APPENDIX E

CARTY LAKE MAINTENANCE AND MONITORING PLAN

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APPENDIX E-1

CARTY LAKE SEDIMENT MONITORING SAMPLING AND ANALYSIS PLAN

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FORMER PACIFIC WOOD TREATING CO. SITE
FACILITY ID 1019, CLEANUP SITE ID 3020

Prepared for
PORT OF RIDGEFIELD
March 2, 2016
Project No. 9003.01.40

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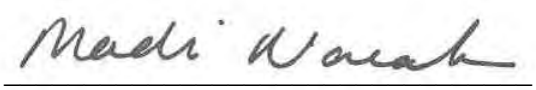
CARTY LAKE SEDIMENT MONITORING SAMPLING AND ANALYSIS PLAN

FORMER PACIFIC WOOD TREATING CO. SITE
FACILITY ID 1019, CLEANUP SITE ID 3020

The material and data in this plan were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.



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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
CAP	cleanup action plan
CFR	Code of Federal Regulations
cm	centimeter(s)
COC	chain of custody
COMP	comprehensive operations and maintenance plan
CUL	cleanup level
DGPS	differential global positioning system
dioxins	polychlorinated dibenzo dioxins and furans
DMMP	Dredged Material Management Program
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
ISM	incremental sampling methodology
LCS	laboratory control sample
MFA	Maul Foster & Alongi, Inc.
Port	Port of Ridgefield
PSEP	Puget Sound Estuary Program
PWT	Pacific Wood Treating Co.
QA/QC	quality assurance
QC	quality control
REL	remediation level
RNWR	Ridgefield National Wildlife Refuge
RSD	relative standard deviation
SAP	sampling and analysis plan
TEQ	toxicity equivalent
TOC	total organic carbon
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code

1 INTRODUCTION

On behalf of the Port of Ridgefield (Port), Maul Foster & Alongi, Inc. (MFA) has prepared this sampling and analysis plan (SAP) for post-remedy monitoring to be conducted in Carty Lake. Carty Lake is located in the Ridgefield National Wildlife Refuge (RNWR), adjacent to the former Pacific Wood Treating Co. (PWT) site in Ridgefield, Washington (see Figure 1-1). PWT operated a wood-treating facility from 1964 to 1993 at the Port's Lake River Industrial Site, now known as Miller's Landing.

On November 5, 2013, the Port entered into a Consent Decree with the State of Washington requiring remedial action to address contaminated sediments in Carty Lake. The selected remedial action was substantively completed in 2014 and consisted of sediment excavation, placement of a clean sand cap layer, and stabilization of a treated-wood bulkhead as described in the cleanup action plan (CAP) (Washington State Department of Ecology [Ecology], 2013). In addition, the CAP specifies institutional controls to limit fishing in the lake. The remedy includes post-remedial monitoring, which will assess the efficacy of the remedial action and quantify the reduction in concentrations relative to the cleanup level (CUL) (Ecology, 2013).

The Consent Decree requires a comprehensive operations and maintenance plan (COMP) that summarizes requirements for inspection and maintenance of former PWT site cleanup actions; includes actions required to operate and maintain equipment, structures, or other remedial systems (including management and maintenance of soil caps); and describes compliance monitoring plans. This SAP addresses the compliance monitoring plan for cleanup actions in Carty Lake and will be an appendix to the forthcoming COMP.

This SAP describes sampling objectives and methods that will be used to meet compliance monitoring requirements. This SAP is generally consistent with current Puget Sound Estuary Program (PSEP) and U.S. Environmental Protection Agency (USEPA) protocols for sampling and analysis (PSEP, 1986, 1997a,b; USEPA, 1993) and standard USEPA methods based on USEPA test methods for evaluating solid waste, physical/chemical methods (also known as SW-846) requirements, as amended (USEPA, 1986). This SAP meets the requirements of Washington Administrative Code (WAC) 173-340-820, and its contents are consistent with the Sediment Management Standards (WAC 173-204) and guidance provided in Ecology's Sediment Cleanup Users Manual II (Ecology, 2015).

1.1 Background

The CAP identifies remediation levels (RELs) based on risk-based ecological factors and a CUL for polychlorinated dibenzo-p-dioxins and furans (collectively referred to as dioxins) in Carty Lake sediments (see Table 1-1).[1] As described in the Carty Lake Engineering Design Report (MFA, 2014), areas in the southern end of Carty Lake that exceeded RELs were excavated and treated with a clean

[1] RELs protective of ecological resources are congener-specific; the CUL is based on human health considerations and is evaluated as a dioxin toxicity equivalent (TEQ).

sand layer. The planned post-excavation surface was well-characterized prior to finalizing the project design, and the excavation prism was conservatively designed to remove contaminants (MFA, 2014). Confirmation monitoring will be conducted in surface sediments of the active remedy area five years after remedy completion to quantify the long-term effectiveness of the cleanup action, i.e., the reductions in dioxin concentrations relative to RELs and the CUL of 5 nanograms per kilogram dioxin TEQ.

1.2 Investigation Objectives

The objective of this SAP is to provide procedures for collection of data of sufficient quality to characterize the long-term effectiveness of the cleanup action in the remedy area (see Figure 1-2). The average concentration and variability of surface sediment (0 to 10 centimeters [cm] deep) dioxins in the remedy area will be quantified. Sampling will be conducted in a way that ensures that results are reproducible, to the extent practicable, and that results are representative.

This SAP specifies field and analytical methods, including quality assurance (QA) and quality control (QC) requirements.

1.3 Sampling Schedule

The CAP calls for surface sediment dioxin monitoring in the remedy area five years after cleanup. The remedy was substantively completed in 2014, and thus long-term effectiveness monitoring will be conducted in 2019. Additional Carty Lake sediment sampling after 2019 could be conducted in consideration of eliminating institutional controls on fishing and to further evaluate long-term concentration trends.

2 SITE CONDITIONS

Carty Lake is a 52-acre lake in the RNWR Carty Unit. The National Wetlands Inventory classifies much of Carty Lake as a lacustrine, limnetic, unconsolidated bottom, permanently tidal. The remedy area is in the southern end; this area is a shallow, open water body with a fringe of emergent wetland (Category II lake-fringe) (MFA, 2013). During the rainy season, Gee Creek and Carty Lake can be hydraulically connected at the lake's northern end. During most of the year, Carty Lake has no outlet. Water depths range from 3 to 10 feet, varying seasonally, and are generally greater during winter and spring and lower during summer and fall. Water fluctuations are generally muted relative to Lake River, with increases and decreases occurring more gradually because there is no direct connection with the Columbia River.

Hydrodynamics and grain size distribution indicate that Carty Lake features a low-energy, depositional environment. Percent fines in Carty Lake are uniformly high, generally over 75 percent fines. Carty Lake's hydraulic exchange with other surface water bodies is limited to unusually high water events.

Further, given that human access to Carty Lake is limited and boat access is restricted, anthropogenic high-velocity events are not expected.

Predicted post-excavation (i.e., prior to clean sand placement) sediment concentrations are shown in Figure 2-1. Predicted post-remedy (i.e., following excavation and clean sand placement but prior to long-term recovery) surface sediment dioxin concentrations are shown in Figure 2-2. The estimated sediment concentrations were calculated as described in the Carty Lake Engineering Design Report (MFA, 2014).

3 SEDIMENT SAMPLING

The incremental sampling methodology (ISM) will be used to characterize the average concentration of dioxins in sediments (HDOH, 2009, 2011; ITRC, 2012). ISM characterizes the average concentration of contaminants in a predefined area termed the decision unit. Samples (called increments) are collected from multiple locations within a decision unit under evaluation. The increments are combined into one sample (called an ISM sample) and analyzed to obtain a representative average contaminant concentration for the entire decision unit. Replicates are collected to define variability due to sampling error or spatial heterogeneity. ISM obtains data that are more representative of average concentrations than areawide concentrations derived from discrete or composite samples (HDOH, 2009; ITRC, 2012).

3.1 ISM Design

ISM requires selection of a decision unit(s). A decision unit is the area and depth of sediment to be represented by the sampling process. The sampling objective is to characterize the average concentration of dioxins in surface sediments in the remedy area. As specified in the CAP (Ecology, 2013), surface sediments in Carty Lake are defined as the top 10 cm of sediment. The proposed decision unit therefore spans the remedy area and extends from surface to 10 cm below mudline (see Figure 3-1).

ISM sampling theory demonstrates that 30 increments of an adequate mass from a given decision unit of any size will generally result in a sample that is adequately representative of the average contaminant level in the decision unit (HDOH, 2009; ITRC, 2012). Additional increments may reduce error in estimating the true mean, and more than 30 increments are typically recommended when spatial heterogeneity is expected to be high. Since dioxin spatial heterogeneity is expected to be low following remedy implementation, 30 increments will be collected during the monitoring event.

Three field replicates (called a triplicate) will be used to assess sample variability (i.e., relative standard deviation [RSD]) and to assign confidence levels to results. If it is determined that additional monitoring samples are necessary and the initial ISM sample RSD is high, i.e., above 30 percent, triplicates will also be collected during subsequent monitoring events (ADEC, 2009). If RSD is low but it is determined that average concentrations in subsequent monitoring samples have changed relative to the initial ISM sample, triplicates may be collected to confirm acceptable sample variability.

Increment locations were selected based on a systematic random approach using a triangular grid (using ArcGIS 10 and Visual Sample Plan 6). Using a systematic random grid, as opposed to a simple random sampling approach, reduces the probability of missing areas with significantly elevated concentrations. Three ISM samples from 30 locations each (A, B, and C) are assigned for collection of the triplicate composite increment samples A, B, and C. Increment locations are shown on Figure 3-1. Subsequent monitoring events, if necessary, will be collected at location set A.

All ISM samples will be analyzed for dioxins and total organic carbon (TOC).

3.2 Sampling Methods

Surface sediment samples will be retrieved by a 1-inch-diameter, thin-walled, stainless steel sampling tube. The sampling tubes will be manually advanced to a depth greater than 10 cm. The sampling tube will be withdrawn and the increment extruded, using a plunger, onto a clean work surface. The increment will be measured and trimmed to 10 cm. If increment recovery is poor, the increment will be discarded and resampled within a few feet of the original location. Approximately 100 grams per increment, for a total of 3 kilograms per ISM sample, will be collected to provide the overall mass required by the analytical laboratory.

If it is determined that sampling tubes do not achieve sufficient recovery, a grab sampler (e.g., clamshell-style petite ponar or clamshell-style petite Van Veen) will be deployed from a vessel or land, depending on the water level. The speed of the grab sampler's descent will be controlled to minimize disturbance of the sediment. The speed of ascent will also be controlled to minimize loss of sediment from washout. The sediment sample will be inspected upon retrieval to ensure that the grab sampler was completely closed and retained all sediment, including any surficial fines. Upon retrieval of an acceptable sediment sample, an approximately 100-gram increment that extends from 0 to 10 cm will be collected from the retrieved material. Sediment that is in contact with the sides of the sampler will not be sampled.

Procedures for handling and analyzing sediment are as follows:

- Samplers will wear clean, disposable gloves while collecting samples. Gloves will be changed after collection of each ISM replicate.
- Field activities and conditions and sampling data (e.g., sample description) will be recorded in a field notebook. Any deviations from the sampling protocol will be noted on field records and will be brought to the attention of the project manager. General sediment observations, such as description of surface materials, soil type and variability within decision units, and any staining or discoloration, will be recorded.
- Increment composites will be placed in glass jars. Samples will be labeled, stored in iced shipping containers with chain-of-custody (COC) documentation, and transported to the contract laboratory.
- Each increment composite will be analyzed for dioxins and TOC, using USEPA Method 1613B and PSEP/SM Method 5310B, respectively. Laboratory test methods, QA/QC procedures, and data validation and reporting procedures are described in Section 4.

3.3 Positioning

A differential global positioning system (DGPS) will be used to locate the sampling position for each proposed location shown on Figure 3-1. Sample locations will be determined to an accuracy of ±3 meters. Horizontal coordinates will be referenced to the Washington South State Plane HARN (NAD83). Reasonable effort will be made to collect sediment from each location; however, some locations may remain inaccessible. Sample locations may be field adjusted and will be collected as close as possible to the intended sample location. The DGPS will be used to record the location of each location that has been field adjusted. Locations may be accessed by boat or on foot (e.g., locations adjacent to the shoreline).

3.4 Equipment Decontamination Procedures

Nondisposable sampling equipment that comes in direct contact with the sample (e.g., scoops, bowls) will be decontaminated before use for each ISM replicate, according to the following procedure:

- Distilled-water rinse.
- Wash with scrub brush and Alconox™ soap and distilled water solution.
- Distilled-water rinse.
- Methanol solution rinse (1:1 solution with distilled water).
- Final distilled-water rinse.

The sampling tube or grab sampler will be decontaminated before use for each ISM replicate according to the following procedure:

- Rinse with site water.
- Wash with scrub brush and Alconox soap and distilled water solution.
- Rinse with distilled water.

The thoroughness of equipment decontamination will be verified by collection and analysis of equipment rinsate samples. Liquid generated by decontamination will be properly handled, according to procedures specified in Section 3.5.

3.5 Management of Investigation-Derived Waste

Decontamination fluids will be collected and stored in sealed plastic buckets and disposed of through a permitted service provider. Personal protective equipment will be disposed of in a sanitary landfill.

3.6 Field QA/QC Samples

QC samples will be collected to ensure that field samples and quantitative field measurements are representative of the media collected. Field QA/QC samples and collection frequency are as follows:

- **Equipment Rinsate Blanks—**To ensure that decontamination procedures are sufficient, an equipment rinsate blank will be collected when nondedicated equipment is used. One equipment rinsate blank will be collected for each monitoring event. Equipment rinsate blanks will be collected by passing laboratory-provided deionized/distilled water through or over sampling equipment and will be submitted for analysis of dioxins by USEPA Method 1613B. The rinsate blank results will be evaluated during data quality review.
- **Field Replicates—**Field replicates are collected to measure sampling and laboratory precision. Samples will be collected in triplicate (three sets of 30 increment samples) (see Section 3.1). The field replicate results will be evaluated during data quality review (see Section 4.3).

3.7 Work Documentation

Accurate recordkeeping will be maintained throughout the field sampling effort. A field notebook will be prepared documenting the following information:

- Name(s) of the person(s) collecting samples
- Sampling vessel and field staff
- A record of site health and safety meetings and updates
- Weather conditions
- Date and time of collection of each sample
- Representative photographs with sample location ID
- Gross characteristics of the sample, such as organic matter, biota, debris, and sheen
- Physical description of the sample soil, consistent with the Unified Soil Classification System (includes soil type, density/consistency of soil, color)
- Description of material selectively removed from the sample before filling of containers for chemical analysis (e.g., gravel, wood debris)
- Any deviation from this Ecology-approved SAP

3.8 Sample Containers, Preservation, and Transport

Sample container, preservations, and holding-time requirements are summarized in Table 3-1. All sediment samples will be collected in glass jars. Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. Samples will be uniquely identified with a sample identification that, at a minimum, specifies sample name, sample location, and sample date/time. Sample containers, sample coolers, and packing materials will be supplied by the laboratory. The laboratory will maintain documentation certifying the cleanliness of containers provided. The samples will be stored in iced coolers at 4 ($\pm$ 2) degrees Celsius (°C).

Individual sample containers, along with COC forms, will be placed in a sealed plastic bag. Glass jars will be packed to prevent breakage and will be separated in the shipping container by a shock-absorbent material, such as bubble wrap. Ice in sealed plastic bags will be placed in the cooler to maintain a temperature of approximately 4°C.

When the cooler is full, the COC form will be placed in a zip-locked bag inside the cooler and a temperature blank will be placed in the cooler. Coolers will be taped and then sealed with two COC seals. The temperature blanks are prepared by the laboratory, using analyte-free (reagent) water. Temperature blanks are used by the laboratory to record the temperature of each cooler used to transport samples from the field to the laboratory. The laboratory will verify that the temperature blank measurement is 4 (±2)°C.

Coolers will be transported to the laboratory by courier or overnight shipping service. Packing and shipping procedures are consistent with U.S. Department of Transportation regulations as specified in 49 Code of Federal Regulations (CFR) 173.6 and 49 CFR 173.24.

3.9 Sample Custody, Packaging, and Shipping

Sample custody will be tracked from point of origin through final analysis and disposal, using a COC form, which will be filled out with the appropriate sample and analytical information as soon as possible after samples are collected. For purposes of this work, custody will be defined as follows:

- In plain view of MFA field representatives
- Inside a cooler that is in plain view of MFA field representatives
- Inside any locked space such as a cooler, locker, car, or truck to which the MFA field representatives have the only available key(s)

After sample containers have been filled, they will be packed on ice in coolers and then transported to the laboratory in iced shipping containers (with a custody seal affixed).

COC procedures will begin in the field and will track delivery of the samples to the laboratories. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24.
- Individual sample containers will be packed to prevent breakage.
- A sealed envelope containing COC forms will be enclosed in a plastic bag inside the cooler.
- Signed and dated COC seals will be placed on all coolers before shipping.

Upon transfer of samples to the laboratory, the COC form will be signed by the persons transferring custody of the coolers. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the receiver. Copies of the COC will be included in laboratory reports and data validation memoranda.

3.10 Field Instrumentation

Staff or subcontractors responsible for navigation will confirm proper operation of the navigation equipment daily. This verification may consist of internal diagnostics or visiting a location with known coordinates to confirm the coordinates indicated by the navigation system. No other field equipment requires calibration. Any issues will be noted in the field logbook and corrected before sampling operations continue.

4 LABORATORY MEASUREMENTS AND QA/QC PROCEDURES

4.1 Laboratory Test Methods and Reporting Limits

Chemical testing will be conducted using the analytical methods and detection limits presented in Table 4-1. A laboratory that can achieve detection limits lower than those required by the associated USEPA method will be selected. Samples will be maintained according to the appropriate holding times and temperatures for each analysis.

MFA will submit samples representing the decision unit replicate for chemical ISM analysis. The decision unit will have equal mass collected from its 30 increments (approximately 100 grams wet weight per increment). As discussed above, the approximately equal mass collected from each increment will be field consolidated to generate a sample of approximately 3 kilograms (wet weight).

The laboratory will air dry each decision unit sample at room temperature. The entire volume of each sample will be chopped and sieved to facilitate obtaining a representative subsample and improving analyte extraction efficiency. The sample will be sieved using an American Society for Testing and Materials No. 10 (2-millimeter) sieve.

Once the sample is dried and sieved, the laboratory will perform the "1-dimensional slabcake" subsampling procedure to sub-aliquot sample volume to be used for analysis. The slabcake procedure involves spreading the sample at a consistent depth in a line, using 20 or more passes and using a square scoop to cut across the line as needed to create an aliquot for each analysis. Samples for TOC will be ground prior to analysis.

Each sub-aliquot will be placed in its own, single-sample container, consistent with the volume and preservation requirements indicated in Table 4-1. The final mass of the sample must be sufficient to run the requested analyses and attain the requested reporting limit. Please note that sufficient sample volume must be composited by the laboratory to create a laboratory duplicate sample and matrix spike and matrix spike duplicate, where applicable.

The remaining volume of the composite samples will be archived at the laboratory at -18°C.

An ISM standard operating procedure is included as the appendix.

4.2 Laboratory Instrumentation

Laboratory QA/QC will be maintained through the use of standard USEPA methods, based on USEPA test methods for evaluating solid waste, physical/chemical methods (also known as SW-846) requirements, as amended (USEPA, 1986). Table 4-1 presents the data quality objectives of solid-phase testing for precision, accuracy, and completeness, while Table 4-2 summarizes general laboratory QA/QC procedures. The laboratory will also meet QA/QC requirements specified in the 2010 Dredged Material Management Program (DMMP) clarification paper (Hoffman and Fox, 2010). If the laboratory does not meet QA/QC acceptance limits, particularly if estimated maximum potential concentration qualifiers are anticipated, MFA will be contacted and corrective actions consistent with DMMP requirements will be taken (Hoffman and Fox, 2010).

4.2.1 Preventive Maintenance

Preventive maintenance of laboratory equipment will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments, and inspection and monitoring of carrier gases, solvents, and glassware used in analyses. The preventive-maintenance approach for specific equipment will follow the manufacturers' specifications and good laboratory practices.

Precision and accuracy data will be examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to change, as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet any of the QC criteria.

4.2.2 Laboratory QA/QC Checks

QC samples and procedures verify that an instrument is calibrated properly and remains in calibration throughout the analytical sequence, and that the sample preparation procedures have been effective and have not introduced contaminants into the samples. Additional QC samples are used to identify and quantify positive or negative interference caused by the sample matrix. The following laboratory QC procedures are required for most analytical procedures:

- **Calibration Verification—**Initial calibration of instruments will be performed at the start of the project or sample run, as required, and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in the analytical method. To track instrument performance, continuing calibration will be performed as specified in the analytical method. If a continuing calibration does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was outside control limits will be reanalyzed.
- **Method Blanks—**Method blanks are used to assess possible laboratory contamination of samples associated with all stages of preparation and analysis of samples and extracts.

The laboratory will not apply blank corrections to the original data. A minimum of one method blank will be analyzed for every sample extraction group, or one for every 20 samples, whichever is more frequent.

- **Laboratory Control Samples (LCSs)—**LCSs are fortified with target analytes to provide information on analysis accuracy. Analyses of LCSs will be performed by the lab at a frequency that satisfies the analytical method requirements.
- **Laboratory Duplicates—**Laboratory duplicates are used to assess laboratory batch precision associated with all stages of preparation and analysis of samples and extracts. Laboratory duplicates will be analyzed according to method frequency requirements.
- **Surrogate Spike Compounds—**Surrogate spikes are used to evaluate the recovery of an analyte from individual samples. All project samples to be analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analysis method, i.e., carbon-13 labeled internal standards for the dioxin method. Recoveries determined using these surrogate compounds will be reported by the laboratory; however, the laboratory will not correct sample results using these recoveries.

4.3 Data Reduction, Validation, and Reporting

The analytical laboratory will submit analytical data packages that include laboratory QA/QC results to permit independent and conclusive determination of data quality. Data quality will be determined by MFA, using the data evaluation procedures described in this section. The results of the MFA evaluation will be used to determine if the project data quality objectives have been met.

4.3.1 Field Data Reduction

Daily internal QC checks will be performed for field activities. Checks will consist of reviewing field notes and field activity memoranda to confirm that the specified measurements and procedures are being used. The need for corrective action will be assessed on an ongoing basis, in consultation with the project manager.

4.3.2 Laboratory Evaluation

Initial data reduction, evaluation, and reporting at the analytical laboratory will be carried out as described in USEPA SW-846 manuals for organic analyses (USEPA, 1986), as appropriate. Additional laboratory data qualifiers may be defined and reported to further explain the laboratory's QC concerns about a particular sample result. All additional data qualifiers will be defined in the laboratory's case narrative report associated with each case.

4.3.3 Data Deliverables

Laboratory data deliverables are listed below. Electronic deliverables will contain the same data that are presented in the hard-copy report.

- Transmittal cover letter
- Case narrative
- Analytical results
- COC documentation
- Surrogate recoveries
- Method blank results
- LCS results
- Laboratory duplicate results

4.3.4 Data QA/QC Review

MFA will evaluate the laboratory data for precision, completeness, accuracy, and compliance with the analytical method. Dioxin data will be reported consistent with recent dioxin data treatment guidance (Ecology, 2015). The data review will include an assessment of laboratory performance criteria and will be consistent with the USEPA national functional guidelines (USEPA, 2011, 2014). Results of the data review will be provided as a memorandum to be included with the data report and lab result sheets. Ecology will be notified before development of the data review memorandum if laboratory results indicate any significant data quality issues.

Data qualifiers, as defined by the USEPA, are used to classify sample data according to their conformance to QC requirements. The most common qualifiers are listed below:

J—Estimate, qualitatively correct but quantitatively suspect.
R—Reject, data not suitable for any purpose.
U—Not detected at a specified reporting limit.

Poor surrogate recovery, blank contamination, or calibration problems, among other things, can cause the sample data to be qualified. Whenever sample data are qualified, the reasons for the qualification will be stated in the data evaluation report.

QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method.

The following information will be reviewed during data evaluation, as applicable:

- Sampling locations and blind sample numbers
- Sampling dates
- Requested analysis
- COC documentation
- Sample preservation
- Holding times
- Method blanks
- Surrogate recoveries
- Laboratory duplicates (if analyzed)

- Field replicates
- Field blanks
- LCSs
- Method reporting limits above requested levels
- Any additional comments or difficulties reported by the laboratory
- Overall assessment

The results of the data evaluation review will be summarized for each data package. Data qualifiers will be assigned to sample results on the basis of USEPA guidelines, as applicable.

4.3.5 Evaluation of ISM Replicates

Field QC sampling will include the collection of triplicate samples (see Section 3.1). The RSD of the analytical results for triplicate samples will be calculated to measure data precision. The RSD is calculated using the following equation:

$$RSD\% = \frac{100\% * \text{Standard Deviation}}{\text{Average}}$$

Lower RSD values are desirable, as the lower the RSD, the greater confidence there is that the average approximates a normal distribution and that the average contaminant concentrations are adequately representative of the decision unit (HDOH, 2009). It is assumed that data normally distributed have an RSD of 30 percent or less (ADEC, 2009). Acceptability of the calculated RSD percent will be evaluated in the context of such considerations as analytical results at or near the method reporting limit, which may exhibit a greater level of variability and, therefore, an elevated RSD (ADEC, 2009). However, if results are non-detect or less than 5 times the method reporting limit RSDs will not be calculated.

4.3.6 Data Management and Reduction

MFA uses EQuIS environmental data management software to manage all laboratory data. The laboratory will provide the analytical results in electronic EQuIS-deliverable format. Following data evaluation, data qualifiers and analytical results will be entered into MFA's EQuIS database as well as into Ecology's Environmental Information Management (EIM) database. Consistent with WAC 173-340-840(5) and Ecology Toxics Cleanup Program Policy 840 (Data Submittal Requirements), data will be submitted simultaneously in both written and electronic formats.

Data may be reduced to summarize particular data sets and to aid interpretation of the results. Statistical analyses may also be applied to results. Data reduction QC checks will be performed on all hand-entered data, any calculations, and any data graphically displayed. Data may be further reduced and managed using one or more of the following computer software applications:

- Microsoft Excel® (spreadsheet)
- EQuIS (database)

- Ecology's EIM (database)
- AutoCad and/or Arc GIS (graphics)
- USEPA ProUCL (statistical software)

5 REPORTING

Ecology will be notified in writing at least 30 days before monitoring activities begin. A data report will be prepared and submitted to Ecology within 30 days of receipt and review of the validated analytical data. Data will be submitted to Ecology's EIM data system when the final report is submitted. The data report will include a brief summary of data collection procedures (noting, in particular, deviations from the SAP); increment locations; summary of field notes; analytical results; a data validation memorandum; and data interpretation. Data interpretation will focus on the following issues to assess remedy action effectiveness and compliance:

- Whether the dioxin TEQ and congener concentrations are representative of the decision unit.
- Dioxin concentration trends for the decision unit over time, if applicable.
- TOC trends for the decision unit over time may be used to understand dioxin TEQ trends, if applicable.
- Evaluation of ISM concentrations relative to the CUL. The CUL objective will be attained if one of the following is true:
  - The mean of replicate ISM sample results does not exceed the CUL and the RSD does not exceed 30 percent.
  - If the RSD exceeds 30 percent, compliance will be demonstrated if the 95 percent upper confidence limit (UCL) of the replicate sample results or the maximum replicate sample result does not exceed the CUL. The UCL will be calculated using the Student's-t (representing the low range estimate) and Chebyshev (representing the high range estimate) UCL methods (ITRC, 2012). The UCL method accounts for the increased likelihood of underestimating the true mean when sample variability is high (ITRC, 2012).

The CAP calls for confirmation monitoring in the active remedy area five years after remedy completion. Additional confirmation sampling of Carty Lake sediment could be conducted in consideration of eliminating institutional controls on fishing in the lake, and to evaluate long-term concentration trends.

LIMITATIONS

The services undertaken in completing this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan.

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TABLES

Table 1-1
Sediment Performance Standards
Former PWT Site
Ridgefield, Washington

Analyte	Performance Standards (ng/kg)
Cleanup Level	
Dioxin TEQ	5.0E+00
Remediation Levels	
2,3,7,8-TCDD	3.3E+00
1,2,3,7,8-PeCDD	9.8E+01
1,2,3,4,7,8-HxCDD	2.0E+02
1,2,3,6,7,8-HxCDD	1.2E+03
1,2,3,7,8,9-HxCDD	1.2E+03
1,2,3,4,6,7,8-HpCDD	3.1E+05
OCDD	1.0E+07
2,3,7,8-TCDF	8.6E+01
1,2,3,7,8-PeCDF	5.5E+02
2,3,4,7,8-PeCDF	6.5E+00
1,2,3,4,7,8-HxCDF	9.8E+02
1,2,3,6,7,8-HxCDF	9.8E+02
1,2,3,7,8,9-HxCDF	9.8E+02
2,3,4,6,7,8-HxCDF	9.8E+02
1,2,3,4,6,7,8-HpCDF	2.5E+05
1,2,3,4,7,8,9-HpCDF	2.5E+05
OCDF	1.0E+07

NOTES:
ng/kg = nanograms per kilogram.
TEQ = toxicity equivalent.

Table 3-1
Container Requirements, Holding Times, and Preservation
Former PWT Site
Ridgefield, Washington

Parameter	Sample Size*	Container Size and Type	Hold Time for Analysis	Preservation
Dioxins	3.0 kg	1-gallon jar (protect from light)	30 days	4°C
			1 year	-18°C
Total organic carbon			28 days	4°C
			6 months	-18°C

NOTES:

°C = degrees Celsius.

dioxins = polychlorinated dibenzo-p-dioxins and furans.

kg = kilogram(s).

*Sample size is for each decision unit replicate. Approximately 100 grams will be collected for each sub-aliquot.

Table 4-1
Analytical Methods and Data Quality Objectives
Former PWT Site
Ridgefield, Washington

	Analytical Method	Units	Practical Quantitation Limit	Level of Detection*	Precision	Laboratory Control Sample Accuracy	Internal Standard Accuracy	Completeness
Dioxins								
2,3,7,8-TCDF	USEPA 1613B	ng/kg	0.5	0.10	NA	75-158% R	24-169% R	100%
2,3,7,8-TCDD	USEPA 1613B	ng/kg	0.5	0.10	NA	67-158% R	25-164% R	100%
1,2,3,7,8-PeCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	80-134% R	24-185% R	100%
2,3,4,7,8-PeCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	68-160% R	21-178% R	100%
1,2,3,7,8-PeCDD	USEPA 1613B	ng/kg	2.5	0.50	NA	70-142% R	25-181% R	100%
1,2,3,4,7,8-HxCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	72-134% R	26-152% R	100%
1,2,3,6,7,8-HxCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	84-130% R	26-123% R	100%
2,3,4,6,7,8-HxCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	70-156% R	28-136% R	100%
1,2,3,7,8,9-HxCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	78-130% R	29-147% R	100%
1,2,3,4,7,8-HxCDD	USEPA 1613B	ng/kg	2.5	0.50	NA	70-164% R	32-141% R	100%
1,2,3,6,7,8-HxCDD	USEPA 1613B	ng/kg	2.5	0.50	NA	76-134% R	28-130% R	100%
1,2,3,7,8,9-HxCDD	USEPA 1613B	ng/kg	2.5	0.50	NA	64-162% R	NA	100%
1,2,3,4,6,7,8-HpCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	82-122% R	28-143% R	100%
1,2,3,4,7,8,9-HpCDF	USEPA 1613B	ng/kg	2.5	0.50	NA	78-138% R	26-138% R	100%
1,2,3,4,6,7,8-HpCDD	USEPA 1613B	ng/kg	2.5	0.50	NA	70-140% R	23-140% R	100%
OCDF	USEPA 1613B	ng/kg	5.0	1.00	NA	63-170% R	NA	100%
OCDD	USEPA 1613B	ng/kg	5.0	1.00	NA	78-144% R	17-157% R	100%
Physical Parameters								
Total organic carbon	PSEP/SM 5310B	%	0.02	0.01	+/- 20% RPD	85-115% R	NA	90%

Table 4-1
Analytical Methods and Data Quality Objectives
Former PWT Site
Ridgefield, Washington

NOTES:

dioxins = polychlorinated dibenzo-p-dioxins and furans.

NA = not applicable.

ng/kg = nanograms per kilogram (parts per trillion).

PSEP = Puget Sound Estuary Program.

R = recovery.

RPD = relative percent difference.

USEPA = U.S. Environmental Protection Agency.

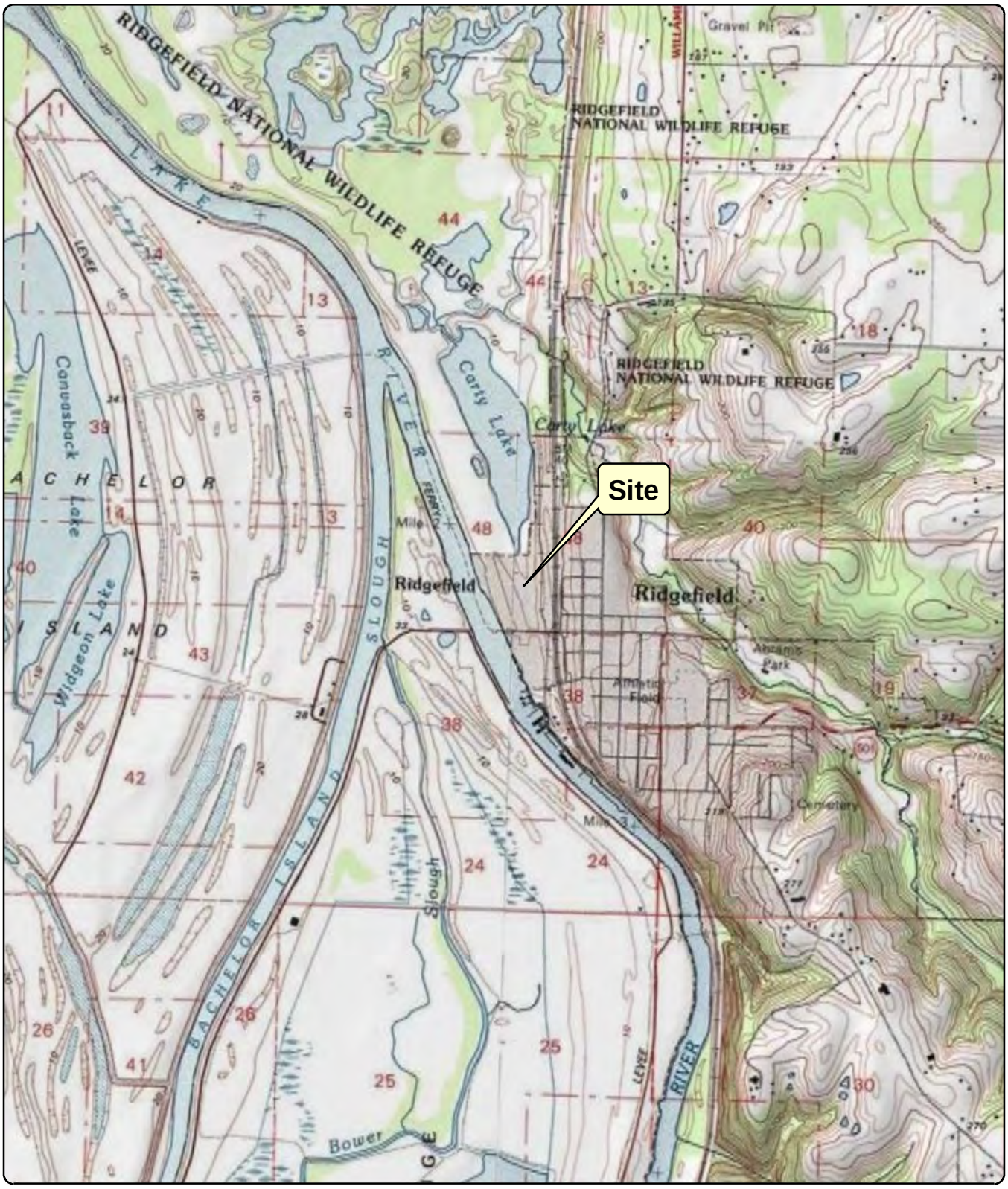
*Level of detection for Method 1613B is based on likely estimated detection limits from Vista Analytical Laboratory. Estimated detection limits may change, depending on matrix conditions and laboratory discretion.

