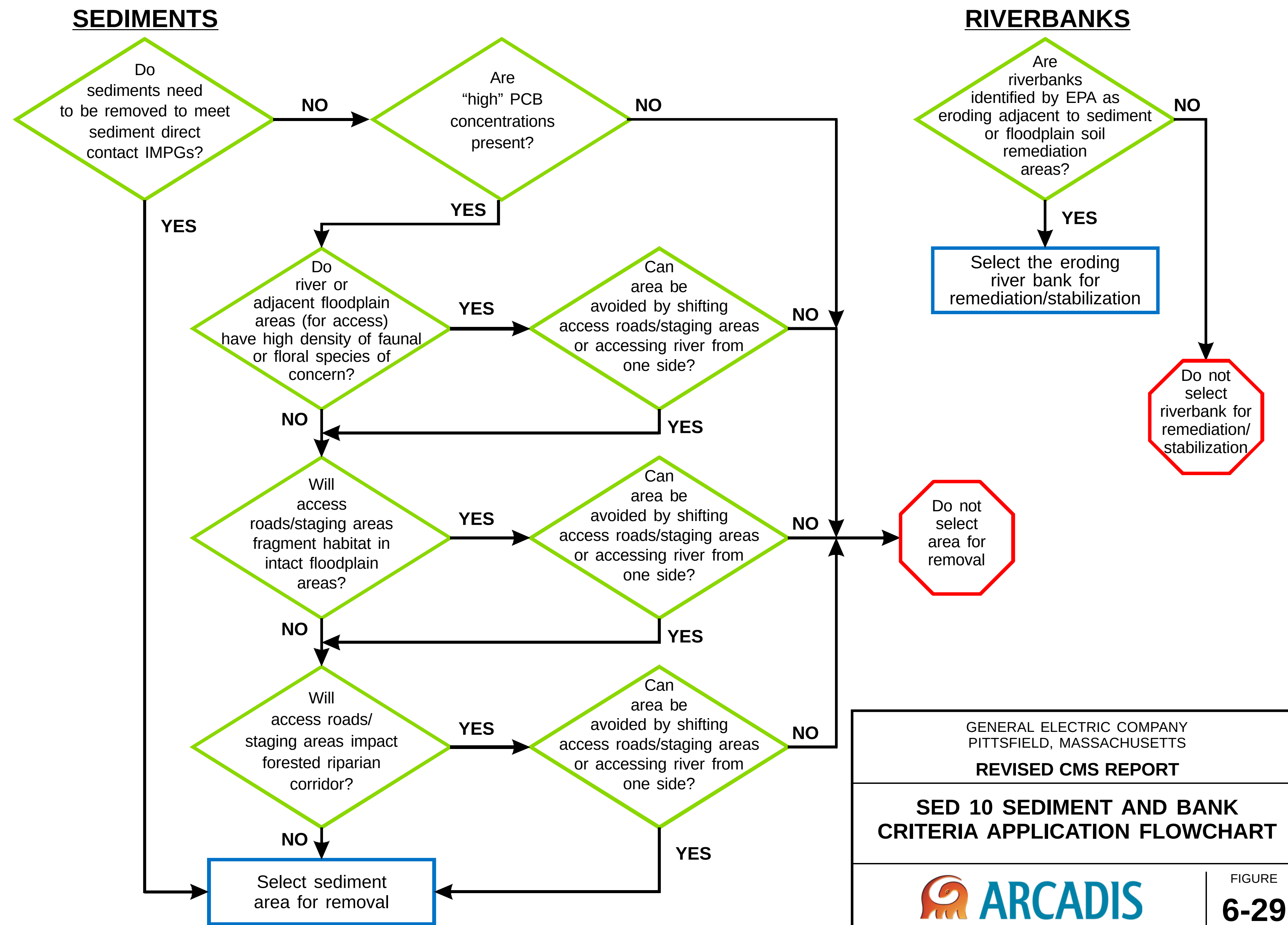

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SED 10 SEDIMENT AND BANK CRITERIA APPLICATION FLOWCHART

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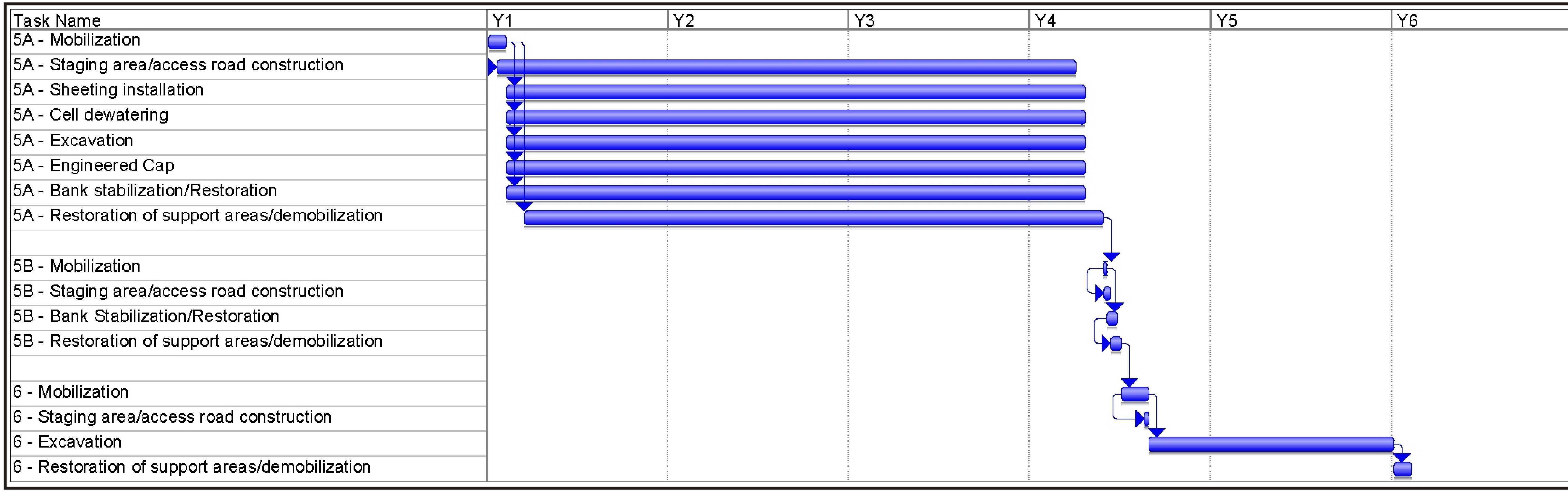
FIGURE
6-29



NOTES:

1. The general timeline associated with Reach 5A and 5B, and subsequent reaches, illustrates the overall timeframe when excavation, capping, and bank stabilization/restoration activities are occurring in terms of construction years. In Reaches 5A and 5B, the river channel will be divided in to a series of dry isolation cells for the performance of excavation, capping, and bank stabilization/restoration activities. However, as there are nearly 100 dry removal cells in Reach 5A alone, it is not possible to illustrate the sequential performance of remedial activities in each of these cells in a similar fashion.

2. Y = Year.

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CONSTRUCTION TIMELINE FOR SED 10

