MEMORANDUM

DATE: September 27, 2018

TO: Yvonne Vallette, EPA

RE: Highland Flats Wetland Mitigation Late Season Monitoring

FROM: Leslie Gecy, EcoWest Consulting, Inc.

INTRODUCTION

EcoWest visited the Highland Flats Tree Farm (HF) wetland mitigation site between September 12 and 16, 2018 to conduct the final 2018 growing season monitoring. The data collected during this monitoring represent the official 2018 results against which the 2018 success criteria will be evaluated. Additionally, both (1) maintenance tasks needed to be completed prior to plant dormancy, and (2) any additional planting, seeding or early spring 2019 maintenance needs were identified.

Because of the staggered implementation dates, 2018 represents a year in which Year 1 criteria apply to the HW Restoration area (HW) and Year 2 criteria apply to the Reservoir Mitigation (Reservoir) and Culvert Enhancement (Culvert) areas. The main difference is that survival is the success criterion regarding the woody species plantings in the HW area, with density the main criterion in the Reservoir and Culvert areas (although survival is still measured in Year 2 in these areas). For this memorandum, survival is reported for all mitigation areas, along with density, where applicable.

MONITORING RESULTS

Success Criteria 1: Woody Plant Survival, Vigor, and Density (where applicable).
Survival and Density. Woody plant survival was high in the HW and Culvert areas (93.6 to 100%, respectively, Table 1). In the HW-3a subarea, there was some loss of willows, cottonwoods and hawthornes in the early summer, but extra bundle plants had been placed in this area, as well as replanting of aspen killed by overwinter rodent activity. As a result, the net number of planted trees and shrubs in this subarea was greater than the target number (i.e., 598 woody plants at the end of 2018, three more than the target of 595).

Likewise, in the Culvert area, several extra plants were transplanted into the area in June, and with these plants, the total surviving number was 114, providing a net 100% survival (i.e, The original planting called for 114 trees/shrubs; with the original and supplemental planting, a total of 125 plants were placed, so that a loss of 11 plants resulted in a total of 114 plants). Counting both planted and naturally-establishing riparian trees and shrubs, the Culvert density was 983 stems/acre, greater than the required density of 435 stems/acre.

Reservoir survival was lower, at 74%. However, the relatively high water levels through July led to vigorous growth of the remaining willows. The naturally establishing alders continue to grow as well, exceeding 12 feet in height, with some of the young plants close to 1 inch in diameter (or tree stature). One of the reasons for willow loss is shading and competition from the alders. In 2018, the woody plant success criterion switches from survival (in which only the planted shrubs are counted) to density (in which both planted and volunteer shrubs are counted). Although willow survival was lower than in 2017, the density of both planted and naturally-establishing shrubs well exceeded the required density of 1,393 stems/acre (see Table 1).

Table 1. Wetland and Riparian Plant Survival and Density (where applicable) in the Highland Flats Mitigation Areas.

Mitigation Area	**Fall Survival (%)**		**Density (# stems/acre)**	
	2017	**2018**	**Required #**	**Total #**
HW-2/Upper HW-3a, 2016 Graded	95.4%	93.6%	NA	NA
HW-2, 2017 Graded	NA	97.6%	NA	NA
HW-3a	NA	100%	NA	NA
HW-3b	NA	96.7%	NA	NA
Culvert	91.2%	100%	435	983
Reservoir	80.0%	74.0%	1,393	2,691-5,937*
TOTAL WETLAND/RIPARIAN	92.3%	97.4%	NA	

*The range of numbers is from a tally of only larger alder, Year 2 naturally-establishing cottonwood, and planted willow stems to all woody stems. Because a very dense alder thicket has developed, it is likely that stem density will naturally reduce over time from the upper stem numbers to the lower number.

Planted Species Vigor. Overall HW area vigor was good with the 2017-planted aspen and cottonwoods recovering well after an organic pepper spray was used to address a small beetle infestation that was affecting those two species.[1] Vigor was very high for the Bebb's willows, meadowsweets, hawthornes and dogwoods, with coyote willow expanding laterally and sending up side shoots in the HW-2, 2017-graded area. Vigor was lower in the HW-2/upper 3a, 2016-graded area, likely as a result of a later irrigation start than for other areas and a dramatic expansion of the trefoil-clover mix (see discussion under Wetland Cover).

[1] The beetles likely came with the nursery plants as the infestation was quite limited and did not spread to native volunteers of the same species.

Culvert area vigor was also very high with many of the alders and dogwoods exceeding their six-foot-tall anti-herbivory cages. The meadowsweet and cottonwoods were not as tall, but the meadowsweet produced abundant flowers indicating healthy plants. The Culvert area was not irrigated in 2018 and no irrigation will be necessary in subsequent years, absent a severe change in conditions.

