
MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

*Bowser Creek
Flathead County, Montana*

*Project Completed: 2010
Monitoring Report #7: December, 2019*



Prepared for:



Prepared by:



MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #7

YEAR 2019

*Bowser Creek
Flathead County, Montana*

MDT Project Number: NH 15(93)
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1.0 INTRODUCTION

As part of construction of the Kalispell Bypass U.S. Highway 2 South, the Montana Department of Transportation (MDT) modified a segment of Bowser Creek to allow for highway widening and improved traffic. In order to offset the impacts of this project, MDT proposed on-site stream mitigation actions within the widened highway right of way. The following report includes results from the seventh year of post-project monitoring of the on-site mitigation actions along the modified segment of Bowser Creek. This monitoring report includes an evaluation of monitoring results in comparison to project performance standards outlined in the post-construction monitoring plan for the site. The project was constructed in 2010; therefore, these results provide documentation of the site's condition nine years following the project's completion.

Over several decades, the alignment of Bowser Creek was modified to fit between the original Highway 2 alignment and residential development. An expanded MDT right-of-way was acquired to provide additional space to relocate the stream away from the widened road footprint. The relocation of Bowser Creek was permitted in a modification to U.S. Army Corps of Engineers (USACE) permit NWO-2009-018098-MTM. The project proposed placement of 0.267 acres of wetland fill in the original Bowser Creek channel and 709 feet of stream impacts resulting from relocating 429 feet of the channel and placing a 218-foot segment of the creek into a culvert beneath MT Highway 2.

One goal of the project is to provide compensatory mitigation for stream impacts resulting from widening of U.S. Highway 2 at its intersection with the Alternate U.S. 93 Kalispell Bypass. MDT has selected on-site stream mitigation to meet this goal. Specific objectives intended to achieve this goal include:

- Constructing 430 linear feet of new Bowser Creek channel slightly north of the existing channel
- Laying back floodplain slopes adjacent to the channel from 1.5:1 to a 4:1 slope or flatter
- Implementing an aggressive revegetation plan to re-establish native riparian and upland vegetation.

If successful, the project will create, enhance, restore, and maintain permanent, naturally self-sustaining, native or native-like stream and riparian habitat. The project is designed to protect the functional values of riparian lands, floodplains, wetlands, and uplands for the benefit of fish and wildlife habitat, water quality, floodwater retention, groundwater recharge, open space, aesthetic values, and environmental education.

Provisions outlined in the USACE permit include monitoring the mitigation areas for at least five years following construction to determine whether the site is meeting, or moving toward meeting the performance criteria outlined in the monitoring plan. Specific success criteria for the Bowser Creek stream mitigation site include:

Quantitative success criteria:

1. **Riparian Buffer Success** will be achieved when
 - a. Woody and riparian vegetation becomes established, and noxious weeds do not exceed 10% cover within the riparian buffer areas.
 - b. Any area within the creditable buffer area disturbed by the project construction must have at least 50% areal cover of non-noxious weed species by the end of the monitoring period.
2. **Vegetation Success** will be achieved when
 - a. Combined areal cover of riparian and stream bank vegetation communities is $\geq 70\%$
 - b. Planted trees and shrubs will be considered successful where they exhibit 50% survival after 5 years.
3. **Vegetation along Stream Banks** will be considered successful when banks are vegetated with a majority of deep-rooting riparian plant species having root stability indices ≥ 6 (subject to 1.a and 1.b above).
4. **Stream Bank Stability Success** will be achieved where; following restoration, less than 25% of bank length is unstable and classified as eroding bank. For this purpose "eroding bank" will be defined as any bank greater than two feet in length that is more than 50% bare mineral soil and has no roots, surface vegetation, or other stabilizing structure (e.g. rock, woody debris) to inhibit erosion.

Qualitative performance criteria:

5. **Channel Form Success** will be achieved when the stream stabilizes, includes pools and riffles, allows for flood events to occupy the floodplain, and the habitat features such as riparian plant communities have successfully established along stream banks.

Additional reporting requirements:

6. **Photo Documenting** success of restored stream channel and stream bank vegetation community development showing distinct positive changes from pre-construction to final monitoring year in comparison with the establishment reference reach.

Results of the seventh year monitoring at the Bowser Creek stream mitigation site are presented in Section 4 and compared to performance standards in Section 5. Additional information to aid in documenting the site's condition are provided as appendices to this report, and include maps showing locations of riparian vegetation transects, perpendicular transects, and locations of noxious weeds; transect and longitudinal profile survey plots; photo documentation of the project site; comprehensive plant species list; noxious weed list; and a planting schematic from the approved design.

2.0 SITE LOCATION

The modified segment of Bowser Creek flows east within a newly constructed channel immediately north of U.S. Hwy 2 near the intersection of U.S. Highway 2 and Alternate U.S. 93 Kalispell Bypass (Figure 1). This monitoring site is located in Section 12, Township 28 North, Range 22 West, in Flathead County, Montana.

3.0 MONITORING METHODS

Monitoring field crews visited the project site on August 13th, 2019 while topographic survey crews visited the site on August 29th, 2019. Field data collection and surveys followed methodologies as described in the 2013 monitoring report for the Bowser Creek mitigation site, which may be accessed at the following Montana Department of Transportation website:

https://www.mdt.mt.gov/other/webdata/external/planning/STREAM-MITIGATION/2013_REPORTS/2013_BOWSER_CREEK_MONITORING_REPORT.PDF

4.0 RESULTS

4.1. Riparian and Stream Bank Vegetation Inventory

Table 1 summarizes the areal percent cover of total vegetation, woody vegetation, and noxious weeds observed along each three-foot wide streambank transect adjacent to the stream, and each 25-foot wide riparian belt transect during the 2014 through 2019 monitoring events. In addition to presenting results for individual transects, Table 1 includes area-weighted, site-wide totals for each of these vegetation cover categories.

In 2019 the percent cover in riparian belt transects decreased to 87%, with 8% cover by woody species and 4% by noxious weeds. Stream bank transects displayed 98% cover, with 5% by woody species and 2% by noxious weeds. More bare ground was observed within riparian areas (13%), as compared to stream bank areas (2%), likely a result of the 2018 and 2019 herbicide application within areas previously dominated by the nonnative weed species Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), and spiny plumeless-thistle (*Carduus acanthoides*). While bare ground increased within both the riparian and stream bank areas, noxious weed cover decreased substantially. In total, using a length-based weighted average of vegetation cover for riparian and stream bank transects, the site exhibited 90% total vegetation cover, with 7% by woody species and 4% by noxious weeds.

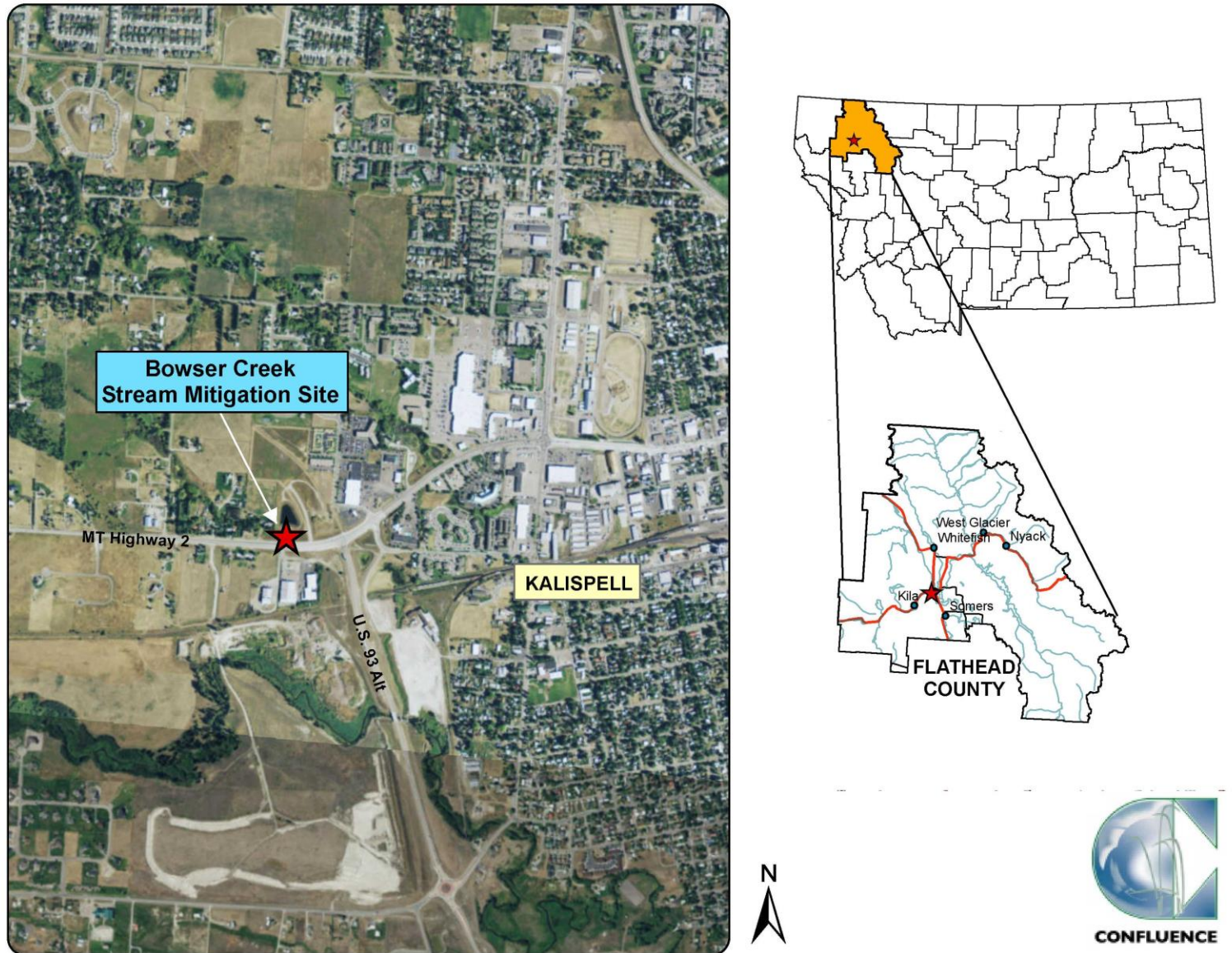


Figure 1. Project location of Bowser Creek stream mitigation site.

Table 1. Percent cover of vegetation transects at Bowser Creek in 2013 through 2019.

