
MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

*North Fork Bear Creek
Ravalli County, Montana*

*Year Project Completed: 2011
Monitoring Report #6: Submitted December, 2018*



Prepared for:



Prepared by:



MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #6

YEAR 2018

*North Fork Bear Creek
Ravalli County, Montana*

MDT Project Number: NH-7-1(114)56
Control Number: 2015 003

MTFWP: MDT-R2-64-2010
USACE: NWO-1997-90821-MTH

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1.0 INTRODUCTION

The following report presents results for the sixth year of post stream re-construction monitoring at the U.S. Highway 93 crossing at North Fork Bear Creek near Victor, Montana. This report includes an evaluation of monitoring results in comparison to performance standards outlined in the post-construction monitoring plan for the site. The mitigation site is to be monitored for a minimum of five years to evaluate compliance toward meeting performance standards. The project was constructed in 2011; therefore, these results provide documentation of the site's condition seven years following the project's completion. Annual monitoring of the site began in 2013.

As part of this project, the Montana Department of Transportation (MDT) requested authorization to replace bridges at North and South Fork Bear Creek, construct a new stream channel segment, and to place 0.07 acres of fill within jurisdictional wetlands. The North Fork Bear Creek work included removal and replacement of the U.S Highway 93 bridge, placement of rock around the new bridge abutments, creation of a new stream channel alignment, filling the deactivated stream segment, and removal of gabions downstream of the bridge. Stream mitigation was required to offset placement of riprap and other fill materials within the ordinary high watermark of the stream corridor.

Performance standards outlined in the mitigation plan for the reconstructed segment of the North Fork Bear Creek include:

1. Riparian Vegetation Coverage

- a) Greater than 50% areal coverage of desirable perennial plants within the riparian buffer zone. Desirable plants include seeded species and those colonizing from adjacent undisturbed habitats.
- b) Greater than 25% areal coverage of woody riparian shrubs and/or trees within the riparian buffer zone.
- c) Less than 10% areal coverage of Montana State listed noxious weeds within the riparian buffer zone.

2. Stream Bank Stability

- a) Less than 25% of total bank length exhibiting signs of active erosion/cutting.

Additional reporting requirements outlined in the monitoring plan include:

1. **As-built** - An as-built drawing will be prepared with a list of plantings for the riparian areas within the stream channel construction zone.
2. **Weed Control** - Monitoring will include identification of state designated noxious weeds and an estimate of areal coverage of each weed species.

3. **Photo Points** - A minimum of 4 photo points will be established to document conditions along the newly constructed sections.
 - a) Photo points will be established to show upstream and downstream bank conditions at bridge locations.
 - b) Streambank reconstruction not associated with bridges will include photo points from upstream and downstream angles.

Results of the sixth year of monitoring in 2018 are presented in Section 4, and are compared to the adopted performance standards in Section 5. A site map of the project area is included in Appendix A, and photo-documentation of the site during the 2013 and 2018 monitoring events is included in Appendix B. The as-built topographic survey of the project site as surveyed in 2013 is included in Appendix C as well as the design schematics for the project area.

2.0 SITE LOCATION

The monitoring reach includes approximately 300 feet of the North Fork of Bear Creek, extending 110 feet upstream and 100 feet downstream of the U.S. 93 Bridge (plus 90 feet beneath the bridge). The project site is located in Section 31, Township 8 North, Range 20 West, and is approximately one mile south of Victor, Montana (Figure 1).

In 2018, western Montana was characterized by a well-above average winter snowpack, cool and wet spring, and short, dry summer. Despite the snowpack and wet spring conditions, the North Fork of Bear Creek was dry during the August, 2018 monitoring event (see all monitoring photos in Appendix B). Annual monitoring at this site indicates the channel typically goes dry during late summer, even in years when annual snowpack and precipitation is above average.

3.0 MONITORING METHODS

Monitoring field crews visited the project site on August 9th, 2018. Field data collection followed methodologies as described in the 2013 monitoring report, which can be accessed at https://www.mdt.mt.gov/other/webdata/external/planning/STREAM-MITIGATION/2013_REPORTS/2013_NF_BEAR_CREEK_MONITORING_REPORT.PDF

4.0 RESULTS

4.1. Riparian Vegetation Inventory

Results of the 2013 through 2018 visual estimates of areal coverage are summarized in Table 1. In 2018, approximately 15% of the project site was bare ground, with 49% of the area vegetated with herbaceous species and 36% woody species. Overall results as compared with the 2017 monitoring results were very similar, with only a slight increase in percent woody cover from 35% to 36%. This result is due to continued maturation of woody species observed following six growing seasons since monitoring

