MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Spring Creek
Flathead County, Montana

Project Completed: 2010
Monitoring Report #2: December, 2014

Prepared for:

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MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #2

YEAR 2014

Spring Creek
Flathead County, Montana

MDT Project Number: NH-MT 5-3(59) 109
Control Number: 2038

USACE Permit: NWO-2009-01808-MTM

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December 2014

CCI Project No: MDT_.007

TABLE OF CONTENTS

TABLES AND FIGURES

APPENDICES

Cover Photo: Relocated segment of Spring Creek, 2014.

1.0 INTRODUCTION

As part of the construction of the Kalispell Bypass U.S. Highway 2 South, the Montana Department of Transportation (MDT) reconstructed a segment of Spring Creek upstream of the Ashley Creek Highway 93 North Bridge crossing on the west side of Kalispell, Montana. The following report presents results of the second year of post stream reconstruction monitoring and compares these results to performance standards outlined in the monitoring plan for the project. The Spring Creek channel relocation project was constructed in 2010; therefore, these results provide documentation of the site's condition four years following the project's completion.

The goal of the Spring Creek stream mitigation project is to provide compensatory mitigation for stream impacts associated with transportation projects including the Kalispell Bypass in the Missoula District. In order to accomplish this goal, the project's objective includes constructing 990 feet of new Spring Creek channel with the following design elements:

- Channel banks will generally be constructed with 0.5:1 side slopes
- Pool bottom widths generally 4 feet wide and top widths generally 7.5 feet wide
- Riffle bottom widths generally 5 feet wide and top widths generally 7.5 feet wide
- Floodplain width adjacent to the new stream channel to vary in width from 15.5 feet to 21 feet.
- Upland slopes varying from 2.2:1 to 6.5:1

These design elements were developed to create, enhance, restore, and maintain permanent, naturally self-sustaining, native, or native-like stream and riparian habitats along the newly constructed segment of Spring Creek. If successful, the project will 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 within the USACE permit include monitoring of the on and off-site stream mitigation areas for five years following channel construction to determine whether the site meets, or is trending toward a series of performance standards outlined in the mitigation plan for the site.

<u>Quantitative success criteria for the Spring Creek project:</u>

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 ≥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 indexes ≥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 an 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 success criteria for the Spring Creek project:

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 monitoring requirements include:

6. **Photo Documenting** the 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 second year monitoring of the Spring Creek project are summarized in Section 4 and compared to performance standards in Section 5. Section 6 provides management recommendations to maximize the potential for meeting all performance standards at this and other similar mitigation sites. Additional reporting requirements including a longitudinal stream profile, repeated survey results at four perpendicular transects, a planting schematic from the approved design, photo documentation of the project site, and maps indicating the endpoints of riparian belt transects, perpendicular transect surveys and locations of noxious weed infestations are included as Appendices to this report.

2.0 SITE LOCATION

The project reach includes approximately 990 feet of reconstructed Spring Creek channel east of the U.S. Highway 93 ALT corridor. The project site is located in Section 13, Township 7 North, Range 22 West, in Flathead County, Montana (Figure 1).

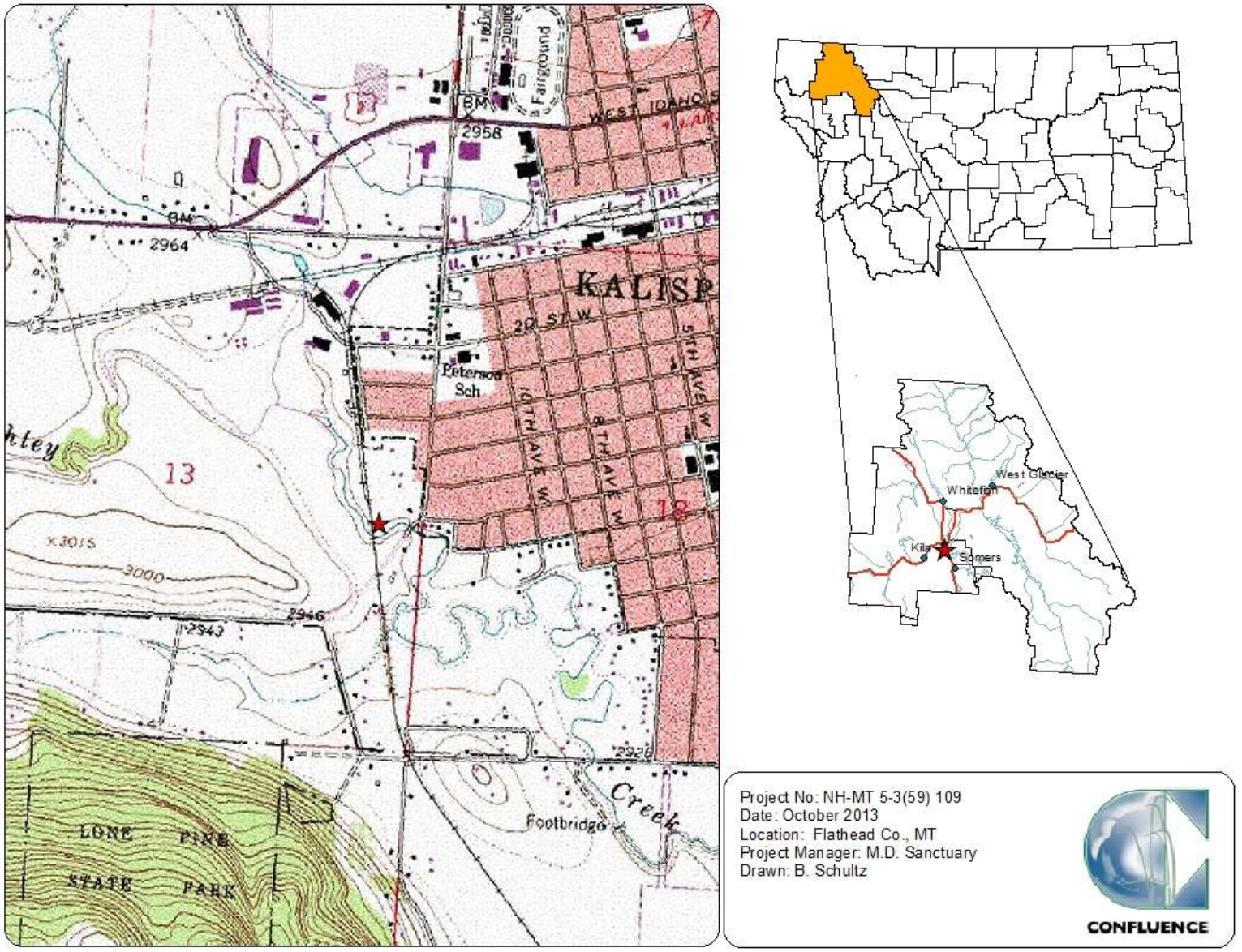

Figure 1. Project location of Spring Creek stream mitigation site.

3.0 MONITORING METHODS

Monitoring field crews visited the project site on August 19, 2014 while survey crews visited the site on July 30, 2014. The following data were collected at the Spring Creek stream mitigation site:

3.1. Vegetation Inventories and Community Mapping

Two riparian belt transects established during the first monitoring event in 2013 were re-surveyed to document areal percent cover of total vegetation, woody vegetation and noxious weeds. The riparian transect on the right (west) bank runs parallel to the channel for 223 feet, while the riparian transect on the left (east) bank is 296 feet long (Figure 3, Appendix A).

A vegetation inventory was conducted along both stream banks, and included documenting dominant species, percent cover of each species, and compiling a list of all species encountered within three feet of the active channel. The stream bank vegetation inventory included the entire 995-foot length of both banks (3 feet wide) within the project site. In 2013, plant species identified along the stream banks were assigned plant stability ratings based on Winward, 2000. In 2014, plant species identified along the stream banks were assigned plant stability ratings based on Burton *et al*., 2011. This change was made per MDT request to use updated values for plant stability ratings.

The project site was visually inspected to document the presence of noxious weeds. All noxious weed infestations were mapped on aerial photographs, with species noted. Observations of isolated noxious weeds were noted in the species lists, but not mapped.

The project area was visually inspected to document woody vegetation plantings. The inspection included recording the total number of live and dead woody plantings observed. Dominant vegetation communities within the project area were mapped on aerial photographs to document vegetative establishment within both upland and riparian zones.

3.2. Bank Erosion Inventory

Both stream banks within the project reach were visually inspected to document eroding banks. Each eroding bank within the project reach was photo-documented. Data collected at each eroding bank included bank length and potential causes of bank erosion.

