i. MITIGATION MONITORING REPORT COVER SHEET
CORPS OF ENGINEERS

Corps Permit Number: 2011-100

Contact Information:

Permittee:	**City of Salem**	**Consultant:**	Pacific Habitat Services, Inc.
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Responsible Party for Monitoring and Date(s) of Inspection:

Name: Pacific Habitat Services (Fred Small) **Date(s):** July 7 and 14, 2017

Summary Paragraph: (purpose of approved project, acreage & type of aquatic resources impacted, & mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts)

The Waln Creek/ Battle Creek riparian enhancement mitigation site is intended to replace the functions and values lost over many years as a result of channelization and vegetation manipulation associated with its previous land uses, most recent as a golf course. This permit authorized the placement of up to 516 cubic yards and removal of up to 900 cubic yards of material below the Ordinary High Water line of Waln Creek and Battle Creek. The fill and removal activities enabled the relocation of the Waln Creek channel to enhance local riparian functions. In addition, riparian buffer planting efforts along the existing and relocated channel sections were to help mitigate for the fill and removal activities.

Written Description of Compensatory Mitigation Site (include identifiable landmarks, including information to locate the site perimeters):

The mitigation work extends both north and south of the Waln Street crossing of Waln Creek. Plantings extend northward to a residential subdivision in strips ~50 feet to either side of the creek, as well as southward to Battle Creek, where the planting area widens to nearly 400 feet.

Directions to the Mitigation Site:

The site can be reached via Commercial Street SE (Business Route 99) south of its intersection with Kuebler Boulevard. Continue south to Waln Street, and turn right (heading west). The Waln Creek channel is crossed approximately 1,000 feet west of Commercial Street.

Commencement of Compensatory Mitigation: Fall 2012
Completion of Compensatory Mitigation: Fall 2017

Statement of Performance Standards Being Met:

None specified in Corps permit; report below addresses DSL standards

Dates of Recent Corrective / Maintenance Activities (since last report submission): Beaver protection installed on 100 trees in November 2016; extensive live cuttings installed along channel

Specific Recommendations for additional corrective/remedial actions:

- Periodic weed control measures will continue on as-need basis
- Plant protective measures to address beaver activity will be implemented as needed

2. WALN CREEK/BATTLE CREEK MITIGATION PLAN PURPOSE AND OVERVIEW

A. Location

The mitigation site is located at:

- T8S, R3W, Section 23B; Tax lots 100, 101, 200, 300, and 400
- Lat: 44.864813^0 Long: -123.023656^0
- The site can be reached via Commercial Street SE (Business Route 99) south of its intersection with Kuebler Boulevard. Continue south to Waln Street, and turn right (heading west). The Waln Creek channel is crossed approximately 1,000 feet west of Commercial Street.

B. Mitigation Goals and Objectives

The Waln Creek/ Battle Creek riparian enhancement mitigation site is intended to replace the functions and values lost over many years as a result of channelization and vegetation manipulation associated with its previous land uses, most recent as a golf course. The permits issued by DSL (No. 47781-RF) and the Corps (NWP No. 2011-100) authorized the placement of up to 516 cubic yards and removal of up to 900 cubic yards of material below the Ordinary High Water line of Waln Creek and Battle Creek. The fill and removal activities enabled the relocation of the Waln Creek channel to enhance local riparian functions. In addition, riparian buffer planting efforts along the existing and relocated channel sections were to help mitigate for the fill and removal activities.

Following the channel relocation and riparian buffer soil preparation activities, seven species of trees and nine species of shrubs were planted, and the site was seeded with a diverse native grass seed mix.

Riparian Vegetation Success Criteria

The DSL permit stipulated that several success criteria be met by the mitigation activities; the Corps permit did not specify performance standards. The DSL standards to be met are:

No.	Condition	DSL Performance Standard
30	Establishment of Permanent Monitoring locations required	Permanent plots must be established…in sufficient number and locations to be representative of the site.
31	Native Species Cover	The cover of native species, as defined in the USDA Plants Database, in the herbaceous stratum is at least 60%.
32	Invasive Species Cover	The cover of invasive species is no more than 10% **[***includes further details on what may constitute an invasive*]
33	Bare Substrate Cover	Bare substrate represents no more than 20% cover.
34	Woody Vegetation	The density of woody vegetation is at least 1,600 live native plants (shrubs) and/or stems (trees) per acre OR the cover of native woody vegetation on the site is at least 50%...standard must be achieved for 2 years without irrigation.
35	Species Diversity	By Year 3 and thereafter, there are at least 6 different native species. To qualify, a species must have at least 5% average cover in the habitat class, and occur in at least 10% of the plots sampled.

Stream Channel Success Criteria

In addition to the above riparian vegetation performance standards**,** an interagency agreement brokered by the City of Salem to establish a Stream Mitigation Bank (to include the Waln Creek channel improvements) also requires that several performance standards that relate to stream morphology be met:

No.	Condition	Mitigation Bank Performance Standard
VI.b.i.	Permanent Monitoring locations	Four permanent cross sections will be established on Waln Creek during the first monitoring year, as follows….[approx. locations described in text of bank agreement]
VI.b.ii	Lateral Stability and Bank Erosion/Migration	Lateral stability and bank erosion/migration will be assessed through annual cross sectional surveys done at permanently established cross section locations. Comparison of cross sections to those done in previous years shall indicate that bank erosion is not occurring at a rate that would result in lateral instability or excessive channel migration. Bank erosion at the cross section locations shall remain at <0.1 ft. / yr., as measured by the cross section surveys.
VI.b.iii	Incision and Floodplain Connectivity	The degree of incision and floodplain connectivity will be assessed through the annual cross-sectional surveys done at permanently established cross section locations. Comparison of cross sections to those done in previous years shall indicate that the streambed is not downcutting and that the stream remains connected to its floodplain at the 1.2-year recurrence interval, as designed. The bank height ratio (BHR), which is a direct measure of channel incision, will be calculated from the cross sections. The BHR shall remain between 1.0 and 1.2 to confirm that the channel is not incising and remains connected to the floodplain benches.

The permanent monitoring locations were just established this last year (the fourth year of riparian vegetation monitoring), and as a consequence cross sections in subsequent years are less likely to capture significant channel erosion that could have occurred in previous years, even upon comparison with next year's measurements. Nevertheless, there may still be detectable changes to channel structure as a result of ongoing beaver activity or unusually strong storm events.

These standards are further addressed below in Section D.

C. Maintenance and Management Actions

Following the fourth year monitoring report, only limited weed control measures were exercised at the site during 2017. As in previous years, these measures have primarily targeted invasive species such as reed canarygrass (*Phalaris arundinacea*) and Canada thistle (*Cirsium arvense*); however, with the ongoing removal of some streamside woody vegetation by beavers, the reed canarygrass cover along the streambanks in particular has persisted or even increased in some reaches, and may warrant additional control efforts in 2018.

Given the high densities of woody plantings persisting across the site, only limited remedial woody plantings were installed during 2017. Several hundred willow and red-osier cuttings were installed along the banks of Waln Creek, primarily in response to recent losses from beaver activity. In additional over 100 maturing saplings (primarily cottonwood, Oregon ash, and white alder) were protected with wire mesh to deter future beaver depradations.

Since groundcover was relatively continuous and comprised primarily of non-invasive species, no additional seeding has been warranted to date.

D. Monitoring Methods

Vegetation Monitoring

Vegetation monitoring followed the routine methods specified in the DSL Removal-Fill Guidelines (as laid out in the *Routine Monitoring Guidance for Vegetation* (interim draft 2009).

A total of twenty-seven 15-foot radius circular plots were sampled to determine woody plant survival and density, covering nearly 10% of the study area. Groundcover development was also assessed using two 1-meter square quadrats positioned at opposite ends of each circular plot.

Data collected in the woody plant sampling plots was then tabulated in an MS Excel spreadsheet (Appendix A), and the mean, standard error, standard deviation, and confidence interval (for an 80% confidence level) of the sampled population were calculated for the total live count for all plots.

Similarly, the groundcover plots were tabulated and analyzed for relative success per the routine DSL performance standards for groundcover development. These standards include cover by native woody and herbaceous species, as well as cover by non-native and invasive species.

Stream Channel Monitoring

Stream channel monitoring has been implemented according to the methodology specified in the Salem Stream Mitigation Bank/ Waln Creek Enhancement and Battle Creek Culvert Removal Project Prospectus (PHS 2013) and the Umbrella Mitigation Bank Instrument (City of Salem 2012). Four permanent cross sections have been established along Waln Creek at the approximate locations specified in the stream mitigation bank agreement, with each of the eight endpoints comprised of a 5-foot long section of rebar placed halfway into an augered 30-inch deep pit and secured using Quikrete fast-setting concrete mix. Since these were not installed until the 4th summer of vegetation monitoring (2016), an absolute baseline of the initial post-construction conditions at the site cannot be provided. Nevertheless, a comparison can now be made between the 2016 and 2017 cross-sections.

Elevational measurements were made at one-foot intervals through each channel section, using a laser leveler and Stadia rod. Since this is the second series of cross-sections, a direct comparison with last year can be made to determine whether the performance standards for bank stability and floodplain connectivity have been met. As such, the current Index Values of the Bank Erodibility Hazard Index (BEHI) rating system have been determined for the four cross-section locations, and will be compared with last year's measurements. The four BEHI index value datasheets are included in Appendix C, along with each cross-section.

E. Monitoring Data Locations

Vegetation Monitoring

Data plots were established by first generating a randomized, self-avoiding series of points distributed across the site. A shapefile was created using this list of Easting and Northing coordinates, which was then used in a GPS unit to locate each point in the field. Plot centers were then staked with white PVC tubing for permanence and visibility. Table 1 below lists the coordinates for each plot, while the sampling layout is depicted in Figure 2 (Appendix B).

Table 1. Easting and Northing Coordinates* for Sample Plots within the Waln Creek/Battle Creek Riparian mitigation site in Salem, OR

Sample Plot	Easting	Northing	Sample Plot	Easting	Northing
1	7547940.88	447345.19	15	7547804.51	446270.96
2	7547940.88	447200.81	16	7547730.85	446238.95
3	7547949.28	446927.46	17	7547724.73	446297.46
4	7547949.28	446831.41	18	7547646.11	446300.08
5	7547949.28	446774.75	19	7547721.84	446364.39
6	7547966.40	446467.48	20	7547774.03	446360.09
7	7548025.11	446302.73	21	7547833.08	446374.50
8	7548087.45	446170.07	22	7547873.33	446510.49
9	7548107.78	446048.27	23	7547873.46	446566.78
10	7548134.32	445978.97	24	7547864.28	446768.36
11	7547947.56	446059.03	25	7547864.28	446942.42
12	7547951.35	446114.48	26	7547865.28	447274.96
13	7547980.36	446183.98	27	7547865.28	447417.57
14	7547842.36	446204.46			

**Coordinate System: Oregon State Plane North NAD83 (international feet)*

Stream Channel Morphology Monitoring

The four cross-sectional transects were established at the approximate locations specified in the bank agreement. Final placement of each transect was adjusted to a limited degree to minimize travel through heavy vegetation. Locations of each transect endpoint were documented by GPS; coordinates are listed in Table 2 below.

