US Army Corps of Engineers ®
Walla Walla District

YAKIMA RIVER DELTA ECOSYSTEM RESTORATION

Final Feasibility Report with Integrated Environmental Assessment

Appendix G

Monitoring and Adaptive Management Plan

Monitoring and Adaptive Management Plan
Yakima River Delta Section 1135 Ecosystem Restoration Study
September 2024

1. Project Overview

The U.S. Army Corps of Engineers, Walla Walla District (Corps), and the non-federal sponsor, the Washington State Department of Fish and Wildlife (WDFW), are conducting a feasibility study with an intended goal of improving aquatic habitat and ecosystem functionality to the Yakima River Delta (Delta) in Richland, Washington. Water quality in the Delta was negatively impacted by construction of McNary Lock and Dam, the Tri-Cities Levee System, and other contributing factors and is currently proving to be detrimental to Endangered Species Act (ESA)-listed salmonids and bull trout that are present in the Delta during their various life stages. Both the Yakima River and the Columbia River are designated Critical Habitat for ESA-listed species.

A 500-foot-long by 40-foot-wide land bridge (causeway) was constructed from the mainland across the Delta to Bateman Island in 1940 for agricultural access. It is composed of earthen material and has been reinforced with rock riprap over time. It is maintained for emergency vehicle and recreational foot traffic access to Bateman Island. It is a complete barrier to river flow, boats, and fish, so it reduces the ability of Yakima and Columbia River waters to freely mix, thus resulting in a greater occurrence of stagnant water, increased surface water temperatures, and enhanced sediment deposition rates within the Delta.

In order to achieve the intended goal of the feasibility study (to improve aquatic habitat and ecosystem functionality in the Delta), numerous management measures were considered early in the planning process. Management measures are the building blocks of any planning solution and can either be used alone or combined with other management measures to create various alternatives that could solve the problem. Originally, 14 measures were conceived that were then evaluated further and screened. Two measures remained and were combined into alternatives, based on whether they were mutually exclusive, combinable, or dependent on other measures. Measure 7 – Complete or Partial Removal of the Causeway, and Measure 13 – Increase Fringe Riparian Habitat. The initial array of alternatives is, 1) the No Action Alternative, Alternative 2a) Full Removal of the Causeway with Riparian Habitat Restoration, Alternative 2b) Partial Removal of the Causeway with Riparian Habitat Restoration, Alternative 3a) Full Removal of the Causeway without Riparian Habitat Restoration, and Alternative 3b) Partial Removal of the Causeway without Riparian Habitat Restoration.

Alternative 3a – Full Removal of the Causeway without Riparian Habitat Restoration is the selected alternative or Tentatively Selected Plan (TSP). The selected alternative is intended to restore aquatic habitat and ecosystem functionality in the Yakima River Delta. Please refer to Section 3 of the main report for specifics related to the goals and objectives.

There are uncertainties related to the physical and/or biological performance of these measures that could affect the ability to meet the project goals and objectives. These measures will be monitored following project construction or after initial implementation to inform decision-makers whether 1) The project is meeting performance measures and should continue as implemented 2) The project is not meeting performance measures and should be adjusted, or 3) The project has met success criteria and no further monitoring for ecological performance is needed.

USACE Implementation Guidance for Section 1161 (Monitoring Ecosystem Restoration) of the Water Resources Development Act of 2016, and Section 2036 (Mitigation for Fish and Wildlife and Wetlands Losses) of the Water Resources Development Act of 2007 require monitoring sufficient to evaluate ecosystem restoration and mitigation success. USACE is required to consider adaptive management (or contingency plans) for ecosystem restoration projects and mitigation projects because they often involve uncertainty that can be reduced through an adaptive management approach. For this project, adaptive management is an appropriate management strategy because there is: 1) uncertainty regarding the outcome of the management measures, 2) an ability to monitor and evaluate the system response to management measures, 3) capacity to learn from monitoring, and 4) the ability to apply a decision to change management if needed.