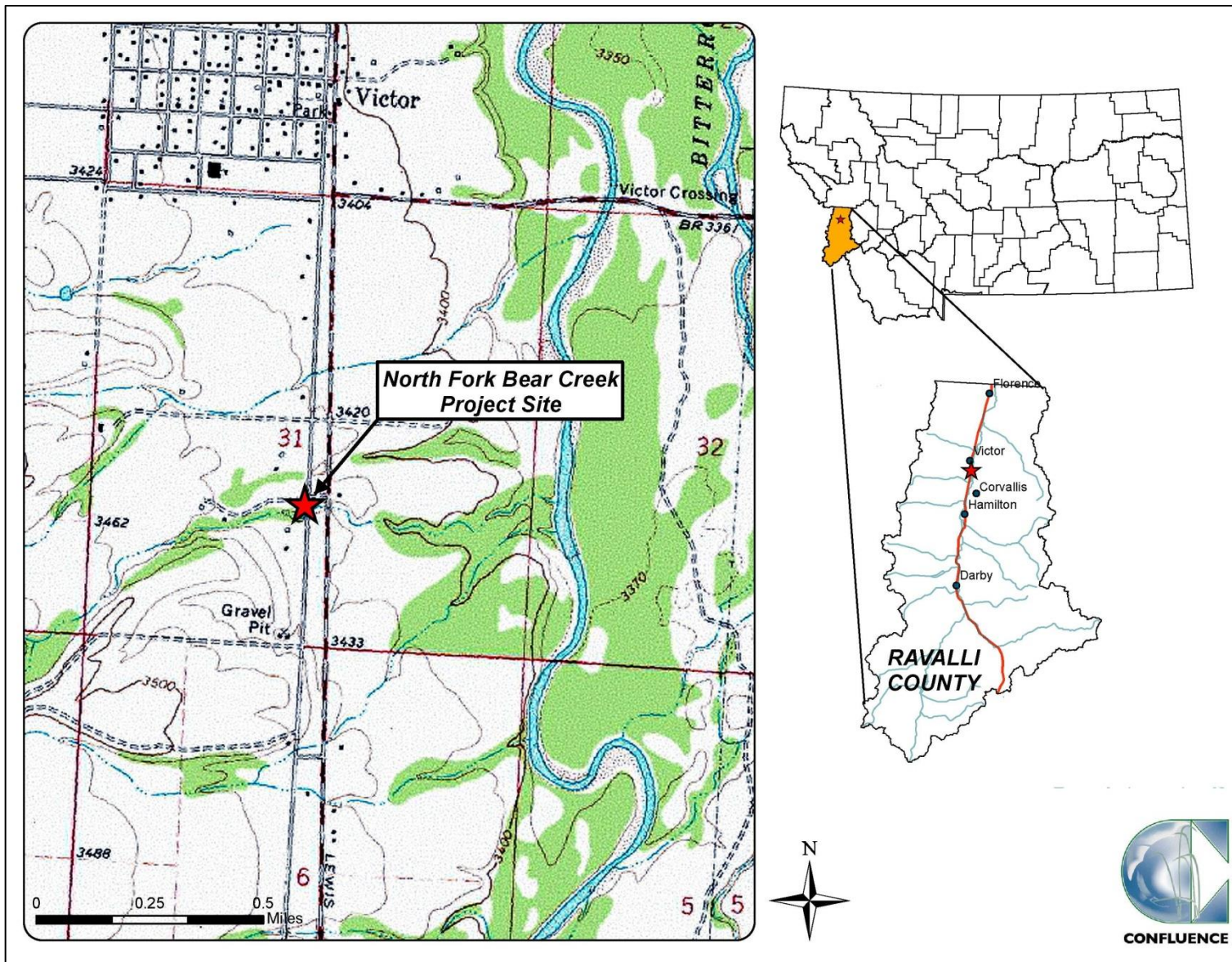


Figure 1. Project location of North Fork Bear Creek stream mitigation site.

efforts began. The site exhibited the same percentage of noxious weeds as observed in 2017, lower than that observed during previous monitoring efforts, and was estimated at 30% of the total cover.

Table 1. Visual estimate of plant coverage at North Fork Bear Creek Stream Mitigation Site from 2013 through 2018.

Year	Total % Riparian Cover	% Bare Ground	% Woody Cover	% Noxious Weed Cover	% Annual/Biennial Cover	% Herbaceous Non-Noxious Perennial Cover	% Desirable Cover ¹
2013	90	10	27	35	*	*	*
2014	90	10	30	35	*	*	*
2015	90	10	32	40	9	9	41
2016	92	8	34	45	7	7	40
2017	85	15	35	30	7	13	48
2018	85	15	36	30	7	13	48

*Data not collected in 2013 or 2014

¹ % Desirable Cover = (Total % Riparian Cover) – (%Noxious Weed Cover) – (% Annual/Biennial Cover)

Table 2 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas from 2013 through 2018. The comprehensive list includes 120 species, representing an increase by 9 species since 2017, 11 species since 2016, 25 species since 2015, 53 species since 2014, and 75 species since 2013. In 2018, 48% of species observed were hydrophytic based on the 2016 National Wetland Plant List (Lichvar *et al.* 2016). Two of the nine new species observed in 2018 were considered hydrophytic, and included lesser poverty rush (*Juncus tenuis*) and creeping buttercup (*Ranunculus repens*). The remaining seven new species observed in 2018 were considered upland, and included pearly-everlasting (*Anaphalis margaritacea*), ripgut brome (*Bromus diandrus*), little-pod false flax (*Camelina microcarpa*), panicked willowherb (*Epilobium brachycarpum*), narrowleaf hawkweed (*Hieracium umbellatum*), bladder campion (*Silene latifolia*), and smooth blue American-aster (*Symphotrichum leave*).

The relatively steep stream bank along the left (north) bank upstream of the Highway 93 Bridge may hinder the growth of riparian vegetation in this area. Downstream of the bridge, stream banks are less steep and cottonwoods (*Populus spp.*) and grasses (*Poa spp.*, *Elymus spp.*, *Phleum pratense*, and *Phalaris arundinacea*) are abundant.

Eighteen infestations of Montana Listed Priority 2B noxious weeds were observed within the project area, all of which were classified as low cover class (1-5%). Two infestations of Priority 1B noxious weeds were found within the riparian corridor and were also considered low cover class (Table 3 and Figure 2, Appendix A). Cheatgrass (*Bromus tectorum*), a Montana Priority 3 regulated weed species was also observed across the site. Two noxious weed species originally observed in 2014 (*Convolvulus arvensis* and *Cynoglossum officinale*) have not been observed during the past four monitoring events, and as a result, they are no longer considered present within the reach.

An estimated 30% of the project area has been colonized by noxious weed infestations. Weeds were observed on both stream banks upstream and downstream of the Highway 93 Bridge. The percent cover estimates recorded for all vegetation categories may have been influenced by a combination of factors, including, but not limited to, adjacent land management, previous herbicide applications, differences in annual precipitation and temperature, calibration training completed by field staff, and other factors that make it difficult to determine the exact cause(s) for increases or decreases in coverage. While previous weed spraying efforts by MDT may have reduced areal coverage of noxious weeds, the 30% percent cover by eight noxious weed species remains a concern at this site.

