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December 31, 2014

Russ Klassen ODSL/ODOT Liaison 775 Summer Street N.E., Suite 100 Department of State Lands Salem, OR 97301-1279 Phone: 503-986-5244 Email: Russ.Klassen@state.or.us

Anita Andazola U.S. Army Corps of Engineers North Bend Office Compliance & Enforcement 2201 Broadway, Suite C North Bend, OR 97459

SUBJECT: Annual Mitigation Monitoring Report for Off-site Mitigation for: USCOE Permit # NWP-2006-943 DSL Permit # 37571-RF Project Name: North Fork Siuslaw River Bridge Replacement (Hwy 126 MP 0.8-1.51) Lane County, Oregon (ODOT Key # 11791)

Dear Russ and Christopher:

Enclosed you will find the annual monitoring report for the above referenced mitigation site that was constructed in the year 2007. According to the permit requirements, ODOT is required to monitor this site for 15 years to demonstrate whether the site is meeting permit conditions and success criteria. This report fulfills our monitoring requirement for year 7.

Our assessment is that the compensatory mitigation site has met 7 of 8 of the benchmarks required by the permit conditions and is on a good trajectory towards the desired conditions (forested and shrub tidal wetland). Full tidal hydrology is present and the site meets wetland regulatory criteria. Sitka spruce plantings have been highly successful, but heavy browse pressure and competition from reed canarygrass have limited survival and growth of planted shrubs. Some additional Sitka spruce plantings have been conducted at the site to increase spruce density, but further spruce and willow plantings in specific areas are recommended to speed the full development of native woody vegetation at the site.

Please refer to the enclosed report for our full findings and recommendations. If you have any questions regarding this report, please contact me at (541) 752-7671 or by email at <u>brophyonline@gmail.com</u>.

Sincerely,

Lama D. Brophy

Laura Brophy Principal

# Compensatory Wetland Mitigation (CWM) Monitoring Summary Form By the Oregon Department of State Lands For Oregon Department of Transportation CWM Projects

Permit Number <u>37571-RF (Off-site Mitigation ONLY)</u> Monitoring Year <u>Year 7 of 15 yrs required (2014)</u> County Lane ODOT Key # <u>11791</u> Authors Laura Brophy, Laura Brown

SC	R	FR	Results summary/comments
1	1		Post-construction measurements verified construction per specifications, as described in the Year 1 (2008) monitoring report.
2	1		Wetland determination in 2012 indicated the entire site is wetland, as described in the Year 5 (2012) report.
3	1		Tide gauges at the mitigation site and reference site verified that water levels are the same at both sites, as described in the Year 2 (2009) monitoring report.
4	2	5	The site met 4 of 5 benchmarks for this criterion: 1) significant increase in cover of native woody species; 2) significant decrease in reed canarygrass cover; 3) 108% survival of plantings, and 5) virtually no invasive species cover (other than reed canarygrass). Benchmark 4 was not met; it requires a significant increase in native tree and shrub stem counts within the vegetation monitoring plots. This increase could come from multiplication of stems of plantings, or from natural recruitment. Reasons for failure are: 1) the most successful species on the site (Sitka spruce) has grown rapidly but does not spread vegetatively; 2) shrubs have produced new stems, but they are attached to the original planting and therefore are not counted as new individuals; and 3) natural recruitment of shrubs is not yet occurring in the plots (which are located in the center of the site). Despite the failure to meet Benchmark 4, the trajectory of vegetation development is clearly towards the target (shrub and forested tidal wetland). Additional plantings could speed progress towards the target; see <b>Recommendations</b> below. This criterion will be evaluated again in 2016.

**Summary of recommendations:** Site is successful and meets 7 of 8 benchmarks (3 of 4 success criteria and 4 of 5 benchmarks for the 4<sup>th</sup> criterion). Additional plantings in specific areas are recommended to speed the development of native woody vegetation.

List of success criteria (from Off-site Mitigation Plan pages 22-23):

• Criterion 1: Restoration design is implemented to specifications.

• Criterion 2: 4.2 ac of existing wetland remains wetland throughout the monitoring period as mitigation for impacts at N. Fork Siuslaw River Bridge.

• Criterion 3: Tidal influence is restored, creating a tidal inundation regime similar to that of the reference sites (after adjusting for relative elevations).