2. Objectives

An important part of the monitoring and adaptive management plan is the translation of the management goals and objectives from the planning process into specific performance measures (sometimes called metrics), success criteria (sometimes called targets), and decision triggers (triggers for implementing a contingency plan or other decision). During development of the monitoring and adaptive management plan the team worked from the planning study conceptual model(s) and impact/benefit assessments to define the physical, chemical, biological, and ecological criteria that will be monitored to assess project performance.

The following have been developed for this monitoring and adaptive management plan:

Objective 1: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Water temperature and associated dissolved oxygen. USACE would monitor water temperature and associated dissolved oxygen levels in the Yakima Delta prior to construction and for five years following construction.

Success Criteria: The water temperature for the western side of Bateman Island would become more suitable for ESA-listed fish during the warmer months of the year.

Monitoring Design: USACE would deploy approximately 10 Onset HOBO water temperature probes along the western shoreline of Bateman Island, beginning pre-breach until five years post breach. These probes would collect daily water temperatures. USACE would evaluate the overall effect to fish habitat and prepare one report, 6 years after breach of the causeway.

Decision Trigger(s): There are no management actions associated with this metric and therefore no triggers for decision.

Objective 2: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Turbidity during Construction. Turbidity monitoring would be conducted upstream, within, and downstream of the construction area pre-, during, and immediately post-breach of the causeway in accordance with Washington Department of Ecology turbidity monitoring protocol.

Success Criteria: Meeting 401 certification water quality standards and ESA biological opinion conditions for the project, if applicable. These would be decided during ESA consultation and 401 water quality certification.

Monitoring Design: Monitoring would be designed in accordance with the Washington Department of Ecology turbidity monitoring protocol.

Decision Trigger(s): USACE and the contractor would develop best management practices to minimize turbidity during construction activities. If turbidity exceeds the success criteria, construction activities would cease until the water quality meets success criteria.

Objective 3: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Sediment Transport. Sediment and mudflat development would be assessed and documented prior to construction and at 1-, 5-, and 10-year intervals following construction.

Success Criteria: There would be mudflats remaining within the Yakima Delta or confluence with the Columbia River 10 years post breach. The rate of sediment loss would not result in a large sediment plume creating long term increase in turbidity for more than one year. Sediment should not accumulate in areas of navigation or water intake/outfall structures.

Monitoring Design: Sediment transport monitoring would consist of qualitative visual surveys of the Delta and hydroacoustic surveys of key downstream areas.

Decision Trigger(s): USACE, the WDFW and affected stakeholders would collaborate to find a solution to restore navigation or intake/outfall structures, if undesirable patterns of sediment transport emerge during the monitoring period.

Objective 4: Improve the quality and complexity of aquatic and riparian habitat within the Yakima River Delta by increasing flows, reducing predator habitat, and providing native plant diversity.

Performance Measure: Riparian and Wetland Habitat. Riparian and wetland habitat development would be assessed and documented prior to construction and at 1-, 3-, 5-, and 10-year intervals following construction.

Success Criteria: There would be substantial development of wetland and riparian habitats within the Yakima Delta or confluence with the Columbia River 10 years post breach.

Monitoring Design: Riparian and wetland habitat monitoring would be designed per the California Rapid Assessment Method or other rapid assessment protocol.

Decision Trigger(s): If riparian habitat does not naturally establish by year 5, then a one-time planting will be implemented with invasive species management. The focus for these plantings will be at sites 1-4 that were identified during the alternative formulation.

Objective 5: Minimize risks of contaminated sediments transport.

Performance Measure: Contaminant levels in water column and sediments at beaches and water intakes downstream of the Yakima Delta.

Success Criteria: Contaminants would remain below levels of safety concern at water intakes and beaches downstream of Yakima Delta.

Monitoring Design: The water column and sediments would be monitored at key downstream locations before, during, and after construction in accordance with Ecology 401 water quality certification, if applicable.

Decision Trigger(s): If contaminants temporarily exceed safe levels, local authorities would be notified, and appropriate safety protocols could be initiated.

3. Monitoring Design

The monitoring design for this project includes the minimum monitoring actions necessary to evaluate success of the implemented management measures. It focuses on monitoring the performance measures of the project objectives to determine success. Each relevant objective and the associated performance measures are described below along with information required by USACE guidance.

Objective 1: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Water temperature and associated dissolved oxygen.