4.1. Bank Erosion Inventory

One eroding bank was identified within the project reach, which occurs just downstream of the highway bridge along the right (south) bank. Erosion along this 25-foot long bank segment was initially observed in 2017. Over the past year, the bank has continued to erode laterally and captured a camera tower installed by MDT to record wildlife use in the area. The bank consists of cobble and gravel material and is vegetated with a mixture of herbaceous and woody species including common yarrow (*Achillea millefolium*), narrow-leaf cottonwood (*Populus angustifolia*), Woods' rose (*Rosa woodsii*), and spotted knapweed (*Centaurea stoebe*). Based on photo documentation, it appears the bank has retreated by approximately 3 feet in the past year and 4-5 feet in the past two years (see photo points 3.2 and 3.3 in Appendix B).

The 25 feet of erosion represents approximately 6% of the 420 feet of stream banks within the monitoring reach. The relatively short extent of erosion and lack of infrastructure in jeopardy of being damaged by continued erosion here makes stabilization or correction efforts unwarranted at this time. No other erosion was noted along the project reach and all root wads installed to prevent erosion upstream and downstream of the bridge appear to be intact and functioning properly.

Table 2. Comprehensive list of plant species observed at the North Fork Bear Creek Stream Mitigation Site from 2013 through 2018.

Scientific Name	Common Name	WMVC Indicator Status*	Duration	Scientific Name	Common Name	WMVC Indicator Status*	Duration
<i>Achillea millefolium</i>	Common Yarrow	FACU	P	<i>Mellilotus officinalis</i>	Yellow Sweet-Clover	FACU	A/B/P
<i>Agropyron cristatum</i>	Crested Wheatgrass	UPL	P	<i>Mentha arvensis</i>	American Wild Mint	FACW	P
<i>Agrostis gigantea</i>	Black Bent	FAC	P	<i>Myosotis laxa</i>	Bay Forget-Me-Not	OBL	A/B/P
<i>Agrostis scabra</i>	Rough Bent	FAC	P	<i>Nasturtium officinale</i>	Watercress	OBL	P
<i>Alopecurus aequalis</i>	Short-Awn Meadow-Foxtail	OBL	P	<i>Osmorhiza occidentalis</i>	Sweet-cicely	UPL	P
<i>Alnus incana</i>	Speckled Alder	FACW	P	<i>Pascopyrum smithii</i>	Western-Wheat Grass	FACU	P
<i>Alyssum alyssoides</i>	Pale Alyssum	UPL	A/B	<i>Penstemon procerus</i>	Pin cushion Beardtongue	FAC	P
<i>Amelanchier alnifolia</i>	Saskatoon Service-Berry	FACU	P	<i>Penstemon sp.</i>	Beardtongue	N/A	P
<i>Anaphalis margaritacea</i>	Pearly-Everlasting	FACU	P	<i>Peritoma serrulata</i>	Rocky Mountain Beeplant	FACU	A
<i>Antennaria parvifolia</i>	Nuttall's Pussytoes	UPL	P	<i>Phalaris arundinacea</i>	Reed Canary Grass	FACW	P
<i>Aster sp.</i>	Aster	N/A	A/P	<i>Phleum pratense</i>	Common Timothy	FAC	P
<i>Bassia scoparia</i>	Mexican-Fireweed	FAC	A	<i>Picea pungens</i>	Blue Spruce	FAC	P
<i>Berteroa incana</i>	Hoary False-Alyssum	UPL	A/B/P	<i>Pinus ponderosa</i>	Ponderosa Pine	FACU	P
<i>Bromus diandrus</i>	Ripgut Brome	UPL	A/P	<i>Poa compressa</i>	Flat-Stem Blue Grass	FACU	P
<i>Bromus inermis</i>	Smooth Brome	UPL	P	<i>Poa palustris</i>	Fowl Blue Grass	FAC	P
<i>Bromus tectorum</i>	Cheatgrass	UPL	A	<i>Poa pratensis</i>	Kentucky Blue Grass	FAC	P
<i>Camelina microcarpa</i>	Little-Pod False Flax	FACU	A/B	<i>Polygonum cuspidatum</i>	Japanese Knotweed	UPL	P
<i>Carex bebbii</i>	Bebb's Sedge	OBL	P	<i>Populus angustifolia</i>	Narrow-Leaf Cottonwood	FACW	P
<i>Carex nebrascensis</i>	Nebraska Sedge	OBL	P	<i>Populus balsamifera</i>	Balsam Poplar	FAC	P
<i>Carex sp.</i>	Sedge	N/A	P	<i>Potentilla anserina</i>	Silverweed	OBL	P
<i>Carex stipata</i>	Stalk-Grain Sedge	OBL	P	<i>Potentilla recta</i>	Sulphur Cinquefoil	UPL	P
<i>Centaurea stoebe</i>	Spotted Knapweed	UPL	B/P	<i>Prunella vulgaris</i>	Common Selfheal	FACU	P
<i>Cerastium arvense</i>	Field Mouse-Ear Chickweed	FACU	P	<i>Prunus virginiana</i>	Choke Cherry	FACU	P
<i>Chenopodium album</i>	Lamb's-Quarters	FACU	A	<i>Pseudoroegneria spicata</i>	Bluebunch Wheatgrass	UPL	P
<i>Cirsium arvense</i>	Canadian Thistle	FAC	P	<i>Pseudotsuga menziesii</i>	Douglas-Fir	FACU	P
<i>Cirsium vulgare</i>	Bull Thistle	FACU	B	<i>Ranunculus repens</i>	Creeping Buttercup	FAC	P
<i>Cornus alba</i>	Red Osier	FACW	P	<i>Ranunculus sp.</i>	Buttercup	N/A	P
<i>Convolvulus arvensis</i>	Field Bindweed	UPL	P	<i>Ribes lacustre</i>	Bristly Black Gooseberry	FAC	P
<i>Coronilla varia</i>	Common Crown-Vetch	UPL	P	<i>Rosa woodsii</i>	Woods' Rose	FACU	P
<i>Crataegus douglasii</i>	Black Hawthorn	FAC	P	<i>Rubus idaeus</i>	Common Red Raspberry	FACU	P
<i>Crepis tectorum</i>	Narrowleaf Hawksbeard	UPL	A	<i>Rubus sp.</i>	Raspberry sp.	N/A	P
<i>Cynoglossum officinale</i>	Gypsy-Flower	FACU	B	<i>Rumex acetosa</i>	Garden Sorrel	FAC	P
<i>Dactylis glomerata</i>	Orchard Grass	FACU	P	<i>Rumex acetosella</i>	Common Sheep Sorrel	FACU	P
<i>Dasiphora fruticosa</i>	Golden-Hardhack	FAC	P	<i>Salix amygdaloides</i>	Peach-Leaf Willow	FACW	P
<i>Deschampsia caespitosa</i>	Tufted Hairgrass	FACW	P	<i>Salix bebbiana</i>	Gray Willow	FACW	P
<i>Elymus canadensis</i>	Nodding Wild Rye	FAC	P	<i>Salix drummondiana</i>	Drummond's Willow	FACW	P
<i>Elymus glaucus</i>	Blue Wild Rye	FACU	P	<i>Salix lasiandra</i>	Pacific Willow	FACW	P
<i>Elymus repens</i>	Creeping Wild Rye	FAC	P	<i>Salix sp.</i>	Willow	N/A	P
<i>Elymus trachycaulus</i>	Slender Wild Rye	FAC	P	<i>Salsola tragus</i>	Prickly Russian-Thistle	FACU	A
<i>Epilobium brachycarpum</i>	Panicled Willowherb	UPL	A	<i>Scutellaria galericulata</i>	Hooded Skullcap	OBL	P
<i>Epilobium ciliatum</i>	Fringed Willowherb	FACW	P	<i>Silene latifolia</i>	Bladder Campion	UPL	B/P
<i>Erigeron compositus</i>	Cutleaf Fleabane	UPL	P	<i>Silene noctiflora</i>	Night-flowering Catchfly	UPL	A
<i>Festuca idahoensis</i>	Bluebunch Fescue	FACU	P	<i>Sinapis arvensis</i>	Corn Mustard	UPL	A
<i>Galium aparine</i>	Sticky-Willy	FACU	A	<i>Sisymbrium altissimum</i>	Tall Hedge-Mustard	FACU	A/B
<i>Galium boreale</i>	Northern Bedstraw	FACU	P	<i>Solanum dulcamara</i>	Climbing Nightshade	FAC	P
<i>Geranium viscosissimum</i>	Sticky Purple Crane's-Bill	FACU	P	<i>Solidago canadensis</i>	Canadian Goldenrod	FACU	P
<i>Geum macrophyllum</i>	Large-Leaf Avens	FAC	P	<i>Sonchus arvensis</i>	Field Sow-Thistle	FACU	P
<i>Glyceria striata</i>	Fowl Manna Grass	OBL	P	<i>Symphoricarpos albus</i>	Common Snowberry	FACU	P
<i>Hieracium umbellatum</i>	Narrowleaf Hawkweed	UPL	P	<i>Symphoricarpos occidentalis</i>	Western Snowberry	FAC	P
<i>Hordeum jubatum</i>	Fox-Tail Barley	FAC	P	<i>Symphyotrichum ascendens</i>	Western American-Aster	FACU	P
<i>Hypericum perforatum</i>	Common St. John's-Wort	FACU	P	<i>Symphyotrichum laeve</i>	Smooth Blue American-Aster	FACU	P
<i>Juncus balticus</i>	Baltic Rush	FACW	P	<i>Tanacetum vulgare</i>	Common Tansy	FACU	P
<i>Juncus effusus</i>	Lamp Rush	FACW	P	<i>Taraxacum officinale</i>	Common Dandelion	FACU	P
<i>Juncus sp.</i>	Rush	N/A	P	<i>Thalictrum dasycarpum</i>	Purple Meadow-Rue	FACW	P
<i>Juncus tenuis</i>	Lesser Poverty Rush	FAC	P	<i>Thlaspi arvense</i>	Field Pennycress	UPL	A
<i>Lactuca serriola</i>	Prickly Lettuce	FACU	A/B	<i>Tragopogon dubius</i>	Meadow Goat's-beard	UPL	A/B
<i>Lepidium campestre</i>	Field Pepper-Grass	UPL	A/B	<i>Trifolium pratense</i>	Red Clover	FACU	B/P
<i>Leucanthemum vulgare</i>	Ox-Eye Daisy	FACU	P	<i>Trifolium repens</i>	White Clover	FAC	P
<i>Lycopus asper</i>	Rough Water-Horehound	OBL	P	<i>Verbascum thapsus</i>	Great Mullein	FACU	B
<i>Medicago lupulina</i>	Black Medick	FACU	A/P	<i>Veronica americana</i>	American-Brooklime	OBL	P