Table 2. Easting and Northing Coordinates* for Transect monuments within the Waln Creek/Battle Creek Riparian mitigation site in Salem, OR

Transect Monument	Easting	Northing
A-W	7548023	446034
A-E	7548054	446043
B-W	7547981	446312
B-E	7548010	446321
C-W	7547943	446484
C-E	7547911	446494
D-W	7547884	446880
D-E	7547917	446880

**Coordinate System: Oregon State Plane North NAD83 (international feet)*

F. Hydrology Methods and Context

The intent of the vegetation enhancement measures along the Waln Creek riparian corridor was primarily to improve its water quality and wildlife functions through dense tree and shrub plantings and invasive vegetation management. As such, hydrologic monitoring (beyond that associated with stream morphology changes discussed above) is not pertinent to this project.

3. RESULTS

A. Vegetation Standards

Performance Standard 1 Result:

Native Species Cover: *The cover of native species, as defined in the USDA Plants Database, in the herbaceous stratum is at least 60%.*

Summary Metric:

This standard was not quite met in the fifth year, even when artificially bare ground is taken into account. The sampling plots provided a mean of approximately 47% (80% CI), while the amount of ground taken up by a gravel and plastic 'mulch' used around each shrub and tree planting averaged approximately 8% of each plot, with nearly as much bare ground remaining (average 7.5%) much of which is comprised of organic litter. When the artificially 'bare ground' component is factored in, the native herbaceous stratum may still approximate only 55%.

Performance Standard 2 Result:

Invasive Species Cover: *The cover of invasive species is no more than 10%. A plant species should automatically be labeled as invasive if it appears on the current ODA noxious weed list, plus known problem species including Phalaris arundinacea, Mentha pulegum, Holcus lanatus, Anthoxanthum odoratum, and the last crop plant if it is non-native. Non-native plants should be labeled as such if they are listed as non-native on the USDA Plants Database. Beginning in Year 2 of monitoring, DSL will consider a non-native plant species invasive if it comprises more than 15% cover in 10% or more of the sample plots in any habitat class, and increases in cover or frequency from the previous monitoring period. Plants that meet this definition will be considered invasive for all successive years of monitoring. After the site has matured to the stage when desirable canopy species reach 50% cover, the cover of invasive understory species may increase but may not exceed 30%*

Summary Metric:
This standard has been met again for the fifth year, with the sampling plots providing a mean of 2.93% (80% CI) for invasive herbaceous species. No invasive woody species were detected within the sampling plots this year.

Performance Standard 3 Result:

Bare Substrate Cover*: Bare substrate represents no more than 20% cover.*

Summary Metric:

This standard has been met for the fifth year, especially when artificially bare substrate is taken into account. The sampling plots now provide an overall mean of 15.5% (80% CI) of bare substrate, with approximately half of this cover being comprised of bare soil or thatch. The other half of this bare cover is comprised of portions of squares of gravel/plastic 'mulch' that were installed around each woody planting. This artificial substrate may gradually fill in with accumulated litter, but is limited in its ability to establish longlived groundcover.

Performance Standard 4 Result:

Woody Vegetation: *The density of woody vegetation is at least 1,600 live native plants (shrubs) and/or stems (trees) per acre OR the cover of native woody vegetation on the site is at least 50%. Native species volunteering on the site may be included, dead plants do not count, and the standard must be achieved for 2 years without irrigation.*

Summary Metric:

This standard has been met again for the fifth year, with the sampling plots providing an estimated density of approximately 2,821 plants per acre for the 4.78-acre planting area. This density is based on an estimated 13,486 plants overall, for a survival rate of 138% (80% CI) relative to the specified number of planted woody species.

Table 3 lists the woody plantings originally specified for the Waln Creek/Battle Creek riparian mitigation area, along with the number of plants surviving in July 2017. A more detailed breakdown of actual counts and associated statistics is included on spreadsheets in the Appendix A.

Table 3. Summary of 2017 Woody Plant Estimates for the Waln Creek/Battle Creek Riparian mitigation site in Salem, OR

Botanical Name	Common Name	Original No's Spec'd	July 2017 Sampling Estimates*	Estimated % Survival**
TREES				
Acer macrophyllum	Bigleaf maple	907	0	0
Alnus rhombifolia	White alder	1,209	753	62
Crataegus douglasii	Douglas hawthorn	302	306	101
Fraxinus latifolia	Oregon ash	1,511	1,496	99
Malus fusca	Pacific crabapple	302	66	22
Populus balsamifera spp. trichocarpa	Black cottonwood	1,209	1,125	93
Thuja plicata	Western red cedar	605	11	2
SHRUBS				
Cornus sericea	Red-osier dogwood	557	874	157
Lonicera involucrata	Twinberry	557	1,682	302
Physocarpus capitatus	Pacific ninebark	557	546	98
Rosa nutkana, R. pisocarpa	Nootka rose, clustered rose	668	3,047 total roses counted	456
Sambucus cerulea	blue elderberry	371	0	0
Spiraea douglasii	Douglas spirea	371	1,769	479
Symphoricarpos albus	snowberry	631	1,813	287
TOTAL WOODY PLANTINGS		**9,757**	**13,486**	**138% overall**

**Based on extrapolated values from overall mean of 45.74 plants per sampling unit [factor of 208,400 sf (overall area)/706 sf (sampling unit)=295.18]; individual spp. counts have been similarly inferred*

***As shown on the attached spreadsheet, the extrapolated mean (13,486) may vary based on the assigned confidence interval. For example, at a sampling CI of 80%, the mean could range anywhere from 12,525 to 14,258. Consequently, the overall survival rate varies from 128% to 146% of the original numbers planted.*

[1]Since the numerous rose plantings were typically not in flower or fruit when tallied, they were not distinguished as to species. As such, the total estimate is for Rosa spp., and the estimated total was divided equally between species.

Performance Standard 5 Result:

Species Diversity: *By Year 3 and thereafter, there are at least 6 different native species. To qualify, a species must have at least 5% average cover in the habitat class, and occur in at least 10% of plots sampled.*

Summary metric:

This standard is not currently met if sampling on a species by species basis only; at this time two woody species (*Alnus rhombifolia and Rosa nutkana*) and two grasses (*Agrostis exarata* and *Hordeum brachyantherum*) exceed this criterion. However, if considered in terms of functional groups, the two *Deschampsia* species now combine to exceed the standard, and 3 additional shrub species (*Cornus, Lonicera, Spiraea*) combine to meet the standard as well, resulting in at least 6 different species or species assemblages now meeting the standard. In addition, the cover of at least 8 of the tree and shrub species will only increase with time and are likely to exceed this standard within a few years.

Currently, the cover values for woody plantings can only address those plants that overlap with the one meter^2 quadrants, despite having an average density of 46 woody plants in each of the larger (15'-radius) plots. Unfortunately, it is not practicable to obtain accurate cover estimates across the larger plots while using our current sampling methodologies. It is apparent both from sampling and on an anecdotal basis that the developing woody plant community is quite diverse and is on a trajectory to exceed this standard on an individual species basis as well.

B. Hydrology Standards Result

Not Applicable

C. Delineation of Wetland Acreage Achieved

Not Applicable

D. Stream Channel Morphology Results

Since cross-section measurements have now been collected and channel sections depicted graphically for two consecutive years, a direct comparison with the previous year is now possible. Graphical overlays of Channel Sections A to D for both 2016 and 2017 were generated to show whether significant changes to bed/bank morphology had occurred over the past year (Figures 9 to 12).

Virtually no distinctions can be made between the two years for Channel Sections A, C, and D; however, the bed and banks at Channel Section B have been modified somewhat during this time. One side of the channel has been broadened by up to 2 feet while the other side appears to have been built up by 0.5 feet or more. However, please note that there has been beaver dam activity in the vicinity, with increased water depths at different times of year. This factor appears to have resulted in significant siltation, some minor local bank slumping, and expanded reed canarygrass growth along the banks. The poorly consolidated silts and developing root mats have likely contributed to bottom dimension changes as well.

With regard to the two stream channel success criteria, only Criterion VI.b.ii (Lateral Stability and Bank Erosion/Migration) appears to be significant with Channel Section B showing evidence of such changes. However, given the lack of changes at other sections, it is highly unlikely that channel modifying instabilities are occurring.

With regard to Criterion VI.b.iii (Incision and Floodplain Connectivity), none of the channel sections indicate any change in the bank height ratio (BHR), which remains 1.0 at each section. The 2016 BEHI forms are included in the Appendix.

4. CONCLUSIONS AND RECOMMENDATIONS

A. Project Status

Groundcover Development

Groundcover estimates within the riparian planting area currently fall below the standard for native cover (47% versus the >60% standard), especially when the artificially bare (gravel/plastic) substrate is not taken into account. However, even when this artificial substrate (which currently accounts for approximately 8% average cover in plots) is discounted, the native groundcover standard is still not met.

However, the cover standards for both invasive herbaceous (<10%) and invasive woody (<10%) species have been met.

The dominant groundcover species is still meadow barley, with spike bentgrass, sickle-keeled lupine, and tufted hairgrass also common. The most common non-natives are creeping bentgrass, hairy hawkbit, and birds-foot trefoil; however, these represent relatively low overall cover.

Woody Plant Survival and Density

Woody plant survival in 2017 continues to be high relative to the number of plants specified, at 138% overall, and relatively few dead plants were encountered. More importantly, the estimated stem density was approximately 2,821 plants per acre for the 4.78-acre planting area, significantly above the performance target of 1,600 stems per acre. Since most plants persisting this year are thriving and have developed strong root systems, this standard should continue to be met in subsequent years as well.

Stream Channel Morphology Findings

As mentioned above, a comparison of channel section measurements for 2016 and 2017 indicated minimal changes, except in the case of Channel Section B. At this location, the apparent bottom and bank changes are most likely explained by the ongoing beaver activity (water ponding behind dams, sediment accumulations, bank slumping, an increase in reed canarygrass along the banks). In addition, the calculations for the Bank Erosion Hazard Index (BEHI) at each cross section again indicate that the stream channel has an overall low level of susceptibility to erosion (BEHI index ranges from 19 to 20.5), with bank/height ratio remaining at 1.0. This index is based on multiple factors, including bank height and angle, root depth and density, bank material, and surface protection. Given the relatively low gradient, low velocity channel as well as its relatively well vegetated banks, the BEHI index is unlikely to appreciably change over time. In fact, none of the measures used to determine the BEHI index have changed during the past year.