Belt Transect	Length (ft)	Total % Vegetation Cover							% Woody Cover							% Noxious Weed Cover						
		2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
Right (South) Riparian	204	100	100	100	100	95	90	85	2	5	7	5	5	6	6	2	5	10	13	15	15	3
Left (North) Riparian	167	100	100	100	100	95	93	90	14	15	17	15	15	13	10	5	10	12	15	17	17	5
Riparian Subtotal		100	100	100	100	95	91	87	8	10	12	10	10	9	8	4	7	11	14	16	16	4
Right (South) Stream Bank	465	100	100	100	100	100	100	98	17	20	15	7	7	3	4	4	5	6	10	10	7	2
Left (North) Stream Bank	465	100	100	100	100	100	99	98	12	10	10	5	5	5	4	4	10	10	10	10	8	2
Stream Bank Subtotal		100	100	100	100	100	100	98	15	15	13	6	6	4	5	4	8	8	10	10	8	2
Area Weighted Total		100	100	100	100	96	93	90	9	11	12	9	9	8	7	3	7	10	13	15	14	4

Dominant species recorded along the riparian and stream bank transects were combined with visual observations in other areas to develop a vegetation community map (Figure 3, Appendix A). Four vegetation community types were observed in 2019, and are included in Table 2.

Table 2. Vegetation community types observed at Bowser Creek in 2019.

Community Type	Dominant Species
2	<i>Phalaris arundinacea</i>
3	<i>Nasturtium officinale</i>
5	<i>Elymus</i> spp./ <i>Festuca ovina</i>
6	<i>Elymus</i> spp./ <i>Bromus inermis</i>

Vegetation community Type 2 – *Phalaris arundinacea* was identified along both stream banks and riparian zones adjacent to the channel. Reed canary grass dominated this community type, with lesser cover provided by Canada thistle, bull thistle, Nebraska sedge (*Carex nebrascensis*), watercress (*Nasturtium officinale*) along both stream banks, fringed willowherb (*Epilobium ciliatum*), and others.

Vegetation community Type 3 – *Nasturtium officinale* was identified within the channel. Watercress dominated this community type with more than 50% cover growing in the channel bed and 6 to 10% cover along both stream banks. This community has been consistently observed in dense stands along the stream bed during the growing season, and had expanded to both stream banks during the 2017 through 2019 monitoring events.

Vegetation community Type 5 – *Elymus* spp./*Festuca ovina* was identified along the upper side slopes of the project area. Sheep fescue (*Festuca ovina*), nodding wild rye (*Elymus canadensis*), slender wild rye (*Elymus trachycaulus*), and western-wheat grass (*Pascopyrum smithii*) were the most commonly observed species within this vegetation community.

Vegetation community Type 6 – *Elymus* spp./*Bromus inermis* was observed for the first time in 2019 due to a shift in dominance from the noxious Canada thistle and nonnative bull thistle to patchily distributed bare ground and an increase in the nonnative smooth brome (*Bromus inermis*).

Appendix D provides a comprehensive list of plant species observed on site during the 2013 through 2019 monitoring events. Since 2013, 101 plant species have been identified within the project area, including one new species observed in 2019. Halberd-leaf orache (*Atriplex patula*), a nonnative annual species was identified within the project area. In 2019, 50% of the species observed were hydrophytic based on the 2016 National Wetland Plant List (NWPL) (Lichvar *et al.* 2016).

4.2. Stream Bank Vegetation Composition

The stream bank vegetation inventory identified 46 plant species along the banks of Bowser Creek (Table 3). Reed canary grass comprised 21-50% cover along both stream banks in 2019 (see additional photos 1-3 in Appendix C). The Winward stability ratings are based on vegetation communities rather than individual species; therefore, a vegetation community was assigned to each stream bank based on one or more dominant species (Winward 2000). Vegetation community Type 2 – *Phalaris arundinacea* was the dominant vegetation community observed along the stream banks, with an associated Winward stability rating of 9.

4.3. Noxious Weed Inventory

A total of seven Montana Listed Priority 2B noxious weeds were identified within the Bowser Creek stream mitigation site and are listed in Appendix E. Locations of fifteen noxious weed infestations are provided on Figure 3 in Appendix A, with the exception of those observed as isolated occurrences and those in trace amounts (i.e., spotted knapweed (*Centaurea stoebe*), St. Johnswort (*Hypericum perforatum*), oxeye daisy (*Leucanthemum vulgare*), and common tansy (*Tanacetum vulgare*)). St. Johnswort was observed for the first time within the project site, although only in trace amounts. A low cover class (1 to 5 percent) was identified for all mapped weed occurrences within the project area. In 2019, a visual estimate of 4% of the project area was colonized by noxious weeds, representing a considerable decrease of 10% since the 2018 monitoring event. Infestations of Canada thistle, the most prevalent noxious weed, were located throughout the project area, although in far lesser amounts than observed in previous monitoring inspections. Vegetation community Type 4 shifted to community Type 6, due to the decrease in Canada thistle infestations (Figure 3, Appendix A). The reduction in noxious weeds is likely due to application of herbicide within the project area.

Table 3. Plant species and their associated cover classes along the stream banks of the Bowser Creek stream mitigation site in 2019.

Streambank Species	Left bank	Left Bank Cover Class	Right bank	Right Bank Cover Class	WMVC Indicator Status*
<i>Agrostis stolonifera</i>	X	0	X	0	FAC
<i>Alnus incana</i>			X	0	FACW
<i>Alopecurus arundinaceus</i>	X	2	X	2	FAC
<i>Artemisia absinthium</i>			X	0	UPL
<i>Bromus inermis</i>	X	1	X	1	UPL
<i>Carex nebrascensis</i>	X	2	X	1	OBL
<i>Carex utriculata</i>	X	2	X	2	OBL
<i>Cirsium arvense</i>	X	1	X	1	FAC
<i>Cirsium vulgare</i>	X	0	X	1	FACU
<i>Cornus alba</i>	X	0	X	0	FACW
<i>Cynoglossum officinale</i>		0	X	0	FACU
<i>Elymus repens</i>	X	0	X	0	FAC
<i>Epilobium ciliatum</i>	X	1	X	1	FACW
<i>Equisetum arvense</i>	X	1	X	1	FAC
<i>Geum macrophyllum</i>			X	0	FAC
<i>Glyceria striata</i>	X	0	X	0	OBL
<i>Helianthus maximiliani</i>	X	0	X	1	UPL
<i>Juncus balticus</i>	X	1			FACW
<i>Lactuca serriola</i>			X	0	FACU
<i>Leucanthemum vulgare</i>			X	0	FACU
<i>Medicago lupulina</i>			X	0	FACU
<i>Medicago sativa</i>			X	0	UPL
<i>Melilotus officinalis</i>	X	0	X	1	FACU
<i>Mentha arvensis</i>	X	0	X	1	FACW
<i>Myosotis scorpioides</i>	X	0	X	0	FACW
<i>Nasturtium officinale</i> ***	X	2	X	2	OBL
<i>Persicaria amphibia</i>	X	0			OBL
<i>Phalaris arundinacea</i> **	X	4	X	4	FACW
<i>Poa palustris</i>	X	1	X	1	FAC
<i>Poa pratensis</i>	X	1	X	1	FAC
<i>Rosa woodsii</i>	X	0			FACU
<i>Rumex crispus</i>	X	0	X	0	FAC
<i>Salix bebbiana</i>	X	0	X	0	FACW
<i>Salix drummondiana</i>	X	0	X	1	FACW
<i>Salix exigua</i>			X	1	FACW
<i>Scirpus microcarpus</i>	X	0	X	0	OBL
<i>Solanum dulcamara</i>			X	1	FAC
<i>Sonchus arvensis</i>	X	0	X	0	FACU
<i>Taraxacum officinale</i>	X	0	X	0	FACU
<i>Trifolium pratense</i>	X	0	X	1	FACU
<i>Trifolium repens</i>	X	0	X	0	FAC
<i>Typha latifolia</i>	X	1	X	1	OBL
<i>Urtica dioica</i>			X	0	FAC
<i>Verbascum thapsus</i>			X	0	FACU
<i>Veronica americana</i>	X	0	X	0	OBL
<i>Vicia americana</i>	X	0	X	0	FAC

*2016 National Wetland Plant List; *Western Mountains, Valleys, and Coasts* (WMVC) (Lichvar *et al.* 2016)

** Dominant species observed along Bowser Creek stream banks

*** Dominant species observed along Bowser Creek stream bed

Classification Values and Percent Cover Classes: 0 = <1%, 1 = 1-5%, 2 = 6-10%, 3 = 11-20%, 4 = 21-50%, 5 = >50%

4.4. Woody Plant Survival

Willows (*Salix* spp.), speckled alder (*Alnus incana*), red osier dogwood (*Cornus alba*), common snowberry (*Symphoricarpos albus*), chokecherry (*Prunus virginiana*), bog birch (*Betula pumila*), and Woods' rose (*Rosa woodsii*) were observed as planted woody vegetation species. In 2019, 287 planted trees and shrubs were located, with 271 of those observed alive (Table 4). It is unknown how many plants were installed during construction of the project; however, the revegetation plan called for planting 505 trees and shrubs. As compared to the revegetation plan, 54% (271 of 505) have survived nine years following construction. While a few of the surviving shrubs have grown to between 4 and 5 feet tall, the majority of these shrubs remain small and don't substantially contribute to the percent cover of the site by woody species. Many of the surviving shrubs were observed with poor vigor, particularly in areas that had been recently sprayed with herbicide. Additionally, it is challenging to locate shrubs that may have died several years ago, which can skew the results toward a higher survival rate if the number of live shrubs is compared to the number of dead shrubs observed. Overall, the project site includes less than 10% cover by woody species.

Table 4. Woody plant survival at Bowser Creek stream mitigation site from 2013 through 2019.

Year	Total Plants Inspected	Surviving Plants	# of Woody Plantings in Design	Woody plant survival based on planting plan
2013	127	122	505	24%
2014	127	119		24%
2015	312	279		55%
2016	181	143		28%
2017	188	147		29%
2018	190	176		35%
2019	287	271		54%

4.5. Bank Erosion Inventory

The eroding bank inventory is challenging to perform in late summer due to the density of watercress within the channel and groundcover along both banks. As such, eroding banks are best observed outside of the growing season when vegetation is dormant and the stream banks can be easily observed. A bank erosion inventory was conducted during a site visit in April, 2019, during which one eroding bank was observed. This eroding bank (EBL3 on Figure 2 in Appendix A) is due to an incoming seep which saturates a 15-foot segment of the left (north) bank. This seep has been observed for three consecutive years, and is resulting in minor bank sloughing. The bank has colonized with wetland vegetation and is unlikely to continue eroding or need corrective action. This bank length represents less than 2% of the overall reconstructed bank length of 880 feet. Photos of this eroding bank during both the April and August site visits can be found in Appendix C.

Eroding bank segments documented in previous monitoring reports have since stabilized and are no longer considered eroding. Channel widening was observed in 2015 along multiple bank segments following degradation of the coir logs used during

construction; however, the channel has not continued to widen in these areas. Erosion observed within the project reach in 2019 is due to the seeps entering the channel from the north side of the channel rather than scour during high flows.