• Criterion 4: Scrub-shrub and/or forested vegetation is established within the 4.2 ac pasture area, with woody stem densities on a trajectory towards those of the reference sites.

#### Result (R):

- 1. Met
- 2. Not Met
- 3. Indeterminate (needs monitoring data)

4. Incomplete (mitigation not completed)

#### Failure Reason (FR):

- 1. Construction specifications not followed
- 2. Design assumptions flawed
- 3. Hydrological source altered
- 4. Not done (submitted reports, documentation, etc.)
- 5. Other

### Mitigation Data Form for Off-Site Mitigation (There is a separate form for on-site mitigation)

<b>Reg Hepacehold Dol Laison Obbl</b> , Russ Russen <b>1</b>	<b>Key</b> #11791	j Name: N. Fork Siuslaw River Bridge Replacement ODOT Liais	on: ODSL, Russ Klassen	12-31-14
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Authorized Impact,																		
Mitigation Type	Acreage*					HGM Class*					Cowardin Class*							
Auth. Permanent Impact	1.38 Ac.	1	0.35 Ac	2	0.025Ac.	3	MSL/ MSH	1	EMS Intertidal	2	EMS Subtidal	3	E2EM/ SSN	1	E2US3M	2	E1UBL	3
Mit. Creation		1		2		3		1		2		3		1		2		3
Mit. Enhancement		1		2		3		1		2		3		1		2		3
Mit. Protection		1		2		3		1		2		3		1		2		3
Mit. Restoration	4.2 Ac.	1		2		3	RS Fully tidal	1		2		3	PFOR/ PSSR	1		2		3
Mit. Bank Credits		P	TP credit	s*			Bank Na	ame										

Note: Be sure that acreage, HGM, and Cowardin class boxes correspond, i.e., if acreage is 0.5<sup>2</sup>/, then you are reporting that this relates to RFT<sup>2</sup>/ in the HGM class, and PFO<sup>2</sup>/ in Cowardin class. If you have more than 3 of any impact or mitigation type, use the back of this sheet and write **OVER** on this side.

\*Additional Impacts: Eelgrass Beds: 0.26 ac. From shading, work bridge bents. HGM class: EMS (Estuarine Marine Sourced). Cowardin Class: E1AB (Estuarine Subtidal, Aquatic Bed).

\*Additional Mitigation: Eelgrass Transplanting. Acreage to be determined/measured. Location: SW and NW of bridge.

\*On-Site Mitigation: For this form, contact Irene Ulm, ODOT Wetland Specialist 541-757-4107

Protection 1 state-owned pr	「 <b>ype</b> (not req'd if on ODOT or operty)	Bonding Type (not req'd for ODOT)	Bond Amount	
	· · · · · · · · · · · · · · · · · · ·	None Required	\$	
Conservation Conse	ation Easement ve Covenant in Deed striction	<ul> <li>Surety Bond</li> <li>Letter of Credit</li> <li>Assignment of CD</li> <li>Other:</li> </ul>	Ave. Buffer Width ft	
Monitoring				
Years:	15	Report Due: Dec 31	As-Built Done:	Aug 2007

#### Mitigation Site Location (Only if different from impact site. Add pages for additional sites.)

Site Number (if applicable):	S65 (site # from Tidal Wetland Prioritization for the Siuslaw River Estuary, Brophy 2005)
Name (if applicable):	Weathers site; Site S65
Water body (on or adjacent):	North Fork Siuslaw River
City (if in city limits):	
County (required):	Lane
Tax Lot (if applicable):	Tax Lot 1201, S 1/2 Sec 7, Township 18S, Range 11W
TRSQQ:	18S 11W, S 1/2 Sec 7

Annual Compensatory Wetland Mitigation Monitoring Report for 2014 (Year 7) Off-site Mitigation, North Fork Siuslaw River Bridge Project



Google Earth imagery of mitigation site (imagery date: 7/22/12). Over 100 planted Sitka spruce can be seen within the restored area (dark dots in grassy former pasture).