B. Recommendations

Remedial Planting

Given the high stem densities observed in 2017 as well as in past years, no remedial woody plantings are either recommended or warranted at this time.

Weed Control

Invasive species such as reed canarygrass, Canada thistle, St. Johns' wort, and Himalayan blackberry persist in scattered locations across the site, and generally do not represent infestations.

However, reed canarygrass is well established along the channel, as it responds especially well to the hydrologic changes associated with beaver activity. Weed control efforts should be continued on an as-need basis to detect and control any emerging populations through either physical removal or chemical spot treatments.

Beaver Damage Control

The potential for plant losses due to beaver activity remains a valid concern. With beaver losses significant along streambanks and also farther from the channel, steps were taken this past winter and spring to offset those losses. Several hundred willow and red-osier cuttings were installed along the channel, and over 100 tree saplings were protected using wire mesh guards.

This initial program will be observed through the coming years to determine whether further protective measures will be necessary to preserve the developing riparian plant community.

Further measures that may be implemented during the winter and spring of 2017-18 and beyond include (1) the planting of additional willow and cottonwood stakes on the channel banks and on adjacent terraces in order to enhance beaver-impacted areas, and (2) the protection of additional trees with exclusionary fencing.

5. MAPS AND FIGURES

Appendix A includes the woody vegetation and groundcover data sheets. Appendix B includes Figures 1 through 7. Figure 1 depicts the overall grading and site plan for the Waln Creek/Battle Creek riparian enhancement area. Figure 2 provides the buffer planting areas, sample plot, channel cross-section locations, and photopoint locations, while Figure 3 provides the species list and typical spacing. Figure 4 includes a recent aerial of the project vicinity, and Figures 5 to 8 provide photodocumentation of the site. Appendix C includes each channel cross-section (Figures 9 to 12) along with the 2016 BEHI worksheets, which have not changed.

Appendix A

Sampling Data

Site: Wahn/Battle Creek Riparian Enhancement site, Salem
Shrub-Dominated and Forested Wetland Habitat Unit

Sample Dates: July 7 and 14, 2017

Percent Cover per sample plot

Species	Origin (N, NN, I)	Wetland Status (1 - 5)	1 NE	1 SW	2 NE	2 SW	3 NE	3 SW	4 NE	4 SW	5 NE	5 SW	6 NE	6 SW	7 NE	7 SW	8 NE	8 SW	9 NE	9 SW	10 NE	10 SW	11 NE	11 SW	12 NE	12 SW	13 NE	13 SW	14 NE	14 SW	15 NE	15 SW
Native Herbaceous Species *species-latin name*																																
Achillea millefolium	N	4	2	0.5	2	3	15	0	8	15	20	0	3	0	5	0	0	0	10	0	5	0	5	0	0	0	0	0	0	0	0	0
Agrostis exarata	N	2	2	0	2	0	15	0	8	0	20	2	3	0	5	1	0	5	10	10	5	2	5	5	0	15	30	25	5	15	2	0
Carex sp.	N	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deschampsia cespitosa	N	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	20	12	5	0	0	0	0	20	3	0	
Deschampsia elongata	N	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	20	12	5	0	0	0	0	2	0	0	0
Epilobium brachycarpum (=E. paniculatum)	N	5	0	0	0	3	5	0	7	5	10	15	0	0	1	15	8	1	7	1	3	0	0	0	0	0.5	0	0	0	0	0	0
Epilobium ciliatum (=E. watsonii)	N	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca occidentalis	N	3	0	0	5	5	0	0	0	0	0	0	3	0	0	1	10	0	5	1	2	5	0	0	10	0	1	0	0	0	5	0
Hordeum brachyantherum	N	2	30	0	5	5	30	4	20	35	15	30	40	60	40	50	50	30	15	25	30	15	0	0	0	20	35	25	50	50	30	40
Juncus effusus	N	2	0	5	0	0	0	0	0	0	0	20	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
Juncus tenuis	N	3	0	0	0	0	0	0	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotus purshianus	N	5	0	0	0	0	0	0	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Lupinus rivularis	N	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	5	0	0	0	0
Invasive Herbaceous Species *species-latin name*																																
Cirsium vulgare	I	4	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hypericum perforatum	I	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jacobaea vulgaris	I	4	0	0	0	0	2	3	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalaris arundinacea	I	2	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	20	30	0	0	0	0	0	0	0	0
Non-Native Herbaceous Species *species-latin name*																																
Agrostis stolonifera/ A. capillaris	NN	3	10	4	0	0	0	1	10	0	0	0	7	7	5	5	5	2	1	1	1	0	0	0	5	0	0	0	0.5	5	20	2
Bromus mollis	NN	5	10	4	0	0	0	1	10	0	0	0	7	7	5	2	5	0.5	1	0	1	0	0	0	5	0	0	0	0	0	0	0
Centaureum erythraea	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0
Daucus carota	NN	4	0	1	2	0.5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0
Holcus lanatus	NN	3	0	10	20	25	0	5	5	0	5	0	0	3	0	0	0	0	0	0	0	0	3	25	10	5	0	5	0	0	0	0
Hypochaeris radicata	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lactuca serriola	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lapsana communis	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leontodon nudicaulis ssp. taraxacoides	NN	5	0	2	3	1	20	0	5	0	1	0	0	0	0	0	1	0	10	25	0	15	5	0	5	15	0	0	0	0	0	0
Leucanthemum vulgare	NN	4	0	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Lolium perenne	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotus corniculatus	NN	3	0	15	30	5	0	40	0	0	5	15	5	0	0	0	0	0	0	0	0	0	15	15	50	25	0	0	0	0	0	0
Parentucellia viscosa	NN	3	0	15	0.5	5	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago major	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poa pratensis	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
Prunella vulgaris	NN	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
Rumex acetosella	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sonchus asper	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium repens	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
Vicia tetrasperma	NN	5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	5	10	0	0	15	0	0	0	0	0	0
Vulpia myuros	NN	4	0	5	5	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	1	0	0	0	0	0	0
Native Shrub and Tree Species *species-latin name*																																
Alnus rhombifolia	N	3	0	0	0	0	0	30	0	0	0	0	20	40	0	0	0	0	0	0	0	0	50	0	0	10	0	30	0	0	0	0
Cornus sericea	N	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65
Crataegus douglasii	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fraxinus latifolia	N	2	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	1	15	0	10	2	3	0	0	0	0	0	0
Lonicera involucrata	N	3	10	0	0	0	15	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	10	0	0	0	2	2	0	0	0
Physocarpus capitatus	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0
Populus balsamifera ssp trichocarpa	N	3	0	5	0	0	0	0	0	0	0	0	30	0	5	10	0	0	0	0	0	0	5	0	0	0	0	0	0	0	20	0
Rosa nutkana	N	3	0	0	0	35	0	0	0	0	3	0	0	0	0	0	10	60	30	0	10	0	0	0	12	0	5	4	15	0	20	0
Spiraea douglasii	N	2	0	10	15	0	0	0	5	0	0	0	0	0	0	15	10	0	5	0	0	0	0	0	0	0	0	15	0	0	0	0
Symphoricarpos albus	N	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Non-Native Shrub and Tree Species *species-latin name*																																
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Invasive Shrub and Tree Species *species-latin name*																																
Rubus armeniacus	I	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bare Substrate																																
gravel/plastic weed barrier			10	20	25	0	5	0	25	20	15	7	0	10	15	5	0	0	15	15	0	10	0	0	0	0	0	0	0	0	0	0
bare soil			40	0	0	5	5	0	15	20	15	5	5	5	5	0	5	5	5	10	10	10	0	10	5	0	30	20	15	5	5	0

Plant Count (Shrubs) + Stem Count (Trees)

Routine Performance Standards	Threshold		1 NE	1 SW	2 NE	2 SW	3 NE	3 SW	4 NE	4 SW	5 NE	5 SW	6 NE	6 SW	7 NE	7 SW	8 NE	8 SW	9 NE	9 SW	10 NE	10 SW	11 NE	11 SW	12 NE	12 SW	13 NE	13 SW	14 NE	14 SW	15 NE	15 SW
Cover of Native Herbaceous Species	>=60%		34	16	14	16	65	5	53	55	65	67	49	75	51	67	70	36	48	48	45	62	34	15	10	37	66	55	72	85	40	40
Lower CI (80%)																																
Upper CI (80%)																																
Cover of Invasive Herbaceous Species	<=10%		0	0	5	0	12	8	0	0	6	0	0	0	0	0	0	0	1	0	0	0	20	30	0	0	0	0	0	0	0	0
Lower CI (80%)																																
Upper CI (80%)																																
Cover of Invasive Shrubs and Trees	<=10%		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lower CI (80%)																																
Upper CI (80%)																																
Bare Substrate	<=20%		50	20	25	5	10	0	40	40	30	12	5	15	20	5	5	5	20	25	10	20	0	10	5	0	30	20	15	5	5	0
Lower CI (80%)																																
Upper CI (80%)																																
Native Diversity (all layers)	6																															
Prevalence Index--All strata	<3.0		2	2	3	3	3	3	2	2	3	3	2	2	2	3	2	3	3	3	3	2	2	2	3	3	2	2	2	2	3	2
Weighted Prevalence Index			124	176	262	250	260	259	161	105	198	224	281	280	215	255	244	269	256	219	256	224	318	250	294	281	148	268	183	205	265	216
Sum of plant cover			62	92	93	92	92	95	75	45	77	82	115	132	91	99	102	101	94	80	96	107	157	105	100	111	71	111	90	95	100	107

Site: Wahn/Battle Creek Riparian
Enhancement site, Salem
Shrub-Dominated and Forested Wetland Habitat Unit