4.6. Perpendicular Transect Surveys

Two perpendicular cross section transects were surveyed at pools and two at riffles, with maximum depth and bankfull width for each indicated in Table 5 (plots for each transect included in Appendix B). In 2019, maximum bankfull depths ranged from 1.8 to 3.3 feet and bankfull widths ranged from 5.9 to 13.6 feet. Over the past seven years, the average maximum depth surveyed has varied by less than a half foot, while the average bankfull width has varied by less than one foot. These data, when combined with the bank erosion inventory, indicate the channel has only slightly adjusted since 2013, and the channel appears to have reached an equilibrium with regard to its dimensions.

Two segments of the channel are wider than originally constructed due to a combination of the natural degradation of coir logs placed during construction and bank slumping where seeps enter the channel from the north. These channel segments are unlikely to recover back to the design dimension due to the unnatural hydrology and continuous saturation caused by seepage from the adjacent retention pond; however they provide a diversity in channel form and are not continuing to degrade or erode. Based on the vast majority of the reconstructed channel performing as intended, attempts to narrow the channel through these relatively short, over-wide segments remains unwarranted.

Table 5. Pool and riffle widths surveyed at Bowser Creek stream mitigation site from 2013 through 2019.

Transect	Type	Max Depth (ft)							Bankfull Width (ft)						
		2013	2014	2015	2016	2017	2018	2019	2013	2014	2015	2016	2017	2018	2019
1	Pool	1.9	1.9	1.5	1.7	1.7	1.8	1.8	6.0	6.1	5.0	6.0	6.3	6.4	5.9
2	Riffle	2.2	2.2	1.9	2	1.9	2.1	2.0	12.7	13.5	12.5	11.8	12.8	13.1	12.6
3	Pool	3.6	3.9	3.6	3.5	3.0	3.1	3.3	14.8	13.8	13.6	13.8	13.5	13.7	13.6
4	Riffle	1.9	2	1.7	1.9	1.9	2.1	2.1	7.8	8.1	7.6	7.5	7.5	7.3	7.3
Average Riffles		2.1	2.1	1.8	2.0	1.9	2.1	2.1	10.3	10.8	10.1	9.7	10.2	10.2	10.0
Average Pools		2.8	2.9	2.6	2.6	2.4	2.5	2.6	10.4	10.0	9.3	9.9	9.9	10.1	9.8
Average All		2.4	2.5	2.2	2.3	2.1	2.3	2.3	10.3	10.4	9.7	9.8	10.0	10.1	9.9

4.7. Longitudinal Profile Survey

A longitudinal profile through the Bowser Creek project area has been surveyed annually since 2014, with results provided on pages B-5 and B-6. The profile on page B-5 provides the results of each year's profile, indicating the channel has generally maintained a variety of habitat features including pools and riffles over the past six years. Three distinct pools exist along the reconstructed channel alignment, which are approximately one foot deeper than riffle features. A plot of the thalweg profile for 2014 and 2019 only is provided on page B-6, which indicates the pools may be filling with small gravel and fine materials. Pool length has become shorter and pool depths have become slightly shallower since 2014 based on this profile.

Fine sediment deposits have been commonly observed in the channel, and may be due to a combination of factors, including 1) increased roughness of the channel bed and

water column caused by proliferation of watercress during the growing season, 2) the reduced ability of the channel to transport fine sediments through the short reaches that have widened, 3) upstream development along Bowser Creek that may be contributing fine sediment, and 4) the inability of the channel to scour pool features due to the relatively straight channel alignment. Although reference reach data was not collected as part of this monitoring effort, Bowser Creek may also have a naturally high sediment load.

4.8. Wildlife Documentation

Wildlife observations at the Bowser Creek Stream Mitigation site from 2013 through 2019 have thus far been relatively limited. No new wildlife species were observed in 2019. Limited use of this area by wildlife may be due to the proximity MT Highway 2 and U.S. Highway 93 and lack of mature riparian habitat.

Table 6. Wildlife observations at Bowser Creek stream mitigation site from 2013 through 2019.

Common Name	Scientific Name
Mammals	
Raccoon (scat, tracks)	<i>Procyon lotor</i>
White-tailed Deer	<i>Odocoileus virginianus</i>
Birds	
Gull sp.	<i>Larus</i> sp.
American Robin	<i>Turdus migratorius</i>
Mallard	<i>Anas platyrhynchos</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
Sparrow sp.	<i>Passer</i> sp.

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Bowser Creek stream mitigation site is intended to document whether the reconstructed segment of the channel is meeting, or moving toward meeting the performance standards outlined in the monitoring plan. Results from the seventh year of monitoring suggests all six quantitative performance standards are being met nine years following completion of the project (Table 7). Thus far, the project has met the physical objectives of a) constructing 430 linear feet of new channel; b) laying back floodplain slopes adjacent to the channel from 1.5:1 to 4:1 slope or flatter; and c) implementing a revegetation plan to re-establish native riparian and upland vegetation. Channel form success is considered a qualitative criterion, and is discussed in more detail in Section 5.4.

5.1. Riparian Buffer Success

The results in Table 1 indicate the reconstructed segment of Bowser Creek has developed a primarily herbaceous plant community, dominated by nonnative graminoids in the riparian zone and nonnative and native graminoids in the stream bank zone. Woody riparian vegetation is still establishing, with a 19% increase in woody planting survival observed during the 2019 monitoring event, but a 1% decrease in overall areal woody cover observed in the riparian and streambank transects. Despite this increase

in survival, the plantings are relatively small in size, many were observed with poor vigor, and therefore offer a limited percent of the overall cover.

Vegetation monitoring of the riparian buffer indicated 83% of disturbed areas have revegetated with non-noxious weed species following construction. Non-noxious vegetation cover was determined by subtracting the areal percent noxious weed cover observed in the riparian transects (4%) from the total areal vegetation cover observed in the riparian transects (87%). Performance criteria specify at least 50% of the disturbed areas within the creditable buffer area must be vegetated with non-noxious weed species; therefore, this criterion is currently being met. Noxious weeds comprise 4% of the vegetation cover site-wide, which is now meeting and well below the performance criterion of 10% cover. The notable decrease in noxious weed cover, increase in bare ground, decrease in planted shrub vigor, and decrease in overall forb diversity observed across the site are a result of the 2018 and 2019 herbicide applications.

Total combined areal vegetation cover of the riparian zone and both right and left stream banks along Bowser Creek decreased in 2019 to 90%. Both riparian and stream bank zones are primarily vegetated with herbaceous species, while woody species are slowly establishing along the sloped areas adjacent to the channel. The performance criterion for this category specifies $\geq 70\%$ of the combined riparian and stream bank vegetation communities must have vegetation establishment; therefore, this criterion is currently being met.

Woody vegetation plantings indicated a survival rate of 54% nine years following the project's completion. The performance criteria states 50% or more of the woody plants installed must survive after five years; therefore, this criterion is now being met. If the remaining woody plantings survive and overall vigor improves, their continued growth and maturation should provide increased woody cover to the site. Areal cover of woody vegetation is currently 7%, with many shrubs affected by recent herbicide application. The majority of planted shrubs and trees have yet to grow above the herbaceous understory layer. Those that have are now providing an important habitat feature that may be utilized by migratory birds.

Table 7. Performance standards for the Bowser Creek Stream Mitigation Site.

Type	Parameter	Performance Standard	Status	Site Meeting Performance Criteria?
Performance Criteria	Riparian Buffer Success	1a. Areas within creditable riparian buffer disturbed during construction must have 50% or greater aerial cover of non-noxious weed species by the end of the monitoring period	Vegetation transects indicate 83% cover of the riparian zones with non-noxious weed species	YES
		1b. Noxious weeds do not exceed 10% cover within the riparian buffer areas.	Vegetation transects indicate 4% cover of noxious weeds within riparian zones.	YES
	Vegetation Success	2a. Combined aerial cover of riparian and stream bank vegetation communities is at least 70%	Combined aerial cover of riparian and stream bank vegetation is 90%	YES
		2b. Planted trees and shrubs must exhibit 50% survival after 5 years	Planted tree and shrub survival documented at 54% .	YES
	Vegetation along Streambanks	3. Majority of plants on the stream bank must have root stability indices of at least 6	Dominant streambank community along both stream banks is community Type 2- <i>Phalaris arundinacea</i> , with a root stability index of 9.	YES
	Streambank Stability Success	4. Less than 25% of bank length is unstable and classified as eroding bank.	Observations noted less than 2% of the stream banks are eroding or unstable.	YES
Qualitative Criteria	Channel Form	5. Will be achieved when the stream stabilizes, includes pools and riffles, allows for flood events to occupy the floodplain, and the habitat features such as riparian plant communities have successfully established along streambanks.	Evidence of channel form success provided in Section 5.4	YES

5.2. Vegetation along Stream Banks

Reed canary grass comprised between 21-50% cover (closer to 50%) along both stream banks in 2019. As a result, vegetation community Type 2 – *Phalaris arundinacea* was the dominant vegetation community observed along the stream banks, with an associated Winward stability rating of 9. Therefore, stream bank vegetation is successfully meeting the associated performance criteria.

5.3. Stream Bank Stability

Bank instability has primarily been tied to saturation along the north bank causing segments of the bank to slough into the channel. The majority of these areas have stabilized over the past three years. One 15-foot bank segment (EBL3) continues to exhibit soil losses where a seep is entering the channel, although the bank has established wetland vegetation and is not exhibiting signs of severe erosion. As such, no corrective actions are warranted. This bank segment represents less than 2% of the overall stream bank length of 880 feet, which is well below the 25% eroding bank success criteria threshold.

5.4. Channel Form Success

The channel form success criteria states, “will be achieved when the stream stabilizes, includes pools and riffles, allows for flood events to occupy the floodplain, and the habitat features such as riparian plant communities have successfully established along streambanks”. The following section addresses each of these channel form components as observed along Bowser Creek.

5.4.1. Channel stability

Measures to document stability of the project reach include 1) surveying a longitudinal profile along the channel thalweg, 2) surveying channel cross sections, and 3) conducting an erosion inventory along both banks. The longitudinal profile of the stream bed has thus far offered no evidence of vertical instability such as head cutting or degradation of the stream bed. Cross section surveys reveal portions of the channel have become wider since the project was constructed; however, the channel has not continued to widen over the past five years. The channel width increased along portions of the channel within the first two years following construction and prior to the first monitoring event in 2013. Bank erosion inventories conducted over the past six years indicate the cause of erosion is primarily due to saturated banks, all but 15 feet of which have stabilized. While one bank continues to slough into the channel as a result of a seep, overall bank stability is good throughout the project.

