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# MONTANA DEPARTMENT OF TRANSPORTATION STREAM MITIGATION MONITORING REPORT

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*Clark Fork River  
Granite County, Montana*

*Project Completed: 2013  
Monitoring Report #5: December, 2017*



Prepared for:



Prepared by:



**MONTANA DEPARTMENT OF TRANSPORTATION**  
**STREAM MITIGATION MONITORING REPORT**  
**YEAR 2017**

*Clark Fork River*  
*Granite County, Montana*

Permit No.  
MFWP: SPA MDT R2-14-2012  
USACE: NWO-2012-00831-MTH

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Cover Photo: 2017 view of Clark Fork River with rip-rap and willow plantings looking east.

## **1.0 INTRODUCTION**

The following report presents the fifth year of monitoring results of a bank stabilization project on Interstate 90 along the Clark Fork River located approximately 24 miles west of Drummond, Montana. In 2013, the Montana Department of Transportation (MDT) requested authorization for placement of approximately 200 cubic yards of rip-rap along 150 linear feet of the Clark Fork River to protect Interstate 90 from bank erosion and encroachment upon the highway right-of-way. This report evaluates the monitoring results in comparison to project performance standards as required by the U.S. Army Corps of Engineers (USACE) in permit NWO-2012-00831-MTH.

The approved U.S. Army Corps 404 permit requires monitoring for three years post-construction, and outlines the following performance standards:

1. Minimum of 80 percent survival of plantings three years after planting.
2. Riprap must be covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark.

Additional reporting requirements include:

1. Annual report detailing the extent of revegetation efforts and survival rates of plantings.
2. Photographs of the site prior to, during, and immediately following construction, as well as for three years post-construction, must be a part of the monitoring reports.

Inspection of the site from 2013 through 2017 provides the opportunity to determine whether the project is meeting, or moving toward the intended performance targets. MDT has met the minimum requirement of performing three years of monitoring at this site; subsequent monitoring efforts will be at the discretion of MDT and the USACE based on the site's ability to meet performance standards.

## **2.0 SITE LOCATION**

The project site is located north of the westbound lane of Interstate 90 between mile posts 137 and 138, and is 24 miles west of Drummond, MT. The site lies within Section 24, Township 11 North, Range 15 West, Granite County, Montana (Latitude: 46.170007°N; Longitude: -113.4392°W) (Figure 1).