Species	Origin (N, NN, I)	Wetland Status (1 - 5)	16 NE	16 SW	17 NE	17 SW	18 NE	18 SW	19 NE	19 SW	20 NE	20 SW	21 NE	21 SW	22 NE	22 SW	23 NE	23 SW	24 NE	24 SW	25 NE	25 SW	26 NE	26 SW	27 NE	27 SW	Row Average
Native Herbaceous Species *species-latin name*																											
Achillea millefolium	N	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
Agrostis exarata	N	2	15	0	0	0	10	0	0	0	10	0	5	5	0	0	3	20	25	30	15	0	5	2	2		6.3
Carex sp.	N	2	0	0	0	0	0	0	0	2	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Deschampsia cespitosa	N	2	10	0	20	0	10	0	10	10	10	0	20	12	0	0	5	0	0	0	0	0	0	25	5	35	4.5
Deschampsia elongata	N	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9
Epilobium brachycarpum (=E. paniculatum)	N	5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	1	0	0	2	0	0	0	0	0	0	0	1.6
Epilobium ciliatum (=E. watsonii)	N	2	0	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Festuca occidentalis	N	3	0	0	0	0	0	0	2	0	0	5	0	5	0	5	0	0	0	0	0	0	0	0	1	0	1.3
Hordeum brachyantherum	N	2	50	20	75	60	30	45	35	5	3	10	3	8	10	30	35	5	15	5	5	5	10	2	10	7	23.4
Juncus effusus	N	2	5	0	0	2	0	0	0	0	15	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
Juncus tenuis	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Lotus purshianus	N	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3
Lupinus rivularis	N	3	0	0	0	0	0	0	20	5	15	0	0	25	0	5	0	0	0	0	0	0	0	0	2	0	1.5
Invasive Herbaceous Species *species-latin name*																											
Cirsium vulgare	I	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Hypericum perforatum	I	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Jacobaea vulgaris	I	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Phalaris arundinacea	I	2	0	0	2	10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1.4
Non-Native Herbaceous Species *species-latin name*																											
Agrostis stolonifera/ A. capillaris	NN	3	0	0	3	10	5	0	5	40	30	50	0	20	15	0	0	0	0	0	0	0	5	15	0	1	5.4
Bromus mollis	NN	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1
Centaureum erythraea	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Daucus carota	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0.2
Holcus lanatus	NN	3	10	10	0	0	20	0	20	10	0	10	0	1	30	2	0	65	0.5	1	0	0	20	20	25	0	6.8
Hypochaeris radicata	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0.0
Lactuca serriola	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Lapsana communis	NN	4	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3
Leontodon nudicaulis ssp. taraxacoides	NN	5	0	0	0	0	0	0	0	0	0	0	0	0	20	30	0	0	15	30	0	0	15	7	0	0	4.2
Leucanthemum vulgare	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Lolium perenne	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Lotus corniculatus	NN	3	10	0	0	0	0	0	10	0	0	2	0	0	2	0	0	0	0	0	2	10	10	5	35	15	5.9
Parentucellia viscosa	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
Plantago major	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Poa pratensis	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Prunella vulgaris	NN	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Rumex acetosella	NN	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Sonchus asper	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Trifolium repens	NN	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Vicia tetrasperma	NN	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0.7
Vulpia myuros	NN	4	0	0	0	0	0	0	0	0	5	0	0	0	2	0	0	7	0	0	0	0	0	0	0	0	0.6
Native Shrub and Tree Species *species-latin name*																											
Alnus rhombifolia	N	3	0	0	0	0	50	100	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.7
Cornus sericea	N	2	0	0	0	3	0	10	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.9
Crataegus douglasii	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Fraxinus latifolia	N	2	0	0	0.5	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	10	0	0	0	0	1.7
Lonicera involucrata	N	3	0	5	0	2	0	25	0	0	0	0	0	25	0	0	0	20	0	10	0	0	0	0	0	0	2.9
Physocarpus capitatus	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7
Populus balsamifera ssp trichocarpa	N	3	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	1.6
Rosa nutkana	N	3	0	0	0	0	0	0	0	0	2	0	80	0	0	0	40	0	0	0	2	0	10	0	0	0	6.3
Spiraea douglasii	N	2	0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	8	10	0	0	0	0	1.9
Symphoricarpos albus	N	4	0	35	0	0	25	0	0	0	5	0	0	0	0	0	0	0	0	0	0	10	0	5	5	0	1.7
Non-Native Shrub and Tree Species *species-latin name*																											
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Invasive Shrub and Tree Species *species-latin name*																											
Rubus armeniacus	I	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Bare Substrate																											
gravel/plastic weed barrier			0	0	0	0	0	0	0	0	0	0	0	0	10	10	30	10	35	25	20	50	25	5	15	0	8.0
bare soil			0	10	0	0	0	0	0	0	5	0	10	5	5	5	10	0	15	5	25	5	5	5	0	40	7.5

Routine Performance Standards	Threshold		16 NE	16 SW	17 NE	17 SW	18 NE	18 SW	19 NE	19 SW	20 NE	20 SW	21 NE	21 SW	22 NE	22 SW	23 NE	23 SW	24 NE	24 SW	25 NE	25 SW	26 NE	26 SW	27 NE	27 SW	Habitat Average	Standard Error	Standard Met?
Cover of Native Herbaceous Species	>=60%		80	25	95	67	50	45	67	22	53	20	33	55	16	41	40	8	37	30	35	20	10	32	20	44	46.93	4.2	NO
Lower CI (80%)																											41.54		
Upper CI (80%)																											52.32		
Cover of Invasive Herbaceous Species	<=10%		0	0	2	10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2.93	1	YES
Lower CI (80%)																											1.23		
Upper CI (80%)																											4.63		
Cover of Invasive Shrubs and Trees	<=10%		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	YES
Lower CI (80%)																											0.00		
Upper CI (80%)																											0.00		
Bare Substrate	<=20%		0	10	0	0	0	0	0	0	5	0	10	5	15	15	40	10	50	30	45	55	30	10	15	40	15.96	2	YES
Lower CI (80%)																											12.77		
Upper CI (80%)																											19.15		
Native Diversity (all layers)	6																												
Prevalence Index--All strata	<3.0		2	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	2	2.44		YES
Weighted Prevalence Index			220	235	204	212	425	495	261	289	257	281	306	286	284	299	200	299	157	243	158	150	238	239	251	136			
Sum of plant cover			100	90	101	100	150	185	102	102	95	107	113	103	86	90	80	100	53	71	77	60	72	89	87	60			

Fifth Year Monitoring for Waln Creek riparian corridor, Salem (data collected on July 7 and 14, 2017)

Specified Plantings			Quadrats														
R9-IND Status	**Plant Species**	**Common Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
			No. of live plants															**No. of live**
TREES																		
FACU	*Acer macrophyllum*	Bigleaf maple	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FAC	*Alnus rhombifolia*	White alder	0	0	3	2	2	12	2	2	0	1	4	1	4	3	2	2
FAC	*Crataegus douglasii*	Black hawthorn	1	1	2	2	1	2	1	1	0	0	0	1	0	0	0	0
FACW	*Fraxinus latifolia*	Oregon ash	9	8	4	3	7	1	1	3	5	6	6	4	4	12	3	5
FACW	*Malus fusca*	Pacific crabapple	0	0	0	0	0	1	0	1	1	2	0	0	0	0	0	0
FAC	*Populus balsamifera ssp. trichocarpa*	black cottonwood	7	4	1	3	1	18	15	1	0	2	6	5	2	0	2	2
FAC	*Thuja plicata*	Western red cedar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHRUBS																		
FACW	*Cornus sericea*	Red-osier dogwood	2	2	4	0	0	2	0	8	8	5	7	9	3	0	3	8
FAC	*Lonicera involucrata*	Twinberry	9	9	4	5	3	2	13	4	0	3	5	0	8	4	2	12
FAC	*Physocarpus capitatus*	Pacific ninebark	0	0	2	0	2	0	0	0	3	1	1	0	2	4	0	0
FAC	*Rosa nutkana, R. pisocarpa*	Nootka rose, swamp rose	13	8	3	16	18	17	7	14	30	33	11	7	7	3	20	1
FACU	*Sambucus cerulea*	Blue elderberry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FACW	*Spiraea douglasii*	Douglas' spirea	12	18	2	10	1	2	7	5	3	0	4	5	14	2	0	1
FACU	*Symphoricarpos albus*	snowberry	1	0	30	7	3	4	8	9	0	7	3	8	7	8	3	2
		TOTAL LIVE	**54**	**50**	**55**	**48**	**38**	**61**	**54**	**48**	**50**	**60**	**47**	**40**	**51**	**36**	**35**	**33**

17	18	19	20	21	22	23	24	25	26	27				
e **plants**											**Mean (by spp.)**	**plants per SF**	**inferred plant #'s**	**STDEV BY SPP.**
0	0	0	0	0	0	0	0	0	0	0	**0.00**	0.0000	0	0.00
0	9	4	0	1	3	3	1	7	0	1	**2.56**	0.0036	753	2.85
0	0	1	0	0	3	1	1	4	3	3	**1.04**	0.0015	306	1.16
2	4	0	0	3	5	9	11	12	4	6	**5.07**	0.0072	1496	3.36
0	0	0	0	0	0	0	0	0	1	0	**0.22**	0.0003	66	0.51
4	2	6	1	0	3	2	0	10	3	3	**3.81**	0.0054	1125	4.38
0	0	1	0	0	0	0	0	0	0	0	**0.04**	0.0001	11	0.19
3	3	2	7	0	0	1	0	1	1	1	**2.96**	0.0042	874	2.98
7	10	2	3	2	1	6	10	8	4	18	**5.70**	0.0081	1682	4.35
1	0	2	10	0	1	0	1	3	7	10	**1.85**	0.0026	546	2.85
0	4	0	10	26	3	5	2	9	6	6	**10.33**	0.0146	3047	8.93
0	0	0	0	0	0	0	0	0	0	0	**0.00**	0.0000	0	0.00
2	15	5	2	5	8	8	7	17	1	6	**6.00**	0.0085	1769	5.25
4	3	10	3	6	6	10	8	3	6	7	**6.15**	0.0087	1813	5.59
											Overall Mean			**Overall SD**
23	**50**	**33**	**36**	**43**	**33**	**45**	**41**	**74**	**36**	**61**	**45.74**	0.0647	13486	11.29

