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Feasibility Study Addendum Operable Unit E

Former Georgia-Pacific Wood Products Facility Fort Bragg, California

2 April 2025

Prepared for

Mendocino Railway
100 West Laurel Street
Fort Bragg, California 95437

KJ Project No. 1965021*21

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Section 1: Introduction

This Feasibility Study (FS) Addendum was prepared by Kennedy/Jenks Consultants, Inc. (Kennedy Jenks) on behalf of Mendocino Railway (MR) for Operable Unit E (OU-E) at the former Georgia-Pacific Wood Products Facility (site) located at 90 West Redwood Avenue in Fort Bragg, Mendocino County, California, as shown on Figure 1-1. This document is an addendum to the 2019 OU-E FS dated 12 September 2019 (Kennedy Jenks 2019), which was approved by the Department of Toxic Substances Control (DTSC) on 24 October 2019 (DTSC 2019). DTSC has requested preparation of an FS Addendum to evaluate additional alternatives (DTSC 2022, 2024a, 2024b)[1]. Therefore, this FS Addendum expands on the work presented in the 2019 OU-E FS and uses the same approach to evaluate the alternatives described in the 2019 OU-E FS. The purpose of this FS Addendum is to evaluate select new alternatives and, together with alternatives previously evaluated in the 2019 OU-E FS, identify feasible remedial methods for OU-E that will meet cleanup objectives, comply with applicable laws and requirements, and protect human health and the environment.

This FS Addendum was prepared as required by DTSC under the Second Amendment to the Site Investigation and Remediation Order Docket No. HAS-RAO 06-07-150 (Order Second Amendment) in accordance with the federal National Oil and Hazardous Substances Pollution Contingency Plan (NCP; U.S. Environmental Protection Agency [USEPA] 1990) and the Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) under the federal Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA; USEPA 1988).

The FS Addendum focuses on new alternatives for three Areas of Concern (AOCs) in OU-E: Pond 7 Aquatic Sediment AOC, North Pond and Pond 6 Aquatic Sediment AOC, and Pond 8 Aquatic Sediment AOC.

1.1 Background

The 415-acre site is located west of Highway 1 along the Pacific Ocean coastline and is bounded by Noyo Bay to the south, the City of Fort Bragg (City) to the east and north, and the Pacific Ocean to the west. OU-E is one of five operable units on the site (Figure 1-2) and consists of approximately 12 acres of man-made ponds and seasonal wetland areas and 45 terrestrial acres divided into eight Areas of Interest (AOIs)[2]. The ponds were constructed and operated by prior owners during mill operation to manage wastewater from site operations, provide a source of water for firefighting, and as a log pond. Pond 8 also currently provides stormwater management for runoff from the City. The historical use of the ponds was described

[1] Mendocino Railway provided responses to DTSC letters (Mendocino Railway 2023, 2024a, 2024b) and held a meeting with DTSC and other agencies on 26 April 2024 to discuss Pond 8 and next steps.

[2] Areas evaluated due to the presence of potential risk following completion of the remedial investigation (RI), Baseline Human Health and Ecological Risk Assessment (BHHERA), and subsequent OU-E Removal Action Work Plan (RAW) implementation are herein described as “Areas of Concern” or AOCs. In some cases, AOIs were grouped into AOCs due to similarities in nature and extent of chemicals of interest (COIs) and affected media for development of remedial alternatives.

in the *Preliminary Site Investigation Work Plan Operable Unit E – Onsite Ponds* (Arcadis BBL 2007a).

Additional site and OU-E information, including site setting and the conceptual site model, was presented in the 2019 OU-E FS. Select information from the 2019 OU-E FS is provided herein where relevant for the additional alternatives evaluation.

1.1.1 OU-E Regulatory Status

The 2019 OU-E FS (Kennedy Jenks 2019) and this FS Addendum are based on data presented in the *Final Remedial Investigation Report Operable Unit E* (OU-E RI Report; Arcadis 2013, DTSC 2013), the *Baseline Human Health and Ecological Risk Assessment – Operable Unit E* (OU-E BHHERA; Arcadis 2015, DTSC 2015) and data collected from subsequent investigations. Sediment constituents of concern (COCs) for OU-E include polychlorinated dibenzo-p-dioxin (dioxin) and polychlorinated dibenzofuran (furan), which is evaluated by estimating the 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxic equivalent (TEQ), and arsenic.

As presented in the BHHERA, the individual aquatic AOI evaluations indicate the hazard index (HI) for each pond is less than 1; a hazard index of 1 or less means estimated exposure to the contaminant at the screening level over a lifetime is not expected to cause harmful, noncancer health effects. This evaluation assumes a passive recreational visitor with an exposure frequency of 50 days per year for a period of 24 hours per day (meaning a person ignores fencing and/or signage restricting access to the ponds and enters the pond, and therefore comes into contact with pond sediment, at a frequency of 50 days each year, all day, for a lifetime); this exposure scenario is conservative given the presence of physical access restrictions and posted warnings which prohibit visitors from entering the ponds, located on private property. In addition to access restrictions and warnings, the pond is surrounded by, and the sediment is covered by, thick, difficult to penetrate vegetation. Further, exposure based on 24 hours of contact is unlikely as temperatures in the ponds are likely to cause acutely dangerous cold-related illness during much shorter exposures. Aquatic elevated lifetime cancer risks (ELCRs) for the passive recreational visitor, as analyzed on an individual pond basis, ranged from less than 1×10^{-6} (Ponds 5 and 9, individually) to 2×10^{-5} (Pond 7) and are all within the risk management range of 1×10^{-4} to 1×10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by CalEPA (CalEPA 1996a). The Ecological Risk Assessment (ERA) contained within the BHHERA for the aquatic AOIs concluded that unacceptable risks are not expected for populations of plants, benthic organisms, amphibians, birds, or mammals exposed to COCs in sediment (Arcadis 2015).

Hot spots identified in the OU-E BHHERA were removed in 2017. The BHHERA defined hot spots based on a comparison of soil/sediment data to not-to-exceed (NTE) values, approved by DTSC (Arcadis 2015, 2016; DTSC 2014). The OU-E Removal Action Work Plan (OU-E RAW; Arcadis 2016) was developed to expedite remediation of identified AOIs/AOCs to facilitate construction of the City's coastal trail and expedite remediation of the site. The AOIs/AOCs included in the OU-E RAW were the Lowland Terrestrial AOI, the Ponds 1, 2, 3, and 4 (Southern Ponds) AOC, the Riparian AOI, and the Pond 7 AOC. The OU-E RAW included an evaluation of remedial alternatives and proposed excavation and disposal as the selected remedial action. The NTE values defined target concentrations for the hot spot excavations; if confirmation sampling indicated residual concentrations were below the NTE value, excavation

was complete, but if confirmation sample results were greater than the NTE value a step out excavation was completed. The NTE value represented a value protective of the 12-day passive child/adult recreator for sediment where, if concentrations were below that value, concentrations did not represent unacceptable risk to human health and could remain in place. The Arsenic NTE value was 67 milligrams per kilogram (mg/kg); the dioxin TEQ value was 503 picogram per gram (pg/g). The OU-E RAW and, therefore, the excavation and disposal remedial alternative, was approved by DTSC on 13 October 2016 (DTSC 2016). A summary of completed activities is presented in the Final Remedial Action Completion Report (RACR; Kennedy Jenks 2018, DTSC 2018). Excavated soil and sediment was non-hazardous and disposed at an appropriate landfill (Kennedy Jenks 2018). The Lowland Terrestrial Soil AOI and its four associated AOIs and the Riparian AOI were recommended for No Further Action (NFA) in the 2018 RACR, which was approved by DTSC (DTSC 2018).

Additional sediment sampling activities were completed in 2019 in Pond 6, North Pond, and Pond 8 per DTSC request. The results were summarized in the Pond 6, North Pond, and Pond 8 Sediment Sampling Report (Kennedy Jenks 2020a), which was approved by DTSC on 26 May 2020 (DTSC 2020a). Data collected was consistent with or lower than past results. The Pond 6, North Pond, and Pond 8 Sediment Sampling Report concluded that site sediment present low risk to the offshore environment and that the additional data continued to support the remedial alternative recommended in the 2019 OU-E FS.

A draft OU-E RAP was submitted to DTSC on 8 September 2020 (Kennedy Jenks 2020b). DTSC provided comments on 7 October 2020 (DTSC 2020a), and a revised Draft OU-E RAP was submitted to DTSC on 14 October 2020 (Kennedy Jenks 2020c). Ponds 5 and 9 AOIs were recommended for NFA in the Draft OU-E RAP and were approved for NFA by DTSC (DTSC 2020b). Approval of the OU-E RAP is dependent on completion of the California Environmental Quality Act (CEQA) process. DTSC is the lead agency for activities associated with the OU-E FS, whereas the City is the lead agency for CEQA. To initiate the CEQA process, a Coastal Development Permit (CDP) was submitted to the City in July 2022 (CDP 9-22) to complete the Mill Pond Dam improvements associated with the recommended/preferred alternative in the 2019 FS and Draft OU-E RAP. Additional information was provided per City request in January 2023 (Kennedy Jenks 2023). During this process, DTSC requested evaluation of additional alternatives in an OU-E FS Addendum.

As described in the 2019 OU-E FS, the AOIs have been grouped into AOCs by media (lowland terrestrial, aquatic, and groundwater) and by nature and extent of constituents. The AOI/AOC locations and site features are shown on Figure 1-3. The additional alternatives evaluated in this FS Addendum are relevant for the following AOCs:

- Pond 7 Aquatic Sediment
- North Pond and Pond 6 Aquatic Sediment
- Pond 8 Aquatic Sediment

1.1.2 Ponds

The following sections provide pond descriptions, risk summaries, and removal action areas (RAAs) for Pond 7, the North Pond, Pond 6, and Pond 8. The OU-E RAW evaluated risk, presented estimated areas and volumes for excavation, and evaluated the selected remedial action for aquatic sediment in Pond 7. For aquatic AOCs, RAAs were developed based on risk drivers identified in the OU-E BHHERA. Additional information is provided in the 2019 FS and the Draft OU-E RAP.

An exposure point concentration (EPC) was calculated for a combined Pond 6, Pond 7, and North Pond dataset and presented in the Pond 6, North Pond, and Pond 8 Sediment Sampling Report (Kennedy Jenks 2020a). The arsenic EPC is 25 mg/kg, which is greater than the unrestricted goal (10 mg/kg; Kennedy Jenks 2020b) but within the range of concentrations used to calculate the background value (0.6 mg/kg to 31 mg/kg; Arcadis BBL 2007b). The dioxin TEQ EPC is 109 pg/g, which is greater than the unrestricted/residential cleanup goal of 50 pg/g (Kennedy Jenks 2020b) but less than the commercial/industrial screening level of 200 pg/g (Kennedy Jenks 2019).

1.1.2.1 Pond 7

Pond 7 (0.13 acres) is located in the OU-E Lowlands and was part of active mill operations from the mid-1970s until 1996.

1.1.2.1.1 Risk Summary

Pond 7 was evaluated as an individual aquatic AOI in the OU-E BHHERA. As presented in the OU-E BHHERA, arsenic and dioxin TEQ are the primary Pond 7 AOC risk drivers via incidental sediment ingestion for intervals 0 to 0.5 feet (ft) below sediment surface (bss) and 0 to 2 ft bss. The OU-E BHHERA concluded that non-cancer HIs are below 1, while cumulative ELCRs for an occasional recreator are 2×10^{-5} (0 to 0.5 ft bss and 0 to 2 ft bss) assuming a 50-day-per-year exposure frequency. The ELCRs are within the risk management range of 1×10^{-4} to 1×10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by the California Environmental Protection Agency (CalEPA 1996a).

The ELCRs and HIs presented in the OU-E BHHERA assumed Pond 7 sediment remained in place. However, because the entire footprint of Pond 7 was excavated in 2017, actual residual ELCRs and HIs are lower than presented in the OU-E BHHERA.

1.1.2.1.2 Removal Action Area and Remedial Alternative Development

Prior to Pond 7 sediment removal in 2017, water depth was typically 6 ft and sediment was approximately 7 ft thick. Currently, water is approximately 10 ft deep, and approximately 3 ft of fill was placed in Pond 7 following excavation activities. The surrounding land surface is approximately 2 ft above the observed water level.

Post-excavation confirmation samples were collected, as described in the RACR. Confirmation samples indicate residual dioxin TEQ concentrations (between 93 and 350 pg/g) above the unrestricted use goal (50 pg/g) but below the NTE sediment goals established in the OU-E RAW

(503 pg/g) as protective of the 12-day recreator for sediment (Arcadis 2016). Additional excavation was not feasible (Kennedy Jenks 2018).

The area where concentrations remain above unrestricted use goals is assumed as the new remedial action area (RAA) for Pond 7 (results of remediation activities and confirmation samples are presented in the RACR). An area of approximately 5 ft wide and 180 ft long along the south perimeter of the pond where concentrations remain above unrestricted use goals is assumed as the new RAA for Pond 7. Assuming a depth of approximately 5 ft, it is estimated that approximately 170 cubic yards (CY) of sediment containing COCs above unrestricted cleanup goals remains in Pond 7.

1.1.2.2 Pond 6 and North Pond

The North Pond (0.06 acres) and Pond 6 (0.17 acres) are located in the OU-E Lowlands, north of Pond 7.

1.1.2.2.1 Risk Summary

As presented in the OU-E BHHERA, arsenic and dioxin TEQs are the primary risk drivers within Pond 6 sediment, while arsenic is the primary risk contributor in North Pond sediment. Assuming an exposure frequency of 50 days per year, ELCRs for the North Pond and Pond 6 were within the range of 2×10^{-6} to 4×10^{-6}. The ELCRs are within the risk management range of 1×10^{-4} to 1×10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by CalEPA (CalEPA 1996a).

The Pond 6 arsenic EPC in the 0 to 0.5 ft bss interval is 37.2 mg/kg (equal to the maximum detected concentration of arsenic in Pond 6) and in the 0 to 2-ft bss range is 28.2 mg/kg; these EPCs are less than the NTE sediment goal for arsenic established in the OU-E RAW (67 mg/kg) as protective of the 12-day recreator (Arcadis 2016). The dioxin TEQ EPC is 175 pg/g in both the 0 to 0.5 ft bss and 0 to 2 ft bss intervals; this is less than the NTE sediment goal for dioxin TEQ established in the OU-E RAW (503 pg/g) as protective of the 12-day recreator (Arcadis 2016). At the North Pond, the EPC and maximum concentration of arsenic is 103 mg/kg (EPC equal to maximum in North Pond), which is greater than the NTE sediment goal for arsenic established in the OU-E RAW. The ERA concluded that unacceptable ecological risk is not likely for populations of plants, benthic organisms, birds, mammals and amphibians exposed to site sediment and surface water.

1.1.2.2.2 Removal Action Area and Remedial Alternative Development

In the North Pond, the maximum water depth is typically 1.5 ft and sediment is approximately 8.5 ft thick. In Pond 6, the maximum water depth is typically 2 ft and sediment is approximately 10 ft thick. The surrounding land surface is approximately 3 ft above the observed water.

While concentrations of arsenic in the ponds vary by location, generally arsenic is highest in sample depths less than 5 ft. The area exceeding remedial goals is assumed to be over the footprint of the ponds to depths between 2 and 5 ft. The areas for remedial alternative development in the North Pond and Pond 6 are approximately 3,000 square feet (sf) and 7,000 sf, respectively. Assuming a depth of approximately 6 ft, it is estimated that approximately

2,200 CY of sediment containing COCs above unrestricted cleanup goals remains in the North Pond and Pond 6.

1.1.2.3 Pond 8

Pond 8 (7.3 acres), also known as the Log Pond or Mill Pond, was created in the late 1800s by the damming of Alder and Maple Creeks. Pond 8 receives stormwater runoff from the site and the City as well as overflow from Pond 5. Water from Pond 8 discharges over the dam spillway to the beach adjacent to Fort Bragg Landing. The total contributing watershed to Pond 8 is approximately 417 acres, consisting of 190 acres (including Pond 8) within the Mill Site property and 227 acres outside the Mill Site property (related to stormwater management for the City). Total direct rainfall to the surface of the pond is less than 2 percent (%) of the total inflow to the pond.

1.1.2.3.1 Risk Summary

As presented in the OU-E BHHERA, arsenic and dioxin TEQ were the primary risk drivers via incidental sediment ingestion in Pond 8 sediment. Pond 8 ELCRs are 2×10^{-6} in both the 0 to 0.5 ft bss and 0 to 2 ft bgs depth intervals using the 50-day-per-year exposure frequency. The ELCRs are within the risk management range of 1×10^{-4} to 1×10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by CalEPA (CalEPA 1996a).

While the OU-E BHHERA findings indicated dioxin does not pose an unacceptable risk based on the expected future use for Pond 8, the pond does not meet the criteria for unrestricted use. The dioxins TEQ EPCs (110 pg/g in 0 to 2 ft bss; 118 pg/g in 0 to 0.5 ft bss) are above the California residential screening level of 50 pg/g, but less than the NTE sediment goal for dioxin TEQ established in the OU-E RAW (503 pg/g) as protective of the 12-day recreator (Arcadis 2016) and below the commercial/industrial screening level of 200 pg/g. The maximum concentration of dioxin TEQ in Pond 8 is 243 pg/g, which is less than the NTE sediment goal for dioxin TEQ established in the OU-E RAW (503 pg/g) as protective of the 12-day recreator. Arsenic EPCs ranged from 11.2 mg/kg (0 – 2 ft bss) to 12.3 mg/kg (0 – 0.5 ft bss), which are similar to the background screening criteria for arsenic in soil (10 mg/kg) and below the NTE sediment goal for arsenic established in the OU-E RAW (67 mg/kg) as protective of the 12-day recreator (Arcadis 2016). As presented in the Background Metals Report, background concentrations of arsenic in California soil range from 0.6 mg/kg to 31 mg/kg (Arcadis BBL 2007b).