3.3. Channel Surveys

Four perpendicular transects (cross sections) were surveyed by licensed survey crews; two at riffles and two at pools. Locations of pool and riffle cross sections were selected based on the Spring Creek planform design sheet, which indicated where riffle and pool habitats were to be constructed. Endpoints of each transect were marked with a pin, flagging, or stake for locating during subsequent monitoring events. Photo-

documentation of each transect included photos taken facing upstream, downstream, left, and right from the channel centerline. In addition to the perpendicular transects, a longitudinal profile of the channel thalweg was surveyed to document bedform complexity and aquatic habitat conditions.

3.4. Photo-Documentation

The project site was photographed from several locations to document vegetation establishment and stream bank conditions within the project site. Four locations for establishing permanent photo points were selected to document changes in the site over time. In addition, photos were taken at the endpoints and facing upstream, downstream, left and right from the center of the channel at each perpendicular transect. All permanent photo documentation sites were recorded on field maps with compass bearings noted to allow for repetition during subsequent monitoring years.

3.5. Wildlife Documentation

Wildlife use of the project reach was documented by creating a list of all bird, mammal, and herpetile species observed during the site visit. Wildlife species were identified through visual observation, scat, tracks, and observation of nests, burrows, dens, feathers, etc.

4.0 RESULTS

4.1. Riparian and Stream bank Vegetation Inventory

Table 1 summarizes percent cover of total vegetation, woody vegetation, and noxious weeds for each riparian and stream bank transect. Subtotals for the combined riparian and combined stream bank inventories are provided, as well as an area-weighted total for riparian and stream bank zones. No bare ground was observed within any of the vegetation transects. In 2014, the total riparian and stream bank cover was 100%, and included 41% herbaceous cover and 59% woody coverage. Noxious weed coverage increased by 2% in 2014 to 5% cover.

No bare ground was observed within the entire project reach, and both the riparian and stream bank transects exhibited a diversity of herbaceous and woody vegetation species. Noxious weeds were sporadically found along both banks of the inventoried transects. Additional information about weed species observed is included in Section 4.3.

Table 1. Percent cover of vegetation transects at Spring Creek in 2013 and 2014.

Belt Transect	Length (ft)	Total % Vegetation Cover		% Woody Cover		% Noxious Weed Cover	
		2013	2014	2013	2014	2013	2014
Right (West) Riparian	223	100%	100%	35%	35%	2%	5%
Left (East) Riparian	296	100%	100%	57%	60%	2%	4%
Riparian Subtotal		100%	100%	47%	49%	2%	4%
Right (West) Streambank	995	100%	100%	38%	60%	6%	6%
Left (East) Streambank	995	100%	100%	100%	100%	4%	4%
Streambank Subtotal		100%	100%	69%	80%	5%	5%
Area Weighted Total		100%	100%	54%	59%	3%	5%

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 4, Appendix A). The upper side slopes are dominated by wild rye (*Elymus spp.),* while the lower slopes and riparian zones are dominated by willows (*Salix spp.*), reed canary grass (*Phalaris arundinacea*), and sunflower (*Helianthus maximiliani*). A small patch of chokecherry (*Prunus virginiana*) and alder (*Alnus spp*) exists just north of the culvert outlet at the upstream extent of the project reach. As the planted shrubs mature and become larger over time, the corridor is expected to become more dominated by woody species.

Table 2 is a comprehensive list of vegetative species identified within the two belt transects, two stream bank transects, and other incidental plants observed on site. In 2014, 76 plant species were observed on site, an increase of 22 species from 2013. In 2014, 47% of the species observed on site were considered hydrophytic based on the National Wetland Plant List (NWPL) (Lichvar et al., 2014).

4.2. Stream Bank Vegetation Composition

In 2014, 39 plant species were observed along the stream banks, representing an increase by 11 species from 2013 (Table 3). Stability ratings were assigned to each species observed along the banks to help determine overall bank stability. Stability ratings (1-10 scale) indicate a plant's ability to resist erosive forces based on root characteristics (Winward 2000). Of the 39 species observed, 25 have stability indices provided by Burton et al., 2011, while the remaining 14 species do not. Scores for plants without stability indices are listed in Table 3 as N/A. Nine of the 25 species (36%) had stability indices of 6 or higher. The most prevalent species observed along the stream banks was reed canary grass (*Phalaris arundinacea*), which comprised >50% of the stream bank area and has an assigned stability index of 9. Three additional dominant species included pacific willow (*Salix lasiandra*), sandbar willow (*Salix exigua*), and Maximilian's sunflower (*Helianthus maximiliani*) covered a minimum of 40% of the stream banks and have stability indices of 7, 5, and N/A, respectively.

Table 2. Comprehensive vegetative species list for the Spring Creek stream mitigation site in 2013 and 2014.

Scientific Name	Common Name	WMVC Indicator Status*
Agropyron cristatum	Crested Wheatgrass	NL
Agrostis gigantea	Black Bent	FAC
Algae, green	Algae, green	NL
Alnus incana	Speckled Alder	FACW
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Alopecurus pratensis	Field Meadow-Foxtail	FAC
Artemisia biennis	Biennial Wormwood	FACW
Aster sp.	**Aster**	**NL**
Beckmannia syzigachne	American Slough Grass	OBL
Betula papyrifera	Paper Birch	FAC
Betula pumila	**Bog Birch**	**OBL**
Bromus inermis	Smooth Brome	FAC
Bromus tectorum	**Cheatgrass**	**NL**
Carduus nutans	Nodding Plumeless-Thistle	UPL
Carex stipata	**Stalk-Grain Sedge**	**OBL**
Centaurea stoebe	Spotted Knapweed	NL
Chenopodium album	Lamb's-Quarters	FACU
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Clematis occidentalis	**Purple Clematis**	**NL**
Convolvulus arvensis	Field Bindweed	NL
Cornus alba	Red Osier	FACW
Cynoglossum officinale	**Gypsy-Flower**	**FACU**
Deschampsia cespitosa	**Tufted Hairgrass**	**NL**
Descurainia sophia	**Herb Sophia**	**NL**
Elymus canadensis	Nodding Wild Rye	FAC
Elymus cinereus	**Great Basin Wildrye**	**NL**
Elymus hispidus	**Intermediate Wheatgrass**	**NL**
Elymus repens	Creeping Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Festuca idahoensis	**Bluebunch Fescue**	**FACU**
Glyceria grandis	American Manna Grass	OBL
Glyceria striata	Fowl Manna Grass	OBL
Helianthus maximiliani	Maximilian Sunflower	UPL
Helianthus nuttallii	Nuttall's Sunflower	FACW
Hordeum jubatum	**Fox-Tail Barley**	**FAC**
Lactuca serriola	**Prickly Lettuce**	**FACU**
Lemna minor	Common Duckweed	OBL
Linaria vulgaris	Butter-and-eggs	NL
Lupinus arbustus	Long-spur Lupine	NL
Lupinus sp.	**Lupine**	**NL**
Medicago lupulina	Black Medick	FACU
Medicago sativa	Alfalfa	UPL
Melilotus albus	**White Sweetclover**	**NL**
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	**American Wild Mint**	**FACW**
Nasturtium officinale	**Watercress**	**OBL**
Onopordum acanthium	Scotch Thistle	NL
Pascopyrum smithii	Western-Wheat Grass	FACU
Persicaria amphibia	**Water Smartweed**	**OBL**
Persicaria sp.	**Smartweed**	**NL**
Phalaris arundinacea	Reed Canary Grass	FACW
Pinus ponderosa	Ponderosa Pine	FACU
Plantago major	**Great Plantain**	**FAC**
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Prunus virginiana	Choke Cherry	FACU
Pseudotsuga menziesii	Douglas-Fir	FACU
Rosa woodsii	Woods' Rose	FACU
Rumex crispus	Curly Dock	FAC
Salix bebbiana	Gray Willow	FACW
Salix drummondiana	**Drummond's Willow**	**FACW**
Salix exigua	Narrow-Leaf Willow	FACW
Salix lasiandra	Pacific Willow	FACW
Shepherdia argentea	Silver Buffalo-Berry	FACU
Silene vulgaris	Maiden's-tears	NL
Sonchus arvensis	Field Sow-Thistle	FACU
Symphoricarpos albus	Common Snowberry	FACU
Tanacetum vulgare	Common Tansy	FACU
Thlaspi arvense	**Field Pennycress**	**UPL**
Tragopogon dubius	**Meadow Goat's-beard**	**NL**
Trifolium repens	White Clover	FAC
Urtica dioica	Stinging Nettle	FAC
Verbascum thapsus	Great Mullein	FACU
Vicia americana	American Purple Vetch	FAC

*Based on 2014 NWPL (Lichvar *et al*., 2014)
New species identified in 2014 are **bolded**.