Nature of Monitoring: USACE would deploy approximately 10 Onset HOBO or similar water temperature probes with dissolved oxygen monitoring capabilities along the western shoreline of Bateman Island, beginning pre-breach until five years post breach. These probes would collect daily water temperatures and dissolved oxygen levels, focused on summer months. USACE would evaluate the overall effect to fish habitat and prepare one report, 6 years after breach of the causeway.

Proposed monitoring locations would include the mainstem Columbia River upstream and downstream of the Delta, the Yakima River upstream of the Delta, the south and west sides of Bateman Island, and throughout the Delta. Approximate locations for installing probes are seen in Figure 1. Actual locations would be determined in the field and would depend on localized patterns of thermal variability, persistence of submersion, the presence of suitable anchor points, and the ability to conceal the probe from potential human interference or theft. Monitoring locations would also be selected to ensure access and permanence through the construction period. Locations that would be expected to undergo notable morphological changes post construction would not be used. Bateman Island monitoring locations would be located sufficiently far from the shoreline as to not substantially increase in depth following construction.

Backup probes and loggers would be purchased and if monitoring sites with a low potential for theft cannot be identified, multiple probes would be installed at each monitoring point.

Probe and logger choice, field procedures, and data processing would be consistent with procedures described in *Measuring Stream Temperature with Digital Data Loggers: A User's Guide* (Dunham et. al 2005).