Reservoir willow vigor was high for the surviving plants, as it was for the naturally-establishing alders.

Buffer Areas. Planted species survival in upland buffer areas was variable. All three of the planted red cedars in the reservoir buffer (plus one additional extra plant) survived and produced vigorous growth. The ponderosa pines planted in the HW-1 and HW-2 upland buffers to increase shade did not fare as well, with 10 of the 16 planted pines surviving and with the survivors exhibiting low vigor. Their low vigor was in contrast to the higher ponderosa pine vigor observed in the HW-3b upland riparian area, likely reflecting soil and depth to water table differences. The in-channel willows in the HW-1 buffer also did not survive.

Success Criteria 2: Non-Native Invasive Weeds. Weed success criteria in both Years 1 and 2 are that non-native invasive weeds provide 10% or less cover. RCG , tansy and creeping foxtail (*Alopecurus arundinaceus*) provided from less than 1 to 3.4% cover in the HW area. There was no RCG, tansy or creeping foxtail in either the Culvert or the Reservoir areas, including all around the reservoir shoreline both within and outside of the designated mitigation areas. The HW-1 buffer, along with the areas adjacent to HW-3a and HW-3b were cut twice during the growing season (with all material removed) to prevent RCG and tansy expansion into the mitigation areas.

Milfoil occurred throughout the reservoir, with a mean cover of 7.6% in the mitigation areas (higher in the deep marsh plots). In spite of on-going removal efforts in 2017 and 2018, the milfoil continues to persist, unlike the RCG which has been eliminated. The milfoil will be difficult to eradicate given the local waterfowl use of both the mitigation area and the nearby milfoil-infested McArthur Lake Wildlife Management Area.

Success Criteria 3: Wetland Cover. The Reservoir mitigation area is the only area in which there is a cover requirement in Year 2, but cover is regularly examined in all areas to ensure that it remains on track to meeting the final 80% native cover requirement, and identify any situations that might require remedial activities. The native cover status of each mitigation area is summarized below.

HW Restoration Area. The native grasses establishing from the seed mix were overtaken in much of the area by the bird's-foot trefoil (*Lotus corniculatus*) and white clover (*Trifolium repens*; trefoil-clover mix) mix used elsewhere on the HF site for erosion control and as a green cover crop. Although the trefoil-clover cover was effective at preventing RCG from establishing within the mitigation areas, it also eliminated much of the native herbaceous cover. Overall, the native species provided from 11 to 33% total cover, as opposed to up to 58% total cover of the trefoil-clover mix.

Relative native cover was greatest in the HW-2, 2017 graded and HW-3b subareas (65.8to 69.2%). In these areas, there was minimal establishment of the erosion control mix. Relative native cover was

lowest in the HW-2, 2016 graded area at only 15.1% relative cover. Relative native cover was generally low, but variable in the HW-3a subarea.

In conjunction with evaluating the trefoil-clover cover, the continued growth of a large number of naturally establishing cottonwoods was observed. Although heavily grazed by ungulates, the naturally-establishing cottonwood vigor was high. To assist in meeting the long term native plant cover requirement and help shade out the trefoil-clover mix, an exclosure was constructed in July around the area in which the greatest concentration of naturally establishing cottonwoods occurred. The exclosure extended from the HW access road to the unnamed stream channel (approximately 50 feet wide) and extended 110 feet along the road. More than 200 cottonwoods were tallied in the exclosure. The cottonwoods in the exclosure more than doubled in height within a 6-week time period (see Figure A-2). As a result of this success, two additional exclosures were constructed encompassing another estimated 300 cottonwood seedlings. The new exclosures were 125 and 74.5 feet long along the access road and also extending to the channel. Corridors were left between exclosures for ungulate passage to and from the heavily used reference area. Overall, in addition to protecting the naturally establishing cottonwoods, all of the aspen, 90% of the planted cottonwoods and most of the dogwoods fell inside the exclosures. These taller plants had outgrown their anti-herbivory cages requiring new caging to protect against ungulate herbivory. In lieu of new individual plant cages, the existing cages will be removed once plants within the exclosures enter dormancy.

Culvert. The Culvert area total cover is 61.9%, greater than the required Year 5 cover of at least 40% from plants within the mitigation area (with the remaining cover provided by an existing canopy).

Shrub cover was 10% overall, but along the channel where planting was concentrated, shrub cover ranged between 10 to 30% , with a mean channel shrub cover of 17.5%.

Reservoir. Cover of a number of native herbaceous plants increased (such as both the planted and volunteer sedges, water-plantain, spikerush and cattail), but the bulrush cover declined between May and July as waterfowl herbivory substantially impacted the species, reducing its cover to 10%. Total native herbaceous cover was 33.2%, which met the Year 2 Reservoir cover criterion. Total shrub cover increased to 10.1% with some of the shrubs approaching tree size.