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

Duration: A=Annual; B=Biennial; P=Perennial; USDA PLANTS Database (2018)

New species identified in 2018 are **bolded**

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

Table 3. Weeds observed within the North Fork Bear Creek riparian zone in 2018.

Category*	Scientific Name	Common Name
Priority 1B	<i>Polygonum cuspidatum</i>	Knotweed Complex
Priority 2B	<i>Berteroa incana</i>	Hoary False-Alyssum
	<i>Centaurea stoebe</i>	Spotted Knapweed
	<i>Cirsium arvense</i>	Canadian Thistle
	<i>Hypericum perforatum</i>	Common St. John's-Wort
	<i>Leucanthemum vulgare</i>	Ox-Eye Daisy
	<i>Potentilla recta</i>	Sulphur Cinquefoil
	<i>Tanacetum vulgare</i>	Common Tansy
Priority 3 State Regulated	<i>Bromus tectorum</i>	Cheatgrass

* Based on the MT Department of Agriculture 2017 Noxious Weed List

5.0 COMPARISON OF RESULTS TO PERFORMANCE CRITERIA

Monitoring of the North Fork Bear Creek Stream Mitigation site is intended to document whether the reconstructed segment of the channel is meeting or moving toward meeting performance standards outlined in the North Fork Bear Creek Mitigation Plan. Results from the sixth year of monitoring indicates two of the four performance standards are being met seven years post-construction, including percent woody vegetation cover and stream bank stability (Table 4). Percent cover of a) desirable non-noxious perennial species and b) noxious weed species failed to meet the success criteria of >50% and <10%, respectively. Photographs of photo points (Appendix B) and as-built drawings (Appendix C) have been provided as additional documentation of the site's condition in this monitoring report.