Table 4-2
Analytical Quality Control Requirements
Former PWT Site
Ridgefield, Washington

Analysis Type	Initial Calibration	Ongoing Calibration	Labeled Analogs	Batch Duplicates	Matrix Spikes	LCS/OPR	Method Blanks	Surrogate Spikes	Equipment Rinsate Blank	Field Triplicates
Dioxins	As required by USEPA Method 1613B	Every 12 hours	Every sample	NA	NA	1 per 20 samples	1 per 20 samples	Every sample	1 per sampling event	1
Total organic carbon	As required	1 per 15 samples	NA	1 per 10	NA	1 per 20 samples	1 per 20 samples	NA	NA	1

NOTES:
dioxins = polychlorinated dibenzo-p-dioxins and furans.
LCS = laboratory control sample.
NA = not applicable.
OPR = ongoing precision and recovery sample (used for dioxin analysis).
USEPA = U.S. Environmental Protection Agency.

FIGURES



Source: Topographic Quadrangle obtained from ArcGIS Online Services/NGS-USGS TOPO! US Geological Survey (1999)
7.5-minute topographic quadrangle: Ridgefield
Address: Lake River Industrial Site
111 W. Division Street, Ridgefield, WA 98642
Section: 24 Township: 4N Range: 1W Of Willamette Meridian

Figure 1-1
Site Location

Former PWT Site
Ridgefield, Washington

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0 990 1,980
Feet

Path: X:\9003.01 Port of Ridgefield\401\Projects\06\Lake River Initial Design Report\Fig1-1_Site Location.mxd
Print Date: 4/19/2013
Approved By: J. King
Produced By: D. Coe/ W. Coffey
Project: 9003.01.20

Source: Aerial photograph (2014) obtained from Clark County GIS. Site features and boundaries provided through a survey conducted by Minister & Glaeser Surveying in 2014 and 2015. All features are approximate.

Legend

- Ordinary High Water
- Fish-Mix Rock
- Bank
- Excavation Extent
- Former Berm (Approximate)

Figure 1-2
Remedy Location

Former PWT Site
Ridgefield, Washington

0 50 100
Feet

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Project: 9003.01.40
Produced By: jschane
Approved By: P. Wiescher
Print Date: 6/12/2015

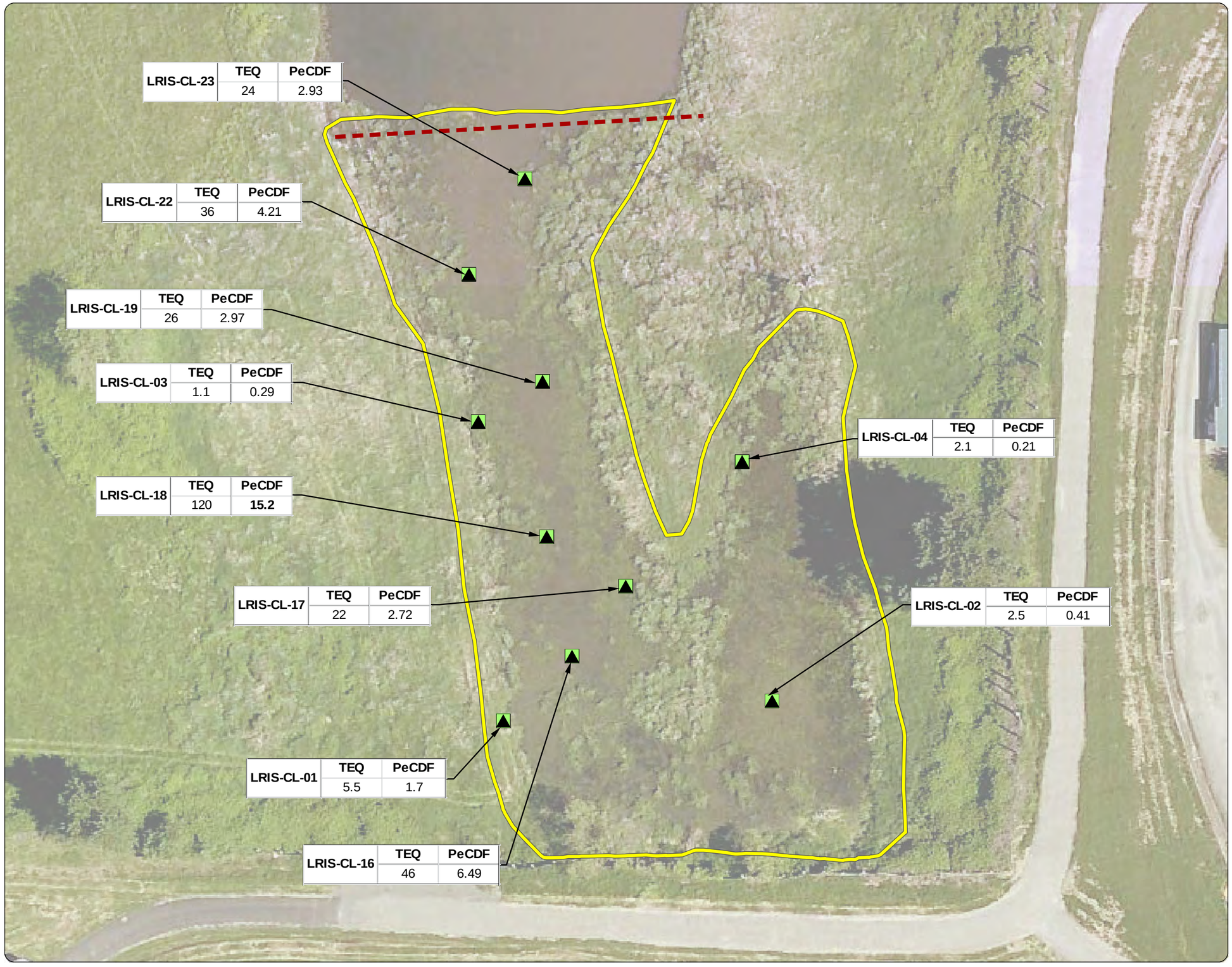

Figure 2-1
Post Excavation Surface Sediment

Former PWT Site
Ridgefield, Washington

Legend

- Sediment Sample Location
- Excavation Extent
- Former Berm (Approximate)

Notes:
1. **Bold** value exceeds remediation level.
2. TEQ = Toxicity Equivalent
3. PeCDF = 2,3,4,7,8-Pentachlorodibenzofuran
4. TEQ and 2,3,4,7,8-PeCDF measured in ng/kg (nanograms per kilogram)
5. Conditions shown prior to clean sand placement.

0 20 40
Feet

Source: Aerial photograph (2014) obtained from Clark County GIS.

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Figure 2-2
Modeled Post Remedy Surface Sediment Concentrations

Former PWT Site
Ridgefield, Washington

LRIS-CL-23	TEQ	PeCDF
	12	1.5

LRIS-CL-22	TEQ	PeCDF
	18	2.2

LRIS-CL-19	TEQ	PeCDF
	13	1.6

LRIS-CL-03	TEQ	PeCDF
	0.73	0.22

LRIS-CL-18	TEQ	PeCDF
	60	**7.7***

LRIS-CL-17	TEQ	PeCDF
	11	1.4

LRIS-CL-01	TEQ	PeCDF
	2.9	0.93

LRIS-CL-16	TEQ	PeCDF
	23	3.3

LRIS-CL-DU5	TEQ	PeCDF
	27	3.8

LRIS-CL-DU3	TEQ	PeCDF
	39	5.4

LRIS-CL-04	TEQ	PeCDF
	1.2	0.18

LRIS-CL-02	TEQ	PeCDF
	1.4	0.28

Legend

- Sediment Sample Location
- Decision Unit
- Former Berm (Approximate)
- Excavation Extent

Notes:
1. **Bold** value exceeds remediation level.
2. TEQ = Toxicity Equivalent
3. PeCDF = 2,3,4,7,8-Pentachlorodibenzofuran
4. TEQ and 2,3,4,7,8-PeCDF measured in ng/kg (nanograms per kilogram)
5. Final conditions assume 100% mixing with clean sand layer.

* The modeled concentration marginally exceeds the remediation level of 6.5 ng/kg. This estimated concentration is based on a number of conservative assumptions and is not expected to result in unacceptable risk for a variety of reasons discussed in the Carty Lake Engineering Design Report (MFA, 2014).

0 20 40
Feet

Source: Aerial photograph (insert date) obtained from Esri ArcGIS Online

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Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Long Term Monitoring SAP - Carty Lake\Fig2-2_Modeled Post Remedy Surface Sediment Concentrations.mxd
Print Date: 5/18/2015
Approved By: P. Wiescher
Produced By: jschane
Project: 9003.01.40

Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Long Term Monitoring SAP - Carty Lake\Fig3-1_Carty Lake Sample Locations.mxd

Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online (2010). Site features and boundaries provided through a survey conducted by Minister & Glaeser Surveying in 2014 and 2015. All features are approximate.

Legend

- Incremental Sample Location A
- Incremental Sample Location B
- Incremental Sample Location C
- Ordinary High Water
- Decision Unit
- Excavation Extent
- Bank
- Fish-Mix Rock

Figure 3-1
Carty Lake
Sample Locations

Former PWT Site
Ridgefield, Washington

0 20 40
Feet

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Produced By: jschane
Approved By: P. Wiescher
Print Date: 5/18/2015
Project: 9003.01.40

APPENDIX

ISM STANDARD OPERATING PROCEDURE

APEX LABORATORIES, LLC

STANDARD OPERATING PROCEDURE
APPROVAL SIGNATURE PAGE

SOP Title: **Incremental Sampling Methodology (ISM)**

SOP Number: **GS-103 R0 ISM**

Effective Date: June 3rd, 2011

Approval Signatures:

Technical Manager: _____ 6/3/11
David Jack — date

QA Manager: _____ 6-3-11
Evan Holloway (Technical Review) — date

1 INTRODUCTION

This SOP describes the policies and procedures of Apex Laboratories concerning the preparation of soil samples received from Incremental Sampling Methodology (ISM) events. ISM is a sampling procedure that relies on a large number of samples (typically greater than 30) being collected in a certain area and combined into a single sample, rather than a smaller number of discrete samples that are analyzed individually. This procedure involves preparation of the combined sample and differs from normal lab compositing.

2 SCOPE AND APPLICATION

This procedure is typically applicable for analysis of metals and non-volatile organics. Preservation of samples for volatile organic analysis (VOA) is performed in the field. Compositing of preserved ISM VOA samples is not covered by this version of this SOP, which will be revised as necessary. See ITRC guidance for further information on VOA sampling and compositing.

ISM is a very project specific procedure, and should be driven by the client's Sampling Analysis Plan. Contact with the client is essential prior to beginning ISM processing, as the end use of the data may significantly change the procedure used to composite the samples. This SOP is intended as guidance for the steps common for most ISM samples, and is not intended to supersede client instructions as to how their samples should be handled. Modifications will be documented on the ISM request form (example, Appendix A).

3 SUMMARY OF METHOD

The entire volume of each sample is used in this preparation. The samples are air dried, then sieved through a #10 (2 mm mesh) sieve and the material that does not pass through is discarded. The material is either extracted and analyzed as is or further prepared for metals extraction.

4 SAFETY AND ENVIRONMENTAL

4.1 Personal protective equipment (P.P.E.) such as lab coats, nitrile gloves, and safety glasses must be worn while working with samples. Dust masks are optional, but recommended.

4.2 All secondary containers used to store samples or solutions beyond immediate use require proper labeling.

4.3 All waste, rinsate, expired solutions and/or solvents generated by this method should be handled in accordance with Apex's hazardous waste procedures. Care should be taken not to discharge any potentially hazardous or unknown substances into the drains or sinks.

4.4 Any step that creates dust, such as sieving or grinding, must be performed in a fume hood.

5 APPARATUS AND MATERIALS

- #10, #20 or other sieves
- Stainless steel bowls and spoons
- Ceramic mortar and pestle, Automated or Manual
- Dish and Puck Mill
- Aluminum baking sheets
- Heavy duty aluminum foil
- Butcher's paper
- Flat metal spatulas
- Sieve cleaning brushes
- Lab grade acetone or methanol

6 PREPARATION FOR PROCESSING

6.1 CLIENT CONTACT

An ISM coordinator will be designated for each project. This person will be the main client contact at Apex for the duration of the ISM event, and will supervise and review all steps of the process that occur at Apex and any portions of the processing that are subcontracted.

The ISM coordinator MUST contact the client regarding appropriate sample handling procedures and fill out an ISM Request Form. This should be done significantly prior to samples being received at the laboratory to allow for modifications of the method or apparatus as necessary.

The client's Sampling and Analysis Plan (SAP), however named, and DQOs must also be received by the laboratory prior to sample processing.

The ISM coordinator will also generate a project specific ISM Worksheet (example, Appendix B) to use as a template for the ISM process. This spreadsheet will act as a guide for sample login by designating the appropriate log in procedure and will outline the steps required by the client's SAP.

Effective communication between the lab, the samplers, and the project team is essential to a successful ISM project.

6.2 SAMPLE RECEIPT

6.2.1 ISM samples will be received either in multitudes of individual soil jars (at least 30) or in multiple bags containing samples pulled from at least 30 sites. These containers will generally not be logged in to Element as being associated with the sample work order or sample number. The sample referenced by Apex for all analyses will be created by this procedure. Log samples in for the Incremental Sampling Methodology test code, and create empty sample jars with labels in accordance with the ISM worksheet.

6.2.2 Once the ISM procedure is complete, the jars will be returned to sample receiving and

requested analysis can be added to the appropriate samples.

6.3 BLANK SAMPLE

6.3.1 A Blank sample consisting of Ottawa Sand will be processed through most steps of the ISM procedure along with the samples IF metals analysis is requested. It will be analyzed for metals only unless otherwise specified by the ISM worksheet. All references to a sample in the following steps will also include the Blank sample.

6.3.1.1 Due to volume restrictions, some steps of the process are not applicable to the blank. Note any steps not performed on the ISM worksheet. 1-D Japanese Slab Cake Subsampling is performed by default, 2-D Slab Cake is not applicable for the small volume used for the blank.

6.3.2 The Blank sample should be logged in as the last two samples on each work order where ISM will be performed. The first of the two Blanks will be processed as a sample by ISM. It will be provided to Sample Receiving in a 1 gallon plastic bag. The second will be analyzed as is in order to provide a baseline for metals analysis, and will be provided in a 4 oz jar.

6.3.3 Log in jars for the first of the two Blank samples according to the following table:

Jar A	Plastic Bag	Blank	<2mm	NA	No analysis
Jar B	4 oz jar	Metals analysis	Requested final grain size	> 15 g	Requested metals

6.4 EQUIPMENT CLEANING

6.4.1 All equipment and work spaces must be cleaned before and after each sample is processed in order to minimize the potential for cross contamination. The fume hood used for sieving and grinding must have its work surface and inside walls washed with soap and warm water and rinsed with acetone initially and between preparation of each composite batch of samples. All equipment should be washed with warm water and soap before and in between each sample batch, followed by a rinse with acetone.

6.4.2 Trays used for air drying, subsampling, etc. may be lined with new aluminum foil or butcher's paper prior to use instead of the above cleaning procedure.

6.4.3 All references to cleaned equipment indicate that one of these procedures should be followed before use.

7 SAMPLE PROCESSING

In order to reduce potential sources of error, this procedure processes the entire sample received

at the laboratory through as many steps as possible. Unless otherwise specified, references to sample in this document refer to the total amount of sample received, or what is still defined as sample after prior processing steps. See the Quality Control section for a further discussion on sources of error and Data Quality Objectives (DQOs).

Each ISM sample will be different. The following steps are potential parts of any ISM processing, but may not be used for all samples. As such, the processing for each ISM sample will be driven by the SAP and the steps below should not be considered sequential requirements for all ISM projects. Refer to the SAP and the ISM worksheet for which steps are necessary for each sample. Steps not included in this SOP may be necessary. Details of these steps should be included in the ISM worksheet or other documentation.

7.1 SAMPLE IDENTIFICATION

ISM samples may include material that is not considered part of the analytical sample. Vegetation, oversized material, and decantable water are examples of material that may be requested to be removed before sample processing begins. The SAP should include detailed instructions as to what defines the analytical sample, and what to do with materials that are removed. This may include documenting their removal photographically, and potentially by weight.

7.2 PERCENT MOISTURE DETERMINATION

If as received percent moisture determination is requested on samples, it must be performed before samples are air dried. Samples will be homogenized as best as possible with field most samples, and a subsample aliquot taken as using the 2-D Japanese Slab Cake method. This may be done with or without wet sieving.

This result will be reported as the percent moisture. Dry weight analysis and correction will be performed on the prepared samples, but this result does not reflect the percent moisture of the sample as received.

7.3 SAMPLE SPLITTING/MASS REDUCTION

Splitting an ISM sample may be requested prior to other processing in order to have two separate sample processing paths for two different types of analysis, for sample mass reduction, or other reasons. This is not recommended due to potential increases in uncertainty of the data. Duplicate field samples are the preferred method for separate processing steps.

7.3.1 Three simple sample splitting techniques are available for use at Apex:

7.3.1.1 Alternate Shoveling divides the sample into two subsamples by placing alternate subsample scoops of the original sample into two separate sample containers.

7.3.1.2 Fractional Shoveling is similar to alternate shoveling except the sample is divided into three or more subsamples.

7.3.1.3 Cone and Quartering splits the sample into two subsamples by pouring the sample into a large cone, flattening the top and dividing into four sections. Opposite sections of the sample are then combined to form the two subsamples. This requires a flowable sample, and should be performed after samples are air dried and disaggregated. Therefore, this is only an option if both sample splits can be air dried.

7.4 SAMPLE CONDITIONING

Sample conditioning is usually necessary before homogenization or particle size reduction steps, in order to produce a flowable sample. Some sample conditioning steps may not be appropriate for some Chemicals of Concern (COCs), such as low boiling point SVOCs and Mercury. (See ITRC Table 6.1.) The SAP should address acceptable sample conditioning steps and how to process samples if conditioning is not acceptable.

Air drying at room temperature is the default sample conditioning step used by Apex if particle size reduction steps such as sieving are required. Other conditioning steps include drying at elevated temperature, freeze drying, and water addition. If these methods are requested, their procedure should be carefully specified in the SAP.

7.4.1 AIR DRY

7.4.1.1 Air dry the entire volume of all the sample containers by emptying them out on flat aluminum bakers sheets lined with heavy duty aluminum foil or butcher's paper and spread out to a depth of < 1 inch.

NOTE: Aluminum may not be an appropriate choice for samples where aluminum, chromium, or other compounds that may react with aluminum, are COCs. Paper or plastic maybe better choices in these cases. However, plastic must be avoided if phthalates or placsticizers are COCs, and paper cannot be used if organic carbon or other organics that may sorb to paper are COCs.

7.4.1.2 Place trays in bakery rack and allow to dry at ambient temperature in a low traffic area with sufficient air flow to carry away evaporated moisture, such as in or near a fume hood. 1-2 days are normally needed. Turning samples may be necessary to aid the drying process for wet samples, and layers of clay should be broken up in a mortar and pestle halfway through the drying process to avoid formation of bricks that are difficult to break apart after they are fully dried.

7.4.1.3 Samples should not be allowed to dry for more than three days, due to potential loss of more volatile analytes.

7.4.1.4 Record the air drying start and end times on the ISM worksheet.

7.4.1.5 After samples are dry, remove any visible sticks, rocks, vegetation, or other non-soil materials.

NOTE: If samples will be air dried, they do not need to be stored in the refrigerator. However, they most likely will be for ease of sample control. Ask the Sample Control department if questions arise about appropriate sample storage locations.

7.5 PARTICLE SIZE REDUCTION

For many projects, particle size reduction will be required in order to reduce the uncertainty associated with the data. Most samples will require that the particle size is less than 2 mm before analysis. This will ensure that a 10 to 30 gram aliquot will be enough sample volume to meet DQOs. For analyses that cannot use at least 10 grams of sample, (metals, cyanide, and other wet chem tests) grain size of less than 0.25mm must be achieved. Specific projects may require even finer grain sizes for these analyses.

If the ISM worksheet specifies that the sample will be processed to reduce particle size, there are many techniques that may be used. Automated mortar and pestle or dish and puck mill are two that are available to Apex. Depending on the COCs, these may not be appropriate, and SAP should specify which technique to use.

If a particle size reduction step is required, the entire sample should be ground so that it can pass through the sieve corresponding to the final grain size requested by the ISM worksheet. If multiple analyses are to be performed, this may require multiple samples to be taken in the field, or the sample to be split prior to processing.

7.5.1 SAMPLE SIEVING

7.5.1.1 Soil clumps should be broken up to allow them to pass through the sieve, and anything remaining in the sieve (stones, metal, glass) should be discarded and noted. Clay, wet, and/or rocky samples pose significant difficulties during this process. Breaking up dried clumps of dirt/clay and separating them from the material to be removed may be facilitated by grinding, pounding, tumbling or shaking samples by any available means. Record procedure used on ISM worksheet.

7.5.1.1.1 A sieve stack consisting of a lid, #4 and #10 sieves and a sieve pan may be loaded with sample and placed in to a sieve shaker for 5 to 10 minutes to breakup clumps without changing particle sizes.

7.5.1.1.2 A blender or coffee grinder may be used to disaggregate samples, but keep blending times low to reduce wear on blade, contamination of samples with blade material, and loss of analyte due to sample heating.

7.5.1.1.3 A mortar and pestle may be used, though this method can cause more particle size reduction than other methods.

7.5.2 MILLING/GRINDING

This step is often done on the sample that has passed through the #10 sieve. (Everything larger than 2mm is not defined as sample.)

7.5.2.1 Automated Mortar and Pestle:Using a cleaned mortar and pestle, grind the entire sample until it is fine enough to pass through the required sieve, as noted on the ISM

worksheet. See instrument manual or Apex operating procedure for details.

NOTE: This can also me done manually, which is a very laborious process and should only be done for small samples with few particles greater than the required size.

7.5.2.2 Dish and Puck Mill: This may be appropriate for some projects where metals are not COCs. See instrument manual or Apex operating procedure for details.

7.5.3 Enter details of the operation, operator initials and date on the ISM worksheet.

7.6 HOMOGENIZATION

The sample mixing step specified here assumes that the sample has been sieved so that all particles are less than 2mm. If this is not the case, simply stirring the sample will be more likely to increase sample homogeneity than decrease it, due to particle size separation within the bowl. Tumbling the sample in a container with sufficient headspace to allow free movement, or placing the entire sample into a blender or mill are better options in the case of un-sieved samples.

7.6.0.1 Place the entire sample (minus any portions removed during the Air drying and Sieving steps, if performed) into a stainless steel bowl. Stir the sieved sample well (approximately 3 minutes) to homogenize.

7.6.0.2 If it is necessary to complete the compositing procedure at a later time, place the entire homogenized sample into the 1 gallon re-closeable plastic bag labeled A for storage.

7.6.1 Enter operator initials and date on the ISM worksheet.

7.7 SUBSAMPLING

There are many methods available for subsampling, some of which produce less error than others. Apex has available two simple incremental sampling methods. If other methods are required, Apex will procure the appropriate technology or subcontract this portion of the process.

If subsampling for an analytical aliquot, pay close attention to the ISM worksheet. The aliquots taken must be very close to the mass requirements, because the entire aliquot subsampled must be used for analysis.

If specified by the ISM worksheet, repeat this process as needed to provide sample volume for process duplicate or triplicate analyses.

7.7.1 1-D JAPANESE SLAB CAKE

7.7.1.1 Pour the entire sample into a line, using 20 or more passes along the line to distribute the sample. For samples where small analytical masses are required (e.g. metals, cyanide) a long thin line should be created.

7.7.1.2 Using a square scoop, cut across the line to create an aliquot. Combine as many of these aliquots as needed to create the analytical sample or mass reduction required. Repeat until all analytical aliquots have been created.

7.7.1.3 Place the aliquots into their respective containers, according to the ISM worksheet.

7.7.1.4 Place the remainder of the sample into the 1 gallon re-closeable plastic bag labeled A for storage.

7.7.2 2-D JAPANESE SLAB CAKE

7.7.2.1 Pour the entire sample into a cleaned aluminum tray and spread evenly. Use a pre-formed grid with 30 sections to divide the sample. Pull an equally sized aliquot of sample from each section of the grid and combine into the appropriate container for analysis. Be sure to scrape along the bottom of the tray in order to include a representative portion of all grain sizes present in the sample.

7.7.2.2 Pull an aliquot of sample from each section of the grid to ensure that the final sample size is close to the mass requested for analyses, typically 10-30 grams. Place the aliquots into their respective containers, according to the ISM worksheet.

7.7.2.3 Place the remainder of the sample into the 1 gallon re-closeable plastic bag labeled A for storage.

7.7.3 When subsampling is complete, roll the jar(s) for 1 minute to homogenize the sample. Initial and date the ISM worksheet.

7.8 DOCUMENTATION:

7.8.1 Create a batch in Element for the ISM test code, add the samples processed as a batch, and print out the bench sheet. Set sample status to Needs Review, attach the completed ISM worksheet and submit for review and scanning.

7.8.2 Return jars to Sample Receiving for completion of log in.

7.9 LOG IN

7.9.1 After samples are returned from ISM processing, analysis test codes can be added to the samples.

7.9.2 Be sure to add comments indicating the use for each jar in accordance with the ISM worksheet. Because one jar will be created per analysis, duplicate, and MS/MSD, there will be a large number of containers for some samples. The container comments should match the ISM worksheet, and the work order should be reviewed carefully by the person coordinating the ISM project.

7.10 ANALYSIS

Each aliquot for analysis has been pulled during sample processing and placed into a separate container. Use the ISM worksheet and the analysis comments to find which container is designated for your analysis. Be sure to use the entire amount of the aliquot provided, and rinse the container into the extraction vessel. Check the sample comments for sample specific instructions (e.g. MS/MSD, etc).

8 QUALITY CONTROL

8.1 FUNDAMENTAL ERROR

The steps in this procedure are designed to ensure that the fundamental error (FE) associated with the sample is below 15% in the final aliquot used for extraction and analysis. This FE measure has been determined to be the primary lab DQO.

Fundamental Error is calculated using the following equation:

$FE = \text{Square Root}((20 * d^3)/m)$

Where:

20 = sampling constant
d = maximum sample grain size (cm)
m = sample mass used for extraction and analysis (g)

For samples taken from the - #10 sieve fraction, d = 0.2, m = 10 and FE = 12.6%
d = 0.2, m = 20 and FE = 8.9%

For samples taken from the milled fraction, d = 0.0850, m = 1 and FE = 11.1 or
d = 0.0250, m = 1 and FE = 1.8%

8.2 CONVENTIONS

8.2.1 Samples will be reported on a dry weight basis. The reported dry weight result will reflect the moisture left in the sample after air drying.

8.3 QUALITY CONTROL SAMPLES

8.3.1 Blank: A blank using Ottawa sand is processed and analyzed along with samples tested for metals to verify that no contamination is being added by processing the samples. This will be done as requested for other classes of COCs.

8.3.1.1 The Ottawa sand will have to be tested before and after processing to compare levels of metals present, as no known clean matrices for metals exist.

8.3.2 Process Replicates: Whether process replicates will be analyzed should be determined by the client on a project basis. They may request that one or two replicates be performed per

project, per batch, or per sample.

8.3.2.1 Aliquots may be pulled and designated to be analyzed as batch duplicates in the same manner as sample aliquots. This should be specified on the ISM worksheet, as a separate container will have to be created for them.

8.3.3 Matrix Spikes: Apex will not evaluate spike samples through the entire ISM process unless requested. If required to do so by a client, the client should specify or provide a standard reference material suitable for ISM processing.

9 REFERENCES

9.1 Hawai'i Department of Health *Technical Guidance Manual for the Implementation of the Hawai`i State Contingency Plan*, Section 4, November 12, 2008.

9.2 Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program *Draft Guidance on Multi-Increment Soil Sampling,* March 2009.

9.3 EPA Method 8330B Appendix A Revision 2 October 2006.

9.4 Interstate Technology Regulatory Council *Technical and Regulatory Guidance: Incremental Sampling Methodology*, March 2011 (Draft)

Appendix A – Example ISM Request Form

Client:

Project:

Client Contact:

# of Decision Units:

# of Increments / Unit:

Notes:

Analysis: Note any that require subcontracting or small sample size (e.g. Metals)

Which ISM guidance document is being used for this project?

Alaska Hawaii EPA 8330A Appendix A ITRC Draft ISM Guidance

When will the Sampling and Analysis Plan be completed?
A copy must be provided to Apex before the project begins.

Project Specific Data Quality Objectives and procedures.
Apex follows the ITRC Draft guidance where possible. The following categories are procedural steps that are likely to have project specific goals. Our standard procedure is listed under the Apex heading, followed by specific requirements from the guidance documents. Each sampling event is unique, and modifications from our default procedure are expected. These differences should be noted.

Sample Storage:

Apex: Store refrigerated until air drying, room temperature thereafter.

Client request?

Air Drying:

Apex/ITRC: Air dry samples to help with sieving and grinding. Consider potential effects on volatile Contaminates of Concern (COCs) such as SVOCs and Mercury.

AK: Air dry only if necessary to sieve to < 2mm. May not be appropriate for Pesticides and PAHs.

HI: Air dry for all non-volatile analytes.

Client request?

Dry Weight:

Apex/ITRC: Samples are air dried, sieved, and then subsampled. That subsample is tested for most analysis and for dry weight. Results are reported on a dry weight basis, corrected to the air dried sample. If field percent moisture is requested, then a separate aliquot must be made prior to air drying.

HI: Air dried = dry weight, no further correction needed.

Client request?

Appendix A – Example ISM Request Form

Fundamental Error / Sample size:

Apex:	Our goal is to have less than 15% Fundamental Error at all steps. Our particle size and sample mass requirements are chosen to meet this goal for each analysis. We use at least 10 grams and generally ~20 for most tests, with a particle size smaller than 2 mm. We try to use at least 1 grams for Metals and other limited volume tests, with a particle size less than 250 µm.
AK:	Requires at least 30 grams of sample, particle size smaller than 2 mm.
HI:	At least 10 grams for most tests, particle size smaller than 2 mm. At least 1 gram for Metals and other limited volume tests, particle size less than 250 µm.
ITRC:	Somewhat contradictory. Generally, 10 grams for <2 mm fraction, 2 grams for < 0.25 mm.
Client request?	

Project Specific Fundamental Error (FE) goal?

Laboratory Replicate Samples:

Apex:	Per client SAP.
ITRC:	Field and lab triplicates are recommended for most projects.
Client request?	

Blank:

Apex/ITRC:	We have a blank sand matrix go through all steps of the analysis to ensure that metals are not added by the ISM process. Other analysis can be performed on the blank at additional cost. Matrix spikes are performed on a batch basis, per analysis.

Matrix Spikes:

ITRC:	Suggests that processing standard reference materials may be appropriate for some projects and COCs.

Notes:

Appendix B – ISM Worksheet

Batch

Sample Log in

Each sample created by the ISM procedure will be logged in with the containers and comments specified below. If samples will be treated differently, multiple sections will need to be created.

Sample IDs:

	Container	Use/Analysis	Particle size	Weight Needed	Comments
Jar A	Plastic Bag	Composite	<2mm	NA	No analysis
Jar B	4 oz jar				
Jar C					
Jar D					
Jar E					
Jar F					
Jar G					

Air Dry

Sample ID	Analyst	# of Containers to Composite	Air Dry Start Time	Air Dry End Time	Comments (Note sticks, rocks, etc removed.)

#10 Sieve

Sample ID	Date	Analyst	Homogenized?	Comments

Appendix B – ISM Worksheet

Splitting or Subsampling

This section may be needed multiple times for each sample. Modify worksheet to include this section for each step.

Method Used: 1-D Japanese Slabcake | 2-D Japanese Slabcake | Alternate Shoveling | Fractional Shoveling | Cone and Quarter | Other:

Sample ID	Date	Analyst	Replicates?*	Weight Obtained**	Homogenized?	Comments

*Indicate use for Replicates (Dry Weight, Duplicate analysis, etc)

**Total weight minus tare. (8 oz jar tare weight is 215g, 4 oz jar tare weight is 130g)

Grinding

This section may be needed for only a portion of each sample. Ensure that the proper container is noted.

Method Used: Automated Mortar and Pestle | Manual Mortar and Pestle | Dish and Puck Mill

Sample ID	Jar	Date	Analyst	Sieve size	Homogenized?

Sieve Size Chart	
#10	2 mm
#20	850 µm
#40	425 µm
#60	250 µm
#100	150 µm
#140	106 µm
#200	75 µm

Comments:

APPENDIX E-2

CARTY LAKE BANK INTEGRITY MONITORING PLAN

CARTY LAKE BANK INTEGRITY MONITORING PLAN

The Cary Lake engineered embankment will be monitored annually through 2020 to verify effective protection of the bulkhead embankments. The bank monitoring procedures are designed to evaluate changes in stability along the embankment over time and determine any corrective actions. The embankment was constructed consistent with the project design and specifications as described in the Comprehensive Operations and Maintenance Plan (COMP), to which this document is an appendix.

1. BACKGROUND

As part of the Carty Lake remedial action, embankments were constructed to provide erosion resistance and stabilization of the soils behind the bulkhead. The embankment includes a toe-of-fill keyway composed of granular structural fill (rock) on top of filter fabric geotextile. The surface of the embankment is covered by an 18-inch-thick topsoil layer and planted turf reinforcement mat.

2. VISUAL MONITORING SCHEDULE

Visual monitoring will be completed for the rock and planted turf reinforcement mat annually through 2020 to identify changes and areas of erosion and to evaluate the stability of the embankment. Visual monitoring will be conducted during low-water periods so that the embankment areas most susceptible to wind-wave action and other physical changes can be observed. Low-water elevation typically will depend on seasonal fluctuations and will occur in late summer or in the fall.

3. VISUAL MONITORING PROCEDURES

Visual monitoring events will be conducted by the engineer or representative of the engineer familiar with the site and the monitoring requirements. Monitoring will be conducted from the top of the embankment. The embankment will be visually inspected for the following:

- General embankment conditions
- Areas where rock or planted turf mat appear unstable or disturbed
- Areas of apparent erosion
- Areas of inconsistent vegetative cover or where invasive vegetative species are observed, consistent with procedures identified in the Carty Lake Maintenance Plan (see COMP Appendix E-6)
- Any apparent loss of structural granular fill or planted turf material

During the inspection, observations will be documented on the attached form. Representative photographs will also be taken to document general bank conditions and any of the areas identified above.

4. VISUAL MONITORING RESULTS

Areas having erosion or minimal embankment stability will be reviewed by the engineer, and corrective actions will be developed to address the issue(s).

Results of the visual monitoring will be reported annually along with the Soil Management and Cap Maintenance Plan (SMCMP) monitoring results. The SMCMP is provided as COMP Appendix B-1.

CARTY LAKE BANK INTEGRITY MONITORING FORM -2017

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 10/29/2017 Inspector: LINDSEY CROSBY

General Bank Conditions

GENERAL BANK CONDITION IS GOOD. NO EVIDENCE OF EROSION ISSUES, BUT SOME INVASIVE SPECIES OBSERVED AND ALMOST ALL UPLAND SHRUBS HAVE DIED

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	SCOTCH BROOM AND CANARY GRASS OBSERVED ON EASTERN BANK.
2	THISTLE AND BLACKBERRY OBSERVED AT TOP OF SOUTHERN BANK NEAR FOOTPATH.
3	UPLAND SHRUBS HAVE DIED. MARKER STAKES IN-PLACE, BUT NO LIVE PLANTS OBSERVED AT STAKES.
4	INVASIVE SPECIES AND DEAD SHRUBS TO BE ADDRESSED DURING REVEGETATION ACTIVITIES.