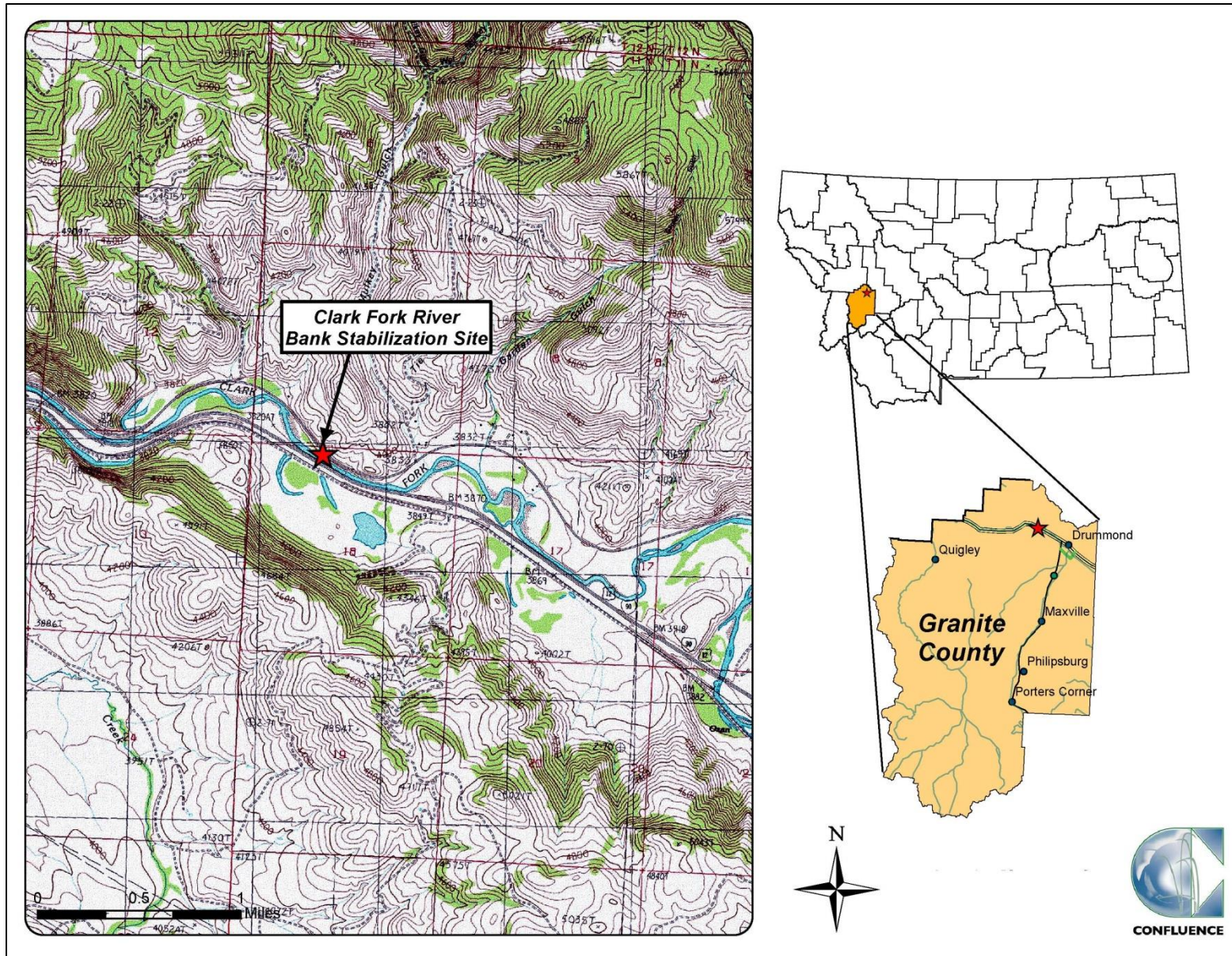


Figure 1. Project location of Clark Fork River bank stabilization site.

### **3.0 MONITORING METHODS**

The Army Corps permit issued in 2013 requires annual monitoring of the project site to detail the extent of revegetation efforts and survival rates of plantings. The project site was monitored for the fifth time on July 11, 2017. Monitoring inspections performed in 2017 included:

- Documenting overall stability of the bank by inspecting for voids within the rip-rap, shifting of the rip-rap, and erosion upstream and downstream of the rip-rap,
- Recording the number of live and dead willow stems observed beneath and above the rip-rap to determine survival rates of planted vegetation,
- Documenting vegetation establishment throughout the site by creating a list of all vegetation species observed and noting areas of poor vegetation establishment,
- Documenting the presence of all noxious and invasive species,
- Documenting site conditions by repeating photo points established in 2013 and taking additional photographs of other notable occurrences.

These methodologies have been repeated annually to allow for a comparison of the site's condition with the performance standards while meeting all other monitoring requirements as outlined in the Army Corps permit for the project.

### **4.0 MONITORING RESULTS**

#### **4.1. Bank Stability**

Inspection of the site between 2014 and 2016 indicated some loss of the smaller sized riprap along the bank, likely as a result of shear forces during spring runoff events. Some of the smaller sized rock placed along the bank had either sloughed further down the bank or been transported downstream, exposing several of the willow stems installed beneath the bank. No additional voids were observed in 2017. All larger sized rock has remained in place and the bank has not retreated southward toward the highway. Placement of additional rock to maintain lateral stability along the length of the stabilized bank does not appear warranted at this time.

Bank erosion was initially noted just upstream of the riprap in 2014 with approximately 4 feet of additional bank loss observed in 2016. Continued monitoring of this bank has indicated less than a foot of additional bank loss in the past year (See Photo 7 in Appendix A) and no additional exposed riprap along the keyway. At this time, no additional stabilization measures are warranted at the upstream end of the stabilized bank.