The results presented in the BHHRA for Pond 8 are mitigated by the following factors:

- From a practical standpoint, human exposure to the Pond 8 sediments for any duration is unlikely and remote due to site-specific factors that discourage access such as barrier fencing, warning signs, dense vegetation, steep banks, and cold surface water and air temperatures for much of the year. Potential future restrictions on boating, swimming, wading, fishing, and other active recreation in Pond 8 for the protection of public safety from physical hazards such as drowning and entrapment in deep, soft sediment and the protection of wildlife are also consistent with a more limited estimate of exposure.
- From a risk analysis standpoint, arsenic concentrations in Pond 8 are comparable to background; arsenic ELCRs are not associated with site conditions for the Pond 8 AOC.

When the Pond 8 occasional recreator is evaluated without considering background arsenic exposures, the resulting cumulative ELCR in Pond 8 is 1 x 10^{-6} [equal to the low end of the risk management range of 1 x 10^{-4} to 1 x 10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by CalEPA (CalEPA 1996a)].

- The range of concentrations of COCs in Pond 8 are generally similar in magnitude throughout the pond, but decrease within that range to the west, where water is shallowest. Concentrations increase toward the east where the discharges from Alder and Maple creek enter the pond and water is deepest.

Additional samples were collected in 2019 and the EPCs were updated (Kennedy Jenks 2020a). Arsenic EPCs for Pond 8 West (12 mg/kg), Pond 8 East (9.1 mg/kg), and Pond 8 (9.7 mg/kg) are approximately equal to the draft remedial goal (10 mg/kg). The dioxin TEQ EPC is lower in the west portion of Pond 8, near the ocean (58 pg/g), and higher in the east portion of Pond 8, near the storm drain outfalls into the pond (142 pg/g). With the addition of new and deeper data representative of all Pond 8 sediment, the dioxin TEQ EPC for the whole pond presented in the Pond 6, North Pond, and Pond 8 Sediment Sampling Report (107 pg/g) is less than the previously calculated value presented in the BHHERA (Arcadis 2015). The updated dioxin TEQ EPC is greater than the California residential screening level of 50 pg/g but below the NTE sediment goal for dioxin TEQ established in the OU-E RAW (503 pg/g) as protective of the 12-day recreator (Arcadis 2016) and below the commercial/industrial screening level of 200 pg/g.

1.1.2.3.2 Removal Action Area and Remedial Alternative Development

In Pond 8, the water depth is typically less than 1 ft in the west and up to approximately 5 ft in the east, and sediment depths range from approximately 6 ft to 24 ft thick. The top of the dam and surrounding land surface is approximately 10 ft above the observed water surface. While concentrations of dioxin in the pond are generally highest in the east near the storm drain outfalls and lowest in the west close to the ocean, significant variability is not observed laterally or vertically, particularly as compared to the screening levels, and no discernable patterns are observed.

Based on the area exceeding remedial goals and the relative uniformity of sediment quality, the area for remedial alternative development for Pond 8 is the entire 280,000 sf pond area. Sediment thickness ranges up to approximately 25 ft and is typically on the order of 10 ft on average. The total volume of sediment in Pond 8 is estimated to be 106,000 CY.

1.1.3 Evaluation Approach

The additional alternatives included in this FS Addendum will be evaluated consistent with the approach taken in the 2019 OU-E FS. The approach generally follows the process outlined below:

1. Definition of the objectives and requirements of remediation (Section 3 of the 2019 OU-E FS)

2. Identification and screening of remedial technologies and process options (Section 5 of the 2019 OU-E FS)

3. Identification of screening criteria (Section 6 of the 2019 OU-E FS)

4. Further development and evaluation of the remedial alternatives retained for consideration after the above steps (Section 7 of the 2019 OU-E FS).

A brief description of these steps is provided in the following sections. Additional information on the evaluation approach is provided in the 2019 OU-E FS.

1.1.3.1 Objectives and Requirements of Remediation

The objectives and requirements of remediation were presented in Section 3 of the 2019 OU-E FS and have not changed. These objectives and requirements drive the development and screening of remedial alternatives and are briefly summarized in the following sections.

- **Applicable or Relevant and Appropriate Requirements (ARARs):** As required by CERCLA, ARARs include chemical-specific ARARs, performance, design, or action-specific ARARs, and location-specific ARARs. Some requirements are called to-be-considered (TBC) criteria; the TBC requirements are non-promulgated advisories or guidance issued by federal, state, or local government that are not legally binding, but may provide useful information or recommend procedures for remedial action.

  ARARs were presented in Table 3-1 of the 2019 OU-E FS. A table presenting ARARs in more detail was provided to DTSC in July 2024 (Kennedy Jenks 2024); DTSC subsequently provided the ARARs table to the California Coastal Commission (CCC), the City, the California Division of Safety of Dams (DSOD), the California Department of Fish and Wildlife (CA DFW), National Oceanic and Atmospheric Administration (NOAA), the United States Army Corps of Engineers (USACE), the Sherwood Valley Band of Pomo Indians, and the North Coast Regional Water Quality Control Board (RWQCB). To date, feedback has been received from DTSC, CCC, the City, the Sherwood Valley Band of Pomo Indians (through DTSC), and the RWQCB; DSOD acknowledged receipt.

- **Remedial Action Objectives (RAOs):** RAOs are medium-specific goals for protecting human health and the environment that, in consideration with the estimated remedial scope and cost for screening alternatives and existing data, are used to define the scope of remediation work. Additional discussion is presented in the 2019 OU-E FS and in the Draft OU-E RAP.

- **Chemical-Specific Remedial Goals:** Remedial goals were defined for arsenic and dioxin TEQ in sediment in Table 3-2 of the 2019 OU-E FS and in Table 3-2 of the Draft OU-E RAP.

1.1.3.2 Identification and Screening of Remedial Technologies and Process Options

Identification and screening of remedial technologies and process options were presented in Section 5 of the 2019 OU-E FS. Process options are first screened based on technical implementability. The screening for technical implementability is based on 1) the site-specific RAOs and ARARs, 2) site-specific conditions, such as geologic setting and contaminant distribution, and 3) contaminant characteristics. During the preliminary identification and screening process, remedial technologies that cannot be technically implemented are eliminated from further evaluation. If retained after the first screening step, the technology and/or process

option is further evaluated and refined based on effectiveness, implementability, and relative cost. Remedial technologies or process options retained after both screening steps are developed into remedial alternatives and evaluated against screening criteria, as presented in Section 7 of the 2019 OU-E FS. The remedial technologies and process options considered previously are summarized in Section 2.1. The remedial technologies and process options associated with new alternatives are presented in Section 2.2 and are evaluated following the same approach.

1.1.3.3 Screening Criteria

Remedial alternative screening criteria were presented in the 2019 OU-E FS and have not changed for this FS Addendum. In accordance with USEPA FS and DTSC RAP guidance, the nine criteria listed below must be used to evaluate remedial alternatives (USEPA 1988; DTSC 1995). For an alternative to be selected, it must meet the first two threshold criteria, which are: 1) overall protection of human health and the environment; and 2) compliance with ARARs. Criteria 3 through 7 are the five primary balancing criteria that provide comparisons between the alternatives and identify tradeoffs between them; Criteria 8 and 9 are the two modifying criteria that consider acceptance by the state and local community.

1.1.3.3.1 Threshold Screening Criteria

Threshold screening criteria are those considered absolutely necessary for an alternative to be considered sound. Threshold criteria are typically considered “yes or no” criteria. If a screened technology fails a threshold criterion, the technology is considered as not viable for further consideration. The two threshold criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs

As requested by DTSC, potential climate change impacts and sea level rise will be considered in the evaluation of the alternatives (Kennedy Jenks 2025a).

1.1.3.3.2 Balancing Criteria

Balancing criteria represent a combination of technical measures and management controls for addressing the environmental issues at the site. The five balancing criteria are:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

1.1.3.3.3 Modifying Criteria

Modifying criteria, which include state (support agency) and community acceptance, will be evaluated after submission of the FS Addendum to DTSC and submittal of a RAP and receipt of public comments. The modifying criteria are:

- State support/agency acceptance
- Community acceptance
- Other criteria[3]

1.1.4 Additional Project Objectives

In addition to CERCLA criteria for evaluating remedial alternatives, there are other objectives that must be considered when evaluating a comprehensive project to address aquatic sediment in OU-E. Ultimately, a project must be identified to address two agency requirements related to long-existing ponds at the Mill Site: 1) manage human health and environmental risk due to arsenic and dioxins/furans in Pond 6, Pond 7, Pond 8, Southern Ponds (Ponds 1-4), and North Pond sediment and petroleum hydrocarbons and arsenic in OU-E groundwater[4] (DTSC), and 2) maintain safe operation of the Mill Pond Dam such that sediment and water are retained in the impoundment during and following a seismic event (DSOD). Separately, a project is needed to manage human health and environmental risk due to petroleum hydrocarbons and arsenic in OU-E groundwater (DTSC).

As presented in the 30 August 2024 letter (Mendocino Railway 2024c) and discussed in the December 2024 meeting with agencies, project objectives include the following:

- Control the public's exposure, including trespassers or occasional recreators, to incidental ingestion of dioxins/furans in pond sediments. Pond 6, Pond 7, Pond 8, North Pond, and the Southern Ponds (Ponds 1-4) are on private property with restricted access and fenced; public recreation is not allowed.
- Control the public's exposure, including trespassers or occasional recreators, to incidental ingestion of petroleum hydrocarbons and arsenic in groundwater. Due to City restrictions on groundwater use and concerns for saltwater intrusion, groundwater use from OU-E is not anticipated and therefore exposure to OU-E groundwater is not anticipated.
- Control migration of arsenic and dioxins/furans in pond sediment.

[3] As described in the 2019 OU-E FS, California Health and Safety Code Section 25356.1(d) also outlines six additional criteria, which need to be addressed for the recommended remedial alternative. As these criteria are addressed within the nine USEPA criteria, a separate analysis has not been conducted.

[4] As reported in prior project documents, including the 2019 OU-E FS and Draft OU-E RAP, barium was included as a groundwater COC for the OU-E Lowlands due to detections in MW-4.1 only. As reported in the Five-Year Review Report, barium concentrations in MW-4.1 consistently meet the barium remedial goal as of the March 2023 groundwater monitoring event (Kennedy Jenks 2025). Accordingly, barium is no longer a COC for OU-E groundwater.

- Retention of stormwater management and treatment for City stormwater (currently provided by Pond 8), if feasible. The City has discharged, and continues to discharge, untreated stormwater containing dioxins/furans to Pond 8. These historical and ongoing discharges by the City have been documented as a significant source historically and the primary source of continued contributions of dioxins/furans in Pond 8 sediment. Stormwater treatment for the City is not an objective relevant to selection of an appropriate and effective remedial technology for managing dioxins/furans in Mill Pond sediment.
- Control risk to public safety due to loss of containment of water and sediment at the existing Mill Pond Dam, a structural component of Pond 8, due to seismic activity, sea level rise, tsunami, and/or episodic, short-term or long-term erosion events.
- Improve safety and reduce risk of dam failure and associated environmental or economic losses by modifying the existing Mill Pond Dam so that it no longer falls within DSOD jurisdictional risk thresholds.
- Meet, if feasible, and balance conflicting laws, regulations and policies, and agency requirements, to identify a feasible project that meets the above project objectives.

The Mill Pond Dam, Pond 6, Pond 7, Pond 8, the Southern Ponds (Ponds 1-4), North Pond, and groundwater are on private property with restricted access.

1.2 Objectives

The purpose of this FS Addendum is to develop and evaluate additional remedial alternatives for OU-E, as requested by DTSC in letters dated 27 December 2022 (DTSC 2022), 28 March 2024 (DTSC 2024a), and 16 May 2024 (DTSC 2024b), such that relevant information concerning the remedial action options can be presented and an appropriate remedy selected. A draft list of alternatives was submitted to DTSC in a letter dated 30 August 2024 (Mendocino Railway 2024c), and these alternatives were discussed with the California Coastal Commission (CCC), the City, the DTSC, DSOD, and the Regional Water Quality Control Board (RWQCB) in a meeting on 17 December 2024. Discussion in the December 2024 meeting was documented in meeting minutes (Kennedy Jenks 2025a).

Consistent with the December 2024 meeting minutes (Kennedy Jenks 2025a) and February 2025 letter (Mendocino Railway 2025), the additional remedial alternatives to be evaluated in this FS Addendum consist of the following:

- Excavation and filling of Pond 8 west, disposal of excavated sediment, and dam modifications
- Institutional controls with dam modifications, including north dam improvements, cutoff wall, and rock slope protection on the interior of Pond 8 at the cribwall
- Institutional controls with dam modifications, including north dam improvements, cutoff wall, and a seawall at the cribwall

1.3 Report Organization

The remainder of this FS Addendum is organized as follows:

Section 2: Identification and Screening of Remedial Technologies and Process Options evaluates the effectiveness, implementability, and cost-effectiveness of potential technologies associated with the additional alternatives to be evaluated and screens for further analysis.

Section 3: Development and Evaluation of Remedial Alternatives develops remedial alternatives for select aquatic sediment areas (North Pond and Pond 6, Pond 7, and Pond 8) and evaluates against the screening criteria. Remedial alternatives are compared and a preferred alternative is selected, per area.

Section 4: Summary of Recommended Remedial Alternatives summarizes the preferred alternative for the North Pond and Pond 6 AOC, Pond 7 AOC, and Pond 8 AOC.

Section 5: References presents the references cited throughout this report.

Section 2: Identification and Screening of Additional Remedial Technologies and Process Options

Remedial technologies and process options were formally identified and screened in the 2019 OU-E FS. As discussed in Section 1, DTSC has since requested evaluation of additional remedial alternatives. A summary of previously considered remedial alternatives and descriptions of new alternatives are provided in the following sections.

2.1 Creek Daylighting

DTSC and community feedback has highlighted the concept of "creek daylighting." A narrative is provided herein to address this topic.

As discussed in the December 2024 meeting (documented in meeting minutes; Kennedy Jenks 2025a), creek daylighting and restoration are not remedial technologies or process options and therefore do not address COCs in pond sediment. In the context of this feasibility study and addendum effort, where the objective is selection of an appropriate and effective remedial technology for managing dioxins/furans in OU-E aquatic sediment, creek daylighting is not relevant to the remediation of aquatic sediment.

It is noted that in current conditions, the Mill Pond is "daylighted" from the outlets of the City's Maple and Alder Creek storm drain outfalls in Pond 8 East to the ocean. Daylighting can be accomplished upstream of the Mill Pond by removing City and Caltrans storm drain infrastructure that convey stormwater from Highway 1 to the Mill Pond under the eastern portion of the property; this is a project that can be considered by others but is not associated with remedial action for OU-E pond sediment. Additionally, the Mill Pond provides stormwater polishing for City stormwater discharged via Maple Creek and Alder Creek outfalls to the Mill Pond. As described above, City stormwater contains dioxins/furans, and newly constructed ponds and/or bioswales would collect additional dioxins/furans-impacted sediment to be managed.

2.2 Alternatives Evaluated in 2019 OU-E Feasibility Study

As presented in the 2019 OU-E FS, General Response Actions (GRAs) were developed for sediment. GRAs are categories of actions that, when implemented, will allow meeting of RAOs established for the site, and provide a basis for identifying specific remedial technologies and process options. GRAs are developed for each medium of interest and define remedial actions that may, as standalone or in combination, be taken to satisfy the RAOs for the site. The GRAs that have previously been considered for remediation of site sediment are as follows:

- No action
- Institutional controls (ICs)
- Containment
- In-situ treatment
- Ex-situ treatment
- Removal

Specific process options within each GRA were described and screened based on technical implementability in the 2019 OU-E FS. The screening for technical implementability is based on 1) the site-specific RAOs and ARARs, 2) site-specific conditions, such as geologic setting and contaminant distribution, and 3) contaminant characteristics. During the preliminary identification and screening process, remedial technologies that cannot be technically implemented are eliminated from further evaluation. If retained after the first screening step, the technology and/or process option is further evaluated and refined based on effectiveness, implementability, and relative cost. A summary of technologies screened in the 2019 OU-E FS is provided in the following section.

2.2.1 Sediment Remedial Technologies

The preliminary identification and screening process of remedial technologies and associated process options for treatment of sediment at the site are discussed in this section; this process was summarized in Table 5-2 of the 2019 OU-E FS. The following remedial technologies and associated process options for sediment were identified and evaluated based on technical implementability:

- **No action**: To provide a baseline for comparison of alternatives as required by the National Oil and Hazardous Substances Contingency Plan (NCP; USEPA 1990), the "No Action" technology was retained in the 2019 OU-E FS.
- **ICs and natural recovery**: ICs, such as land use restrictions / land use controls (LUCs), along with natural recovery, have been retained to provide protection of human health and the environment through administratively restricting land use until chemical-specific cleanup goals are met.