Signature Reviewer/Representative: [signature] Date: 10/29/17

Firm: MAUL FOSTER & ALONGI

Attach photos:

PHOTOGRAPHS

Project Name:Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 1

Scotch broom near top of eastern bank (looking south)

Photo No. 2

Scotch broom near top of eastern bank (looking north)

PHOTOGRAPHS

Project Name:Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 3

Southern bank (looking west)

Photo No. 4

Southern bank (looking west)

PHOTOGRAPHS

Project Name:Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 5

Blackberry at top of south bank bank near footpath

Photo No. 6

Thistle at top of south bank bank near footpath

PHOTOGRAPHS

Project Name:Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 7

Top of south bank (looking west)

CARTY LAKE BANK INTEGRITY MONITORING FORM -2018

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 10/16/18 Inspector: BROOKE HARMON

General Bank Conditions

GENERAL BANK CONDITION IS GOOD. NO EVIDENCE OF EROSION. SOME INVASIVE SPECIES OBSERVED. ALMOST ALL UPLAND SHRUBS ARE DEAD.

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	SCOTCH BROOM, COMMON TANSY, CANARY GRASS, BLACK BERRY, AND THISTLE OBSERVED ON EASTERN BANK.
2	THISTLE AND BLACKBERRY OBSERVED ON SOUTHERN BANK.
3	UPLAND SHRUBS HAVE DIED. MARKER STAKES IN PLACE, BUT NO LIVE PLANTS OBSERVED AT STAKES.

Signature Reviewer/Representative: Brooke Harmon Date: 10/16/18

Firm: MAUL FOSTER + ALONGI

Attach photos:

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 1

Common tansy near top of eastern bank (looking west)

Photo No. 2

Scotch broom near top of eastern bank (looking north)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 3

Southern bank (looking west)

Photo No. 4

Southern bank (looking west)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 5

Blackberry on east bank

Photo No. 6

Thistle at top of east bank near footpath

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 7

Top of south bank (looking west)

CARTY LAKE BANK INTEGRITY MONITORING FORM -2019

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 11/6/2019 Inspector: M. Pollock

General Bank Conditions

General bank condition is good. There is no evidence of erosion. Invasive species observed. Nearly all upland shrubs are dead.

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	Common tansy, canary grass, thistle, blackberry, & scotch broom observed on east bank.
2	Many upland shrubs have died. Marker stakes in place with no live plants. Only live plants observed at top of south bank.
3	thistle, blackberry, holly, common snowberry, wild carrot observed on south bank.

Signature Reviewer/Representative: Meaghan Pollock Date: 11/6/19

Firm: Maul Foster & Along.

Attach photos:

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 1.

Description
Common tansy and thistle near top of eastern bank (facing northwest)

Photo No. 2.

Description
East bank facing southwest

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 3.

Description
East bank facing north

Photo No. 4.

Description
Wild carrot and common snowberry near top of southern bank (facing north)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 5.

Description
Thistle near top of southern bank (facing northeast)

Photo No. 6.

Description
Holly near top of southern bank (facing northeast)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 7.

Description
Blackberry near top of southern bank (facing north)

Photo No. 8.

Description
Southern bank (facing west)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.49
Location: Port of Ridgefield, Washington

Photo No. 9.

Description
Southern bank (facing east)

Photo No. 10.

Description
Top of southern bank (facing west)

CARTY LAKE BANK INTEGRITY MONITORING FORM -2020

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE ~~LAKE RIVER~~ BANK INTEGRITY MONITORING FORM

Inspection date: 11/11/2020 Inspector: B. HARMON

General Bank Conditions

GENERAL BANK CONDITION IS GOOD. THERE IS NO EVIDENCE OF EROSION. INVASIVE SPECIES OBSERVED. MOST UPLAND SHRUBS ARE DEAD.

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where fish mix rocks appear unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or turf mat appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	COMMON TANSY, CANARY GRASS, THISTLE, BLACKBERRY, + SCOTCH BROOM OBSERVED ON EAST BANK
2	MOST UPLAND SHRUBS HAVE DIED. MARKER STAKES + CAGES ARE IN PLACE WITH OUT LIVE PLANTS.
3	THISTLE, BLACKBERRY, + CANARY GRASS OBSERVED ON SOUTH BANK.

Signature Reviewer/Representative: Brooke Harmon Date: 11/11/2020

Firm: MAUL FOSTER + ALONGI

Attach photos:

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.55
Location: Port of Ridgefield, Washington

Photo No. 1.

Description
Common tansy near top of eastern bank (facing north)

Photo No. 2.

Description
East bank facing southwest

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.55
Location: Port of Ridgefield, Washington

Photo No. 3.

Description
Reed canary grass and thistle on east bank (facing north)

Photo No. 4.

Description
Thistle near top of southern bank (facing north)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.55
Location: Port of Ridgefield, Washington

Photo No. 5.

Description
Thistle near top of southern bank (facing northeast)

Photo No. 6.

Description
Himalayan blackberry near top of southern bank (facing northeast)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.55
Location: Port of Ridgefield, Washington

Photo No. 7.

Description
Blackberry near top of eastern bank (facing north)

Photo No. 8.

Description
Southern bank (facing west)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.55
Location: Port of Ridgefield, Washington

Photo No. 9.

Description
Southern bank (facing east)

Photo No. 10.

Description
Top of southern bank (facing west)

CARTY LAKE BANK INTEGRITY MONITORING FORM -2021

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 12-2-2021 Inspector: M. Pollock

General Bank Conditions

General bank condition is good. There is no evidence of erosion. Invasive species observed. Upland shrubs dead or in winter dormancy.

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	common tansy, canary grass, thistle, himalayan blackberry, and scotch broom observed on east bank.
2	Many upland shrubs have died. Marker stakes in place with no live plants. Only live plants observed at top of southern bank.
3	thistle, himalayan blackberry, holly, common snowberry, and wild carrot observed on southern bank.

Signature Reviewer/Representative: Meaghan Black Date: 12-2-21

Firm: Mauf Foster & Alongi, Inc

Attach photos:

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.56
Location: Port of Ridgefield, Washington

Photo No. 1.

Description
Top of eastern bank (facing northwest)

Photo No. 2.

Description
East bank facing southwest

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.56
Location: Port of Ridgefield, Washington

Photo No. 3.

Description
East bank facing north

Photo No. 4.

Description
Wild carrot near top of southern bank (facing north)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.56
Location: Port of Ridgefield, Washington

Photo No. 5.

Description
Thistle near top of southern bank (facing north)

Photo No. 6.

Description
Himalayan blackberry near top of southern bank (facing northeast)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.56
Location: Port of Ridgefield, Washington

Photo No. 7.

Description
Eastern bank (facing north)

Photo No. 8.

Description
Southern bank (facing southwest)

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: 9003.01.56
Location: Port of Ridgefield, Washington

Photo No. 9.

Description
Southern bank (facing east)

Photo No. 10.

Description
Top of southern bank (facing west)

CARTY LAKE BANK INTEGRITY MONITORING FORM -2022

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 11-15-2022 Inspector: M. Pollock

General Bank Conditions

General bank condition is good. There is no evidence of erosion. Invasive species observed along bank. Uplands shrubs dead

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	common tansy, canary grass, thistle, himalayan blackberry, and scotch broom observed on east bank.
2	many uplands shrubs have died. Marker stakes in place with no live plants. Only live plants observed at top of southern bank. himalayan blackberry observed.
3	Thistle, himalayan blackberry, holly, common snowberry, and wild carrot observed on southern bank.

Signature Reviewer/Representative: Meghan Pollock Date: 11-15-22

Firm: Mauri Foster & Associates, inc

Attach photos:

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: November 15, 2022

Photo No. 1.

Description
Top of eastern bank (facing northwest). Note Himalayan blackberry along lower portion of bank.

Photo No. 2.

Description
East bank (facing southwest). Note canary grass and Himalayan blackberry along lower portion of bank.

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: November 15, 2022

Photo No. 3.

Description
East bank (facing north). Note canary grass and Himalayan blackberry along lower portion of bank.

Photo No. 4.

Description
Wild carrot and thistle near top of southern bank (facing north).

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: November 15, 2022

Photo No. 5.

Description
Top of southern bank (facing north).

Photo No. 6.

Description
Himalayan blackberry near top of southern bank (facing northeast).

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: November 15, 2022

Photo No. 7.

Description
Southern bank (facing southwest). Note Himalayan blackberry along lower portion of bank.

Photo No. 8.

Description
Southern bank (facing east). Note Himalayan blackberry along lower portion of bank.

PHOTOGRAPHS

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: November 15, 2022

Photo No. 9.

Description
Top of southern bank (facing west).

CARTY LAKE BANK INTEGRITY MONITORING FORM -2023

PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON
CARTY LAKE BANK INTEGRITY MONITORING FORM

Inspection date: 7-10-2023 Inspector: M. Pollock

General Bank Conditions

General bank condition is good. There is no evidence of erosion. Invasive species observed along bank. Upland shrub plantings dead.

Visual Monitoring Checklist

Visual observations made from top of bank:	YES	NO	COMMENT NO.
1. Are there areas where rock or planted turf appears unstable or disturbed?	☐	☒	
2. Are there any areas of apparent erosion?	☐	☒	
3. Are there areas of inconsistent cover or invasive vegetative species?	☒	☐	1-3
4. Are there areas where amount of rock or planted turf appears to be diminished?	☐	☒	

Comments

If any items listed above were checked YES, provide detailed description of the issue and the location:

COMMENT NUMBER	COMMENT
1	common tansy, canary grass, thistle, himalayan blackberry, and scotch broom observed on east bank.
2	Many upland shrub plantings have died. Marker stakes in place with no live plants observed at toe of bank. Himalayan blackberry, thistle, and knapweed observed along southern bank.
3	Thistle, knapweed, Himalayan blackberry, holly, and wild carrot observed on southern bank.

Signature Reviewer/Representative: [signature] Date: 7-10-23

Firm: Mauri Foster & Alongi, Inc.

Attach photos:

Photographs

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: July 10, 2023

Photo No. 1.

Description

Top of eastern bank (facing northwest). Note Himalayan blackberry along lower portion of bank.

Photo No. 2.

Description

East bank (facing southwest). Note canary grass and Himalayan blackberry along lower portion of bank.

Photographs

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: July 10, 2023

Photo No. 3.

Description

East bank (facing north). Note canary grass and Himalayan blackberry along lower portion of bank.

Photo No. 4.

Description

Top of southern bank (facing north).

Photographs

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: July 10, 2023

Photo No. 5.

Description

Knapweed, sweet pea, and Himalayan blackberry along top of southern bank (facing north).

Photo No. 6.

Description

Thistle near top of southern bank (facing northeast).

Photographs

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: July 10, 2023

Photo No. 7.

Description

Himalayan blackberry near top of southern bank (facing northeast).

Photo No. 8.

Description

Southern bank (facing southwest). Note Himalayan blackberry along lower portion of bank and knapweed along upper portion of bank.

Photographs

Project Name: Carty Lake Bank Monitoring
Project Number: M9003.01.056
Location: Port of Ridgefield, Washington
Date: July 10, 2023

Photo No. 9.

Description

Southern bank (facing east). Note Himalayan blackberry along lower portion of bank and knapweed along upper portion of bank.

Photo No. 10.

Description

Top of southern bank (facing west).

APPENDIX E-3

CARTY LAKE MITIGATION PLAN

CARTY LAKE MITIGATION PLAN

ADDENDUM TO THE JOINT AQUATIC RESOURCES PERMIT APPLICATION NO. NWS-2013-1209

CARTY LAKE REMEDIAL ACTION
111 W DIVISION STREET
RIDGEFIELD, WASHINGTON

Prepared for
PORT OF RIDGEFIELD
RIDGEFIELD, WA
October 22, 2014
Project No. 9003.01.40

Prepared by
Maul Foster & Alongi, Inc.
400 E Mill Plain Blvd., Suite 400, Vancouver WA 98660

MAUL
FOSTER
ALONGI

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TABLES AND ILLUSTRATIONS

FOLLOWING PLAN:

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EXHIBITS

On behalf of the Port of Ridgefield (Port), Maul Foster & Alongi, Inc. has prepared this draft mitigation plan as a supplement to the Carty Lake Remedial Action Joint Aquatic Resources Permit Application (JARPA No. NWS-2013-1209) submitted to the U.S. Army Corps of Engineers (COE). The purpose of the remedial action is to address historical contamination of sediment in the southern end of Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR). Carty Lake is located north of the former Pacific Wood Treating Co. (PWT) site in Ridgefield, Washington (see the figure). PWT operated a wood-treating facility from 1964 to 1993 at the Port's Lake River Industrial Site (LRIS) (now known as Miller's Landing), and cleanup actions have been conducted at the LRIS since 2000. The remedial action required by the Washington State Department of Ecology (Ecology) in Carty Lake addresses unacceptable risks to ecological receptors and includes excavating contaminated sediment, placing clean sand to contain residual contamination, stabilizing a failing treated-wood retaining wall, and vegetating the wetland and upland banks with native plants (see Attachment 1 to the JARPA for a more detailed project description).

Two types of impacts to the wetland resulting from the remedial action are identified:

- Short-term temporary impacts to 1.2 acres[1] of wetland will result from sediment excavation. Sediment removal will result in construction impacts to benthic populations and vegetation.
- Permanent impacts to up to 0.23 acre[2] of wetland will result from the construction of bank stabilization and remediation elements.

Short-term temporary impacts will be mitigated by 1.2[3] acres of revegetation and maintenance in the excavation area. In addition, areas surrounding the mitigation area will be revegetated and maintained to impede nonnative species encroachment. This draft mitigation plan addresses temporary impacts and was prepared consistent with Section 33 CFR Parts 325 and 332 and guidance provided in *Wetland Mitigation in Washington State—Part 1: Agency Policies and Guidance* (Ecology, COE, and USEPA, 2006a) and *Wetland Mitigation in Washington State—Part 2: Developing Mitigation Plans* (Ecology, COE, and USEPA, 2006b). The plan describes mitigation objectives, mitigation site selection, and monitoring and maintenance requirements for on-site mitigation. The mitigation was developed in consultation with the USFWS.

Permanent impacts will be mitigated by the purchase of mitigation credits. A bank use plan describing off-site mitigation to compensate for wetland filling is provided as an addendum to the JARPA. The bank use plan is prepared consistent with the 2009 Interagency Review Team for Washington State Guidance Paper *Using Credits from Wetland Mitigation Banks: Guidance to Applicants on Submittal Contents for Bank Use Plans.*

1. MITIGATION APPROACH

The process of avoiding, minimizing, and mitigating temporary impacts is incorporated into the project design, which has been overseen by Ecology and coordinated with the USFWS. Following

[1] The area of temporary impacts is approximate and does not include areas that will be excavated and permanently covered by bank stabilization elements. These permanent impacts will be addressed by mitigation banking.

[2] The acreage includes contingency as described in the JARPA. Permanent impacts may therefore be less.

[3] The area of mitigation planting will be equivalent to the final temporary impact area.

the best practices of wetland habitat restoration, the remedial action has been designed to enhance functions and values relative to existing conditions.

1.1. AVOIDANCE AND MINIMIZATION

Avoiding and minimizing impacts to the maximum extent practicable are fundamental to the mitigation sequencing process. The following avoidance approaches were used:

- The in-water remedial investigation used a sample-intensive methodology in consultation with the USFWS to ensure that only areas exceeding cleanup levels would be excavated. Areas with sediments that did not exceed cleanup levels are therefore avoided and are not disturbed unnecessarily.
- Bank stabilization along the eastern side of the wetland was redesigned from a 3:1 soil slope to a 2.5:1 (minimum) slope to avoid wetland encroachment.
- A spill prevention and pollution control plan will be implemented during construction, along with erosion- and sediment-control best management practices, to avoid potential impacts to water quality.

To minimize the impacts of the work that must be conducted in the wetland, a number of measures will be taken, including the following:

- Bank stabilization on the southern side of the wetland is designed at a 2:1 slope. This slope was selected as the preferred alternative among several design options because it minimizes encroachment into the wetland.[4] Other evaluated stabilization designs (e.g., 3:1 slope, ecology blocks) would result in greater encroachment or were infeasible.
- The sediment area will be dewatered before excavation. Construction "in the dry" allows the use of conventional excavation equipment and minimizes the disturbance of adjacent sediments and wetlands.
- The sediment excavation area will be functionally isolated (using sandbags or placement of a temporary isolation berm) from wetland habitat to the north, thereby minimizing impacts outside the work area.

1.2. MITIGATION

Sediment excavation and clean sand placement will be conducted in the southern end of the wetland to remove and control contaminated sediments as part of the remedial action. However, benthic populations and vegetation (including nonnative and native species) will be temporarily disturbed or removed. Benthic populations are expected to recover quickly following construction and are expected to benefit from contaminant removal in the long term (see Attachment 2 to the JARPA). The following mitigation measures will be conducted during or following construction to account for unavoidable impacts and will enhance the wetland plant community relative to existing baseline conditions:

[4] Wetland encroachment is addressed in the Carty Lake bank use plan.

- Invasive species control. At the request of the USFWS, the final depth of Carty Lake in the mitigation area will be at least 6 inches deeper than the current condition to inhibit the growth of reed canary grass (*Phalaris arundinacea*). The deepening will be equivalent to the acreage of temporary construction impacts.
- Native wetland plantings. The mitigation area will be planted with native species suited to the post-remedy elevations, enhancing habitat quality. The acreage of native wetland plantings will be equivalent to the acreage of temporary construction impacts.

The sediment remediation and proposed measures will rehabilitate and enhance resource functioning of the Carty Lake watershed as follows:

- Water quality. Contaminated sediment removal reduces the potential for water quality impacts throughout the watershed. The wetland is hydraulically connected with the 52-acre Carty Lake. Contaminants present in wetland sediment may reduce water quality functions (i.e., the functions that trap and transform pollutants through biological, geological, and chemical processes) locally and, if transported from the southern end, could impact the larger watershed.
- Habitat. Sediment removal, wetland deepening, and native plantings reduce the potential for contaminant transport and uptake throughout the watershed; reduce nonnative plant establishment; and provide for native species diversity and associated beneficial ecological processes (e.g., support of native wildlife present in the watershed). Habitat is currently severely degraded, as sediment conditions are not protective of benthos and wetland species that rely on benthos (e.g., wetland biota may bioaccumulate contaminants). Several other factors currently negatively impact habitat conditions in the remedy area. While the wetland is home to a relatively high diversity of species present in the wetland, it is dominated by two nonnative invasives (reed canary grass and Himalayan blackberry [*Rubus armeniacus*]). The wetland is shallow and seasonally inundated, supporting establishment and propagation of reed canary grass, which outcompetes native species (Weinmann et al., 1984).

In addition to rehabilitation and enhancement of the excavation area, the wetland surrounding the mitigation area will be revegetated with native species, providing separation from surrounding nonnative species that may encroach on the mitigation area. The proposed bank stabilization slopes are designed to contain upland (i.e., on the LRIS) subsurface soil contamination and will also be planted with a diverse palette of native plants. These measures will increase both the area and the quality of transition habitat between the wetland and the surrounding uplands.

2. SITE OVERVIEW

Carty Lake is a 52-acre lake in the RNWR and is a unit of the National Wildlife Refuge System (NWRS).

The mission of the NWRS is:

> To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United

States for the benefit of present and future generations of Americans. (National Wildlife System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee])

The project site, located in the southern end of Carty Lake, encompasses approximately 8.6 acres, including 4.7 acres of wetland habitat. Temporary impacts to wetland will occur on the mitigation site, approximately 1.2 acres (see Exhibit 1).

The Carty Lake project description (Attachment 1 to the JARPA) details the remedial action construction plans and existing site conditions, including site topography, hydrodynamics, sediment conditions, and site use. Ecological and physical characteristics are provided in the biological evaluation (Attachment 2 to the JARPA) and the wetland delineation (Attachment 3 to the JARPA). An overview of the site is provided below.

2.1. SITE CONDITIONS

The project site is zoned parks/open space. The topography of the site generally consists of gently rolling terrain, with elevations ranging from 7 feet to 34 feet National Geodetic Vertical Datum of 1929/1947. A bathymetric and topographic survey of Carty Lake was conducted to inform the remedy design. These contours are provided in Attachment 1 to the JARPA.

Hydrodynamics and grain size distribution indicate that Carty Lake features a low-energy, depositional environment. Percent fines in Carty Lake are uniformly high, generally over 75 percent. Carty Lake's hydraulic exchange with other surface water bodies is limited to events involving unusually high water. Water fluctuations are generally muted, with increases and decreases occurring gradually because there is no direct connection with the Columbia River. Water levels in Carty Lake range from 3 to 10 feet, varying seasonally, while the project site in the southern end is underwater or seasonally inundated. A confining layer composed of clay that restricts vertical movement of water has been identified.

Metals (arsenic and chromium), pentachlorophenol, and dioxins/furans are present in site sediment. Percent total fines (silt and clay) generally dominate the particle size distribution, ranging from 56 to 93 percent in surface samples. In surface samples, total organic carbon ranged from 1.3 to 5.4 percent. Total organic carbon generally decreases with depth.

2.2. HABITAT

Oregon ash (*Fraxinus latifolia*), black cottonwood (*Populus trichocarpa*), and several willow species (*Salix spp.*) comprise the vast majority of the canopy cover in forested habitat of the RNWR. The understory is typical of lower Columbia River floodplain habitats, with nettles (*Urtica dioica*), red-osier dogwood (*Cornus sericea*), and nonnative Himalayan blackberry providing the bulk of the shrub and forb layer. Remnant stands of western red cedar (*Thuja plicata*) and Douglas fir (*Pseudotsuga menziesii*) occur on the highest portions of the Carty Unit, with species such as snowberry (*Symphoricarpos albus*) and Himalayan blackberry dominating the understory. Oregon white oak (*Quercus garryana*) woodlands (Washington State priority designated habitat) occur to the east and north of Carty Lake, but not near the project area at the southern end of Carty Lake.

Virtually all of the grasslands in the RNWR have been impacted by past agricultural activities, including row crop and field crop production and grazing. Near Carty Lake, nonnative reed canary grass is ubiquitous and generally dominates the shoreline, forming dense monocultures.

The National Wetlands Inventory classifies much of Carty Lake as a lacustrine, limnetic, unconsolidated bottom, permanently tidal (L1UBV). The southern portion of the lake is classified as palustrine, emergent, and persistent (PEM1); the western side is subdesignated as temporarily (PEM1A) or seasonally flooded (PEM1C); and the eastern side is subdesignated as temporary-tidal (PEM1S). Washington State priority designated palustrine aquatic habitats are present within 0.15 mile of the project area. Because Carty Lake lacks a consistent connection with the Columbia River system, the lake's functionality has been reduced, particularly with respect to anadromous fish-rearing habitat and native mussel beds. As with similar wetlands on the RNWR, water quality and aquatic plants have been negatively impacted by introduced carp. The southern end of Carty Lake is submerged for most of the year and is intermittently exposed during dry summer months. Aquatic plants, including wapato (*Sagittaria latifolia*), occur in the lake, and the fringe wetland is dominated by nonnative, invasive reed canary grass.

A wetland delineation and Wetland Rating Form for Western Washington were completed for the project area at the southern end of Carty Lake in 2013. The project area is rated as a Category II lake fringe wetland. The wetland boundary is shown in Exhibit 1. The assessment found that water quality functions scored high, with the vegetation exceeding 33 feet in width and herbaceous plants covering more than 90 percent of the area. The hydrologic functions scored low, receiving 4 out of the possible 12 for lake-fringe. The wetland scored 25 out of 48 in habitat functions, based on the high species diversity and complex habitat structure. However, species evenness is relatively low, with reed canary grass widespread. In addition, the standard wetland rating system is limited in its application to this site because it does not account for contamination impacts in scoring habitat quality. Carty Lake is not designated as federal critical habitat and is not on the 303(d) water quality impairment list.

Areas of the site to the south and east and above the wetland boundary are characterized by steep slopes overgrown with primarily nonnative vegetation (e.g., Himalayan blackberry). A portion of the Port property is separated from the southern portion of Carty Lake by a treated wooden soldier pile and lagging bulkhead approximately 1,800 feet long and between 7 and ten feet tall. Portions of the bulkhead have begun to fail, causing some erosion into the RNWR. Failure of the wall could result in release of contamination into Carty Lake.

2.3. WILDLIFE AND SPECIES OF CONCERN

Waterfowl are abundant at the RNWR during fall, winter, and spring. Abundant wintering species include Canada geese, cackling geese, tundra swan, mallard, American wigeon, gadwall, northern shoveler, northern pintail, and green-winged teal. The RNWR also attracts significant numbers of diving ducks, largely ring-necked duck, lesser scaup, and bufflehead. Several species of duck nest on the RNWR in limited numbers, including wood duck, mallard, blue-winged teal, and cinnamon teal. Carty Lake also provides habitat for warm water fish such as introduced carp (*Cyprinidaceous spp.*) and largescale sucker (*Catostomus macrocheilus*); waterbirds such as the great blue heron (*Ardea herodias*) and common egret (*A. alba*); and aquatic mammals such as beaver (*Castor canadensis*), mink (*Mustela vison*), and nutria (*Myocastor coypus*).

The Columbian white-tailed deer (*Odocoileus virginianus leucurus*) is federally designated as endangered and historically occurred in Clark County. Columbian white-tailed deer were recently transplanted from Julia Butler Hansen National Wildlife Refuge to the RNWR and are present in the Carty Unit. Other federally designated species are not known to occur in or near the project area. Because Carty Lake does not maintain connectivity with Gee Creek (a 4th order tributary of the Columbia River located north and east of Carty Lake) or the Columbia River, federally listed anadromous species are unlikely to utilize Carty Lake; in addition, the proposed project would be conducted in the dry. In the Blackwater Island Research Natural Area (located in the Carty Unit), there are three sites where the federally listed threatened plant water howellia (*Howellia aquatilis*) is known to occur; however, the Natural Area is more than 1 mile north of the project area.

3. SITE SELECTION AND JUSTIFICATION

On-site mitigation for short-term temporary impacts is proposed. Regulatory, ecological, and cultural considerations demonstrate that on-site mitigation (i.e., wetland deepening and planting) following rehabilitation construction is appropriate and necessary to meet watershed needs and that it contributes to the functioning of the larger landscape:

- Under the November 5, 2013, Consent Decree between the Port and Ecology, on-site planting following construction is required.
- USFWS management objectives for the Carty Unit include enhancing wetland habitats as described in the RNWR Comprehensive Conservation Plan (USFWS, 2010), and on-site mitigation is therefore compatible with planned future land-use objectives.
- The mitigation objectives are consistent with existing site conditions; the *Wetland Mitigation in Washington State—Part 1: Agency Policies and Guidance* (Ecology, 2006a) states "if the impacts are to wetlands dominated by non-native vegetation (e.g., blackberry, reed canary grass, or pasture grasses), restoration of the affected wetland with native species and monitoring after construction is generally all that is required."
- Mitigation is appropriate based on the ecological status of the wetland. Category II wetlands have significant habitat value and functioning[5] and are rated as sensitive (WAC 173-183-710).
- The wetland is and will remain hydraulically connected with Carty Lake and is part of a large protected landscape (the RNWR) featuring multiple wetland and upland habitats and associated wildlife.
- Plants of cultural significance (i.e., wapato) may be removed during sediment excavation and should be replaced to meet tribal interests.

3.1. COMPENSATION RATIO

The on-site compensatory mitigation project components will provide the required compensation for unavoidable short-term, temporary impacts to aquatic resources resulting from remedial construction. Removal of contaminated sediment provides significant environmental rehabilitation.

[5] Note that the standard wetland rating system is limited in its application to this site because it does not account for contamination impacts.

A 1:1 baseline mitigation ratio (acreage) is therefore proposed for associated temporary impacts to aquatic resources (CFR 332.3(f)). Table 1, summarizing unavoidable short-term, temporary impacts; associated mitigation measures; and additional enhancement measures, demonstrates that a 1:1 ratio is met.

A small area of wetland (a maximum of 0.23 acre) will be permanently filled to stabilize the bank. Off-site mitigation banking will account for permanent impacts to the wetland is described in the Carty Lake bank use plan.

4. GOALS, OBJECTIVES, AND PERFORMANCE STANDARDS

Goals, objectives, and performance standards for the on-site mitigation area are presented in this section. Performance standards are ecologically-based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives (Section 33 CFR Part 332.5). Some areas outside the mitigation area will be planted with native vegetation and maintained. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Monitoring results will not be presented for these areas and they will not be subject to performance standards. The areas will be monitored and maintained by the permittee to help ensure the success of the adjacent mitigation.

Goal. Compensate for unavoidable short-term temporary impacts to 1.2 acres of wetland.

Objective 1.1. Grade substrate as specified in the grading plan (Attachment 1 to the JARPA).

> **Performance Standard 1.1.** As shown by the proposed grading plan (Attachment 1 to the JARPA), the site will be graded to the proposed contours.

Objective 1.2. Establish a predominantly native plant community.

> **Performance Standard 1.2.** The areal cover of native species shall be at least 20 percent by Year One, 40 percent by Year Three, and 60 percent by Year Five. Replace dead or dying plants as needed to meet the performance standard.

Objective 1.3. Significantly reduce invasive plant cover.

> **Performance Standard 1.3:** During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.

Objective 1.4. Create a diverse native plant community.

> **Performance Standard 1.4.** By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.

5. MITIGATION WORK PLAN

The proposed mitigation site is shown in Exhibit 1. Compensatory mitigation elements will be constructed during and following remedial action construction (expected to be completed in summer 2014).

See Attachment 1 to the JARPA for the remedial action construction schedule, sediment excavation and sand placement construction methods, and the location of the temporary isolation berm. Water quality impacts are not expected, as construction will take place in the dry and erosion- and sediment-control best management practices will be applied. Upland bank stabilization elements are designed to provide improved transition habitat between the wetland and surrounding areas, and fencing on the adjacent Miller's Landing will protect the site. See Attachment 1 to the JARPA for details.

5.1. CONSTRUCTION

The remedial action includes construction elements that intersect with mitigation objectives. Approximately 1.2 acres of wetland will be deepened a minimum of 6 inches during sediment excavation to provide sufficient hydrology to discourage reed canary grass reestablishment. Hydraulic connection to Carty Lake will be maintained. The deepening is expected to lead to increases in seasonal depths and duration of inundation. The depth of excavation is less than the vertical extent of the clay confining layer, and therefore vertical movement of water will continue to be restricted. See plans submitted in response to the December 31, 2013, COE information request for existing and postconstruction Carty Lake elevations and slopes.

To control for sediment contamination residuals, 1 foot of clean sand will be placed over the excavation area. Sand will be certified clean as part of the remedial action. The top 4 to 6 inches of sand will be amended with organic compost to promote conditions conducive to plant establishment (i.e., sufficient nutrients and organic carbon).

A small area (0.94 acre) of wetland outside the mitigation area will be scraped clean with an excavator to remove vegetation. Up to 8 inches of soil will be removed to account for the typical maximum depth of reed canary grass rhizomes. Soil will be disposed along with excavated sediments. Clean topsoil will be placed to bring the elevation up to existing grade and to provide nutrients and biota necessary for plant establishment. In addition, vegetation in the 0.93-acre upland bank stabilization area will be removed; bank stabilization includes placement of topsoil along the southern and eastern embankment and placement of rounded-rock fish mix at the base of the southern embankment. These areas will be planted consistent with the specifications in the planting plan.

5.2. PLANTING PLAN

Vegetation will be planted following completion of remedial construction. The temporary isolation berm designed for remedial construction will be maintained, if needed, to allow planting access. The berm will be removed following planting. Natives will be planted in the 1.2 acre mitigation area. A total of 1.9 acres of natives will be planted in areas surrounding the mitigation area to impede nonnative species encroachment.

The proposed planting area is organized into two specific areas: the wetland mitigation area and the scrub-shrub/upland bank area. Plant selection is based on the plants' location (relationship to the water's elevation) and their tolerance for wet and dry conditions. Culturally significant native plants (i.e., wapato) will be included throughout the wetland mitigation area. Native submerged planting groups will be located in deeper areas of the wetland mitigation area, while native emergent plants will be rooted in shallower areas. The scrub-shrub wetland fringe includes a mix of water-tolerant grasses, sedges, rushes, and shrubs. The upland bank areas are to be planted with native, drought-tolerant shrubs and groundcover. See Exhibits 1 through 3. Exhibits L0 through L4 provide the planting plan in COE plan format.

5.2.1. PLANT LIST

Native submergent plants will be installed in the wetland mitigation area at elevation 7 and below. Native emergent plants will be installed between elevations 7 and 11. These emergent plants include specific groupings of in-water plants that tolerate wetter conditions between elevations 7 and 10 and in-water edge plantings that perform well in wet and dry conditions from elevations 10 to 11 (see Table 2). In addition, native scrub-shrub plantings will be planted approximately between elevations 11 to 15 and native upland bank plants will be planted from elevation 15 and above. The scrub-shrub plantings include a mix of native shrub clusters and a transitional grass mix that can tolerate both moist and dry conditions. The upland bank will be planted with a variety of drought-tolerant native shrubs and grasses (see Table 3). The planting plan has been designed to provide structural habitat while protecting scenic views.

The plants specified for the mitigation site are intended to provide diversity in each stratum and will provide cover and habitat in both the short and long terms. The proposed plant lists include a diverse mix of native shrubs, along with variety of native grasses, sedges, rushes, aquatic plants, and groundcovers (see Tables 2 and 3).

5.2.2. PLANTING SPECIFICATIONS

Plants will be installed according to the following specifications.

Planting

- Plant the site with native species according to the planting list.
- Lay out the plants according to the planting plan.
- Plant containerized and bareroot trees and shrubs with a shovel or comparable tool. Position the plants' root crowns so that they are at or slightly above the level of the surrounding soil surface.
- Firmly compact the soil around the plants to eliminate air spaces.
- Install anti-herbivore devices, such as seedling protection tubes or mesh protection netting, around the stems of plants as appropriate. Secure with stakes.
- Irrigate all newly installed plants as weather conditions warrant.

Bareroot Stock

- Bareroot stock will be a minimum of 18 to 36 inches tall.
- Bareroot stock will be kept cool and moist before planting.
- The bareroot stock will have well-developed roots and sturdy stems with an appropriate root-to-shoot ratio.
- No damaged or desiccated roots or diseased plants will be accepted.
- Unplanted bareroot stock will be properly stored at the end of each planting day to prevent desiccation.

6. SITE PROTECTION AND MAINTENANCE

On May 18, 1965, the Migratory Bird Commission, under the authority of the Migratory Bird Treaty Act of 1929, approved the establishment of the RNWR and identified a 6,130.8-acre acquisition boundary; the project site is currently under USFWS ownership and is managed as part of the NWRS within a framework provided by legal and policy guidelines. The RNWR comprehensive conservation plan (USFWS, 2010) describes the long-term land protection instruments for the RNWR, agency missions and policies, and federal biological resource protection acts applicable to the site. These instruments will ensure the long-term protection of the compensatory mitigation site.

As described in the November 5, 2013, Consent Decree between the Port and Ecology, the Port will be responsible for monitoring and maintenance of the site. These activities will be coordinated with the owner (the USFWS).

The planting areas will be maintained during the monitoring period to support native plant establishment and to control wildlife and nonnative invasive species. Maintenance will include the following activities.

Irrigation—An irrigation system will be established. In the first year following planting, the irrigation system will be set to allow for 0.5 inch of precipitation two times per week between June 15 and October 1. In the second year following planting, the irrigation system will be set to allow for 0.5 inch of precipitation once per week between June 15 and October 1.

Nonnative Invasive Control—Nonnative plants will be controlled through mechanical means, including hand removal, brush cutting, and mowing. These activities will be conducted two to three times per growing season, or as needed, during the monitoring period, from approximately April 1 through October 1.

Wildlife Control—Some wildlife present at the site may consume newly planted vegetation. Appropriate measures to control loss of native vegetation will be evaluated and implemented, as needed, from approximately April 1 through October 1.

Plant Replacement—Dead or failing plants may be replaced to meet the performance standards. Dead or failing plants will be evaluated to determine the cause of the decline. Alternate native

species may be selected as replacement plants if it appears that these will have a better chance of survival. Replacement plants will be installed as described for the original installation.

7. MONITORING PLAN

Planting areas will be inspected and monitored annually for five years. The goal of the monitoring inspections is to determine the survival rate of the installed plant material, to determine the extent of nonnative invasive plant encroachment, and to identify maintenance tasks that are required to meet performance standards. Monitoring will be conducted in late spring during periods of low water. Monitoring in the planting areas will include:

- Establishing photodocumentation points to monitor plant growth.
- To measure the percent cover of native vegetation, the point-line or point-frame method will be used (Bonham, 1989; Coulloudon et al., 1999). In the point-line method, sample units consisting of fixed sets of points are randomly placed along sampling transects. A point-frame is a rectangular frame that encloses a set of points collectively serving as a sample unit. For each method, the sample unit is lowered over herbaceous vegetation and data are recorded where native vegetation intercepts point locations. Native percent cover is determined based on the number of times native vegetation is encountered divided by the total number of points. For example, if native species were encountered on 6 points from a sample unit composed of 10 points, the percent cover of native species for that sample unit is 60 percent.
- Identification of invasive plant material percent cover will be conducted as described for native vegetation.