Table 4. Performance results of North Fork Bear Creek seven years following project completion.

Monitoring Parameter	Performance Criteria	Status 7 Years Following Construction	Meeting Performance Criteria?
Riparian Cover	Greater than 50% aerial coverage of desirable perennial plants, including seeded species and those colonizing from adjacent undisturbed habitats.	Desirable cover estimated at 48% (85% total cover - 30% weed cover - 7% annual/biennial).	No
	Greater than 25% aerial coverage of woody riparian shrubs and/or trees.	Woody riparian species cover estimated at 36% of project area and increasing over past 5 years	Yes
	Less than 10% aerial coverage of site has Montana noxious weeds.	Noxious weed cover is estimated at 30% of the project area.	No
Streambank Stability	Less than 25% of total bank length exhibiting signs of active erosion/cutting	Erosion inventory documented 6% of project reach exhibits active erosion/cutting	Yes

5.1. Riparian Cover

Desirable non-noxious perennial plants including riparian trees, shrubs, and forbs were estimated at 48% cover of the project site. This estimate was calculated by subtracting the sum of the visual estimates for noxious weed cover (30%), bare ground (15%), and annual/biennial cover (7%) from 100. The trend in percent desirable cover from 2015 to 2018 is trending upward and is currently only 2% below the success standard for this monitoring parameter.

Percent cover of woody vegetation has increased by 1-3% per year since the initial monitoring event in 2013. The majority of woody plants include shrubs and trees that existed prior to relocating the channel and volunteer species that are colonizing the site. Although techniques used to install woody cuttings have resulted in very low survival rates, the combination of volunteer shrub establishment and mature tree cover currently stands at 36%, which exceeds the established success criteria for woody cover by 11%

Many noxious weed infestations were observed along both banks of the project reach. Although each individual weed infestation is relatively small in extent, the area of all infestations combined warrants concern and must be addressed to achieve the success criterion for riparian cover. Future weed management efforts should take into account the presence of wildlife fencing along the riparian corridor upstream and downstream of the U.S. 93 Bridge over the North Fork of Bear Creek.

Attempts at establishing woody riparian vegetation within the project reach included installing cuttings along the banks upstream and downstream of the Highway 93 Bridge. Cottonwood and willow (*Salix* spp.) cuttings installed along the banks were unsuccessful. Only one of the cuttings has developed leafy stems, which have sprouted from the base of the plant. Upon inspection, all cuttings were installed to a depth of approximately one foot, with 4 to 5 feet of the stem extending above ground. The lack of specialized equipment to install willow stems in rocky/cobbly substrate was likely the limiting factor for installing the cuttings to the proper depth. High mortality of these cuttings can be attributed to the shallow planting depth and inability of the cuttings to quickly extend roots down to the low water table elevation.

5.2. Streambank Stability

One relatively short bank segment has retreated by approximately three feet in the past year. The eroding bank segment is 25 feet long and represents 6% of the overall bank length (not including banks beneath the highway bridge). This erosion is relatively short and does not currently jeopardize any infrastructure; as such, its repair is unwarranted at this time.

Root wads placed along the north bank both upstream and downstream of the bridge appear stable. Cobble placed atop one of the rootwads upstream of the bridge partially washed out during 2014; however no additional bank erosion has been noted in this area during the past four years. Given the integrity of the channel, no measures are currently warranted to improve bank stability within the project reach, and the project site is currently meeting success criteria for bank stability.

6.0 LITERATURE CITED

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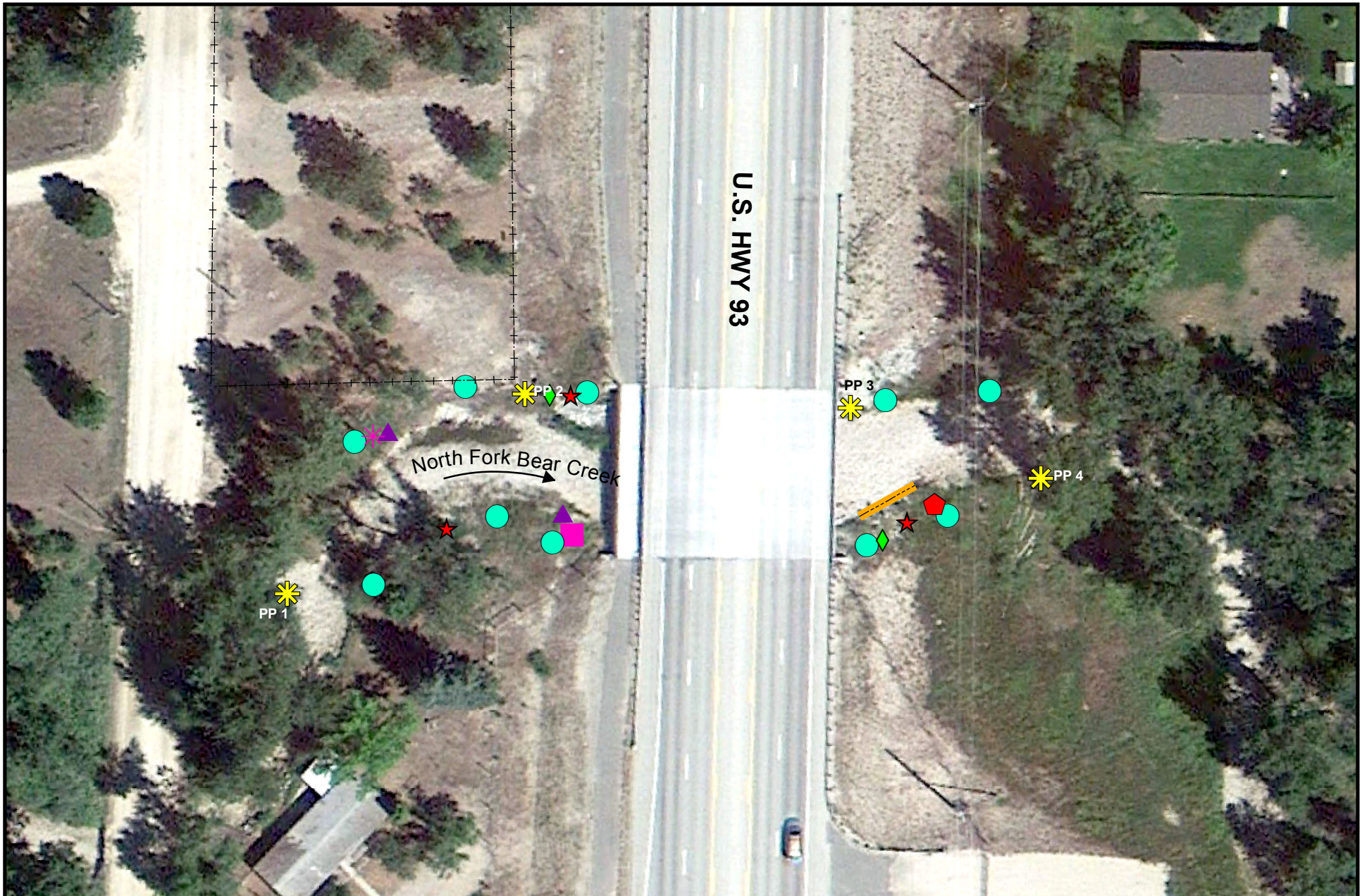
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Appendix A