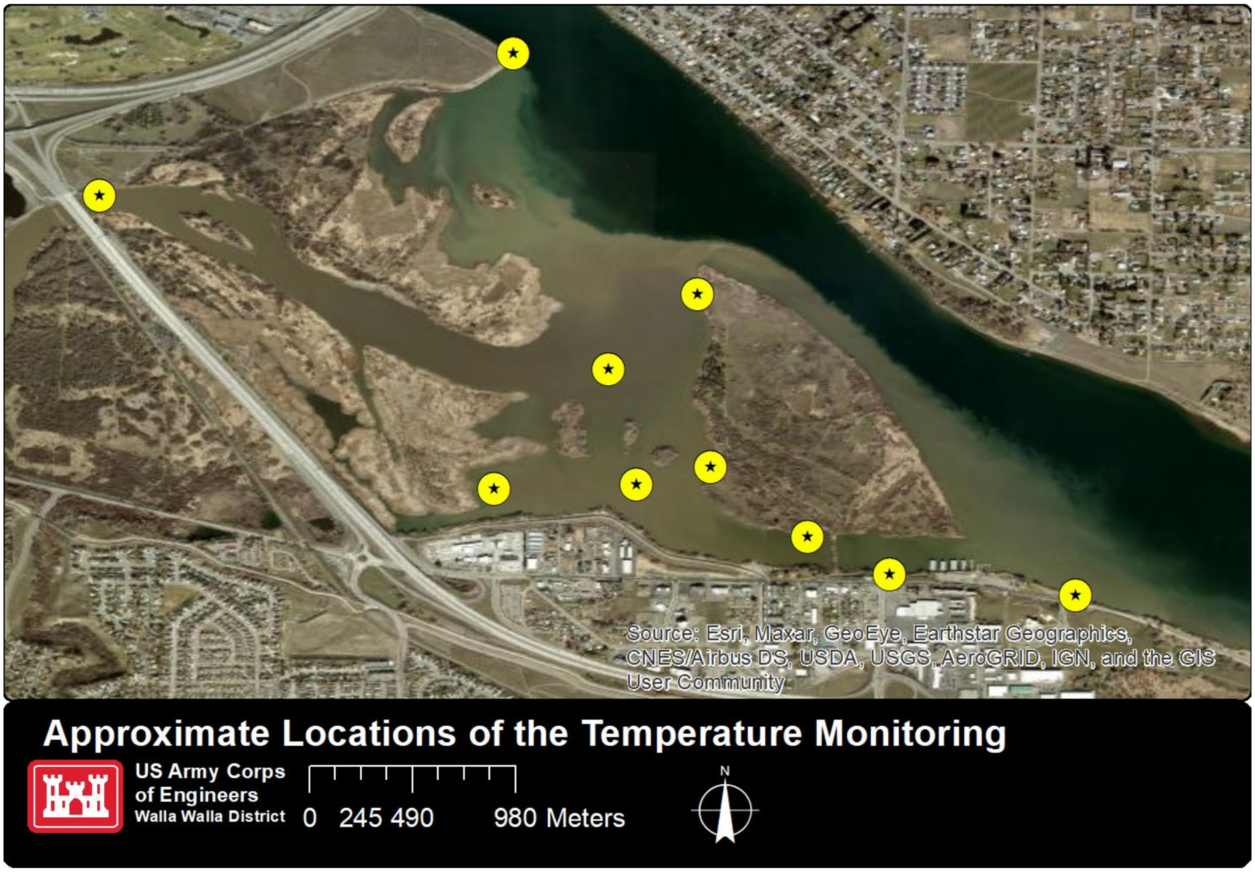

Figure 1. Approximate Locations of Temperature Monitoring

Duration: Monitoring would occur for the daily for one year prior to construction until five years post construction. Monitoring would begin at least one year prior to construction, and would include at least one full summer period prior to construction.

Periodicity: The temperature probes collect data continuously throughout the day and would be left in place throughout the 6-year monitoring period. The temperature probes would be visually inspected, and the data downloaded at quarterly intervals.

Data Analysis and Use: USACE would log and report the water temperature and dissolved oxygen values and the selected sites and compare conditions in the post construction period with those seen prior to the causeway breach, in a manner consistent with that described in Dunham et al. 2005.

Costs: Temperature monitoring is estimated to cost $14500 in the first year and $8500 in each following year.

Responsibilities: USACE would be responsible for all facets of temperature monitoring.

Project Closeout Plan: USACE would evaluate the overall effect to fish habitat and prepare one report, 6 years after breach of the causeway.

Objective 2: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Turbidity during construction

Nature of Monitoring: The Contractor would devise a plan of turbidity monitoring consistent with Washington Administrative Code (WAC) 173-201A-200 and the project's 401 Water Quality Certification and submit the plan to USACE for approval 30 days prior to any onsite work. The plan would at minimum specify monitoring during the length of the construction period at both upstream and downstream locations. The plan would specify actions that would be taken in response to turbidity levels above those specified in WAC 173-201A-200.

Duration: Monitoring would occur for the duration of the construction period and until turbidity levels returned to background levels following construction.

Periodicity: Monitoring would occur at intervals consistent with WAC 173-201A-200 and the 401 Water Quality Certification.

Data Analysis and Use: Turbidity would be monitored upstream and downstream of the work area, to include an extended mixing zone due to the potential for sediment mobilization. If downstream turbidity exceeds upstream turbidity by 10 nephelometric turbidity units (NTU) over background when the background is 50 NTU or less; or by a 20 percent increase in turbidity when the background turbidity is more than 50 NTU, then actions would be taken to reduce turbidity generated by construction as specified in the turbidity monitoring plan. Turbidity data would be recorded in the field according to the contractor's preferred method and transmitted electronically to USACE.

Costs: Turbidity monitoring is estimated to require 8 hours daily for two technicians and would roughly cost $2000 per construction-day.

Responsibilities: The contractor would be responsible for all facets of turbidity monitoring.

Project Closeout Plan: Turbidity monitoring would be conducted throughout the construction period. Following the end of construction and the establishment of baseline turbidity levels, construction-related monitoring would cease. Focused turbidity monitoring related to post-construction sediment mobilization would be concurrent with and tied to the sediment transport monitoring below under Objective 3. Documentation of monitoring efforts and results to include corrective actions would be summarized by the contractor and reported to USACE.

Objective 3: Restore, for the 50-year period of analysis, the aquatic ecosystem function and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.

Performance Measure: Sediment Transport.

Nature of Monitoring: USACE would visually monitor the deposition and erosion of mudflats and the Bateman Island shorelines in the Yakima Delta for 10 years following construction. USACE would monitor key navigation areas and downstream water intakes. The monitoring would consist of qualitative monitoring of the Delta itself along with hydroacoustic surveys at navigation areas and water intakes.

Duration: Monitoring would be instantaneous and not continuous in nature and would be conducted during lower water periods, if possible.