Monitoring Report

Following each inspection, a monitoring report will be prepared that presents field observations. The report will be submitted to the COE and will indicate if the planting is successful, not successful, or moving toward successful establishment. Monitoring reports will also be provided to the USFWS. The information will indicate performance metrics, and photographs and a written description of the planting areas will be included. The report will be consistent with COE Regulatory Guidance Letter No. 08-03 and will include the following information:

- The date of the inspection.
- Photodocumentation from established photo points to compare plant growth between monitoring inspections. The photos will be used to support the findings and recommendations referenced in the report and to assist in assessing whether the project is successful for the monitoring period.
- A site location map indicating the monitoring area and locations of specific photo locations.
- A description of the conditions of the planting project and monitoring results.
- Conclusions. (If performance standards are not being met, a brief explanation of the difficulties will be included.)

- Recommendations for maintenance and adaptive management.

8. MITIGATION, MAINTENANCE, AND MONITORING SCHEDULE

Year 1: 2014-2015

- August 2014—Sediment excavation, sand placement, and wetland deepening are expected to be completed.
- September–October—Plant installation.
- April–October—Irrigation and maintenance.
- June–August—Conduct monitoring.
- September–October—Replace dead or failing plants as needed.

Year 2: 2015-2016

- April–October—Irrigation and maintenance.
- June–August—Conduct monitoring.
- September–October—Replace dead or failing plants as needed.

Year 3: 2016-17

- April–October—Irrigation as needed and maintenance.
- June–August—Conduct monitoring.
- September–October—Replace dead or failing plants as needed.

Year 4: 2017-2018

- April–October—Irrigation as needed and maintenance.
- June–August—Conduct monitoring.

Year 5: 2018-2019

- April–October—Irrigation as needed and maintenance.
- June–August—Conduct monitoring.
- September–October—Replace dead or failing plants as needed.

9. ADAPTIVE MANAGEMENT

The monitoring and maintenance events will provide a basis of information for evaluating the success of the project and for making any recommendations for adaptive management that may be needed. If the COE or the Port believes that adaptive management of the mitigation is needed, they will collaboratively discuss options, and the Port will present a written proposal to the COE, identifying specific issues and measures for addressing them. Upon receiving written approval by the COE, the Port will proceed to implement the adaptive management measures. The USFWS will be consulted throughout the process.

Significant challenges to project success include the widespread reed canary grass monoculture surrounding the site. As described in Ecology, COE, and USEPA (2006a), the intent of invasive species performance standards is to prevent the establishment of monocultures of invasive species

and unattainable performance standards which lead to compensatory mitigation failure should not be required. Wetland deepening (a minimum of 6 inches) is expected to provide sufficient hydrology to control reed canary grass reestablishment and was selected as a primary control measure. Additional native planting areas outside the sediment excavation area were included in the mitigation design to impede reed canary grass. If it is determined that encroachment is significant despite these efforts, the performance standard 1.3 for nonnative invasive species may be modified upward to no more than 30 percent nonnative species present.

10. FINANCIAL ASSURANCES

The Port has received a grant from Ecology to perform the remedial action and the mitigation work described in this plan. The Port will be responsible for implementing monitoring and maintenance according to the schedule provided above.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

Bonham, C. D. 1989. Measurements for terrestrial vegetation. New York: John Wiley & Sons.

Coulloudon, B., K. Eshelman, J. Gianola, N. Habich, L. Hughes, C. Johnson, M. Pellant, P. Podborny, A. Rasmussen, B. Robles, P. Shaver, J. Spehar, and J. Willoughby. 1999. Sampling vegetation attributes. BLM technical reference 1734-4. Bureau of Land Management, Denver, Colorado.

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TABLES

Table 1
Wetland Impacts and Mitigation
Carty Lake Remedial Action
Ridgefield, Washington

Area	Temporary Impacts	Impact (acres)	Proposed Measures	Mitigation (acres)	Habitat Enhancement (acres)	NWI Classification (Cowardin)	Western Washington Wetland Rating	HGM Classification
Mitigation Area[a]	Benthos and native vegetation disturbance or removal	1.2	Nonnative invasive species removal, native plantings, wetland deepening	1.2	1.2	Palustrine emergent, seasonally flooded	Category II	Lake-fringe
Wetland Areas adjacent to Mitigation Area[b]	--	--	Nonnative invasive species removal, native plantings	--	0.94	Palustrine emergent, temporarily flooded or temporary-tidal	Category II	Lake-fringe
Wetland Fringe and Upland Bank Area[c]	--	--	Nonnative invasive species removal, native plantings	--	0.93	--	--	--
Totals	--	1.2	--	1.2	3.1	--	--	--

NOTES:

-- = not applicable.

HGM = hydrogeomorphic classification based on western Washington wetland rating form.

NWI = National Wetlands Inventory.

[a]Does not include areas that will be excavated and permanently filled (these areas will be addressed with mitigation banking).

[b]Existing vegetation is primarily nonnative reed canary grass.

[c]Existing vegetation is primarily nonnative reed canary grass and Himalayan blackberry.

Table 2
Wetland Mitigation Plant List
Carty Lake Remedial Action
Ridgefield, Washington

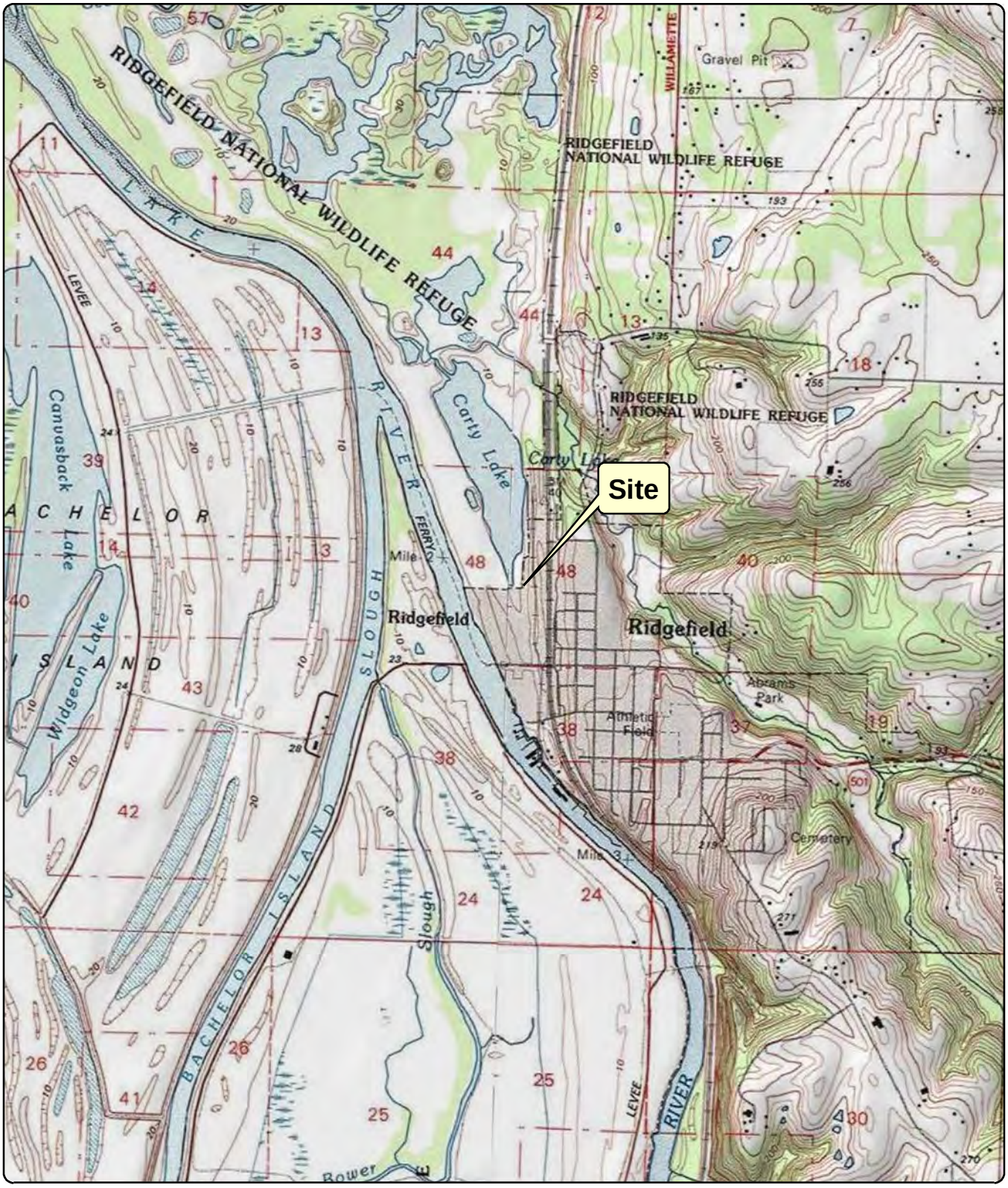
Common Name	Botanical Name	Size	Spacing
In-water Mix 1 (approx. elev. 7 and below)			
American Waterplantain	*Alisma plantago-aquatica*	Tuber	1'-0, o.c.
Wapato	*Sagittaria latifolia*	Tuber	1'-0, o.c.
Water Smartweed	*Polygonum amphibium*	BR Seedling	18"-0, o.c.
Floating-leaf Pondweed	*Potamogeton natans*	BR Seedling	18"-0, o.c.
Bur-reed	*Sparganium emersum*	BR Seedling	18"-0, o.c.
In-water Mix 2 (approx. between elev. 7 and 10)			
American Waterplantain	*Alisma plantago-aquatica*	Tuber	1'-0, o.c.
Wapato	*Sagittaria latifolia*	Tuber	1'-0, o.c.
Small-fruited Bulrush	*Scirpus microcarpus*	BR Seedling	18"-0, o.c.
Hardstem Bulrush	*Scirpus acutus*	BR Seedling	18"-0, o.c.
In-water Edge Mix (approx. between elev. 10 and 11)			
Columbia Sedge	*Carex aperta*	BR Seedling	18"-0, o.c.
Slough Sedge	*Carex obnupta*	BR Seedling	18"-0, o.c.
Tufted Hairgrass	*Deschampsia cespitosa*	BR Seedling	2'-0, o.c.
Ovate Spikerush	*Eleocharis ovata*	BR Seedling	2'-0, o.c.
Soft Rush	*Juncus effusus*	BR Seedling	2'-0, o.c.
Live Stakes[a] (within Fish Mix)			
Ninebark	*Physocarpus capitatus*	--	--
Red-Osier Dogwood	*Cornus sericea*	--	--
Douglas' Spiraea	*Spiraea douglasi*	--	--

[a]All proposed live stakes will be planted within the fish mix, adjacent to the wetland mitigation area (see Exhibit L1.2). This area is not identified as mitigation.

Table 3
Scrub-Shrub and Upland Bank Plant List
Carty Lake Remedial Action
Ridgefield, Washington

Common Name	Botanical Name	Qty	Size*	Spacing
Trees				
Pacific Willow	*Salix lasiandra*	*26*	3 gal	15'-0', o.c.
River Willow	*Salix fluviatilis*	*30*	3 gal	12'-0, o.c.
Sitka Willow	*Salix sitchensis*	*45*	3 gal	18"-0, o.c.
Shrubs				
Twinberry	*Lonicera involucrata*	*71*	3 gal	8'-0', o.c.
Ninebark	*Physocarpus capitatus*	*82*	3 gal	7'-0', o.c.
Ocean Spray	*Holodiscus discolor*	*75*	3 gal	6'–0", o.c.
Red-Osier Dogwood	*Cornus sericea*	*114*	3 gal	5'–0", o.c.
Western Viburnum	*Viburnum ellipticum*	*119*	1 gal	5'–0", o.c.
Snowberry	*Symphoricarpos albus*	*179*	1 gal	4'–0", o.c.
Red Flowering Currant	*Ribes sanquineum*	*188*	1 gal	4'–0", o.c.
Tall Oregon Grape	*Mahonia aquifolium*	*155*	1 gal	4'–0", o.c.
Douglas' Spiraea	*Spiraea douglasi*	*221*	1 gal	4'–0", o.c.
Cluster Rose	*Rosa pisocarpa*	*170*	1 gal	3'–0", o.c.
Nootka Rose	*Rosa nutkana*	*244*	1 gal	3'–0", o.c.
Transitional Fringe Mix (approx. between elev. 11 and 14)				
Mannagrass	*Glyceria occidentalis*	--	Seed	--
Blue Wildrye	*Elymus glaucus*	--	Seed	--
Tufted Hairgrass	*Deschampsia cespitosa*	--	Seed	--
Meadow Barley	*Hordeum brachyantherum*	--	Seed	--
Path Rush	*Juncus tenuis*	--	Seed	--
Upland Grass Mix				
Roemer's Fescue	*Festuca roemeri*	--	Seed	--
Blue Wildrye	*Elymus glaucus*	--	Seed	--
Spike Bentgrass	*Agrostis exarata*	--	Seed	--
California Brome	*Bromus carinatus*	--	Seed	--
Eco Grass Mix				
Idaho Fescue	*Festuca idahoensis*	--	Seed	--
California Oatgrass	*Danthonia californica*	--	Seed	--
Slender Hairgrass	*Deschampsia elongata*	--	Seed	--
Pine bluegrass	*Poa scabrella*	--	Seed	--
*If specified sizes are not available, bare root stock may be substituted.				

FIGURE



Source: Topographic Quadrangle obtained from ArcGIS Online Services/NGS-USGS TOPO! US Geological Survey (1999) 7.5-minute topographic quadrangle: Ridgefield

REFERENCE: NWS-2013-1209

APPLICANT: Port of Ridgefield

ADJACENT PROPERTY OWNERS: Multiple. See JARPA

LOCATION: 111 West Division St. Ridgefield, WA 98642

LAT/LONG: 45.822 N / -122.751 W

PAGE #4 OF #10 DATE: 09/20/2013

PROPOSED PROJECT: Carty Lake Remedial Action

IN: Carty Lake
NEAR/AT: Ridgefield
COUNTY: Clark
STATE: Washington

Figure
Site Location

Former PWT Site
Ridgefield, Washington

Township 4N, Range 1W, W.M Section 24

0 1,000 2,000
Feet

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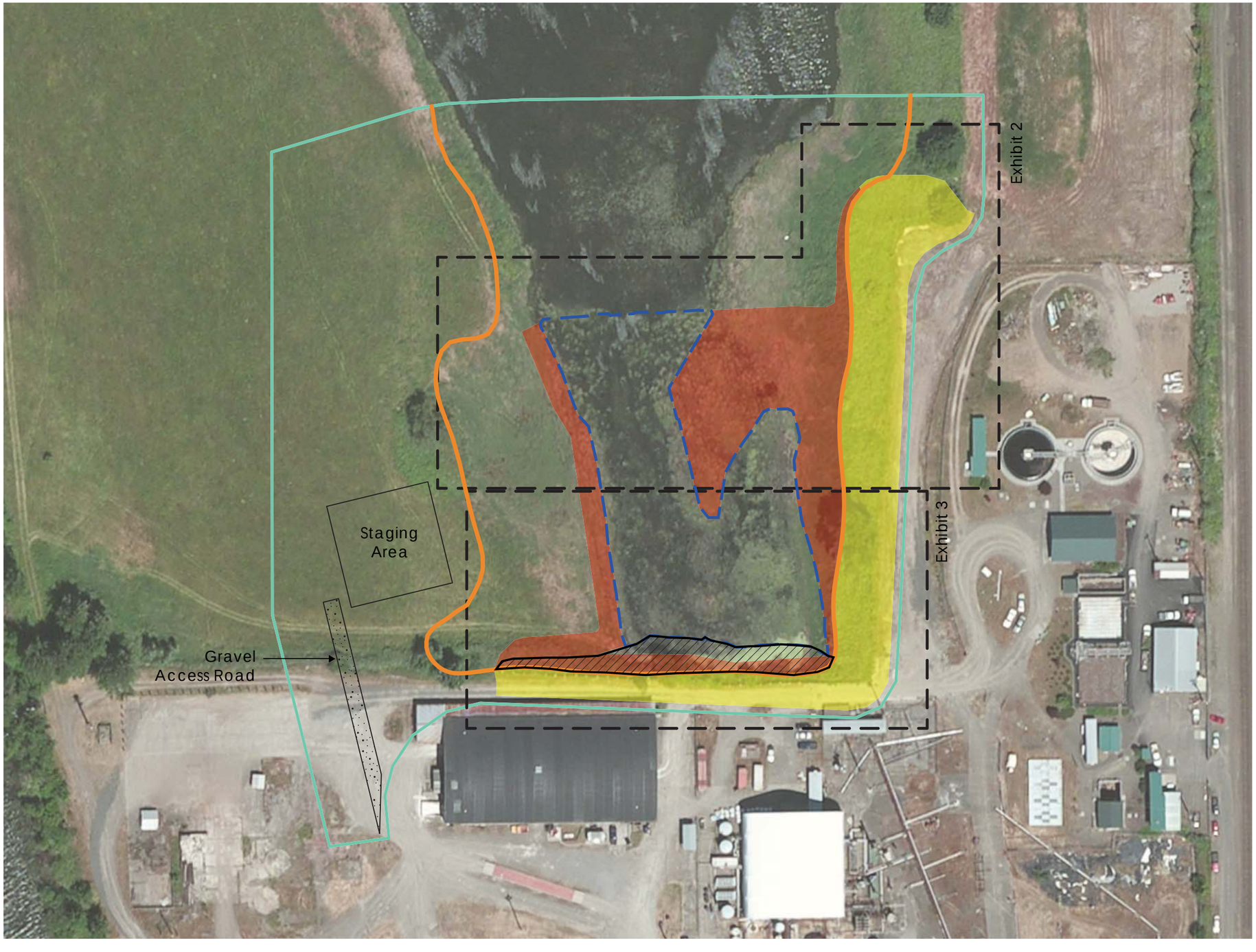
Project: 9003.01.20 Produced By: jschane Approved By: J. King Print Date: 1/14/2014 Path: X:\9003.01 Port of Ridgefield\40\Projects\06\JARPA\Carty Lake\Fig_Site_Location.mxd

EXHIBITS



LEGEND

- Site Boundary
  8.6 ACRES
- Wetland Boundary
  4.7 ACRES
- Mitigation Site
  1.2 ACRES
- Current Wetland Areas Adjacent to Mitigation Area 0.94 ACRES
- Wetland Fringe and Upland Bank
  0.93 ACRES
- Wetland Mitigation Banking
  Up to 0.23 ACRES

0 100 200
Feet

SITE OVERVIEW
CARTY LAKE
PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON

EXHIBIT
1

MFA JOB #:	9003.01.40
ISSUE DATE:	01/29/2014
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DRAWN:	C.RILEY

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PLANT MATERIAL SCHEDULE

SYM	COMMON NAME
	PACIFIC WILLOW
	SANDBAR WILLOW
	SITKA WILLOW
	TWINBERRY
	NINEBARK
	RED TWIG DOGWOOD
	OCEAN SPRAY
	WESTERN VIBURNUM
	SNOWBERRY
	DOUGLAS' SPIRAEA
	RED FLOWERING CURRANT
	NOOTKA ROSE
	CLUSTER ROSE
	TALL OREGON GRAPE

GROUNDCOVER

FISH MIX W/ LIVE STAKES
(ELEV. 9 TO 14)
LIVE STAKES INCLUDE:
NINEBARK
REDTWIG DOGWOOD
DOUGLAS' SPIRAEA

IN-WATER PLANTING

IN-WATER MIX 1
(APPROX. ELEV. 7 & BELOW)
AMERICAN WATERPLANTAIN
WAPATO
WATER SMARTWEED
FLOATING-LEAF PONDWEED
BUR-REED

IN-WATER MIX 2
(APPROX. ELEV. 7 TO 10)
AMERICAN WATERPLANTAIN
WAPATO
SMALL-FRUITED BULRUSH
HARDSTEM BULRUSH

IN-WATER EDGE MIX
(APPROX. ELEV. 10 TO 11)
COLUMBIA SEDGE
SLOUGH SEDGE
TUFTED HAIRGRASS
OVATE SPIKERUSH
SOFT RUSH

TRANSITIONAL FRINGE MIX
(APPROX. ELEV. 11 TO 14)
MANNAGRASS
BLUE WILDRYE
TUFTED HAIRGRASS
MEADOW BARLEY
PATH RUSH

UPLAND GRASS MIX
ROEMER'S FESCUE
BLUE WILDRYE
SPIKE BENTGRASS
CALIFORNIA BROME

ECO GRASS MIX
IDAHO FESCUE
CALIFORNIA OATGRASS
SLENDER HAIRGRASS
PINE BLUEGRASS

PROPOSED 4' SMOOTH WIRE FENCE

WETLAND BOUNDARY

WETLAND MITIGATION AREA

EXISTING TREE TO REMAIN

SITE BOUNDARY

MATCHLINE

NOTE:
1. SEE ATTACHMENT 1 IN THE JARPA FOR THE PROPOSED GRADING PLAN.

0 40' 80'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

ENLARGED PLANTING PLAN 1
CARTY LAKE
PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON

EXHIBIT
2

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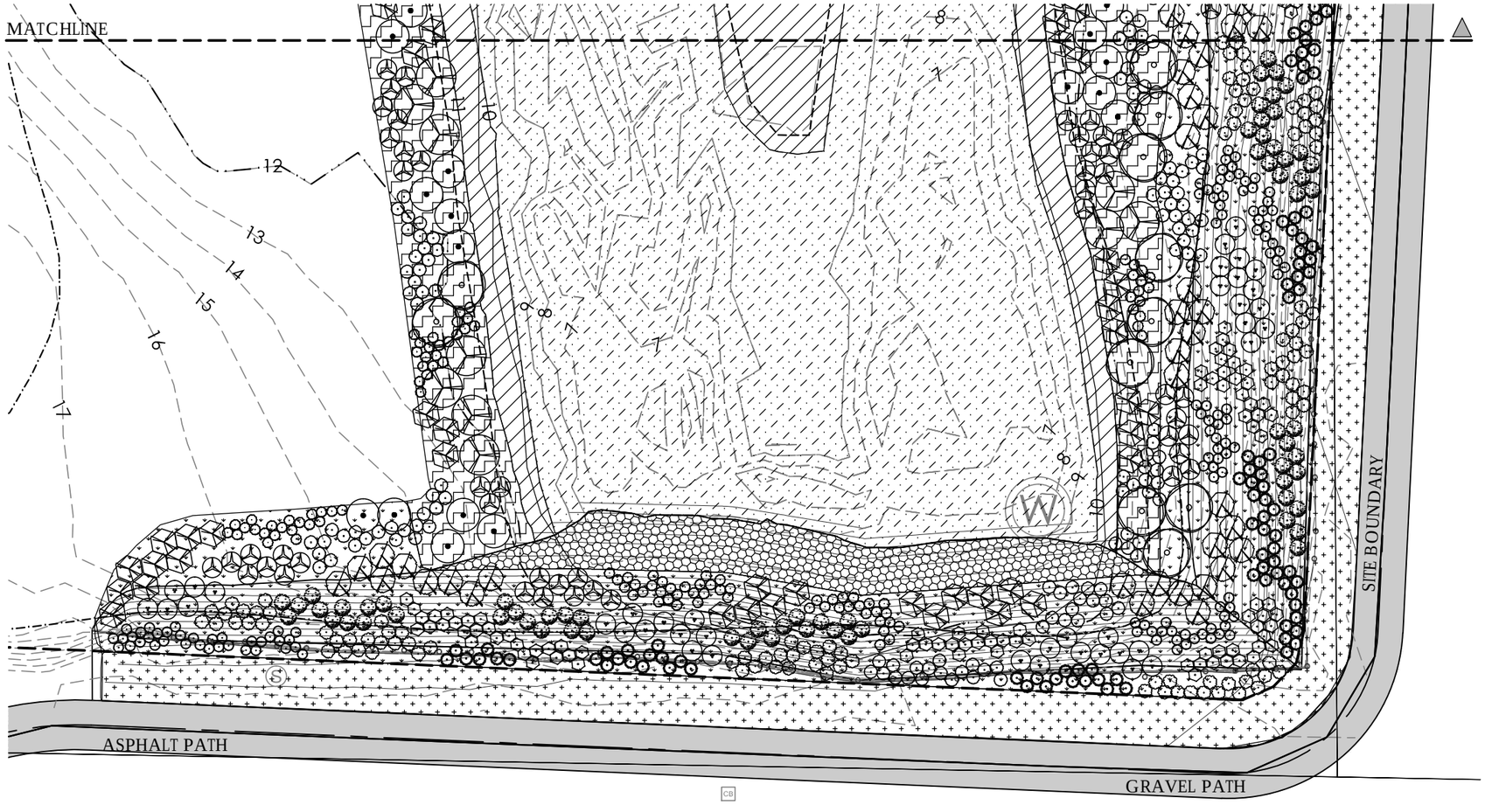
NOTE:
1. SEE ATTACHMENT 1 IN THE JARPA FOR THE PROPOSED GRADING PLAN.



PLANT MATERIAL SCHEDULE

SYM	COMMON NAME
	PACIFIC WILLOW
	SANDBAR WILLOW
	SITKA WILLOW
	TWINBERRY
	NINEBARK
	RED TWIG DOGWOOD
	OCEAN SPRAY
	WESTERN VIBURNUM
	SNOWBERRY
	DOUGLAS' SPIRAEA
	RED FLOWERING CURRANT
	NOOTKA ROSE
	CLUSTER ROSE
	TALL OREGON GRAPE

GROUNDCOVER

FISH MIX W/ LIVE STAKES
(ELEV. 9 TO 14)
LIVE STAKES INCLUDE:
NINEBARK
REDTWIG DOGWOOD
DOUGLAS' SPIRAEA

IN-WATER PLANTING

IN-WATER MIX 1
(APPROX. ELEV. 7 & BELOW)
AMERICAN WATERPLANTAIN
WAPATO
WATER SMARTWEED
FLOATING-LEAF PONDWEED
BUR-REED

IN-WATER MIX 2
(APPROX. ELEV. 7 TO 10)
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SMALL-FRUITED BULRUSH
HARDSTEM BULRUSH

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TUFTED HAIRGRASS
OVATE SPIKERUSH
SOFT RUSH

TRANSITIONAL FRINGE MIX
(APPROX. ELEV. 11 TO 14)
MANNAGRASS
BLUE WILDRYE
TUFTED HAIRGRASS
MEADOW BARLEY
PATH RUSH

UPLAND GRASS MIX
ROEMER'S FESCUE
BLUE WILDRYE
SPIKE BENTGRASS
CALIFORNIA BROME

ECO GRASS MIX
IDAHO FESCUE
CALIFORNIA OATGRASS
SLENDER HAIRGRASS
PINE BLUEGRASS

PROPOSED 4' SMOOTH WIRE FENCE

WETLAND BOUNDARY

WETLAND MITIGATION AREA

0 40' 80'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

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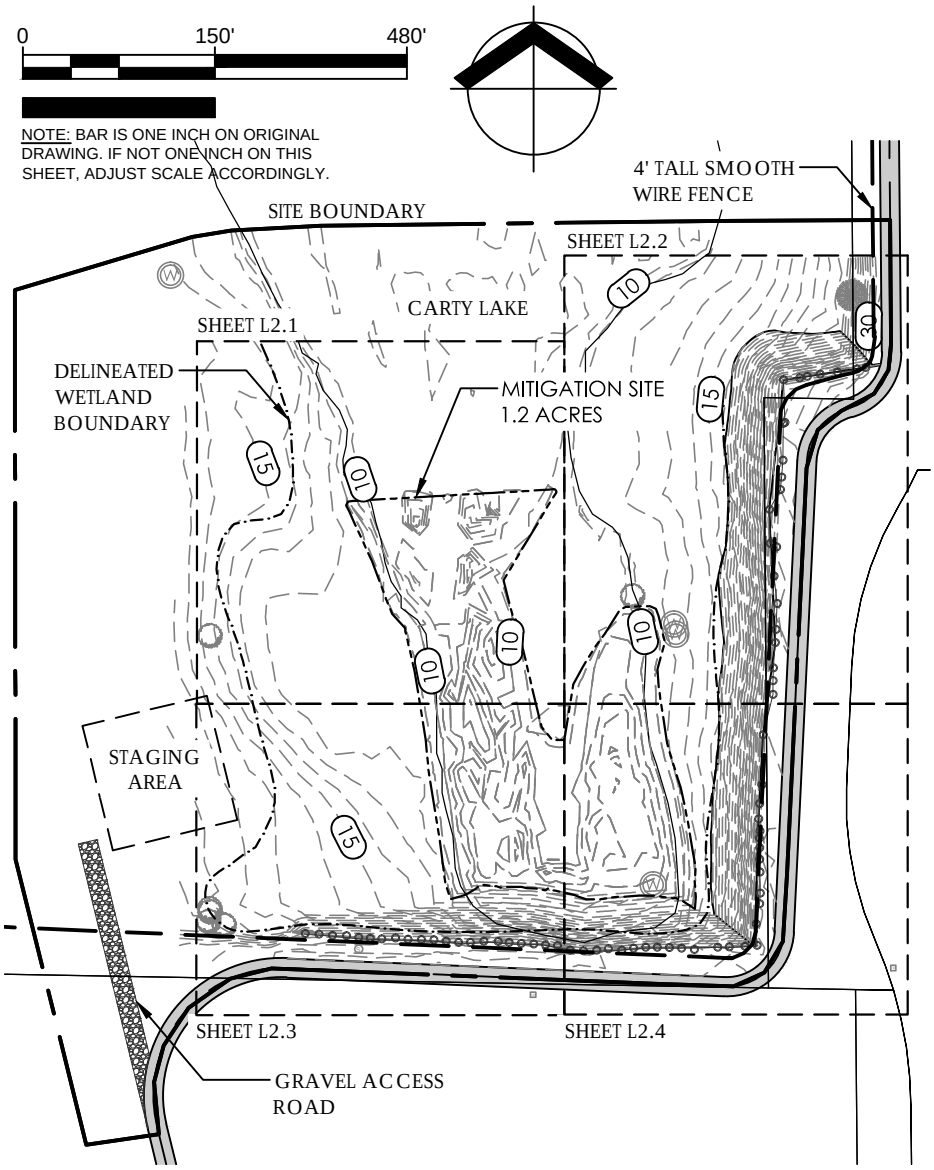
ENLARGED PLANTING PLAN 2
CARTY LAKE
PORT OF RIDGEFIELD
RIDGEFIELD, WASHINGTON

EXHIBIT
3



PLANT MATERIAL SCHEDULE

SYM	COMMON NAME	SPACING
	PACIFIC WILLOW	15'-0", O.C
	SANDBAR WILLOW	12'-0", O.C
	SITKA WILLOW	10'-0", O.C
	TWINBERRY	8'-0", O.C.
	PACIFIC NINEBARK	8'-0", O.C.
	RED TWIG DOGWOOD	6'-0", O.C.
	OCEAN SPRAY	6'-0", O.C.
	WESTERN VIBURNUM	5'-0", O.C.
	SNOWBERRY	4'-0", O.C.
	DOUGLAS' SPIRAEA	4'-0", O.C.
	RED FLOWERING CURRANT	4'-0", O.C.
	TALL OREGON GRAPE	4'-0", O.C.
	NOOTKA ROSE	3'-0", O.C.
	CLUSTER ROSE	3'-0", O.C.

