MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

North Fork Bear Creek
Ravalli County, Montana

Year Project Completed: 2011
Monitoring Report #2: Submitted December, 2014

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MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #2:

YEAR 2014

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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December 2014

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1.0 INTRODUCTION

The following report presents the results of the second year of post stream reconstruction 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 project performance standards outlined in the post-construction monitoring plan for the site. Mitigation is to be monitored for 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 three years following the project's completion.

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 wetland fill. The North Fork Bear Creek work included: removal and replacement of the existing bridge, placement of rock at bridge abutments, placement of fill within the stream channel, creation of a new stream channel, 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.

Mitigation performance standards adopted for the reconstructed segment of the North Fork Bear Creek site 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. Streambank Stability
   a) Less than 25% of total bank length exhibiting signs of active erosion/cutting.

Additional reporting requirements included 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 second year of monitoring in 2014 are presented in Section 4, and are compared to the adopted performance standards in Section 5. Section 6 provides management and recommendations for future projects to maximize the potential for meeting all performance criteria. A site map of the project area is included in Appendix A, and photo-documentation of the site during the 2013 and 2014 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, and extends 110 feet upstream and 100 feet downstream of the U.S. 93 Bridge. The project site is located in Section 31, Township 8 North, Range 20 West, and is approximately 1 mile south of Victor, Montana (Figure 1).

3.0 MONITORING METHODS
Monitoring field crews visited the project site on July 23, 2014. The following data were collected at the North Fork Bear Creek stream mitigation site:

3.1. Riparian Vegetation Establishment
Visual estimates of all vegetation species, woody species, and noxious weeds were performed within riparian buffer areas extending 25 feet on either side of the active stream channel. Percent cover was recorded for each vegetative category based on ocular estimates.

3.2. Stream bank Stability
Both streambanks within the project area were visually assessed to document eroding streambanks. Eroding streambanks were labeled with a specific numeric identifier, photographed, and a GPS location was recorded.

3.3. Photo Documentation
Four photo points were selected to photo-document vegetation establishment and streambank conditions within the project site. Photo documentation includes upstream and downstream bank conditions at the Highway 93 Bridge. All sites selected for photo-documentation were recorded using GPS and compass direction noted to allow for repetition during future monitoring (Appendix B).
Figure 1. Project location of North Fork Bear Creek stream mitigation site.
3.4. As Built Drawings
An as-built topographic drawing of the project site was prepared as part of the 2013 (Year 1) monitoring, and included one-foot elevation contours and control points established by MDT during project construction (Appendix C).

4.0 RESULTS

4.1. Riparian Vegetation Inventory
Results of the 2013 and 2014 visual estimates of areal coverage are summarized in Table 1, and are separated into total vegetative cover, cover by woody species, and cover of noxious weeds. In 2014, approximately 10% of the project site was bare ground, with 60% of the area vegetated with herbaceous species and 30% woody species. The site exhibited a relatively high percentage of noxious weeds, estimated at approximately 35% of the total cover. Overall results as compared to 2013 were very similar, with a slight increase in percent woody cover from 27% to 30%. This result is likely due to maturation of woody species observed following an additional growing season.

Table 1. Visual estimate of plant coverage at North Fork Bear Creek Stream Mitigation Site in 2013 and 2014.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Total % Riparian Cover</th>
<th>% Bare Ground</th>
<th>% Woody Cover</th>
<th>% Noxious Weed Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>90</td>
<td>10</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>2014</td>
<td>90</td>
<td>10</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 2 includes a comprehensive list of plant species observed along the new channel alignment and riparian buffer areas in 2013 and 2014. Sixty-nine species were observed in 2014, representing an increase by 24 species from 2013. In 2014, 44% of species observed were hydrophytic based on the 2014 National Wetland Plant List (Lichvar et al 2014).