  Natural recovery is the process of degradation or transformation of a COC into less toxic compounds or forms. These natural recovery processes are present in aquatic sediment at the site and are documented in the OU-E BHHERA via arsenic speciation testing and carbon equilibrium partitioning (EqP) modeling. Further, geomorphological and biological cycles in the ponds generate additional sediment mass and organic carbon, subsequently reducing residual COC concentrations over time.

  ICs include a variety of measures designed to restrict current and future property owners from taking actions that would expose potential receptors to unacceptable risk, interfere with effectiveness of the final remedial action, and/or convert the site to an end use that is not consistent with the level of remediation. The primary objective of ICs is to limit potential for exposure to COCs by restricting access to impacted areas.

  For sediment, this technology would protect human health by assigning LUCs to prevent the potential risk of receptors encountering COC-impacted sediment. A Sediment Management Plan (SMP) would be developed based on COCs and associated risks to further protect potential future receptors. Implementing ICs is possible given current site conditions, and the overall cost is relatively low. ICs were retained in the 2019 OU-E FS to provide protectiveness through administrative actions until chemical-specific ARARs are met.
- **Containment**: Covers with sand, gravel, or other suitable materials, or structures such as a dam or berm.

A cover would be implemented as a vegetated barrier to cover sediments in the ponds to restrict exposure of potential receptors to affected media. A cover would effectively restrict the potential risk to receptors in accordance with RAOs until cleanup goals are achieved; therefore, covers were retained for incorporation in remedial alternatives in the 2019 OU-E FS.

Containment can also be achieved via a dam or berm. The existing Mill Pond Dam and beach berm currently act as containment structures, keeping sediment in place and protecting sediment from storms, erosion, tsunamis, and sea-level rise. These structures are current containment structures for Ponds 6, 7, 8, and the North Pond. Containment by the existing Mill Pond Dam and beach berm combined with ICs was retained in the 2019 OU-E FS.

On-site consolidation in a lined cell may not be acceptable within the Coastal Zone. Past experience with consolidation of contaminants at the former Mill Site demonstrated the difficulty with implementing this type of process option; therefore, on-site consolidation was not retained for further evaluation in the 2019 OU-E FS. DTSC has requested that on-site consolidation be re-considered in this FS Addendum (see Section 2.3).

- **In-situ physical treatment**: In-situ soil mixing.

  In-situ soil mixing (ISM) technology can be used to immobilize organic and inorganic compounds in saturated sediments, using reagents to produce an inert, geotechnically strong, and relatively less permeable material, such as Portland cement. This process option does not destroy COCs, but incorporates them into a dense, homogeneous, low-permeability structure that reduces concentrations and mobility.

  Implementation of in-situ soil mixing may pose difficulties due to accessibility restrictions for construction equipment; however, various modifications of the technology exist to adapt to site conditions. Previous treatability tests of in-situ soil mixing have been conducted at the site to evaluate the technical feasibility and the effectiveness at reducing COC accessibility to receptors. Results of the treatability test indicate that due to high sediment organic and moisture content and poor post-treatment strength results, in-situ soil mixing requires significant volumes of binders and Portland cement to be effective.

  Adding Portland cement to the sediment increases the volume of treated material to greater than the original material volume. In order to account for bulking, excess material would be tested and used for backfill elsewhere at the site, or transported offsite for disposal. Use of Portland cement in aquatic environments is generally not accepted without significant mitigation and the areas treated could not remain aquatic environments due to elevated pH and the loss of suitable habitat materials. In-situ mixing was retained for further evaluation in the 2019 OU-E FS.

- **In-situ biological treatment**: Mycoremediation and in-situ biological oxidation (ISB).

  Mycoremediation within the Pond AOIs sediment is not feasible as the sediments are typically submerged. Further, mycoremediation was not shown to be effective in previous bench-scale tests. Based on these results, mycoremediation was determined to not be a viable remedial process option and was not carried forward for further evaluation in the 2019 OU-E FS.

ISB involves injection of substrates into the target media to promote biological degradation of target COCs. ISB relies upon reactions within the aqueous phase, which would occur within the pore space of the target sediments. Technical implementability concerns exist with ISB; additionally, installation and direct push injection activities to deliver reagents would be restricted for sediments located in pond areas. Further, achieving significant distribution of reagents is likely not feasible within fine-grained matrices characteristic of the sediments at the site. ISB was not retained for further evaluation in the 2019 OU-E FS.

- **In-situ chemical treatment**: In-situ chemical oxidation (ISCO).

  ISCO technology involves reduction/oxidation reactions that chemically convert hazardous contaminants to non-hazardous or less toxic compounds that are more stable or inert. One reactant is oxidized (loses electrons) and another is reduced (gains electrons). ISCO relies upon abiotic reactions between reagents and target COCs to achieve mass reduction. Technical implementability concerns exist with ISCO; additionally, installation and direct push injection activities to deliver reagents would be restricted for sediments located in pond areas. Further, achieving significant distribution of reagents is likely not feasible within fine-grained matrices characteristic of the sediments at the site. ISCO was not retained for further evaluation in the 2019 OU-E FS.

- **Ex-situ physical/biological treatment**: Landfarming, biopiling.

  Land farming and biopiling can both be readily implemented for COCs in sediment; however, both rely upon biological treatment of COCs to achieve effective mass reduction. Based on the nature of COCs driving risk within the sediment AOIs, biological treatment will not be sufficient to reduce COC concentrations to meet target cleanup goals and achieve RAOs. Landfarming and biopiling were not retained for further evaluation for sediment in the 2019 OU-E FS.

- **Removal**: Excavation and offsite disposal.

  Removal (i.e., excavation) provides immediate and effective removal of impacted sediment from the site to achieve RAOs. Excavation of sediment relies upon similar methods of removal as excavation of soils; however, additional consideration is required to address access restrictions and dewatering. Excavation may require the need for long-stick excavators and potential engineered controls adjacent the excavation to support equipment during removal. Dewatering of excavated sediment is required to reduce the moisture content prior to transportation and disposal. After dewatering, excavated sediment is transported to a landfill offsite and is required to meet federal and state transportation and disposal regulations. Restoration following excavation of sediments may require backfilling and revegetation to restore existing habitat. When compared to other technologies, excavation and disposal may have a higher capital cost but represents a lower risk as all COCs are removed offsite. Excavation and disposal was retained for further consideration in the 2019 OU-E FS.

2.2.2 Recommended Alternative

The recommended alternatives for Pond 7 AOC, the Pond 6 and North Pond AOC, and Pond 8 AOC in the Draft OU-E RAP are the following:

- Pond 7 AOC: Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management
- North Pond and Pond 6 AOC: Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management
- Pond 8 AOC: Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management

The Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management alternative presented as the selected remedy in the Draft OU-E RAP includes modifications to the existing Mill Pond Dam to comply with DSOD requirements. Proposed modifications to the Mill Pond Dam include: 1) a rock slope protection (RSP) buttress at the crib wall section; 2) ground improvements and an earth-fill buttress at the eastern dam section; and 3) a cutoff wall installed near the center of the pond to divide into two smaller ponds. A Coastal Development Permit (CDP) was submitted to the City in July 2022 (CDP 9-22) to complete the Mill Pond Dam improvements. Additional information was provided per City request in January 2023 (Kennedy Jenks 2023).

2.3 New Remedial Alternatives

As described in Section 1, additional alternatives have been identified per DTSC request. The following sections complement the identification and screening of technologies and process options presented in Section 5.2 of the 2019 OU-E FS.

These alternatives were developed over multiple discussions with DTSC and other agencies, including in agency meetings in April 2024 and December 2024 and recurring Project Manager Meetings with DTSC. The list of alternatives in the section below is the culmination of these discussions and was presented to DTSC and other agencies in a letter dated 30 August 2024 (Mendocino Railway 2024c) and discussed in a meeting in December 2024 (documented in meeting minutes; Kennedy Jenks 2025a).

2.3.1 Preliminary Identification and Screening of Technologies and Process Options

The preliminary identification and screening process of new remedial technologies and associated process options for treatment of sediment at the site consist of the following:

- Excavation and filling of Pond 8 west, disposal of excavated sediment, and dam modifications (herein termed “Pond 8 West Excavation and Disposal”)
- Institutional controls/containment with dam modifications, including north dam improvements, cutoff wall, and rock slope protection on the interior of Pond 8 at the cribwall

(alternative to current proposed rock slope protection design; herein termed “Institutional Controls with Interior Rock Slope Protection Alternative”)

- Institutional controls/containment with dam modifications, including north dam improvements, cutoff wall, and a seawall at the cribwall (alternative to current proposed rock slope protection design; herein termed “Institutional Controls with Seawall Alternative”)

- Institutional controls/containment with dam modifications, including north dam improvements, cutoff wall, and construction of a secant pile wall at the cribwall (alternative to current proposed rock slope protection design; herein termed “Institutional Controls with Secant Pile Wall Alternative”)

- Institutional controls/containment with dam modifications, including north dam improvements, cutoff wall, and jet grouting at the cribwall (alternative to current proposed rock slope protection design; herein termed “Institutional Controls with Jet Grouting Alternative”)

- On-site terrestrial treatment and consolidation

The Pond 8 West Excavation and Disposal alternative is a combination of removal and ICs. Pond 8 West Excavation and Disposal was retained for further evaluation.

The Institutional Controls with Interior Rock Slope Protection Alternative, the Institutional Controls with Seawall Alternative, the Institutional Controls with Seacant Pile Wall Alternative, and the Institutional Controls with Jet Grouting Alternative incorporate design alternatives to the “Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management” remediation process option evaluated in the 2019 OU-E FS for the Pond 7 AOC, the North Pond and Pond 6 AOC, and the Pond 8 AOC. The Institutional Controls with Interior Rock Slope Protection Alternative, the Institutional Controls with Seawall Alternative, the Institutional Controls with Secant Pile Wall Alternative, and the Institutional Controls with Jet Grouting Alternative were retained for further evaluation.

The on-site terrestrial treatment and consolidation alternative is a combination of removal and containment. As described in Section 2.1.1, on-site consolidation was considered in the 2019 OU-E FS but not retained for further evaluation. The on-site terrestrial treatment and consolidation alternative is included herein per DTSC request (DTSC 2022, 2024a).

2.3.2 Evaluation of Technology Types and Selection of Representative Process Options

Following completion of the preliminary screening based on technical implementability, the retained remedial technologies and associated process options are to be further evaluated in greater detail based on effectiveness, implementability (i.e., administrative), and relative cost, as described in Section 5.2.2 of the 2019 OU-E FS. The detailed screening of process options for treatment of sediment at the site are discussed in this section.

The Pond 8 West Excavation and Disposal alternative is a combination of removal and ICs. As described in Section 2.1.1 and the 2019 OU-E FS, ICs can provide protectiveness through

administrative actions until chemical-specific ARARs are met and excavation is immediately effective and readily implementable; therefore, Pond 8 West Excavation and Disposal was retained for further evaluation.

The Institutional Controls with Interior Rock Slope Protection Alternative and the Institutional Controls with Seawall Alternative incorporate design alternatives to the "Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management" remediation process option evaluated in the 2019 OU-E FS for the Pond 7 AOC, the North Pond and Pond 6 AOC, and the Pond 8 AOC. As described in Section 2.1.1 and the 2019 OU-E FS, ICs can provide protectiveness through administrative actions until chemical-specific ARARs are met, and interior rock slope protection and a seawall may balance ARARs differently as compared to the rock slope protection recommended in the 2019 OU-E FS and Draft OU-E RAP and included in the CDP 9-22 application; therefore, the Institutional Controls with Interior Rock Slope Protection Alternative and the Institutional Controls with Seawall Alternative were retained for further evaluation.

The Institutional Controls with Secant Pile Wall Alternative and the Institutional Controls with Jet Grouting Alternative also incorporate design alternatives to the "Institutional Controls: Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Management" remediation process option evaluated in the 2019 OU-E FS for the Pond 7 AOC, the North Pond and Pond 6 AOC, and the Pond 8 AOC. However, based on discussion in the meeting with agencies on 17 December 2024 (as documented in the meeting minutes; Kennedy Jenks 2025a), a secant pile wall and jet grouting would likely not be accepted by DSOD. Therefore, these alternatives were not retained for further evaluation.

The on-site terrestrial treatment and consolidation alternative is a combination of removal and containment. As described in Section 2.1.1, on-site consolidation was considered in the 2019 OU-E FS but not retained for further evaluation. The on-site terrestrial treatment and consolidation alternative is included herein per DTSC request (DTSC 2022, 2024a). This alternative involves the excavation and on-site consolidation of sediment from Pond 8, Pond 6, North Pond, and Pond 7. Removal of sediment would be completed until confirmation sampling indicates remaining concentrations of COCs in sediment allow for unrestricted use classification of Pond 8, Pond 6, North Pond, and Pond 7. The alternative would include the following steps:

- Sediment would be removed and dewatered and/or stabilized with Portland cement. A new Title 27 (California Code of Regulations [CCR]) landfill would be constructed on-site for consolidation of treated sediment. Assuming a height of 8 ft, the footprint of the new Title 27 landfill is roughly estimated to be over 11 acres (or approximately the size of two Pond 8-sized areas). The excavation areas may be backfilled with clean imported soil or the pond depth may be allowed to increase depending on the resulting geometry and agency permit requirements. Institutional controls would be implemented for the new Title 27 landfill and an operation and maintenance plan would be developed.

- Although not required to comply with DTSC requirements, the Mill Pond Dam would remain and modifications would be required in this alternative. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end and rock slope protection at the crib wall near the ocean. A cutoff wall would also be installed near the center of Pond 8 to divide into two smaller ponds. Pond 8 would continue to receive and

treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. Require regular inspection and maintenance of both the Mill Pond Dam and the beach berm would be required.

Past experience with consolidation of contaminants at the former Mill Site demonstrated the difficulty with implementing this type of process option; ultimately, the OU-A consolidation cell was removed and soil requiring disposal was hauled to an off-site landfill for disposal (Arcadis 2012b). During implementation of the OU-A consolidation cell, the RWQCB clarified that removing soil (or, by extension, sediment) containing COCs and encapsulating it underground for permanent storage constitutes a waste management unit, and designated or non-hazardous solid waste may only be discharged at a waste management unit that has been approved and classified by the RWQCB (RWQCB 2008). RWQCB requires that the waste management unit be designed compliant with the requirements of Title 27 (RWQCB 2008). On-site consolidation in a lined cell may not be acceptable within the Coastal Zone and has other issues with implementability. The City's Coastal Land Use & Development Code defines the allowable uses for industrial zoning districts (Chapter 17.24); allowable uses include timber resources industrial (which is the current zoning of the Mill Site). Per Chapter 17.20, if a use is not listed it is not allowed. A landfill, waste disposal, and other waste containment is not an allowed use in the City's Coastal Land Use & Development Code for timber resources industrial, and is therefore not an allowable use at the Mill Site under the City's current Coastal Land Use & Development Code. As stated in an email to DTSC in January 2025 (Kennedy Jenks 2025b) and letter dated 24 February 2025 (Mendocino Railway 2025), these factors indicate that implementation of an on-site consolidation cell may not be permittable, and therefore, this alternative was not retained for further evaluation.

2.3.3 Alternatives Retained for Further Evaluation

Following the December 2024 meeting with agencies, the following alternatives were retained for further consideration in the FS Addendum:

- Pond 8 West Excavation and Disposal
- Interior Rock Slope Protection Alternative
- Seawall Alternative

The following sections present a detailed description of the new remedial alternatives for consideration. These descriptions were provided to DTSC in a letter dated 24 February 2025 (Mendocino Railway 2025).

2.3.3.1 Pond 8 West Excavation and Disposal

This alternative involves the excavation and offsite disposal of sediment in the western portion of Pond 8, Pond 7, Pond 6, and North Pond until confirmation sampling indicates remaining concentrations of COCs in sediment allow for unrestricted use classification of Pond 8 West.

Sediment would be excavated from Pond 8 West, Pond 7, Pond 6, and North Pond using conventional construction equipment and would be either temporarily stockpiled and managed to control dust and odors or directly loaded into truck beds. Dewatering and or stabilization with Portland cement may be necessary for excavated material with free draining water that cannot be dried within a reasonable space and/or time. Immediately after loading, the truck beds would be covered with a tarp and transported to an appropriate non-hazardous waste disposal facility. The final condition of the excavated area (e.g., cribwall removal) will be evaluated during design development and engineering feasibility and agency permit requirements will be taken into consideration. This alternative would require significant sediment removal and removal/destruction of habitat in Pond 8 West, Pond 7, Pond 6, and North Pond. Mitigation for disturbing the existing wetlands of Pond 8 West is expected.

Modifications to the Mill Pond Dam would be required. The existing spillway would remain, and a new spillway would be constructed at the approximate middle point of Pond 8, where the pond is narrow. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end. Pond 8 East would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland and would provide sediment containment for Pond 7, Pond 6, and the North Pond. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm.

Sediment in Pond 8 East would remain in place. ICs would be implemented for Pond 8 East to provide land use controls (LUCs) for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable. The LUCs would provide requirements for development within the restricted area, such as development of a comprehensive SMP that provides detailed procedures for sediment-disturbing activities and describes required sampling and criteria for reuse of disturbed sediment. The LUCs and SMP would be consistent with future site use.