GROUNDCOVER

FISH MIX W/ LIVE STAKES
(ELEV. 9 TO 14)
LIVE STAKES INCLUDE:
NINEBARK
REDTWIG DOGWOOD
DOUGLAS' SPIRAEA

IN-WATER PLANTING

IN-WATER MIX 1
(APPROX. ELEV. 7 & BELOW)
AMERICAN WATERPLANTAIN
WAPATO
WATER SMARTWEED
FLOATING-LEAF PONDWEED
BUR-REED

IN-WATER MIX 2
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AMERICAN WATERPLANTAIN
WAPATO
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HARDSTEM BULRUSH

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OVATE SPIKERUSH
SOFT RUSH

TRANSITIONAL FRINGE MIX
(APPROX. ELEV. 11 TO 14)
MANNAGRASS
BLUE WILDRYE
TUFTED HAIRGRASS
MEADOW BARLEY
PATH RUSH

NOTE:
REFER TO CARTY LAKE MITIGATION PLAN (01/29/2014) FOR GROUNDCOVER PLANT SPACING

PERMIT DOCUMENT

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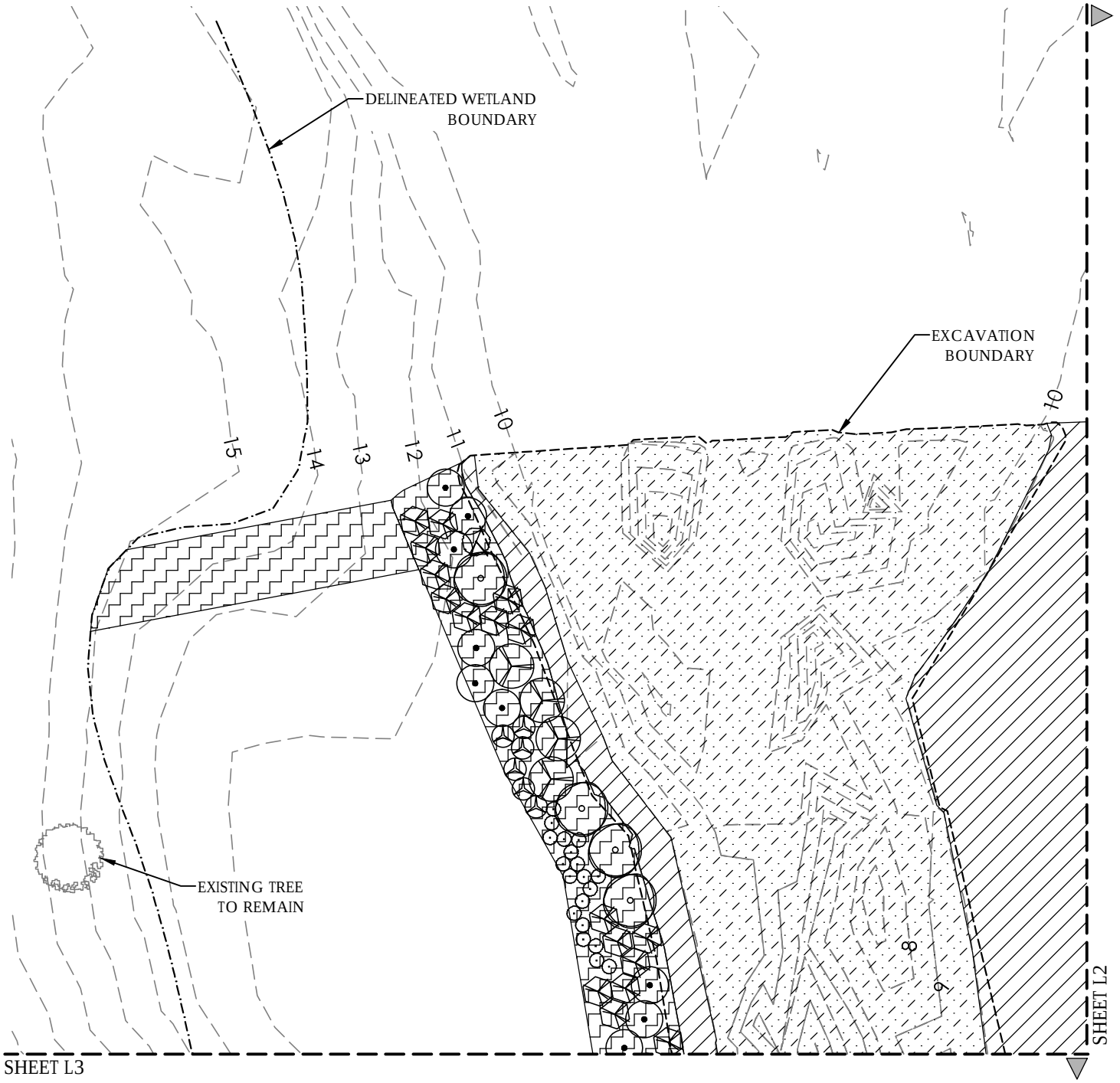
PLANTING OVERVIEW

CARTY LAKE REMEDIAL ACTION

PORT OF RIDGEFIELD
RIDGEFIELD, WA

REFERENCE #: NWS-2013-1209

SHEET
L0



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ENLARGED PLANTING PLAN 1

CARTY LAKE REMEDIAL ACTION

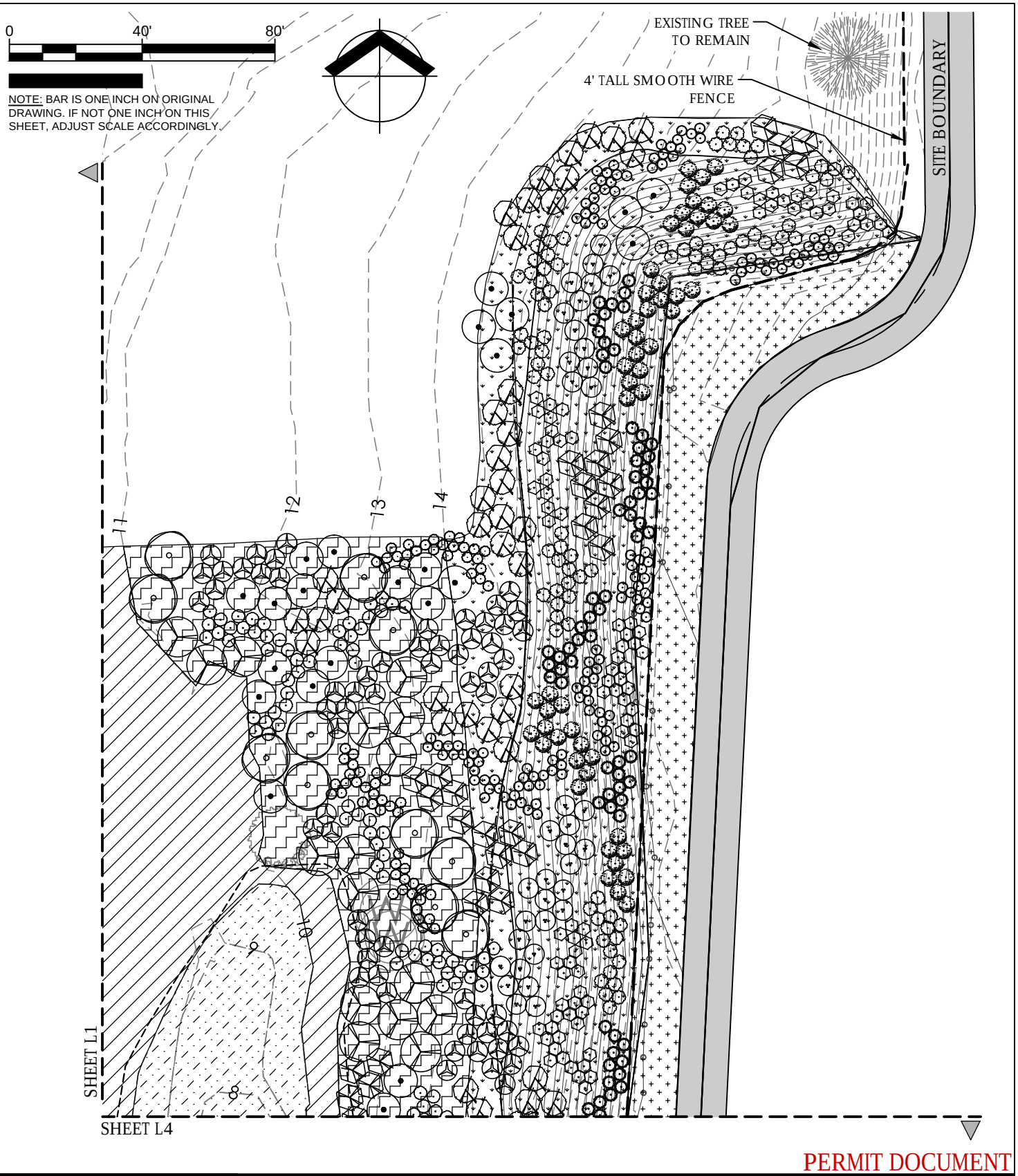
PORT OF RIDGEFIELD

RIDGEFIELD, WA

REFERENCE #: NWS-2013-1209

SHEET

L1



PERMIT DOCUMENT

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ENLARGED PLANTING PLAN 2

CARTY LAKE REMEDIAL ACTION

PORT OF RIDGEFIELD

RIDGEFIELD, WA

REFERENCE #: NWS-2013-1209

SHEET

L2

0 40' 80'

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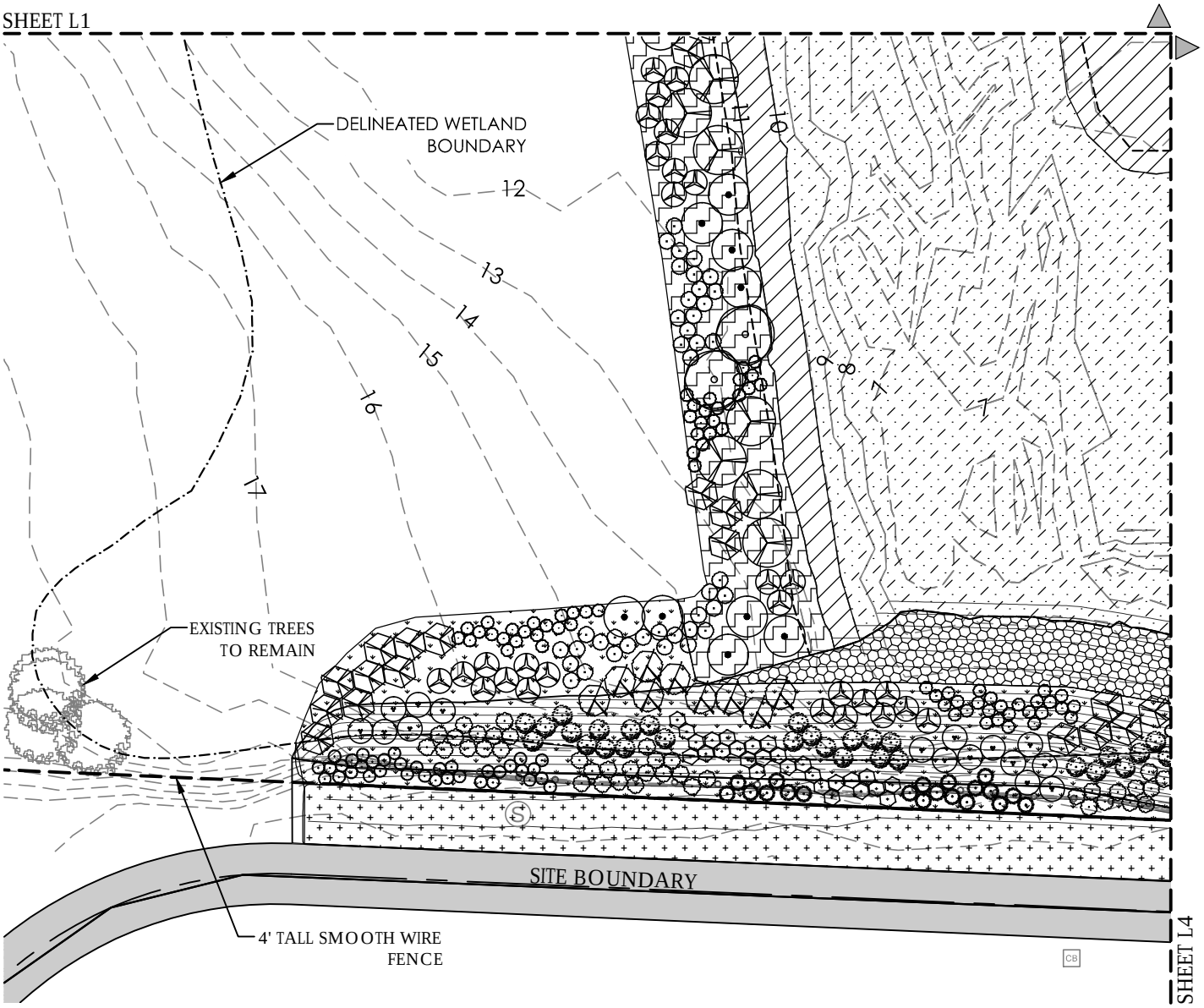

PERMIT DOCUMENT

MFA JOB #:	9003.01.40
ISSUE DATE:	01/29/2014
CHECKED:	J. ELLIOTT
DRAWN:	C. RILEY

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ENLARGED PLANTING PLAN 3

CARTY LAKE REMEDIAL ACTION

PORT OF RIDGEFIELD

RIDGEFIELD, WA

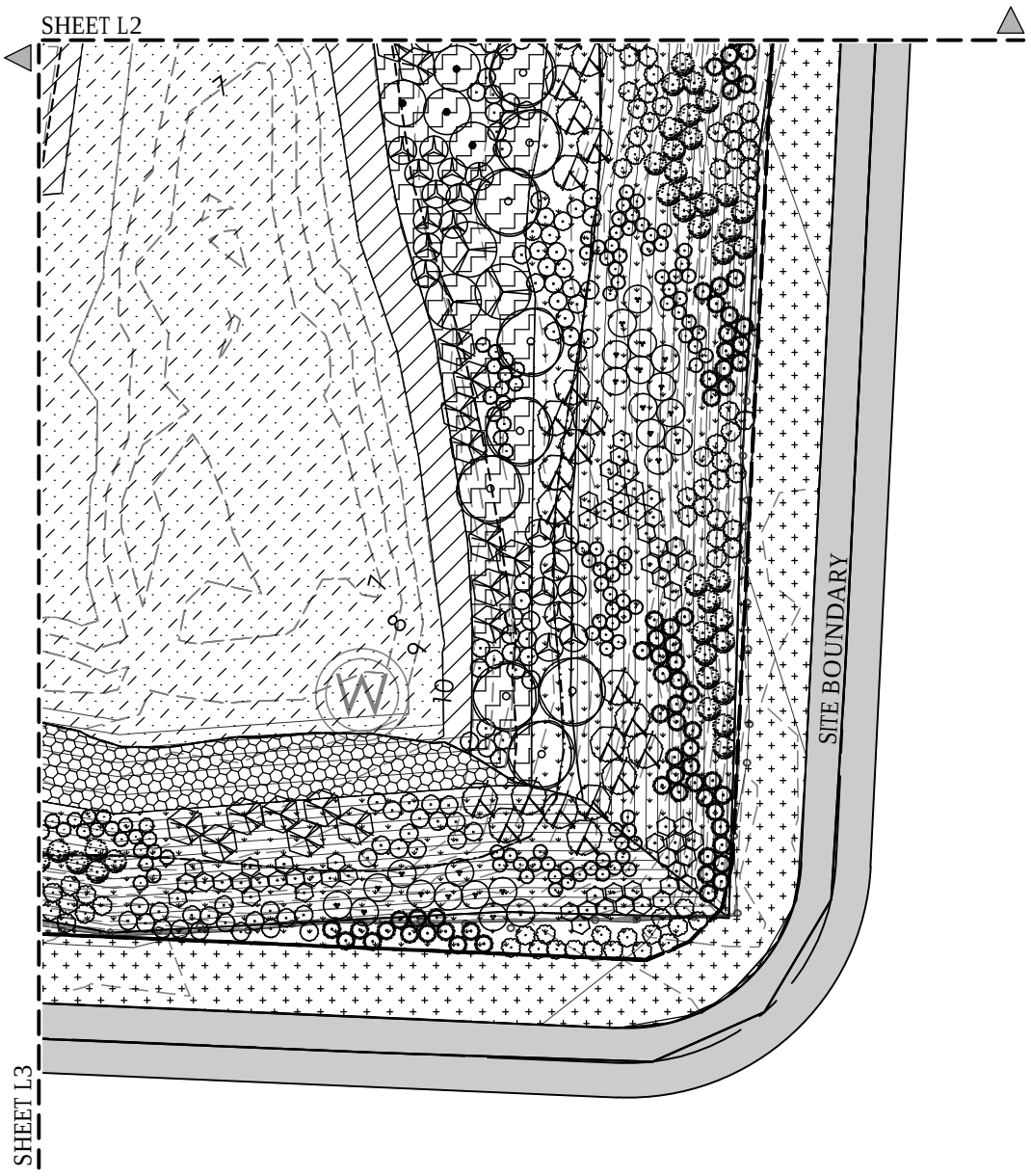
REFERENCE #: NWS-2013-1209

SHEET

L3

0 40' 80'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.



PERMIT DOCUMENT

MFA JOB #:	9003.01.40
ISSUE DATE:	01/29/2014
CHECKED:	J. ELLIOTT
DRAWN:	C. RILEY

MAUL FOSTER ALONGI
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ENLARGED PLANTING PLAN 4

CARTY LAKE REMEDIAL ACTION

PORT OF RIDGEFIELD

RIDGEFIELD, WA

REFERENCE #: NWS-2013-1209

SHEET

L4

APPENDIX E-4

MITIGATION BANK DOCUMENTATION

CLARK COUNTY MITIGATION PARTNERS

US Army Corps of Engineers
Mitigation Banking Specialist
Regulatory Branch
PO BOX 3755
Seattle, WA 98124-3755

WA Dept. of Ecology
Mitigation Banking Specialist
Shorelands and Environment Program
PO BOX 47600
Olympia, WA 98504-7600

US EPA
Aquatic Resources Unit
ETPA-083
1200 Sixth Ave
Seattle WA 98101

City of Vancouver
Community Planning
PO Box 1995
Vancouver, WA 98668-1995

Brent Grening
Port of Ridgefield
PO Box 55
Ridgefield, WA 98642

Notice is hereby given that on August 25, 2013 the Columbia River Wetland Mitigation Bank has transferred 0.276 wetland credits to The Port of Ridgefield.

These credits are to be applied to the following permits:

Issuing Regulatory Agency	Permit #	Issue Date
USACOE	NWS-2013-1209	August 19, 2014

Notice will be filed on the property title with the Clark County Auditor per the Mitigation Banking Agreement. The bank credit ledger has been updated.

Sincerely,

Victor Woodward
Manager
Columbia River Wetland Mitigation Bank

APPENDIX E-5

CARTY LAKE VEGETATION MONITORING

TECHNICAL MEMORANDUM

To:	Jim Carsner, U.S. Army Corps of Engineers	Date:	November 15, 2016
From:	Phil Wiescher, PhD, Maul Foster & Alongi, Inc.	Project:	NWS-2013-1209
RE:	Port of Ridgefield Carty Lake Remedial Action (NWS-2013-1209) Year 1 (2016) Vegetation Monitoring		

On behalf of the Port of Ridgefield, Maul Foster & Alongi, Inc. (MFA) has prepared this vegetation monitoring report consistent with the requirements of the U.S. Army Corps of Engineers (COE) Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake remedial action in Ridgefield, Washington. The remedial action addressed historical contamination of sediment in Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR) (see Figure 1). The remedial action was required by the Washington State Department of Ecology and included excavating contaminated sediment, placing clean sand to contain residual contamination, and removing a failing treated-wood retaining wall at the southern end of the lake. The wetland and upland banks were restored with native plants, consistent with the Carty Lake Mitigation Plan (CLMP).[1] The remediation work was completed in 2014 and restoration plantings were completed in 2015.

Carty Lake is a 52-acre lake in the RNWR. The southern end of Carty Lake was rated as a Category II lake fringe wetland in 2013. Before remediation, nonnative reed canary grass was ubiquitous and generally dominated the shoreline, forming dense monocultures; Himalayan blackberry was dominant along the former retaining wall and the southern end of the lake. The remediation work was conducted to meet sediment standards protective of ecological receptors. The mitigation approach was developed in consultation with the COE and the USFWS. Consistent with the CLMP, the short-term temporary construction impacts are mitigated by 1.2 acres of revegetation to be maintained in the excavation area (the mitigation area) (see Figure 1). The CLMP provides ecologically based performance standards for the mitigation area that will be used to determine whether the compensatory mitigation project is achieving its objectives. In addition, areas surrounding the mitigation area were revegetated and are maintained to impede nonnative species encroachment. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Permanent impacts associated with the construction of bank stabilization and remediation elements were mitigated by the purchase of

[1] MFA. Carty Lake mitigation plan, addendum to the Joint Aquatic Resources Permit Application No. NWS-2013-1209. Maul Foster & Alongi, Inc., January 30, 2014.

mitigation credits; associated documentation is provided in the Carty Lake Construction Completion Report (CLCR).[2]

Vegetation monitoring is to be conducted annually for five years (until 2020). Year 1 (2016) mitigation monitoring results for the on-site mitigation area are provided below, consistent with the requirements of NWS-2013-1209 special condition (e).

SITE MANAGEMENT ACTIVITIES

Paul Brothers, Inc. (PBI) of Boring, Oregon, performed the restoration and planting of the 1.2-acre mitigation area. Following completion of the remediation work in fall 2014, PBI began mobilizing their materials and equipment to the site to complete the site restoration and all associated plantings. Plants were installed as described in the CLCR. Installation of mitigation area submergent, emergent, and marginal vegetation began in winter 2014. Wildlife management fencing; cross-pattern, in-water string lines; and Mylar® strips were installed following the planting effort to protect the newly placed vegetation from grazing. Planting operations resumed in early 2015, when PBI began planting additional vegetation; however, planting was delayed in the marginal and upland transitional areas because of high water in Carty Lake. When water levels dropped to a manageable level for planting in spring 2015, PBI proceeded with installation of the remaining vegetation. This completed the mitigation area and upland planting efforts further described in the CLCR.[3] PBI maintained the planted areas during the summer months; this work included irrigation, removing invasive plants, removing plant collars as the plants grew beyond the confines of these protective barriers, and making irrigation system adjustments and repairs as needed. PBI removed the temporary isolation barrier (installed for conducting remediation and restoration work in the dry) in early September 2015; at that time, the water elevation in Carty Lake was well below the base of the barrier. The in-water perimeter fencing and cross-pattern, in-water string lines and stakes were also removed, as the vegetation had grown large enough to sustain itself. A temporary gravel access road to Carty Lake was removed in fall 2015, followed by the reseeding of all disturbed areas with the appropriate seed mixes.

MFA gave verbal notice of substantial completion to PBI at a site inspection in fall 2015.[4] Subsequently, MFA conducted site inspections (September 2015), which included walking the entire project site, documenting the condition of landscaping, weed infestations, and plant damage. At that time, PBI continued ongoing maintenance of invasive-plant removal and irrigation-system repair.

PERFORMANCE STANDARDS

As described in the CLMP, the performance standards for the on-site mitigation are as follows:

---

[2] MFA. Carty Lake construction completion report. Maul Foster & Alongi, Inc., November 17, 2015.

[3] Because plantings were not completed until 2015, instead of 2014 as anticipated in the CLMP, Year 1 monitoring was initiated in 2016 consistent with NWS-2013-1209 requirements (i.e., Year 1 monitoring to be conducted at least one year following completion of mitigation plantings).

[4] This does not include PBI's ongoing maintenance requirements, which include maintaining all planted areas through September 2017 in order to meet performance standards identified in the contract documents.

Performance Standard 1.1. *As shown by the proposed grading plan (Attachment 1 to the NWS-2013-1209 JARPA), the site will be graded to the proposed contours.*

This performance standard has been met as described in the CLCR.

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard for Year 1 is evaluated below.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

This performance standard for Year 1 is evaluated below.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard does not apply to this monitoring event; progress toward this standard is evaluated below.

COMPLIANCE MONITORING METHODOLOGY

On-site planting areas were monitored on August 23, 2016. Low water levels at this time of year facilitated site access and plant inspection. The goal of the monitoring inspection was to determine the survival rate of the installed plant material, to determine the extent of nonnative invasive plant encroachment, and to identify maintenance tasks that are required to meet the performance standards. The monitoring was performed by MFA ecologists and included:

- Establishing the identity and percent cover of native and invasive vegetation, using a point-line method; monitoring points at fixed intervals (approximately 10 feet) along three sampling transects spanning the on-site mitigation area were evaluated (see Figure 2). Transect A spans, predominantly, the submergent zone planting area (deeper water portion); Transect C spans, predominantly, the emergent zone; and Transect B spans both emergent and submergent zones. All transects include sampling units in the marginal zone. A portion of Transect C intersects a higher elevation "island" that is not part of the mitigation area; data were not collected in this area. Data were recorded for plants within 1 foot of the sampling units. Native percent cover for each transect was determined based on the number of times native vegetation was present at a sampling unit divided by the total number of units in a sampling transect. Invasive percent cover was determined in the same way.
- Establishing representative photodocumentation points to compare plant vigor/growth between monitoring inspections. The photos will be used during upcoming monitoring years

to assess the project's long-term success. Three photodocumentation points per habitat zone were identified as shown in Figure 2.

RESULTS

This is the first year of monitoring. Monitoring focused on plant identification and cover to provide management recommendations and to evaluate performance standards. Transect data are provided in the attached table and are discussed below with respect to the relevant performance standards.

In general, the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed and wapato (both culturally significant species) are widespread, and flowering wapato and American water plantain were observed. Limited invasive species encroachment from the surrounding upland areas was observed in the marginal zones. Invasive species were nearly absent in the emergent zones. In the submergent zones, invasive species (primarily the ubiquitous pond weed milfoil) were more frequently observed. Ducks, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions. A photo array for the mitigation area and photodocumentation points is attached.

CONCLUSIONS AND RECOMMENDATIONS

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

Areal cover for transects B and C (100 percent) is well above 20 percent for native species, and multiple species contribute to the cover observed. Areal cover for transect A is also 100 percent and is in part the result of the widespread presence of hornwort; other native species are less abundant. This may be related to water depths that exceed preferred growing conditions for some of the native species planted in the submergent zone. In addition to the wetland being deepened 0.5 feet at the request of USFWS to help limit reed canary grass encroachment seasonal fluctuations attributed to rainfall and stormwater runoff may be contributing to deeper open water areas. However, overall areal cover for the on-site mitigation area is 100 percent and meets the performance standard. No additional native plantings are warranted at this time.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

Areal cover for transects A (94 percent), B (78 percent), and C (40 percent) are above 20 percent for invasive species and the performance standard is not met at this time. This is due primarily to the presence of the pond weed Eurasian milfoil, which likely has encroached from Carty Lake to the north of the mitigation area. Eurasian milfoil is a common invasive present in much of the RNWR and was observed in Carty Lake immediately north of the mitigation area; existing USFWS budgets and staffing levels do not allow adequate acreage to be treated to control spreading of invasives such as

milfoil.[5] Eurasian watermilfoil can be mechanically controlled by raking or seining it from the water, but it can reestablish from any remaining fragments and roots. Chemical controls can be effective but their use would require coordination with the USFWS and evaluation of the potential for associated impacts (e.g., oxygen depletion after decomposition of the dead plant material). In both cases, it is likely that milfoil would reestablish over time because of its presence throughout the RNWR and in Carty Lake.

To meet performance standards, the planting contractor will manually remove invasives such as reed canary grass in the marginal zone and milfoil in the submergent zone as part of ongoing control measures. Isolated plants or small patches of reed canary grass will be removed by digging out and removing the entire root mass by hand. Care will be taken to remove all rhizomes and roots to reduce resprouting. Milfoil will be hand pulled from the wetland bottom with care taken to remove the entire root crown and not to create fragments.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard does not apply to this monitoring event. However, 13 native species were observed in the mitigation area. More than three species, including American water plantain, bur-reed, and wapato, occurred in more than 10 percent of the sampling units. These and other species also show more than 5 percent cover in a habitat zone (e.g., emergent zone). Therefore, progress toward this standard is being made.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

[5] USFWS. Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service, September 2010.

ATTACHMENTS

Table
Figures
Photographs

TABLE

Carty Lake Remedial Action (NWS-2013-1209)
Year 1 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	CARE	E.ACI	JUNC	NAGR	P. NAT	S.EME	S.LAS	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	M.SPI	P.ARU	P.CRI
			Native Species													Invasive Species		
A1	0	Marginal	X	X	X	X	X			X	X				X			
A2	1	Emergent							X			X	X			X		X
A3	2.5	Submergent											X			X		X
A4	2.5	Submergent											X			X		X
A5	2.5	Submergent										X	X			X		X
A6	2.5	Submergent											X			X		
A7	2	Submergent											X			X		
A8	1.5	Submergent											X			X		X
A9	2	Submergent											X			X		X
A10	2	Submergent											X			X		X
A11	2	Submergent											X			X		
A12	1.5	Submergent											X			X		X
A13	1.5	Submergent											X			X		X
A14	1.5	Submergent											X			X		
A15	2	Submergent											X			X		X
A16	1.5	Submergent											X			X		X
A17	1	Emergent											X			X		X
A18	0.5	Marginal						X	X			X	X		X	X		X
Native Percent Cover			100%															
Native Species Diversity			12															
Invasive Percent Cover			94%															
B1	0	Marginal		X	X	X				X							X	
B2	0	Marginal	X						X		X				X			
B3	1	Emergent							X			X				X		
B4	1.5	Submergent										X	X			X		X
B5	2	Submergent											X			X		
B6	2	Submergent											X			X		
B7	2	Submergent							X				X			X		
B8	2	Submergent							X				X			X		
B9	0.5	Emergent							X			X	X			X		
B10	0	Emergent	X						X		X							
B11	0	Emergent	X			X			X		X						X	
B12	0	Emergent							X									
B13	0.5	Emergent							X			X				X		
B14	1	Submergent										X	X			X		
B15	2.5	Submergent											X			X		X
B16	3	Submergent										X	X			X		
B17	1.5	Submergent										X	X			X		
B18	0	Marginal				X		X							X			
Native Percent Cover			100%															
Native Species Diversity			11															
Invasive Percent Cover			78%															

Carty Lake Remedial Action (NWS-2013-1209)
Year 1 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	CARE	E.ACI	JUNC	NAGR	P. NAT	S.EME	S.LAS	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	M.SPI	P.ARU	P.CRI
			Native Species													Invasive Species		
C1	0	Marginal	X		X	X	X											
C2	0.25	Marginal	X	X	X				X		X							
C3	0.25	Marginal	X						X		X				X			
C4	0.25	Emergent	X						X		X				X			
C5	0.25	Emergent	X						X		X				X			
C6	0.25	Emergent	X						X									
C7	0.5	Emergent							X			X						
C8	0.75	Emergent							X							X		
C9	1	Emergent							X			X						
C10	1	Emergent							X			X				X		X
C11	1	Emergent							X			X		X		X		
C12	1	Emergent						X	X									
C13	1	Emergent	X					X	X			X				X		
C14	0.5	Emergent	X	X					X		X						X	
C15	0.5	Emergent	X		X				X		X				X			
C16	0.5	Emergent	X						X									
C17	0.5	Emergent	X						X			X		X				
C18	1	Emergent							X			X		X		X		
C19	1	Emergent							X			X	X			X		
C20	0.5	Marginal	X						X		X	X				X		
Native Percent Cover			100%															
Native Species Diversity			12															
Invasive Percent Cover			40%															

Overall Mitigation Area Results	A.PLA	CARE	E.ACI	JUNC	NAGR	P. NAT	S.EME	S.LAS	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	M.SPI	P.ARU	P.CRI
Species Cover (All habitats)	29%	7%	9%	9%	4%	7%	54%	4%	20%	34%	50%	5%	14%	64%	5%	29%
Species Cover (Marginal zone)	67%	33%	44%	44%	22%	22%	56%	22%	56%	22%	11%	0%	56%	22%	11%	11%
Species Cover (Emergent zone)	42%	4%	4%	4%	0%	8%	96%	0%	25%	50%	17%	13%	13%	46%	8%	13%
Species Cover (Submergent zone)	0%	0%	0%	0%	0%	0%	9%	0%	0%	22%	100%	0%	0%	100%	0%	52%

NOTES:

Photodocumentation points shown in **bold.**

A.PLA	American water plantain
C.DEM	hornwort
CARE	Carex species
E.ACI	needle spikerush
E.CAN	Canadian waterweed
JUNC	Juncus species
L.MIN	duckweed
M.SPI	Eurasian watermilfoil
NAGR	native grass
P.ARU	reed canary grass
P.CRI	curlyleaf pondweed
P.NAT	floating leaf pondweed
S.EME	bur-reed
S.LAS	Pacific willow
S.LAT	wapato
T.LAT	broadleaf cattail

[a]Planting zone determinations are based on site observations and may differ slightly from the approximate planting zone boundaries shown in Figure 2.

[b]Native but listed in Whitson, T.D. (ed) et al., 2000. Weeds of the West (9th ed.). Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming, Laramie, Wyoming.
Native and invasive designations made according to USFWS (2010), Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

FIGURES

Source: Aerial photograph (2015) obtained from National Agriculture Imagery Program.

Legend

- Road
- Mitigation Site

Figure 1
Site Location

Port of Ridgefield
Ridgefield, Washington

0 390 780
Feet

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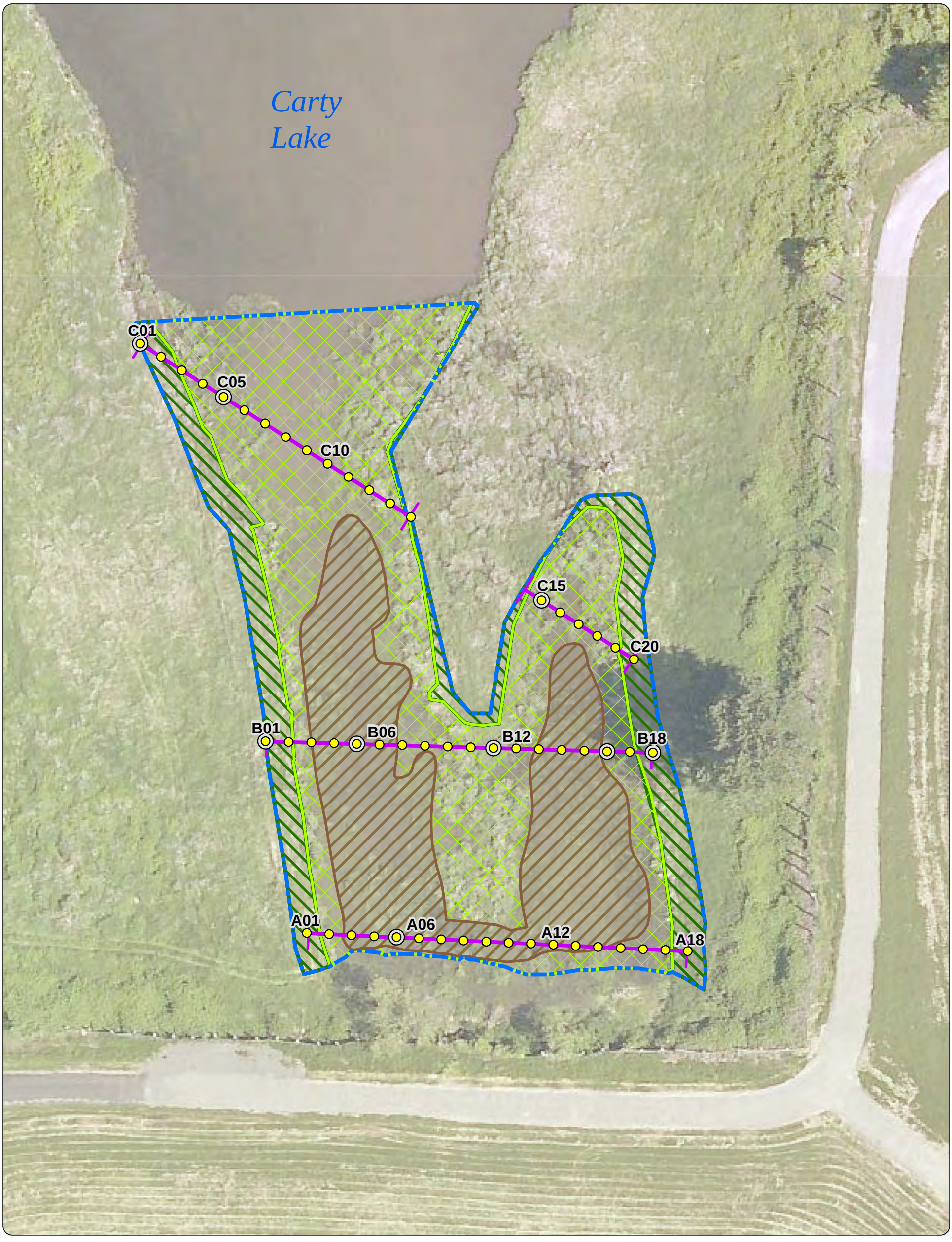
Project: 9003.01.40-06 Produced By: apadilla Approved By: P. Wiescher Print Date: 9/22/2016
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd

Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig2_Carty Lake Vegetation Transects.mxd



Source: Aerial photograph (2014) obtained from Clark County GIS.

Notes:
1. Aerial photo date precedes remediation and restoration activities occurring 2014 through 2015.
2. Vegetation group boundaries are approximate.

Legend

- Sample Location
- Sample Photo Documentation Point
- Mitigation Site
- Vegetation Transect

Vegetation Groups

- Marginal (Approx. Elev 10 to 11)
- Emergent (Approx. Elev 8 to 10)
- Submergent (Approx. Elev 8 and Below)

Figure 2 Carty Lake Vegetation Transects

Port of Ridgefield
Ridgefield, Washington

0 25 50
Feet

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Print Date: 9/22/2016
Approved By: P. Wescher
Produced By: apadilla
Project: 9003.01.40-06

PHOTOGRAPHS

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 1
Fall 2013. Mitigation area prior to remediation. Reed canary grass dominant vegetation. Looking northeast.

Photo No. 2
Winter 2014/15. Remediation area prior to plantings and temporary dam removal. Wildlife fencing installed. Looking northwest.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 3
August 2016. Mitigation area. Looking west.

Photo No. 4
August 2016. Mitigation area. Flowering wapato and bur-reed. Looking northeast.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 5
August 2016. South end of mitigation area. Looking north.

Photo No. 6
August 2016. Photo point C1. Marginal zone. Spikerush, Juncus, American water plantain, and grasses.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 7
August 2016. Photo point B1. Marginal zone. Spikerush, Juncus, Carex species, Pacific willow, and reed canary grass.

Photo No. 8
August 2016. Photo point B18. Marginal zone. Juncus, cattail, and floating leaf pondweed nearby.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 9
August 2016. Photo point C5. Emergent zone. Wapato, American water plantain, bur-reed, and cattail nearby.

Photo No. 10
August 2016. Photo point C15. Emergent zone. Wapato, American water plantain, bur-reed, spikerush, and cattail nearby.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 11
August 2016. Photo point B11. Emergent zone. Wapato, American water plantain, bur-reed, Juncus, and reed canary grass nearby.

Photo No. 12
August 2016. Photo point B5. Submergent zone. Hornwort and milfoil.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 13
August 2016. Photo point B16. Submergent zone. Hornwort, Canadian waterweed, and milfoil.

Photo No. 14
August 2016. Photo point A5. Submergent zone. Hornwort, Canadian waterweed, curlyleaf pondweed, and milfoil.

TECHNICAL MEMORANDUM

To:	Jim Carsner, U.S. Army Corps of Engineers	Date:	November 20, 2017
From:	Phil Wiescher, PhD, Maul Foster & Alongi, Inc.	Project:	NWS-2013-1209
RE:	Port of Ridgefield Carty Lake Remedial Action (NWS-2013-1209) Year 2 (2017) Vegetation Monitoring		

On behalf of the Port of Ridgefield, Maul Foster & Alongi, Inc. (MFA) has prepared this Year 2 (2017) vegetation monitoring report consistent with the requirements of the U.S. Army Corps of Engineers (COE) Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake remedial action in Ridgefield, Washington. The remedial action addressed historical contamination of sediment in Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR) (see Figure 1). The remedial action was required by the Washington State Department of Ecology (Ecology) and included excavating contaminated sediment, placing clean sand to contain residual contamination, and removing a failing treated-wood retaining wall at the southern end of the lake. The wetland and upland banks were restored with native plants, consistent with the Carty Lake Mitigation Plan (CLMP) (MFA, 2014). The remediation work was completed in 2014 and restoration plantings were completed in 2015.