5.4.2. Pool and riffle features

Inspection of the longitudinal profile indicates the presence of three distinct pool features separated by riffles. Cross section surveys indicate channel depth currently ranges between 1.8 and 3.3 feet. These results indicate the channel provides a variety of shallow and deeper water habitat features, and supports aquatic organisms such as salmonids and macroinvertebrates that flourish in diverse habitat types (shallow versus deep water), and variable flow velocities. A comparison of longitudinal profiles from

2014 and 2019 indicates the pools are shorter and slightly shallower than immediately following construction, but still remain distinctly deeper than the riffle features.

5.4.3. Floodplain connectivity

The reconstructed segment of Bowser Creek was designed to convey an estimated 2 year return interval discharge within the low flow channel. Discharges greater than the 2 year flow are able to access a floodplain approximately 14 feet wide with a design grade of 5% slope toward the channel. Beyond this floodplain, the floodway has been designed to convey up to a 100 year discharge without over-topping Highway 2. The channel shows no signs of incision or headcutting and the floodplain remains well connected to the stream channel throughout the project reach.

5.4.4. Riparian habitat along stream banks

The vegetation along the banks of Bowser Creek is dominated by reed canarygrass, although several additional species have been documented along the banks (see Section 4.2). Reed canarygrass provides excellent resistance to bank erosion. Although five species of planted and/or volunteer woody shrubs were observed, their contribution to cover along the banks is limited to an estimated 5%. The unrooted willow stems installed along the outside meander bends either did not successfully establish or were washed out where the channel widened. As a result, woody species composition along the banks is limited. Photo documentation of the stream channel is provided in Appendix C and offers additional evidence of riparian vegetation composition along Bowser Creek's banks and riparian corridor. Based on these results and the condition of the riparian corridor along Bowser Creek, this success criterion is currently being met.

6.0 LITERATURE CITED

- Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and monitoring plant populations*. Bureau of Land Management (BLM) Technical Reference 1730-1. Washington, DC: U.S. Department of the Interior.
- Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. *The National Wetland Plant List. 2016 Update of Wetland Ratings*. Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X
- Montana Department of Agriculture. *Montana Noxious Weed List*. June 2019. Accessed October 2019 at:
<https://agr.mt.gov/Portals/168/Documents/Weeds/2019%20Montana%20Noxious%20Weed%20List.pdf?ver=2019-07-02-095540-487>
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- Winward, 2000. Monitoring the Vegetation Resources in Riparian Areas. Gen. Tech. Report RMRS-GTR.47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Appendix A








Project Site Maps

MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

U.S. HWY 2



Legend

-  Photo Points
-  Channel Thalweg
-  Major Station (100')
-  Minor Station (25')
-  Eroding Banks
-  Pool and Riffle Transects
-  Riparian Transects