Project Site Map

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana



Legend

✱ Photo Points

■ Berteroa incana

● Centaurea stoebe

◆ Leucanthemum vulgare

▲ Polygonum cuspidatum

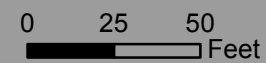
★ Tanacetum vulgare

◆ Hypericum perforatum

✱ Potentilla recta

Note: Cirsium arvense was observed in trace amounts and was not mapped

--- Eroding Bank



**2018 Monitoring
NF Bear Creek**

Figure 2

Date: 10/11/2018

NFBear_features2018.mxd

Appendix B

Project Area Photos

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana

PROJECT NAME North Fork Bear Creek Stream Mitigation Site
DATE RANGE 2013-2018 Monitoring Events
PHOTO INFO. **Photo Point 1.2:** North streambank facing downstream
Direction: 45° (Northwest)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 1.3: South streambank**
Direction: 90° (East)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site
DATE RANGE 2013-2018 Monitoring Events
PHOTO INFO. **Photo Point 1.1: Tributary/culvert entrance from west**
Direction: 270° (West)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 1.4:** View of Dry channel looking upstream
Direction: 230° (Southwest)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site
DATE RANGE 2013-2018 Monitoring Events
PHOTO INFO. **Photo Point 2.1: Root wads on the north bank**
Direction: 225° (Southwest)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site
DATE RANGE 2013-2018 Monitoring Events
PHOTO INFO. **Photo Point 2.2:** Root wads on the north bank
Direction: 225° (Southwest)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 2.3:** View across the channel from the North bank
Direction: 135° (Southeast)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 3.1:** Downstream view from bridge abutment
Direction: 90° (East)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 3.2:** View of South bank from left abutment
Direction: 135° (Southeast)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 3.3:** View of south bank, taken looking across the channel from north abutment
Direction: 180° (South)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 4.1:** Upstream view taken from the south bank on the downstream extent of the project
Direction: 270° (West)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 4.2:** Root wads on north bank downstream of bridge
Direction: 0° (North)



2013



2014



2015



2016



2017



2018

PROJECT NAME North Fork Bear Creek Stream Mitigation Site

DATE RANGE 2013-2018 Monitoring Events

PHOTO INFO. **Photo Point 4.3:** View looking north from downstream extent
Direction: 68° (East-Northeast)