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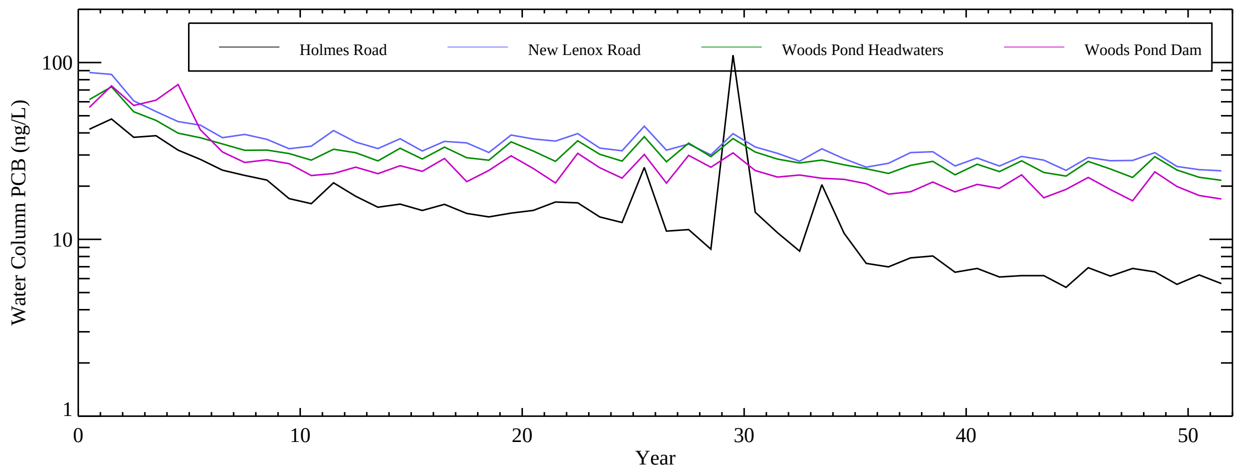
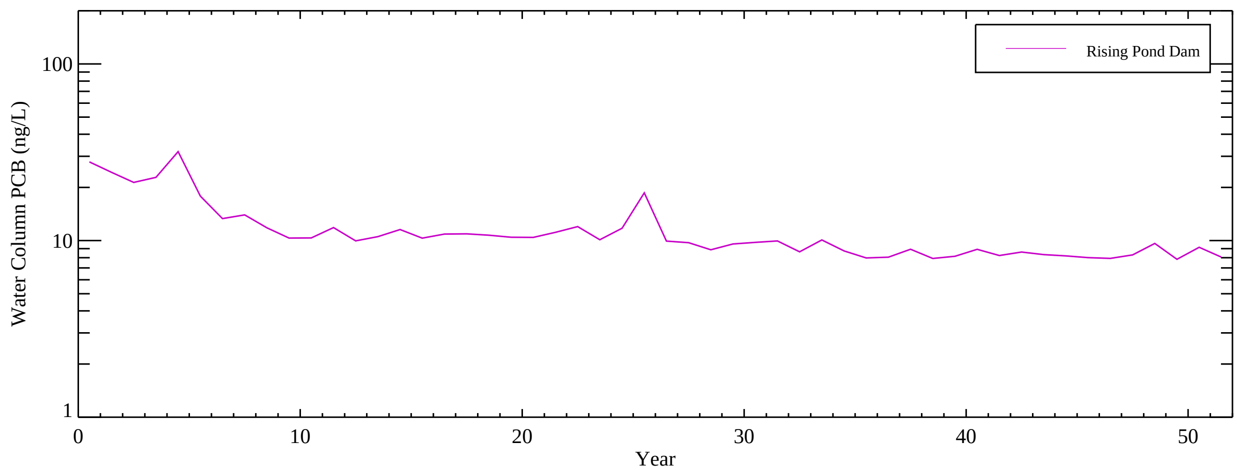
FIGURE
6-30