In addition to the cleanup completed, the Ecology cleanup action plan requires restriction of fish consumption for protection of human health. As determined in coordination with Ecology, the Port of Ridgefield and the RNWR will enter into an agreement, such as a memorandum of understanding, stating that a fish consumption restriction will be incorporated into an interpretive center display that is under construction at the southern end of Carty Lake. Additional evaluations of the potential for impacts to human health from fish consumption may be necessary if Carty Lake is reconnected with the Columbia River in the future.

Carty Lake is a 52-acre lake in the RNWR. The southern end of Carty Lake was rated as a Category II lake fringe wetland in 2013. Before remediation, nonnative reed canary grass was ubiquitous and generally dominated the shoreline, forming dense monocultures; Himalayan blackberry was dominant along the former retaining wall and the southern end of the lake. The remediation work was conducted to meet sediment standards protective of ecological receptors. The mitigation approach was developed in consultation with the COE and the USFWS. Consistent with the CLMP, the short-term temporary construction impacts are mitigated by 1.2 acres of revegetation to be maintained in the excavation area (the mitigation area) (see Figure 1). The CLMP provides ecologically based performance standards for the mitigation area that will be used to determine

whether the compensatory mitigation project is achieving its objectives. In addition, areas surrounding the mitigation area were revegetated and are maintained to impede nonnative-species encroachment. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Permanent impacts associated with the construction of bank stabilization and remediation elements were mitigated by the purchase of mitigation credits; associated documentation is provided in the Carty Lake completion report (MFA, 2015).

Monitoring of the mitigation area is to be conducted annually for five years (until 2020). Year 1 (2016) mitigation monitoring was conducted in summer 2016, with results provided in the November 2016 monitoring report submitted to the COE (MFA, 2016). In brief, the 2016 report concluded that the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones, and limited invasive-species encroachment was observed in the marginal and emergent zones. In the submergent zones, invasive species (primarily the ubiquitous pond weed Eurasian milfoil) were more frequently observed. The performance standard for plant areal cover was met for the mitigation area, while the invasive species performance standard was not met, primarily because of presence of milfoil in the submergent zone.

The Year 2 (2017) mitigation monitoring results for the on-site mitigation area are provided below, consistent with the requirements of NWS-2013-1209 special condition (e).

SITE MANAGEMENT ACTIVITIES

Paul Brothers, Inc. (PBI) of Boring, Oregon, performed the restoration and planting of the 1.2-acre mitigation area. Plants were installed as described in the Carty Lake completion report (MFA, 2015).[1] MFA gave verbal notice of substantial completion to PBI at a site inspection in fall 2015.[2]

At that time, PBI continued ongoing maintenance of invasive-plant removal and irrigation-system repair. Following the 2016 site monitoring, MFA provided the 2016 monitoring report to PBI, informing them that some invasive-species control would be necessary to meet the associated performance standard. In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) are necessary to meet maintenance requirements; PBI recommended conducting fall/winter 2017 replacement plantings to optimize plant establishment. Invasive species in the mitigation area marginal and emergent zones (i.e., primarily reed canary grass) will be removed as part of these 2017 activities. Because milfoil is ubiquitous throughout Carty Lake/RNWR, and can quickly spread and recolonize from fragments, milfoil was not removed from the submergent zones. MFA recommends not removing milfoil, as this would, at best, result in temporary, short-term improvement at significant effort and cost. Further removal may result in fragmentation and additional spreading of milfoil. Long-term control of milfoil would

[1] Because plantings were not completed until 2015, instead of in 2014 as anticipated in the CLMP, Year 1 monitoring was initiated in 2016, consistent with NWS-2013-1209 requirements (i.e., Year 1 monitoring to be conducted at least one year following completion of mitigation plantings).

[2] This does not include PBI's ongoing maintenance requirements, which include maintaining all planted areas through October 2018 in order to meet performance standards identified in the contract documents.

best be achieved if milfoil were treated throughout Carty Lake; however, existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading in the lake (USFWS, 2010). The Year 2 (2017) mitigation monitoring results provided below reflect conditions prior to removal of invasives (primarily reed canary grass) in the marginal and emergent zones.

PERFORMANCE STANDARDS

As described in the CLMP, the performance standards for the on-site mitigation are as follows:

Performance Standard 1.1. *As shown by the proposed grading plan (Attachment 1 to the NWS-2013-1209 JARPA), the site will be graded to the proposed contours.*

This performance standard has been met as described in the Carty Lake construction completion report (MFA, 2015).

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard does not apply to this monitoring event; progress toward this standard is evaluated below.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

This performance standard for Year 2 is evaluated below.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard does not apply to this monitoring event; progress toward this standard is evaluated below.

COMPLIANCE MONITORING METHODOLOGY

On-site planting areas were monitored on September 28, 2017. Low water levels at this time of year facilitated site access and plant inspection. The goal of the monitoring inspection was to determine the areal cover of native plants and the extent of nonnative invasive plant encroachment, and to identify maintenance tasks that are required in order to meet the performance standards. The monitoring was performed by MFA staff consistent with the 2016 methodology and included:

- Establishing the identity and percent cover of native and invasive vegetation, using a point-line method; monitoring points at fixed intervals (approximately 10 feet) along three sampling transects spanning the on-site mitigation area were established in 2016 and were reevaluated (see Figure 2). Transect A spans, predominantly, the submergent

zone planting area (deeper water portion); Transect C spans, predominantly, the emergent zone; and Transect B spans both emergent and submergent zones. All transects include sampling units in the marginal zone. A portion of Transect C intersects a higher elevation "island" that is not part of the mitigation area; data were not collected in this area. Data were recorded for plants within approximately 1 foot of the sampling units. Native percent cover for each transect was determined based on the number of times native vegetation was present at a sampling unit divided by the total number of units in a sampling transect. Invasive percent cover was determined in the same way. Points were navigated to using a handheld GPS unit.

- Photodocumentation points document conditions and compare plant vigor/growth between monitoring inspections. Three photodocumentation points per habitat zone were identified, as shown in Figure 2.

RESULTS

This is the second year of monitoring. Monitoring focused on plant identification and cover to provide management recommendations and to evaluate performance standards. Transect data are provided in the attached table and are discussed below with respect to the relevant performance standards.

In general, the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed, wapato (both culturally significant species), American water plantain, spikerush, and sedges are widespread. Limited invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, native algae, hornwort, and duckweed were common, and invasive species (primarily the ubiquitous pond weed milfoil) were frequently observed. Ducks, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions, and as a whole, the area appears to have naturalized. For example, other native species (nodding beggartick flower) that were not planted and were not observed during Year 1 monitoring were observed in Year 2. A photo array for the mitigation area and photodocumentation points is attached.

CONCLUSIONS AND RECOMMENDATIONS

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard does not apply to this monitoring event. However, 16 native species were observed in the mitigation area and 100 percent native areal cover was observed in all transects. Therefore, progress toward this standard is being made.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

Areal cover for transects A (100 percent), B (94 percent), and C (90 percent) are above 20 percent for invasive species, and the performance standard is not met at this time. This is due primarily to the presence of the pond weed Eurasian milfoil, which has encroached from Carty Lake to the north of the mitigation area. Eurasian milfoil is a common invasive present in much of the RNWR and was observed in Carty Lake immediately north of the mitigation area; existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading of invasives such as milfoil (USFWS, 2010). Eurasian milfoil can be controlled by raking or seining it from the water, but it can reestablish from any remaining fragments and roots, and these activities can lead to further spreading. Chemical controls can be effective but their use would require coordination with the USFWS and evaluation of the potential for associated impacts (e.g., oxygen depletion after decomposition of the dead plant material). In both cases, it is likely that milfoil would reestablish quickly because of its presence throughout the RNWR and in Carty Lake.

To meet performance standards, PBI will manually remove invasives such as reed canary grass in the marginal zone as part of ongoing control measures. Isolated plants and small patches of reed canary grass will be removed by digging out and removing the entire root mass by hand. Care will be taken to remove all rhizomes and roots to reduce resprouting. MFA recommends not removing milfoil, as this would, at best, result in temporary, short-term improvement at significant effort and cost. Further removal may result in additional spreading of milfoil. Long-term control of milfoil would best be achieved if milfoil were treated throughout Carty Lake; however, existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading in the lake (USFWS, 2010).

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard does not apply to this monitoring event. However, 16 native species were observed in the mitigation area. More than three species, including American water plantain, spikerush, bur-reed, and wapato, occurred in more than 10 percent of the sampling units. These and other species also show more than 5 percent cover in a habitat zone (e.g., marginal zone). Therefore, progress toward this standard is being made.

In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) will be installed this winter (December 2017 through January 2018) as part of the maintenance contract with PBI. While conducting the annual monitoring, MFA observed a greater survival rate with specific plant varieties. The information collected, along with the coordinated efforts with local native nurseries, has led to MFA's selection of hardy native upland plants. The proposed plant list for replanting includes the following species: bald hip rose *(Rosa gymnocarpa),* Nootka rose *(Rosa nutkana),* Indian plum *(Oemleria cerasiformis),* salmonberry *(Rubus spectabilis),* thimbleberry *(Rubus parviflorus),* Douglas spiraea *(Spiraea douglasii),* willow species *(Salix spp.),* and serviceberry *(Amelanchier alnifolia).* As bare root and seedling plants become available from

nurseries in December 2017, PBI will immediately proceed with replanting as directed by MFA to meet the performance standards per the contract.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

MFA. 2014. Carty Lake mitigation plan, addendum to the Joint Aquatic Resources Permit Application No. NWS-2013-1209. Maul Foster & Alongi, Inc. January 30.

MFA. 2015. Carty Lake construction completion report. Maul Foster & Alongi, Inc. November 17.

MFA. 2016. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 1 (2016) vegetation monitoring. Maul Foster & Alongi, Inc. November 11.

USFWS. 2010. Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

ATTACHMENTS

Table
Figures
Photographs

TABLE

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 2 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																Invasive Species			
A1	0	Marginal			X	X	X	X		X	X	X				X		X			X	
A2	0	Emergent		X						X	X	X	X	X	X	X	X		X			
A3	1.5	Submergent											X	X	X		X		X			
A4	2	Submergent											X	X	X		X		X			
A5	2	Submergent											X	X	X		X		X			
A6	2	Submergent											X	X	X		X		X			
A7	1.5	Submergent											X	X	X		X		X			
A8	1	Submergent											X	X	X		X		X			
A9	1.5	Submergent											X	X	X		X		X			
A10	1.5	Submergent											X	X	X		X		X			X
A11	1.5	Submergent											X	X	X		X		X			
A12	1	Submergent											X	X	X		X		X			X
A13	1	Submergent											X	X	X		X		X			X
A14	1	Submergent											X	X	X		X		X			
A15	1.5	Submergent											X	X	X		X		X			X
A16	1	Submergent											X	X	X		X		X			X
A17	0.5	Emergent											X	X	X	X	X		X			X
A18	0	Marginal					X		X							X		X		X	X	X
Native Percent Cover			100%																			
Native Species Diversity			15																			
Invasive Percent Cover			100%																			
B1	0	Marginal	X		X	X	X				X	X				X		X			X	
B2	0	Marginal	X			X				X		X				X						
B3	0.5	Emergent											X	X	X		X		X			
B4	1	Submergent											X	X	X		X		X			
B5	1.5	Submergent											X	X	X		X		X			
B6	1.5	Submergent											X	X	X		X		X			
B7	1.5	Submergent											X	X	X		X		X			
B8	1.5	Submergent											X	X	X		X		X			
B9	0.5	Emergent								X			X						X			
B10	0	Emergent				X				X		X	X							X		
B11	0	Emergent				X				X										X	X	
B12	0.5	Emergent								X			X	X	X		X		X			
B13	1	Emergent											X	X	X				X			
B14	1	Submergent											X	X	X				X			
B15	2	Submergent											X	X	X		X		X			
B16	2.5	Submergent											X	X	X		X		X			
B17	1	Submergent											X	X	X		X		X		X	
B18	0	Marginal	X			X	X				X					X		X			X	
Native Percent Cover			100%																			
Native Species Diversity			13																			
Invasive Percent Cover			94%																			

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 2 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																Invasive Species			
C1	0	Marginal				X	X	X			X							X			X	
C2	0	Marginal	X		X	X	X	X		X	X	X				X		X			X	
C3	0	Marginal	X							X		X				X						
C4	0	Emergent								X		X				X						
C5	0.25	Emergent								X		X	X			X			X			
C6	0.25	Emergent								X		X					X		X			
C7	0.5	Emergent										X	X		X				X			
C8	0.5	Emergent											X		X		X		X			
C9	1	Emergent											X		X		X		X			
C10	1	Emergent								X			X		X		X		X			
C11	1	Emergent								X			X		X		X		X			
C12	1	Emergent				X	X			X		X			X		X		X			
C13	1	Emergent				X	X			X	X	X						X	X			
C14	0	Emergent			X	X	X	X				X						X			X	
C15	0	Emergent	X			X				X		X				X					X	
C16	0.5	Emergent								X			X		X		X		X			
C17	0.5	Emergent								X			X		X		X		X			
C18	0.5	Emergent								X			X		X		X		X			
C19	0.5	Emergent					X			X			X		X	X	X		X			
C20	0	Marginal	X					X		X		X				X					X	
Native Percent Cover			100%																			
Native Species Diversity			13																			
Invasive Percent Cover			90%																			

Overall Mitigation Area Results	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
Species Cover (All habitats)	13%	2%	7%	21%	18%	9%	2%	39%	13%	29%	71%	50%	68%	25%	64%	14%	75%	5%	20%	13%
Species Cover (Marginal zone)	67%	0%	33%	67%	67%	44%	11%	56%	56%	67%	0%	0%	0%	89%	0%	67%	0%	11%	78%	11%
Species Cover (Emergent zone)	4%	4%	4%	25%	17%	4%	0%	71%	8%	42%	71%	21%	63%	25%	58%	8%	79%	8%	13%	4%
Species Cover (Submergent zone)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	0%	96%	0%	100%	0%	4%	22%

NOTES:

Photodocumentation points shown in **bold.**

A.PLA	American water plantain
B.CER	nodding beggartick flower
C.DEM	hornwort
CARE	*Carex* species
E. SP	*Eleocharis* species (spikerush)
E.CAN	Canadian waterweed
EQ. SP	*Equisetum* species (horsetail reed)
JUNC	*Juncus* species
L.MIN	duckweed
M.SPI	Eurasian watermilfoil
NA	native algae
NAGR	native grass
P.ARU	reed canary grass
P.CRI	curlyleaf pondweed
P.NAT	floating leaf pondweed
R.CRI	curly dock
S.EME	bur-reed
S.LAT	wapato
S.SP	*Salix* species (willow)
T.LAT	broadleaf cattail

[a]Planting zone determinations are based on site observations and may differ slightly from the approximate planting zone boundaries shown in Figure 2.

[b]Native but listed in Whitson, T.D. (ed) et al., 2000. Weeds of the West (9th edition). Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming, Laramie, Wyoming.

Native and invasive designations made according to USFWS (2010), Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

FIGURES

Source: Aerial photograph (2015) obtained from National Agriculture Imagery Program.

Legend

- Road
- Mitigation Site

Figure 1
Site Location

Port of Ridgefield
Ridgefield, Washington

0 390 780
Feet

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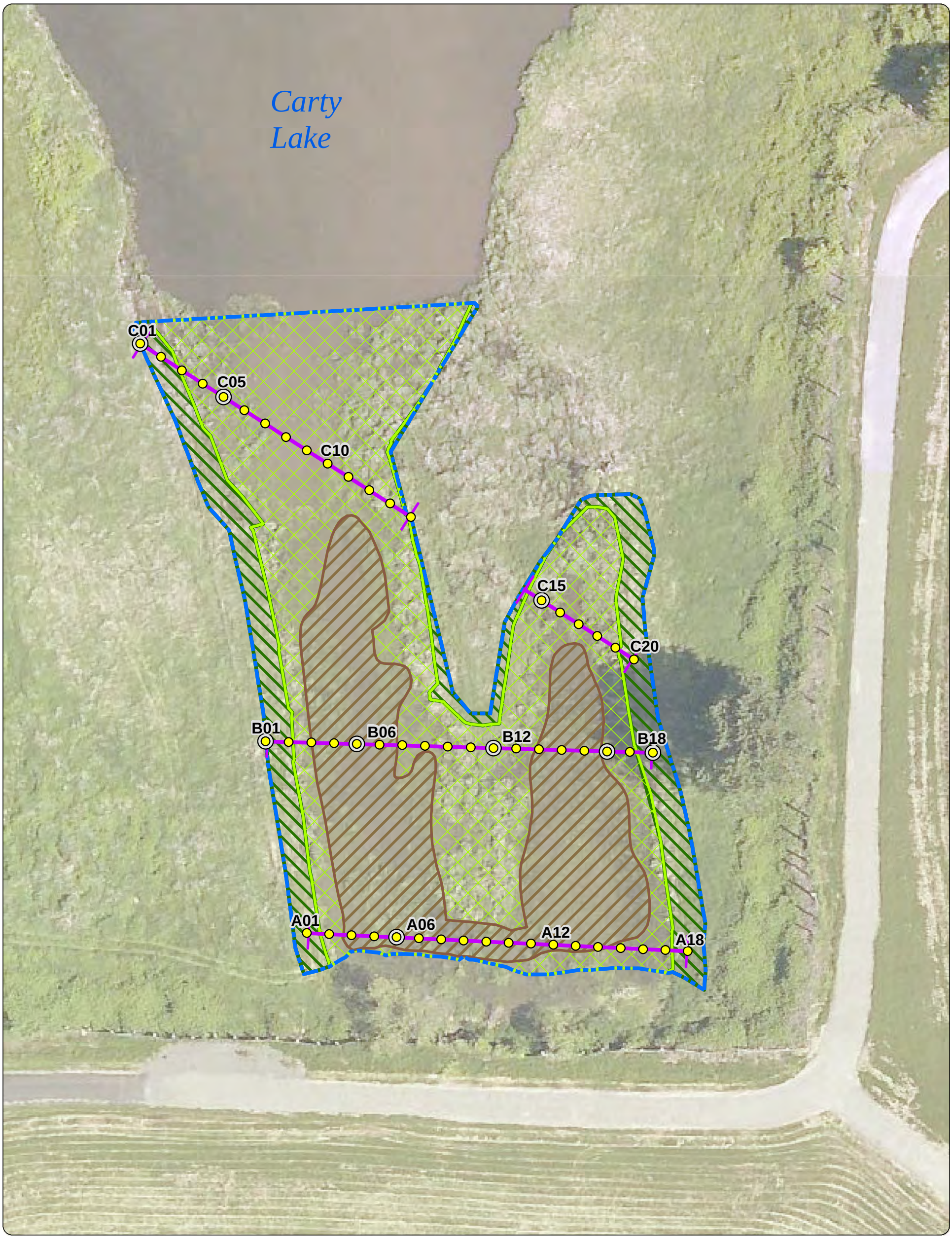
Project: 9003.01.40-06 Produced By: apadilla Approved By: P. Wiescher Print Date: 9/22/2016
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd

Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig2_Carty Lake Vegetation Transects.mxd



Source: Aerial photograph (2014) obtained from Clark County GIS.

Notes:
1. Aerial photo date precedes remediation and restoration activities occurring 2014 through 2015.
2. Vegetation group boundaries are approximate.

Legend

- Sample Location
- Sample Photo Documentation Point
- Mitigation Site
- Vegetation Transect

Vegetation Groups

- Marginal (Approx. Elev 10 to 11)
- Emergent (Approx. Elev 8 to 10)
- Submergent (Approx. Elev 8 and Below)

Figure 2 Carty Lake Vegetation Transects

Port of Ridgefield
Ridgefield, Washington

0 25 50
Feet

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Print Date: 9/22/2016
Approved By: P. Wescher
Produced By: apadilla
Project: 9003.01.40-06

PHOTOGRAPHS

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 1
Fall 2013.
Mitigation area before remediation. Reed canary grass is dominant vegetation. Looking northeast.

Photo No. 2
Winter 2014/15.
Remediation area prior to plantings and temporary dam removal. Wildlife fencing installed. Looking northwest.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 3
August 2016.
Mitigation area.
Looking west.

Photo No. 4
August 2016.
Mitigation area.
Flowering wapato and bur-reed.
Looking northeast.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 5
August 2016.
South end of mitigation area.
Looking north.

Photo No. 6
September 2017.
North end of mitigation area.
Looking southeast.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 7
September 2017. Photo point C1. Marginal zone. Salix species, spikerush, Juncus, nodding beggartick, and reed canary grass observed in vicinity.

Photo No. 8
September 2017. Photo point B1. Marginal zone. American water plantain, spikerush, Salix species, Juncus, sedges, wapato, cattail, nodding beggartick, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 9
September 2017.
Photo point B18.
Marginal zone.
American water plantain, spikerush, Juncus, Salix species, cattail, nodding beggartick, and reed canary grass observed in vicinity.

Photo No. 10
September 2017.
Photo point C5.
Emergent zone.
Bur-reed, wapato, Canadian waterweed, cattail, and Eurasian watermilfoil observed in vicinity.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 11
September 2017.
Photo point C15.
Emergent zone.
American water plantain, spikerush, bur-reed, wapato, cattail, and reed canary grass observed in vicinity.

Photo No. 12
September 2017.
Photo point B11.
Emergent zone.
Spikerush, bur-reed, curly dock, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 13
September 2017.
Photo point B5.
Submergent zone.
Canadian waterweed, hornwort, duckweed, native algae, and Eurasian watermilfoil.

Photo No. 14
September 2017.
Photo point B16.
Submergent zone.
Canadian waterweed, hornwort, duckweed, native algae, and Eurasian watermilfoil.

PHOTOGRAPHS

Project: NWS-2013-1209
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 15
September 2017. Photo point A5. Submergent zone. Hornwort, Canadian waterweed, duckweed, native algae, and Eurasian watermilfoil.

TECHNICAL MEMORANDUM

To:	Jim Carsner, U.S. Army Corps of Engineers	Date:	December 13, 2018
From:	Phil Wiescher, PhD, Maul Foster & Alongi, Inc.	Project:	NWS-2013-1209
RE:	Port of Ridgefield Carty Lake Remedial Action (NWS-2013-1209) Year 3 (2018) Vegetation Monitoring		

On behalf of the Port of Ridgefield, Maul Foster & Alongi, Inc. (MFA) has prepared this Year 3 (2018) vegetation monitoring report consistent with the requirements of the U.S. Army Corps of Engineers (COE) Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake remedial action in Ridgefield, Washington. The remedial action addressed historical contamination of sediment in Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR) (see Figure 1). The remedial action was required by the Washington State Department of Ecology (Ecology) and included excavating contaminated sediment, placing clean sand to contain residual contamination, and removing a failing treated-wood retaining wall at the southern end of the lake. The wetland and upland banks were restored with native plants, consistent with the Carty Lake Mitigation Plan (CLMP) (MFA, 2014). The remediation work was completed in 2014 and restoration plantings were completed in 2015.

In addition to the cleanup completed, the Ecology cleanup action plan requires restriction of fish consumption for protection of human health. As determined in coordination with Ecology, the Port of Ridgefield and the RNWR will enter into an agreement, such as a memorandum of understanding, stating that a fish consumption restriction will be incorporated into an interpretive center display that is under construction at the southern end of Carty Lake. Additional evaluations of the potential for impacts to human health from fish consumption may be necessary if Carty Lake is reconnected with the Columbia River in the future.

Carty Lake is a 52-acre lake in the RNWR. The southern end of Carty Lake was rated as a Category II lake fringe wetland in 2013. Before remediation, nonnative reed canary grass was ubiquitous and generally dominated the shoreline, forming dense monocultures; Himalayan blackberry was dominant along the former retaining wall and the southern end of the lake. The remediation work was conducted to meet sediment standards protective of ecological receptors. The mitigation approach was developed in consultation with the COE and the USFWS. Consistent with the CLMP, the short-term temporary construction impacts are mitigated by 1.2 acres of revegetation to be maintained in the excavation area (the mitigation area) (see Figure 1). The CLMP provides ecologically based performance standards for the mitigation area that will be used to determine whether the compensatory mitigation

project is achieving its objectives. In addition, areas surrounding the mitigation area were revegetated and are maintained to impede nonnative-species encroachment. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Permanent impacts associated with the construction of bank stabilization and remediation elements were mitigated by the purchase of mitigation credits; associated documentation is provided in the Carty Lake completion report (MFA, 2015).

Monitoring of the mitigation area is to be conducted annually for five years (until 2020). Year 1 (2016) mitigation monitoring was conducted in summer 2016, with results provided in the November 2016 monitoring report submitted to the COE (MFA, 2016). In brief, the 2016 report concluded that the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones, and limited invasive-species encroachment was observed in the marginal and emergent zones. In the submergent zones, invasive species (primarily the ubiquitous pond weed Eurasian milfoil) were more frequently observed. The performance standard for plant areal cover was met for the mitigation area, while the invasive species performance standard was not met, primarily because of the presence of milfoil in the submergent zone.

In general, the Year 2 (2017) mitigation monitoring report for the on-site mitigation area concluded that the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed, wapato (both culturally significant species), American water plantain, spikerush, and sedges are widespread. Limited invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, native algae, hornwort, and duckweed were common, and invasive species (primarily the ubiquitous pond weed milfoil) were frequently observed. Ducks, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions, and as a whole, the area appears to have naturalized. For example, other native species (nodding beggartick flower) that were not planted and were not observed during Year 1 monitoring were observed in Year 2.

The Year 3 (2018) mitigation monitoring results for the on-site mitigation area are provided below, consistent with the requirements of NWS-2013-1209 special condition (e).

SITE MANAGEMENT ACTIVITIES

Paul Brothers, Inc. (PBI), of Boring, Oregon, restored and planted the 1.2-acre mitigation area. Plants were installed as described in the Carty Lake completion report (MFA, 2015).[1] MFA gave PBI verbal notice of substantial completion at a site inspection in fall 2015.[2]

[1] Because plantings were not completed until 2015, instead of in 2014 as anticipated in the CLMP, Year 1 monitoring was initiated in 2016, consistent with NWS-2013-1209 requirements (i.e., Year 1 monitoring to be conducted at least one year following completion of mitigation plantings).

[2] This does not include PBI's ongoing maintenance requirements, which include maintaining all planted areas through October 2018 in order to meet performance standards identified in the contract documents.

At that time, PBI continued ongoing maintenance of invasive-plant removal and irrigation-system repair. Following the 2016 site monitoring, MFA provided the 2016 monitoring report to PBI, informing them that some invasive-species control would be necessary to meet the associated performance standard. In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) were necessary to meet maintenance requirements; PBI conducted fall/winter 2017 replacement plantings to optimize plant establishment. The replanting list included the following species: bald hip rose *(Rosa gymnocarpa),* Nootka rose *(Rosa nutkana),* Indian plum *(Oemleria cerasiformis),* salmonberry *(Rubus spectabilis),* thimbleberry *(Rubus parviflorus),* Douglas spiraea *(Spiraea douglasii),* willow species *(Salix spp.),* and serviceberry *(Amelanchier alnifolia)*. Invasive species in the mitigation area marginal and emergent zones (i.e., primarily reed canary grass) were removed as part of these 2017 activities.

In spring 2018, Sound Native Plants (SNP), of Olympia, Washington, continued vegetation management with mowing, cutting, and hand pulling competing vegetation; controlling invasive species; and operating/repairing the irrigation system. SNP conducted six irrigation/maintenance visits from April through September 2018 to manually turn on the aboveground irrigation system and manage vegetation as needed. Invasive species in the mitigation area and the marginal and emergent zones (i.e., primarily reed canary grass) were removed as part of these 2018 activities. In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) will be installed this winter/spring (December 2018 through March 2019) as part of the maintenance contract with SNP.

The Year 3 (2018) mitigation monitoring results are provided below.

PERFORMANCE STANDARDS

As described in the CLMP, the performance standards for the on-site mitigation are as follows:

Performance Standard 1.1. *As shown by the proposed grading plan (Attachment 1 to the NWS-2013-1209 JARPA), the site will be graded to the proposed contours.*

This performance standard has been met as described in the Carty Lake construction completion report (MFA, 2015).

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard for Year 3 is evaluated below.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

This performance standard for Year 3 is evaluated below.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard for Year 3 is evaluated below.

COMPLIANCE MONITORING METHODOLOGY

On-site planting areas were monitored on September 20, 2018. Low water levels at this time of year facilitated site access and plant inspection. The goal of the monitoring inspection was to determine the areal cover of native plants and the extent of nonnative, invasive plant encroachment, and to identify maintenance tasks that are required in order to meet the performance standards. The monitoring, performed by MFA staff consistent with the 2016 methodology, included:

- Establishing the identity and percent cover of native and invasive vegetation, using a point-line method; monitoring points established in 2016 at fixed intervals (approximately 10 feet) along three sampling transects spanning the on-site mitigation area were reevaluated (see Figure 2). Transect A spans, predominantly, the submergent zone planting area (deeper water portion); Transect C spans, predominantly, the emergent zone; and Transect B spans both emergent and submergent zones. All transects include sampling units in the marginal zone. A portion of Transect C intersects a higher elevation "island" that is not part of the mitigation area; data were not collected in this area. Data were recorded for plants within approximately 1 foot of the sampling units. Native percent cover for each transect was determined based on the number of times native vegetation was present at a sampling unit divided by the total number of units in a sampling transect. Invasive percent cover was determined in the same way. A handheld GPS unit was used to navigate to points.
- Photodocumentation points document conditions and compare plant vigor/growth between monitoring inspections. Three photodocumentation points per habitat zone were identified, as shown in Figure 2.

RESULTS

This is the third year of monitoring. Monitoring focused on plant identification and cover to provide management recommendations and to evaluate performance standards. Transect data are provided in the attached table and are discussed below with respect to the relevant performance standards.

In general, the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed, wapato (both culturally significant species), rush, spikerush, and sedges are widespread. Limited invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, native algae, hornwort, and duckweed were common, and invasive species (primarily the ubiquitous pond weed milfoil) were frequently observed. Blue heron, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions, and as a whole, the

area appears to have naturalized. For example, other native species (nodding beggartick flower and waterpepper) that were not planted and were not observed during Year 1 monitoring were observed in Years 2 and 3. A photo array for the mitigation area, including photodocumentation points, is attached.

CONCLUSIONS AND RECOMMENDATIONS

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

Fifteen native species were observed in the mitigation area and 100 percent native areal cover was observed in all transects. Therefore, this performance standard is met.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

Areal cover for transects A (94 percent), B (89 percent), and C (75 percent) are above 20 percent for invasive species, and the performance standard is not met at this time. This is due primarily to the presence of the pond weed Eurasian milfoil, which has encroached from Carty Lake to the north of the mitigation area. Eurasian milfoil is a common invasive present in much of the RNWR and was observed in Carty Lake immediately north of the mitigation area; existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading of invasives such as milfoil (USFWS, 2010). Eurasian milfoil can be controlled by raking or seining it from the water, but it can reestablish from any remaining fragments and roots, and these activities can lead to further spreading. Chemical controls can be effective but their use would require coordination with the USFWS and evaluation of the potential for associated impacts (e.g., oxygen depletion after decomposition of the dead plant material). In both cases, it is extremely likely that milfoil would reestablish quickly because of its presence throughout the RNWR and in Carty Lake.

To progress toward the performance standard, SNP will manually remove invasives such as reed canary grass in the marginal zone as part of ongoing control measures. Isolated plants and small patches of reed canary grass will be removed by digging out and removing the entire root mass by hand. To reduce resprouting, care will be taken to remove all rhizomes and roots. MFA recommends not removing milfoil, as this would, at best, result in temporary, short-term improvement at significant effort and cost. Further removal may result in additional spreading of milfoil. Long-term control of milfoil would best be achieved if milfoil were treated throughout Carty Lake; however, existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading in the lake (USFWS, 2010).

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

Fifteen native species were observed in the mitigation area. More than three species, including rush, spikerush, waterpepper, and wapato, occurred in more than 10 percent of the sampling units. These and other species also show more than 5 percent cover in a habitat zone (e.g., marginal zone). Therefore, this performance standard is being met.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

MFA. 2014. Carty Lake mitigation plan, addendum to the Joint Aquatic Resources Permit Application No. NWS-2013-1209. Maul Foster & Alongi, Inc. January 30.

MFA. 2015. Carty Lake construction completion report. Maul Foster & Alongi, Inc. November 17.

MFA. 2016. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 1 (2016) vegetation monitoring. Maul Foster & Alongi, Inc. November 11.

USFWS. 2010. Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

ATTACHMENTS

Table
Figures
Photographs

TABLE

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 3 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																	Invasive Species			
A1	0	Marginal			X	X	X	X			X	X	X				X		X			X	
A2	0	Emergent				X				X	X		X				X						
A3	1.5	Submergent												X	X	X		X		X			
A4	2	Submergent												X	X	X		X		X			
A5	2	Submergent												X	X	X		X		X			
A6	2	Submergent								`				X	X	X		X		X			
A7	1.5	Submergent												X	X	X		X		X			
A8	1	Submergent												X	X	X		X		X			
A9	1.5	Submergent												X	X	X		X		X			
A10	1.5	Submergent												X	X	X		X		X			
A11	1.5	Submergent												X	X	X		X		X			
A12	1	Submergent												X	X	X		X		X			
A13	1	Submergent									X			X	X	X		X		X			
A14	1	Submergent												X	X	X		X		X			
A15	1.5	Submergent												X	X	X		X		X			
A16	1	Submergent												X		X		X		X			
A17	0.5	Emergent												X		X	X	X		X			
A18	0	Marginal				X	X				X						X		X			X	
Native Percent Cover			100%																				
Native Species Diversity			14																				
Invasive Percent Cover			94%																				
B1	0	Marginal	X		X	X	X			X	X	X	X				X		X			X	
B2	0	Marginal	X			X					X		X				X		X				
B3	0.5	Emergent												X		X		X		X			
B4	1	Submergent												X	X	X		X		X			
B5	1.5	Submergent												X	X	X		X		X			
B6	1.5	Submergent												X	X	X		X		X			
B7	1.5	Submergent												X		X		X		X			
B8	1.5	Submergent												X		X		X		X			
B9	0.5	Emergent												X		X		X		X			
B10	0	Emergent				X				X													
B11	0	Emergent				X				X	X								X			X	
B12	0.5	Emergent												X	X	X		X		X			
B13	1	Emergent												X	X	X		X		X			
B14	1	Submergent												X	X	X		X		X			X
B15	2	Submergent												X	X	X		X		X			
B16	2.5	Submergent												X	X	X		X		X			
B17	1	Submergent												X	X	X		X		X			
B18	0	Marginal	X			X	X	X			X	X					X		X			X	
Native Percent Cover			100%																				
Native Species Diversity			15																				
Invasive Percent Cover			89%																				

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 3 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																	Invasive Species			
C1	0	Marginal				X	X	X				X							X			X	
C2	0	Marginal			X	X	X	X					X						X			X	
C3	0	Marginal				X		X					X						X			X	
C4	0	Emergent				X				X			X				X		X				
C5	0.25	Emergent				X				X			X				X		X				
C6	0.25	Emergent								X						X		X		X			
C7	0.5	Emergent									X					X		X		X			
C8	0.5	Emergent									X					X		X		X			
C9	1	Emergent									X					X		X		X			
C10	1	Emergent												X		X		X		X			X
C11	1	Emergent														X		X		X			
C12	1	Emergent														X		X		X			
C13	1	Emergent				X		X		X	X		X										
C14	0	Emergent			X	X	X	X			X		X						X			X	
C15	0	Emergent				X				X	X		X				X					X	
C16	0.5	Emergent				X					X												
C17	0.5	Emergent												X				X		X			
C18	0.5	Emergent												X				X		X			
C19	0.5	Emergent												X		X		X		X			
C20	0	Marginal				X		X		X	X						X						
Native Percent Cover			100%																				
Native Species Diversity			13																				
Invasive Percent Cover			75%																				

Overall Mitigation Area Results	A.PLA	EQ. SP	CARE	E. SP	JUNC	NAGR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
Species Cover (all habitats)	5%	0%	7%	32%	13%	14%	0%	20%	29%	7%	20%	57%	39%	64%	20%	68%	21%	68%	0%	18%	4%
Species Cover (marginal zone)	33%	0%	33%	100%	67%	67%	0%	22%	67%	44%	56%	0%	0%	0%	67%	0%	89%	0%	0%	78%	0%
Species Cover (emergent zone)	0%	0%	4%	38%	4%	8%	0%	33%	38%	0%	25%	38%	8%	54%	21%	63%	17%	63%	0%	13%	4%
Species Cover (submergent zone)	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	100%	87%	100%	0%	100%	0%	100%	0%	0%	4%

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 3 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

NOTES:

Photodocumentation points shown in **bold.**

A.PLA	American water plantain
B.CER	nodding beggartick flower
C.DEM	hornwort
CARE	*Carex* species
E. SP	*Eleocharis* species (spikerush)
E.CAN	Canadian waterweed
EQ. SP	*Equisetum* species (horsetail reed)
JUNC	*Juncus* species
L.MIN	duckweed
M.SPI	Eurasian watermilfoil
NA	native algae
NAGR	native grass
P.ARU	reed canary grass
P.CRI	curlyleaf pondweed
P. SP	waterpepper
P.NAT	floating leaf pondweed
R.CRI	curly dock
S.EME	bur-reed
S.LAT	wapato
S.SP	*Salix* species (willow)
T.LAT	broadleaf cattail

[a]Planting zone determinations are based on site observations and may differ slightly from the approximate planting zone boundaries shown in Figure 2.