Periodicity: Monitoring would occur prior to construction and at 1-, 3-, 5-, and 10-year intervals.

Data Analysis and Use: Mudflat development and shoreline erosion would be assessed visually and documented in a qualitative manner with a brief narrative description accompanied by photographs of the Delta. Key navigation points and water intakes would be assessed using simple hydroacoustic techniques. The depth at each area of concern would be documented prior to construction and assessed at 1-, 3-, 5-, and 10-year intervals to ensure that intakes were not being obstructed with sediment. Either down looking or side scan sonar could be used, depending on availability. Hydroacoustic data would be recorded by the technician and then logged digitally.

Costs: Mudflat development and shoreline erosion monitoring would cost approximately $1250 per occurrence. Navigation and Intake monitoring would cost approximately $3000 per occurrence.

Responsibilities: USACE would be responsible for all facets of sediment transport monitoring.

Project Closeout Plan: Sediment transport monitoring would be conducted prior to construction and at 1-, 3-, 5-, and 10-year intervals. Documentation of monitoring efforts and results would be summarized by USACE.

Objective 4: Improve the quality and complexity of aquatic and riparian habitat within the Yakima River Delta by increasing flows, reducing predator habitat, and providing native plant diversity.

Performance Measure: Riparian and Wetland Habitat.

Nature of Monitoring: USACE would survey the west and south shorelines of Bateman Island to assess the development of riparian and wetland habitats. Habitats would be assessed using the California Rapid Assessment Method for wetlands and riparian areas (CRAM) or similar visual rapid assessment protocol. Habitats would be quantified via field assessment or remotely sensed imagery.

Duration: Riparian and wetland habitat development would be assessed in early summer, following freshet. Surveys would take one day.

Periodicity: Riparian and wetland habitat development would be assessed and documented prior to construction and at 1-, 3-, 5-, and 10-year intervals following construction.

Data Analysis and Use: Habitat quantity and quality would be assessed at the described intervals and compared to baseline. If riparian and wetland habitat does not develop along the Bateman Island shoreline, USACE would coordinate with WDFW to undertake a onetime planting at areas discussed in the Feasibility Report (Sites 1-4).

Costs: Riparian and wetland monitoring is estimated to require 8 hours daily for two technicians and one GIS specialist and would roughly cost approximately $3250 per occurrence.
Responsibilities: USACE would be responsible for all facets of riparian and wetland habitat monitoring.

Project Closeout Plan: Riparian and wetland monitoring would be conducted prior to construction and at 1-, 3-, 5-, and 10-year intervals. Documentation of monitoring efforts and results would be summarized by USACE.

Objective 5: Minimize risks of contaminated sediments transport.

Performance Measure: Contaminant levels in sediments at beaches and water intakes downstream of the Yakima Delta.

Nature of Monitoring: USACE would monitor sediments downstream of the delta, focusing on areas near water facility intakes, in a manner that meets Washington State Department of Ecology (Ecology) requirements. Sampling and laboratory analyses will adhere to the protocols and guidelines set forth in the U.S. EPA's *Sampling Analysis Plan Guidance* and the USACE's *2018 Sediment Evaluation Framework for the Pacific Northwest* (SEF).

Duration: Monitoring would take approximately one day to gather samples per occurrence.

Periodicity: Monitoring would occur monthly for the duration of the construction period and during freshet the following spring. Should sediments mobilized during construction settle at water intake locations generating elevated levels of substances above EPA or DOE safety guidelines, monitoring would occur monthly until levels returned to background. Monitoring related to subsequent sediment mobilization would occur over the next 2-3 freshets following causeway removal.

Data Analysis and Use: Representative samples will be submitted to a USACE-qualified analytical laboratory for physical and chemical testing. Based on SEF guidelines, each sample will be analyzed for the following using the method specified in the SEF:

- beta-hexachlorocyclohexane
- Chlorinated pesticides (including DDT)
- Dioxins/furans
- Grain Size Distribution
- Metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc)
- Nitrogen as ammonia
- Organometallic compounds (mono-, di-, tri-, and tetrabutyltin ion)
- Polychlorinated biphenyls
- Polycyclic aromatic hydrocarbons
- Semi-volatile organic compounds
- Total petroleum hydrocarbons (TPH)-diesel and residual ranges
- Sulfide
- Total organic carbon
- Total solids
- Total sulfides
- Total volatile solids

Costs: Sediment monitoring would cost approximately $8,250 per occurrence.