2.3.3.2 Interior Rock Slope Protection Alternative

This alternative is consistent with the current recommended alternative for Pond 8, North Pond, Pond 6 sediments in the 2019 OU-E FS and the preferred alternative in the Draft OU-E RAP but proposes an alternative design element at the cribwall.

Sediment in Pond 8, Pond 7, Pond 6, and the North Pond would remain in place. ICs would be implemented for Pond 8, Pond 7, Pond 6, and the North Pond to provide LUCs for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable. The LUCs would provide requirements for development within the restricted area, such as development of a comprehensive SMP that provides detailed procedures for sediment-disturbing activities and describes required sampling and criteria for reuse of disturbed sediment. The LUCs and SMP would be consistent with future site use.

Containment of sediment in Pond 8, Pond 7, Pond 6, and the North Pond would be provided by the existing Mill Pond Dam and beach berm. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end and rock slope protection on the interior of Pond 8 at the crib wall near the ocean. Mitigation for disturbing the existing

wetlands of Pond 8 for the interior rock slope protection is expected. A cutoff wall would also be installed near the center of Pond 8 to divide into two smaller ponds. Pond 8 would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm.

2.3.3.3 Seawall Alternative

This alternative is consistent with the current recommended alternative for Pond 8, North Pond, Pond 6 sediments in the 2019 OU-E FS and the preferred alternative in the Draft OU-E RAP but proposes an alternative design element at the cribwall.

Sediment in Pond 8, Pond 7, Pond 6, and the North Pond would remain in place. ICs would be implemented for Pond 8, Pond 7, Pond 6, and the North Pond to provide LUCs for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable. The LUCs would provide requirements for development within the restricted area, such as development of a comprehensive SMP that provides detailed procedures for sediment-disturbing activities and describes required sampling and criteria for reuse of disturbed sediment. The LUCs and SMP would be consistent with future site use.

Containment of sediment in Pond 8, Pond 7, Pond 6, and the North Pond would be provided by the existing Mill Pond Dam and beach berm. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end and a seawall at the crib wall near the ocean. The seawall is assumed to be a new structure on the beach side of the existing Mill Pond Dam at the cribwall. A cutoff wall would also be installed near the center of Pond 8 to divide into two smaller ponds. Pond 8 would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative is not expected to require significant soil removal or destruction of habitat.

Section 3: Development and Evaluation of Additional Remedial Alternatives

As discussed previously, remedial alternatives are developed by combining remedial technologies and process options for sediment. Additional alternatives are described and evaluated herein for select AOCs per DTSC request.

AOCs evaluated in the 2019 OU-E FS and in this FS Addendum and the remedial alternatives considered are summarized as follows:

- Pond 7 Aquatic Sediment
  - 2019 OU-E FS
    - ♦ No Action (Alternative 1)
    - ♦ Institutional Controls (Alternative 2)
    - ♦ Vegetated Soil Cover (Alternative 3)
    - ♦ Excavation and Disposal (Alternative 4)
    - ♦ Vegetated Sediment Cover (Alternative 5)
  - FS Addendum
    - ♦ Pond 8 West Excavation and Disposal (Alternative 6)
- North Pond and Pond 6 Aquatic Sediment
  - 2019 OU-E FS
    - ♦ No Action (Alternative 1)
    - ♦ Institutional Controls (Alternative 2)
    - ♦ Vegetated Soil Cover (Alternative 3)
    - ♦ Excavation and Disposal (Alternative 4)
    - ♦ Vegetated Sediment Cover (Alternative 5)
  - FS Addendum
    - ♦ Pond 8 West Excavation and Disposal (Alternative 6)
- Pond 8 Aquatic Sediment

- 2019 OU-E FS
  - No Action (Alternative 1)
  - Institutional Controls (Alternative 2)
  - In-situ Soil Mixing (Alternative 3)
  - Excavation and Disposal (Alternative 4)
  - Vegetated Sediment Cover (Alternative 5)
  - Vegetated Soil Cover (Alternative 6)
- FS Addendum
  - Pond 8 West Excavation and Disposal (Alternative 7)
  - Institutional Controls with Interior Rock Slope Protection (Alternative 8)
  - Institutional Controls with Seawall (Alternative 9)

The new remedial alternatives were compared against the nine screening criteria presented in Section 1.1.2.3 and are developed and evaluated in the following section. A cost estimate presenting estimated remedial alternative costs is provided in Table 3-1.

3.1 Pond 7 Aquatic Sediment

Remedial technologies for this AOC were preliminarily screened in Section 2. This section presents an evaluation of the selected alternatives for the Pond 7 AOC based on the screening criteria presented in Section 1.

3.1.1 Development and Evaluation of Remedial Alternatives

3.1.1.1 Pond 7 Aquatic Sediment: Alternative 6 – Pond 8 West Excavation and Disposal

As described in Section 2.2.3.1, the Pond 8 West Excavation and Disposal alternative involves the excavation and offsite disposal of non-hazardous sediment in Pond 8 West, Pond 7, Pond 6, and North Pond and containment in place for sediment in Pond 8 East.

Modifications to the Mill Pond Dam would be required. The existing spillway would remain, and a new spillway would be constructed at the approximate middle point of Pond 8, where the pond is narrow. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end. Pond 8 East would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative would require

significant sediment removal and removal/destruction of habitat in Pond 8 West, Pond 7, Pond 6, and North Pond; habitat restoration and/or mitigation is expected to be required.

The sections below focus on the Pond 7 element of the Pond 8 West Excavation and Disposal alternative. For Pond 7, this alternative is comparable to the excavation and disposal alternative (Alternative 4).

3.1.1.1.1 Overall Protection of Human Health and the Environment

The affected sediment would be directly removed and disposed of offsite in an accredited non-hazardous landfill. This alternative is anticipated to be protective of human health and the environment as it provides restrictions for access to the affected sediment and guidelines for disturbing the remaining sediment.

3.1.1.1.2 Compliance with ARARs

This alternative is generally in compliance with the projected ARARs, though may be difficult to permit within the California Coastal Zone as excavation and disposal will result in the disruption and destruction of wetland habitat which would require significant mitigation. Other alternatives (e.g., Alternative 2) are anticipated to be less environmentally damaging as they require less disturbance of a wetland area. At a minimum, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

Pond 7 sediment would be removed; therefore, climate change and sea level rise are not anticipated to affect the ability of this alternative to comply with projected ARARs. Sea level rise will be considered during design development of the Mill Pond Dam soil buttress and new spillway; an updated wave study and sea level rise evaluation will be completed by ESA. Additional analysis of the beach berm to assess future tidal conditions and sea level rise can be considered during design development. This alternative would require regular inspection and maintenance of the Mill Pond Dam and the beach berm to address impacts from sea level rise. As discussed in Section 3.3.1.1.5, transportation of excavated sediment to an appropriate non-hazardous waste disposal facility would generate CO_2 emissions.

3.1.1.1.3 Long-Term Effectiveness and Permanence

O&M is not required for Pond 7 after completion of the excavation and disposal and affected sediment would be removed, as confirmed by confirmation sampling. Removing affected sediment to allow unrestricted land use would be expected to reduce risk such that institutional controls for Pond 7 are not necessary. The design life of the proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probably flood will be used for design. Periodic inspection and maintenance of the Mill Pond Dam and the beach berm will be required. Major repairs are anticipated to be relatively infrequent, on the order of 50 or more years between major maintenance activities. Therefore, this alternative is ranked high for long-term effectiveness and permanence.

3.1.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Excavation and disposal would remove residual affected sediment from Pond 7, thereby reducing the volume of affected sediment and the toxicity and mobility of the COCs remaining. However, affected sediment would remain in Pond 8 East. Overall, this alternative ranks moderate for this criterion. As demonstrated in the BHHERA and Draft OU-E RAP, COC concentrations in Pond 7 sediment do not present significant risk to receptors; therefore, the reduction in toxicity or risk from sediments is small.

3.1.1.1.5 Short-Term Effectiveness

An estimated 1,500 truckloads would be required to transport the sediment in the pond to an appropriate non-hazardous waste disposal facility. Each round-trip is estimated to be 400 miles and the total sediment transport effort is estimated to generate[5] approximately 1,300,000 kilograms of CO_2. Additionally, there is a risk of upset and spill on each trip to the appropriate waste disposal facility, and construction workers would be temporarily exposed to COC-affected sediment during implementation. Therefore, this alternative is ranked low for short-term effectiveness.

Transportation of sediment out of Fort Bragg via rail is not currently viable due to the collapse of Noyo Canyon Tunnel No. 1. There are plans to repair the tunnel, however, the timeline for funding of the needed repairs is uncertain and the tunnel is unlikely to be repaired in a time frame such that transport by rail is a viable option for this project. In the short-term, transportation by truck is the only available transportation method.

3.1.1.1.6 Implementability

The Pond 8 West Excavation and Disposal alternative is ranked moderate for implementability. It is readily implementable with standard construction equipment, backfilling materials would be locally obtainable, and waste likely qualifies as non-hazardous waste for reduced disposal hazards and transport; however, required permitting and mitigation requirements would be significant, and the depth of the excavation and likely soft sediment conditions would pose significant challenges. As discussed above, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost. Anticipated permits required to complete this alternative include: CCC CDP, City Coastal Development and Grading Permits, Mendocino County Air Quality Management District (MCAQMD) Dust Control Permit, RWQCB Section 401 of the Clean Water Act Permit, USACE Section 404 of the Clean Water Act Permit, and Stormwater Construction General Permit. A wetland mitigation modifier of 4:1 was assumed for cost estimation purposes. It is assumed that mitigation will be performed on-site. Approximately 900 sf are estimated to be disturbed in Pond 7, which would correspond to 0.3 acres of required mitigation.

3.1.1.1.7 Cost

Excavation and disposal for unrestricted use is ranked low as it is significantly more expensive than other remedial alternatives. Costs include documentation of permitting, removal, disposal,

[5] CO_2 generation estimate based on an emission factor from the Environmental Defense Fund's "The Green Freight Handbook."

wetland restoration/mitigation, institutional controls and annual inspection and periodic maintenance of established controls such as fencing, routine maintenance, and vegetation control on the beach berm as well as annual inspection, maintenance, vegetation control, and periodic survey of the Mill Pond Dam. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design.

3.1.1.1.8 Overall Rating

Overall, the Pond 8 West Excavation and Disposal alternative ranks moderate (see Section 3.3.1.1) and, for the Pond 7, is comparable to the excavation and disposal alternative (Alternative 4). It is ranked high for long term effectiveness and permanence, but moderate to low for other criteria. The benefits of this alternative are offset by the likelihood that not all sediment containing COCs would be able to be removed from Pond 8 West, and a contingency remedy of containment and institutional controls would still be required. In addition, this alternative has a high cost as compared to other alternatives evaluated for the relatively small reduction of risk achieved.

3.1.2 Selection of Preferred Alternative – Pond 7 Aquatic Sediment

The Institutional Controls alternative (Alternative 2), which was recommended in the 2019 OU-E FS, remains the preferred alternative for the Pond 7 AOC as it provides adequate elimination of potential exposure pathways for future receptors while minimizing the destruction of wetlands and associated mitigation. The Institutional Controls alternative evaluates the risk associated with affected sediment and provides LUCs for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable. It would also include a comprehensive SMP which would provide detailed procedures for sediment disturbing activities and describe required sampling and criteria for reuse of disturbed sediment. In addition, ongoing O&M of the existing beach berm would provide continued sediment containment. Although it is associated with a slightly lower reduction of toxicity, mobility and volume, ICs would provide adequate elimination of potential exposure pathways for future receptors.

The benefits of a physical cover are offset by the effort and disruption required for implementation and potentially regular O&M, as well as the disturbance of the newly-created wetland establishment area. The benefits of Excavation and Disposal are offset by the effort and disruption required for implementation and the need to transport and dispose the sediment at a landfill. The cost difference between the alternatives is not justified by any significant benefits of the Vegetated Soil Cover or Excavation and Disposal alternatives. The benefits of Pond 8 West Excavation and Disposal are offset by the effort and disruption required for implementation and the need to transport and dispose the sediment at a landfill.

3.2 North Pond and Pond 6 Aquatic Sediment

Remedial technologies for this AOC were preliminarily screened in Section 2. This section presents an evaluation of the selected alternatives for the North Pond and Pond 6 AOC based on the screening criteria presented in Section 1.

3.2.1 Development and Evaluation of Remedial Alternatives

3.2.1.1 North Pond and Pond 6 Aquatic Sediment: Alternative 6 – Pond 8 West Excavation and Disposal

As described in Section 2.2.3.1, the Pond 8 West Excavation and Disposal alternative involves the excavation and offsite disposal of non-hazardous sediment in Pond 8 West, Pond 7, Pond 6, and North Pond and containment in place for sediment in Pond 8 East.

Modifications to the Mill Pond Dam would be required. The existing spillway would remain, and a new spillway would be constructed at the approximate middle point of Pond 8, where the pond is narrow. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end. Pond 8 East would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative would require significant sediment removal and removal/destruction of habitat in Pond 8 West, Pond 7, Pond 6, and North Pond; habitat restoration and/or mitigation is expected to be required.

The sections below focus on the North Pond and Pond 6 element of the Pond 8 West Excavation and Disposal alternative. For the North Pond and Pond 6, this alternative is comparable to the excavation and disposal alternative (Alternative 4).

3.2.1.1.1 Overall Protection of Human Health and the Environment

The affected sediment would be directly removed and disposed of offsite in an accredited non-hazardous landfill. This alternative is anticipated to be protective of human health and the environment as it provides restrictions for access to the affected sediment and guidelines for disturbing the remaining sediment.

3.2.1.1.2 Compliance with ARARs

This alternative is generally in compliance with the projected ARARs, though may be difficult to permit within the California Coastal Zone as excavation and disposal will result in the disruption and destruction of wetland habitat which would require significant mitigation. Other alternatives (e.g., Alternative 2) are anticipated to be less environmentally damaging as they require less disturbance of a wetland area. At a minimum, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

Pond 6 and North Pond sediment would be removed; therefore, climate change and sea level rise are not anticipated to affect the ability of this alternative to comply with projected ARARs. Sea level rise will be considered during design development of the Mill Pond Dam soil buttress and new spillway; an updated wave study and sea level rise evaluation will be completed by ESA. Additional analysis of the beach berm to assess future tidal conditions and sea level rise can be considered during design development. This alternative would require regular inspection and maintenance of the Mill Pond Dam and the beach berm to address impacts from sea level rise. As discussed in Section 3.3.1.1.5, transportation of excavated sediment to an appropriate non-hazardous waste disposal facility would generate CO_2 emissions.

3.2.1.1.3 Long-Term Effectiveness and Permanence

O&M is not required for Pond 6 and North Pond after completion of the excavation and disposal and affected sediment would be removed, as confirmed by confirmation sampling. Removing affected sediment to allow unrestricted land use would be expected to reduce risk such that institutional controls for Pond 6 and North Pond are not necessary. The design life of the proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probably flood will be used for design. Periodic inspection and maintenance of the Mill Pond Dam and the beach berm will be required. Major repairs are anticipated to be relatively infrequent, on the order of 50 or more years between major maintenance activities. Therefore, this alternative is ranked high for long-term effectiveness and permanence.

3.2.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Excavation and disposal would remove affected sediment from Pond 6 and North Pond, thereby reducing the volume of affected sediment and the toxicity and mobility of the COCs remaining. However, affected sediment would remain in Pond 8 East. Overall, this alternative is ranked moderate for this criterion. As demonstrated in the BHHERA, COC concentrations in Pond 6 and North Pond sediment do not present significant risk to receptors; therefore, the reduction in toxicity or risk from sediments is small.

3.2.1.1.5 Short-Term Effectiveness

An estimated 1,500 truckloads would be required to transport the sediment in the pond to an appropriate non-hazardous waste disposal facility. Each round-trip is estimated to be 400 miles and the total sediment transport effort is estimated to generate[6] approximately 1,300,000 kilograms of CO_2. Additionally, there is a risk of upset and spill on each trip to the appropriate waste disposal facility, and Construction workers would be temporarily exposed to COC-affected sediment during implementation. Therefore, this alternative is ranked low for short-term effectiveness.

Transportation of sediment out of Fort Bragg via rail is not currently viable due to the collapse of Noyo Canyon Tunnel No. 1. There are plans to repair the tunnel, however, the timeline is uncertain and the tunnel is unlikely to be repaired such that transport by rail is a viable option for this project; in the short-term, transportation by truck is available transportation method.

3.2.1.1.6 Implementability

The Pond 8 West Excavation and Disposal alternative is ranked moderate for implementability. It is readily implementable with standard construction equipment, backfilling materials would be locally obtainable, and waste likely qualifies as non-hazardous waste for reduced disposal hazards and transport; however, required permitting and mitigation requirements would be significant, and the depth of the excavation and likely soft sediment conditions would pose significant challenges. As discussed above, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

[6] CO_2 generation estimate based on an emission factor from the Environmental Defense Fund's "The Green Freight Handbook."

Anticipated permits required to complete this alternative include: CCC CDP, City Coastal Development and Grading Permits, MCAQMD Dust Control Permit, RWQCB Section 401 of the Clean Water Act Permit, USACE Section 404 of the Clean Water Act Permit, and Stormwater Construction General Permit. A wetland mitigation modifier of 4:1 was assumed for cost estimation purposes. It is assumed that mitigation will be performed on-site. Approximately 10,000 sf are estimated to be disturbed in Pond 6 and North Pond, which would correspond to 0.9 acres of required mitigation.