Table 3. Comprehensive list of plant species and accompanying stability index values found along Spring Creek in 2014 (stability score from Burton *et al*., 2011).

Streambank Species	Left bank	Right bank	WMVC Indicator Status**	Stability Index
*Phalaris arundinacea**	X	X	FACW	9
Betula papyrifera		X	OBL	8.5
Carex stipata	X		OBL	8.5
Salix drummondiana	X	X	FACW	8.5
Cornus alba	X	X	FACW	8
Alnus incana	X	X	FACW	7
*Salix lasiandra**	X	X	FACW	7
Alopecurus arundinaceus	X		FAC	6
Alopecurus pratensis		X	FAC	6
Deschampsia caespitosa	X	X	FACW	5
Glyceria striata	X	X	OBL	5
Pascopyrum smithii	X	X	FACU	5
Plantago major		X	FAC	5
Rosa woodsii	X	X	FACU	5
*Salix exigua**		X	FACW	5
Vicia americana	X	X	FAC	5
Bromus inermis		X	FAC	2
Cirsium arvense	X	X	FAC	2
Epilobium ciliatum	X	X	FACW	2
Hordeum jubatum	X		FAC	2
Mentha arvensis	X		FACW	2
Nasturtium officinale	X		OBL	2
Onopordum acanthium	X	X	NL	2
Poa palustris	X	X	FAC	2
Rumex crispus	X	X	FAC	2
Beckmannia syzigachne	X		OBL	N/A
Carduus nutans		X	UPL	N/A
Convolvulus arvensis		X	NL	N/A
Descurainia sophia		X	NL	N/A
*Helianthus maximiliani**	X	X	UPL	N/A
Lactuca serriola		X	FACU	N/A
Linaria vulgaris		X	NL	N/A
Medicago sativa	X		UPL	N/A
Persicaria amphibia	X		OBL	N/A
Persicaria sp.	X		NL	N/A
Prunus virginiana	X		FACU	N/A
Tanacetum vulgare	X		FACU	N/A
Tragopogon dubius	X		NL	N/A

*Dominant vegetation along Spring Creek banks
**Based on 2014 NWPL (Lichvar *et al*., 2014)

4.3. Noxious Weed Inventory

The Spring Creek field assessment identified the presence of six Montana state-listed noxious weeds and one state-regulated species (Table 4). Locations of all noxious weed species observed are shown on Figure 4 in Appendix A. As noted in Section 4.1, the percent cover of the site exhibiting weeds was 5%, and represents all weed species combined.

Table 4. Montana State listed noxious weed and regulated species observed in 2014 at the Spring Creek Stream Mitigation Site.

Category*	Scientific Name	Common Name
Priority 2B	*Centaurea stoebe*	Spotted Knapweed
	Cirsium arvense	Canadian Thistle
	Convolvulus arvensis	Field Bindweed
	Cynoglossum officinale	Gypsy-Flower
	Linaria vulgaris	Butter-and-eggs
	Tanacetum vulgare	Common Tansy
Priority 3 State Regulated	*Bromus tectorum*	Cheatgrass

*Based on the MSU Extenstion Services' Noxious Weed List, 2013

4.4. Woody Plant Survival

Pacific willow, gray willow, coyote willow, black cottonwood, alder, snowberry, red osier dogwood, buffalo-berry, birch, and Wood's rose were observed throughout the site as planted woody vegetation species. Table 5 indicates the total number of plants inspected and the number of those surviving. Due to their relatively small size, the planted woody shrubs were difficult to find beneath the extremely dense stands of sunflower along both stream banks. Many additional shrubs likely exist along the planted corridor than are reported. Overall, 5% of the observed shrubs did not survive.

Table 5. Woody plant survival at the Spring Creek stream mitigation site in 2013 and 2014.

Year	Total Plants Inspected	Surviving Plants	Plant Survival Percentage
2013	600	596	99%
2014	377	360	95%

4.5. Bank Erosion Inventory

No eroding stream banks were observed at the Spring Creek stream mitigation site. All banks were well vegetated with no signs of bank sloughing or instability.

4.6. Channel Form

The formation of pool and riffle habitats within the project reach may be analyzed from the results of perpendicular transect and longitudinal profile surveys of the channel bed (Appendix B). The longitudinal profile along the thalweg of the channel indicates the

presence of nine pools varying in depth from 0.5 to 1.25 feet deeper than the riffles separating them. Design plans (Appendix D, Design Sheet 55 and 56) call for nine pools along the channel profile excavated 1.0 feet deeper than riffles. The longitudinal profile surveyed along the project reach verifies the channel displays a variety of riffle and pool habitats throughout its length.

Transect surveys were conducted at four locations including two pool and two riffle habitats as designated on the design plans. Maximum depth and bankfull widths for each transect are shown in Table 6, and survey results are illustrated in Appendix B. These results indicate the average pool depth is approximately 1.0 feet deeper than the average riffle depth at the surveyed transects. The relatively low variability in channel depth may be attributed to the planform geometry of the channel, which exhibits low sinuosity and very gently arced meander bends. The high radius of curvatures along designated pool sections likely will not generate deep pools, although based on the survey results, are creating slightly deeper and slower water habitat than in riffles.

Table 6. Spring Creek maximum depths and bankfull widths in 2013 and 2014.

Transect	Type	Max Depth (ft)		Bankfull Width (ft)	
		2013	2014	2013	2014
1	Pool	3.1	3.5	8.8	10.6
2	Riffle	2.6	2.2	9.1	10.8
3	Pool	2.5	2.7	9.1	8.6
4	Riffle	2.1	2.1	6.3	5.6
Average Riffles		2.4	2.1	7.7	8.2
Average Pools		2.8	3.1	9.0	9.6

The spring creek and urban runoff hydrology of this channel are also unlikely to generate deep pools over time. The hydrologic factors at play in Spring Creek generally do not result in flashy or snowmelt driven runoff events. As a result, natural development of deep pool features is unlikely to occur within the reconstructed section of Spring Creek.

Maximum depth surveyed at both riffles and pools in 2014 fell below the design depth of 2.7 and 3.7 feet, respectively, although the shallower pool depths have been affected by the location of the transects not occurring at the deepest part of the pool. Surveyed bankfull widths at both riffles and pools indicated a slightly wider channel than the 7.5 feet targeted in the design, although the channel does not appear to be actively widening.

4.7. Wildlife Documentation

Table 7 provides a comprehensive list of wildlife observed at the Spring Creek stream mitigation site. Species observed on site in 2014 included American robin, mallards, Ring-necked pheasant, and Sparrow spp. The low number of species observed may be

attributed to the relatively close proximity to the adjacent highway, human/dog use of the adjacent bike path, and lack of mature tree and shrub cover habitat.

Table 7. Wildlife species observed at the Spring Creek stream mitigation site in 2013 and 2014.

Common Name	Scientific Name
Birds	
American Robin	***Turdus migratorius***
Mallard	***Anas platyrhynchos***
Common Raven	*Corvus corax*
Ring-necked Pheasant	***Phasianus colchicus***
Song Sparrow	*Melospiza melodia*
Sparrow Sp.	***Passer sp.***
Mammals	
White-tailed Deer	*Odocoileus virginianus*

Species observed in 2014 are **bolded.**

5.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Spring Creek stream mitigation site is intended to document whether the reconstructed segment of the channel is meeting, or moving toward the performance standards outlined in the monitoring plan. The second year of monitoring suggests all six quantitative performance standards are being met four years after the project has been constructed (Table 8). Channel form success is considered a qualitative criterion, and is discussed in more detail in the following section. Additional reporting requirements including photo documentation of the project site, channel construction details, and a planting schematic have been included as appendices to this annual monitoring report.

5.1. Riparian Buffer Success

The project reach exhibits vigorous vegetation establishment within the designated riparian areas with no bare ground observed. The densely vegetated riparian zones were well established by a variety of woody and herbaceous species, and a total of 76 species were identified within the mitigation area. Overall, the project area has 95% cover by desirable, non-weed species. Approximately 5% of the area has been colonized by a variety of noxious weeds, which are identified in Section 4.3.

5.2. Vegetation Success

The combined, area-weighted percent cover of the riparian and stream banks within the project area was measured at 100%, as no bare ground was observed. The riparian areas and stream banks exhibited dense vegetative growth with a variety of shrubs, forbs, and herbaceous vegetation, indicating establishment exceeding the 70% coverage criteria.

Table 8. Monitoring results as compared to performance criteria for the Spring Creek mitigation site in 2014.