0 37.5 75 150 Feet

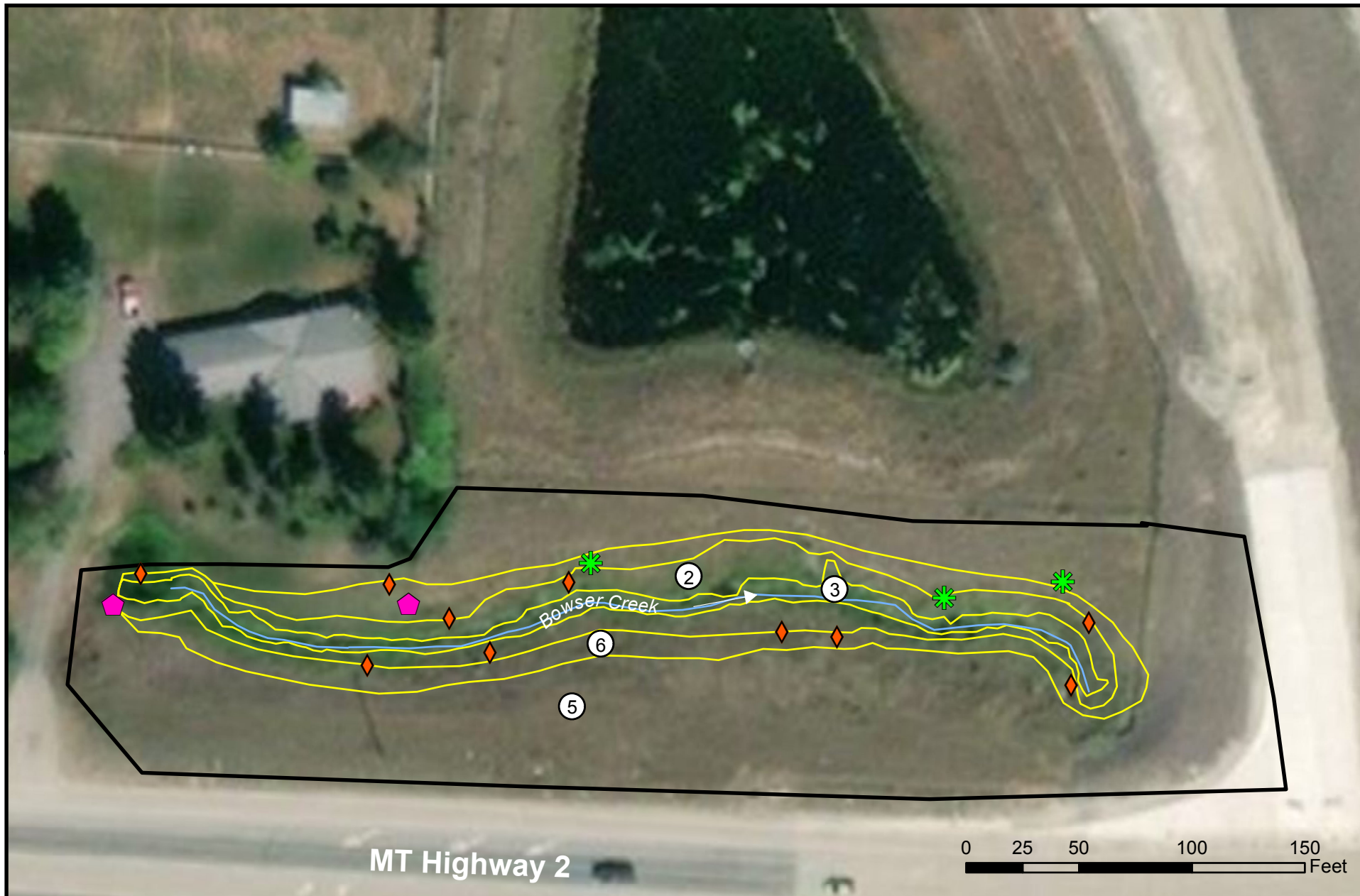


Bowser Creek - 2019 Monitoring Features

Figure 2

Date: 10/29/2019

Bowser_features2019.mxd



Legend

— Project Boundary

— Vegetation Community Boundary



Cirsium arvense



Cynoglossum officinale



Linaria vulgaris

②

Phalaris arundinacea Community

③

Nasturtium officinale Community

⑤

Elymus spp./*Festuca ovina* Community

⑥

Elymus spp./*Bromus inermis* Community



Bowser Creek - 2019 Noxious Weeds and Vegetation Community

Figure 3

Date: 10/23/2019

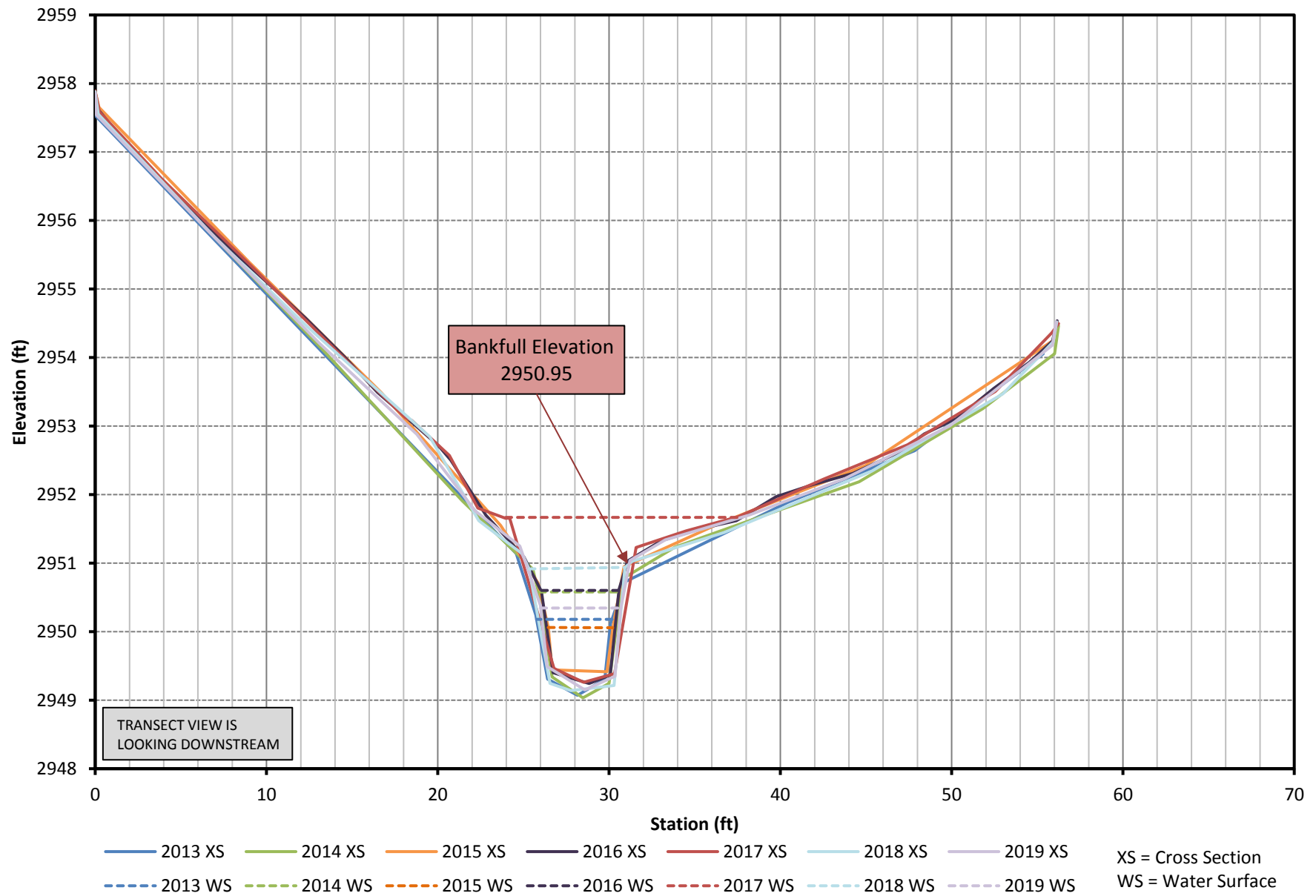
Bowser_monitor2019.mxd

Appendix B

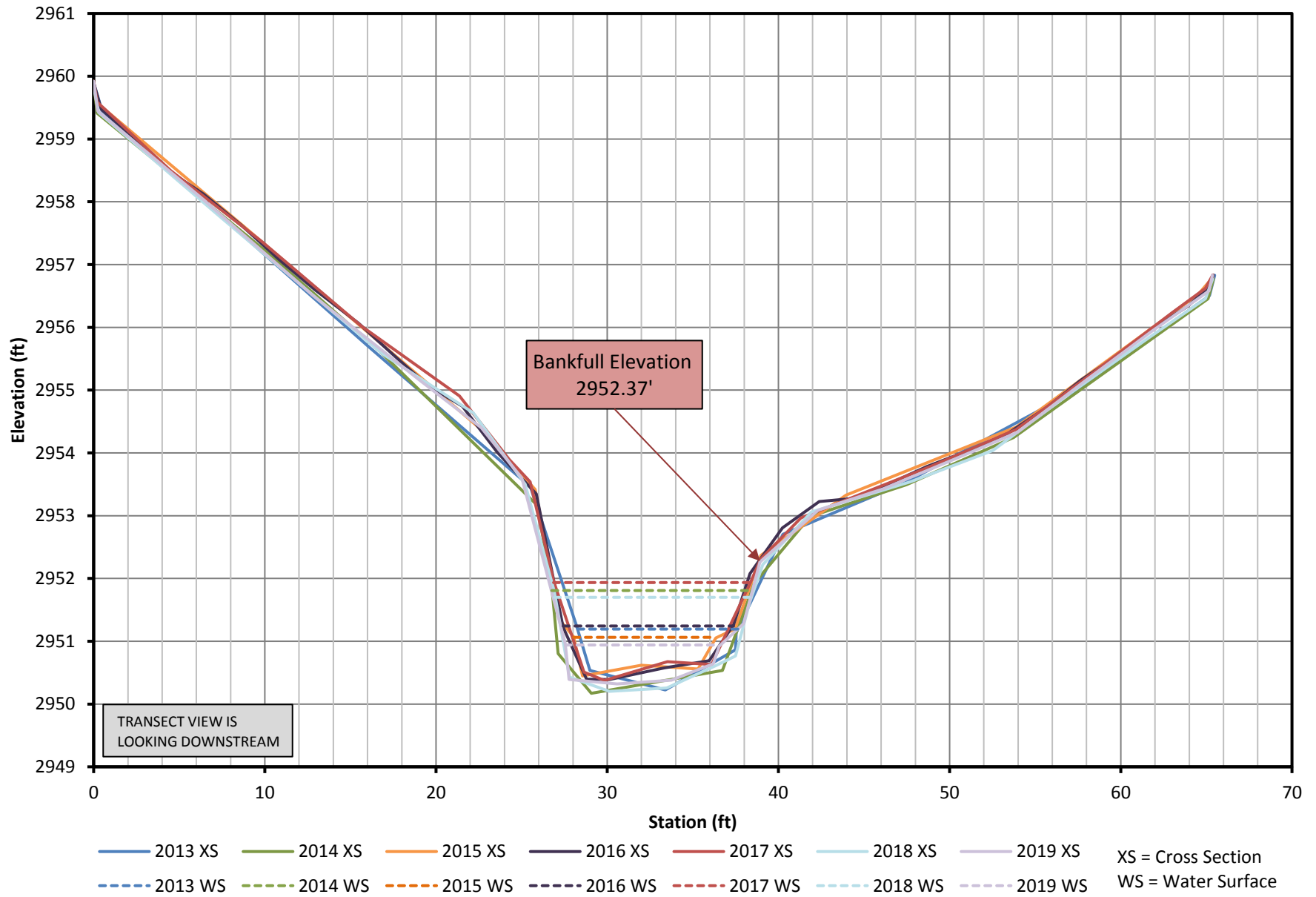
Perpendicular Transect and Longitudinal Profile Plots

MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

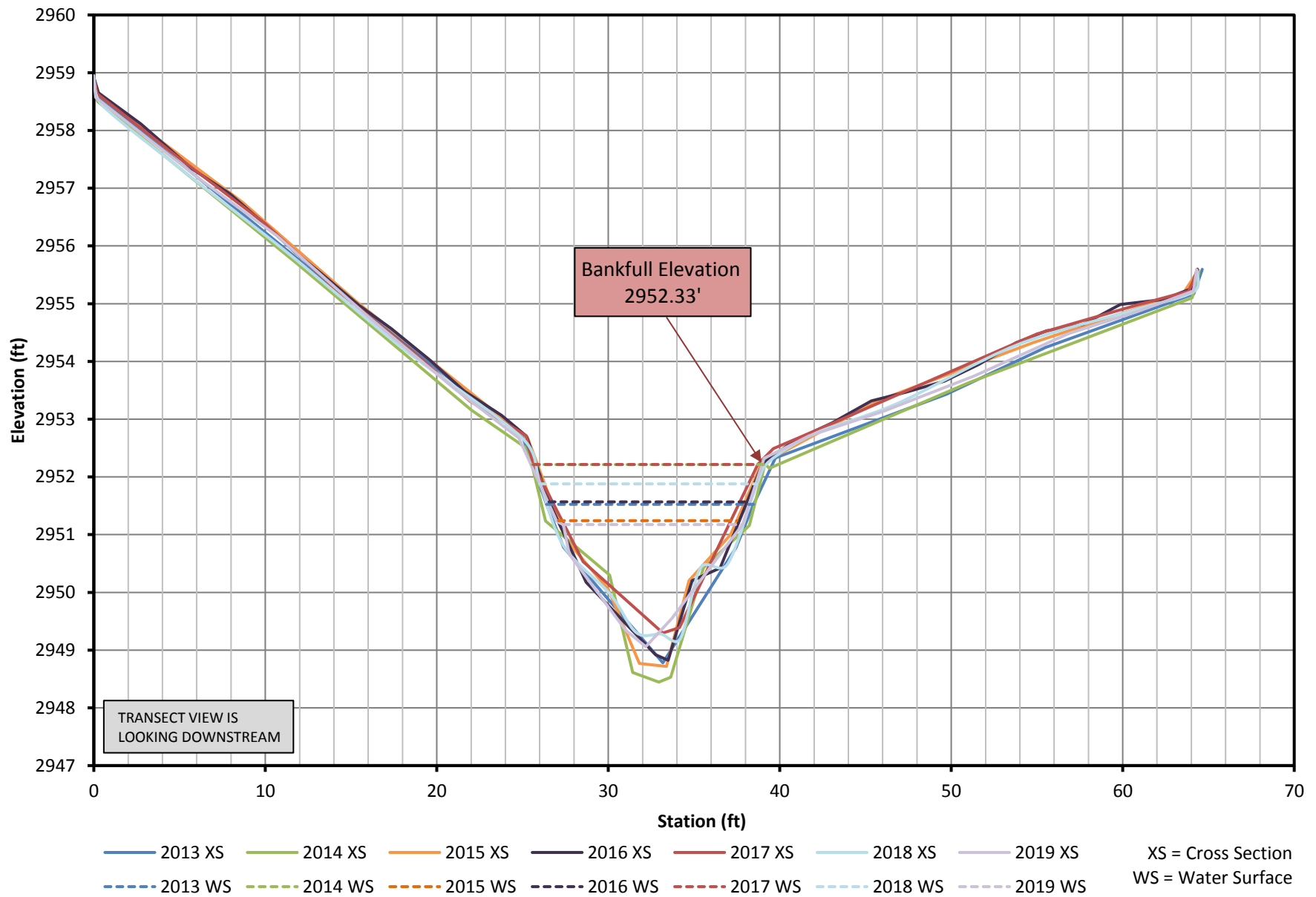
Bowser Transect #1 - Pool



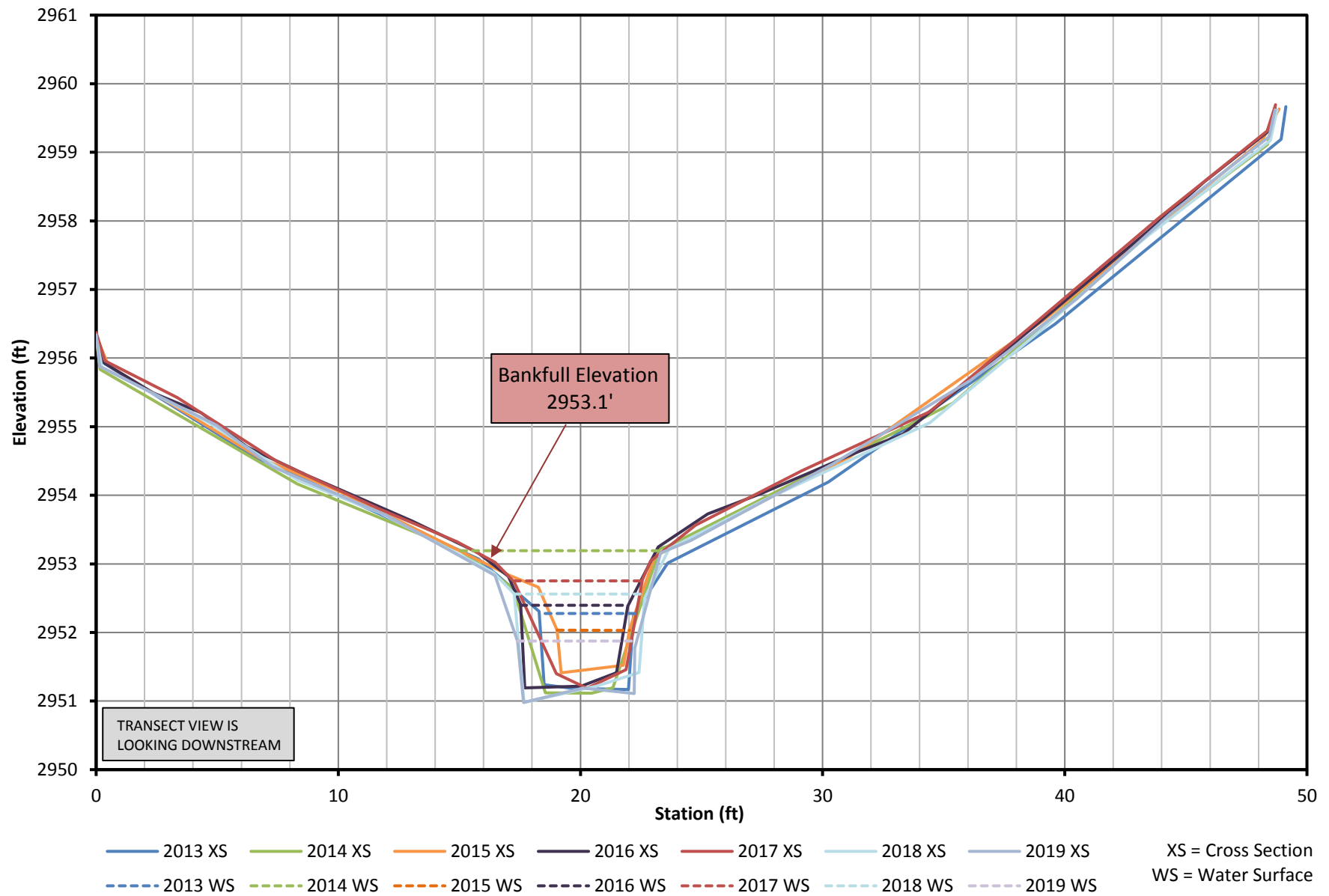
Bowser Transect #2 - Riffle



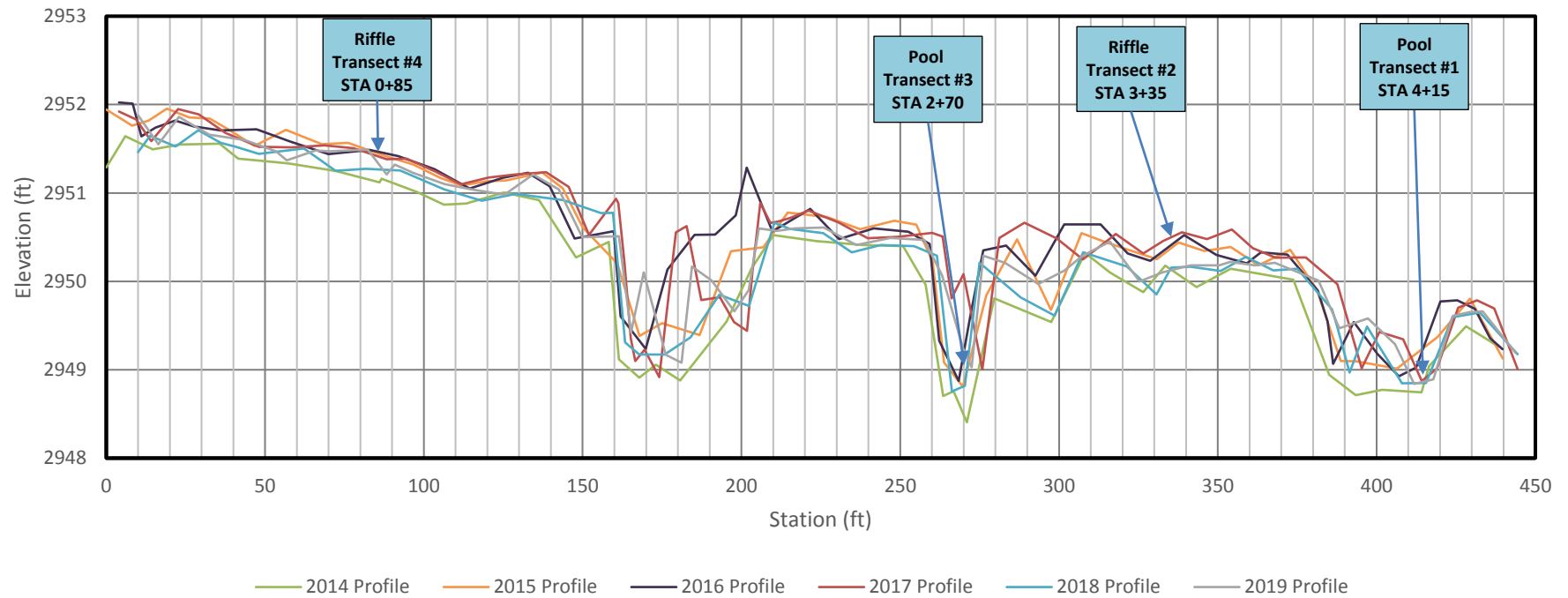
Bowser Transect #3 - Pool



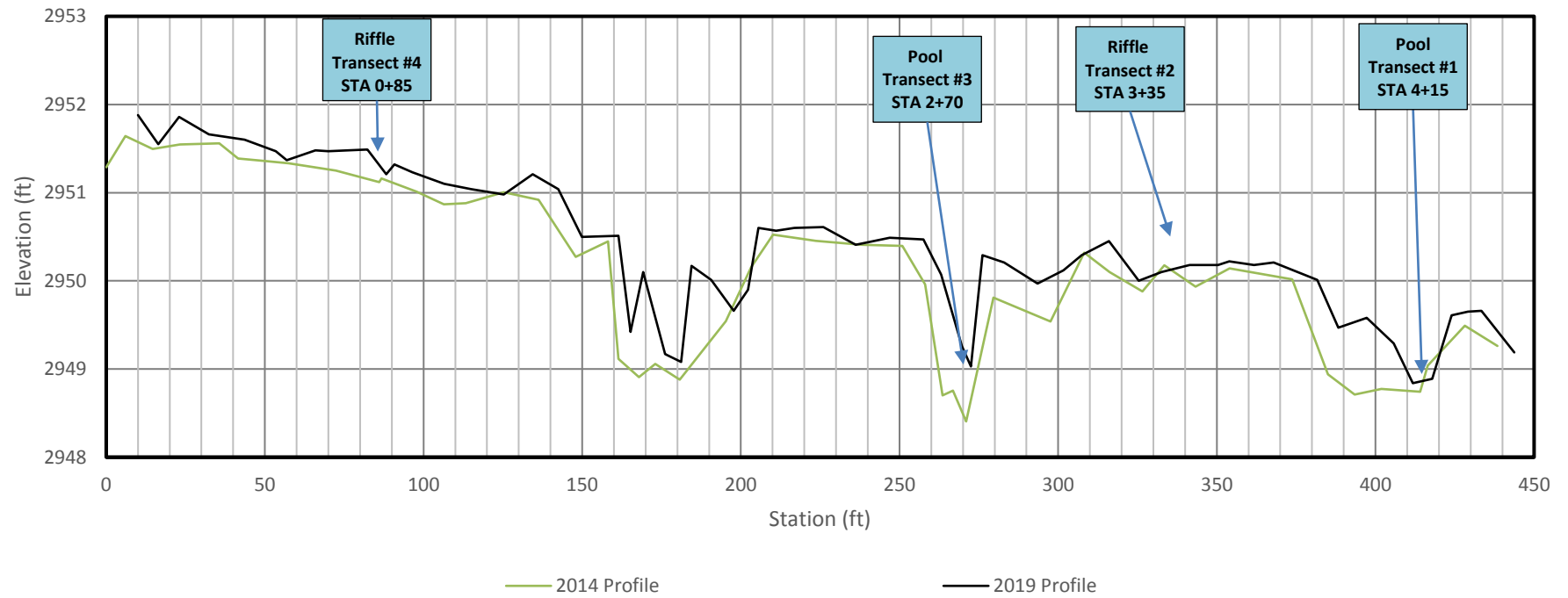
Bowser Transect #4 - Riffle



Bowser Creek Longitudinal Profiles: 2014 - 2019



Bowser Creek Longitudinal Profiles: 2014 and 2019



Appendix C

Project Area Photos

MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

PHOTO INFORMATION

PROJECT NAME: Bowser Creek Stream Mitigation Site

DATE: 2013 and 2019 Monitoring Events



2013



2019

Photo 1: View looking west (upstream) of Bowser Creek.



2013



2019

Photo 2.1: View looking northwest at Bowser Creek.



2013



2019

Photo 2.2: View across Bowser Creek looking north.

PHOTO INFORMATION

PROJECT NAME: Bowser Creek Stream Mitigation Site

DATE: 2013 and 2019 Monitoring Events



2013



2019

Photo 2.3: View looking east (downstream) of Bowser Creek from photo point 3.



2013



2019

Photo 2.4: View looking east across Bowser Creek. from photo point 2.



2013



2019

Photo 3: View looking east (downstream) of Bowser Creek from photo point 3.

PHOTO INFORMATION

PROJECT NAME: Bowser Creek Stream Mitigation Site

DATE: 2013 and 2019 Monitoring Events



2013



2019

Additional Photo 1: Prolific watercress growth shown in 2013 was less prevalent in 2018.



2013



August 2019

Additional Photo 2: Eroding bank EBL3.



2019

Additional Photo 2: Eroding bank EBL3 (taken in April 2019)

PHOTO INFORMATION

PROJECT NAME: Bowser Creek Stream Mitigation Site

DATE: 2013 and 2019 Monitoring Events



2013

2019

Additional Photo 3: Widened channel segment.



PHOTOGRAPHIC INSPECTION INFORMATION

Page 1 of 16

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T1 LEFT: LOOKING SOUTHWEST TO T1 RIGHT



T1 RIGHT: LOOKING NORTHEAST TO T1 LEFT

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T1 LEFT: LOOKING WEST UPSTREAM



T1 LEFT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T1: LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK



T1: LOOKING EAST DOWNSTREAM FROM MIDDLE CREEK

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T1 RIGHT: LOOKING WEST UPSTREAM



T1 RIGHT: LOOKING EAST DOWNSTREAM



PHOTOGRAPHIC INSPECTION INFORMATION

Page 5 of 16

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T2 LEFT: LOOKING SOUTH TO T2 RIGHT



T2 RIGHT: LOOKING NORTH TO T2 LEFT

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T2 LEFT: LOOKING WEST UPSTREAM



T2 LEFT: LOOKING SOUTH EAST DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T2: LOOKING WEST UPSTREAM FROM MIDDLE CREEK



T2: LOOKING EAST DOWNSTREAM FROM MIDDLE CREEK

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T2 RIGHT: LOOKING WEST UPSTREAM



T2 RIGHT: LOOKING EAST DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T3 LEFT: LOOKING SOUTH TO T3 RIGHT



T3 RIGHT: LOOKING NORTH TO T3 LEFT

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T3 LEFT: LOOKING WEST UPSTREAM



T3 LEFT: LOOKING EAST DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T3: LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK



T3: LOOKING EAST DOWNSTREAM FROM MIDDLE CREEK

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T3 RIGHT: LOOKING WEST UPSTREAM



T3 RIGHT: LOOKING EAST DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T4 LEFT: LOOKING SOUTH TO T4 RIGHT



T4 RIGHT: LOOKING NORTH TO T4 LEFT

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T4 LEFT: LOOKING WEST UPSTREAM



T4 LEFT: LOOKING EAST DOWNSTREAM

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T4: LOOKING WEST UPSTREAM FROM MIDDLE OF CREEK



T4: LOOKING EAST DOWNSTREAM FROM MIDDLE CREEK

PROJECT NAME: 2019 MDT STREAM MITIGATION—BOWSER CREEK

DATE: 8-29-19



T4 RIGHT: LOOKING WEST UPSTREAM



T4 RIGHT: LOOKING EAST DOWNSTREAM

Appendix D

2013 – 2019 Comprehensive Plant Species List

MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

Comprehensive vegetation species list for the Bowser Creek stream mitigation site from 2013 through 2019.