[b]Native but listed in Whitson, T.D. (ed) et al., 2000. Weeds of the West (9th edition). Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming, Laramie, Wyoming.

Native and invasive designations made according to USFWS (2010), Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

FIGURES

Source: Aerial photograph (2015) obtained from National Agriculture Imagery Program.

Legend

- Road
- Mitigation Site

Figure 1
Site Location

Port of Ridgefield
Ridgefield, Washington

0 390 780
Feet

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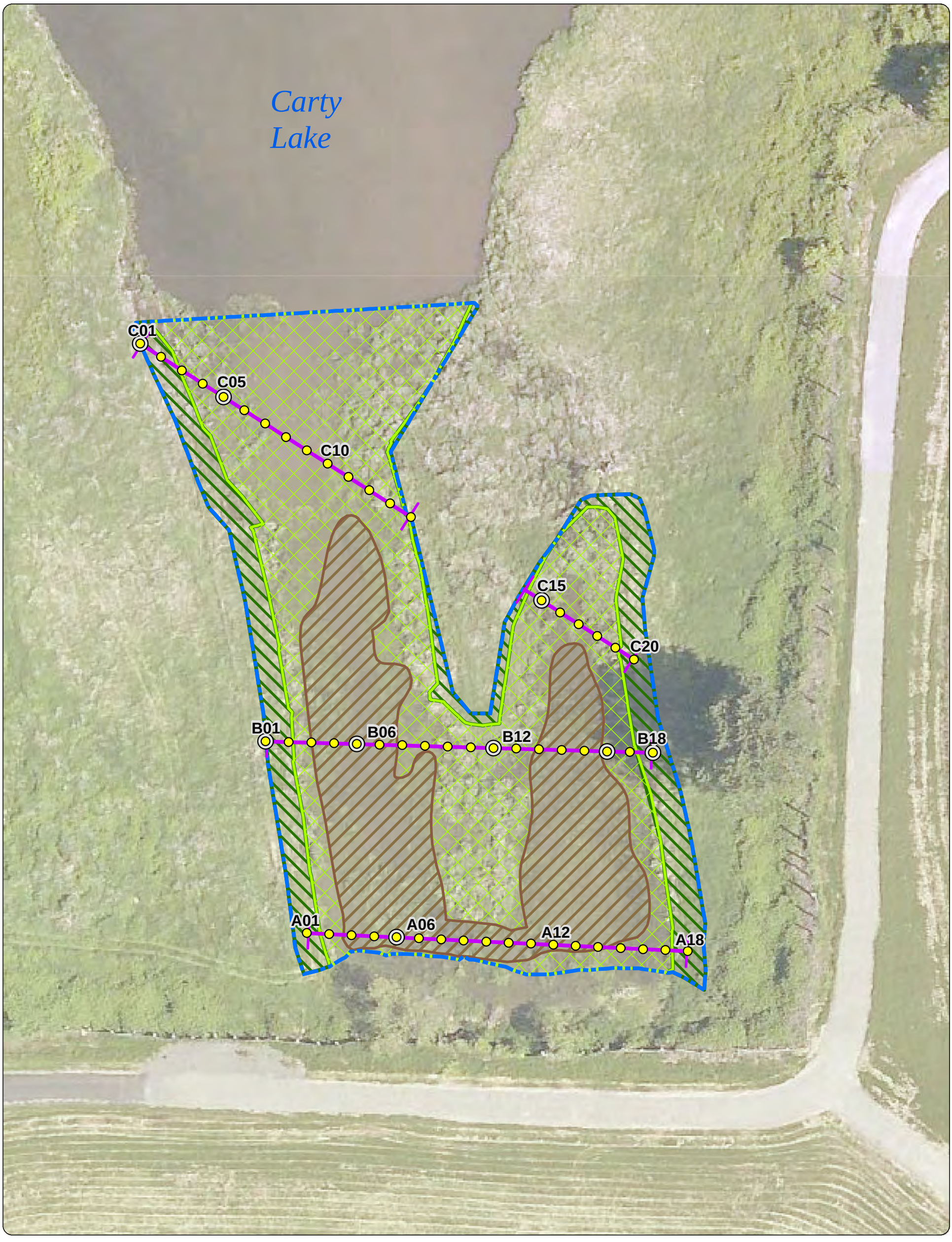
Project: 9003.01.40-06 Produced By: apadilla Approved By: P. Wiescher Print Date: 9/22/2016
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd



Source: Aerial photograph (2014) obtained from Clark County GIS.

Notes:
1. Aerial photo date precedes remediation and restoration activities conducted from 2014 through 2015.
2. Vegetation group boundaries are approximate.

Legend

- Sample Location
- Sample Photo Documentation Point
- Mitigation Site
- Vegetation Transect

Vegetation Groups

- Marginal (Approx. Elev 10 to 11)
- Emergent (Approx. Elev 8 to 10)
- Submergent (Approx. Elev 8 and Below)

Figure 2 Carty Lake Vegetation Transects

Port of Ridgefield
Ridgefield, Washington

0 25 50
Feet

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Project: 9003.01.40-06
Produced By: apadilla
Approved By: P. Wescher
Print Date: 9/22/2016

PHOTOGRAPHS

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 1.

Description
Fall 2013. Mitigation area before remediation. Reed canary grass is dominant vegetation. Looking northeast.

Photo No. 2.

Description
Winter 2014/15. Remediation area prior to plantings and temporary dam removal. Wildlife fencing installed. Looking northwest.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 3.

Description
August 2016.
Mitigation area.
Looking west.

Photo No. 4.

Description
August 2016.
Mitigation area.
Flowering wapato and bur-reed. Looking northeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 5.

Description
August 2016. South end of mitigation area. Looking north.

Photo No. 6.

Description
September 2017. North end of mitigation area. Looking southeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 7.

Description
September 2018. East end of mitigation area. Looking northwest.

Photo No. 8.

Description
September 2018. Photo point C1. Marginal zone. Spikerush, *Salix* species, *Juncus* species, nodding beggartick, smartweed, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 9.

Description
September 2018. Photo point B18. Marginal zone. American water plantain, spikerush, *Juncus* species, *Salix* species, cattail, nodding beggartick, smartweed, and reed canary grass observed in vicinity.

Photo No. 10.

Description
September 2018. Photo point C5. Emergent zone. Bur-reed, wapato, cattail, nodding beggartick, and spikerush observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 11.

Description
September 2018. Photo point C15. Emergent zone. Spikerush, bur-reed, wapato, cattail, smartweed, and reed canary grass observed in vicinity.

Photo No. 12.

Description
September 2018. Photo point B11. Emergent zone. Spikerush, bur-reed, nodding beggartick, smartweed, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 13.

Description
September 2018. Photo point B5. Submergent zone. Canadian waterweed, hornwort, duckweed, native algae, and Eurasian watermilfoil.

Photo No. 14.

Description
September 2018. Photo point B16. Submergent zone. Canadian waterweed, hornwort, duckweed, native algae, and Eurasian watermilfoil.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 15.

Description
September 2018. Photo point B1. Marginal zone. American water plantain, sedges, spikerush, *Juncus* species, bur-reed, *Salix* species, wapato, cattail, nodding beggartick, smartweed, and reed canary grass observed in vicinity.

Photo No. 16.

Description
September 2018. Photo point A5. Submergent zone. Hornwort, Canadian waterweed, duckweed, native algae, and Eurasian watermilfoil.

TECHNICAL MEMORANDUM

To:	Jim Carsner, U.S. Army Corps of Engineers	Date:	December 17, 2019
From:	Phil Wiescher, PhD, Maul Foster & Alongi, Inc.	Project:	NWS-2013-1209
RE:	Port of Ridgefield Carty Lake Remedial Action (NWS-2013-1209) Year 4 (2019) Vegetation Monitoring		

On behalf of the Port of Ridgefield, Maul Foster & Alongi, Inc. (MFA) has prepared this Year 4 (2019) vegetation monitoring report consistent with the requirements of the U.S. Army Corps of Engineers (COE) Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake remedial action in Ridgefield, Washington. The remedial action addressed historical contamination of sediment in Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR) (see Figure 1). The remedial action was required by the Washington State Department of Ecology (Ecology) and included excavating contaminated sediment, placing clean sand to contain residual contamination, and removing a failing treated-wood retaining wall at the southern end of the lake. The wetland and upland banks were restored with native plants, consistent with the Carty Lake Mitigation Plan (CLMP) (MFA, 2014). The remediation work was completed in 2014, and restoration plantings were completed in 2015.

In addition to the cleanup completed, the Ecology cleanup action plan requires restriction of fish consumption for protection of human health. As determined in coordination with Ecology, the Port of Ridgefield and the RNWR will enter into an agreement, such as a memorandum of understanding, stating that a fish consumption restriction will be incorporated into an interpretive center display that is under construction at the southern end of Carty Lake. Additional evaluations of the potential for impacts to human health from fish consumption may be necessary if Carty Lake is reconnected with the Columbia River in the future.

Carty Lake is a 52-acre lake in the RNWR. The southern end of Carty Lake was rated as a Category II lake fringe wetland in 2013. Before remediation, nonnative reed canary grass was ubiquitous and generally dominated the shoreline, forming dense monocultures; Himalayan blackberry was dominant along the former retaining wall and the southern end of the lake. The remediation work was conducted to meet sediment standards protective of ecological receptors. The mitigation approach was developed in consultation with the COE and the USFWS. Consistent with the CLMP, the short-term temporary construction impacts are mitigated by 1.2 acres of revegetation to be maintained in the excavation area (the mitigation area) (see Figure 1). The CLMP provides ecologically-based performance standards for the mitigation area that will be used to determine whether the compensatory mitigation

project is achieving its objectives. In addition, areas surrounding the mitigation area were revegetated and are maintained to impede nonnative-species encroachment. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Permanent impacts associated with the construction of bank stabilization and remediation elements were mitigated by the purchase of mitigation credits; associated documentation is provided in the Carty Lake completion report (MFA, 2015).

Monitoring of the mitigation area is to be conducted annually for five years (until 2020). Year 1 (2016) mitigation monitoring was conducted in summer 2016, with results provided in the November 2016 monitoring report submitted to the COE (MFA, 2016). In brief, the 2016 report concluded that the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones, and limited invasive-species encroachment was observed in the marginal and emergent zones. In the submergent zones, invasive species (primarily the ubiquitous pondweed Eurasian milfoil) were more frequently observed. The performance standard for plant areal cover was met for the mitigation area, while the invasive species performance standard was not met, primarily because of the presence of milfoil in the submergent zone.

In general, the Year 2 (2017) mitigation monitoring report for the on-site mitigation area concluded that the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones (MFA, 2017). Limited invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, native nonplanted aquatics such as native algae, hornwort, and duckweed were common, and invasive species (primarily the ubiquitous pondweed milfoil) were frequently observed. Ducks, great egrets, frogs, small fish, and insects were also observed, indicating that the mitigation area is serving ecological functions. As a whole, the area appears to have naturalized.

In general, the Year 3 (2018) mitigation monitoring report concluded that the planted native vegetation continues to establish itself and is dense and diverse in the marginal, emergent, and submergent zones (MFA, 2018). Some invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. Blue heron, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions; and the area continues to naturalize. For example, other native species (nodding beggartick flower and waterpepper) that were not planted and were not observed during Year 1 monitoring were observed in Year 3.

The Year 4 (2019) mitigation monitoring results for the on-site mitigation area are provided below, consistent with the requirements of NWS-2013-1209 special condition (e).

SITE MANAGEMENT ACTIVITIES

Paul Brothers, Inc. (PBI), of Boring, Oregon, restored and planted the 1.2-acre mitigation area. Plants were installed as described in the Carty Lake completion report (MFA, 2015).[1] MFA gave PBI verbal notice of substantial completion at a site inspection in fall 2015.[2]

At that time, PBI continued ongoing maintenance of invasive-plant removal and irrigation-system repair. Following the 2016 site monitoring, MFA provided the 2016 monitoring report to PBI, informing them that some invasive-species control would be necessary to meet the associated performance standard. In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) were necessary to meet maintenance requirements; PBI conducted fall/winter 2017 replacement plantings to optimize plant establishment. The replanting list included the following species: bald hip rose *(Rosa gymnocarpa),* Nootka rose *(Rosa nutkana),* Indian plum *(Oemleria cerasiformis),* salmonberry *(Rubus spectabilis),* thimbleberry *(Rubus parviflorus),* Douglas spiraea *(Spiraea douglasii),* willow species *(Salix spp.),* and serviceberry *(Amelanchier alnifolia)*. Invasive species in the mitigation area marginal and emergent zones (i.e., primarily reed canary grass) were removed as part of these 2017 activities.

In spring 2018, Sound Native Plants (SNP) of Olympia, Washington, continued vegetation management with mowing, cutting, and hand-pulling competing vegetation; controlling invasive species; and operating/repairing the irrigation system. SNP conducted six irrigation/maintenance visits from April through September 2018 to manually turn on the aboveground irrigation system and manage vegetation as needed. Invasive species in the mitigation area and the marginal and emergent zones (i.e., primarily reed canary grass) were removed as part of these 2018 activities.

In 2019, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) were installed as part of the maintenance contract with SNP. This included installation of 350 live willow stakes and 300 bare root native shrubs (i.e., oceanspray, Indian plum, mock orange, cascara, and Nootka rose). To ensure the success of this newly installed vegetation, SNP retrofitted the existing irrigation system to an automated system to deliver water consistently over the summer. SNP conducted two weed control treatments using manual methods and spot applications of aquatic labeled herbicides by Washington State Department of Agriculture licensed applicators.

The Year 4 (2019) mitigation monitoring results are provided below.

[1]Because plantings were not completed until 2015, instead of in 2014 as anticipated in the CLMP, Year 1 monitoring was initiated in 2016, consistent with NWS-2013-1209 requirements (i.e., Year 1 monitoring to be conducted at least one year following completion of mitigation plantings).

[2] This does not include PBI's ongoing maintenance requirements, which include maintaining all planted areas through October 2018 in order to meet performance standards identified in the contract documents.

PERFORMANCE STANDARDS

As described in the CLMP, the performance standards for the on-site mitigation are as follows:

Performance Standard 1.1. *As shown by the proposed grading plan (Attachment 1 to the NWS-2013-1209 Joint Aquatic Resources Permit Application), the site will be graded to the proposed contours.*

This performance standard has been met as described in the Carty Lake construction completion report (MFA, 2015).

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard does not apply to Year 4 monitoring, however progress towards the Year 5 performance standard is evaluated below.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

This performance standard for Year 4 is evaluated below.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard does not apply to Year 4 monitoring, however progress towards the Year 5 performance standard is evaluated below.

COMPLIANCE MONITORING METHODOLOGY

On-site planting areas were monitored on September 30, 2019. The goal of the monitoring inspection was to determine the areal cover of native plants and the extent of nonnative, invasive plant encroachment and to identify maintenance tasks that are required in order to meet the performance standards. The monitoring, performed by MFA staff consistent with the 2016 methodology, included:

- Establishing the identity and percent cover of native and invasive vegetation, using a point-line method; monitoring points established in 2016 at fixed intervals (approximately 10 feet) along three sampling transects spanning the on-site mitigation area were reevaluated (see Figure 2). Transect A spans, predominantly, the submergent zone planting area (deeper water portion); Transect C spans, predominantly, the emergent zone; and Transect B spans both emergent and submergent zones. All transects include sampling units in the marginal zone. A portion of Transect C intersects a higher elevation "island" that is not part of the mitigation area; data were not collected in this area. Data were recorded for plants within approximately 1 foot of the sampling units. Native percent cover for each transect was determined based on the number of times native vegetation was present at a sampling unit divided by the total

number of units in a sampling transect. Invasive percent cover was determined in the same way. A handheld global positioning system unit was used to navigate to points.

- Photodocumentation points documenting conditions and comparing plant vigor/growth between monitoring inspections. Three photodocumentation points per habitat zone were identified, as shown in Figure 2.

RESULTS

This is the fourth year of monitoring. Monitoring focused on plant identification and cover to provide management recommendations and to evaluate performance standards. Transect data are provided in the attached table and are discussed below with respect to the relevant performance standards.

In general, the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed and wapato (both culturally significant species), rush, spikerush, and sedges are widespread. Wapato has begun to naturalize and spread into the nearby banks north of the mitigation area. Increased invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, hornwort and duckweed were common, and invasive species (primarily milfoil) were frequently observed. Blue heron, great egrets, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions, and as a whole, the area appears to have naturalized. For example, other native species (Mexican water fern and waterpepper) that were not planted and were not observed during Year 1 monitoring were observed in Years 2, 3, and 4. A photo array for the mitigation area, including photodocumentation points, is attached.

CONCLUSIONS AND RECOMMENDATIONS

Performance Standard 1.2. The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.

Fifteen native species were observed in the mitigation area, and 100 percent native areal cover was observed in all transects. Therefore, progress towards the Year 5 performance standard was observed.

Performance Standard 1.3. During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.

Areal cover for transects A (100 percent), B (100 percent), and C (90 percent) are above 20 percent for invasive species, and the performance standard is not met at this time. This is due primarily to the presence of the pondweed Eurasian milfoil, which has encroached from Carty Lake to the north of the mitigation area as noted during prior monitoring efforts (MFA, 2018). Eurasian milfoil is a common invasive present in much of the RNWR and was observed in Carty Lake immediately north of the mitigation area; existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading of invasives such as milfoil (USFWS, 2010). Eurasian milfoil can be controlled by raking or seining it from the water, but it can reestablish from any remaining fragments and roots, and these activities can lead to further spreading. Chemical controls can be effective, but

their use would require coordination with the USFWS and evaluation of the potential for associated impacts (e.g., oxygen depletion after decomposition of the dead plant material). In both cases, it is extremely likely that milfoil would reestablish quickly because of its presence throughout the RNWR and in Carty Lake.

To progress toward the performance standard, SNP will manually remove invasives such as reed canary grass in the marginal zone as part of ongoing control measures. Isolated plants and small patches of reed canary grass will be removed by digging out and removing the entire root mass by hand. To reduce reed cancry grass resprouting, care will be taken to remove all rhizomes and roots. MFA continues to recommend not removing milfoil, as this would, at best, result in temporary, short-term improvement at significant effort and cost. Further removal may result in additional spreading of milfoil. Long-term control of milfoil would best be achieved if milfoil were treated throughout Carty Lake; however, existing USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading in the lake (USFWS, 2010).

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

Seventeen native species were observed in the mitigation area. More than three species, floating leaf pondweed, Mexican water fern, Canadian waterweed, spikerush, waterpepper, and wapato, occurred in more than 10 percent of the sampling units. These and other species also show more than 5 percent cover in a habitat zone (e.g., marginal zone). Therefore, progress towards the Year 5 performance standard was observed.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

MFA. 2014. Carty Lake mitigation plan, addendum to the Joint Aquatic Resources Permit Application No. NWS-2013-1209. Maul Foster & Alongi, Inc., Vancouver, Washington. January 30.

MFA. 2015. Carty Lake construction completion report. Maul Foster & Alongi, Inc., Vancouver, Washington. November 17.

MFA. 2016. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 1 (2016) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. November 11.

MFA. 2017. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 2 (2016) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. November 20.

MFA. 2018. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 3 (2016) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. December 13.

USFWS. 2010. Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

ATTACHMENTS

Table
Figures
Photographs

TABLE

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 4 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																			Invasive Species			
A1	0	Marginal			X	X		X	X				X						X					X	
A2	1	Emergent		X							X		X					X	X			X			
A3	2.5	Submergent		X							X					X		X				X			
A4	2.5	Submergent		X							X					X	X	X				X			
A5	2.5	Submergent		X							X					X		X				X			
A6	2.5	Submergent		X							X	`				X		X				X			
A7	2.5	Submergent		X							X					X		X				X			
A8	2.5	Submergent		X							X					X		X				X			
A9	3	Submergent		X							X					X	X	X				X			
A10	3	Submergent		X												X	X	X				X			
A11	2.5	Submergent		X												X	X	X				X			
A12	2.5	Submergent		X												X	X	X				X			
A13	2.5	Submergent		X												X		X				X			
A14	2.5	Submergent		X							X					X		X				X			
A15	2	Submergent		X														X				X			
A16	1.5	Submergent		X							X					X	X	X				X			
A17	1	Emergent		X											X			X	X			X			
A18	0	Marginal							X				X						X					X	
Native Percent Cover			100%																						
Native Species Diversity			12																						
Invasive Percent Cover			100%																						
B1	0	Marginal	X		X	X	X	X					X						X		X			X	
B2	1.5	Marginal		X												X		X				X			
B3	2	Emergent		X												X		X				X			
B4	2.5	Submergent		X							X							X				X			
B5	3	Submergent		X												X	X	X				X			
B6	2.5	Submergent		X							X							X				X			
B7	2	Submergent		X							X					X	X	X				X			
B8	1	Submergent		X												X		X				X			
B9	0	Emergent	X				X					X									X			X	
B10	0	Emergent			X	X	X	X					X								X			X	
B11	0.25	Emergent	X	X			X					X						X			X			X	
B12	1.5	Submergent		X							X						X	X				X			
B13	2.5	Submergent		X													X	X				X			
B14	3	Submergent		X														X				X			
B15	3	Submergent		X														X				X			
B16	2.5	Submergent		X														X				X			
B17	0.5	Emergent	X	X			X					X	X			X	X	X	X			X			
B18	0	Marginal				X	X	X	X				X						X		X			X	
Native Percent Cover			100%																						
Native Species Diversity			15																						
Invasive Percent Cover			100%																						

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 4 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
			Native Species																			Invasive Species			
C1	0	Marginal						X	X				X											X	
C2	0	Marginal				X	X	X	X	X				X										X	
C3	0	Marginal				X		X	X	X				X										X	
C4	0	Emergent	X				X		X				X								X				
C5	0	Emergent	X				X		X			X	X						X		X			X	
C6	0	Emergent	X	X			X					X			X			X	X		X				
C7	0.25	Emergent		X								X						X				X			
C8	0.75	Emergent		X								X						X				X			
C9	1	Emergent		X														X				X			
C10	1	Emergent		X														X				X			
C11	1.25	Emergent		X														X				X			
C12	1.5	Emergent		X														X				X			
C13	0.5	Emergent		X												X		X				X			X
C14	0.5	Emergent		X							X	X						X				X			
C15	0.25	Emergent					X					X	X		X				X					X	
C16	0.25	Emergent		X								X	X					X				X			
C17	1	Emergent		X													X	X				X			
C18	1.25	Emergent		X														X				X			
C19	0.5	Emergent		X								X	X			X		X	X			X			
C20	0	Marginal					X		X	X			X	X					X					X	
Native Percent Cover			100%																						
Native Species Diversity			17																						
Invasive Percent Cover			90%																						
Overall Mitigation Area Results			A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	R. CRI	P.ARU	P.CRI
Species Cover (all habitats)			13%	77%	5%	11%	21%	13%	16%	5%	27%	21%	25%	5%	5%	38%	21%	77%	21%	0%	14%	73%	0%	23%	2%
Species Cover (marginal zone)			11%	11%	22%	56%	44%	67%	78%	33%	0%	0%	67%	33%	0%	11%	0%	11%	56%	0%	22%	11%	0%	89%	0%
Species Cover (emergent zone)			26%	78%	4%	4%	35%	4%	9%	0%	9%	48%	35%	0%	13%	17%	9%	78%	30%	0%	26%	70%	0%	22%	4%
Species Cover (submergent zone)			0%	100%	0%	0%	0%	0%	0%	0%	54%	0%	0%	0%	0%	67%	42%	100%	0%	0%	0%	100%	0%	0%	0%

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 4 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

NOTES:
Photodocumentation points shown in **bold.**

A.PLA	American water plantain.
A.MEX	Mexican water fern.
B.CER	nodding beggartick flower.
C.DEM	hornwort.
CARE	*Carex* species.
E. SP	*Eleocharis* species (spikerush).
E.CAN	Canadian waterweed.
EQ. SP	*Equisetum* species (horsetail reed).
JUNC	*Juncus* species.
L.COR	Bird's foot.
L.MIN	Duckweed.
M.SPI	Eurasian watermilfoil.
NA	native algae.
NAGR	native grass.
P.ARU	reed canary grass.
P.CRI	curlyleaf pondweed.
P. SP	waterpepper.
P.NAT	floating leaf pondweed.
R.CRI	curly dock.
S.EME	bur-reed.
S.LAT	wapato.
S.SP	*Salix* species (willow).
T.LAT	broadleaf cattail.

[a]Planting zone determinations are based on site observations and may differ slightly from the approximate planting zone boundaries shown in Figure 2.
[b]Native but listed in Whitson, T.D. (ed) et al., 2000. Weeds of the West (9th edition). Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming, Laramie, Wyoming.
Native and invasive designations made according to USFWS (2010), Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

FIGURES

Source: Aerial photograph (2015) obtained from National Agriculture Imagery Program.

Legend

- Road
- Mitigation Site

Figure 1
Site Location

Port of Ridgefield
Ridgefield, Washington

0 390 780
Feet

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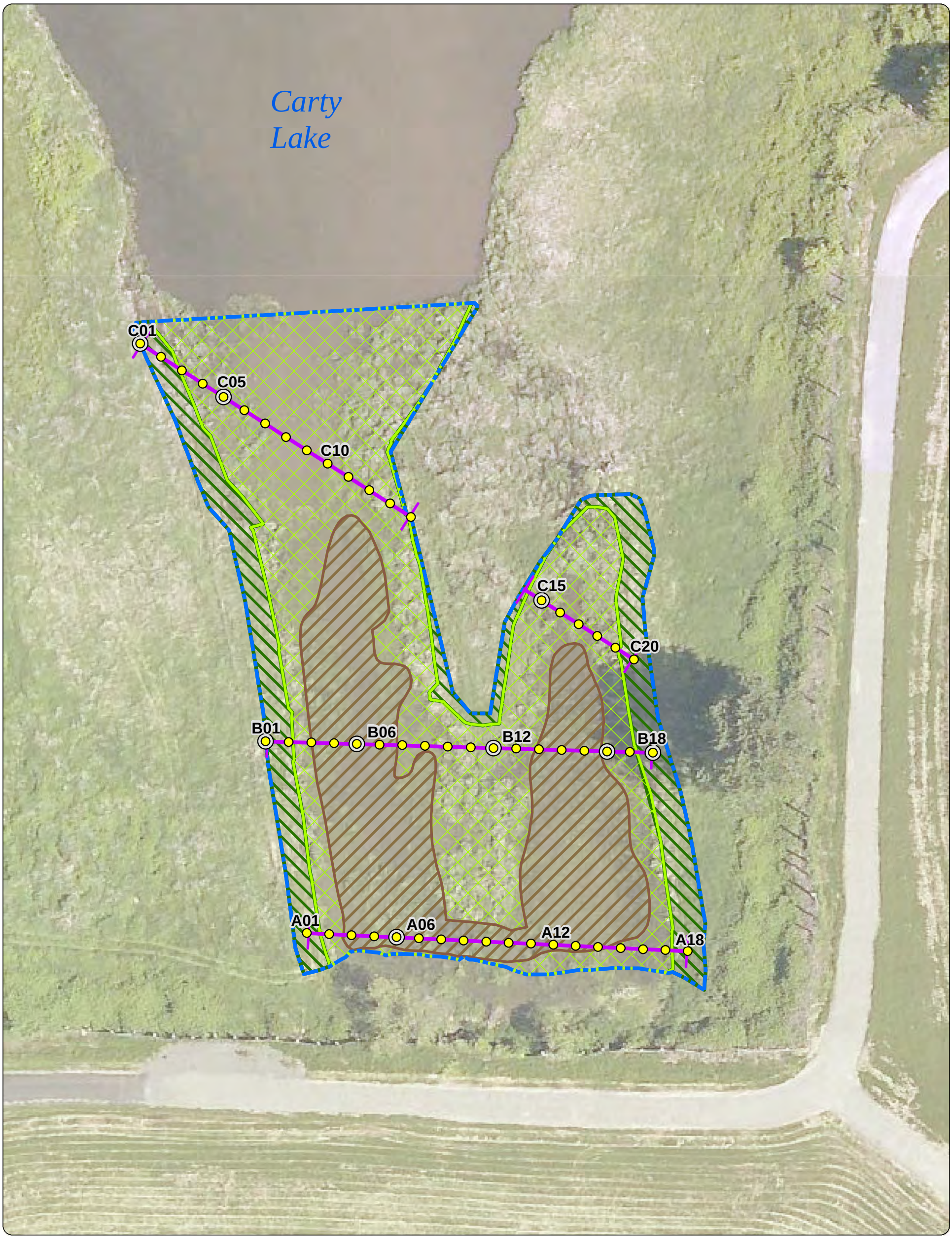
p. 971 544 2139 | www.maulfoster.com

Project: 9003.01.40-06 Produced By: apadilla Approved By: P. Wiescher Print Date: 9/22/2016
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd



Source: Aerial photograph (2014) obtained from Clark County GIS.

Notes:
1. Aerial photo date precedes remediation and restoration activities conducted from 2014 through 2015.
2. Vegetation group boundaries are approximate.

Legend

- Sample Location
- Sample Photo Documentation Point
- Mitigation Site
- Vegetation Transect

Vegetation Groups

- Marginal (Approx. Elev 10 to 11)
- Emergent (Approx. Elev 8 to 10)
- Submergent (Approx. Elev 8 and Below)

Figure 2 Carty Lake Vegetation Transects

Port of Ridgefield
Ridgefield, Washington

0 25 50
Feet

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Project: 9003.01.40-06
Produced By: apadilla
Approved By: P. Wescher
Print Date: 9/22/2016

PHOTOGRAPHS

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 1.

Description
Fall 2013. Mitigation area before remediation. Reed canary grass is dominant vegetation. Looking northeast.

Photo No. 2.

Description
Winter 2014/15. Remediation area prior to plantings and temporary dam removal. Wildlife fencing installed. Looking northwest.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 3.

Description
August 2016.
Mitigation area.
Looking west.

Photo No. 4.

Description
August 2016.
Mitigation area.
Flowering wapato and bur-reed.
Looking northeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 5.

Description
August 2016. South end of mitigation area. Looking north.

Photo No. 6.

Description
September 2017. North end of mitigation area. Looking southeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 7.

Description
September 2018. East end of mitigation area. Looking northwest.

Photo No. 8.

Description
September 2019. Southeast end of mitigation area. Looking northwest.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 9.

Description
September 2019.
Photo point C1.
Marginal zone. *Juncus* species, waterpepper, and reed canary grass observed in vicinity.

Photo No. 10.

Description
September 2019.
Photo point B18.
Marginal zone. *Carex* species, spikerush, *Juncus* species, cattail, nodding beggartick, waterpepper, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 11.

Description
September 2019. Photo point C5. Emergent zone. American water plantain, bur-reed, waterpepper, nodding beggartick, and spikerush observed in vicinity.

Photo No. 12.

Description
September 2019. Photo point C15. Emergent zone. Spikerush, bur-reed, wapato, cattail, waterpepper, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 13.

Description
September 2019. Photo point B11. Emergent zone. American water plantain, Mexican water fern, Spikerush, bur-reed, nodding beggartick, and reed canary grass observed in vicinity.

Photo No. 14.

Description
September 2019. Photo point B5. Submergent zone. Mexican water fern, Canadian waterweed, hornwort, duckweed, and Eurasian watermilfoil.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 15.

Description
September 2019.
Photo point B16.
Submergent zone.
Mexican water fern, duckweed, and Eurasian watermilfoil.

Photo No. 16.

Description
September 2019.
Photo point B1.
Marginal zone.
American water plantain, horsetail reed, sedges, spikerush, *Juncus* species, cattail, nodding beggartick, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.40
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 17.

Description
September 2019. Photo point A5. Submergent zone. Mexican water fern, floating leaf pondweed, Canadian waterweed, duckweed, and Eurasian watermilfoil.

TECHNICAL MEMORANDUM

To:	Jim Carsner, PWS, U.S. Army Corps of Engineers	Date:	December 16, 2020
From:	Phil Wiescher, PhD and Curtis Riley, RLA	Project:	NWS-2013-1209
RE:	Port of Ridgefield Carty Lake Remedial Action (NWS-2013-1209) Year 5 (2020) Vegetation Monitoring		

On behalf of the Port of Ridgefield (Port), Maul Foster & Alongi, Inc. (MFA) has prepared this final Year 5 (2020) vegetation monitoring report consistent with the requirements of the U.S. Army Corps of Engineers (COE) Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake remedial action in Ridgefield, Washington. The remedial action addressed historical contamination of sediment in Carty Lake in the U.S. Fish and Wildlife Service (USFWS) Ridgefield National Wildlife Refuge (RNWR) (see Figure 1). The remedial action was required by the Washington State Department of Ecology (Ecology) and included excavating contaminated sediment, placing clean sand to contain residual contamination, and removing a failing treated-wood retaining wall at the southern end of the lake. The wetland and the upland banks were restored with native plants, consistent with the Carty Lake Mitigation Plan (CLMP) (MFA, 2014). The remediation work was completed in 2014, and restoration plantings were completed in 2015.

In addition to the cleanup completed, the Ecology cleanup action plan requires restriction of fish consumption for protection of human health. As determined in coordination with Ecology, the Port and the RNWR will enter into an agreement, such as a memorandum of understanding, stating that a fish consumption restriction will be incorporated into an interpretive center display that is under construction at the southern end of Carty Lake. Additional evaluations of the potential for impacts to human health from fish consumption may be necessary if Carty Lake is reconnected with the Columbia River in the future.

Carty Lake is a 52-acre lake in the RNWR. In 2013, the southern end of the lake was rated as a Category II lake fringe wetland. Before remediation, nonnative reed canary grass was ubiquitous and generally dominated the shoreline, forming dense monocultures; Himalayan blackberry was dominant along the former retaining wall and the southern end of the lake. The remediation work was conducted to meet sediment standards protective of ecological receptors. The mitigation approach was developed in consultation with the COE and the USFWS. Consistent with the CLMP, the short-term temporary construction impacts are mitigated by 1.2 acres of revegetation to be maintained in the excavation area (the mitigation area) (see Figure 1). The CLMP provides ecologically based performance standards for the mitigation area that will be used to determine whether the compensatory mitigation

project is achieving its objectives. In addition, areas surrounding the mitigation area were revegetated and are maintained to impede encroachment of nonnative species. These areas are being treated at the behest of the permittee and are not regulated as mitigation areas. Permanent impacts associated with the construction of bank stabilization and remediation elements were mitigated by the purchase of mitigation credits; associated documentation is provided in the Carty Lake construction completion report (MFA, 2015).

Monitoring of the mitigation area is to be conducted annually for five years (until the end of 2020). Year 1 (2016) mitigation monitoring was conducted in summer 2016, with results provided in the November 2016 monitoring report submitted to the COE (MFA, 2016). In brief, the 2016 report concluded that the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones, and that limited invasive-species encroachment was observed in the marginal and emergent zones. In the submergent zones, invasive species (primarily the ubiquitous pondweed Eurasian watermilfoil) were more frequently observed. The performance standard for plant areal cover was met for the mitigation area, while the invasive species performance standard was not met, primarily because of the presence of milfoil in the submergent zone.