# December 31, 2014

Prepared by: Laura Brophy <sup>1,2</sup> Laura Brown <sup>2</sup>

<sup>1</sup> Green Point Consulting, Corvallis, Oregon <sup>2</sup> Estuary Technical Group, Institute for Applied Ecology, Corvallis, Oregon

Prepared for: Oregon Department of Transportation Salem, Oregon



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## Compensatory Wetland Mitigation Monitoring Report Off-site Mitigation, North Fork Siuslaw River Bridge Project

ODOT Key Number: 11791	Region/County:
Corps Permit # NWP-2006-943	DSL permit # 37571-RF
ODOT Contact name, address	Irene Ulm
	ODOT Region 2 Wetlands Specialist
	3700 SW Philomath Blvd.
	Corvallis, OR 97333
Monitoring conducted by:	Laura Brophy, Green Point Consulting
Date(s):	Laura Brown, Estuary Technical Group,
	Institute for Applied Ecology
	August 7, 2014
Driving Directions to the mitigation site:	Hwy 126 W to N Fork Siuslaw River
	Road. Drive N on N Fork Rd ~2.1mi to
	wooden bridge across N Fork. Cross
	bridge; drive 1.7mi NE on dike road to
	site.
Site constructed date:	August 2-11, 2007
Planting completed:	March 3-14, 2008; additional Sitka
	spruce planted during 2008-2012.
Grading completed:	August 11, 2007
Corrective maint- spraying for weeds (date(s)):	none
Corrective maint- other (list):	none

## Section 1. Introduction/Project Overview (Off-site Mitigation only):

#### Summary

This report describes results of monitoring at the off-site mitigation area, which provides mitigation for wetland impacts at the bridge that was constructed by the Oregon Department of Transportation (ODOT) at the mouth of the North Fork of the Siuslaw River (the "North Fork Bridge"). The phrase "mitigation site" in this document refers only to the off-site mitigation area. A separate report describes monitoring at the on-site mitigation area.

Please refer to the attached mitigation data form for the acreage and type of wetland impacts and the mitigation acreage and type.

Monitoring results are summarized in this document; raw data are available on request.

#### Mitigation site location description

The mitigation site is located on Tax Lot 1201, in the S 1/2 of Section 7, Township 18S, Range 11W. It is at approximately River Mile 5 on the North Fork Siuslaw River. See Appendix 1 for vicinity and site maps.

## Section 2. Requirements/Goals, Objectives, Success Criteria (maximum 1 page)

See the Mitigation Plan for details (Brophy 2007, Off-site Mitigation Plan: North Fork Siuslaw River Bridge).

**Goal:** The goal of the off-site mitigation work is to restore 12.2 ac of tidal swamp (scrub-shrub and/or forested tidal wetland), by re-establishing the controlling factors typical of undisturbed river-sourced tidal wetlands.

- **Objectives:** 1. Restore 12.2 ac of tidally-influenced scrub-shrub and/or forested wetland;
  - 2. Re-establish tidal hydrology;
  - 3. Re-establish native tidal swamp vegetation.

**Special Conditions not included in Success Criteria:** *Partially bury at least 10 root wads, or LWD pieces with root wads attached, with minimum diameters of 18 inches, adjacent to tidal channels; record locations in as-built survey (ACE Sp. Cond. 6B, DSL Sp. Cond. 17).* This Special Condition was met, as described in the Year 1 monitoring report (Brophy 2008). The LWD pieces are still in place as of summer 2014.

**Success Criteria summary:** The project currently meets all Special Conditions and Success Criteria 1, 2, 3 and 4. **Success criterion 1:** Restoration is implemented to specifications.

**Monitoring and evaluation method:** Measurement of as-built conditions during and after construction. **Benchmark:** This criterion will be met if as-built conditions match the specifications listed in "Construction Specifications" in the Mitigation Plan, and in Appendix 5 of that Plan, "Construction Methods."

Success criterion 2: 4.2 ac of existing wetland remains wetland throughout the monitoring period.
 Monitoring and evaluation method: Wetland determination following current regulatory methods.
 Benchmark: This criterion will be met if wetland determination shows that the mitigation area meets the regulatory definition of wetland 5 and 15 years after implementation of restoration (in 2012 and 2022).

**Success criterion 3:** Tidal influence is restored, creating a tidal inundation regime similar to that of the reference sites (after adjusting for relative elevations).