The relatively steep stream bank along the left (north) bank of the channel 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 sp.) and grasses (Poa, Elymus, Phleum, and Phalaris spp) are abundant.
Table 2. Comprehensive list of plant species observed at the North Fork Bear Creek Stream Mitigation Site in 2013 and 2014.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>WMVC Indicator Status*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea millefolium</td>
<td>Common Yarrow</td>
<td>FACU</td>
</tr>
<tr>
<td>Agropyron cristatum</td>
<td>Crested Wheatgrass</td>
<td>NL</td>
</tr>
<tr>
<td>Agrostis gigantea</td>
<td>Black Bent</td>
<td>FAC</td>
</tr>
<tr>
<td>Alnus incana</td>
<td>Speckled Alder</td>
<td>FACW</td>
</tr>
<tr>
<td>Alyssum alyssoides</td>
<td>Pale Alyssum</td>
<td>NL</td>
</tr>
<tr>
<td>Antennaria parvifolia</td>
<td>Nuttall's Pussytoes</td>
<td>NL</td>
</tr>
<tr>
<td>Aster sp.</td>
<td>Aster</td>
<td>NL</td>
</tr>
<tr>
<td>Bromus inermis</td>
<td>Smooth Brome</td>
<td>FAC</td>
</tr>
<tr>
<td>Bromus tectorum</td>
<td>Cheatgrass</td>
<td>NL</td>
</tr>
<tr>
<td>Centaurea stoebe</td>
<td>Spotted Knapweed</td>
<td>NL</td>
</tr>
<tr>
<td>Cirsium arvense</td>
<td>Canadian Thistle</td>
<td>FAC</td>
</tr>
<tr>
<td>Convolvulus arvensis</td>
<td>Field Bindweed</td>
<td>NL</td>
</tr>
<tr>
<td>Cornus alba</td>
<td>Red Osier</td>
<td>FACW</td>
</tr>
<tr>
<td>Crataegus douglasii</td>
<td>Black Hawthorn</td>
<td>FAC</td>
</tr>
<tr>
<td>Cynoglossum officinale</td>
<td>Gypsy-Flower</td>
<td>FACU</td>
</tr>
<tr>
<td>Dactylis glomerata</td>
<td>Orchard Grass</td>
<td>FACU</td>
</tr>
<tr>
<td>Dasiphora fruticosa</td>
<td>Golden-Hardhack</td>
<td>FAC</td>
</tr>
<tr>
<td>Deschampsia cespitosa</td>
<td>Tufted Hairgrass</td>
<td>FACW</td>
</tr>
<tr>
<td>Elymus repens</td>
<td>Creeping Wild Rye</td>
<td>FAC</td>
</tr>
<tr>
<td>Elymus trachycaulus</td>
<td>Slender Wild Rye</td>
<td>FAC</td>
</tr>
<tr>
<td>Epilobium ciliatum</td>
<td>Fringed Willowherb</td>
<td>FACW</td>
</tr>
<tr>
<td>Festuca idahoensis</td>
<td>Bluebunch Fescue</td>
<td>FACU</td>
</tr>
<tr>
<td>Geranium viscosissimum</td>
<td>Sticky Purple Crane’s-Bill</td>
<td>FACU</td>
</tr>
<tr>
<td>Geum macrophyllum</td>
<td>Large-Leaf Avens</td>
<td>FAC</td>
</tr>
<tr>
<td>Glyceria striata</td>
<td>Fowl Manna Grass</td>
<td>OBL</td>
</tr>
<tr>
<td>Hordeum jubatum</td>
<td>Fox-Tail Barley</td>
<td>FAC</td>
</tr>
<tr>
<td>Juncus sp.</td>
<td>Rush</td>
<td>NL</td>
</tr>
<tr>
<td>Lactuca serriola</td>
<td>Prickly Lettuce</td>
<td>FACU</td>
</tr>
<tr>
<td>Leucanthemum vulgare</td>
<td>Ox-Eye Daisy</td>
<td>FACU</td>
</tr>
<tr>
<td>Medicago lupulina</td>
<td>Black Medick</td>
<td>FACU</td>
</tr>
<tr>
<td>Mellilotus officinalis</td>
<td>Yellow Sweet-Clover</td>
<td>FACU</td>
</tr>
<tr>
<td>Mentha arvensis</td>
<td>American Wild Mint</td>
<td>FACW</td>
</tr>
<tr>
<td>Osmorhiza occidentalis</td>
<td>Sweet-cicely</td>
<td>NL</td>
</tr>
<tr>
<td>Pascopyrum smithii</td>
<td>Western-Wheat Grass</td>
<td>FACU</td>
</tr>
<tr>
<td>Phalaris arundinacea</td>
<td>Reed Canary Grass</td>
<td>FACW</td>
</tr>
<tr>
<td>Phleum pratense</td>
<td>Common Timothy</td>
<td>FAC</td>
</tr>
<tr>
<td>Picea pungens</td>
<td>Blue Spruce</td>
<td>FAC</td>
</tr>
</tbody>
</table>
*Based on Lichvar et al 2014. New species identified in 2014 are bolded.