Scientific Name	Common Name	WMVC Indicator Status*	Scientific Name	Common Name	WMVC Indicator Status*
<i>Achillea millefolium</i>	Common Yarrow	FACU	<i>Lemna minor</i>	Common Duckweed	OBL
<i>Acer negundo</i>	Ash-Leaf Maple	FAC	<i>Leucanthemum vulgare</i>	Ox-Eye Daisy	FACU
<i>Agastache urticifolia</i>	Nettle-Leaf Giant-Hyssop	FACU	<i>Leymus cinereus</i>	Great Basin Lyme Grass	FAC
<i>Agropyron cristatum</i>	Crested Wheatgrass	UPL	<i>Linaria vulgaris</i>	Butter-and-Eggs	UPL
<i>Agrostis gigantea</i>	Black Bent	FAC	<i>Lysichiton americanus</i>	Yellow-Skunk-Cabbage	OBL
<i>Agrostis stolonifera</i>	Spreading Bent	FAC	<i>Medicago lupulina</i>	Black Medick	FACU
<i>Alnus incana</i>	Speckled Alder	FACW	<i>Medicago sativa</i>	Alfalfa	UPL
<i>Alopecurus arundinaceus</i>	Creeping Meadow-Foxtail	FAC	<i>Melilotus albus</i>	White Sweetclover	UPL
<i>Amelanchier alnifolia</i>	Saskatoon Service-Berry	FACU	<i>Melilotus officinalis</i>	Yellow Sweet-Clover	FACU
<i>Artemisia absinthium</i>	Absinthium	UPL	<i>Mentha arvensis</i>	American Wild Mint	FACW
<i>Artemisia biennis</i>	Biennial Wormwood	FACW	<i>Myosotis scorpioides</i>	True Forget-Me-Not	FACW
<i>Atriplex patula</i>	Halberd-Leaf Orache	FACW	<i>Nasturtium officinale</i>	Watercress	OBL
<i>Beckmannia syzigachne</i>	American Slough Grass	OBL	<i>Onopordum acanthium</i>	Scotch Thistle	UPL
<i>Betula pumila</i>	Bog Birch	OBL	<i>Pascopyrum smithii</i>	Western-Wheat Grass	FACU
<i>Bromus inermis</i>	Smooth Brome	UPL	<i>Persicaria amphibia</i>	Water Smartweed	OBL
<i>Carduus acanthoides</i>	Spiny Plumeless Thistle	NL	<i>Phalaris arundinacea</i>	Reed Canary Grass	FACW
<i>Carduus nutans</i>	Nodding Plumeless-Thistle	UPL	<i>Phleum pratense</i>	Common Timothy	FAC
<i>Carex nebrascensis</i>	Nebraska Sedge	OBL	<i>Plantago lanceolata</i>	English Plantain	FACU
<i>Carex</i> sp.	Sedge	N/A	<i>Plantago major</i>	Great Plantain	FAC
<i>Carex stipata</i>	Stalk-Grain Sedge	OBL	<i>Poa palustris</i>	Fowl Blue Grass	FAC
<i>Carex utriculata</i>	Northwest Territory Sedge	OBL	<i>Poa pratensis</i>	Kentucky Blue Grass	FAC
<i>Centaurea cyanus</i>	Garden Cornflower	FACU	<i>Prunus virginiana</i>	Choke Cherry	FACU
<i>Centaurea stoebe</i>	Spotted Knapweed	UPL	<i>Ranunculus</i> sp.	Buttercup	N/A
<i>Chamaenerion angustifolium</i>	Narrow-Leaf Fireweed	FACU	<i>Rosa woodsii</i>	Woods' Rose	FACU
<i>Chenopodium album</i>	Lamb's-Quarters	FACU	<i>Rudbeckia hirta</i>	Black-Eyed-Susan	FACU
<i>Chorispora tenella</i>	Common Blue-Mustard	UPL	<i>Rumex crispus</i>	Curly Dock	FAC
<i>Cicuta douglasii</i>	Western Water-Hemlock	OBL	<i>Salix bebbiana</i>	Gray Willow	FACW
<i>Cirsium arvense</i>	Canadian Thistle	FAC	<i>Salix drummondiana</i>	Drummond's Willow	FACW
<i>Cirsium vulgare</i>	Bull Thistle	FACU	<i>Salix exigua</i>	Narrow-Leaf Willow	FACW
<i>Cornus alba</i>	Red Osier	FACW	<i>Salix</i> sp.	Willow	N/A
<i>Cynoglossum officinale</i>	Gypsy-Flower	FACU	<i>Scirpus microcarpus</i>	Red-Tinge Bulrush	OBL
<i>Descurainia sophia</i>	Herb Sophia	UPL	<i>Silene vulgaris</i>	Maiden's-tears	UPL
<i>Elymus canadensis</i>	Nodding Wild Rye	FAC	<i>Solanum dulcamara</i>	Climbing Nightshade	FAC
<i>Elymus repens</i>	Creeping Wild Rye	FAC	<i>Solidago canadensis</i>	Canadian Goldenrod	FACU
<i>Elymus trachycaulus</i>	Slender Wild Rye	FAC	<i>Sonchus arvensis</i>	Field Sow-Thistle	FACU
<i>Epilobium ciliatum</i>	Fringed Willowherb	FACW	<i>Stachys byzantina</i>	Woolly Hedgenettle	UPL
<i>Equisetum arvense</i>	Field Horsetail	FAC	<i>Stuckenia pectinata</i>	Sago False Pondweed	OBL
<i>Festuca ovina</i>	Sheep Fescue	UPL	<i>Symphoricarpos albus</i>	Common Snowberry	FACU
<i>Geum macrophyllum</i>	Large-Leaf Avens	FAC	<i>Tanacetum vulgare</i>	Common Tansy	FACU
<i>Geum</i> sp.	Avens	N/A	<i>Taraxacum officinale</i>	Common Dandelion	FACU
<i>Geum triflorum</i>	Old-Man's-Whiskers	FACU	<i>Thlaspi arvense</i>	Field Pennycress	UPL
<i>Glyceria grandis</i>	American Manna Grass	OBL	<i>Tragopogon dubius</i>	Meadow Goat's-beard	UPL
<i>Glyceria striata</i>	Fowl Manna Grass	OBL	<i>Trifolium pratense</i>	Red Clover	FACU
<i>Helianthus maximiliani</i>	Maximilian Sunflower	UPL	<i>Trifolium repens</i>	White Clover	FAC
<i>Helianthus nuttallii</i>	Nuttall's Sunflower	FACW	<i>Triglochin maritima</i>	Seaside Arrow-Grass	OBL
<i>Hordeum jubatum</i>	Fox-Tail Barley	FAC	<i>Typha latifolia</i>	Broad-Leaf Cat-Tail	OBL
<i>Hypericum perforatum</i>	Common St. John's-Wort	FACU	<i>Urtica dioica</i>	Stinging Nettle	FAC
<i>Juncus balticus</i>	Baltic Rush	FACW	<i>Verbascum thapsus</i>	Great Mullein	FACU
<i>Juncus</i> sp.	Rush	N/A	<i>Veronica americana</i>	American Brooklime	OBL
<i>Lactuca serriola</i>	Prickly Lettuce	FACU	<i>Vicia americana</i>	American Purple Vetch	FAC
<i>Lathyrus sylvestris</i>	Flat Pea	UPL			

*2016 National Wetland Plant List; *Western Mountains, Valleys, and Coasts* (WMVC) (Lichvar *et al.* 2016)

New species identified in 2019 are **bolded**.

Species identified to genus level have been assigned an indicator status of N/A.

Appendix E

2019 Noxious Weed Species List

MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

Montana State-listed noxious weed species observed in 2019 at the Bowser Creek Stream Mitigation Site.

Category*	Scientific Name	Common Name
Priority 2B	<i>Centaurea stoebe</i>	Spotted Knapweed
	<i>Cirsium arvense</i>	Canada Thistle
	<i>Cynoglossum officinale</i>	Houndstongue
	<i>Hypericum perforatum</i>	St. Johnswort
	<i>Leucanthemum vulgare</i>	Oxeye Daisy
	<i>Linaria vulgaris</i>	Yellow Toadflax
	<i>Tanacetum vulgare</i>	Common Tansy

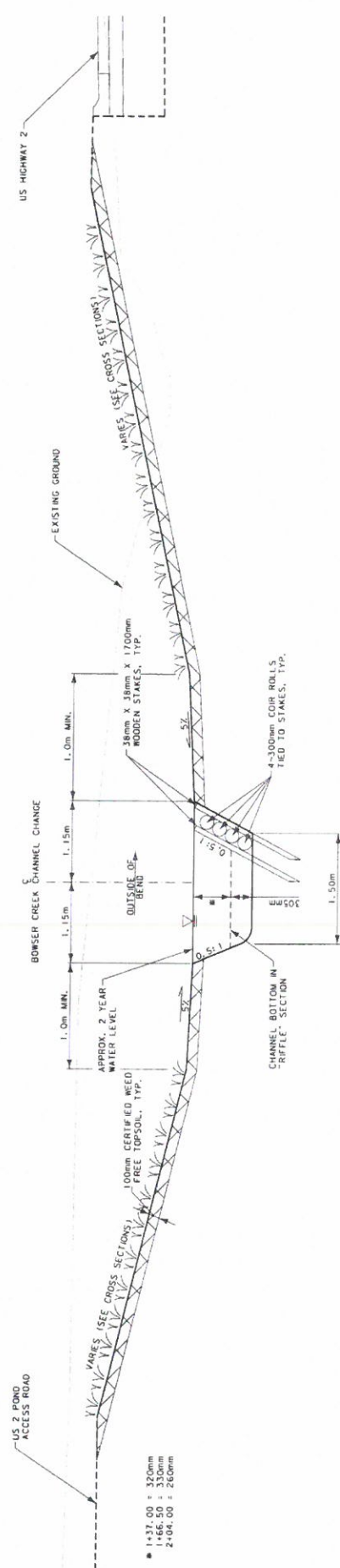
*Based on the Montana Department of Agriculture's Noxious Weed List, June 2019