3.2.1.1.7 Cost

Excavation and disposal for unrestricted use is ranked low as it is more expensive than other remedial alternatives. Costs include documentation of permitting, removal, disposal, wetland restoration/mitigation, institutional controls and annual inspection and periodic maintenance of established controls such as fencing, routine maintenance, and vegetation control on the beach berm as well as annual inspection, maintenance, vegetation control, and periodic survey of the Mill Pond Dam. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design.

3.2.1.1.8 Overall Rating

Overall, the Pond 8 West Excavation and Disposal alternative ranks moderate (see Section 3.3.1.1) and, for the North Pond and Pond 6, is comparable to the excavation and disposal alternative (Alternative 4). It is ranked high for long term effectiveness and permanence, but moderate for other criteria. The benefits of this alternative are offset by the likelihood that not all sediment containing COCs would be able to be removed from Pond 8 West, and a contingency remedy of containment and institutional controls would still be required. In addition, this alternative has a high cost as compared to other alternatives evaluated for the relatively small reduction of risk achieved.

3.2.2 Selection of Preferred Alternative – North Pond and Pond 6 Aquatic Sediment

The Institutional Controls alternative (Alternative 2), which was recommended in the 2019 OU-E FS, remains the preferred alternative for the North Pond and Pond 6 AOC as it provides adequate elimination of potential exposure pathways for future receptors while minimizing the destruction of wetlands and associated mitigation. The Institutional Controls alternative evaluates the risk associated with affected sediment and provides LUCs for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable. It would also include a comprehensive SMP which would provide detailed procedures for sediment disturbing activities and describe required sampling and criteria for reuse of disturbed sediment. In addition, ongoing O&M of the existing beach berm would provide continued sediment containment. Although it is associated with a slightly lower reduction of toxicity, mobility and volume, ICs would provide adequate elimination of potential exposure pathways for future receptors.

The benefits of a physical cover are offset by the effort and disruption required for implementation and potentially regular O&M. The benefits of Excavation and Disposal are offset

by the effort and disruption required for implementation and the need to transport and dispose the sediment at a landfill. The cost difference between the alternatives is not justified by any significant benefits of the Vegetated Soil Cover or Excavation and Disposal alternatives. The benefits of Pond 8 West Excavation and Disposal are offset by the effort and disruption required for implementation and the need to transport and dispose the sediment at a landfill.

3.3 Pond 8 Aquatic Sediment

Remedial technologies for this AOC were preliminarily screened in Section 2. This section presents an evaluation of the selected new alternatives for the Pond 8 AOC based on the screening criteria presented in Section 1.

3.3.1 Development and Evaluation of Remedial Alternatives

3.3.1.1 Pond 8 Aquatic Sediment: Alternative 7 – Pond 8 West Excavation and Disposal

As described in Section 2.2.3.1, the Pond 8 West Excavation and Disposal alternative involves the excavation and offsite disposal of non-hazardous sediment in Pond 8 West, Pond 7, Pond 6, and North Pond and containment in place for sediment in Pond 8 East. Institutional controls would be implemented for Pond 8 East to establish LUCs which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable.

Modifications to the Mill Pond Dam would be required. The existing spillway would remain, and a new spillway would be constructed at the approximate middle point of Pond 8, where the pond is narrow. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end. Pond 8 East would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative would require significant sediment removal and removal/destruction of habitat in Pond 8 West, Pond 7, Pond 6, and North Pond; habitat restoration and/or mitigation is expected to be required.

The sections below focus on the Pond 8 element of the Pond 8 West Excavation and Disposal alternative.

3.3.1.1.1 Overall Protection of Human Health and the Environment

The affected sediment would be directly removed and disposed of offsite in an accredited non-hazardous landfill. ICs would be implemented for Pond 8 East following implementation of Pond 8 West excavation. This alternative is anticipated to be protective of human health and the environment as it provides restrictions for access to the affected sediment and guidelines for disturbing the remaining sediment.

3.3.1.1.2 Compliance with ARARs

This alternative is generally in compliance with the projected ARARs, though may be difficult to permit within the California Coastal Zone as excavation and disposal will result in the disruption

and destruction of wetland habitat which would require significant mitigation. Other alternatives (e.g., Alternative 2) are anticipated to be less environmentally damaging as they require less disturbance of a wetland area. At a minimum, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

Pond 8 West sediment would be removed and sediment remaining in Pond 8 East would be protected by the new spillway; therefore, climate change and sea level rise are not anticipated to affect the ability of this alternative to comply with projected ARARs. Sea level rise will be considered during design development of the Mill Pond Dam soil buttress and new spillway; an updated wave study and sea level rise evaluation will be completed by ESA. Additional analysis of the beach berm to assess future tidal conditions and sea level rise can be considered during design development. This alternative would require regular inspection and maintenance of the Mill Pond Dam and the beach berm to address impacts from sea level rise. As discussed in Section 3.3.1.1.5, transportation of excavated sediment to an appropriate non-hazardous waste disposal facility would generate CO_2 emissions.

3.3.1.1.3 Long-Term Effectiveness and Permanence

O&M is not required for Pond 8 West after completion of the excavation and disposal and affected sediment would be removed, as confirmed by confirmation sampling. Removing affected sediment to allow unrestricted land use would be expected to reduce risk such that institutional controls for Pond 8 West are not necessary. The Institutional Controls would provide adequate protection of potential receptors in the long-term from remaining affected sediment in Pond 8 East. The design life of the proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probably flood will be used for design. Periodic inspection and maintenance of the Mill Pond Dam and the beach berm will be required. Major repairs are anticipated to be relatively infrequent, on the order of 50 or more years between major maintenance activities. Therefore, this alternative is ranked high for long-term effectiveness and permanence.

3.3.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Excavation and disposal would remove affected sediment from Pond 8 West, thereby reducing the volume of affected sediment and the toxicity and mobility of the COCs remaining. Affected sediment would remain in Pond 8 East. Overall, this alternative ranks moderate for this criterion. As demonstrated in the BHHERA, COC concentrations in Pond 8 sediment do not present significant risk to receptors; therefore, the reduction in toxicity or risk from sediments is small.

3.3.1.1.5 Short-Term Effectiveness

An estimated 1,500 truckloads would be required to transport the sediment in the pond to an appropriate non-hazardous waste disposal facility. Each round-trip is estimated to be 400 miles and the total sediment transport effort is estimated to generate[7] approximately 1,300,000 kilograms of CO_2. Additionally, there is a risk of upset and spill on each trip to the appropriate waste disposal facility, and Construction workers would be temporarily exposed to

[7] CO_2 generation estimate based on an emission factor from the Environmental Defense Fund's "The Green Freight Handbook."

COC-affected sediment during implementation. Therefore, this alternative is ranked low for short-term effectiveness.

Transportation of sediment out of Fort Bragg via rail is not currently viable due to the collapse of Noyo Canyon Tunnel No. 1. There are plans to repair the tunnel, however, the timeline is uncertain and the tunnel is unlikely to be repaired such that transport by rail is a viable option for this project; in the short-term, transportation by truck is available transportation method.

3.3.1.1.6 Implementability

The Pond 8 West Excavation and Disposal alternative is ranked moderate for implementability. It is readily implementable with standard construction equipment, backfilling materials would be locally obtainable, and waste likely qualifies as non-hazardous waste for reduced disposal hazards and transport; however, required permitting and mitigation requirements would be significant, and the depth of the excavation and likely soft sediment conditions would pose significant challenges. It is likely that not all sediment containing COCs would be able to be removed from Pond 8 West and a contingency remedy of containment and institutional controls would still be required. As discussed above, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost. Anticipated permits required to complete this alternative include: CCC CDP, City Coastal Development and Grading Permits, MCAQMD Dust Control Permit, RWQCB Section 401 of the Clean Water Act Permit, USACE Section 404 of the Clean Water Act Permit, and Stormwater Construction General Permit. A wetland mitigation modifier of 4:1 was assumed for cost estimation purposes. It is assumed that mitigation will be performed onsite. Approximately 98,000 sf are estimated to be disturbed in Pond 8 West, which would correspond to 9 acres of required mitigation.

3.3.1.1.7 Cost

Excavation and disposal for unrestricted use is ranked low as it is more expensive than other remedial alternatives. Costs include documentation of permitting, removal, disposal, wetland restoration/mitigation, institutional controls and annual inspection and periodic maintenance of established controls such as fencing, routine maintenance, and vegetation control on the beach berm as well as annual inspection, maintenance, vegetation control, and periodic survey of the Mill Pond Dam. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design.

3.3.1.1.8 Overall Rating

Overall, the Pond 8 West Excavation and Disposal alternative ranks moderate. It is ranked high for long term effectiveness and permanence, but moderate for other criteria. The benefits of this alternative are offset by the likelihood that not all sediment containing COCs would be able to be removed from Pond 8 West, and a contingency remedy of containment and institutional controls would still be required. In addition, this alternative has a high cost as compared to other alternatives evaluated for the relatively small reduction of risk achieved.

3.3.1.2 Pond 8 Aquatic Sediment: Alternative 8 - Institutional Controls (Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Maintenance) – Interior Rock Slope Protection

This alternative is consistent with the current recommended alternative for Pond 8, North Pond, and Pond 6 sediments in the 2019 OU-E FS and the preferred alternative for Pond 8, Pond 7, North Pond, and Pond 6 sediments in the Draft OU-E RAP but proposes an alternative design element at the cribwall.

As described in Section 2.2.3.2, sediment in Pond 8 would remain in place. ICs would be implemented to provide LUCs which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable.

Containment of sediment in Pond 8, Pond 7, Pond 6, and the North Pond would be provided by the existing Mill Pond Dam and beach berm. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end and rock slope protection on the interior of Pond 8 at the crib wall near the ocean. A cutoff wall would also be installed near the center of Pond 8 to divide into two smaller ponds. Pond 8 would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative is not expected to require significant soil removal or destruction of habitat.

Concentrations of COCs in sediment in Pond 8 were shown to represent limited risk to receptors for the reasonable foreseeable use in the OU-E BHHERA. Notification to DTSC and sediment removal may occur as part of future redevelopment activities and changes in use in order to achieve acceptable risk for the changed conditions.

3.3.1.2.1 Overall Protection of Human Health and the Environment

The Institutional Controls – Interior Rock Slope Protection alternative is anticipated to be protective of human health and the environment as it provides restrictions for access to the affected sediment and guidelines for disturbing the sediment. This alternative likely meets the RAOs.

3.3.1.2.2 Compliance with ARARs

This alternative is generally in compliance with the projected ARARs. Other alternatives (e.g., Alternative 2) are anticipated to be less environmentally damaging as they require less disturbance and fill of a wetland area. At minimum, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

Climate change and sea level rise are not anticipated to affect the ability of this alternative to comply with projected ARARs. Sea level rise will be considered during design development of the Mill Pond Dam soil buttress; an updated wave study and sea level rise evaluation will be completed by ESA. Additional analysis of the beach berm to assess future tidal conditions and sea level rise can be considered during design development. This alternative would require

regular inspection and maintenance of the Mill Pond Dam and the beach berm to address impacts from sea level rise.

3.3.1.2.3 Long-Term Effectiveness and Permanence

The Institutional Controls – Interior Rock Slope Protection alternative ranks high for the long-term effectiveness criterion as the proposed LUCs and SMP would provide adequate protection of potential receptors in the long term. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design. Periodic inspection and maintenance of the Mill Pond Dam and the beach berm will be required. Major repairs are anticipated to be relatively infrequent, on the order of 50 or more years between major maintenance activities.

3.3.1.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The Institutional Controls – Interior Rock Slope Protection alternative was ranked moderate for the reduction of toxicity, mobility, or volume through treatment criterion as no COC-impacted media would be physically removed or treated, but sediment containment reduces the potential mobility. As demonstrated in the OU-E BHHERA, COC concentrations in Pond 8 sediment do not present significant risk to receptors and the opportunity to further reduce toxicity or risk from sediment is small.

3.3.1.2.5 Short-Term Effectiveness

The Institutional Controls – Interior Rock Slope Protection alternative was ranked moderate for the short-term effectiveness criteria, as construction of the interior rock slope protection requires working within Pond 8 and therefore exposing construction workers to COC-impacted media.

3.3.1.2.6 Implementability

The Institutional Controls – Interior Rock Slope Protection alternative received a high ranking for the implementability criteria, as it is implementable. As discussed above, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost.

3.3.1.2.7 Cost

The Institutional Controls – Interior Rock Slope Protection alternative ranked high, as the cost is comparatively lower than other process options. However, as discussed above, additional wetland would be expected to be disturbed in this alternative as compared to other alternatives, and therefore additional permitting and mitigation would be expected which may impact implementability and cost. Costs include documentation of institutional controls and annual inspection and periodic maintenance of established controls such as fencing, routine maintenance, and vegetation control on the beach berm as well as annual inspection, maintenance, vegetation control, and periodic survey of the Mill Pond Dam. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design.

3.3.1.2.8 Overall Rating

Overall, the Institutional Controls – Interior Rock Slope Protection alternative ranks high. Although it is ranked moderate for the reduction of toxicity, mobility and volume criterion, institutional controls would provide adequate elimination of potential exposure pathways for future receptors. This alternative ranks similarly to the recommended alternative in the 2019 OU-E FS (Alternative 2), but ultimately ranks lower due to a lower short-term effectiveness ranking, additional uncertainty related to implementability and cost, and potential compliance with ARARs concerns related to filling of a wetland.

3.3.1.3 Pond 8 Aquatic Sediment: Alternative 9 - Institutional Controls (Containment, Land Use Controls, Sediment Management, and Long-Term Operations and Maintenance) – Seawall

This alternative is consistent with the current recommended alternative for Pond 8, North Pond, Pond 6 sediments in the 2019 OU-E FS and the preferred alternative in the Draft OU-E RAP but proposes an alternative design element at the cribwall.

As described in Section 2.2.3.3, sediment in Pond 8 would remain in place. ICs would be implemented to provide LUCs which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable.

Containment of sediment in Pond 8, Pond 7, Pond 6, and the North Pond would be provided by the existing Mill Pond Dam and beach berm. To address DSOD requirements, the Mill Pond Dam would be modified to add a soil buttress at the northeast end and a seawall at the crib wall near the ocean. The seawall is assumed to be a new structure on the beach side of the existing Mill Pond Dam at the cribwall. A cutoff wall would also be installed near the center of Pond 8 to divide into two smaller ponds. Pond 8 would continue to receive and treat stormwater from the site and the City. The beach berm would continue to protect the Mill Pond Dam from damage due to ocean intrusion in the lowland. This alternative would require regular inspection and maintenance of both the Mill Pond Dam and the beach berm. This alternative is not expected to require significant soil removal or destruction of habitat.

Concentrations of COCs in sediment in Pond 8 were shown to represent limited risk to receptors for the reasonable foreseeable use in the OU-E BHHERA. Notification to DTSC and sediment removal may occur as part of future redevelopment activities and changes in use in order to achieve acceptable risk for the changed conditions.

3.3.1.3.1 Overall Protection of Human Health and the Environment

The Institutional Controls – Seawall alternative is anticipated to be protective of human health and the environment as it provides restrictions for access to the affected sediment and guidelines for disturbing the sediment. This alternative likely meets the RAOs.

3.3.1.3.2 Compliance with ARARs

This alternative is in compliance with the projected ARARs.

Climate change and sea level rise are not anticipated to affect the ability of this alternative to comply with projected ARARs. Sea level rise will be considered during design development of the Mill Pond Dam soil buttress and seawall; an updated wave study and sea level rise evaluation will be completed by ESA. Additional analysis of the beach berm to assess future tidal conditions and sea level rise can be considered during design development. This alternative would require regular inspection and maintenance of the Mill Pond Dam and the beach berm to address impacts from sea level rise.

3.3.1.3.3 Long-Term Effectiveness and Permanence

The Institutional Controls – Seawall alternative was ranked high for the long-term effectiveness criterion as the proposed LUCs and SMP would provide adequate protection of potential receptors in the long term. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design. Periodic inspection and maintenance of the Mill Pond Dam and the beach berm will be required. Major repairs are anticipated to be relatively infrequent, on the order of 50 or more years between major maintenance activities.

3.3.1.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The Institutional Controls – Seawall alternative was ranked moderate for the reduction of toxicity, mobility, or volume through treatment criterion as no COC-impacted media would be physically removed or treated, but sediment containment reduces the potential mobility. As demonstrated in the OU-E BHHERA, COC concentrations in Pond 8 sediment do not present significant risk to receptors and the opportunity to further reduce toxicity or risk from sediment is small.

3.3.1.3.5 Short-Term Effectiveness

The Institutional Controls – Interior Rock Slope Protection alternative was ranked high for the short-term effectiveness criteria, as exposure to COC-impacted media by construction workers is limited to construction of the cutoff wall; the remaining work would be completed outside of Pond 8.

3.3.1.3.6 Implementability

The Institutional Controls – Seawall alternative received a moderate ranking for the implementability criteria, as it is as it is implementable but may be a challenge to permit.