**Table 2 (Continued). Comprehensive list of plant species observed at the North Fork Bear Creek Stream Mitigation Site in 2013 and 2014.**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>WMVC Indicator Status*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pinus ponderosa</strong></td>
<td>Ponderosa Pine</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Poa palustris</strong></td>
<td>Fowl Blue Grass</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Poa pratensis</strong></td>
<td>Kentucky Blue Grass</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Polygonum sp.</strong></td>
<td>Knotweed Complex</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Populus angustifolia</strong></td>
<td>Narrow-Leaf Cottonwood</td>
<td>FACW</td>
</tr>
<tr>
<td><strong>Populus balsamifera</strong></td>
<td>Balsam Poplar</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Potentilla anserina</strong></td>
<td>Silverweed</td>
<td>OBL</td>
</tr>
<tr>
<td><strong>Prunella vulgaris</strong></td>
<td>Common Selfheal</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Prunus virginiana</strong></td>
<td>Choke Cherry</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Pseudotsuga menziesii</strong></td>
<td>Douglas-Fir</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Ranunculus sp.</strong></td>
<td>Buttercup</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Ribes lacustre</strong></td>
<td>Bristly Black Gooseberry</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Rosa woodsii</strong></td>
<td>Woods' Rose</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Rubus sp.</strong></td>
<td>Raspberry sp.</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Rumex acetosa</strong></td>
<td>Garden Sorrel</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Rumex acetosella</strong></td>
<td>Common Sheep Sorrel</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Salix amygdaloides</strong></td>
<td>Peach-Leaf Willow</td>
<td>FACW</td>
</tr>
<tr>
<td><strong>Salix bebbiana</strong></td>
<td>Gray Willow</td>
<td>FACW</td>
</tr>
<tr>
<td><strong>Salix drummondiana</strong></td>
<td>Drummond's Willow</td>
<td>FACW</td>
</tr>
<tr>
<td><strong>Salix lasiandra</strong></td>
<td>Pacific Willow</td>
<td>FACW</td>
</tr>
<tr>
<td><strong>Salix sp.</strong></td>
<td>Willow</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Sinapis arvensis</strong></td>
<td>Corn Mustard</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Solanum dulcamara</strong></td>
<td>Climbing Nightshade</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Solidago canadensis</strong></td>
<td>Canadian Goldenrod</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Sonchus arvensis</strong></td>
<td>Field Sow-Thistle</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Symphoricarpus albus</strong></td>
<td>Common Snowberry</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Tanacetum vulgare</strong></td>
<td>Common Tansy</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Taraxacum officinale</strong></td>
<td>Common Dandelion</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Tragopogon dubius</strong></td>
<td>Meadow Goat's-beard</td>
<td>NL</td>
</tr>
<tr>
<td><strong>Trifolium pratense</strong></td>
<td>Red Clover</td>
<td>FACU</td>
</tr>
<tr>
<td><strong>Trifolium repens</strong></td>
<td>White Clover</td>
<td>FAC</td>
</tr>
<tr>
<td><strong>Verbascum thapsus</strong></td>
<td>Great Mullein</td>
<td>FACU</td>
</tr>
</tbody>
</table>

*Based on Lichvar et al 2014. New species identified in 2014 are bolded.
The vegetation inventory along the North Fork Bear Creek identified seven Montana State Listed noxious weed species, and one Montana State Regulated plant occurring within the riparian corridor (Table 3). Locations of all weed observations are provided on Figure 2 in Appendix A. Visual observations estimated approximately 35% of the project area has been colonized by weeds. Weeds were observed on both stream banks, and were primarily concentrated upstream of the Highway 93 Bridge. It should be noted that a horse corral exists immediately adjacent to the reconstructed channel segment on the north bank upstream of the Highway 93 Bridge. This corral is entirely bare ground, and may contribute to weed propagation in the mitigation site.

Table 3. Weeds observed within the North Fork Bear Creek riparian zone in 2014.

<table>
<thead>
<tr>
<th>Category*</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1B</td>
<td>Polygonum sp.</td>
<td>Knotweed Complex</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Centaurea stoebe</td>
<td>Spotted Knapweed</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Cirsium arvense</td>
<td>Canadian Thistle</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Convolvulus arvensis</td>
<td>Field Bindweed</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Cynoglossum officinale</td>
<td>Gypsy-Flower</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Leucanthemum vulgare</td>
<td>Ox-Eye Daisy</td>
</tr>
<tr>
<td>Priority 2B</td>
<td>Tanacetum vulgare</td>
<td>Common Tansy</td>
</tr>
<tr>
<td>Priority 3 State Regulated</td>
<td>Bromus tectorum</td>
<td>Cheatgrass</td>
</tr>
</tbody>
</table>

*Based on the MSU Extension Service's Montana Noxious Weed list, 2013

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 cuttings installed along the banks were unsuccessful. No cuttings were found alive during 2013 or 2014 field observations. Upon inspection, all cuttings were installed to a depth of approximately one foot, with 4 to 5 feet of the stem extending above ground. High mortality rates were attributed to the inability of the cuttings to extend roots to the low water table elevation.