Type	Parameter	Performance Standard	Status	Site Meeting Performance Standard?
Quantitative 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	**95%** of riparian zones have revegetated with non-noxious species	**YES**
		1b. Noxious weeds do not exceed 10% cover within the riparian buffer areas.	**5%** of the project area exhibits noxious weeds	**YES**
	Vegetation Success	2a. Combined aerial cover of riparian and stream bank vegetation communities is at least 70%	Combined riparian and streambank vegetation cover is **100%**	**YES**
		2b. Planted trees and shrubs must exhibit 50% survival after 5 years	Planted shrub surveyes indicate **95%** of shrub survival*	**YES**
	Vegetation along Streambanks	3. Majority of plants on the river bank must have root stability indexes of at least 6	Dominant species present on stream banks has plant stability index of 9.	**YES**
	Streambank Stability Success	4. Less than 25% of bank length is unstable and classified as eroding bank.	**0%** of the banks within the project reach 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.	See Channel Form Narrative in Section 5.5	**YES**

* Performance criteria has been met four years following construction. Additional monitoring is required to meet 5-year survival standard

Woody vegetation plantings indicated a survival rate of 95% four years following construction. The performance criteria states 50% of the woody plants installed must survive five years following construction; therefore, additional monitoring is necessary to meet this criterion. Woody plants remain relatively small but should provide increased percent cover of the site as they mature. Extremely dense vegetation growth within the riparian corridor made locating woody plantings difficult; however very few dead woody plantings were observed throughout the project site.

5.3. Vegetation along Stream Banks

The most prevalent species observed along the banks was reed canary grass, which was observed growing along >50% of the stream banks. This species has a stability index of 9, and provides excellent resistance to bank erosion. Secondary dominant species included Pacific and sandbar willow. Combined, these species covered approximately 40% of the stream banks, and have root stability indices of 7 and 5 respectively.

Stream bank vegetation inventories along Spring Creek indicated 36% of the species having assigned root stability indices scored ≥6 (9 of 25). In 2013, 80% of the species having assigned root stability indices scored ≥6 (12 of 15). The disparity between these numbers is partially due to a new plant stability index used for the 2014 monitoring event (Burton et al., 2011). Four of the species identified on the stream banks (*Rosa woodsii, Salix exigua, Cirsium arvense, and Poa palustris*) have stability scores below 6 using the Burton scoring table; whereas, these plants had stability ratings ≥6 using the Winward scoring index. In addition, several new species occupying a relatively minor percent of the overall bank cover were observed in 2014 which have stability indices below 6.

Given the dominant species present along the banks of Spring Creek exhibit high scores using either of the stability indices, the performance criteria for vegetation along the stream banks is currently being met.

5.4. Stream bank Stability Success

The stream bank inventory did not identify any stream segments with eroding or unstable banks. All banks were very well vegetated with many willow cuttings within five feet of the channel providing additional bank protection. As a result, the performance criterion for stream bank stability is currently being met.

5.5. Channel Form Success

The reconstructed segment of Spring Creek appears to have stabilized following construction, as evidenced by a dense stand of riparian and stream bank vegetation, and lack of lateral or vertical erosion. No vertical head cuts or bank erosion was evident, and the channel does not appear to have migrated following construction.

The Spring Creek channel was designed to convey a capacity equivalent to the estimated 2-year discharge using regional regression equations. The estimated 2 year discharge is 50 cfs (MDT 2010). Discharges above 50 cfs are allowed to escape the

main channel and spread across the adjacent floodplain. The Spring Creek floodplain includes a 17.5-foot wide corridor with side slopes of 10% graded toward the channel.

Previous sections of this monitoring report provide data regarding the establishment of dense riparian and wetland vegetation along the stream banks and riparian zones adjacent to the reconstructed segment of Spring Creek. The stream banks have grown in with woody and herbaceous species that will provide additional habitat features in the form of woody debris and potentially undercut banks as vegetation continues to mature and coir rolls eventually decay.

The longitudinal profile surveyed along the length of the reconstructed channel indicates some degree of habitat variability, with a series of shallow pools providing an additional 0.5 to 1.25 feet of depth as compared to riffles. Nine pools can be identified on the profile, which corresponds to the number of pools proposed on the design plans. Riffle and pool transect re-surveys indicate pools are slightly deeper than riffles. The gently meandering planform and spring driven hydrology of this system likely will not generate particularly deep pools over time. However, surveys through pool habitats indicate some degree of habitat variability exists within the reconstructed channel segment.

The existence of riffles, shallow pools, and a dense riparian overstory provide relatively good habitat for fish that may migrate from Ashley Creek into Spring Creek. Although Spring Creek does not provide an abundance of slow, deep water habitat, the water depth (>1 foot) and velocities (<3 feet/second) observed during the monitoring visits may be suitable for spawning fish. Substrate composition was not documented as part of the monitoring at this site, but if small gravels are present, this reach of Spring Creek could be utilized for spawning fish. It should be noted the existing channel planform and habitat elements are a vast improvement from the former condition of the channel, which was highly incised and channelized, with banks consisting of discarded wood chips from the adjacent mill operation.

The combined results of channel form indicate the reconstructed segment of Spring Creek is stable and provides floodplain access during flood discharges greater than the estimated 2-year flood event discharge of 50 cfs. Evidence of pool and riffle habitats is provided by repeat surveys at pool and riffle transects, as well as the longitudinal profile through the project reach. Channel surveys indicate a constructed channel length of 986 feet.

The combination of quantitative and qualitative monitoring results from 2013 and 2014 suggests the Spring Creek mitigation site is successfully meeting its objective of constructing 990 feet of new channel that creates, enhances, restores, and maintains permanent, naturally self-sustaining, native, or native-like stream and riparian habitats. As a result, four years following the project's construction, the site is achieving its intended goal of providing compensatory mitigation for stream impacts associated with transportation projects including the Kalispell Bypass in the Missoula District.

6.0 MANAGEMENT AND DESIGN RECOMMENDATIONS

6.1. Riparian and Floodplain Zones

The reconstructed channel segment is designed with upland side slopes that transition to a narrow, 17.5-foot wide floodplain bench. Perpendicular transect survey results (Appendix B) illustrate floodplain slopes down to the channel which reduces the area available for overbank flooding to a narrow zone adjacent to the channel. This design configuration results in a relatively limited riparian/floodplain zone approximately three times wider than the active channel. Integrating a slightly steeper upland side slope design would provide for a wider, more functional floodplain and riparian zone by allowing the stream to access a larger, flat floodplain adjacent to the active channel (Figure 2). Constructing steeper side slopes and a wider floodplain area requires additional excavation; therefore a cost/benefit analysis of creating additional floodplain and wetland features, and the associated mitigation credits, is potentially worth consideration for future stream and riparian mitigation designs.

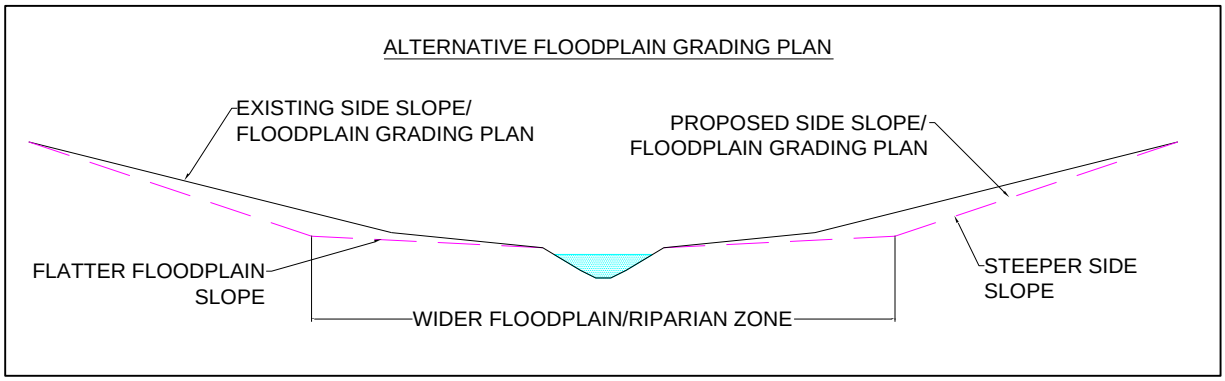

Figure 2. Alternative grading plan to increase floodplain and riparian areas.

6.2. Willow Cutting and Riparian Plug Establishment

The hydrology of Spring Creek is influenced by urban runoff, creating a difficult scenario for predicting typical discharges. During the site visit, Spring Creek was running nearly to the top of its banks, a notable level given the timing of the monitoring event (late August) and the lack of recent precipitation. Design plans called for installing willow cuttings and riparian plugs within the newly constructed stream banks. No willow stems were observed sprouting from within the coir logs and few sedges were observed growing on the inside bends of the pool features, although these features were under water during the site visit. Willow cuttings were very successful establishing just outside of the active channel along the graded floodplain. It is possible the willow cuttings and wetland plugs installed within the active channel did not survive due to long periods of inundation in these planting areas. Verification of vegetation survival in these areas could be conducted when the channel has less water and the banks are more exposed. Overall vegetative growth immediately adjacent to the channel provides excellent protection from bank scour and erosion, and planting techniques employed on this project should be considered for future, similar stream reconstruction plans.