2013



2014



2015



2016



2017

2018
Photo not available

Appendix C

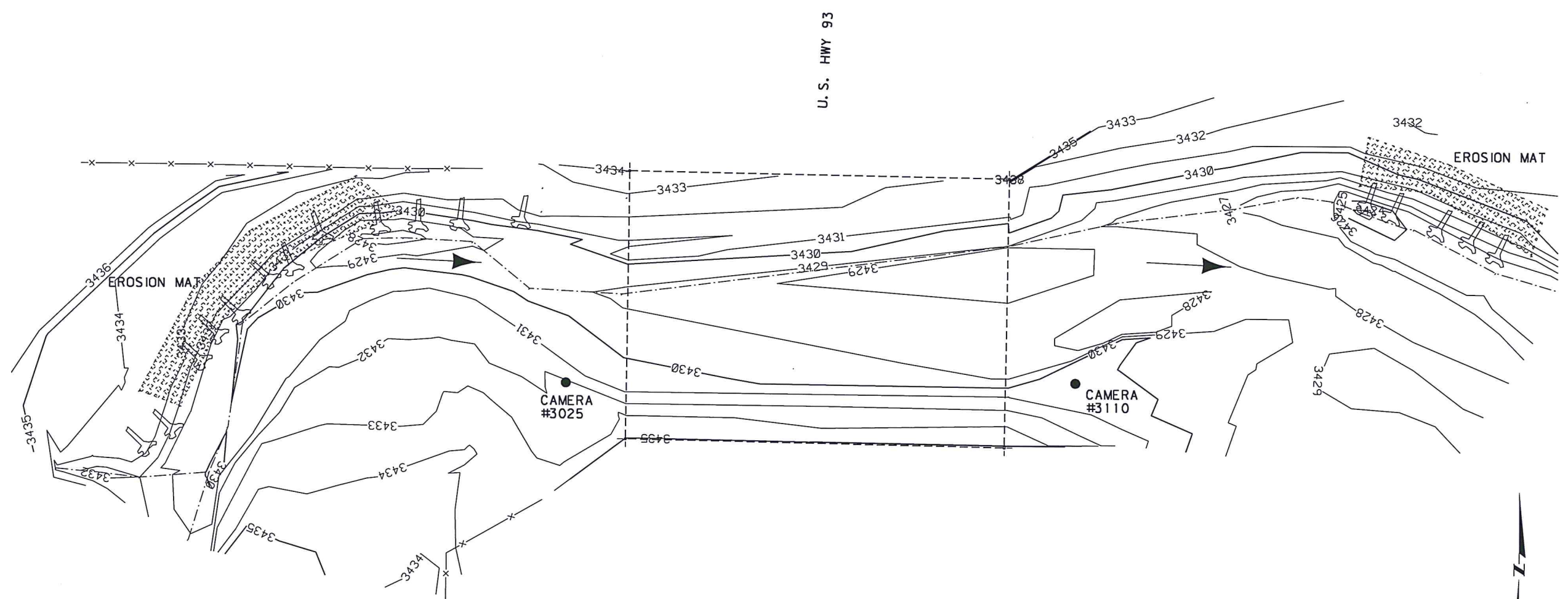
As Built Drawings and Design Schematics

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana

CONTROL TABLE				
PNT#	NORTHING	EASTING	ELEV.	DESCRIPTION
CI2015	820308.760	797947.813	3435.224	MDT AL CAP
CG2015	819805.449	798080.492	3436.854	MDT AL CAP

CI2015

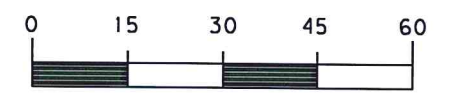
LEGEND
 ROOT BALL



AS-BUILT TOPOGRAPHIC DRAWING OF THE NORTH FORK OF BEAR CREEK CHANNEL

SURVEYOR NOTES:

1. THIS SURVEY IS BASED ON FOUND MDT ALUMINUM CAPS STAMPED CI2015 AND CG2015 BUT THEY DO NOT HAVE ESTABLISHED MDT COORDS AND ELEVATIONS. THEREFORE LOCAL CONTROL WAS ESTABLISHED FOR THIS SITE WITH TRIMBLE GPS RTK SURVEY AND THE APPROXIMATE ASSUMED ELEVATION AT MDT ALUM CAP CI2015.
2. THE COORDINATES SHOWN HEREON ARE BASED ON MONTANA STATE PLANE GRID



3
2
1

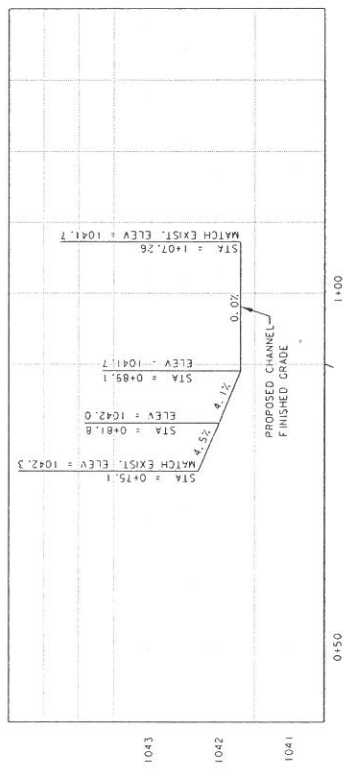
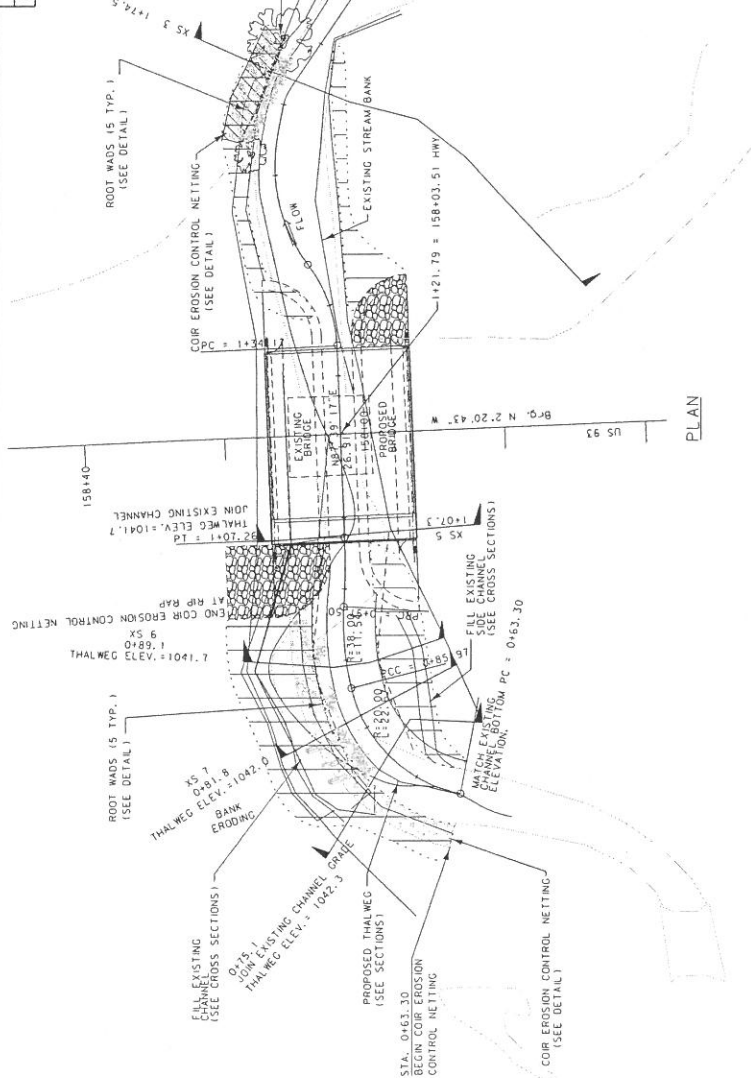
MDT MONTANA DEPARTMENT OF TRANSPORTATION