#### **4.2. Woody Planting Establishment**

Woody vegetation plantings installed during construction of the project included placement of willow cuttings above and beneath the rip-rap. Willow cuttings installed

beneath the rip-rap were placed vertically with the stems set in saturated substrate, then covered by a layer of soil and filter fabric. Rock was then placed on the fabric over the willow cuttings to secure the bank. This approach intended for willows to grow through the fabric and voids in the rip-rap, eventually establishing a vegetated bank. Additional willow cuttings were installed on the bank just above the rip-rap to serve as a buffer between the adjacent hill slope and the stabilized bank (see Photos 1, 4, 8, and 9 in Appendix A). The project did not include installation of containerized plants, although some *Cornus alba* (red osier dogwood) were also observed growing above the riprap. All red osier dogwood observed were considered volunteers and were not included in the planted woody vegetation inventory.

#### **4.2.1. Willow establishment above rip-rap**

Willows placed along the top of the rock were installed as vertical, unrooted sprigs. Willow sprigs along the eastern (upstream) 75 feet of the stabilized bank have shown limited survival and have developed into a sparse stand of shrubs spaced approximately 20-30 feet apart. The few willows that have survived along the eastern 75 feet of project reach since construction four years ago are maturing, have multiple stems, and have grown to a height of 6-8 feet. Along the western (downstream) 75' of the stabilized bank, many of the sprigs have successfully colonized and developed into a relatively tall stand of willows ranging from 5-10 feet in height. It is unclear what factors led to more successful willow generation of the sprigs installed along the downstream end of the project reach.

#### **4.2.2. Willow establishment from beneath rip-rap**

Observations of live willows growing from beneath the riprap indicated very limited survival following their installation in 2013. A total of 15 willow shoots were observed growing out of the rock layer in 2017, all of which occur along the western (downstream) half of the bank (see Additional Photo #2 in Appendix A). No sprigs have produced leafy stems along the eastern (upstream) half of the bank. Many dead willow sprigs were still visible within the rock voids, which did not appear to have adequate topsoil for roots to establish (see Additional Photo #1 on Page 5 of Appendix A). While the exact cause of high mortality rates is unknown, the low survivability of willows installed beneath the rip-rap could be due to long inundation periods during high flows, desiccation within the rip-rap voids, or not having enough soil contact with roots during the first growing season.

#### **4.2.3. Willow survival rates**

Planted willow cutting survival rates were determined by dividing the number of live willows observed by the total number of willows observed. Using this method, the success rate of willow establishment is 85% above the rip-rap, 38% beneath the rip-rap, and 63% overall (Table 1). If the number of surviving plants observed in 2017 is divided by the total number of plants inspected during the first monitoring event, the overall survival rate is 16% five years following completion of the project. Given the likelihood of dead willow stems desiccating or washing away, the latter method is a more accurate representation of the overall willow survival rate.

Although willow survival rates are lower than desired, those that survived have grown to between five and ten feet tall and have sprouted multiple stems. Growth of these willows over the past four years has generated approximately 10% cover of woody vegetation along the top of the stabilized bank. Cover by woody species is expected to increase as these willows mature over time.

**Table 1. Number of live and dead willow stems observed along the Clark Fork River bank stabilization site from 2013 through 2017.**

Year	Location	Plants Inspected	Surviving Plants	Plant Survival Rate
2013	Willows planted above riprap	345	260	75%
	Willows planted beneath riprap	0	0	N/A
	<b>Total - 2013</b>	<b>345</b>	<b>260</b>	<b>75%</b>
2014	Willows planted above riprap	275	275	100%
	Willows planted beneath riprap	52	2	4%
	<b>Total 2014</b>	<b>327</b>	<b>277</b>	<b>85%</b>
2015	Willows planted above riprap	101	67	66%
	Willows planted beneath riprap	50	11	22%
	<b>Total 2015</b>	<b>151</b>	<b>78</b>	<b>52%</b>
2016	Willows planted above riprap	81	50	62%
	Willows planted beneath riprap	76	16	21%
	<b>Total 2016</b>	<b>157</b>	<b>66</b>	<b>42%</b>
2017	Willows planted above riprap	47	40	85%
	Willows planted beneath riprap	40	15	38%
	<b>Total 2017</b>	<b>87</b>	<b>55</b>	<b>63%</b>

### 4.3. Vegetation Composition

Table 2 provides a comprehensive list of vegetation species identified at the Clark Fork River bank stabilization site. In 2017, 56 plant species were observed as compared to 54 species in 2016, 49 species in 2015, 35 species in 2014, and 14 species in 2013. Woody plants establishing above the rip-rapped bank included *Salix exigua* (narrow-leaf willow), *Salix drummondiana* (Drummond's willow) and red-osier dogwood. In general, the vegetation composition along the river bank comprises a majority of noxious and non-native weed species that commonly occur in heavily disturbed riparian areas.