6.3. Channel Planform

The Spring Creek channel planform exhibits a very gently meandering pattern within a relatively narrow floodplain corridor. Channel planform design elements often include a comparison of meander radius of curvatures to bankfull width ratios (Rc/W). Gently meandering streams exhibit high Rc/W ratios, while streams with high sinuosity and sharp bends exhibit low Rc/W ratios. Lower Rc/W ratios generally result in pronounced, deeper scour pools on the outside of meander bends, while higher Rc/W ratios typically result in more planar bed profiles with shallow and infrequent pools.

The Spring Creek design plans indicate meander radii ranging between 20 and 30 meters (66-98 feet), and a riffle bankfull top width of 2.0 meters (6.5 feet). These design parameters generate Rc/W ratios ranging from 10.1 to 15.0, which are considered high for meandering streams. Given the meander radii proposed in the channel planform design as compared to the bankfull width, pool features probably will not result following flood events. Additional habitat complexity elements could be generated in future projects by designing for lower Rc/W ratios, increased sinuosity, and wider floodplain corridors. It is acknowledged that each of these habitat improvement elements requires additional excavation (costs) to the overall project; therefore, a cost/benefit analysis is warranted prior to implementing such design considerations. It is also acknowledged that the design channel planform geometry of this segment of Spring Creek is vastly improved from the historic condition of the channel prior to channel reconstruction.

7.0 LITERATURE CITED

Burton, T.A., S.J. Smith, and E.R. Cowley. 2011. Riparian area management: Multiple indicator monitoring (MIM) of stream channels and streamside vegetation. Technical Reference 1737-23.BLM/OC/ST-10/003+1737. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. 155 pp.

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Montana Department of Transportation, 2010. Kalispell Bypass MDT Project #NH-MT 5-3(59)109 FST, CN 2038 On-Site Stream Mitigation Plan, Flathead County, Montana.

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
Spring Creek
Flathead County, Montana

CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Riparian and Perpendicular Transect Endpoints
- Riparian Transects
- Pool and Riffle Transects
- Channel Thalweg
- Major Station (100')
- Minor Station (25')

2014 Monitoring
Spring Creek

Figure 3

Date: 09/09/2014

X:/MDT_.007/mains

CONFLUENCE
consulting incorporated

Legend

- Project Boundary
- Vegetation Community Boundary
- Cirsium arvense
- Convolvulus arvensis
- Cynoglossum officinale
- Linaria vulgaris
- Tanacetum vulgare
- Centaurea stoebe
- 1 Elymus Community
- 2 Salix/Helianthus Community
- 3 Salix/Phalaris Community
- 4 Prunus/Alnus Community