**Monitoring and evaluation method:** Continuously-recording tide gauges operated for 2 full years at restoration and reference sites; elevation survey by ODOT in 2007 for comparison to tide heights. **Benchmark:** This criterion will be met if the majority of the off-site mitigation area is subject to inundation with depth, duration, frequency and timing comparable to similar elevations at N. Fork Siuslaw reference site.

**Success criterion 4:** Scrub-shrub and/or forested vegetation is established within the 4.2 ac pasture area, with woody stem densities on a trajectory towards those of the reference sites.

**Monitoring methods:** Cover estimates, measurements of survival of plantings, and woody stem counts in four vegetation plots established in 2006 and one plot established in 2007. To improve monitoring of plantings, three additional large monitoring blocks were established in 2008 (see Appendix 1, Map 5). **Benchmark:** *This criterion will be met if:* 

- 1) Vegetation shows a statistically significant increase in percent cover of native shrubs and trees within Plots 1, 3 and 4 by 2012. (Plot 2 was dominated by native shrubs at project implementation).
- 2) Reed canarygrass cover shows a significant decrease by 2012 and this trend continues through 2022.
- *3)* Survival of planted trees and shrubs is at least 60% during 2009.
- 4) Stem counts for native trees and shrubs in Plots 1, 3 and 4 have increased significantly between 2008 and 2012, and Sitka spruce stem counts average 40% of reference site counts by 2022.
- 5) Non-native, invasive species (not including reed canarygrass) shall not exceed 10% coverage at any time after the third year following mitigation site construction.

### Section 3. Methods/Summary Data (maximum of 4 pages- including photos).

See Appendix 1, Map 1 for vicinity, Map 2 for topography, and Map 3 for site landmarks and restoration elements.

# Success Criterion 1 ("Restoration is implemented to specifications") Evaluation: MET

As described in the Year 1 monitoring report, this success criterion was met in 2008.

# Success criterion 2 ("4.2A of existing wetland remains wetland...") Evaluation: MET

The 4.2 ac of existing wetland that was restored in 2007 remains wetland in 2012, as described in the Year 5 report (Brophy 2012).

### Success criterion 3 ("Tidal influence is restored...") Evaluation: MET

As described in the Year 2 monitoring report (Brophy 2009), this success criterion was met in 2009.

# Success criterion 4 ("Scrub-shrub and/or forested vegetation is established...") Evaluation: 4 of 5 benchmarks met; 1 benchmark not met.

**Benchmark 1 (MET)** states that vegetation must show a statistically significant increase in percent cover of native shrubs and trees within Plots 1, 3 and 4 between time of planting (March 2008) and 2012. This benchmark was met in 2012, as described in the Year 5 monitoring report (Brophy 2012). Cover of native shrubs and trees in 2014 (16.4%) was higher than in 2008 (6.3%) (p < 0.1), but not significantly different from 2012 (17.1%) (p = 0.82).

**Benchmark 2 (MET)** states that percent cover of reed canarygrass must show a significant decrease by 2012, and this trend must continue through 2022. As described in Brophy (2012), percent cover of reed canarygrass decreased significantly from 2006 to 2012. Between 2012 and 2014, cover of reed canarygrass continued to decrease in Plots 1, 3 and 4, dropping from 62.1% in 2012 to 53.6% in 2014. Although the decrease from 2012 to 2014 was only marginally significant (p < 0.1), it represents a continuation of the 2006-2012 downward trend, and this benchmark was therefore met. Plot 2 was omitted from this analysis because it was not part of the planted area. Increasing native cover in the plots is illustrated in Figure 1, Section 4.

**Benchmark 3 (MET)** states that survival of planted trees and shrubs must be at least 60% during 2009. This benchmark was met in 2009, but we continue to monitor survival of plantings to help evaluate restoration trajectory. Average survival (across all species) was 108% in 2014. Sitka spruce survival was well over 100% (167%) due to additional plantings during 2008-2009 (Figure 4, Section 4). Pacific crabapple survival also slightly surpassed 100% (104%), due to recruitment of two additional plants of this species. Survival was lowest for black twinberry (32%); only 7 of the 22 planted twinberry shrubs remain. However, some individuals of this species may have been missed during counts because they were planted near the margins of pre-existing willow stands and are now being overgrown by willows, which are gradually spreading into the site.