Reaches 5/6



Reaches 7/8



CT Impoundments*

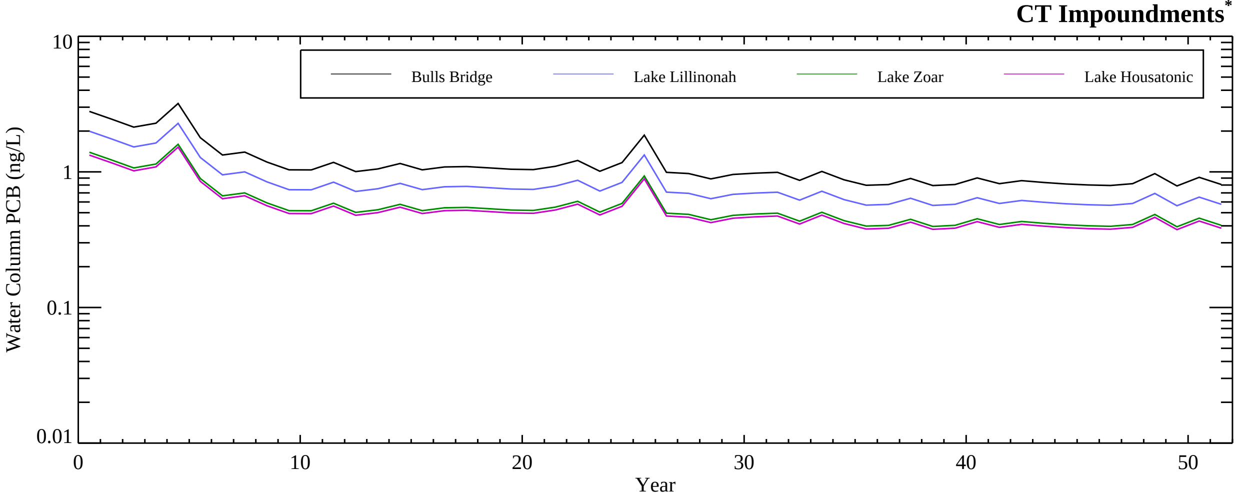


Figure 6-31a. Temporal profile of model-predicted annual average water column PCB concentration by subreach under SED 10.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
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Reaches 7/8 - \\helios\D_Drive\Jobs\GENcms\MODEL\EFDC_OUTPUT\r78\CMS\Proj_R78_SED10CMSBS_1006-03\bins
CT Impoundments - H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED10_1006-03_base\wchem_total

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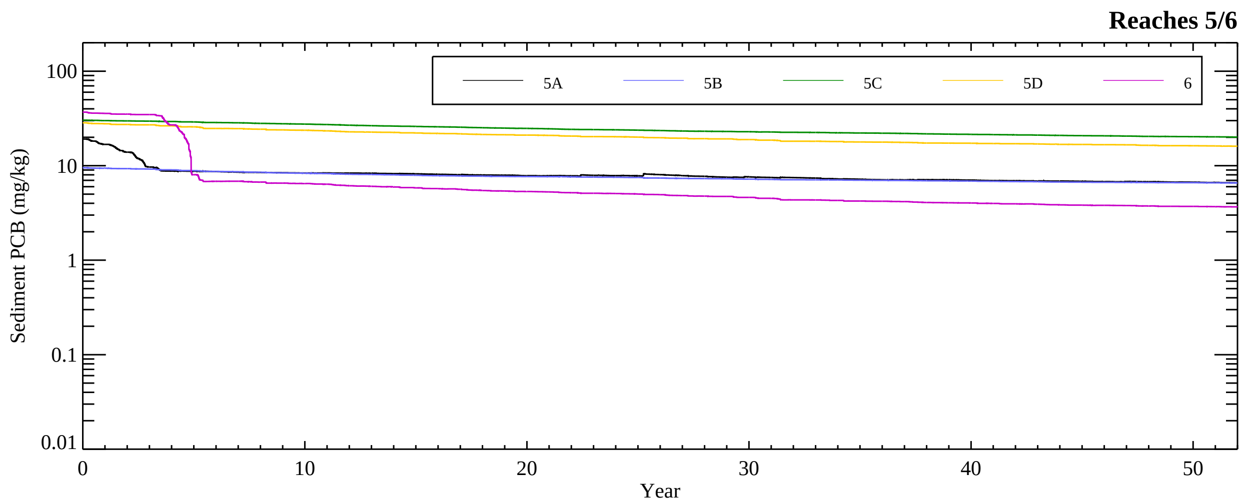