4.2. Bank Erosion Inventory

Field examination of the North Fork Bear Creek project site documented no eroding streambanks within the project area. New banks with large woody debris installations appeared mostly stable with no undercutting or lateral channel migration evident.

The trunk of one root wad installed upstream of Highway 93 appeared more exposed from the year prior (see Photo 2 in Appendix B). The exposure of this trunk appears as a result of the loss of cobble material placed on the upper six inches of the bank during high flows in 2014. Cobble materials placed over this root wad were covered with a layer of topsoil and coir fabric during construction; however, the fabric has peeled back from the top of the bank and is no longer providing protection of the upper bank. If additional cobbles adjacent to this root wad mobilize during subsequent high flows, the root ball may create a scouring hydraulic against the bank, reducing the ability of the
root wad to provide bank protection. Although the bank is not currently considered eroding due to the lack of lateral channel movement, continued monitoring is highly recommended to determine whether this segment of the project reach becomes more susceptible to erosion.

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 performance standards outlined in the North Fork Bear Creek Mitigation Plan. The second year of monitoring indicates three of the four performance standards are being met three years post-construction, including total vegetative cover within the riparian zone, woody vegetation cover, and stream bank stability (Table 4). The percent cover of noxious weed species observed within the riparian zone failed to meet the success criteria of less than 10%. 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 three years following project completion.

<table>
<thead>
<tr>
<th>Monitoring Parameter</th>
<th>Performance Criteria</th>
<th>Status 3 Years Following Construction</th>
<th>Meeting Performance Criteria?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riparian Cover</td>
<td>Greater than 50% aerial coverage of desirable perennial plants, including seeded species and those colonizing from adjacent undisturbed habitats.</td>
<td>Desirable cover estimated at 55% (90% total cover - 35% weed cover).</td>
<td>Yes</td>
</tr>
<tr>
<td>Riparian Cover</td>
<td>Greater than 25% aerial coverage of woody riparian shrubs and/or trees.</td>
<td>Woody riparian species cover estimated at 30% of project area</td>
<td>Yes</td>
</tr>
<tr>
<td>Riparian Cover</td>
<td>Less than 10% aerial coverage of site has Montana noxious weeds.</td>
<td>Noxious weed cover is estimated at 35% of the project area.</td>
<td>No</td>
</tr>
<tr>
<td>Streambank Stability</td>
<td>Less than 25% of total bank length exhibiting signs of active erosion/cutting</td>
<td>Erosion inventory documented 0% of project reach exhibits active erosion/cutting</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5.1. Riparian Cover

Desirable perennial plants including riparian shrubs, trees, grasses, and forbs were estimated at 55% cover for the project site. This estimate was calculated by subtracting the sum of noxious weed cover (35%) and bare ground cover (10%) from 100. The monitoring criteria specify a minimum of 50% of the project reach must exhibit desirable vegetation coverage; therefore this performance criterion is currently being met.

Woody vegetation was estimated at 30% cover, which exceeds the 25% performance criteria. The majority of woody plants include shrubs and trees that existed prior to relocating the channel and volunteer species colonizing the site. Woody cuttings were planted along the left (north) bank, but have not successfully established due to inadequate installation.
Noxious weeds were estimated at 35% areal coverage of the project site, which does not meet the performance standard of less than 10% areal coverage. Three additional noxious weeds were observed in 2014 as compared to the 2013 monitoring event, bringing the total number of noxious weed species observed to eight. Identified noxious weeds include knotweed complex, broad-leaf pepperwort, spotted knapweed, Canadian thistle, field bindweed, gypsy-flower (houndstongue), oxeye daisy, and common tansy. Noxious weeds were observed along both banks of the project reach, and were primarily concentrated upstream of the Highway 93 Bridge.