Appendix F

Construction Plan Sheets

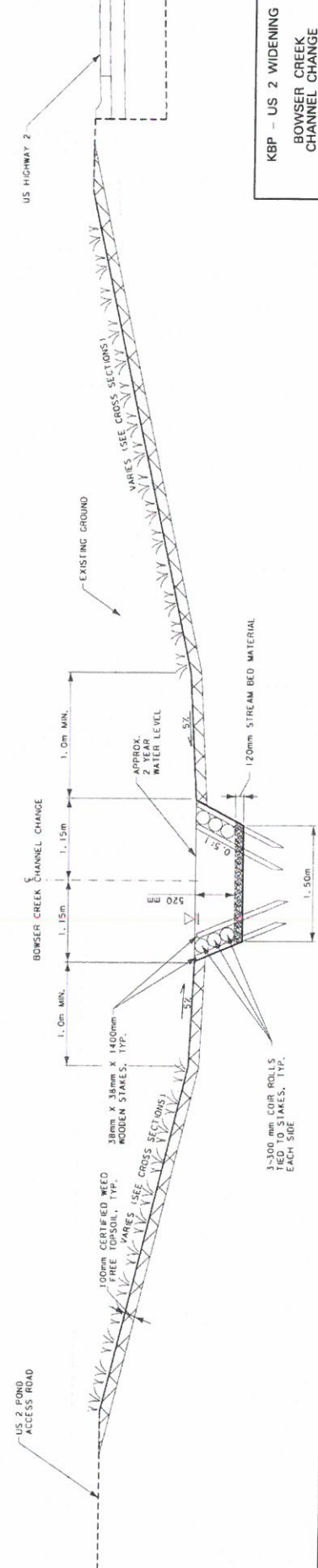
MDT Stream Mitigation Monitoring
Bowser Creek
Flathead County, Montana

DETAIL **BOWSER CREEK CHANNEL CHANGE POOL SECTION**



NOTE: SEE VEGETATION PLANS FOR SEEDING & PLANTINGS

BOWSER CREEK CHANNEL CHANGE RIFFLE SECTION



NOTE: SEE VEGETATION PLANS FOR SEEDING & PLANTINGS

**KBP - US 2 WIDENING
BOWSER CREEK
CHANNEL CHANGE
POOL SECTION
RIFFLE SECTION**

NO SCALE

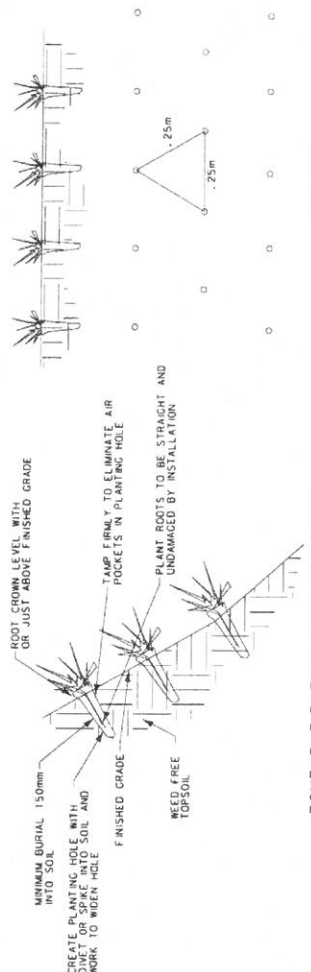
DESIGNER	DATE
DRAWN	
CHECKED	
APPROVED	
REVISED	

DETAIL

TABLE OF CONTENTS & DETAILS

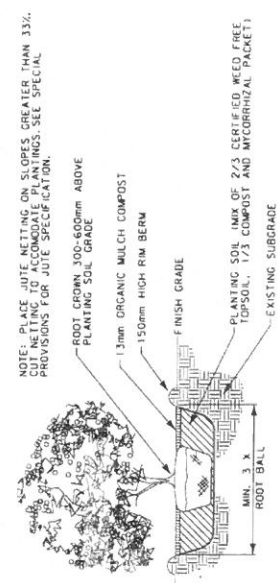


ZONE D COIR BUNDLES WITH WILLOW CUTTINGS AND LAYERING
SCALE: NOT TO SCALE



ZONE D RIPARIAN PLUG PLANTING
SCALE: NOT TO SCALE

SPACING



TREE PLANTING
SCALE: NOT TO SCALE

SHRUB PLANTING

SCALE: NOT TO SCALE

TABLE OF CONTENTS

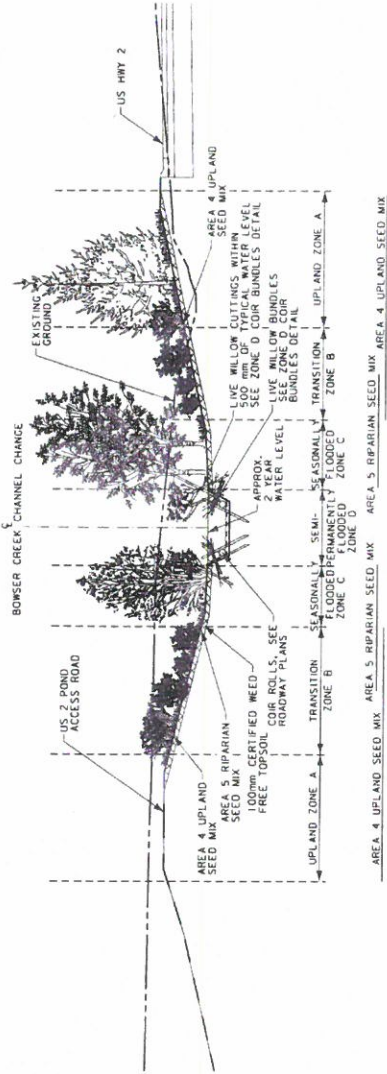
DETAILS

TABLE OF CONTENTS & DETAILS	SHEET NO.
BOWSER CREEK	V1
VEGETATION TYPICAL SECTIONS & SUMMARY	V2
BOWSER CREEK	V3
VEGETATION PLAN	V4
US HWY 2 DETENTION POND	
VEGETATION PLAN	

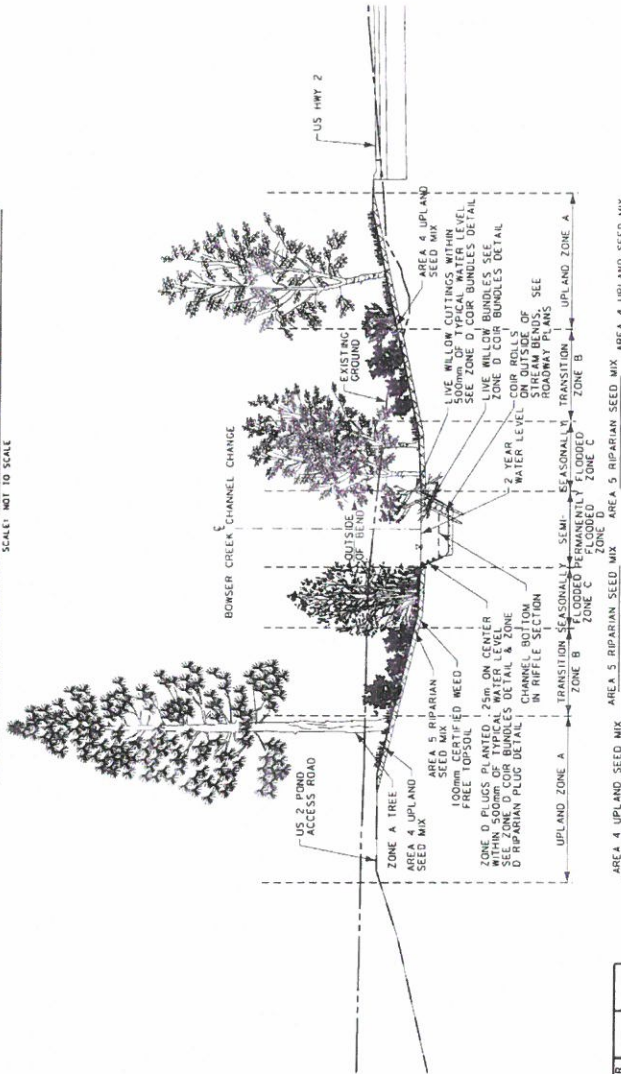
NOTES: 1. SEE ROADWAY PLANS FOR CHANNEL CONSTRUCTION DETAILS. GENERAL CONCEPTUAL DESIGN. FOR INFORMATION ONLY.

DETAIL
BOWSER CREEK VEGETATION TYPICAL SECTIONS & SUMMARY

STATE PROJECT NUMBER SHEET NO
MONTANA NH 154931 V2
CSF - 0.999470385



BOWSER CREEK CHANNEL CHANGE RIFLE TYPICAL SECTION
SCALE: NOT TO SCALE



BOWSER CREEK CHANNEL CHANGE POOL TYPICAL SECTION
SCALE: NOT TO SCALE

MDTX MONTANA TRANSPORTATION
CADD

SE Engineering, Inc.

DESIGNED BY: 10/2/2010
CHECKED BY: 10/2/2010
IN CHARGE: 10/2/2010
DATE: 10/2/2010

BOWSER CREEK CHANNEL CHANGE PLANT LIST				
ZONE A UPLAND				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	BETULA PAPERIFERA	PAPER BIRCH	6	10' BAR
TP	PRUNUS SPINOSA	POWDERBUSH	1	7' BAR
ZONE B TRANSITIONAL				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	124	8' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	174	8' GAL.
TP	SPICEBUSH	SPICEBUSH	174	8' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	1' GAL.
TP	SYCAMORE	SYCAMORE	57	1' GAL.
ZONE C SEASONALLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	BETULA PAPERIFERA	PAPER BIRCH	5	15' GAL.
ZONE D SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE E SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE F SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE G SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE H SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE I SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE J SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE K SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE L SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE M SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE N SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE O SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE P SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE Q SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE R SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE S SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE T SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE U SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE V SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE W SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE X SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE Y SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.
ZONE Z SEMI-PERMANENTLY FLOODED				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
TP	AMELANCHIER ALBA	DOGWOOD	27	5' GAL.
TP	PRUNUS VIRGINIANA	CHERRY	27	5' GAL.
TP	SPICEBUSH	SPICEBUSH	27	5' GAL.
TP	STAPHYLEA TRIFOLIATA	STAPHYLEA	27	5' GAL.
TP	SYCAMORE	SYCAMORE	27	5' GAL.

* FOR INFORMATION ONLY. INCLUDE ALL COSTS AND INCIDENTAL ITEMS ASSOCIATED WITH THE INSTALLATION OF THIS ITEM IN THE LUMP SUM BID PRICE FOR "VEGETATION".

JUTE NETTING		
STATION	TO	square meters
35+34.77	38+58.67	200
TOTAL		200

* FOR INFORMATION ONLY. INCLUDE ALL COSTS AND INCIDENTAL ITEMS ASSOCIATED WITH THE INSTALLATION OF THIS ITEM IN THE LUMP SUM BID PRICE FOR "VEGETATION".

KBP - US 2 WIDENING
BOWSER CREEK
VEGETATION TYPICAL SECTIONS
& SUMMARY

NO SCALE