Vegetation has continued to establish between the north edge of the highway and the stabilized bank (see Photos 5 and 12 in Appendix A). In 2017, *Polygonum cuspidatum* (Japanese knotweed) was identified for the first time, in addition to the five noxious weed species observed during the 2016 monitoring event (Table 3). All noxious weed species, with the exception of *Tanacetum vulgare* (common tansy), were identified in trace to low amounts, which is defined as infestations covering less than 1% and 1-5% of the inspected area, respectively. In the past year, the percent cover of common tansy has increased and was assigned a moderate cover class (6-25% of the inspected area). The visual estimates of percent cover provided for noxious weeds may have been influenced by a combination of factors, including, but not limited to, previous herbicide applications, differences in annual precipitation and temperature, calibration training completed by field staff, and other unknown factors that make it difficult to determine the exact cause(s) for increases or decreases in coverage.



**Table 2. Comprehensive list of plant species identified at the Clark Fork River site from 2013 through 2017.**

Scientific Name	Common Name	WMVC Indicator Status*	Scientific Name	Common Name	WMVC Indicator Status*
<i>Agropyron cristatum</i>	Crested Wheatgrass	NL	<i>Melilotus officinalis</i>	Yellow Sweet-Clover	FACU
<i>Agrostis stolonifera</i>	Spreading Bent	FAC	<i>Onopordum acanthium</i>	Scotch Thistle	NL
<i>Alopecurus arundinaceus</i>	Creeping Meadow-Foxtail	FAC	<i>Panicum capillare</i>	Common Panic Grass	FAC
<i>Bassia scoparia</i>	Mexican-Fireweed	FAC	<i>Pascopyrum smithii</i>	Western-Wheat Grass	FACU
<i>Bromus inermis</i>	Smooth Brome	UPL	<i>Persicaria amphibia</i>	Water Smartweed	OBL
<b><i>Bromus japonicus</i></b>	<b>Japanese Brome</b>	<b>NL</b>	<i>Phalaris arundinacea</i>	Reed Canary Grass	FACW
<i>Bromus tectorum</i>	Cheatgrass	NL	<i>Phleum pratense</i>	Common Timothy	FAC
<i>Chenopodium album</i>	Lamb's-Quarters	FACU	<i>Poa palustris</i>	Fowl Blue Grass	FAC
<i>Cirsium vulgare</i>	Bull Thistle	FACU	<i>Poa pratensis</i>	Kentucky Blue Grass	FAC
<i>Cirsium arvense</i>	Canadian Thistle	FAC	<i>Polygonum aviculare</i>	Yard Knotweed	FAC
<i>Cornus alba</i>	Red Osier	FACW	<b><i>Polygonum cuspidatum</i></b>	<b>Japanese Knotweed</b>	<b>NL</b>
<i>Dactylis glomerata</i>	Orchard Grass	FACU	<i>Populus angustifolia</i>	Narrow-Leaf Cottonwood	FACW
<i>Dasiphora fruticosa</i>	Golden-Hardhack	FAC	<i>Pseudoroegneria spicata</i>	Bluebunch Wheatgrass	NL
<i>Descurainia sophia</i>	Herb Sophia	NL	<i>Rumex crispus</i>	Curly Dock	FAC
<i>Elymus repens</i>	Creeping Wild Rye	FAC	<i>Salix drummondiana</i>	Drummond's Willow	FACW
<i>Elymus trachycaulus</i>	Slender Wild Rye	FAC	<i>Salix exigua</i>	Narrow-Leaf Willow	FACW
<i>Epilobium ciliatum</i>	Fringed Willowherb	FACW	<i>Salix lasiandra</i>	Pacific Willow	FACW
<i>Equisetum hyemale</i>	Tail Scouring-Rush	FACW	<i>Silene noctiflora</i>	Night-flowering Catchfly	NL
<i>Euphorbia esula</i>	Leafy Spurge	NL	<i>Sinapis arvensis</i>	Corn Mustard	NL
<i>Festuca idahoensis</i>	Bluebunch Fescue	FACU	<i>Sisymbrium altissimum</i>	Tall Hedge-Mustard	FACU
<i>Festuca ovina</i>	Sheep Fescue	UPL	<i>Sonchus arvensis</i>	Field Sow-Thistle	FACU
<i>Helianthus annuus</i>	Common Sunflower	FACU	<i>Symphoricarpos occidentalis</i>	Western Snowberry	FAC
<i>Hordeum jubatum</i>	Fox-Tail Barley	FAC	<i>Tanacetum vulgare</i>	Common Tansy	FACU
<i>Lactuca serriola</i>	Prickly Lettuce	FACU	<i>Thlaspi arvense</i>	Field Pennycress	UPL
<i>Lepidium campestre</i>	Field Pepper-Grass	NL	<i>Tragopogon dubius</i>	Meadow Goat's-beard	NL
<i>Lepidium perfoliatum</i>	Clasping Pepperwort	FACU	<i>Trifolium pratense</i>	Red Clover	FACU
<i>Leucanthemum vulgare</i>	Ox-Eye Daisy	FACU	<i>Trifolium repens</i>	White Clover	FAC
<i>Linaria dalmatica</i>	Dalmatian Toadflax	NL	<i>Verbascum thapsus</i>	Great Mullein	FACU