5.2. Streambank Stability
No streambank erosion was noted along the reconstructed banks within the North Fork Bear Creek Stream Mitigation Site. Root wads placed along the north bank appear to be mostly stable, with upper bank scour observed adjacent to one of the root wads. No lateral bank retreat was observed, and as a result, no measures are currently warranted to improve bank stability within the project reach. Monitoring of the exposed root wad is recommended to determine if that bank segment becomes unstable following future high water events.

6.0 MANAGEMENT RECOMMENDATIONS
The following management recommendations were provided following the initial monitoring event in 2013; however, they remain relevant to ensuring the success of this and other mitigation sites in meeting performance standards.

6.1. Recommendations for installing woody cuttings
Successfully establishing woody vegetation from un-rooted cuttings requires the cuttings be installed to a depth that allows newly established roots to reach the low water table elevation. The North Fork of Bear Creek was dry during the 2013 site visit, indicating the low water table elevation in the North Fork of Bear Creek may actually be below the stream bed elevation during some years. The channel was flowing during the 2014 site visit.

Installing woody cuttings to this depth can be very challenging, especially when the native bank materials consist of alluvial cobbles and large gravels overlain with a thin layer of topsoil. Installing riparian cuttings to the proper depth through these materials requires using a either an excavator-mounted stinger or a hand-held stinger outfitted with pressurized water. Cuttings cannot be installed through alluvial cobbles properly with hand tools such as crow bars and hammers. Guidance for installing willow cuttings using excavator mounted stingers and water jet stingers is provided by the NRCS (NRCS 2007).

Monitoring observations revealed many of the cuttings were approximately 2-3” in diameter. Cutting survival and ease of installation may be improved by harvesting cuttings that are no more than 1” in diameter. It is highly recommended to harvest cuttings only while they are dormant, typically between October 15 and April 15. Following installation of un-rooted cuttings, exposed stems should be trimmed to allow
exposure of approximately 12" of the stem. This technique focuses the energy of the cutting toward establishing roots rather than leaves and stems, and improves long term survival rates.

Mortality rates of woody cuttings at the North Fork Bear Creek site may have been reduced if channel restoration details specified installing un-rooted cuttings to a depth below the lowest water table. Based on the poor survival rates encountered at this site, the alternative planting techniques described above, and the incorporation of more detailed planting specifications is recommended for future MDT projects involving bioengineered streambank stabilization projects.

6.2. Coir Fabric Installation
Channel restoration details specified placing coir erosion control netting along the reconstructed streambanks to protect the upper banks from erosion during high water events. Inspections revealed the leading edge of the coir fabric was exposed after being draped over the top of the bank and staked down with wood stakes. Design details called for backfilling 4.5 feet (1.5 meters) of the leading edge of the coir, followed by wrapping the remaining coir around the fill material to create an encapsulated soil lift. It appears the contractor did not follow this procedure, as evidenced by the installation of cuttings within one foot of the edge of the exposed fabric (Photos 1 and 2, Appendix B). As constructed, the coir fabric provides little protection from soil erosion along the top of the bank, particularly along the rootwads placed upstream of the bridge.
Downstream of the bridge, herbaceous vegetation has established through the coir, and is providing some degree of protection against soil losses along the upper bank.

6.3. Storm Water Erosion Control Materials
Several straw logs used for stormwater erosion control were used adjacent to the bridge abutments. Remnants of some straw logs remain, with plastic webbing observed along the stream banks next to the horse corral north of the stream channel. Plastic webbing used to reinforce straw logs and woven fabrics along stream banks typically do not photo-degrade and end up as trash caught in debris jams and may act as gill nets. Straw logs and coir fabrics made with biodegradable or photodegradable materials are recommended for erosion control of future projects adjacent to stream channels. The North Fork Bear Creek project was constructed prior to MDT updating BMP specifications for erosion and storm water control to indicate the use of biodegradable materials. In addition, permits issued by both Montana FWP and the U.S. Army Corps of Engineers include conditions requiring the use of biodegradable and photodegradable materials along streams and wetlands.

6.4. Weed Control
Monitoring events in both 2013 and 2014 documented relatively high occurrences of noxious weeds within the project site, resulting in an overall decline in the percent cover of desirable species. Implementation of a weed control plan at this project site would improve the likelihood of achieving the performance standards established for total vegetative cover of desirable species, and noxious weed cover. Noxious weeds were observed on both banks, and were primarily concentrated on the upstream side of the
Highway 93 Bridge. Locations of specific weed infestations are included on Figure 2 in Appendix A.