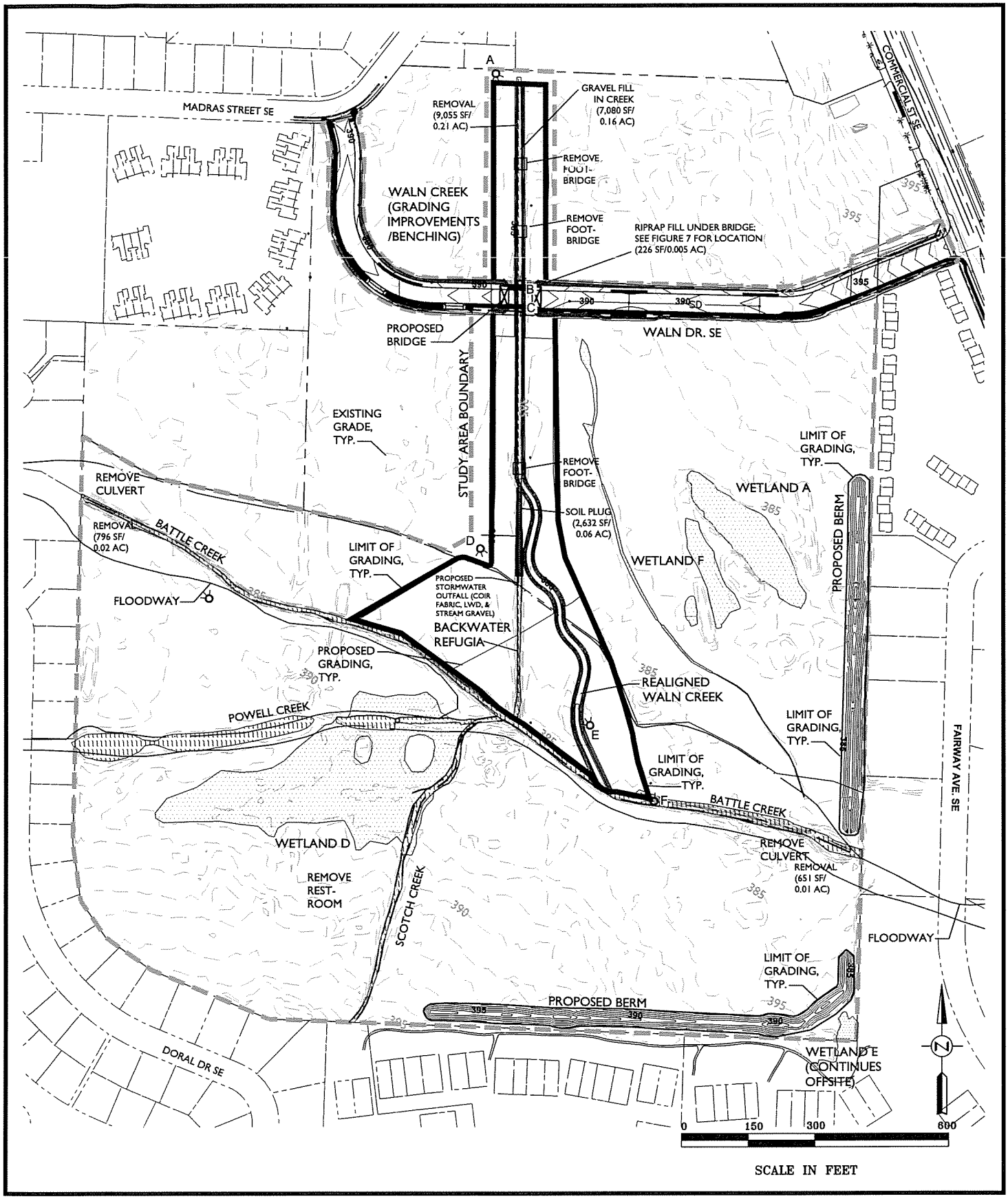
Descriptive Statistics	
Mean	45.42307692
Standard Error	2.232744484
Median	46
Mode	50
Standard Deviation	11.38480769
Sample Variance	129.6138462
Kurtosis	0.267243468
Skewness	0.430631569
Range	51
Minimum	23
Maximum	74
Sum	1181
Count	26
Confidence Level(80.0%)	2.9390622

Notes:

For 80% Confidence Level, mean count per sample can range from 42.48 to 48.36	42.48	0.0601	12525
For 80% Confidence Level, the extrapolated mean total of 13,486 plants can actually vary from 12,525 to 14,258 plants.	48.36	0.0684	14258

Appendix B

Figures



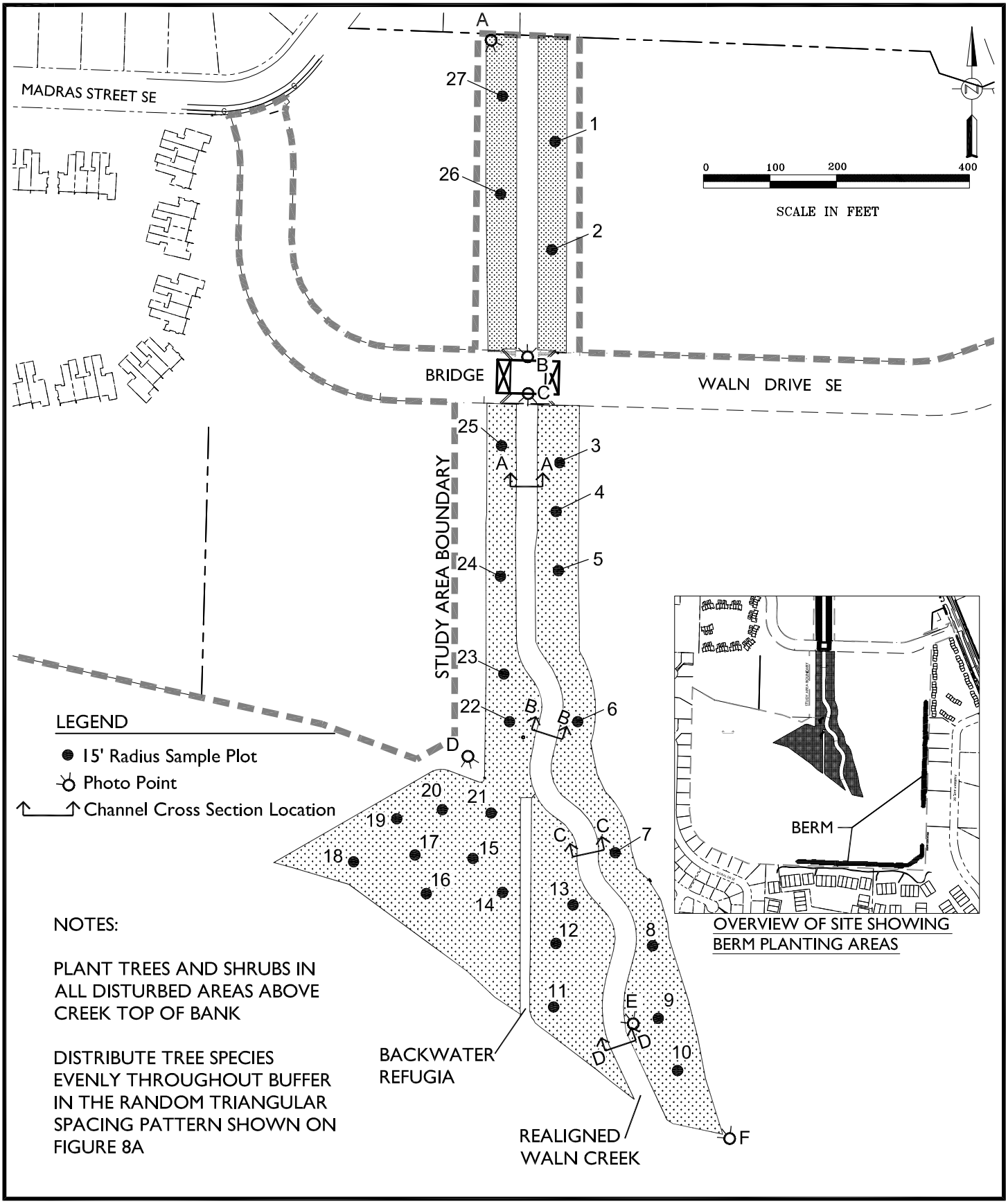
5187
12/16/13

Overall Grading and site plan at the Waln Creek and Battle Creek enhancement project in Salem, Oregon, showing limits of riparian buffer enhancement area. Provided by OTAK, Inc., 2011.

FIGURE 1

Pacific Habitat Services, Inc.

X:\Project Directories\5100\5187 Battle Creek, Salem monitoring\AutoCAD\Plot Dwgs\Fig1-Grading and Site Plan.dwg, 12/18/2013 1:22:19 PM



5187
9/20/2016

Riparian planting plan overview at the Waln Creek and Battle Creek enhancement project in Salem, Oregon, showing sample plot and photo point locations.

FIGURE 2

Pacific Habitat Services, Inc.

X:\Project Directories\5100\5187 Battle Creek, Salem monitoring\AutoCAD\Plot Dwgs\Fig1-Grading and Site Plan.dwg, 9/20/2016 2:55:52 PM

TREES

QUANTITY	COMMON NAME / Botanical name:	Size and Description	Spacing
* 1,511	OREGON ASH / Fraxinus latifolia	Bare root	7.2' o.c.
1,209	WHITE ALDER / Alnus rhombifolia	Bare root	7.2' o.c.
302	DOUGLAS HAWTHORNE / Crataegus douglasii	Bare root	7.2' o.c.
302	WESTERN CRABAPPLE / Malus fusca	Bare root	7.2' o.c.
* 605	WESTERN RED CEDAR / Thuja plicata	Bare root	7.2' o.c.
* 1,209	BLACK COTTONWOOD / Populus trichocarpa	Bare root	7.2' o.c.
907	BIG LEAF MAPLE / Acer macrophyllum	Bare root	7.2' o.c.

* Plant Closer to Stream

SHRUBS

QTY	ABBREV.	COMMON NAME / Botanical name:	Size and description	Spacing
557	CORSEA	RED-OSIER DOGWOOD / Cornus sericea	Bare root	4.7' o.c.
557	LONINV	TWINBERY / Lonicera involucrata	Bare root	4.7' o.c.
371	SPIDOU	DOUGLAS SPIREA / Spiraea douglasii	Bare root	4.7' o.c.
557	PHYCAP	PACIFIC NINEBARK / Physocarpus capitatus	Bare root	4.7' o.c.
371	SAMCER	BLUE ELDERBERRY / Sambucus cerulea	Bare root	4.7' o.c.
334	ROSNUT	NOOTKA ROSE / Rosa nutkana	Bare root	4.7' o.c.
334	ROSPIS	SWAMP ROSE / Rosa pisocarpa	Bare root	4.7' o.c.
631	SYMALB	SNOWBERRY / Symphoricarpos albus	Bare root	4.7' o.c.

