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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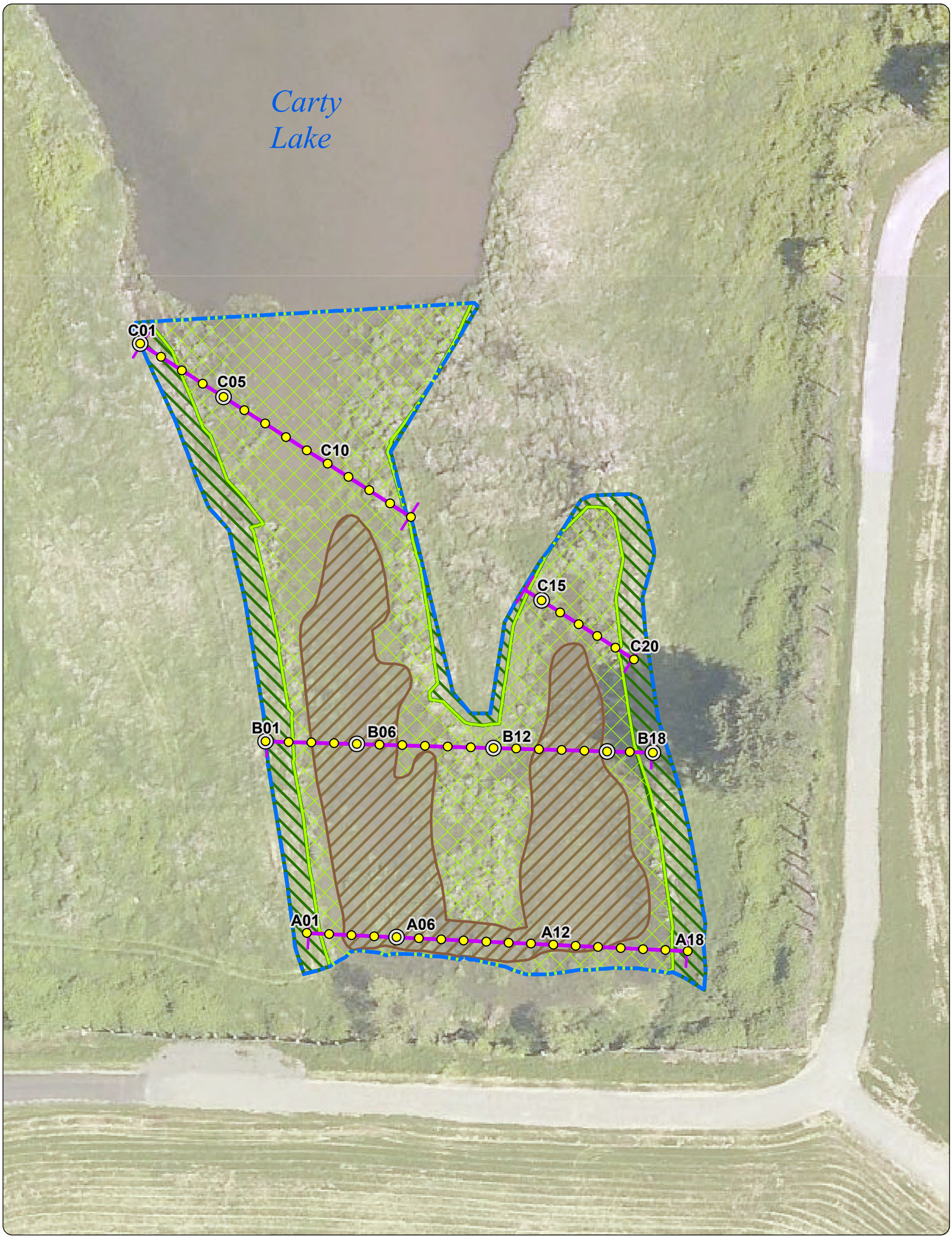
Path: X:\9003.01 Port of Ridgefield\40\Projects\06\Fig1_Site Location_CartyLake.mxd



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

Notes:
1. Aerial photo date precedes remediation and restoration activities 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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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.