3.3.1.3.7 Cost

The Institutional Controls – Seawall alternative ranked low, as the cost is higher than other process options. Costs include documentation of institutional controls and annual inspection and periodic maintenance of established controls such as fencing, routine maintenance, and vegetation control on the beach berm as well as annual inspection, maintenance, vegetation control, and periodic survey of the Mill Pond Dam. The design life of proposed repairs for the Mill Pond Dam is estimated to be over 100 years as the maximum credible earthquake and maximum probable flood will be used for design.

3.3.1.3.8 Overall Rating

Overall, the Institutional Controls – Seawall alternative ranks moderate. Although it is ranked moderate for the reduction of toxicity, mobility and volume criterion, institutional controls would provide adequate elimination of potential exposure pathways for future receptors. This alternative ranks similarly to the recommended alternative in the 2019 OU-E FS (Alternative 2) but ranks lower due to a lower cost ranking.

3.3.2 Selection of Preferred Alternative

The Institutional Controls alternative (Alternative 2), which was recommended in the 2019 OU-E FS, remains the preferred alternative for the Pond 8 AOC as it provides adequate elimination of potential exposure pathways for future receptors while minimizing the destruction of wetlands and associated mitigation. This alternative also allows Pond 8 to continue to receive and treat stormwater from the site and the City. The Institutional Controls alternative evaluates the risk associated with affected sediment and provides LUCs for future site use which limit land use and control activities in areas where the risk from one or more exposure pathways is deemed unacceptable for unrestricted use. It would also include a comprehensive SMP which would provide detailed procedures for sediment disturbing activities and describe required sampling and criteria for reuse of disturbed sediment. In addition, ongoing O&M of the existing beach berm would provide continued sediment containment. Although it is associated with moderate reduction of toxicity, mobility, and volume, institutional controls is protective through elimination of potential exposure pathways for future receptors.

Arsenic EPC for Pond 8 sediment (9.7 mg/kg) is approximately equal to the draft remedial goal (10 mg/kg) and is below the NTE sediment goal for arsenic established in the OU-E RAW (67 mg/kg) as protective of the 12-day recreator (Arcadis 2016). The dioxin TEQ EPC for Pond 8 sediment (107 pg/g) is greater than the California residential screening level of 50 pg/g but below the NTE sediment goal for dioxin TEQ established in the OU-E RAW (503 pg/g) as protective of the 12-day recreator (Arcadis 2016) and below the commercial/industrial screening level of 200 pg/g. Institutional Controls are appropriately protective of human health and the environment given the low concentrations relative to NTE and commercial/industrial values.

Proposed modifications to the Mill Pond Dam include: 1) a RSP buttress at the crib wall section; 2) ground improvements and an earth-fill buttress at the eastern dam section; and 3) a cutoff wall installed near the center of the pond to divide it into two smaller ponds.

The potential benefits of the Pond 8 West Excavation and Disposal alternative are offset by the scale of effort and environmental disruption required for implementation of this alternative, and the need to transport and dispose the sediment at a distant landfill. The benefits of the interior rock slope protection alternative (Alternative 8) are similarly offset by the disruption required in Pond 8 to construct an interior rock slope protection and the associated increased short-term effects and habitat mitigation. The seawall alternative (Alternative 9) scores similarly to Alternative 2, but is significantly more expensive and therefore ranks lower for the cost criteria; the cost difference is not justified by significant reduction of other impacts.

Section 4: Summary of Recommended Alternatives

A summary of AOC recommendations for Pond 8 AOC, Pond 7 AOC, and North Pond and Pond 6 AOC is provided below and presented in Table 4-1.

- Pond 8, Pond 7, North Pond and Pond 6 Aquatic Sediment AOCs
    - Pond 8 Aquatic Sediment Primary COCs: arsenic, dioxin TEQ
    - North Pond and Pond 6 Aquatic Sediment Primary COCs: arsenic, dioxin TEQ.
    - Pond 7 Aquatic Sediment Primary COCs: arsenic, barium, dioxin TEQ
    - Recommended Alternative: Institutional Controls: containment, land use controls, sediment management, and long-term operations and maintenance (Alternative 2)
        - When evaluated as individual aquatic AOCs, human health risks evaluated as excess lifetime cancer risk for Southern Ponds, Pond 6, Pond 7, Pond 8, and North Pond were within the risk management range of 10^{-4} to 10^{-6} established in the NCP (40 CFR 300.430; NCP 2014) and by CalEPA (1996), indicating risk management measures are appropriate remedies for these AOCs.
        - The ERA indicated that unacceptable ecological risk is not likely for populations of plants, benthic organisms, birds, mammals and amphibians exposed to site sediment and surface water.
        - ICs are appropriately protective given the EPCs relative to NTE and commercial/industrial values.
        - Eliminates exposure pathways for potential future on and offsite receptors via institutional and administrative management and provides protection of human health and the environment.
        - Includes implementation of a SMP to restrict site use and soil and sediment disturbing activities.
        - Easily implementable and effective in the short term as no workers are exposure to COC-affected media during implementation.
        - Allows possible future restoration of Maple and Alder Creeks while preserving existing wetland habitats.
        - Cost effective.

Section 5: References

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Tables

Table 3-1: Comparison of Remedial Alternatives (Updated Table 7-1, 2019 OU-E FS)

Media	AOC	Risk Summary	Category	Alternative	Description	Threshold (Yes or No) Criteria		Balancing (Low, Moderate, or High) Criteria				
						Overall Protection of Human Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short Term Effectiveness	Implementability	Cost
Aquatic Sediment	Pond 7	Arsenic and dioxin TEQ are the primary risk drivers in Pond 7 sediment. Risks evaluated in the BHHERA indicate ELCR of 2E-05.	Evaluated in 2019 OU-E FS	No Action	Site remains as is; provide no additional control or action to protect human health or the environment from affected sediment. Existing beach berm would continue to provide sediment containment.	No	No	Low	Low	High	High	$0
			Evaluated in 2019 OU-E FS; Recommended Alternative in 2019 FS	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	High	$200,000
			Evaluated in 2019 OU-E FS	Vegetative Soil Cover and Institutional Controls	Provide an upland vegetative cover to cover the pond. Eliminate exposure pathways through vegetative containment, and implementation of a deed restriction and risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	Moderate	$752,000
			Evaluated in 2019 OU-E FS	Excavation and Disposal	Eliminate exposure pathways through sediment excavation and disposal offsite at a permitted landfill. Beach berm repairs provide improved sediment containment.	Yes	Yes	High	High	Low	Moderate	$452,600
			Evaluated in 2019 OU-E FS	Vegetative Sediment Cover and Institutional Controls	Provide a vegetative wetland cover to cover the pond. Eliminate exposure pathways through vegetative containment, and implementation of a deed restriction and risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	Moderate	$589,000
			New	Excavation and Fill of Pond 8 West, Sediment Disposal, and Dam Modifications	Reduce exposure pathways through sediment excavation of Pond 8 West and disposal offsite at a permitted landfill. Restrict future land use of Pond 8 East via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	High	Moderate	Low	Moderate	$452,600
	North Pond and Pond 6	Arsenic and dioxin TEQ are the primary risk drivers in Pond 6 sediment, while arsenic was the primary risk contributor in North Pond sediment. Risks evaluated in the BHHERA indicate ELCR of 2E10-6.	Evaluated in 2019 OU-E FS	No Action	Site remains as is; provide no additional control or action to protect human health or the environment from affected sediment. Existing beach berm would continue to provide sediment containment.	No	No	Low	Low	High	High	$0
			Evaluated in 2019 OU-E FS; Recommended Alternative in 2019 FS	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	High	$201,000
			Evaluated in 2019 OU-E FS	Vegetative Soil Cover and Institutional Controls	Provide an upland vegetative cover to cover the pond. Eliminate exposure pathways through vegetative containment, and implementation of a deed restriction and risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	Moderate	$840,000
			Evaluated in 2019 OU-E FS	Excavation and Disposal	Eliminate exposure pathways through soil excavation and disposal offsite at a permitted landfill.	Yes	Yes	High	High	Low	Moderate	$1,086,000
			Evaluated in 2019 OU-E FS	Vegetative Sediment Cover and Institutional Controls	Provide a vegetative wetland cover to cover the pond. Eliminate exposure pathways through vegetative containment, and implementation of a deed restriction and risk management plan for soil/sediment based on COIs and associated risks.	Yes	Yes	Moderate	Low	High	Moderate	$725,000
			New	Excavation and Fill of Pond 8 West, Sediment Disposal, and Dam Modifications	Reduce exposure pathways through sediment excavation of Pond 8 West and disposal offsite at a permitted landfill. Restrict future land use of Pond 8 East via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	High	Moderate	Low	Moderate	$1,086,000

Table 3-1: Comparison of Remedial Alternatives (Updated Table 7-1, 2019 OU-E FS)

Media	AOC	Risk Summary	Category	Alternative	Description	Threshold (Yes or No) Criteria		Balancing (Low, Moderate, or High) Criteria				
						Overall Protection of Human Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short Term Effectiveness	Implementability	Cost
Aquatic Sediment	Pond 8	Dioxin TEQ is the primary risk drivers in sediment. Risks evaluated in the BHHERA indicate ELCRs are 2E-6 cumulative with the primary contributors of 1E-6 for dioxin and 1E-6 for arsenic. Arsenic concentrations are at background.	Evaluated in 2019 OU-E FS	No Action	Site remains as is; provide no additional control or action to protect human health or the environment from affected sediment. Mill Pond Dam continues to provide sediment containment.	No	No	Low	Low	High	High	$0
			Evaluated in 2019 OU-E FS; Recommended Alternative in 2019 FS	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Dam repairs provide improved sediment containment.	Yes	Yes	High	Moderate	High	High	$7,616,000
			Evaluated in 2019 OU-E FS	In-Situ Soil Mixing and Institutional Controls	Proposes to treat sediment in place through stabilization by the addition of binders and Portland cement to restrict exposure of potential receptors to affected media, and would limit potential direct contact with affected sediment, or infiltration of water. Dam repairs provide improved sediment containment.	Yes	Yes	High	Moderate	Low	Low	$20,086,000
			Evaluated in 2019 OU-E FS	Excavation and Disposal	Eliminate exposure pathways through excavation and disposal offsite at a permitted landfill. Dam repairs provide improved sediment containment.	Yes	Yes	High	High	Low	Moderate	$38,977,000
			Evaluated in 2019 OU-E FS	Vegatative Sediment Cover and Institutional Controls	Provide a vegetative wetland cover to cover the pond. Eliminate exposure pathways through vegetative containment, and implementation of a deed restriction and risk management plan for soil/sediment based on COIs and associated risks. Dam repairs provide improved sediment containment.	Yes	Yes	Low	Moderate	High	Low	$20,030,000
			Evaluated in 2019 OU-E FS	Vegetated Soil Cover and Institutional Controls	Alternative proposes to provide a vegetative cover to cover the pond to restrict exposure of potential receptors to affected media, and would limit potential direct contact with affected sediment, or infiltration of water. Dam repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	Low	$21,262,000
			New	Excavation and Fill of Pond 8 West, Sediment Disposal, and Dam Modifications	Reduce exposure pathways through sediment excavation of Pond 8 West and disposal offsite at a permitted landfill. Restrict future land use of Pond 8 East via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	High	Moderate	Low	Moderate	$15,282,000
			New	Institutional Controls (Interior Rock Slope Protection Design Alternative to Rock Slope Protection)	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Dam repairs provide improved sediment containment. Propose interior rock slope protection at cribwall (alternate design to beach-side rock slope protection).	Yes	Yes	High	Moderate	Moderate	High	$9,172,000
			New	Institutional Controls (Seawall Design Alternative to Rock Slope Protection)	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Dam repairs provide improved sediment containment. Propose seawall at cribwall (alternate design to beach-side rock slope protection).	Yes	Yes	High	Moderate	High	Moderate	$12,638,000

Notes:

Recommended alternatives are outlined with bold lines.

Cost estimates for alternatives evaluated in 2019 OU-E FS escalated to 2025 for comparison with the new alternatives.

Green shading indicates that the screening criteria is met or has a high ranking in preference.

Yellow shading indicates that the screening criteria is likely met or has a moderate ranking in preference.

Red shading indicates that the screening criteria may not be met or has a low ranking in preference.

Acronyms:

AOC - area of concern
AOI - area of interest
ARARs - Applicable or Relevant and Appropriate Requirements
BHHERA - Baseline Human Health and Ecological Risk Assessment - Operable Unit E (ARCADIS, 2015)
COI - chemical of interest
dioxin - polychlorinated dibenzo-p-dioxin (in case of TEQ, 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD] in particular)
ELCR - excess lifetime cancer risk
ERA - ecological risk assessment
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
TEQ - toxic equivalent

Reference:

Kennedy/Jenks. 2019. Final Feasibility Study, Operable Unit E, Former Georgia-Pacific Wood Products Facility, Fort Bragg, California. 12 September.
ARCADIS. 2015. Baseline Human Health and Ecological Risk Assessment – Operable Unit E, Former Georgia-Pacific Wood Products Facility, Fort Bragg, California. Prepared for Georgia-Pacific LLC. August.

Table 4-1: Remedial Alternative Recommendations Summary (Updated Table 8-1, 2019 OU-E FS)

Media	AOC	Primary Risk Drivers	ELCR	Alternative	Objective	Threshold (Yes or No) Criteria		Balancing (Low, Moderate, or High) Criteria				
						Overall Protection of Human Health and the Environment	Compliance with ARARs	Long Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short Term Effectiveness	Implementability	Cost
Sediment	Pond 7	Arsenic and dioxin TEQ	2E-5 Prior to excavation of full footprint in 2017.	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	High	$200,000
	North Pond and Pond 6	Arsenic and dioxin TEQ	2E-6 (North) 3E-6 (Pond 6 0-2ft) 4E-6 (Pond 6 0-0.5 ft)	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Beach berm repairs provide improved sediment containment.	Yes	Yes	Moderate	Low	High	High	$201,000
	Pond 8	Dioxin TEQ	2E-6 (1E-6 each for Dioxin and Arsenic, Arsenic concentrations are at background)	Institutional Controls	Restrict future land use via deed restriction and implement risk management plan for soil/sediment based on COIs and associated risks. Mill Pond Dam repairs provide improved sediment containment.	Yes	Yes	High	Moderate	High	High	$7,616,000

Notes:

Green shading indicates that the screening criteria is met or has a high ranking in preference.
Yellow shading indicates that the screening criteria is likely met or has a moderate ranking in preference.
Red shading indicates that the screening criteria may not be met or has a low ranking in preference.

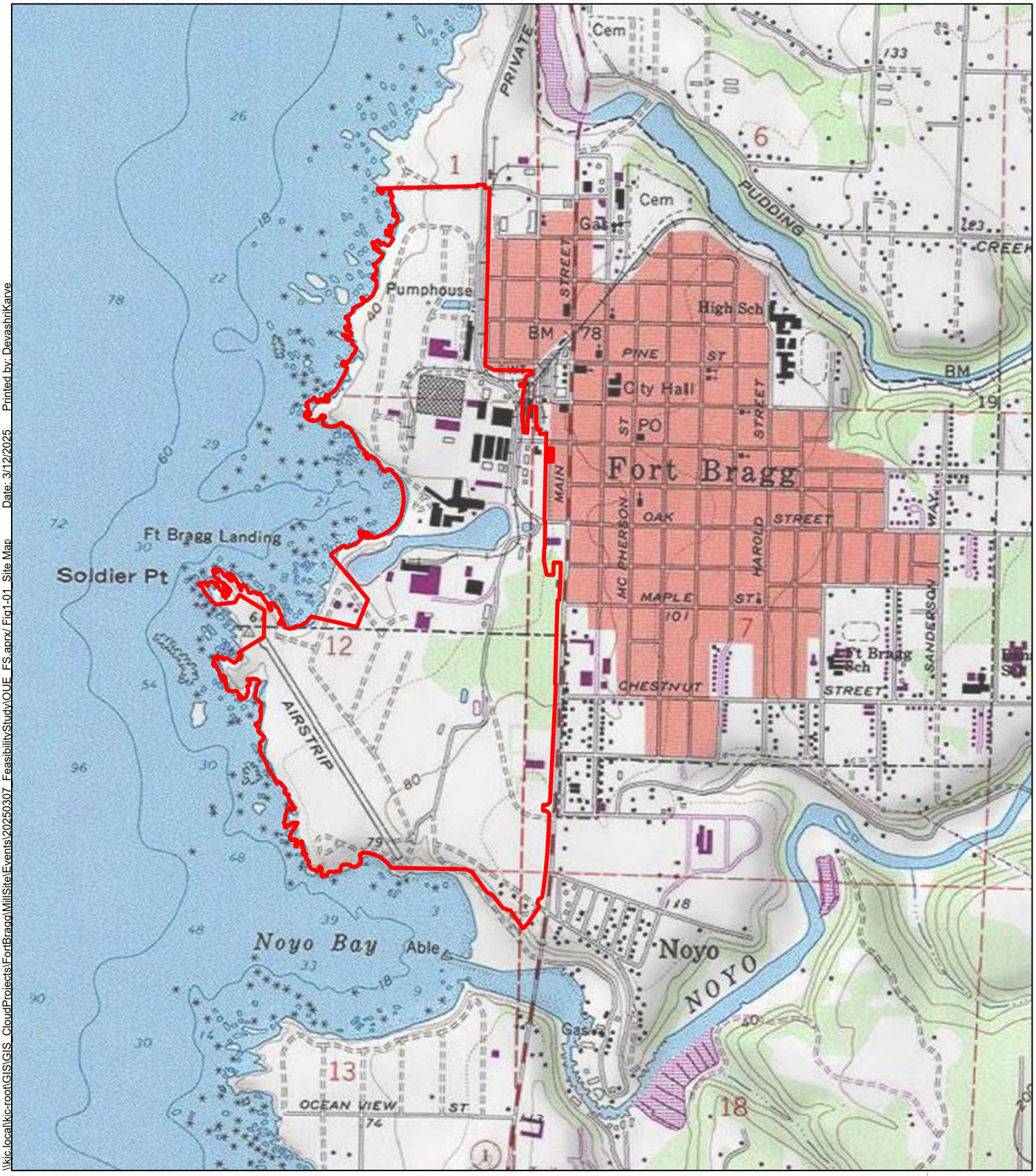
Acronyms:

AOC - area of concern
ARARs - Applicable or Relevant and Appropriate Requirements
COI - chemical of interest
dioxin - polychlorinated dibenzo-p-dioxin (in case of TEQ, 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD] in particular)
ELCR - Excess Lifetime Cancer Risk
TEQ - toxic equivalent

Reference:

Kennedy/Jenks. 2019. Final Feasibility Study, Operable Unit E, Former Georgia-Pacific Wood Products Facility, Fort Bragg, California. 12 September.
ARCADIS. 2015. Baseline Human Health and Ecological Risk Assessment – Operable Unit E, Former Georgia-Pacific Wood Products Facility, Fort Bragg, California. Prepared for Georgia-Pacific LLC. August.