SEED MIX

SYMBOL	QUANTITY	COMMON NAME / Botanical name:	LBS / ACRE
	5.69 Acres	SPIKE BENTGRASS / Agrostis exarata	2.18 lbs / acre
	247,643 SF	TUFTED HAIRGRASSE / Deschampsia cespitosa	2.18 lbs / acre
		SLENDER HAIRGRASS / Deschampsia elongata.	2.18 lbs / acre
		WESTERN FESCUE / Festuca occidentalis	8.71 lbs / acre
		TALL MANNAGRASS / Glyceria elata	2.18 lbs / acre
		MEADOW BARLEY / Hordeum brachyantherum	43.56 lbs / acre
		STREMBANK LUPINE / Lupinus rivularis	13.07 lbs / acre

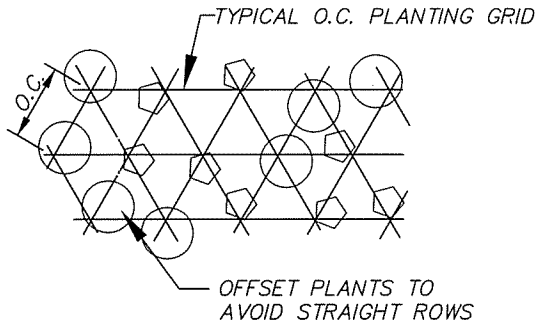
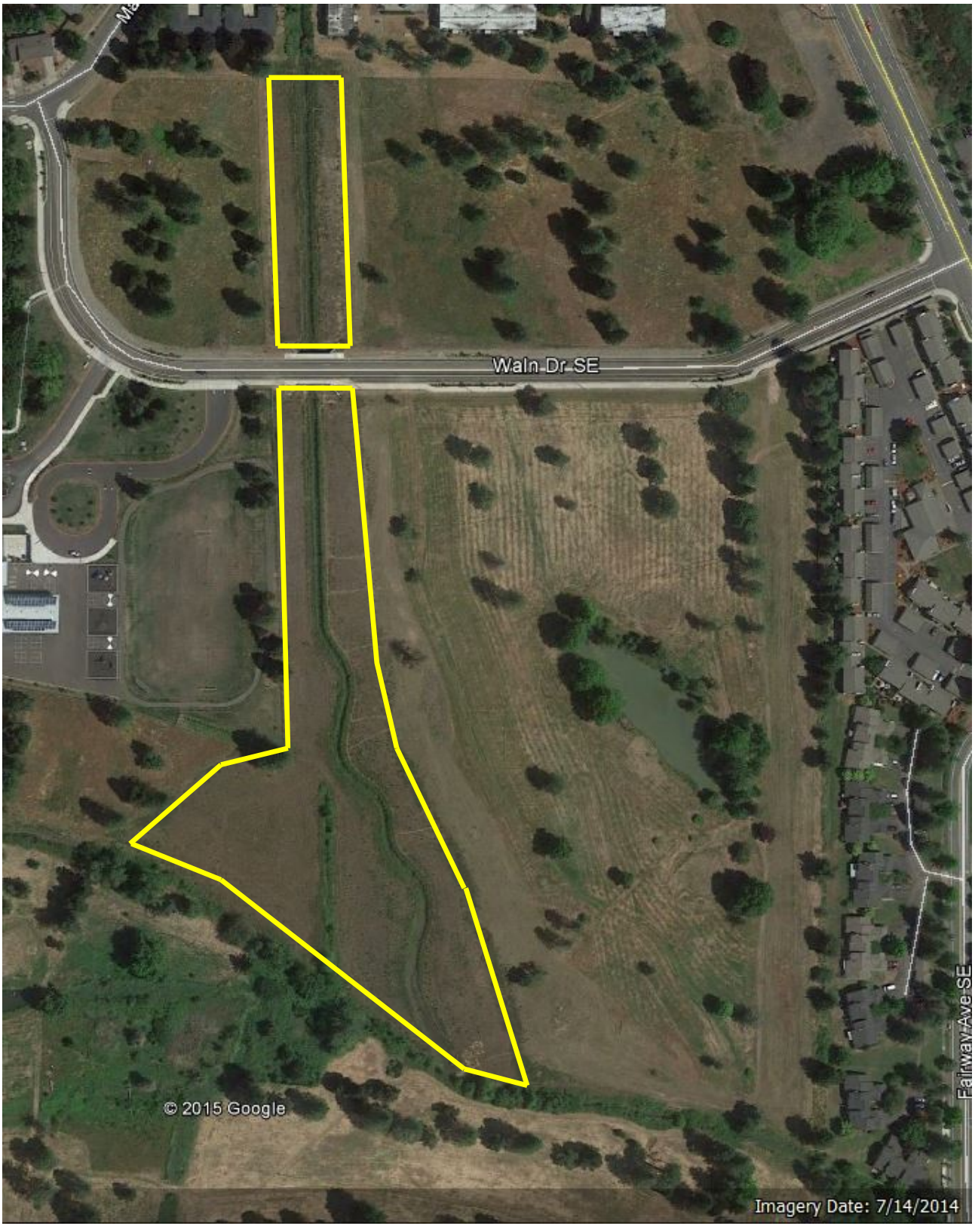


FIGURE 3

Plant list and planting grid at the Waln Creek and Battle Creek enhancement project in Salem, Oregon. Provided by OTAK, Inc., 2011.

5187
12/16/13

Pacific Habitat Services, Inc.



5187
12/10/15

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Aerial photograph (2014)
Waln Creek-Battle Creek riparan enhancement project area in Salem, Oregon. The riparian buffer planting area is outlined in yellow.
(Photo source: GoogleEarth)

FIGURE
4

Photo A:

Looks south from northern boundary of mitigation area

Photo was taken on 7/14/2017

Photo B:

Looks north from bridge at Waln Drive SE

Photo was taken on 7/11/2017

5187
11/22/17

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Photodocumentation
Waln Creek/Battle Creek riparian mitigation area in Salem, Oregon.

FIGURE
5

Photo C:

Looks south from Waln Drive SE bridge

Photo was taken on 7/11/2017

Photo D:

Looks south from west side of mitigation area.

Photo was taken on 7/11/2017

5187
11/22/17

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Wilsonville, OR 97070

Photodocumentation
Waln Creek/Battle Creek riparian mitigation area in Salem, Oregon.

FIGURE
6

Photo E:

Looks north along channel in southern portion of mitigation site, toward active beaver dam.
Photo was taken on 7/11/2017

Photo F:

Looks northwest from southeast edge of mitigation area

Photo was taken on 7/11/2017

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11/22/17

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Wilsonville, OR 97070

Photodocumentation
Waln Creek/Battle Creek riparian mitigation area in Salem, Oregon.

FIGURE
7

Photo shows obtaining measurements at channel section B, from west bank of Waln Creek.

Photo was taken on 6/29/2017

Photo shows obtaining measurements at channel section C, from west bank of Waln Creek.

Photo was taken on 6/29//2017

5187
11/22/17

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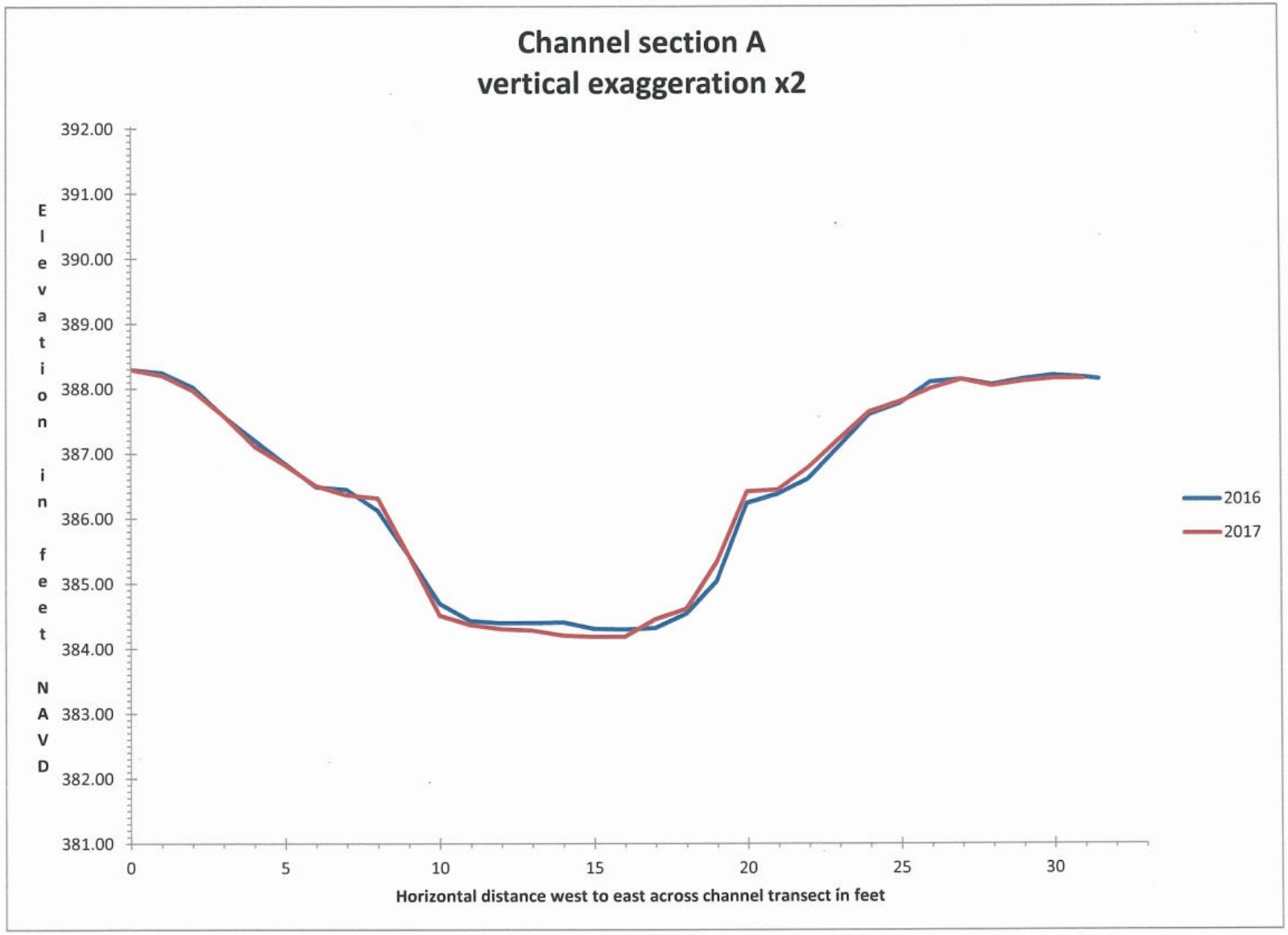
Wilsonville, OR 97070

Photodocumentation
Waln Creek/Battle Creek riparian mitigation area in Salem, Oregon.