\*2016 National Wetland Plant List; Western Mountains, Valleys, and Coast Region (WMVC) (Lichvar *et al.* 2016)  
New species identified in 2017 are **bolded**.

**Table 3. Montana State listed noxious weed species observed in 2017 at the Clark Fork River bank stabilization site.**

Category*	Scientific Name	Common Name
Priority 1B	<i>Polygonum cuspidatum</i>	Japanese Knotweed
Priority 2B	<i>Cirsium arvense</i>	Canada Thistle
	<i>Euphorbia esula</i>	Leafy Spurge
	<i>Linaria dalmatica</i>	Dalmatian Toadflax
	<i>Leucanthemum vulgare</i>	Ox-Eye Daisy
	<i>Tanacetum vulgare</i>	Common Tansy

\*Based on the Montana Dept. of Agriculture's Noxious Weed List, February 2017

#### 4.4. Photo Documentation

Photographs were taken at the upstream and downstream extents, and several additional areas within the project area to document the bank protection measures and the extent and density of vegetation establishment along the riprap and within the project staging area adjacent to Interstate 90. Photographs taken in 2013 and 2017 are included in Appendix A.

## 5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Clark Fork River bank stabilization site is intended to document whether the project is meeting performance standards outlined in the permits issued for project construction. The fifth year of monitoring indicates one of two performance standards are being met five years post-construction (Table 4).

**Table 4. Performance results of Clark Fork bank stabilization project five years following construction.**

Parameter	Success Criteria	Status	Meeting Performance Criteria?
Woody planting survival	Minimum of 80% survival of plantings three years after planting.	<b>63%</b> of woody plantings (55 out of 87) observed in 2017 remain alive. As compared to number of plants observed in 2013, 16% (55 of 345) have survived	No
Construction detail	Riprap must be covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark.	Riprap has been covered with topsoil, seeded, and sprigged with willows above the ordinary high water mark	Yes

### 5.1. Woody Planting Survival

Based solely on the number of both live and dead plants observed in 2017, woody planting survival within the project reach is 63%. If the number of surviving plants is compared to the total number of plants observed in 2013, the planting survival rate is 16%. Based on either result, the target performance standard of 80% has not been met five years after completion of the project. Most of the surviving willows along the top and from within the riprap have established along the western end of the project reach. Although a greater number of willows have been observed sprouting from beneath the rip-rap each year, they continue to show poor survival rates, with approximately 38% of those observed having established leafy stems. Minimal establishment (<1% total cover) of volunteer species, including narrow-leaf cottonwood (*Populus angustifolia*) and red osier dogwood (*Cornus alba*), was observed along the top of the riprapped bank during the 2017 monitoring event.