7.0 LITERATURE CITED


Websites

Appendix A

Project Site Map

MDT Stream Mitigation Monitoring
North Fork Bear Creek
Ravalli County, Montana
Figure 2

Legend

- Photo Points
- Centaurea stoebe
- Cirsium arvense
- Convolvulus arvensis
- Cynoglossum officinale
- Leucanthemum vulgare
- Polygonum sp.
- Tanacetum vulgare

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2014 Monitoring
NF Bear Creek

Date: 10/29/2014
X:/MDT_007/mains
Appendix B

Project Area Photos

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

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATES: 2013 and 2014 Monitoring Events

Photo Point 1.1—2013
Description: View of tributary/culvert entering from west. Compass: 270 (West)

Photo Point 1.1—2014
Description: View of tributary/culvert entering from west. Compass: 270 (West)

Photo Point 1.2—2013
Description: View of north streambank looking downstream. Compass: 45 (Northeast)

Photo Point 1.2—2014
Description: View of north streambank looking downstream. Compass: 45 (Northeast)

Photo Point 1.3—2013
Description: View of north streambank. Compass: 90 (East)

Photo Point 1.3—2014
Description: View of north streambank. Compass: 90 (East)
PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

Photo Point 1.4—2013
Description: View of dry channel looking upstream.
Compass: 230 (Southwest)

Photo Point 1.4—2014
Description: View of dry channel looking upstream.
Compass: 230 (Southwest)

Photo Point 2.1—2013
Description: View of root wads on north bank.
Compass: 225 (Southwest)

Photo Point 2.1—2014
Description: View upstream of root wads on north bank.
Compass: 225 (Southwest)

Photo Point 2.2—2013
Description: View across channel of south streambank.
Compass: 180 (South)

Photo Point 2.2—2014
Description: View across channel of south streambank.
Compass: 180 (South)
PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

Photo Point 2.3—2013
Description: View from north bank looking across channel. Compass: 135 (Southeast)

Photo Point 2.3—2014
Description: View from north bank looking across channel. Compass: 135 (Southeast)

Photo Point 3.1—2013
Description: View downstream from north bridge abutment. Compass: 90 (East)

Photo Point 3.1—2014
Description: View downstream from north bridge abutment. Compass: 90 (East)

Photo Point 3.2—2013
Description: View of south streambank from left abutment. Compass: 135 (Southeast)

Photo Point 3.2—2014
Description: View of south streambank from left abutment. Compass: 135 (Southeast)
PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

Photo Point 3.3—2013
Description: View across channel of south bank from north bridge abutment. Compass: 180 (South)

Photo Point 3.3—2014
Description: View across channel of south bank from north bridge abutment. Compass: 180 (South)

Photo Point 4.1—2013
Description: View from south bank looking upstream from downstream extent. Compass: 270 (West)

Photo Point 4.1—2014
Description: View from south bank looking upstream from downstream extent. Compass: 270 (West)

Photo Point 4.2—2013
Description: View of root wads on north bank downstream of bridge. Compass: 0 (North)

Photo Point 4.2—2014
Description: View of root wads on north bank downstream of bridge. Compass: 0 (North)
PHOTO INFORMATION
PROJECT NAME: North Fork Bear Creek Stream Mitigation Site
DATE: 2013 and 2014 Monitoring Events

Photo Point 4.3—2013
Description: View of north bank from downstream extent of project site. Compass: 68 (East-Northeast)

Photo Point 4.3—2014
Description: View of north bank from downstream extent of project site. Compass: 68 (East-Northeast)
PHOTO INFORMATION

PROJECT NAME: North Fork Bear Creek Stream Mitigation Site
DATE: 2014 Monitoring Event

Photo 1
Description: Root wads upstream of bridge.

Photo 2
Description: Root wad upstream of bridge showing scour.

Photo 3
Description: Underwater photo of large hole downstream of project site.

Photo 4
Description: Underwater photo of large hole downstream of project site.

Photo 5
Description: Large hole downstream of project site.
Appendix C

As Built Drawings and Design Schematics

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

<table>
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<th>Easting</th>
<th>Elev.</th>
<th>Description</th>
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<td>MT AL CAP</td>
</tr>
</tbody>
</table>

### Surveyor Notes:

1. This survey is based on found MDT aluminum caps stamped C2015 and C2025.
   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 C2015.

2. The coordinates shown hereon are based on Montana State Plane Grid.

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**As-Built Topographic Drawing of the North Fork of Bear Creek Channel**

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Legend:
- Root Ball

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**Notes on Drawing:**

- U.S. Hwy 93
- Erosion Mat
- Camera MD020
- Camera MD110