**Benchmark 4 (NOT MET)** states "Stem counts for native trees and shrubs in Plots 1, 3 and 4 must increase significantly between 2008 and 2012, and Sitka spruce density must average 40% of reference site counts by 2022." The 2012 part of this benchmark was not met, even when reevaluated in 2014. For all species, the number of stems within original plantings increased between 2012 and 2014, but these were not counted for this benchmark because they were not at least 1 m away from the original planted stem (as recommended by Irene UIm, personal communication, 12/29/14). Although this benchmark was not met, the planted trees and shrubs did grow substantially during 2012-2014, as described below.

**Benchmark 5 (MET)** states that non-native, invasive species (not including reed canarygrass) shall not exceed 10% coverage at any time after the third year following mitigation site construction. 2014 is the seventh year of monitoring, so this benchmark is currently applicable. The site clearly meets this benchmark. No non-native invasive species (other than reed canarygrass) had more than 2% cover in 2014. The only non-native species (other than reed canarygrass) that had any substantial cover prior to construction (cutleaf blackberry, *Rubus laciniatus*) averaged less than only 0.6% cover overall in 2014, which is not significantly different from its 2012 cover of 0.1% (p = 0.14).

### **Monitoring performed**

Monitoring in 2014 followed the same protocol as in previous years. The protocol is described in detail in the Year 1 monitoring report (Brophy 2008).

### Vegetation monitoring methods

Vegetation monitoring plots are illustrated in Map 4, Appendix 1; the rationale for their locations was provided in the Year 1 monitoring report (Brophy 2008). All plots were monitored for the seventh time in 2014. From 2014 through 2022, the plots will be monitored every 2 years; the 15 year monitoring period will end in 2022.

As described in the 2008 monitoring report, we established three monitoring blocks for determining percent survival of plantings (Map 5, Appendix 1), because the vegetation monitoring plots were too small to provide an adequate sample size for monitoring woody plantings. None of the blocks had any woody vegetation during baseline monitoring in 2006. The monitoring blocks total 0.65 ac and were planted with 77 shrubs and trees, an adequate sample size for determining survival. During 2009-2014, in addition to making measurements of survival, we used these blocks to test three herbivory protection methods (see "*Protection from herbivory*" below).

Within the monitoring blocks, all woody stems >1 cm diameter were counted and their diameter was measured at breast height (dbh). Stem diameters were summed for the total diameter per plant. Stems located within 1m of the original planted stem were considered part of the original planting, and were not counted separately for purposes of stem count benchmarks.

Although performance standards do not require measuring the height of woody plantings at the site, we have used plant heights in the past to measure the effectiveness of different herbivory protection methods (see "*Protection from herbivory*" below). However, in 2012 and 2014, many of the Sitka spruce and some of the shrubs had grown above 10ft, so their height was no longer measurable using our original methods (tape measure). Therefore, starting in 2012, we used diameter at breast height (dbh) to assess growth of woody plantings. Stem diameter has been measured every year and will continue to be used to assess growth of plantings in future years.

Herbivory protection method was recorded in three categories in 2014: 1) Vexar; 2) wire exclosure, and 3) unknown (no visible protection method). In 2014, herbivory protection method no longer affected plant growth or survival (see "*Protection from herbivory*" below), and many of the herbivory protection structures were heavily deteriorated. Therefore, herbivory protection method may not be recorded in future monitoring years.

# Vegetation monitoring results

Vegetation at the off-site mitigation area has met 4 of the 5 applicable benchmarks, as described above. Further information is provided below.

*Cover of native species* continued to increase in 2014 compared to previous years (Figures 1-3, Section 4; Tables 1 and 2, Appendix 3). As described in Section 3 above, reed canarygrass cover (averaged across all plots in the planting area) decreased from 92.8% prior to restoration in 2006-2007, to 53.6% in 2014 (p < 0.0001). The decrease in reed canarygrass cover was likely due to shading by willows in Plot 3, and by increased dominance by native herbaceous species (mainly black vetch [*Vicia nigricans*] and cow parsnip [*Heracleum maximum*]) in Plot 4. Plot 1 has showed a significant decrease in reed canarygrass cover since 2006, from 92.1% in 2006 to 72.1% in 2014 (p < 0.01), likely due to an increase in black vetch and slough sedge (*Carex obnupta*). Cover of Hooker's willow (*Salix hookeriana*) held steady through 2014 in Plot 2 (which had high cover of willow prior to restoration), but slightly decreased since 2012 in Plot 3. Overall, willow cover in Plot 3 increased dramatically from 2006 to 2014 (1.5% to 56.3% respectively) (Figure 2, Section 4). Sitka spruce cover in Plot 4 increased substantially between 2012 and 2014, from 2.0% to 6.8% (Figure 3, Section 4).