FIGURE
8

Appendix C

2016/2017 Channel Cross-Sections
2016 BEHI Worksheets



5187
11/20/17

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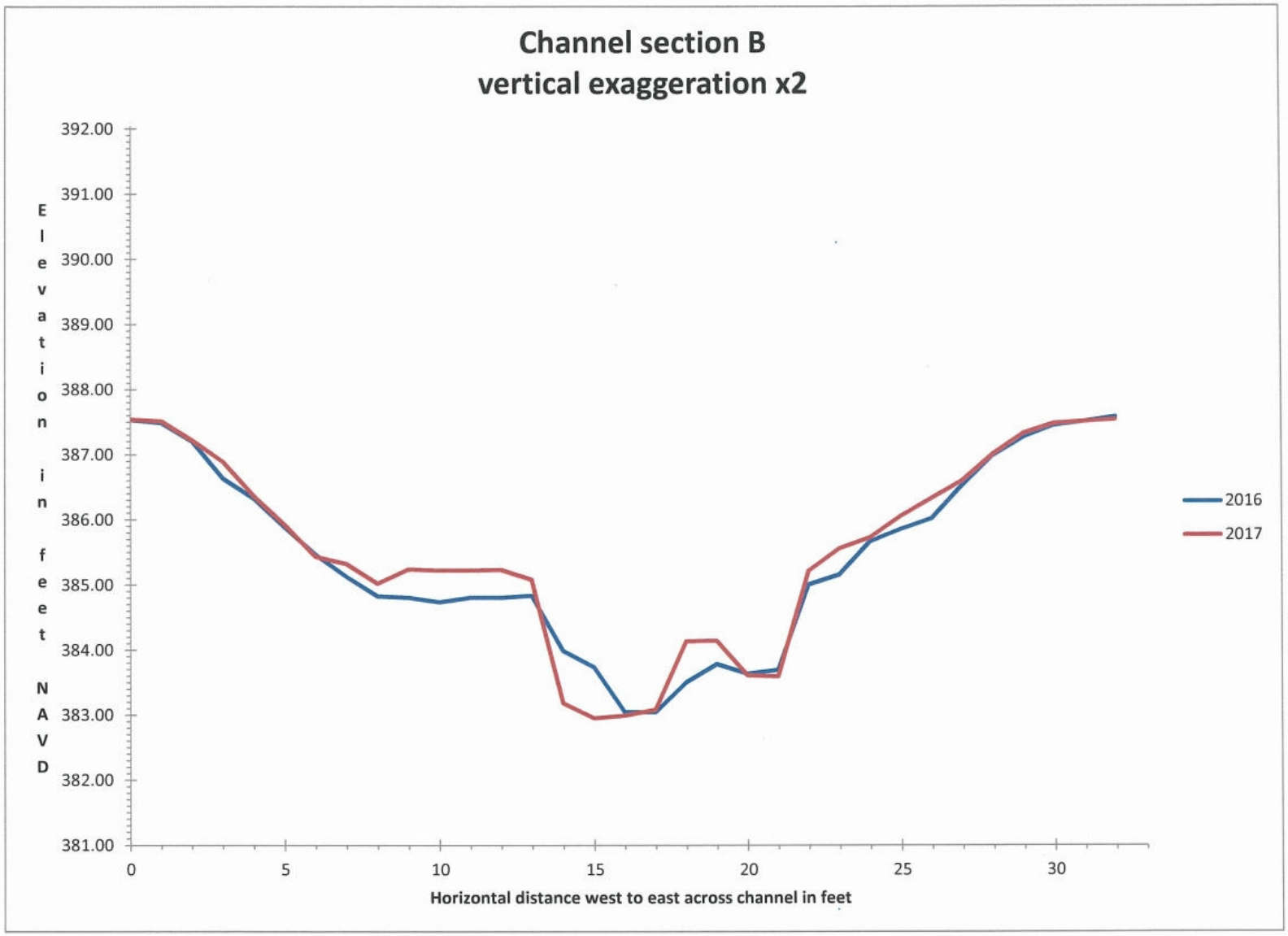
Wilsonville, OR 97070

Stream Channel Cross Section A, 2017
Waln Creek Stream Mitigation Bank site, Salem, Oregon

FIGURE
9



5187
11/20/17

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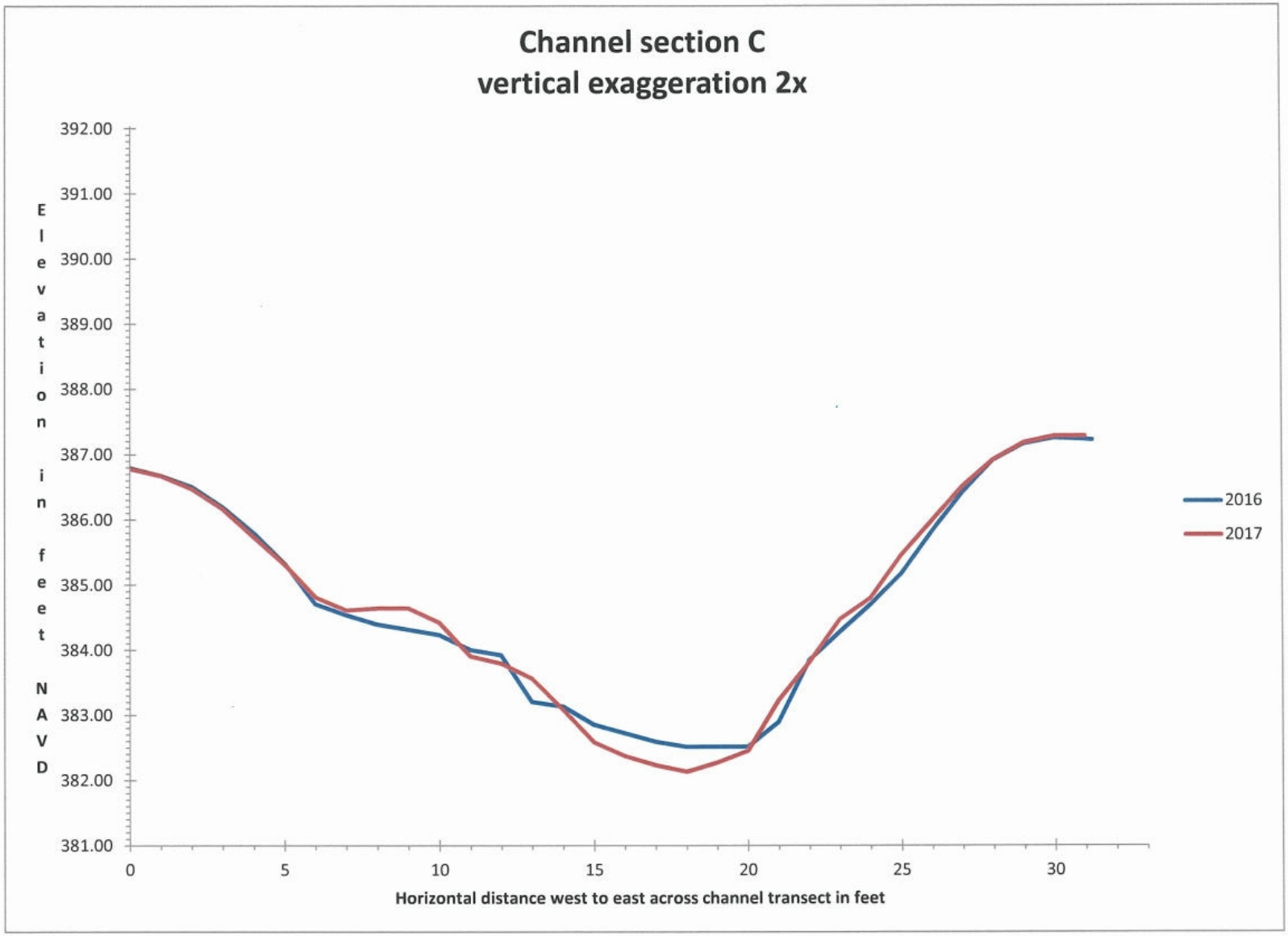
Wilsonville, OR 97070

Stream Channel Cross Section B, 2017
Waln Creek Stream Mitigation Bank site, Salem, Oregon

FIGURE
10

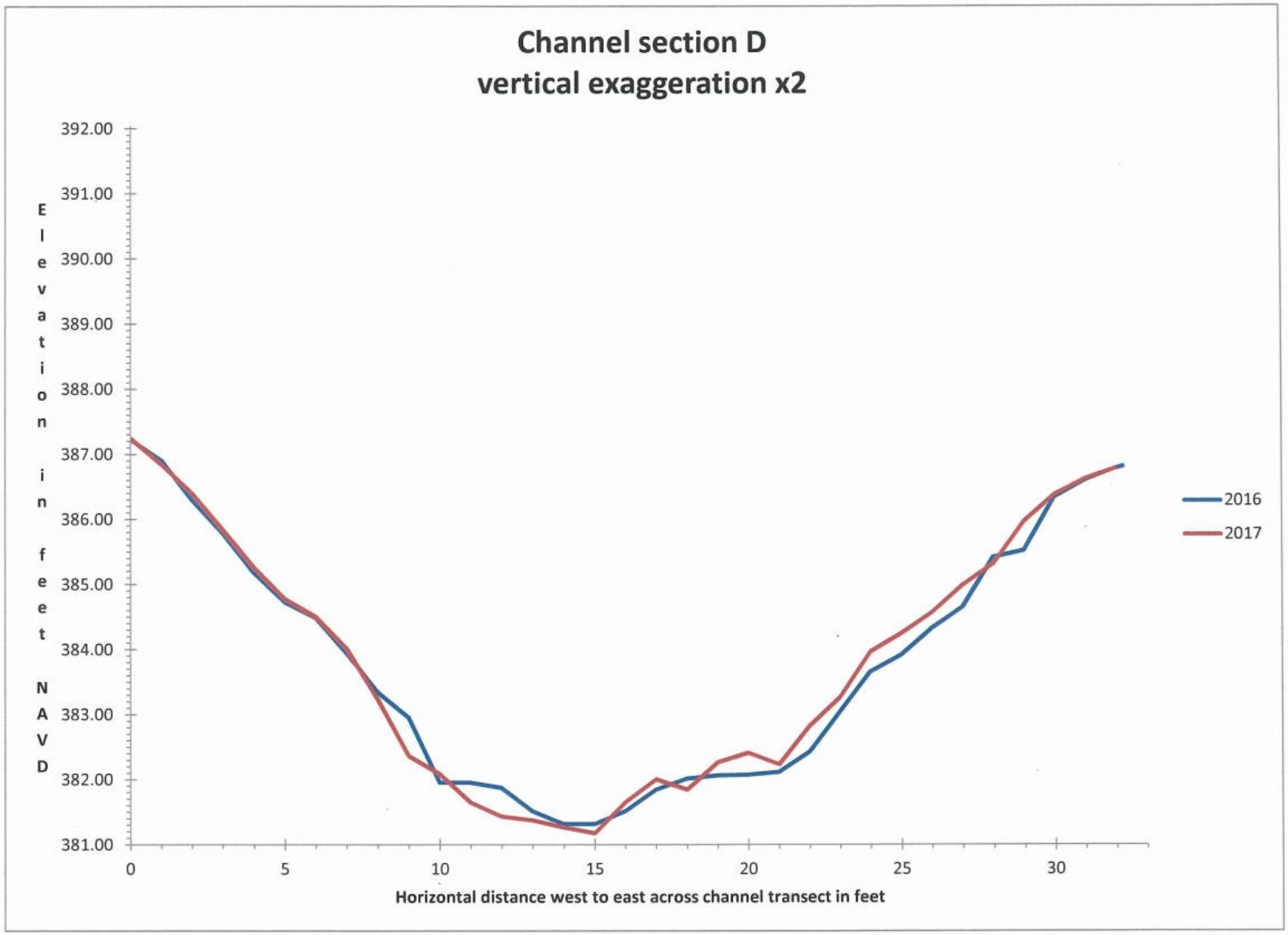


5187
11/20/17

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Stream Channel Cross Section C, 2017
Waln Creek Stream Mitigation Bank site, Salem, Oregon