Although willow survival rates are lower than desired, the bank has remained stable in areas where rock has been installed. Placement of additional willows within the revetment is possible with specialized equipment capable of penetrating through voids in large rock; however, this could also result in reducing the cohesion of the rip-rap protecting the bank and jeopardize the bank's stability. Although adding additional willows to the project could eventually result in added shade and cover along the bank, the added vegetative component of the project is not expected to increase the overall stability of the bank.

## 5.2. Construction Details

The area above the rip-rap has been reclaimed by seeding and sprigging woody cuttings through a layer of topsoil. This area exhibits woody and herbaceous establishment as indicated by maturation of surviving willows and forbs. Weed management efforts should reduce the potential for colonization by new species and spread of those currently inhabiting the site.

## 6.0 MONITORING SUMMARY

The I-90 Clark Fork River bank stabilization site has been monitored for five years following construction of the project in 2013. Overall, stabilization efforts along the project reach appear successful with some loss of the smaller sized fraction of rock materials along the bank. Previously documented erosion immediately upstream of the stabilized bank exposed some riprap installed at the upper end of the project reach, but this area does not appear to have become more exposed in the past year. If the bank continues to erode, placement of additional rip-rap may be recommended to maintain protection of the highway. If necessary, the extent of additional rip-rap installation should be evaluated based on anticipated erosive activity, flow direction, bar formation, existing bank materials, and vegetation composition.

Woody vegetation has established above the rock, particularly along the western half of the project reach. Willows along this area have grown up to ten feet high and are likely to continue growing as they mature. Woody vegetation placed beneath the rip-rap during construction has shown limited success, with approximately 15 sprigs having successfully sprouted stems that range from 1-2 feet long.

Although the site has not met the performance standard for woody survival, the justification of installing additional woody plantings within the rock revetment should be weighed against the potential for destabilizing the bank. Specialized willow planting equipment such as stingers exist that is capable of installing willow sprigs in previously placed rip-rap (NRCS 2007); however caution should be taken while using this type of equipment to prevent the destabilization of the rock layer. If this technique is implemented, a qualified contractor with experience installing plants in rip-rap is recommended.

## 7.0 LITERATURE CITED

- 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*. February 2017. Accessed August 2017 at:  
<http://agr.mt.gov/Portals/168/Documents/Weeds/2017%20Noxious%20Weed%20List.pdf>.

## **Appendix A**

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### Project Site Photos

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MDT Stream Mitigation Monitoring  
Clark Fork River  
Granite County, Montana

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**PHOTO INFORMATION**

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



2013



2017

**Photo 1:** View upstream looking at revetment.



2013



2017

**Photo 2:** Toe of revetment looking upstream.



2013



2017

**Photo 3:** Middle of revetment looking upstream.

**PHOTO INFORMATION**

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



2013



2017

Photo 4: Willow growth at top of revetment.



2013



2017

Photo 5: Highway embankment / access area.



2013



2017

Photo 6: Sandbar willow growth along upper bank.

**PHOTO INFORMATION**

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2016 Monitoring Events



**2013** **2017**  
**Photo 7:** Eroding streambank at upstream extent of stabilized bank



**2013** **2017**  
**Photo 8:** Middle of revetment looking downstream



**2013** **2017**  
**Photo 9:** Looking downstream at revetment from upstream extent of stabilization.

**PHOTO INFORMATION**

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: 2013 and 2017 Monitoring Events



**2013** **2017**  
**Photo 10: Upstream extent of riprapped stream bank.**



**2013** **2017**  
**Photo 11: Highway embankment adjacent to bank.**



**2013** **2017**  
**Photo 12: Looking downstream at revetment**



**PHOTO INFORMATION**

PROJECT NAME: Clark Fork Stream Mitigation Site

DATE: Additional 2017 Monitoring Photos



**Additional Photo 1**  
**Description: Willow growing in revetment**  
**Taken in 2017**



**Additional Photo 2**  
**Description: Dead willows in revetment**  
**Taken in 2017**