In general, the Year 2 (2017) mitigation monitoring report for the on-site mitigation area concluded that the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones (MFA, 2017). Limited invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, native nonplanted aquatics such as native algae, hornwort, and duckweed, were common, and invasive species (primarily the ubiquitous pondweed milfoil) were frequently observed. Ducks, great egrets, frogs, small fish, and insects were also observed, indicating that the mitigation area was serving ecological functions. As a whole, the area appears to have naturalized.

In general, the Year 3 (2018) mitigation monitoring report concluded that the planted native vegetation continued to establish itself and was dense and diverse in the marginal, emergent, and submergent zones (MFA, 2018). Some invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. Blue heron, great egrets, frogs, small fish, and insects were observed, indicating that the mitigation area was serving ecological functions; and the area continued its naturalization. For example, other native species (nodding beggartick flower and waterpepper) that were neither planted nor observed during Year 1 monitoring were observed in Year 3.

In Year 4 (2019) the planted native vegetation was well-established, dense, and diverse in the marginal and emergent zones; bur-reed and wapato (both culturally significant species), rush, spikerush, and sedges were widespread (MFA, 2019). Wapato had begun to naturalize and spread into the nearby banks north of the mitigation area. Increased invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, hornwort and duckweed were common, and invasive species (primarily milfoil) were frequently observed.

In general, Year 5 (2020) mitigation monitoring observed native vegetation that continues to establish itself and that is dense in all the planting zones in the mitigation area. Some invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. Great egrets, ducks, otters, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions; and the area continues to naturalize.

SITE MANAGEMENT ACTIVITIES

Paul Brothers, Inc. (PBI), of Boring, Oregon, restored and planted the 1.2-acre mitigation area. Plants were installed as described in the Carty Lake construction completion report (MFA, 2015).[1] During a site inspection conducted in fall 2015,[2] MFA gave PBI verbal notice of substantial completion.

PBI continued ongoing maintenance of invasive-plant removal and irrigation-system repair. Following the 2016 site monitoring, MFA provided the 2016 monitoring report to PBI, informing them that some invasive-species control would be necessary to meet the associated performance standard. In addition, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) were necessary to meet maintenance requirements; PBI conducted fall/winter 2017 replacement plantings to optimize plant establishment. The replanting list included the following species: bald hip rose *(Rosa gymnocarpa),* Nootka rose *(Rosa nutkana),* Indian plum *(Oemleria cerasiformis),* salmonberry *(Rubus spectabilis),* thimbleberry *(Rubus parviflorus),* Douglas spiraea *(Spiraea douglasii),* willow species *(Salix spp.),* and serviceberry *(Amelanchier alnifolia)*. Invasive species in the mitigation area marginal and emergent zones (primarily reed canary grass) were removed as part of these 2017 activities.

In spring 2018, Sound Native Plants (SNP) of Olympia, Washington, continued vegetation management with mowing, cutting, and hand-pulling competing vegetation; controlling invasive species; and operating/repairing the irrigation system. SNP conducted six irrigation/maintenance visits from April through September 2018 to manually turn on the aboveground irrigation system and manage vegetation as needed. Invasive species in the mitigation area and the marginal and emergent zones (primarily reed canary grass) were removed as part of these 2018 activities.

In 2019, some upland replacement plantings surrounding the mitigation area (i.e., areas not regulated as mitigation areas) were installed as part of the maintenance contract with SNP. This included installation of 350 live willow stakes and 300 bare root native shrubs (i.e., oceanspray, Indian plum, mock orange, cascara, and Nootka rose). To ensure the success of this newly installed vegetation, SNP retrofitted the existing irrigation system to an automated system to deliver water consistently over the summer. SNP conducted two weed-control treatments using manual methods, and had spot

[1]Because plantings were not completed until 2015, instead of in 2014 as anticipated in the CLMP, Year 1 monitoring was initiated in 2016, consistent with NWS-2013-1209 requirements (i.e., Year 1 monitoring to be conducted at least one year following completion of mitigation plantings).

[2] This does not include PBI's ongoing maintenance requirements, which include maintaining all planted areas through October 2018 in order to meet performance standards identified in the contract documents.

applications of aquatic labeled herbicides conducted by Washington State Department of Agriculture licensed applicators.

In 2020, the initial (2015) restoration efforts and the vegetation installed as part of the 2017 replanting showed signs of becoming self-sufficient. The Port has taken on maintenance activities and continues to mow and remove competing vegetation as required. To encourage drought tolerance and successful establishment, supplemental irrigation has been discontinued.

The Year 5 (2020) mitigation monitoring results are provided below.

PERFORMANCE STANDARDS

As described in the CLMP, the performance standards for the on-site mitigation are as follows:

Performance Standard 1.1. *As shown by the proposed grading plan (Attachment 1 to the NWS-2013-1209 Joint Aquatic Resources Permit Application), the site will be graded to the proposed contours.*

This performance standard has been met as described in the Carty Lake construction completion report (MFA, 2015).

Performance Standard 1.2. *The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.*

This performance standard has been exceeded and is described in the evaluation below.

Performance Standard 1.3. *During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.*

This performance standard for Year 5 is evaluated below.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

This performance standard has been exceeded and is described in the evaluation below.

COMPLIANCE MONITORING METHODOLOGY

On-site planting areas were monitored on October 15, 2020. The goal of the monitoring inspection was to determine the areal cover of native plants and the extent of nonnative, invasive plant encroachment and to identify maintenance tasks that are required in order to meet the performance standards. The monitoring, performed by MFA staff consistent with the 2016 methodology, included:

- Establishing the identity and percent cover of native and invasive vegetation, using a point-line method; monitoring points established in 2016 at fixed intervals (approximately 10 feet)

along three sampling transects spanning the on-site mitigation area were reevaluated (see Figure 2). Transect A spans, predominantly, the submergent zone planting area (deeper water portion); Transect C spans, predominantly, the emergent zone; and Transect B spans both emergent and submergent zones. All transects include sampling units in the marginal zone. A portion of Transect C intersects a higher elevation "island" that is not part of the mitigation area; data were not collected in this area. Data were recorded for plants within approximately 1 foot of the sampling units. Both native and invasive percent cover for each transect was determined based on the number of times native vegetation was present at a sampling unit divided by the total number of units in a sampling transect. A handheld global positioning system unit was used to navigate to points.

- Photodocumentation points documenting conditions and comparing plant vigor/growth between monitoring inspections. Three photodocumentation points per habitat zone were identified, as shown in Figure 2.

RESULTS

This is the fifth year of monitoring. Monitoring focused on plant identification and cover to provide management recommendations and to evaluate performance standards. Transect data are provided in the attached table and are discussed below with respect to the relevant performance standards.

In general, the planted native vegetation is well-established, dense, and diverse in the marginal and emergent zones; bur-reed, rush, spikerush, and sedges are widespread. Wapato has begun to naturalize and spread into the nearby banks north of the mitigation area. Increased invasive-species encroachment (primarily reed canary grass) from the surrounding upland areas was observed in the marginal and emergent zones. In the submergent zones, hornwort and duckweed were common, and invasive species (primarily milfoil) were frequently observed. Great egrets, ducks, otters, small fish, and insects were observed, indicating that the mitigation area is serving ecological functions, and as a whole, the area appears to have naturalized. For example, other native species (Mexican water fern and waterpepper) that were neither planted nor observed during Year 1 monitoring were observed in Years 2, 3, 4, and 5. A photo array for the mitigation area, including photodocumentation points, is attached.

CONCLUSIONS AND RECOMMENDATIONS

Performance Standard 1.2. The areal cover of native species shall be at least 20 percent by Year 1, 40 percent by Year 3, and 60 percent by Year 5. Replace dead or dying plants as needed to meet the performance standard.

Sixteen native species were observed in the mitigation area, and 100 percent native areal cover was observed in all transects. These conditions continue to exceed this performance standard.

Performance Standard 1.3. During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.

Areal cover for transects A (100 percent), B (100 percent), and C (100 percent) are above 20 percent for invasive species, and the performance standard is not met at this time. This is due primarily to the

presence of the pondweed Eurasian milfoil, which has encroached from Carty Lake to the north of the mitigation area, as noted during prior monitoring efforts (MFA, 2018). Eurasian milfoil is a common invasive present in much of the RNWR and was observed in Carty Lake immediately north of the mitigation area; current USFWS budgets and staffing levels do not allow treatment of enough acreage to control spreading of invasives such as milfoil (USFWS, 2010). Eurasian milfoil can be controlled by raking or seining it from the water, but it can reestablish from any remaining fragments and roots, and these activities themselves can lead to further spreading. Chemical controls can be effective, but their use would require coordination with the USFWS and evaluation of the potential for associated impacts (e.g., oxygen depletion after decomposition of the dead plant material). In both cases, it is extremely likely that milfoil would reestablish quickly because of its presence throughout the RNWR and in Carty Lake.

MFA continues to recommend not removing milfoil, as this would, at best, result in temporary, short-term improvement at significant effort and cost.

Performance Standard 1.4. *By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.*

Sixteen native species were observed in the mitigation area. More than three species, Mexican water fern, Canadian waterweed, spikerush, waterpepper, bird's foot, and bur-reed, occurred in more than 10 percent of the sampling units. These and other species also show more than 5 percent cover in a habitat zone (e.g., marginal zone). Therefore, the Year 5 performance standard has been met.

This monitoring report demonstrates the completion of the required vegetation monitoring timeframe stated in the COE Nationwide Permit 38 (NWS-2013-1209), issued for the Carty Lake. As mentioned in the conclusions above, the native plant areal cover and plant variety performance standards have been met. The exceedance of invasive species in the mitigation areas does not meet performance standard 1.3 because of the presence of Eurasian milfoil in much of Carty Lake and immediately north of the mitigation area. Control of the milfoil would require a long-term approach by USFWS and would require involve a significant effort.

Vegetation monitoring and maintenance have been consistent throughout the required monitoring period and have met the attainable goals and objectives for this compensatory mitigation project. Upon receiving written concurrence from the District Commander of the COE, the Port will assume that this concludes the monitoring efforts and that no additional reports are required.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the

use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

MFA. 2014. Carty Lake mitigation plan, addendum to the Joint Aquatic Resources Permit Application No. NWS-2013-1209. Maul Foster & Alongi, Inc., Vancouver, Washington. January 30.

MFA. 2015. Carty Lake construction completion report. Maul Foster & Alongi, Inc., Vancouver, Washington. November 17.

MFA. 2016. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 1 (2016) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. November 11.

MFA. 2017. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 2 (2017) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. November 20.

MFA. 2018. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 3 (2018) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. December 13.

MFA. 2019. Port of Ridgefield Carty Lake remedial action (NWS-2013-1209) Year 4 (2019) vegetation monitoring. Maul Foster & Alongi, Inc., Vancouver, Washington. December 17.

USFWS. 2010. Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

ATTACHMENTS

Table
Figures
Photographs

TABLE

Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 5 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	N.ODO	R. CRI	P.ARU	P.CRI
			Native Species																			Invasive Species				
A1	0	Marginal				X		X	X	X			X	X					X						X	
A2	0.5	Emergent											X			X		X	X			X				
A3	2	Submergent														X		X				X	X			
A4	2.5	Submergent														X	X	X				X	X			
A5	2.5	Submergent														X		X				X	X			X
A6	2.5	Submergent										`						X				X	X			
A7	2	Submergent														X		X				X	X			X
A8	2.5	Submergent														X		X				X	X			X
A9	3	Submergent		X												X	X	X				X	X			X
A10	3	Submergent		X												X	X	X				X	X			X
A11	3	Submergent		X												X	X	X		X		X	X			X
A12	2.5	Submergent		X												X	X	X				X	X			X
A13	2.5	Submergent		X												X		X				X	X			X
A14	2.5	Submergent		X												X	X	X				X				X
A15	2	Submergent		X												X		X				X	X			X
A16	1.5	Submergent		X												X	X	X		X		X				X
A17	1.25	Emergent														X		X				X				
A18	0.25	Marginal											X					X	X			X				
Native Percent Cover			100%																							
Native Species Diversity			12																							
Invasive Percent Cover			100%																							
B1	0	Marginal						X	X	X				X					X						X	
B2	1	Marginal											X			X		X	X			X				X
B3	2	Emergent		X												X	X	X				X	X			X
B4	2.5	Submergent															X	X				X	X			X
B5	3	Submergent														X	X	X				X	X			X
B6	2.5	Submergent														X		X				X	X			X
B7	2	Submergent														X		X				X	X			X
B8	1.25	Submergent										X						X				X	X			X
B9	0.25	Emergent	X				X		X			X				X		X				X			X	
B10	0	Emergent					X	X	X			X	X												X	
B11	0	Emergent					X		X				X					X				X			X	X
B12	0.75	Submergent		X												X						X				X
B13	2.5	Submergent		X														X				X	X			X
B14	3	Submergent		X												X	X	X				X				X
B15	3.5	Submergent		X														X				X	X			X
B16	3	Submergent		X												X		X				X				X
B17	1	Emergent		X								X	X			X		X	X			X				
B18	0	Marginal					X	X	X	X			X	X					X						X	
Native Percent Cover			100%																							
Native Species Diversity			13																							
Invasive Percent Cover			100%																							

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Table
Carty Lake Remedial Action (NWS-2013-1209)
Year 5 Vegetation Monitoring
Port of Ridgefield
Ridgefield, Washington

Transect	Water Depth (feet)	Planting Zone[a]	A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	N.ODO	R. CRI	P.ARU	P.CRI
			Native Species																			Invasive Species				
C1	0	Marginal							X	X			X												X	
C2	0	Marginal				X		X	X	X				X											X	
C3	0	Marginal				X		X	X	X				X											X	
C4	0	Emergent	X					X	X				X												X	
C5	0	Emergent	X				X		X			X	X						X		X				X	
C6	0	Emergent					X		X			X	X		X				X		X				X	
C7	0.25	Emergent	X	X								X						X				X				
C8	0.75	Emergent		X								X						X				X	X			X
C9	1	Emergent		X														X				X	X			X
C10	1	Emergent																X				X	X			X
C11	1.25	Emergent																X				X	X			X
C12	1.5	Emergent																X				X	X			
C13	0.5	Emergent																X				X				
C14	0.5	Emergent										X						X				X				
C15	0	Emergent					X					X	X		X				X						X	
C16	0.25	Emergent			X							X	X					X	X			X				
C17	0.75	Emergent		X									X			X		X				X				
C18	1.25	Emergent		X								X						X				X				X
C19	1	Emergent		X								X	X			X		X	X			X				X
C20	0	Marginal						X	X	X			X	X					X						X	
Native Percent Cover			100%																							
Native Species Diversity			16																							
Invasive Percent Cover			100%																							

Overall Mitigation Area Results	A.PLA	A.MEX	EQ. SP	CARE	E. SP	JUNC	NAGR	L.COR	P. NAT	S.EME	P. SP	S.SP	S.LAT	E.CAN	C.DEM	L.MIN	T.LAT[b]	NA	B. CER	M.SPI	N.ODO	R. CRI	P.ARU	P.CRI
Species Cover (all habitats)	7%	38%	2%	5%	13%	14%	23%	13%	0%	25%	30%	11%	4%	48%	20%	77%	23%	4%	4%	79%	45%	0%	25%	54%
Species Cover (marginal zone)	0%	0%	0%	33%	11%	67%	78%	78%	0%	0%	67%	67%	0%	11%	0%	22%	67%	0%	0%	22%	0%	0%	78%	11%
Species Cover (emergent zone)	17%	35%	4%	0%	26%	9%	26%	0%	0%	52%	48%	0%	9%	30%	4%	78%	30%	0%	9%	78%	26%	0%	30%	35%
Species Cover (submergent zone)	0%	54%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	79%	42%	96%	0%	8%	0%	100%	79%	0%	0%	88%

NOTES:

Photodocumentation points shown in **bold.**

A.MEX	American water plantain
A.PLA	Mexican water fern
B.CER	nodding beggartick flower
C.DEM	hornwort
CARE	*Carex* species
E. SP	*Eleocharis* species (spikerush)
E.CAN	Canadian waterweed
EQ. SP	*Equisetum* species (horsetail reed)
JUNC	*Juncus* species
L.COR	Bird's foot
L.MIN	Duckweed
M.SPI	Eurasian watermilfoil
N. ODO	native algae
NA	native grass
NAGR	fragrant water lily
P. SP	reed canary grass
P.ARU	curlyleaf pondweed
P.CRI	waterpepper
P.NAT	floating leaf pondweed
R.CRI	curly dock
S.EME	bur-reed
S.LAT	wapato
S.SP	*Salix* species (willow)
T.LAT	broadleaf cattail

[a]Planting zone determinations are based on site observations and may differ slightly from the approximate planting zone boundaries shown in Figure 2.

[b]Native but listed in Whitson, T.D. (ed) et al., 2000. Weeds of the West (9th edition). Western Society of Weed Science in cooperation with Cooperative Extension Services, University of Wyoming, Laramie, Wyoming.

Native and invasive designations made according to USFWS (2010), Ridgefield National Wildlife Refuge comprehensive conservation plan. U.S. Fish and Wildlife Service. September.

FIGURES

Source: Aerial photograph (2015) obtained from National Agriculture Imagery Program.

Legend

- Road
- Mitigation Site

Figure 1
Site Location

Port of Ridgefield
Ridgefield, Washington

0 390 780
Feet

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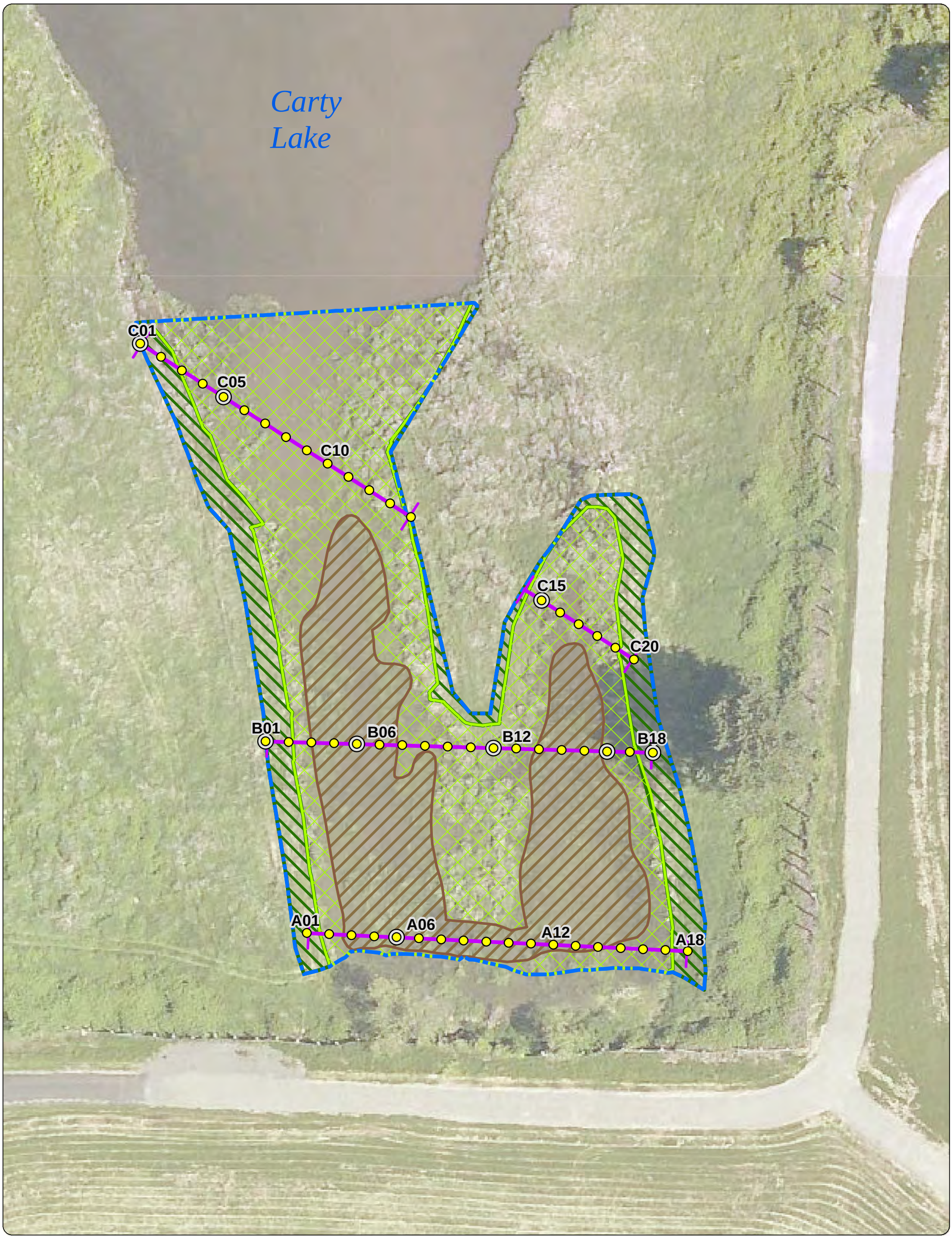
Project: 9003.01.40-06 Produced By: apadilla Approved By: P. Wiescher Print Date: 9/22/2016
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd



Source: Aerial photograph (2014) obtained from Clark County GIS.

Notes:
1. Aerial photo date precedes remediation and restoration activities conducted from 2014 through 2015.
2. Vegetation group boundaries are approximate.

Legend

- Sample Location
- Sample Photo Documentation Point
- Mitigation Site
- Vegetation Transect

Vegetation Groups

- Marginal (Approx. Elev 10 to 11)
- Emergent (Approx. Elev 8 to 10)
- Submergent (Approx. Elev 8 and Below)

Figure 2 Carty Lake Vegetation Transects

Port of Ridgefield
Ridgefield, Washington

0 25 50
Feet

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Project: 9003.01.40-06
Produced By: apadilla
Approved By: P. Wescher
Print Date: 9/22/2016

PHOTOGRAPHS

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 1.

Description
Fall 2013. Mitigation area before remediation. Reed canary grass is dominant vegetation. Looking northeast.

Photo No. 2.

Description
Winter 2014/15. Remediation area before plantings and temporary dam removal. Wildlife fencing installed. Looking northwest.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 3.

Description
August 2016.
Mitigation area.
Looking west.

Photo No. 4.

Description
August 2016.
Mitigation area.
Flowering wapato and bur-reed. Looking northeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 5.

Description
August 2016.
South end of mitigation area.
Looking north.

Photo No. 6.

Description
September 2017.
North end of mitigation area.
Looking southeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 7.

Description
September 2018. East end of mitigation area. Looking northwest.

Photo No. 8.

Description
September 2019. Southeast end of mitigation area. Looking northwest.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 9.

Description
October 2020. South end of mitigation area, looking north.

Photo No. 10.

Description
October 2020. Northwest end of mitigation area, looking southeast.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 11.

Description
October 2020. Photo point C1. Marginal zone. Waterpepper, bird's foot, and reed canary grass observed in vicinity.

Photo No. 12.

Description
October 2020. Photo point B18. Marginal zone. Spikerush, *Juncus* species, cattail, bird's foot, waterpepper, willow species, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 13.

Description
October 2020. Photo point C5. Emergent zone. American water plantain, bur-reed, waterpepper, nodding beggartick, cattail, spikerush, and reed canary grass observed in vicinity.

Photo No. 14.

Description
October 2020. Photo point C15. Emergent zone. Spikerush, bur-reed, wapato, cattail, waterpepper, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 15.

Description
October 2020. Photo point B11. Emergent zone. Spikerush, bur-reed, waterpepper, and reed canary grass observed in vicinity.

Photo No. 16.

Description
October 2020. Photo point B5. Submergent zone. Water lily, Canadian waterweed, duckweed, and Eurasian watermilfoil.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 17.

Description
October 2020. Photo point B16. Submergent zone. Mexican water fern, Canadian waterweed, duckweed, and Eurasian watermilfoil.

Photo No. 18.

Description
October 2020. Photo point B1. Marginal zone. *Juncus* species, cattail, willow species, and reed canary grass observed in vicinity.

PHOTOGRAPHS

Project Name: NWS-2013-1209
Project Number: 9003.01.55
Location: Carty Lake
111 West Division Street
Ridgefield, Washington

Photo No. 19.

Description
October 2020. Photo point A5. Submergent zone. Water lily, Canadian waterweed, duckweed, and Eurasian watermilfoil.

APPENDIX E-6

CARTY LAKE MAINTENANCE PLAN

CARTY LAKE MAINTENANCE PLAN

Carty Lake is part of the Ridgefield National Wildlife Refuge (RNWR) located north of the Port of Ridgefield (Port) Millers' Landing (see the attached figure). The purpose of this maintenance plan is to outline vegetation monitoring and maintenance of the (1) wetland area subject to Nationwide Permit 38 (NWS-2013-1209) required performance standards (i.e., the "permit area") and (2) the surrounding constructed embankment that is not subject to permit requirements (i.e., the "bank area").

Paul Brothers, Inc. (PBI) is under contract until October 2018 to maintain the permit and the bank area. After that, the Port will be responsible for maintenance; performance standards must be met in the permit area until 2020. No permit requirements are associated with the bank area; however, ongoing maintenance will enhance aesthetic qualities and help minimize invasive-species encroachment on the bank and into the wetland. Activities should be coordinated with the landowner (RNWR), as needed.

To help guide the user, **key recommendations are provided in bold** throughout the text.

1. BACKGROUND

As part of the Carty Lake remedial action, the permit area was excavated to remove sediment contamination and a failing retaining wall was removed. The elements were constructed in 2015 and included:

- Grading and installation of materials to stabilize the bank
- Planting of the permit area with native wetland species suited to the post-remedy elevations
- Planting of the bank area with native grasses, shrubs, and trees

The permit area was planted to establish a native plant community consistent with permit mitigation requirements for temporary impacts associated with the remedial action. The wetland is therefore subject to permit-required monitoring and maintenance as described in the Carty Lake Mitigation Plan. This plan provides additional information to meet the permit-required performance standards (provided for reference in Section 6) and to promote successful establishment of the permit area.

The bank area surrounding the permit area was revegetated with native species to provide separation from surrounding nonnative species that may encroach on the permit area. The bank area is not subject to permit-required monitoring and maintenance. This plan also provides information regarding inspection and maintenance of this area.

2. MAINTENANCE OVERVIEW

Maintenance is critical for the first three to five years to ensure the survival and growth of the plantings. **Annual maintenance should include irrigation and weed control at a minimum, until plants are established enough to outcompete invasive species.** Site inspections should take place regularly (twice a year at a minimum is recommended) to assess irrigation needs and

inspect weed growth, damage to plants, and other problems. A general recommended schedule is presented below:

Activity	Timing	Area	Notes
Site Inspection	Fall and spring (2016 and on)	Permit and Bank Area	General inspection.
Irrigation	Every two weeks between April and August, as needed. Every three to four weeks in September/ October, as needed (2016–2022)	Bank Area	**See Section 3 for details.** Port responsible beginning in fall 2018. In 2020, evaluate need for continued watering.
Weed control	April through October (2016 and on)	Permit Area	**See Section 4.1 for details.** Port responsible beginning in fall 2018.
Weed control	April through October (2016 and on)	Bank Area	**See Section 4.2 for details.** Port responsible beginning in fall 2018.
Plant Replacement / Damage Control	Fall, as needed (2016–2020)	Permit Area	**See Section 5 for details.** Beginning in fall 2018, Port responsible for plant replacement to meet performance standards, as needed.
Plant Replacement / Damage Control	Fall, as needed (2016-2020)	Bank Area	**See Section 5 for details.** Beginning in fall 2018, Port responsible for plant replacement, as needed.
Monitoring for Performance Standards	Between June and October (2016–2020)	Permit Area	**See Section 6 for details.** Port responsible for vegetation monitoring to assess performance standards. MFA is currently conducting monitoring.
Activity Scheduling	2016 and on	Permit and Bank Area	**See Section 7 for a detailed recommended schedule.**

3. IRRIGATION

Irrigation of the bank area is strongly recommended for the first three to five years after installation. The native shrub and tree species planted are adapted to Pacific Northwest conditions and should not require long-term irrigation to survive after three to five years, i.e., once they are established. Plantings were installed in 2015; however, some plants will be replaced, likely in fall 2017. **Therefore, irrigation of the bank area between April and October until at least fall 2020 is recommended.** At that time, the need for additional irrigation through 2022 can be assessed. **The permit area is a wetland and does not require irrigation.**

PBI is responsible for adequate irrigation through October 2018. **After October 2018, the Port will be responsible for irrigation.** The Port likely will not need to irrigate until April 2019.

Watering via hoses connected to existing in-ground quick couplers is recommended. An in-ground quick coupler valve was installed at each planting grove to access local water. Other methods, such as a temporary automatic drip system connected to a local water supply, could be used; however, these typically require more ongoing maintenance. While drip systems are the most efficient systems from a water use standpoint, components frequently break and it is imperative that

the system be checked regularly during summer months to ensure continued delivery and avoid plant die-off.

The bank area should be watered **every two weeks between April and August**. Drying down at the end of the growing season helps induce dormancy and increase winter hardiness, so taper down to irrigation **every three to four weeks in September and October**. Care should be taken to **water deeply and slowly to thoroughly wet the rooting zone and avoid soil erosion**. In the event that summer months are more moderate than typical and soil retains moisture or wet areas persist, the watering frequency can be reduced.

4. WEED CONTROL

During vegetation establishment, competition for light and nutrients from weeds can cause mortality and reduce native plantings growth. Additionally, dense grasses create desirable habitat for rodent species that may damage plants. Invasive weeds found in upland areas and along the edges of the wetland may include Himalayan blackberry and reed canary grass; in wetland in-water areas Eurasian milfoil and curlyleaf pondweed are common (see photos below). **Weed control in the permit area and the bank area should be conducted annually between April and October until at least spring 2020,** at which time the need for annual weed-control measures can be assessed.

PBI is responsible for adequate weed control in the permit and bank areas through October 2018. **After October 2018, the Port will be responsible for weed control.** The Port likely will not need to weed until April 2019.

Recommended weed-control methods include mowing, manual control (hand pulling), and mulching. Chemical treatment is not recommended and coordination with the RNWR would be required.

Typical Weeds

Reed canary grass

Blackberry

Thistle

Eurasian milfoil

Curlyleaf pondweed

4.1. Permit Area

To meet the permit-required performance standards, invasive plant species shall not exceed 20 percent aerial cover in the permit area between 2016 and 2020.

Along the edges of the water, hand pulling and small tools (e.g., hand trowels) are labor-intensive but can be effective for controlling certain weeds. **Blackberry and reed canary grass can spread quickly and should be removed with hand tools at least every two months between April and October.** Care should be taken to thoroughly dig up and remove the roots and rhizomes without disturbing nearby native plants. Hand tools can also be used to remove herbaceous weeds that can grow quickly, such as thistle.

In the wetland in-water areas, invasives such as Eurasian milfoil can spread quickly. Milfoil is present in the hydraulically connected Carty Lake, and therefore any attempts to control spread in the wetland may have limited success, as reestablishment is nearly certain. Milfoil is very difficult to control and can spread from fragments created when disturbed (e.g., when hand pulling). Therefore, chemical controls may be needed if milfoil is present and these likely would be effective only if implemented throughout Carty Lake. **Any attempt to control in-water weeds should therefore be coordinated with a landscape architect or biologist and the RNWR.**

4.2. Bank Area

Use of a handheld weed trimmer for mowing at least once a month between April and October is recommended to keep woody weeds under control. The bank is steep and a hand-push mower should not be used in the permit area, since the native plants are densely spaced. **Care must be taken to avoid mowing the native plantings.**

Mowing alone is not a good way to control perennial weeds. Hand pulling and small tools (e.g., hand trowels) are labor intensive but can be more effective for controlling certain weeds. **Blackberry and**

reed canary grass can spread quickly and should be removed with hand tools at least every two months between April and October. Care should be taken to thoroughly dig up and remove the roots and rhizomes without disturbing nearby native plants. Hand tools can also be used to remove herbaceous weeds that can grow quickly, such as thistle and Queen Anne's lace.

Mulches are effective for suppressing weeds around planted seedlings and retaining moisture into the summer. Various mulch materials are available. **Mulching should be applied every April around the base of each tree and shrub**. The recommended minimum mulching diameter is 2 to 3 feet and the depth 2 to 6 inches.

5. PLANT REPLACEMENT AND DAMAGE CONTROL

The permit area is subject to native plant performance standards provided in Section 6. Plant replacement will be based on the results of the annual permit-required monitoring. **It may be necessary to replace dead or failing plantings to meet the performance standards.** MFA is currently conducting the monitoring (required annually until 2020) and associated reporting.

PBI is responsible for replacing plants to meet performance standards through October 2018. **After October 2018, the Port will be responsible for replacing vegetation to meet performance standards.**

Plant replacements in the permit area, as needed, would be planted in the fall. The number, type, location, and planting methods for replacement plants will be based on the results of the annual permit-required monitoring and will be described in the associated monitoring report. The bank area does not require vegetation replacement for permit purposes; however, replacements will be coordinated with PBI to meet construction specifications, as needed, through October 2018.

Controlling weeds to promote rapid seedling growth will help minimize many animal-damage problems. **However, if animal damage to plants is observed during the biannual site inspections, appropriate methods will be evaluated based on type of damage and animal species.** Physical methods of damage prevention (e.g., fences, cages, and tubes) are useful, but they are also expensive and require periodic inspection and maintenance. Applicable methods, if needed, would be further described in the permit area monitoring report.

6. PERMIT AREA MONITORING AND PERFORMANCE STANDARDS

The permit area will be monitored annually for five years (2016–2020) to assess performance standards. The goal of the monitoring inspections is to determine the growth of the installed plant material, as well as the extent of invasive-plant encroachment. MFA is currently conducting monitoring and reporting consistent with the Carty Lake Mitigation Plan on behalf of the Port. Performance standards are also provided below for reference.

Objective 1.1 (Grade substrate as specified in the grading plan) relates to completed wetland grading.

Objective 1.2: Establish a predominantly native plant community.

Performance Standard 1.2: The areal cover of native species shall be at least 20 percent by Year One, 40 percent by Year Three, and 60 percent by Year Five. Replace dead or dying plants as needed to meet the performance standard.

Objective 1.3: Significantly reduce invasive-plant cover.
Performance Standard 1.3: During all monitoring, nonnative, invasive plant species will not exceed 20 percent areal cover.

Objective 1.4: Create a diverse native plant community.
Performance Standard 1.4: By Years 3 and 5, at least three different native species shall be present. To qualify, a species must have at least 5 percent average cover in the habitat class and must occur in at least 10 percent of the plots sampled.

7. SCHEDULE

A recommended maintenance schedule is provided in the attached table.

8. ADAPTIVE MANAGEMENT

The site inspections will provide a basis of information for evaluating the wetland and bank vegetation. If the Port, its representatives, or RNWR believes adaptive management is needed, options can be discussed collaboratively.

LIMITATIONS

The services undertaken in completing this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan.

TABLE

Table
Carty Lake Maintenance Schedule
Former PWT Site
Ridgefield, Washington

Area	Activity	Port Responsibility Start Year[(a)]	April	May	June	July	August	September	October
Permit and Bank Area	Site Inspection	2016	X	--	--	--	--	--	X
Permit Area	Weed control (manual control along water's edge)	2019	X	--	X	--	X	--	X
	Plant Replacement (coordinate with landscape architect)	2019	--	--	--	--	--	--	X
	Performance Standard Monitoring (MFA currently conducting)	2016	--	--	X				
Bank Area	Irrigation (by hand via hoses)	2019	XX	XX	XX	XX	XX	X	X
	Weed control (handheld weed trimmer mowing)	2019	X	X	X	X	X	X	X
	Weed control (manual control)	2019	X	--	X	--	X	--	X
	Weed control (mulching)	2019	X	--	--	--	--	--	
	Plant Replacement (coordinate with landscape architect)	--	--	--	--	--	--	--	X

NOTES:

MFA = Maul Foster & Alongi, Inc.

Port = Port of Ridgefield.

X = one event.

XX = two events (every two weeks).

[(a)]Indicates year in which Port staff or a contractor should be engaged to complete activities. Before the specified year, activities are not required or are conducted by Paul Brothers, Inc. under a contract through October 2018, with oversight provided by MFA.

FIGURE

Source: Aerial photograph (2013) obtained from the National Agriculture Imagery Program (NAIP).

Legend

- Bank Area
- Permit Area
- Road/Trail

Figure
Vegetation Maintenance Areas
Carty Lake

Port of Ridgefield
Ridgefield, Washington

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Feet

Project: 9003.01.40 Produced By: jschane Approved By: P. Wieschner Print Date: 3/31/2017