Figures



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Legend

SITE BOUNDARY

N

0 750 1,500

Scale: Feet

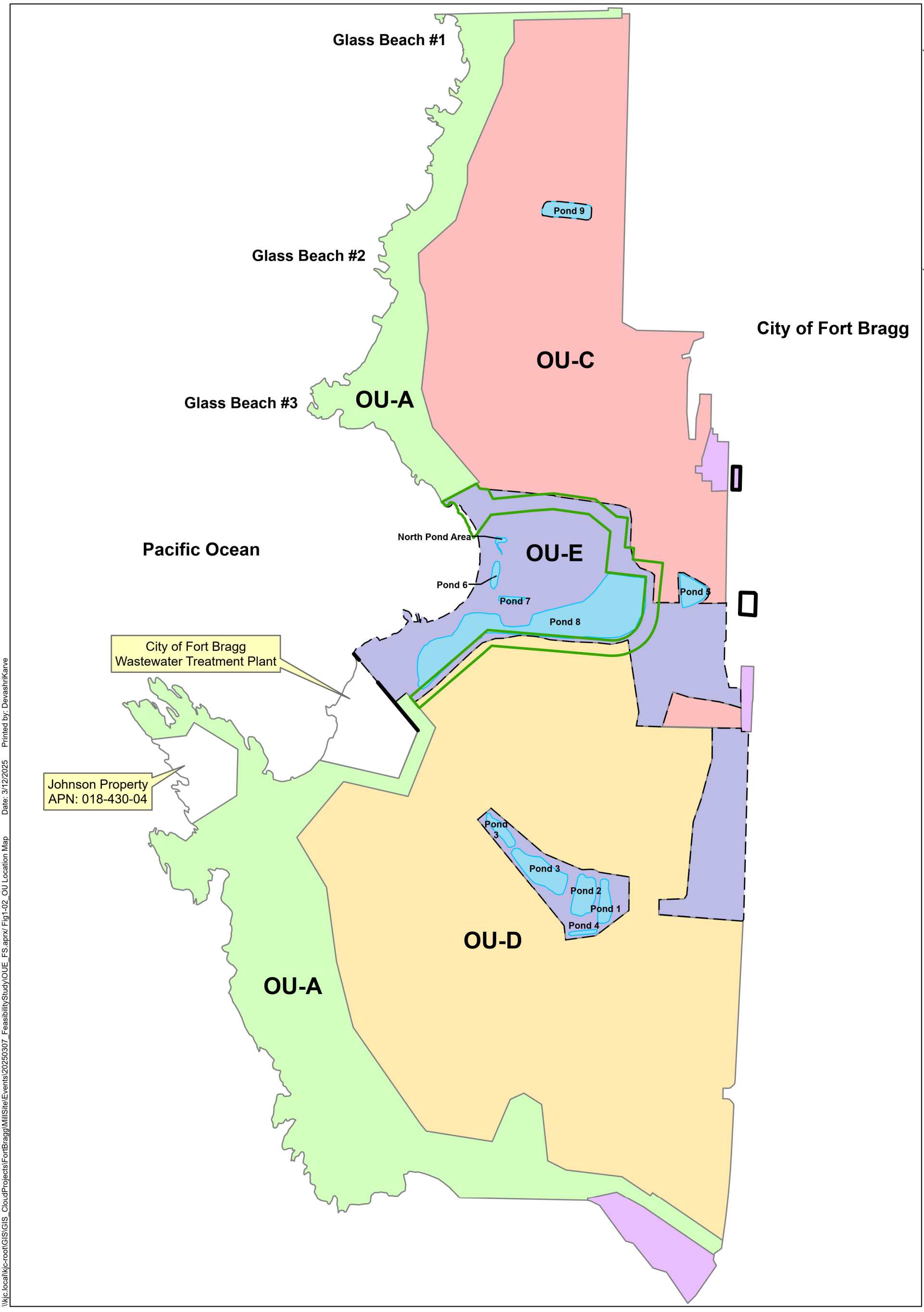
Kennedy Jenks

Former Georgia-Pacific Wood Products Facility
Fort Bragg, California

Site Location Map

1965021*21

Figure 1-1



Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet Projection: Lambert Conformal Conic

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Legend

- APPROXIMATE CENTRAL COASTAL TRAIL PROPERTY (CITY OF FORT BRAGG)
- SITE BOUNDARY
- POND

OPERABLE UNITS

- OU-A
- "OFFSITE" NON-INDUSTRIAL (OU-B)
- NORTHERN (OU-C)
- SOUTHERN (OU-D)
- CENTRAL/AQUATIC (OU-E)

Notes:
1. Abbreviation: OU = Operable Unit

N

0 300 600

Scale: Feet

Kennedy Jenks

Former Georgia-Pacific Wood Products Facility
Fort Bragg, California

Operable Units Location Map

1965021*21

Figure 1-2

World Imagery: Maxar

Coordinate System: NAD 1983 StatePlane California II FIPS 0402 Feet Projection: Lambert Conformal Conic

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Pond 9 (H)

CITY OF FORT BRAGG

Fort Bragg Landing

WATER TREATMENT AND TRUCK DUMP AOI

COMPRESSOR HOUSE AND LATH BUILDING AOI

North Pond (F)

A

SAWMILL #1 AOI

Pond 8 Fill Area AOI - East

D

Pond 6

C

Pond 5

POWERHOUSE AND FUEL BARN AOI

Pond 7 (E)

Pond 8 Fill Area AOI - North

Pond 8

G

IRM AOI

WEST OF IRM AOI

Pond 8 Fill Area AOI - South

POND 8 FILL AREA AOI

Pond 8 Fill Area AOI - West

RIPARIAN AOI

B

Pond 3

B

Pond 3

B

Pond 2

B

Pond 1

Pond 4 (B)

Legend

- SITE BOUNDARY
- NEWLY IDENTIFIED POND 8 FILL AREA AOIS
- AOI BOUNDARY
- OU-E BOUNDARY
- OU-A BOUNDARY
- APPROXIMATE CENTRAL COASTAL TRAIL PROPERTY (CITY OF FORT BRAGG)
- PONDS
- AREA OF CONCERN BOUNDARY

AREAS OF CONCERN:

- A OUE LOWLAND
- B SOUTHERN PONDS
- C POND 5
- D POND 6
- E POND 7
- F NORTH POND
- G POND 8
- H POND 9

Notes:
1. Acronyms:
AOI - Area of Interest
OU - Operable Unit

N

0 200 400

Scale: Feet

Kennedy Jenks

Former Georgia-Pacific Wood Products Facility
Fort Bragg, California

OU-E Area of Interest Map and Associated Features

1965021*21

Figure 1-3

Appendix A

Cost Summary Tables for Sediment Remediation Alternatives
(Updated Appendix A, 2019 OU-E FS)

Appendix A
Cost Summary Table - Sediment Remediation Alternatives Assumptions
(Updated Appendix A, 2019 OU-E FS)

Feasibility Study Addendum - Operable Unit E
Former Georgia Pacific Wood Products Facility
Fort Bragg, California

Line Item	Unit Price	Units	Source
Soil and Sediment Costs			
Delineation and survey	Varies by AOC	per Square Foot	Assumed $0.20 per sf of AOI area, consistent with the OU-C/D FS.
Reporting	$60,000	Lump Sum	Typical cost based on previous work completed
Deed Restriction	$30,000	Lump Sum	Typical cost based on previous work completed
Soil Management Plan	$45,000	Lump Sum	Typical cost based on previous work completed
Mill Pond Dam Repairs - Exterior RSP	$6,350,000	Lump Sum	Contractor estimate of probable cost prepared for Georgia-Pacific, LLC in April 2021, includes $391,616 Rock Slope Protection, $175,000 Spillway Improvement, $1,024,978 Pond Separation, $2,970,205 Soil Buttress.
Mill Pond Dam Repairs - Interior RSP	$7,400,000	Lump Sum	Contractor estimate of probable cost prepared for Georgia-Pacific, LLC in April 2021, includes $900,000 Excavation & Disposal, $391,616 Rock Slope Protection, $175,000 Spillway Improvement, $1,024,978 Pond Separation, $2,970,205 Soil Buttress. Rock Slope Protection cost adjusted for alternate design (i.e., interior of Pond 8).
Mill Pond Dam Repairs - Seawall	$106,000,000	Lump Sum	Contractor estimate of probable cost prepared for Georgia-Pacific, LLC in April 2021 and published costs for seawalls built in California, includes $391,616 Rock Slope Protection, $175,000 Spillway Improvement, $1,024,978 Pond Separation, $2,970,205 Soil Buttress, $84,900,000 Seawall. Seawall costs based on published costs for typical seawalls constructed in California.
Beach Berm Repairs and Long-Term O&M	$270,000	Lump Sum	Based on repair/replacement of portions of beach berm armoring in year 30 of estimate, adjusted to NPV
Project Management	Varies by AOC	percent	Typically 10% of project cost
Design, preparation and oversight	Varies by AOC	percent	Typically 10% of Construction Costs
Permitting	$200,000	Lump Sum	Typical permitting cost for this project, based on previous work at the site, includes biological surveys, cultural resource consultation and reports, stormwater, air, city, and resource agency permits
Mobilization/Demobilization	$50,000	Lump Sum	Based on 2017 excavation effort
Installation of Cover	$80	per Cubic Yard	Based on 2017 excavation effort. Earthwork effort assumed to be similar for excavation as installation of cover.
Annual Maintenance (10% cover replacement annually)	Varies by AOC	Years (NPV)	An annual replacement rate of 10% is assumed for the wet vegetative cover alternatives. This replacement rate is based on sediment cap replacement in areas of active water flow and likely sediment cover scour and transport.
Restoration (4:1)	$64,000 - $320,000	per Acre	Based on creation of wetland establishment area as part of 2017 excavation effort. Restoration costs greater than 20 acres assumed to be an increased unit price due to higher scale of level of effort, including significant earthwork and creek daylighting needed to meet larger area requirements. A mitigation ratio of 4:1 was assumed. If existing pond remains a pond or wetland after alternative is implemented, the existing structure was counted as part of the mitigation (i.e., create new wetland area equal to three times the pond area to achieve 4:1 mitigation). In this scenario, the pond area would require reseeding but not the effort to create new wetland area, and therefore was included in the hydroseed line item but not included in the restoration line item. If the existing pond will not remain after the alternative is implemented, create new wetland area equal to four times the pond area to achieve 4:1 mitigation.
Engineer Oversight and Office Support	$3,700	per Day	Based on 2017 excavation effort. Assumes full-time engineering oversight in field with support from the office as-needed.
Contractor Non-labor Costs (Per Diem, etc.)	$2,000	per Day	Based on 2017 excavation effort. Average contractor team size of four, including one supervisor and one operator.
Misc. Supplies and Fuel	$800	per Day	Based on 2017 excavation effort
Equipment Costs	$3,000	per Day	Based on 2017 excavation effort. Includes Contractor vehicles, water truck, on-site trucking, skid steer, mini-excavator, and excavator (335F).
Excavation	$26	per Cubic Yard	Based on 2017 excavation effort. Assumes Contractor labor was equally divided between excavation, backfill, and stockpile and sediment management.
Stockpile and Sediment Management	$26	per Cubic Yard	Based on 2017 excavation effort. Assumes Contractor labor was equally divided between excavation, backfill, and stockpile and sediment management.
Transportation and Disposal (Class 2 Non-Hazardous)	$100	Tons	Based on 2017 excavation effort
Biological and Cultural Monitoring	$2,300	per Day	Based on 2017 excavation effort. Assumes monitors on-site as needed (not full-time).
Hydroseed	$12,700	per Acre	Based on 2017 excavation effort
In-situ Soil Mixing	$70	per Cubic Yard	Unit cost based on the in-situ soil mixing cost presented in the Remediation Technologies Screening Matrix and Reference Guide, Version 4.0 (https://frtr.gov/matrix2/top_page.html).

Appendix A
Cost Summary Table - Sediment Remediation Alternatives
(Updated Appendix A, 2019 OU-E FS)

Feasibility Study Addendum - Operable Unit E
Former Georgia Pacific Wood Products Facility
Fort Bragg, California

		Pond 7 AOC				North Pond and Pond 6 AOC				Pond 8 AOC			
	Nature and Extent	**• Arsenic, Dioxin TEQ • 900 sf • 170 cy average depth of 5 feet**				**• Arsenic, Dioxin TEQ • 3,000 sf (North Pond); 7,000 sf (Pond 6) • 2,200 cy to depth of 6 feet**				**• Dioxin TEQ • 280,000 sf • 106,000 cy average depth of 10 ft**			
	Remediation Alternative Cost Estimates and Assumptions	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**
Sediment Remediation Alternatives (2019 OU-E FS)	**No Action**	**No Action**				**No Action**				**No Action**			
	Assumptions:	No remediation activities required				No remediation activities required				No remediation activities required			
	Total Cost				**$ -**				**$ -**				**$ -**
	Institutional Controls[5]	**Institutional Controls**				**Institutional Controls**				**Institutional Controls**			
	Assumptions:	Deed restriction, survey, SMP				Deed restriction, survey, SMP				Containment, deed restriction, survey, SMP [2.]			
	Delineation and survey	1	Lump Sum	$ 2,000	$ 2,000	1	Lump Sum	$ 3,000	$ 3,000	1	Lump Sum	$ 58,000	$ 58,000
	Reporting	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000
	Permitting	Not Applicable				Not Applicable				1	Lump Sum	$ 200,000	$ 200,000
	Mill Pond Dam Repairs Present Dollars	Not Applicable				Not Applicable				1	Lump Sum	$ 6,350,000	$ 6,350,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV + 5 yr survey)	Not Applicable				Not Applicable				30	Years (NPV)	$ 6,000	$ 36,000
	Beach Berm Repairs at year 30	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M ($1,000/acre/year NPV)	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000
	Hydroseed	Not Applicable				Not Applicable				1.3	Acres	$ 12,700	$ 17,000
	Restoration (4:1) [2]	Not Applicable				Not Applicable				1.3	Acres	$ 64,000	$ 83,000
	Project Management	1	10% of subtotal	$ 18,100	$ 19,000	1	10% of subtotal	$ 18,200	$ 19,000	1	10% of subtotal	$ 692,300	$ 693,000
	Total Cost				**$ 200,000**				**$ 201,000**				**$ 7,616,000**
	Sediment Cover[5]	**Vegetative Cover (Wet)**				**Vegetative Cover (Wet)**				**Vegetative Cover (Wet)**			
	Assumptions:	5,000 sf vegetative cover 2 feet thick, restoration of 0.6 acres as wet meadow (includes pond)				10,000 sf vegetative cover 2 feet thick, restoration of 0.9 acres as wet meadow (includes ponds)				280,000 sf vegetative cover 2 feet thick, restoration of 20 acres with creek restoration (includes pond)			
	Design, preparation and oversight (10% of Construction)	1	Lump Sum	$ 15,000	$ 15,000	1	Lump Sum	$ 26,000	$ 26,000	1	Lump Sum	$ 1,041,000	$ 1,041,000
	Permitting	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000
	Mobilization/Demobilization	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 150,000	$ 150,000
	Installation of Cover	380	Cubic Yards	$ 80	$ 30,000	750	Cubic Yards	$ 80	$ 60,000	21,000	Cubic Yards	$ 80	$ 1,680,000
	Annual Maintenance (10% cover replacement annually[3])	30	Years (NPV)	$ 3,040	$ 38,000	30	Years (NPV)	$ 6,000	$ 75,000	30	Years (NPV)	$ 168,000	$ 2,085,000
	Hydroseed	0.3	Acres	$ 12,700	$ 4,000	0.9	Acres	$ 12,700	$ 11,000	20	Acres	$ 12,700	$ 248,000
	Restoration (3:1) [2]	0.3	Acres	$ 64,000	$ 19,000	0.9	Acres	$ 64,000	$ 58,000	20	Acres	$ 320,000	$ 6,240,000
	Reporting	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000
	Mill Pond Dam Repairs Present Dollars	Not Applicable				Not Applicable				1	Lump Sum	$ 6,350,000	$ 6,350,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV + 5 yr survey)	Not Applicable				Not Applicable				30	Years (NPV)	$ 6,000	$ 36,000
	Beach Berm Repairs at year 30	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M ($1,000/acre/year NPV)	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000
	Project Management	1	10% of subtotal	$ 53,500	$ 54,000	1	10% of subtotal	$ 65,900	$ 66,000	1	10% of subtotal	$ 1,820,900	$ 1,821,000
	Total Cost				**$ 589,000**				**$ 725,000**				**$ 20,030,000**