Responsibilities: USACE would be responsible for all facets of sediment monitoring.

Project Closeout Plan: Sediment monitoring would be conducted throughout the construction period and the following spring. Following the end of construction and the establishment of baseline chemical levels in sediments levels, construction-period focused monitoring would cease. Monitoring reports related to subsequent sediment mobilization would occur over the course of the following 2 freshets.

4. Assessment

Evaluating the monitoring data includes a comparison of the results of the monitoring effort compared to predictions made in the planning process and success criteria.

Water Temperature

Water temperature and associated dissolved oxygen would be monitored at 10 points in the study area. Temperatures would be evaluated and compared to those seen prior to construction using approaches detailed in Dunham et al 2005 or Gray et al. 2018.

Turbidity

Turbidity would be monitored upstream and downstream of the work area, utilizing an extended mixing zone due to sediment mobilization potential. If downstream turbidity exceeds criteria thresholds, then actions would be taken to reduce turbidity generated by construction as specified in the turbidity monitoring plan. The constructing contractor would be responsible for creating and implementation of the turbidity monitoring plan. If sediment mobilization results in turbidity exceeding criteria thresholds, Ecology and local stakeholders will be notified. There are no opportunities to reduce such turbidity.

Sediment Transport.

Mudflat development would be assessed visually and documented in a qualitative manner with a brief narrative description accompanied by photographs of the Delta. USACE would be responsible for the assessment of sediment transport.

Riparian and Wetland Habitat.

Habitat quantity and quality would be assessed at the described intervals with CRAM or similar and compared to baseline. Habitat Assessments would be used as a foundation for discussions with project sponsors regarding engineered plantings in the Delta.

Sediment Contamination.

USACE would be responsible for monthly monitoring for the duration of the construction period and during freshet the following two spring seasons (or when similar high water occurs) at downstream beaches and water intakes. Should elevated contamination be detected, USACE would notify local stakeholders.

5. Decision-Making

This section describes the process whereby the results from monitoring and assessment will be used to make decisions concerning project management. Primary components of the decision-making process include decisions to be made, decision making responsibilities, how the decision-making group operates, how they report their decisions, and the required timing of decisions in order for potential adjustments to be effective. These components are described in Table 1.

Table 1: Decision-Making Framework

Decisions to be Made	Initiate one-time planting along Bateman Island shoreline
Decision Responsibility	USACE
Operation of Decision-Making Group	PDT would discuss with sponsor merit of and need for planting should shoreline habitats not develop as anticipated.
Reporting of Decisions	Decisions would be reported to sponsor and local stakeholders
Required Timing for Decisions	Planting could be implemented after 5 years if not habitat development is noted of after 10 years if insufficient habitat development occurs.

Once the results of monitoring have been assessed and evaluated, the USACE can decide to: (1) continue the action with no adjustments because performance measures indicate a favorable trajectory, (2) initiate a one-time planting along the Bateman Island shoreline, or reformulate the plan revisiting the planning process, or (3) decide the action is successful and complete based on meeting success criteria.

6. Contingency Plan

To address potential problems with project features, the USACE has identified some potential modifications or different measures that could be implemented. The below table includes a description of potential contingency measures, under what circumstances they would be implemented, an estimated cost for implementation, and identifies responsibilities.

Table 2 – Potential Contingency Measures

Contingency Measure	Decision Trigger	Cost Estimate	Responsible Party
Turbidity mitigation measures	If turbidity exceeds background during construction by 10 nephelometric turbidity units (NTU) over background when the background is 50 NTU or less; or by a 20 percent increase in turbidity when the background turbidity is more than 50 NTU, then	Costs would vary according to measures developed in the turbidity monitoring plan	Construction Contractor

	actions would be taken to reduce turbidity generated by construction as specified in the Contractor developed turbidity monitoring plan		

7. References

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