...NF BEAR CREEK PLAN.dgn
 12/9/2013
 11:02:51 AM awibe

DESIGNED BY ARNE W
 REVIEWED BY
 CHECKED BY LARRY R

N.F. BEAR CREEK

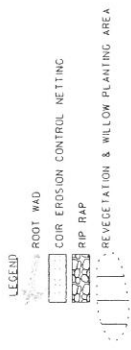
MDT STREAM MITIGATION MONITORING SURVEY



COORDINATE TABLE

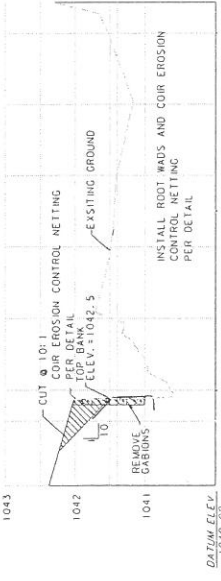
STATION	NORTHING	EASTING
0+76.03	36,218.1167	56,132.1603
0+85.97	36,221.2271	56,204.3003
0+91.78	36,222.6477	56,210.5363
1+02.39	36,222.0482	56,221.2141
1+07.46	36,222.2420	56,226.0927
1+10.14	36,223.4034	56,226.3948
1+15.61	36,223.6668	56,222.3869
1+20.48	36,227.4917	56,224.3830
1+25.48	36,231.0305	56,226.2933
1+30.48	36,230.1936	56,227.8178
1+35.48	36,229.8772	56,229.1522
1+40.48	36,229.1764	56,230.3597
1+45.48	36,218.2584	56,304.6191
1+50.48	36,216.0744	56,305.8532

- NOTES:**
- REMOVE ALL EXISTING GABIONS, APPROXIMATE STATION 1+63 TO 1+78, AND ALL ROOT WAD STRUCTURES BETWEEN STATIONS 1+63 AND 1+78 AS DIRECTED BY ENGINEER.
 - INSTALL SIX (6) ROOT WAD STRUCTURES BETWEEN STATION 0+66 AND 1+10 AS DIRECTED BY ENGINEER.
 - DO NOT DISTURB EXISTING STUMPS/ROOT WADS NEAR STATION 0+90
 - DO NOT DISTURB EXISTING TREES IN GABION AREA 1+78

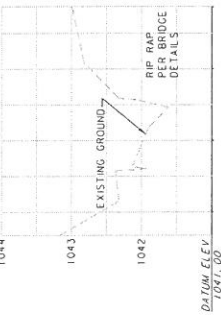


STATE	PROJECT NUMBER	SHEET NO.
MONTANA	BN-W534 7-11114956	27

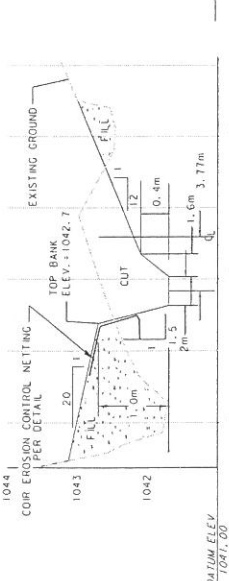
BEAR CREEK ROAD - NORTH



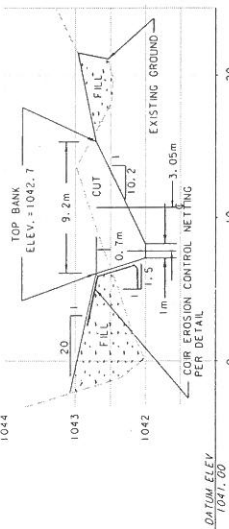
1+74.5



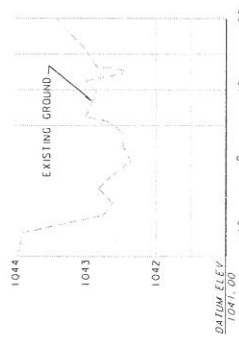
1+07.3



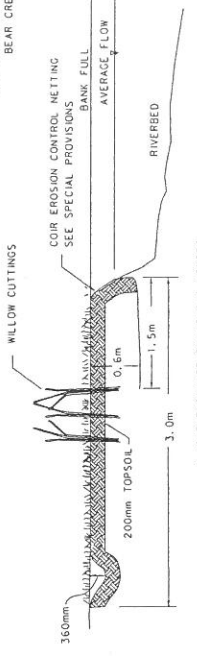
0+89.1



0+81.8

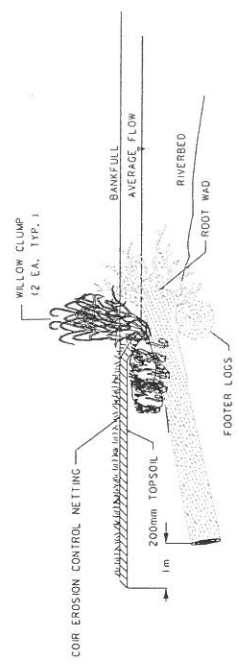


0+75.1

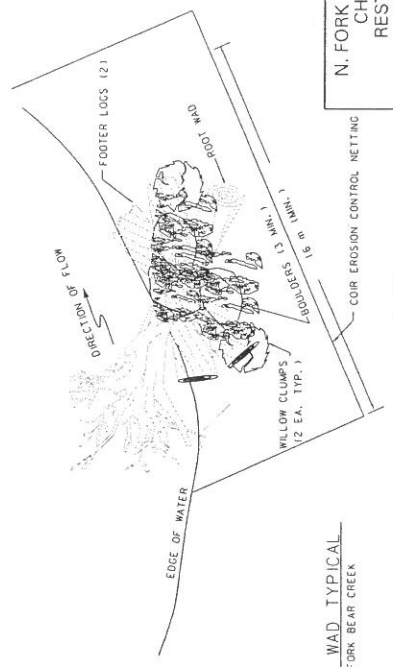


1. SUB EXCAVATE BANKS 0.6 METERS FROM EDGE OF BANK.
2. BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
3. BACK FILL WITH NATIVE MATERIAL AND 0.2 METERS TOPSOIL.
4. WRAP NETTING AND EXTEND 3.0 METERS MIN. FROM BANK EDGE.

COIR EROSION CONTROL NETTING TYPICAL
N. FORK BEAR CREEK



CROSS SECTION



ROOT WAD TYPICAL
N. FORK BEAR CREEK

PLAN

N. FORK BEAR CREEK
CHANNEL
RESTORATION
DETAILS
STA. 158+03
SHEET 2 OF 2
NO SCALE