Appendix A
Cost Summary Table - Sediment Remediation Alternatives
(Updated Appendix A, 2019 OU-E FS)

Feasibility Study Addendum - Operable Unit E
Former Georgia Pacific Wood Products Facility
Fort Bragg, California

Sediment Remediation Alternatives (2019 OU-E FS)		Pond 7 AOC				North Pond and Pond 6 AOC				Pond 8 AOC			
	Nature and Extent	**• Arsenic, Dioxin TEQ • 900 sf • 170 cy average depth of 5 feet**				**• Arsenic, Dioxin TEQ • 3,000 sf (North Pond); 7,000 sf (Pond 6) • 2,200 cy to depth of 6 feet**				**• Dioxin TEQ • 280,000 sf • 106,000 cy average depth of 10 ft**			
	Remediation Alternative Cost Estimates and Assumptions	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**
	Soil Cover[5]	**Vegetative Cover (Dry)**				**Vegetative Cover (Dry)**				**Vegetative Cover (Dry)**			
	Assumptions:	5,000 sf vegetative cover 2 feet thick plus fill to rim of pond (11 feet), restoration of 0.8 acres as wet meadow (excludes pond)				10,000 sf vegetative cover 2 feet thick plus depth of water, restoration of 1.2 acres as wet meadow (excludes ponds)				280,000 sf vegetative cover 3 feet thick, restoration of 26 acres with creek restoration, divert water flow (excludes pond)			
	Design, preparation and oversight (10% of Construction)	1	Lump Sum	$ 28,000	$ 28,000	1	Lump Sum	$ 35,000	$ 35,000	1	Lump Sum	$ 1,143,000	$ 1,143,000
	Permitting	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000
	Mobilization/Demobilization	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 150,000	$ 150,000
	Installation of Cover	2,410	Cubic Yards	$ 80	$ 193,000	2,520	Cubic Yards	$ 80	$ 202,000	31,500	Cubic Yards	$ 80	$ 2,520,000
	Annual Maintenance ($1,000/acre/year NPV)	30	Years (NPV)	$ 200	$ 2,000	30	Years (NPV)	$ 400	$ 5,000	30	Years (NPV)	$ 8,200	$ 101,000
	Hydroseed	0.4	Acres	$ 12,700	$ 5,000	1.2	Acres	$ 12,700	$ 15,000	26	Acres	$ 12,700	$ 330,000
	Restoration (4:1) [2]	0.4	Acres	$ 64,000	$ 26,000	1.2	Acres	$ 64,000	$ 77,000	26	Acres	$ 320,000	$ 8,320,000
	Reporting	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000	1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000	1	Lump Sum	$ 45,000	$ 45,000
	Mill Pond Dam Repairs Present Dollars	Not Applicable				Not Applicable				1	Lump Sum	$ 6,350,000	$ 6,350,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV)	Not Applicable				Not Applicable				30	Years (NPV)	$ 6,000	$ 36,000
	Beach Berm Repairs at year 30	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000	1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000	30	Years (NPV)	$ 1,000	$ 8,000
	Project Management	1	10% of subtotal	$ 68,300	$ 69,000	1	10% of subtotal	$ 76,300	$ 77,000	1	10% of subtotal	$ 1,932,900	$ 1,933,000
	Total Cost				**$ 752,000**				**$ 840,000**				**$ 21,262,000**
	Excavation and Disposal[5]	**Excavation and Disposal**				**Excavation and Disposal**				**Excavation and Disposal**			
	Assumptions: Costs based on recent 2017 excavation effort	Excavation and offsite disposal of 170 cy, restoration mitigation of 0.3 acres as wet meadow (includes pond)				Excavation and offsite disposal of 2,200 cy, restoration mitigation of 0.9 acres as wet meadow (includes ponds)				Excavation and offsite disposal of 106,000 cy, restoration mitigation of 20 acres as stream restoration [2] (includes pond)			
	Design (10% of Construction)	1	Lump Sum	$ 20,000	$ 20,000	1	Lump Sum	$ 70,000	$ 70,000	1	Lump Sum	$ 3,010,000	$ 3,010,000
	Permitting	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000
	Engineer Oversight and Office Support	2	Days	$ 3,700	$ 7,400	8	Days	$ 3,700	$ 30,000	350	Days	$ 3,700	$ 1,295,000
	Mobilization/Demobilization	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 150,000	$ 150,000
	Contractor Non-labor Costs (Per Diem, etc.)	2	Days	$ 2,000	$ 4,000	8	Days	$ 2,000	$ 16,000	348	Days	$ 2,000	$ 696,000
	Misc. Supplies and Fuel	2	Days	$ 800	$ 1,600	8	Days	$ 800	$ 6,000	348	Days	$ 800	$ 278,000
	Equipment Costs	2	Days	$ 3,000	$ 6,000	8	Days	$ 3,000	$ 24,000	348	Days	$ 3,000	$ 1,044,000
	Excavation	170	Cubic Yards	$ 26	$ 4,000	2,200	Cubic Yards	$ 26	$ 57,000	106,000	Cubic Yards	$ 26	$ 2,756,000
	Stockpile and Sediment Management	170	Cubic Yards	$ 26	$ 4,000	2,200	Cubic Yards	$ 26	$ 57,000	106,000	Cubic Yards	$ 26	$ 2,756,000
	Transportation and Disposal (Class 2 Non-Hazardous)	255	Tons	$ 100	$ 26,000	3,300	Tons	$ 100	$ 330,000	159,000	Tons	$ 100	$ 15,900,000
	Biological and Cultural Monitoring	2	Days	$ 2,300	$ 4,600	8	Days	$ 2,300	$ 18,000	348	Days	$ 2,300	$ 800,000
	Hydroseed	0.3	Acres	$ 12,700	$ 4,000	0.9	Acres	$ 12,700	$ 11,000	20	Acres	$ 12,700	$ 248,000
	Restoration (3:1) [2]	0.3	Acres	$ 64,000	$ 19,000	0.9	Acres	$ 64,000	$ 58,000	20	Acres	$ 320,000	$ 6,240,000
	Reporting	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000
	Project Management	1	10% of subtotal	$ 41,060	$ 42,000	1	10% of subtotal	$ 98,700	$ 99,000	1	10% of subtotal	$ 3,543,300	$ 3,544,000
	Total Cost				**$ 452,600**				**$ 1,086,000**				**$ 38,977,000**

Appendix A
Cost Summary Table - Sediment Remediation Alternatives
(Updated Appendix A, 2019 OU-E FS)

Feasibility Study Addendum - Operable Unit E
Former Georgia Pacific Wood Products Facility
Fort Bragg, California

		Pond 7 AOC				North Pond and Pond 6 AOC				Pond 8 AOC			
	Nature and Extent	**• Arsenic, Dioxin TEQ • 900 sf • 170 cy average depth of 5 feet**				**• Arsenic, Dioxin TEQ • 3,000 sf (North Pond); 7,000 sf (Pond 6) • 2,200 cy to depth of 6 feet**				**• Dioxin TEQ • 280,000 sf • 106,000 cy average depth of 10 ft**			
	Remediation Alternative Cost Estimates and Assumptions	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**
Sediment Remediation Alternatives (2019 OU-E FS)	**In-situ Soil Mixing[5]**									**In-situ Soil Mixing**			
	Assumptions:									106,000 cy in-situ soil mixing, restoration of 20 acres with creek restoration			
	Design, preparation and oversight (10% of Construction)									1	Lump Sum	$ 1,630,000	$ 1,630,000
	Permitting									1	Lump Sum	$ 200,000	$ 200,000
	Mobilization/Demobilization									1	Lump Sum	$ 225,000	$ 225,000
	In-situ Soil Mixing [4]									106,000	Cubic Yards	$ 70	$ 7,420,000
	Hydroseeding									26	Acres	$ 12,700	$ 330,000
	Restoration (4:1) [2]									26	Acres	$ 320,000	$ 8,320,000
	Reporting									1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction									1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan									1	Lump Sum	$ 45,000	$ 45,000
	Project Management									1	10% of subtotal	$ 1,826,000	$ 1,826,000
	Total Cost												**$ 20,086,000**
Sediment Remediation Alternatives (New)	**Pond 8 West Excavation and Disposal**	**Pond 8 West Excavation and Disposal**				**Pond 8 West Excavation and Disposal**				**Pond 8 West Excavation and Disposal**			
	Assumptions: Costs based on recent 2017 excavation effort	Excavation and offsite disposal of 170 cy, restoration mitigation of 0.3 acres as wet meadow (includes pond)				Excavation and offsite disposal of 2,200 cy, restoration mitigation of 0.9 acres as wet meadow (includes ponds)				Excavation and offsite disposal of 24,000 cy, restoration mitigation of 9.0 acres as wet meadow (includes pond)			
	Design (10% of Construction)	1	Lump Sum	$ 20,000	$ 20,000	1	Lump Sum	$ 70,000	$ 70,000	1	Lump Sum	$ 620,000	$ 620,000
	Permitting	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000	1	Lump Sum	$ 200,000	$ 200,000
	Engineer Oversight and Office Support	2	Days	$ 3,700	$ 7,400	8	Days	$ 3,700	$ 30,000	80	Days	$ 3,700	$ 296,000
	Mobilization/Demobilization	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 50,000	$ 50,000	1	Lump Sum	$ 100,000	$ 100,000
	Contractor Non-labor Costs (Per Diem, etc.)	2	Days	$ 2,000	$ 4,000	8	Days	$ 2,000	$ 16,000	80	Days	$ 2,000	$ 160,000
	Misc. Supplies and Fuel	2	Days	$ 800	$ 1,600	8	Days	$ 800	$ 6,000	80	Days	$ 800	$ 64,000
	Equipment Costs	2	Days	$ 3,000	$ 6,000	8	Days	$ 3,000	$ 24,000	80	Days	$ 3,000	$ 240,000
	Excavation	170	Cubic Yards	$ 26	$ 4,000	2,200	Cubic Yards	$ 26	$ 57,000	24,000	Cubic Yards	$ 26	$ 624,000
	Stockpile and Sediment Management	170	Cubic Yards	$ 26	$ 4,000	2,200	Cubic Yards	$ 26	$ 57,000	24,000	Cubic Yards	$ 26	$ 624,000
	Transportation and Disposal (Class 2 Non-Hazardous)	255	Tons	$ 100	$ 26,000	3,300	Tons	$ 100	$ 330,000	36,000	Tons	$ 100	$ 3,600,000
	Biological and Cultural Monitoring	2	Days	$ 2,300	$ 4,600	8	Days	$ 2,300	$ 18,000	80	Days	$ 2,300	$ 184,000
	Mill Pond Dam Repairs Present Dollars	Not Applicable				Not Applicable				1	Lump Sum	$ 6,350,000	$ 6,350,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV + 5 yr survey)	Not Applicable				Not Applicable				30	Years (NPV)	$ 6,000	$ 36,000
	Beach Berm Repairs at year 30	Not Applicable				Not Applicable				1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M ($1,000/acre/year NPV)	Not Applicable				Not Applicable				30	Years (NPV)	$ 1,000	$ 8,000
	Hydroseed	0.3	Acres	$ 12,700	$ 4,000	0.9	Acres	$ 12,700	$ 11,000	9	Acres	$ 12,700	$ 114,000
	Restoration (3:1) [2]	0.3	Acres	$ 64,000	$ 19,000	0.9	Acres	$ 64,000	$ 58,000	9	Acres	$ 64,000	$ 576,000
	Reporting	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000	1	Lump Sum	$ 60,000	$ 60,000
	Project Management	1	10% of subtotal	$ 41,060	$ 42,000	1	10% of subtotal	$ 98,700	$ 99,000	1	10% of subtotal	$ 1,389,200	$ 1,390,000
	Total Cost				**$ 452,600**				**$ 1,086,000**				**$ 15,282,000**

Appendix A
Cost Summary Table - Sediment Remediation Alternatives
(Updated Appendix A, 2019 OU-E FS)

Feasibility Study Addendum - Operable Unit E
Former Georgia Pacific Wood Products Facility
Fort Bragg, California

		Pond 7 AOC				North Pond and Pond 6 AOC				Pond 8 AOC			
	Nature and Extent	**• Arsenic, Dioxin TEQ • 900 sf • 170 cy average depth of 5 feet**				**• Arsenic, Dioxin TEQ • 3,000 sf (North Pond); 7,000 sf (Pond 6) • 2,200 cy to depth of 6 feet**				**• Dioxin TEQ • 280,000 sf • 106,000 cy average depth of 10 ft**			
	Remediation Alternative Cost Estimates and Assumptions	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**	**Quantity [1.]**	**Units**	**Unit Rate**	**NPV Cost**
Sediment Remediation Alternatives (New)	**Institutional Controls with Interior Rock Slope Protection[6]**									**Institutional Controls with Interior Rock Slope Protection**			
	Assumptions:									Containment, deed restriction, survey, SMP [2.]			
	Delineation and survey									1	Lump Sum	$ 63,000	$ 63,000
	Reporting									1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction									1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan									1	Lump Sum	$ 45,000	$ 45,000
	Permitting									1	Lump Sum	$ 200,000	$ 200,000
	Mill Pond Dam Repairs Present Dollars									1	Lump Sum	$ 7,400,000	$ 7,400,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV + 5 yr survey)									30	Years (NPV)	$ 6,000	$ 36,000
	Beach Berm Repairs at year 30									1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M ($1,000/acre/year NPV)									30	Years (NPV)	$ 1,000	$ 8,000
	Hydroseed									6	Acres	$ 12,700	$ 76,000
	Restoration (4:1) [2]									6	Acres	$ 64,000	$ 384,000
	Project Management									1	10% of subtotal	$ 833,800	$ 834,000
	Total Cost												**$ 9,172,000**
	Institutional Controls with Seawall									**Institutional Controls with Seawall**			
	Assumptions:									Containment, deed restriction, survey, SMP [2.]			
	Delineation and survey									1	Lump Sum	$ 63,000	$ 63,000
	Reporting									1	Lump Sum	$ 60,000	$ 60,000
	Deed Restriction									1	Lump Sum	$ 30,000	$ 30,000
	Soil Management Plan									1	Lump Sum	$ 45,000	$ 45,000
	Permitting									1	Lump Sum	$ 200,000	$ 200,000
	Mill Pond Dam Repairs Present Dollars[7]									1	Lump Sum	$ 10,000,000	$ 10,000,000
	Mill Pond Dam Inspection and Long-Term O&M ($1,000/acre/year NPV + 5 yr survey)									30	Years (NPV)	$ 76,250	$ 947,000
	Beach Berm Repairs at year 30									1	NPV of repair	$ 270,000	$ 36,000
	Beach Berm Inspection and Long-Term O&M ($1,000/acre/year NPV)									30	Years (NPV)	$ 1,000	$ 8,000
	Hydroseed									1.3	Acres	$ 12,700	$ 17,000
	Restoration (4:1) [2]									1.3	Acres	$ 64,000	$ 83,000
	Project Management									1	10% of subtotal	$ 1,148,900	$ 1,149,000
	Total Cost												**$ 12,638,000**

Notes:

1. Area and volume estimates were based on available AOC data. Most probable estimates of affected areas were utilized for costing; however, actual costs may increase/decrease based on further characterization efforts. Costs are assumed to be within the -30%, +50% range over 30 years using a discount rate of 9% and an inflation rate of 2%.
2. A mitigation ratio of 4:1 was assumed. If existing pond remains a pond or wetland after alternative is implemented, the existing structure was counted as part of the mitigation (i.e., create new wetland area equal to three times the pond area [3:1] to achieve 4:1 mitigation). In this scenario, the pond area would require reseeding but not the effort to create new wetland area, and therefore was included in the hydroseed line item but not included in the restoration line item. If the existing pond will not remain after the alternative is implemented, create new wetland area equal to four times the pond area to achieve 4:1 mitigation. In the case of Pond 8 institutional controls, minor wetlands in former concrete tanks along the north berm and the seeps and beach below the crib wall are affected.
3. An annual replacement rate of 10% is assumed for the wet vegetative cover alternatives. This replacement rate is based on sediment cap replacement in areas of active water flow and likely sediment cover scour and transport.
4. Unit cost based on the Remediation Technologies Screening Matrix and Reference Guide, Version 4.0 (https://frtr.gov/matrix2/top_page.html).
5. Cost estimate for this alternative was previously presented in the 2019 OU-E FS. Costs have been escalated to 2025 for comparison with the new alternatives.
6. Interior RSP costs estimated assume exterior RSP and excavation and disposal costs.
7. Seawall costs based on reported costs for seawalls constructed in California; not based on site-specific conceptual design.

AOC = area of concern
cy = cubic yards
sf = square feet
SMP = soil management plan
TEQ = toxic equivalency factor