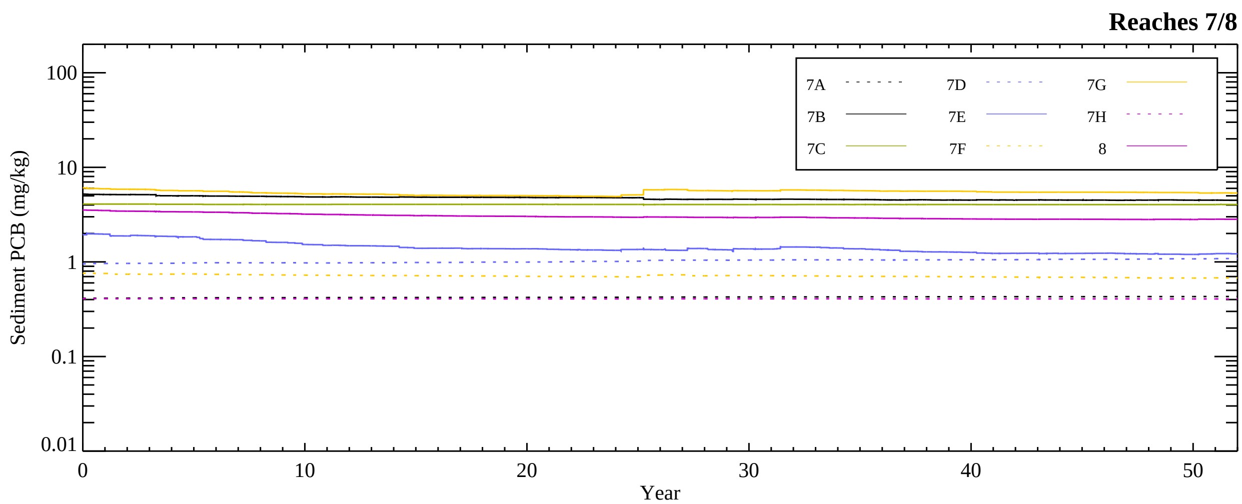

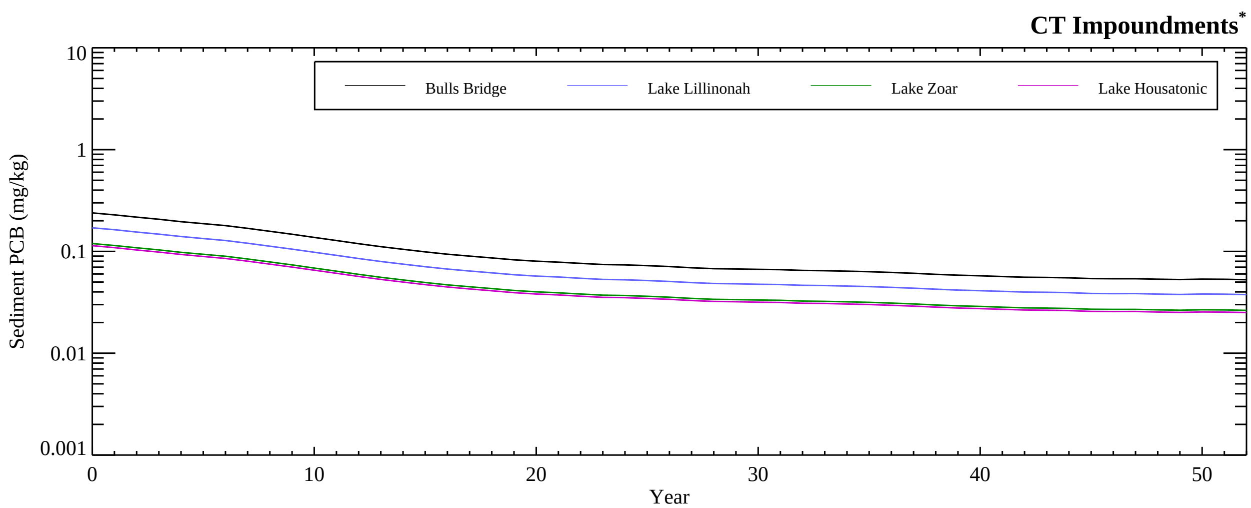

Figure 6-31b. Temporal profile of model-predicted surface (0-6") sediment PCB concentration by subreach under SED 10.

** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*
Model Results:
Reaches 5/6 - \\helios\D_Drive\Jobs\GENcms\MODEL\EFDC_OUTPUT\r56\CMS\Proj_R56_SED10CMSBS_1006-01\bins
Reaches 7/8 - \\helios\D_Drive\Jobs\GENcms\MODEL\EFDC_OUTPUT\r78\CMS\Proj_R78_SED10CMSBS_1006-03\bins
CT Impoundments -H:\GENcms\MODEL\Deposition_model\BBD\outputs\Projection\ProjCT_SED10_1006-03_base

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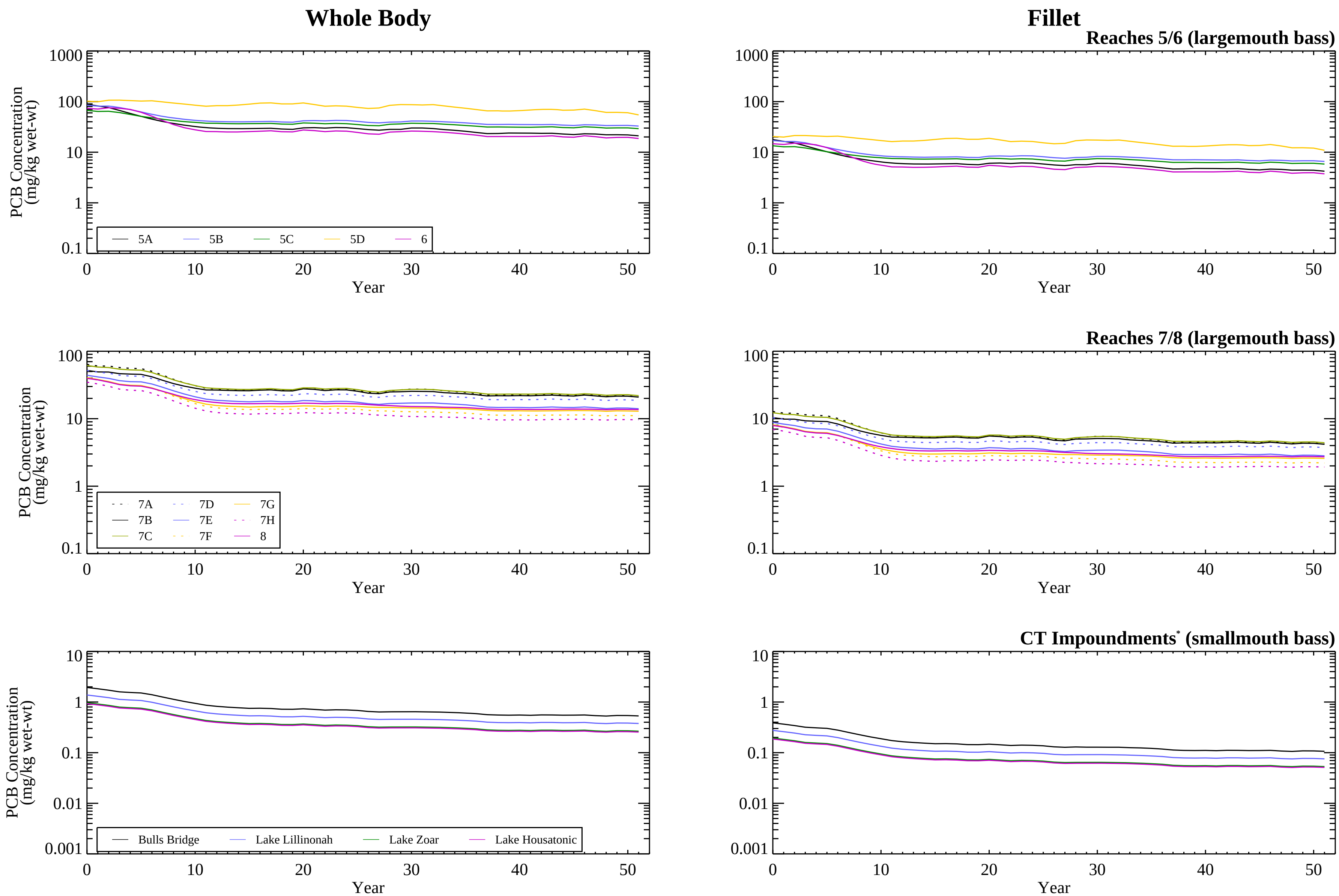

Figure 6-31c. Average PCB concentration in gamefish by subreach under SED 10.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*