FIGURE
11



5187
11/20/17

Pacific Habitat Services, Inc.
9450 SW Commerce Circle, Suite 180
Wilsonville, OR 97070

Stream Channel Cross Section D, 2017
Waln Creek Stream Mitigation Bank site, Salem, Oregon

FIGURE
12

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: Waln Cr Location: Salem, OR

Station: A Observers: FS/DG

Date: Stream Type: Valley Type:

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.8 (A)	Bankfull Height (ft) =	3.8 (B)	(A) / (B) =	1.0 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	≈1.5 (D)	Study Bank Height (ft) =	3.8 (A)	(D) / (A) =	0.4 (E)	5
Weighted Root Density (G)						
Root Density as % =	~30 (F)			(F)×(E) =	12 (G)	8
Bank Angle (H)						
Bank Angle as *Degrees* =	20 (H)					2
Surface Protection (I)						
Surface Protection as % =	80 (I)					2

Bank Material Adjustment:

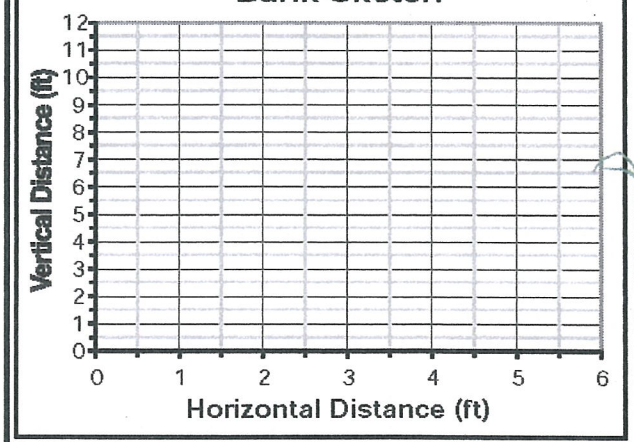
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform med. to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (No adjustment)

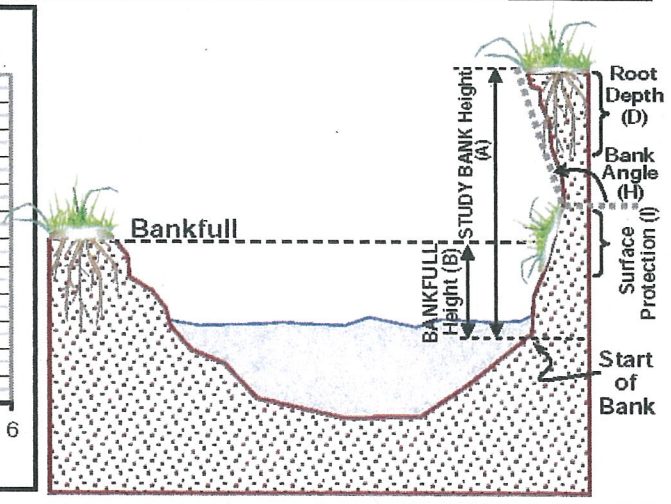
→ **Bank Material Adjustment**: Ø

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: Ø

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	Low / 18

Bank Sketch





Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	Waln Cr.	Location:	Salem, OR
Station:	B	Observers:	FS/DG
Date:	Stream Type:	Valley Type:	

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.5 (A)	Bankfull Height (ft) =	4.5 (B)	(A) / (B) =	1.0 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	~1.5 (D)	Study Bank Height (ft) =	4.5 (A)	(D) / (A) =	0.33 (E)	6
Weighted Root Density (G)						
Root Density as % =	30 (F)			(F)×(E) =	9.9 (G)	8
Bank Angle (H)						
Bank Angle as *Degrees* =	17.5 (H)					2
Surface Protection (I)						
Surface Protection as % =	80 (I)					2

Bank Material Adjustment:

- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform med. to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (No adjustment)

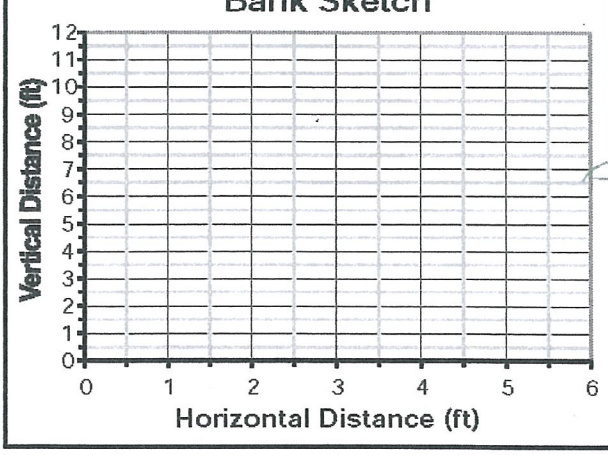
Bank Material Adjustment: 0

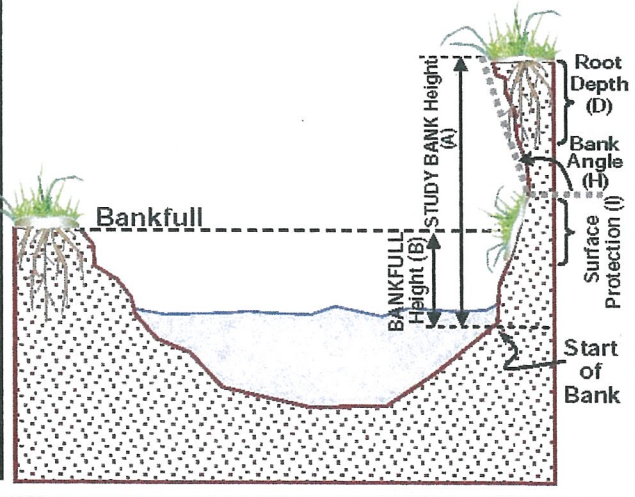
Stratification Adjustment — Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score: Low / 19

Bank Sketch





Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: Waln Cr. Location: Salem, OR

Station: C Observers: FS/DG.

Date: Stream Type: Valley Type:

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.3 (A)	Bankfull Height (ft) =	4.3 (B)	(A) / (B) =	1.0 (C)	1
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	4.3 (A)	(D) / (A) =	0.35 (E)	5
Weighted Root Density (G)						
Root Density as % =	30 (F)			(F)×(E) =	10.5 (G)	8.5
Bank Angle (H)						
Bank Angle as *Degrees* =	23.5 (H)					2
Surface Protection (I)						
Surface Protection as % =	80 (I)					2

Bank Material Adjustment:

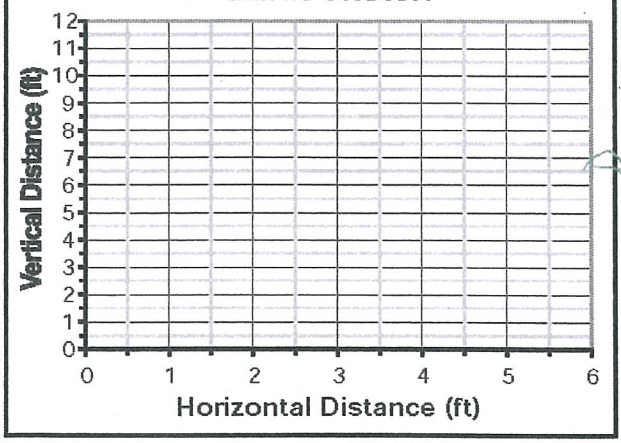
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform med. to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (No adjustment)

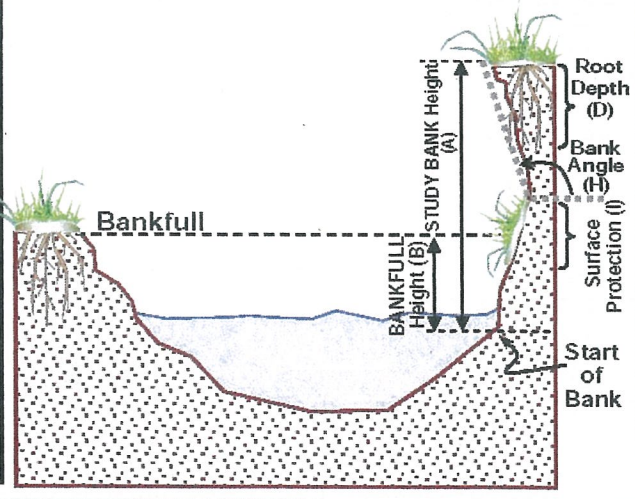
→ **Bank Material Adjustment**: Ø

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: Ø

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	Low / 18.5

Bank Sketch





Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream:	Wain Cr.	Location:	Salem, OR
Station:	D	Observers:	FS/DG
Date:	Stream Type:	Valley Type:	

							BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)							
Study Bank Height (ft) =	5.6 (A)	Bankfull Height (ft) =	5.6 (B)	(A) / (B) =	1.0 (C)		1
Root Depth / Study Bank Height (E)							
Root Depth (ft) =	1.5 (D)	Study Bank Height (ft) =	5.6 (A)	(D) / (A) =	0.27 (E)		6
Weighted Root Density (G)							
Root Density as % =	30 (F)			(F)×(E) =	8.1 (G)		8.5
Bank Angle (H)							
Bank Angle as *Degrees* =	21 (H)						2
Surface Protection (I)							
Surface Protection as % =	80 (I)						2

Bank Material Adjustment:

- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform med. to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (No adjustment)

Bank Material Adjustment: 0

Stratification Adjustment — Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 0

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score: Low / 19.5

Bank Sketch