SUMMARY AND RECOMMENDATIONS

Overall, the mitigation area exhibited high woody species survival and/or density, and mostly very high vigor. Non-native invasive species cover was below 10%, with no RCG or tansy at the Reservoir or Culvert areas, and only limited amounts in the HW area. The buffer areas were maintained to prevent non-native invasive species expansion into the mitigation areas. All 2018 success criteria were met.

The primary items of concern are those that could prevent subsequent year criteria from being met, such as long term woody plant survival, the 80% native cover requirement, and the increased Year 3 Reservoir native herbaceous species cover requirement. Additionally, measures to reduce long term

maintenance by increasing the ability to shade out, rather than continually weed non-native plants, are included. These items are:

- High trefoil-clover cover in the HW area.
- Lower than desired woody plant vigor in the HW-2, 2016 graded area.
- Low woody plant survival in the HW-1 and HW-2 upland buffers.
- Decrease in deep marsh cover in the Reservoir area.

Each of these items is discussed separately below.

HW Trefoil-Lotus Cover. The non-native trefoil and clover mix is being treated as an early seral, allowable ground cover that is providing beneficial soil stabilization and one that will not persist over the long term (i.e., non-native, but not non-native invasive). It is not included in the non-native invasive species cover calculations, and is helping prevent RCG from re-establishing. However, it is also preventing a native herbaceous understory from developing and in some places was interfering with planted tree/shrub growth. Several measures are proposed to address this situation:

(1) Continue clearing out the planting basins in 2019 as was done during mid-summer 2018 to allow irrigation water to get to the desired plants and not support the trefoil-clover mix.
(2) Overseed the area in Fall 2018 with additional native seed to allow increased opportunity for native grass establishment in early spring prior to the trefoil-clover growth.
(3) Evaluate how well the exclosures promote both woody plant growth and shading of the trefoil-clover in 2019 to identify if additional measures to reduce their cover are necessary.
(4) If necessary, replace some of the pre-perforated irrigation lines with self-perforated lines to ensure water supply only to the desired species and not the non-natives in between.
(4) Once irrigation has been completed, remove the drip lines, and if reseeding is necessary, selectively remove the trefoil-clover and drill seed the native species mix to allow greater soil-seed contact and germination.

HW2, 2016 Graded Low Vigor. The lower than desired subarea vigor can be attributed to very heavy trefoil-clover growth, both in the planting basins and climbing up the anti-herbivory cages, and a late irrigation start which resulted in woody species die-back. Recommendations are similar to those listed above, except increasing the planting basin clearance from 6-8 inches to 12 inches to keep the shrubs free of the trefoil-clover, and continuing irrigation for another year to re-establish the shrub vigor. In addition, three more conifers will be planted in the area to assist with shade.

Upland Buffers. Ponderosa pine was selected as the species to use in the upland buffers to create shade as it is one of the faster growing conifers. However, the areas were generally compacted and the soil quality poorer than the pine could tolerate. Replant the buffer with the slower growing, but more tolerant lodgepole pine.

The willows in HW-1 also did not survive. A seasonal low water table with no establishment assistance via irrigation was likely the cause. However, with the aggressive RCG and tansy cutting, the existing meadowsweet, snowberry and Bebb's willow were released and increased their cover.

In lieu of replanting the willows, continued RCG and tansy cutting to not only prevent seeding into adjacent areas but allow existing native shrubs to expand would promote similar benefits as the willow planting.

Reservoir Deep Marsh. The native herbaceous cover for all areas below the OHW was 33.2%, meeting the Year 2 success criterion. However, the bulrush decline in the deeper marsh areas may prevent subsequent year cover requirements from being met (40% in 2019, 80% by 2011). It is possible that the bulrush may recover from the waterfowl damage, or that other native plants may expand into the deep marsh. The need for remedial planting should be re-assessed in early 2019 to allow the potential for bulrush recovery to occur.

Figure A-1. Comparison of the HW-3b photopoint looking north in June 2018 (top) when Montia linearis was the dominant understory species, and in September, post-exclosure construction with volunteer cottonwood growth (bottom).

Figure A-2. Planted species vigor in HW-3a , looking south at meadowsweet from HW-3a, DP1 (top) and looking north at Bebbs willow from HW-3a, DP2 (bottom).

Figure A-3. Culvert area shrub growth in September 2018 looking southwest from Culvert PP3 (top) and northeast from Culvert PP4 (bottom), showing planted shrubs far outgrowing their cages.

Figure A-4. Reservoir cover looking south from PP5 (top) and north at PP5 (bottom).

Figure A-5. Bulrush herbivory damage.