*Survival of woody plantings:* Survival of woody plantings across all species was 107.8% in 2014 (Figure 4, Section 4), with Sitka spruce survival over 100% due to additional plantings during 2008-2012. Pacific crabapple survival was also slightly over 100%, due to two additional plants counted in 2014 that were either missed during earlier counts, or recruited naturally. Survival of these two species is expected to be high in future years, since most individuals had grown tall enough by 2014 to escape browse pressure (see "**Protection from herbivory**" below). Black twinberry survival was lowest at 31.8%, but these plants can be difficult to locate due to their growth habit (they tend to fall over when stem diameter increases) and their location (near the edges of willow stands), so actual survival may be higher.

*Growth of woody plantings:* Stem diameter of Sitka spruce plantings has increased steadily since 2008, and this trend continues through 2014 (p < 0.0001) (Figure 5, Section 4). This rapid growth in diameter reflects the robust condition of most spruce on the site (Appendix 3, Table 3). Average stem diameter for Pacific crabapple and black twinberry stem increased between 2008 and 2014; the increase was significant for crabapple (p < 0.0001) but not for twinberry (p = 0.16) (Figure 5, Section 4).

*Willow cuttings:* Conditions at this site are appropriate for willow, based on the lateral spread of existing willow patches at a rate of 2-3 ft per year. However, surprisingly few of the willow cuttings planted on the site have survived. In 2010, we observed willows beginning to emerge above the reed canarygrass canopy along the pilot channel, but in 2014, few of these remain visible. Use of taller willow cuttings during initial planting might have helped, although willow cuttings sometimes die back to the base after transplanting. Additional willow plantings are recommended (see "*Recommendations*" below).

*Protection from herbivory:* As described in previous reports, plantings were protected from herbivory during 2008-2010 by spray repellant, tall Vexar<sup>®</sup> mesh (6 ft), or wire exclosures (6 ft). The Vexar<sup>®</sup> tube extensions were used only for the black twinberry and Pacific crabapple plantings.

In 2014, herbivory protection method no longer had a strong effect on size or survival of plantings. The effects of herbivory protection method were seen mainly in the first few years of growth, when browse caused high mortality of shrubs. Regardless of protection method, most Sitka spruce were robust and grew fast from 2012 to 2014 (Figures 5 and 6, Section 4; Table 3, Appendix 3). Also regardless of protection method, most of the Pacific crabapple plantings were tall enough by 2014 to escape browse pressure (Table 3, Appendix 3), and were producing many new branches of substantial diameter (Figure 5, Section 4). Black twinberry plantings had high mortality from project inception to 2014; only 7 of the original 22 twinberry plantings (31.8%) survived in 2014. However, the surviving black twinberry shrubs were grew faster from 2012-2014 than in past years (Figure 5, Section 4). Based on our field observations at many wetland sites, the stems of black twinberry tend to fall over and grow horizontally near the ground after reaching 2-3 cm diameter. Because of this somewhat sprawling growth habit, few black twinberry shrubs have exceeded 10 ft height in 2014, and this is not expected for future years.

From 2012 to 2014, herbivory protection structures continued to deteriorate. In 2014, many of the wire exclosures were collapsing due to decay of their wood stakes. The wire was confining and possibly injuring the stems of the more robust plantings. We recommend removal of the collapsing structures and wire, and replacement of support stakes as needed for the structures that are still upright and functional (see "*Recommendations*" below).

#### Photodocumentation

Photodocumentation was conducted each monitoring year from 2006 through 2014, at locations illustrated in Map 6, Appendix 1. Appendix 2 contains the 2014 photographs.





Figure 1. Changes in percent cover of herbaceous species in permanent vegetation monitoring plots 1-4 from 2006 to 2014. Species with >2% percent cover are shown.



Figure 2. Changes in percent cover of Hooker's willow (*Salix hookeriana*) in permanent vegetation monitoring plots 2 and 3 from 2006 through 2014.