2014 Monitoring
Spring Creek

Figure 4

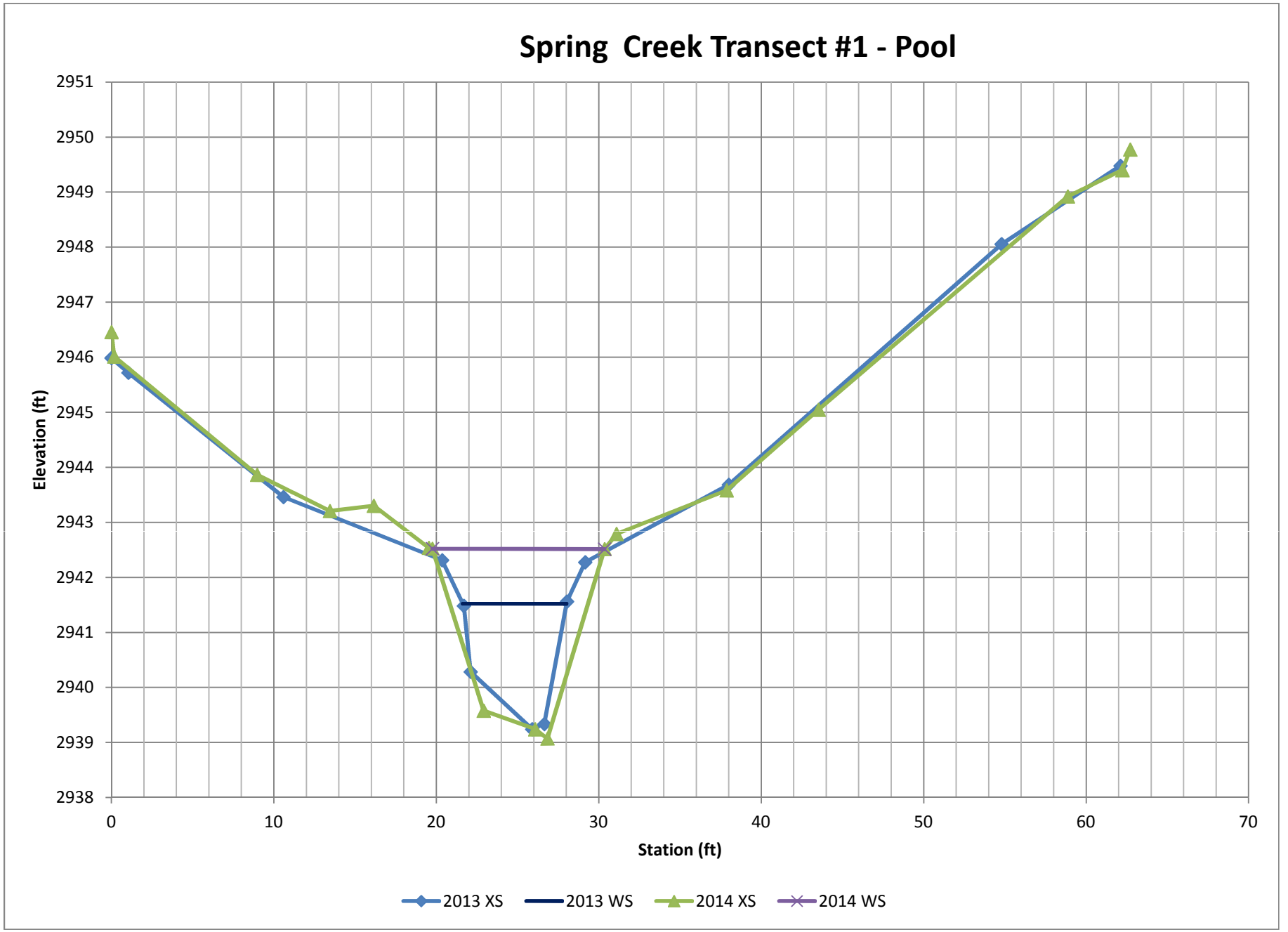
Date: 09/22/2014

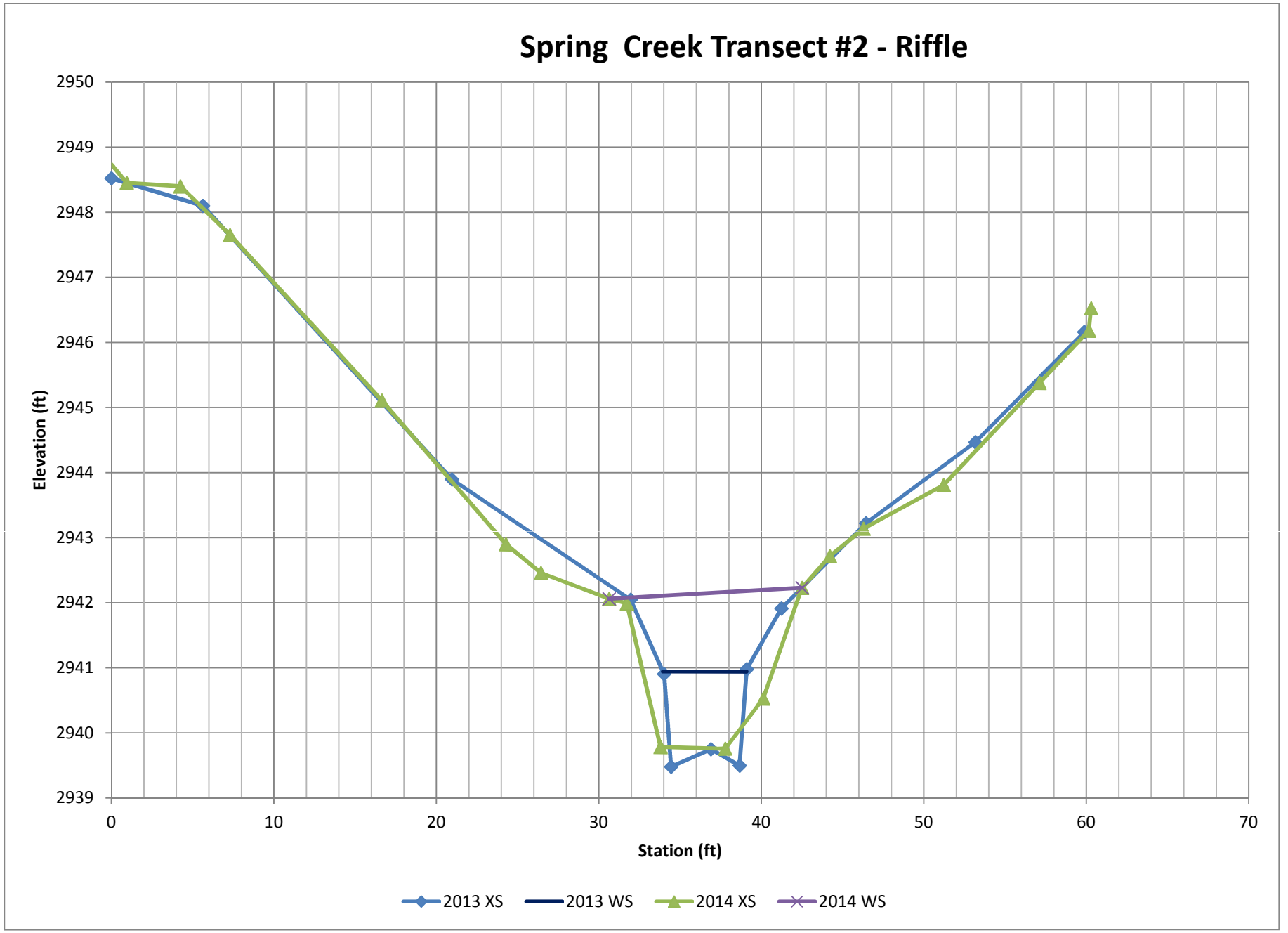
X:/MDT_.007/mains

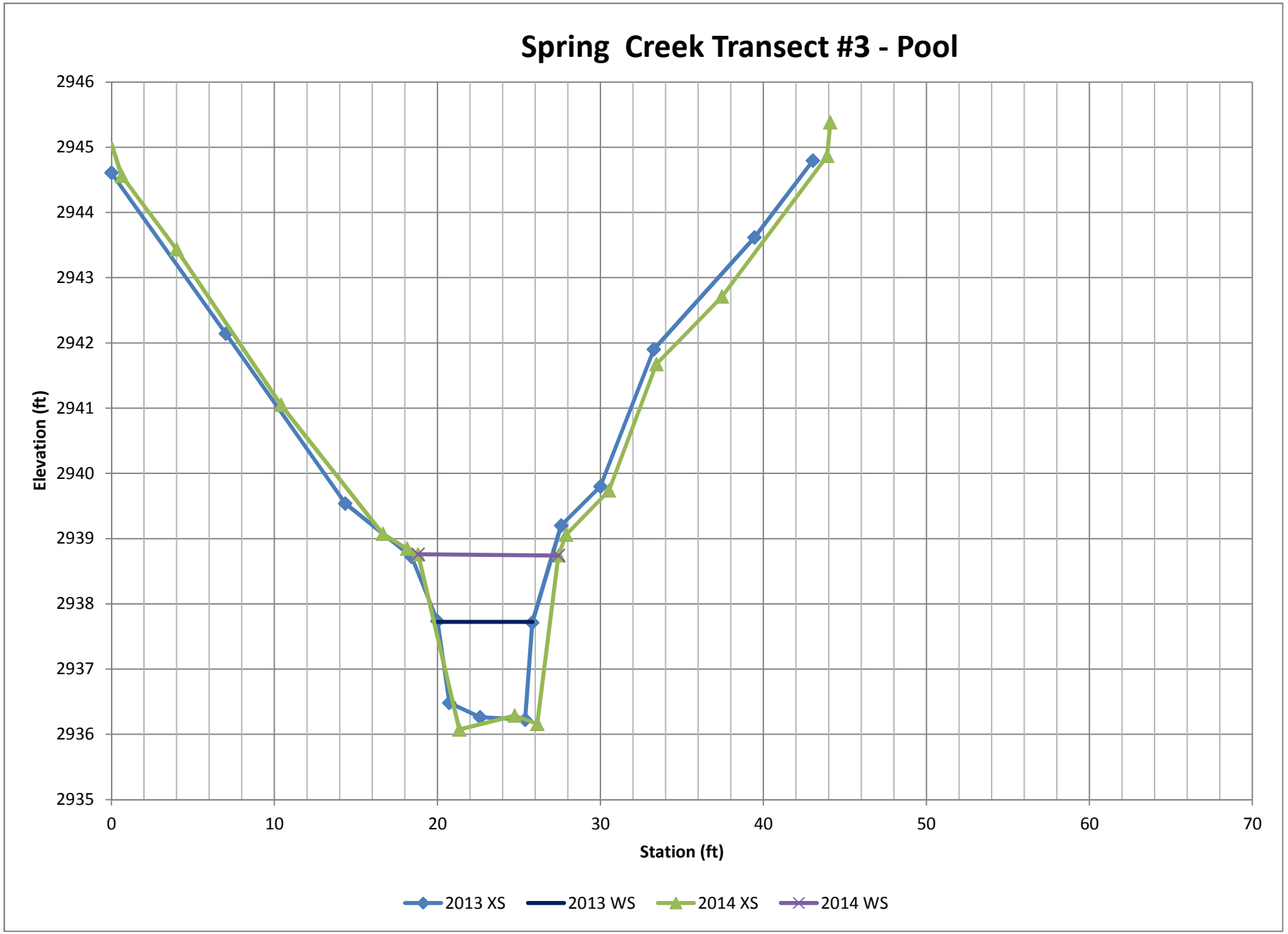
Appendix B

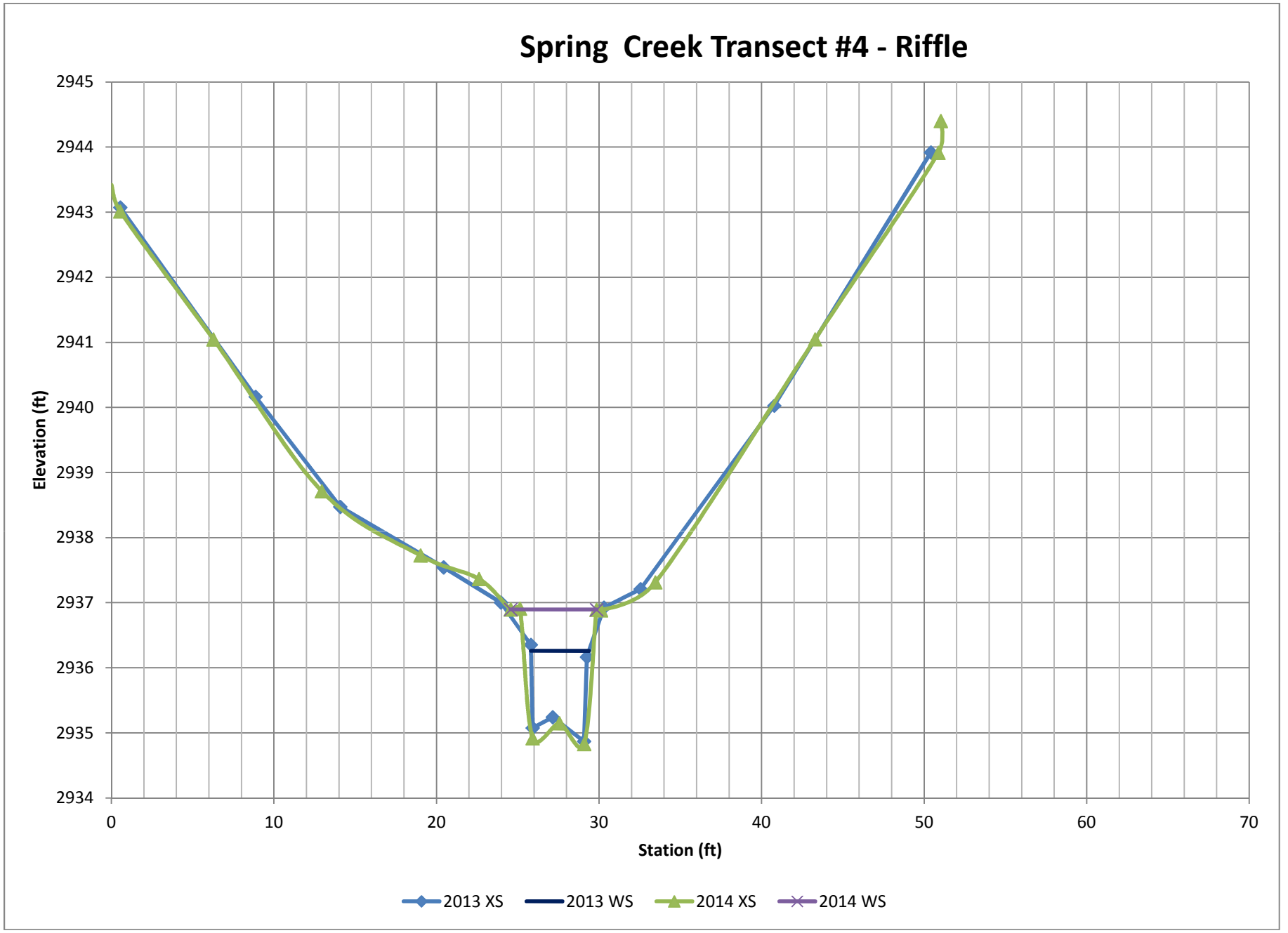
Perpendicular Transect Plots and Longitudinal Profile