Figure 4: Survival of woody plantings, 2008-2014. Woody species were planted in March 2008. Number of surviving plantings is shown. Average survival overall was 107.8%; survival is >100% for spruce due to additional plantings in 2009-2010.



Figure 5: Growth of stem diameter for woody plantings, 2008-2014. Stems >1 cm in diameter were measured and summed per plant, then averaged by species.



Figure 6: Average stem diameters (dbh) by species for woody plantings with three different herbivory protection methods, 2014. See Figure 5 for stem measurement methods.

### **Section 5. Conclusions/Results/Recommendations** (maximum 1 page)

At the time of monitoring in 2014, this mitigation site was evidently successful, meeting nearly all of the success criteria and benchmarks. The site has full tidal exchange and meets wetland criteria. Survival of Sitka spruce plantings has been very high; spruce plantings are growing very well, which in turn is reducing the percent cover of reed canarygrass. Shrub survival has stabilized, and adjacent willow patches are advancing into the site; willows will probably cover much of the site over time. Herbaceous vegetation shows a trajectory towards dominance by native species.

One benchmark was not met (native woody stem density within vegetation monitoring plots did not increase), but we do not believe this indicates any structural or functional problems at the site. The site's main controlling factor (tidal hydrology) is in place, and the failure to meet Benchmark 4 is due to the growth habit of the planted shrubs (which do not spread vegetatively), and slow recruitment of native woody plants into the reed canarygrass sward.

We have been disseminating information from this project to the restoration community, and using it to inform our own tidal wetland restoration activities. This site is a model for restoration of forested and scrub-shrub tidal wetland habitat in Oregon.

#### Maintenance:

No maintenance was reported to us in 2014.

### **Remediation:**

No remediation was needed during 2014 but additional woody plantings in one specific area would speed the site's progress towards vegetation targets (see *Recommendations* below).

### Recommendations

The following recommendations were made in 2012 and are still applicable in 2014. Although the project meets nearly all performance benchmarks, some additional plantings could speed the site's restoration trajectory. Additional Sitka spruce plantings are recommended for the area marked in Map 7 (Appendix 1). Large stock is recommended, for rapid early growth above the reed canarygrass. Fifty to 100 Hooker willow cuttings at least 5ft tall are recommended along the banks of the pilot channel. Few of the past cuttings have emerged above the existing reed canarygrass canopy. If willow could be successfully established along this channel, it would help suppress reed canarygrass in the center of the site. To maximize root growth and potential for survival of top growth, willow cuttings should be planted in fall after the first rains have begun.

# Appendix 1. Maps

### Map 1. Vicinity Map









Map 3. Mitigation design sketch (Map 6 of original Mitigation Plan)

Map 4. Vegetation monitoring plots established in 2006-2007. Background is 2005 color infrared aerial photo (courtesy Oregon DLCD/US EPA).



Map 5. Monitoring blocks (for monitoring survival of plantings), established in 2008. Background is 2005 color infrared aerial photo (courtesy Oregon DLCD/US EPA).



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Map 6. Photodocumentation points (PP1 through PP5); arrows show photo direction. Vegetation monitoring plots are also shown. Background is 2005 color infrared aerial photo (courtesy Oregon DLCD/US EPA).



Map 7. Recommended area for additional Sitka spruce plantings. Spruce plantings are visible as dark dots in pasture; there are very few spruce in the recommended planting area. Vegetation monitoring plots are also shown. Background is 2011 satellite imagery.



# Appendix 2. Photodocumentation, August 7, 2014 (Year 7). All photos were taken by Laura Brophy.

Photo 1. Photodocumentation Point 1A (left side of panorama). Breach area (from former dike). Planted Sitka spruce blocks most of the view at the original photo point.



Photo 2. Photodocumentation Point 1A-1 (left side of panorama), taken from just north of the planted Sitka spruce to show breach area.



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Photo 3. Photodocumentation Pt 1B (center of panorama). View NNE from just S of breach. Photo by L. Brophy.



Photo 4. Photodocumentation Point 1C (right side of panorama). View ENE from S bank of breach; confluence of restored channel and ditch A is under the willows. Photo by L. Brophy.



Photo 5. Photodocumentation Point 2. View S from breach area. Former equipment path is in center of photo. Photo by L. Brophy.