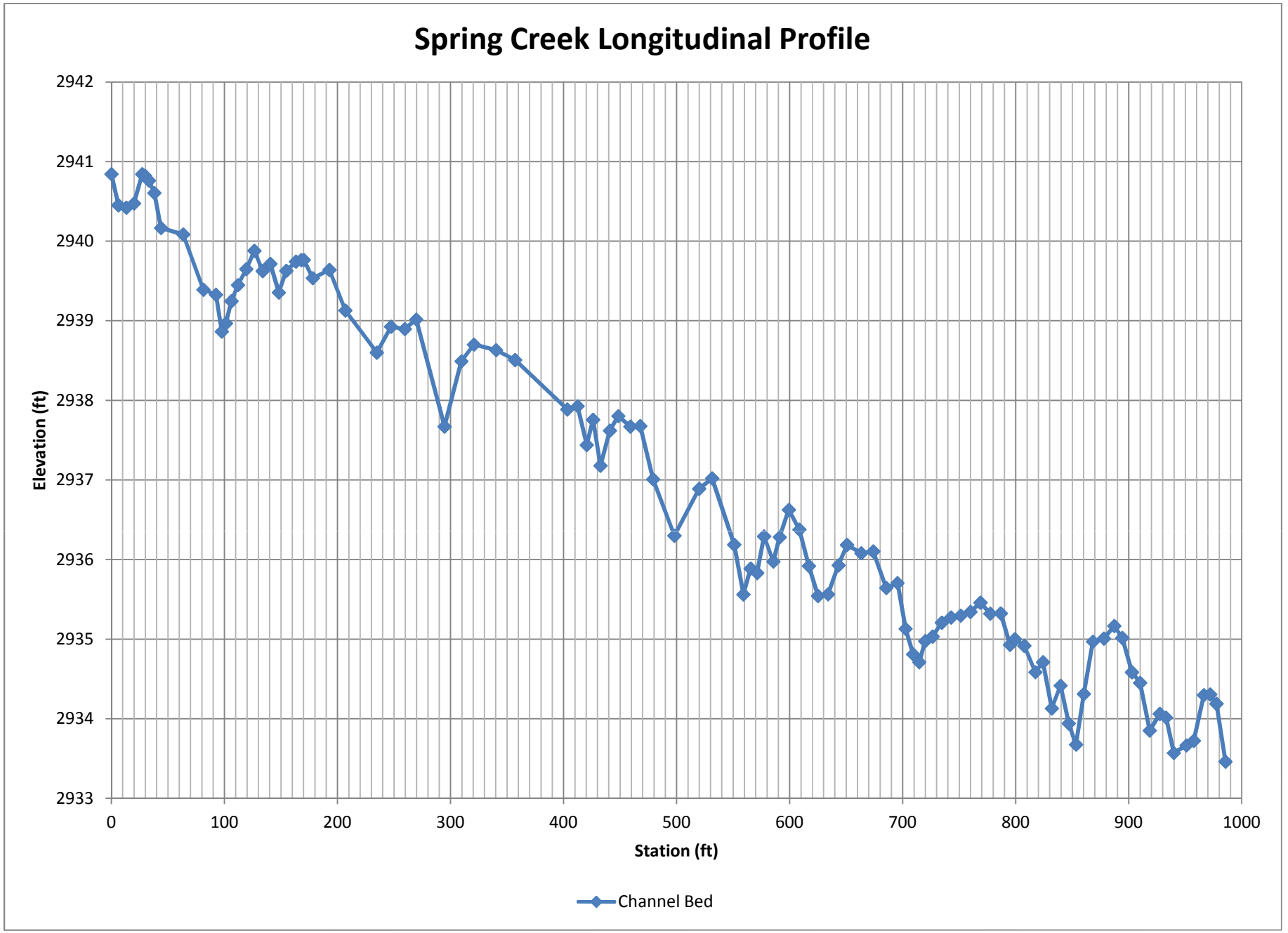
MDT Stream Mitigation Monitoring
Spring Creek
Flathead County, Montana


Spring Creek Transect #1 - Pool
Elevation (ft)
2951
2950
2949
2948
2947
2946
2945
2944
2943
2942
2941
2940
2939
2938
0
10
20
30
40
50
60
70
Station (ft)
2013 XS
2013 WS
2014 XS
2014 WS


Spring Creek Transect #2 - Riffle
Elevation (ft)
2950
2949
2948
2947
2946
2945
2944
2943
2942
2941
2940
2939
0
10
20
30
40
50
60
70
Station (ft)
2013 XS
2013 WS
2014 XS
2014 WS


Spring Creek Transect #3 - Pool
Elevation (ft)
2946
2945
2944
2943
2942
2941
2940
2939
2938
2937
2936
2935
0
10
20
30
40
50
60
70
Station (ft)
2013 XS
2013 WS
2014 XS
2014 WS


Spring Creek Transect #4 - Riffle
2945
2944
2943
2942
2941
2940
2939
2938
2937
2936
2935
2934
Elevation (ft)
0
10
20
30
40
50
60
70
Station (ft)
2013 XS
2013 WS
2014 XS
2014 WS


Spring Creek Longitudinal Profile
2942
2941
2940
2939
2938
2937
2936
2935
2934
2933
Elevation (ft)
0
100
200
300
400
500
600
700
800
900
1000
Station (ft)
Channel Bed

Appendix C

Project Site Photos

MDT Stream Mitigation Monitoring
Spring Creek
Flathead County, Montana

PHOTO INFORMATION

PROJECT NAME: Spring Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

CONFLUENCE

Photo Point 1.1—2013
Description: View looking north (upstream) at project area. **Compass**: 0 (North)

Photo Point 1.1—2014
Description: View looking north (upstream) at project area. **Compass**: 0 (North)

Photo Point 1.2—2013
Description: View looking south (downstream) at project area. **Compass**: 180 (South)

Photo Point 1.2—2014
Description: View looking south (downstream) at project area. **Compass**: 180 (South)

Photo Point 2—2013
Description: View looking north of project area from photo point 2. **Compass**: 0 (North)

Photo Point 2—2014
Description: View looking north of project area from photo point 2. **Compass**: 0 (North)

PHOTO INFORMATION

PROJECT NAME: Spring Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

CONFLUENCE

Photo Point 3.1—2013
Description: View looking south from photo point 3
Compass: 180 (South)

Photo Point 3.1—2014
Description: View looking south from photo point 3
Compass: 180 (South)

Photo Point 3.2—2013
Description: Looking of upstream end of project area from photo point 3. **Compass**: 90 (East)

Photo Point 3.2—2014
Description: Looking of upstream end of project area from photo point 3. **Compass**: 90 (East)

Photo Point 4.1—2013
Description: Northward view of project area from photo point 4. **Compass**: 0 (North)

Photo Point 4.1—2014
Description: Northward view of project area from photo point 4. **Compass**: 0 (North)

PHOTO INFORMATION

PROJECT NAME: Spring Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

CONFLUENCE

Photo Point 4.2—2013
Description: View east across the stream channel.
Compass: 90 (East)

Photo Point 4.2—2014
Description: View east across the stream channel.
Compass: 90 (East)

Photo Point 4.3—2013
Description: View looking downstream at project area.
Compass: 180 (South)

Photo Point 4.3—2014
Description: View looking downstream at project area.
Compass: 180 (South)

Photo 1—2013
Description: Culvert at upstream end of project area.
Compass: 25 (North-Northeast)