Photo 6. Photodocumentation Point 3. Mitigation site: View SW along former dike to mouth of breach. Photo by L. Brophy.



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Photo 7. Photodocumentation Point 4. View SSW along length of pasture, from center of pasture. Photo by L. Brophy.



Photo 7. Photodocumentation Point 5. View SSW along length of pasture, from north end of pasture. Photo by L. Brophy.



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# Appendix 3. Additional tables and figures

1=native,													
2=non-			P1	P1	P1	P1	P1	P2	P2	P2	P2	P2	P2
native	species	P1 2006	2008	2009	2010	2012	2014	2006	2008	2009	2010	2012	2014
	reed												
2	canarygrass	92.8	94.1	93.1	93.0	88.3	72.1	44.0	36.3	35.0	24.7	16.4	26.3
1	black vetch	2.5	0.5	2.1	1.0	3.1	11.0	3.9	3.4	3.3	1.2	1.3	11.3
1	water parsley	0.0	0.0	0.0	0.0	0.0	0.0	12.9	16.3	15.8	25.0	3.3	5.8
1	lady fern	1.8	1.1	3.1	1.4	1.2	4.1	3.0	3.8	5.5	5.1	4.8	5.0
1	cow parsnip	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.1	0	0.0
2	cutleaf blackberry	11.5	0.4	0.3	0.1	0.1	0.5	11.3	3.0	1.1	2.2	0.6	1.8
	Hooker's												
1	willow	0	0.0	0.0	0.0	0.0	0.0	65.8	71.3	70.0	69.9	68.8	62.5
1	slough sedge	2.3	0.4	1.9	-	3.6	9.6	0.3	2.6	5.1	-	6.8	13.8
	stinging												
1	nettle	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0

Table 1. Percent cover for species averaging >2% cover across plots and years: Plots 1 and 2

Table 2. Percent cover for species averaging >2% cover across plots and years: Plots 3 and 4

1=native, 2=non- native	species	P3 2006	P3 2008	P3 2009	P3 2010	P3 2012	P3 2014	P4 2007	P4 2008	P4 2009	P4 2010	P4 2012	P4 2014
	reed												
2	canarygrass	85.5	67.5	62.5	58.8	29.3	41.8	97.7	80.3	55.9	55.0	49.2	36.7
1	black vetch	14.5	3.6	5.9	2.5	2.1	7.3	2.5	4.3	20.2	30.0	35.8	39.3
1	water parsley	0.1	9.3	9.5	15.0	9.4	6.8	0.0	0.0	0.0	0.0	0.0	0.0
1	lady fern	15.4	7.8	5.6	7.5	3	3.5	1.0	0.0	0.0	0.0	0.0	0.0
1	cow parsnip	0.0	0.0	0.0	0.0	0	0.0	3.1	11.0	19.8	12.7	11.8	13.5
2	cutleaf blackberry	0.8	0.0	0.0	0.0	0	0.0	0.9	0.5	1.4	0.8	0.3	1.2
	Hooker's												
1	willow	1.5	27.5	25.8	37.5	73.8	56.3	0	0	0	0	0	0.0
1	slough sedge	0.0	0.0	0.0	-	1.3	11.3	0.1	0.1	0.2	-	0.0	0.0
1	stinging nettle	0.3	0.7	0.5	-	1.6	10.5	0.2	0.1	0.1	-	0.1	0.0

		# of plants in height category							
		in Aug. 20							
Species	Herbivory protection method	<10 ft	>10 ft	Total					
Black twinberry									
	Vexar	2		2					
	Unknown	4	1	5					
	Total			7					
Pacific crabapple									
	Vexar	6	6	12					
	Wire exclosure	7	5	12					
	Unknown	2		2					
	Total			26					
Sitka spruce									
	Vexar	4	23	27					
	Wire exclosure	1	3	4					
	Unknown	15	4	19					
	Total			50					
Grand Total				83					

Table 3. Effect of herbivory protection method on shrub and tree growth above 10ft (Aug. 2014)

#### Appendix 4. Literature cited

Brophy, L.S. (Green Point Consulting). 2012. Annual Compensatory Wetland Mitigation Monitoring Report for 2012: Off-site Mitigation, North Fork Siuslaw River Bridge Project. Prepared for the Oregon Department of Transportation. 45 pp.

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