Photo 1—2014
Description: Culvert at upstream end of project area.
Compass: 25 (North-Northeast)

PHOTO INFORMATION

PROJECT NAME: Spring Creek Stream Mitigation Site

DATE: 2013 and 2014 Monitoring Events

Photo 2—2013
Description: Hose in stream channel.
Compass: 130 (Southeast)

Photo 2—2014
Description: Hose in stream channel.
Compass: 130 (Southeast)

PHOTOGRAPHIC INSPECTION INFORMATION *Page__1 of _16_*

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T1 RIGHT: LOOKING EAST TO T1 LEFT

T1 LEFT: LOOKING WEST TO T1 RIGHT

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T1 RIGHT: LOOKING NORTHEAST UPSTREAM

T1 RIGHT: LOOKING SOUTH DOWNSTREAM

T1: LOOKING NORTH UPSTREAM FROM MIDDLE OF CREEK

T1: LOOKING SOUTH DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T1 LEFT: LOOKING NORTH UPSTREAM

T1 LEFT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T2 RIGHT: LOOKING EAST TO T2 LEFT

T2 LEFT: LOOKING WEST TO T2 RIGHT

T2 RIGHT: LOOKING NORTH UPSTREAM

T2 RIGHT: LOOKING SOUTH DOWNSTREAM

T2: LOOKING NORTH UPSTREAM FROM MIDDLE OF CREEK

T2: LOOKING SOUTH DOWNSTREAM FROM MIDDLE OF CREEK

T2 LEFT: LOOKING NORTH UPSTREAM

T2 LEFT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T3 RIGHT: LOOKING EAST TO T3 LEFT

T3 LEFT: LOOKING WEST TO T3 RIGHT

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T3 RIGHT: LOOKING NORTH UPSTREAM

T3 RIGHT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T3: LOOKING NORTH UPSTREAM FROM MIDDLE OF CREEK

T3: LOOKING SOUTH DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T3 LEFT: LOOKING NORTH UPSTREAM

T3 LEFT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T4 RIGHT: LOOKING EAST TO T4 LEFT

T4 LEFT: LOOKING WEST TO T4 RIGHT

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T4 RIGHT: LOOKING NORTHEAST UPSTREAM

T4 RIGHT: LOOKING SOUTH DOWNSTREAM

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T4: LOOKING NORTH UPSTREAM FROM MIDDLE OF CREEK

T4: LOOKING SOUTHWEST DOWNSTREAM FROM MIDDLE OF CREEK

PROJECT NAME: 2014 MDT STREAM MITIGATION—SPRING CREEK

DATE: 7-30-14

T1 LEFT: LOOKING NORTH UPSTREAM

T1 LEFT: LOOKING SOUTHWEST DOWNSTREAM

Appendix D

Channel Construction Details

MDT Stream Mitigation Monitoring
Spring Creek
Flathead County, Montana

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	ARRA 15(92)	55

CSF-0.999470385

DETAIL

SPRING CREEK CHANNEL CHANGE

LEGEND

STREAM RIFFLE SECTION

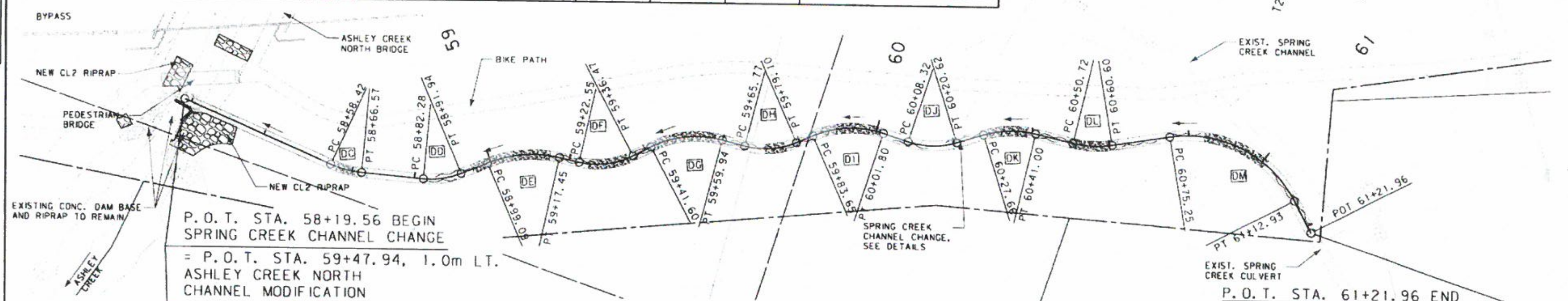
STREAM POOL SECTION

CENTERLINE COORDINATE TABLE NO. 1

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
58+19.56	POT	449 114.0061	240 825.7126	BEGIN CHANNEL CHANGE
58+58.42	PC	449 152.3917	240 831.7521	
58+62.53	PI	449 156.4550	240 832.3914	
58+66.57	PT	449 160.5089	240 831.6951	
58+82.28	PC	449 175.9866	240 829.0369	
58+87.21	PI	449 180.8454	240 828.2025	
58+91.94	PT	449 184.7597	240 825.2055	
58+99.09	PC	449 190.4408	240 820.8558	
59+08.57	PI	449 197.9650	240 815.0949	
59+17.45	PT	449 207.4331	240 814.7015	
59+22.55	PC	449 212.5234	240 814.4900	
59+29.81	PI	449 219.7736	240 814.1888	
59+36.47	PT	449 225.1439	240 809.3085	
59+41.60	PC	449 228.9423	240 805.8567	
59+51.21	PI	449 236.0516	240 799.3961	
59+59.94	PT	449 245.6579	240 799.3585	
59+65.77	PC	449 251.4802	240 799.3357	
59+72.70	PI	449 258.4061	240 799.3087	

CENTERLINE COORDINATE TABLE NO. 2

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
59+79.10	PT	449 263.8320	240 795.0042	
59+83.65	PC	449 267.3957	240 792.1771	
59+93.15	PI	449 274.8368	240 786.2739	
60+01.80	PT	449 284.3204	240 786.8010	
60+08.32	PC	449 290.8215	240 787.1622	
60+14.67	PI	449 297.1630	240 787.5147	
60+20.62	PT	449 302.5459	240 784.1438	
60+27.66	PC	449 308.5190	240 780.4035	
60+34.50	PI	449 314.3098	240 776.7773	
60+41.00	PT	449 321.1399	240 776.6003	
60+50.72	PC	449 330.8541	240 776.3487	
60+55.73	PI	449 335.8581	240 776.2190	
60+60.60	PT	449 340.4264	240 774.1728	
60+75.25	PC	449 353.8003	240 768.1822	
60+97.04	PI	449 373.6782	240 759.2783	
61+12.93	PT	449 388.2997	240 775.4221	
61+21.96	POT	449 394.3585	240 782.1117	END CHANNEL CHANGE



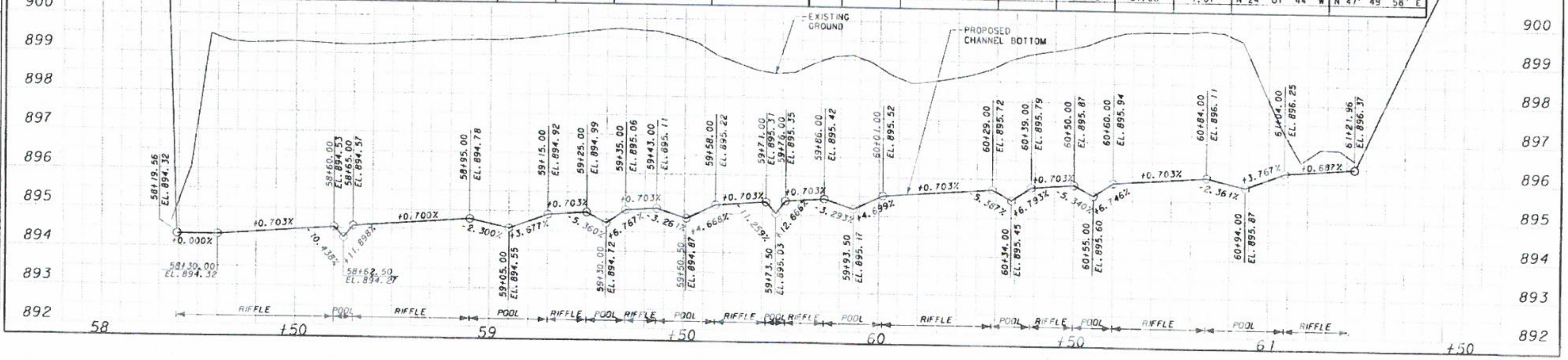
P.O.T. STA. 58+19.56 BEGIN SPRING CREEK CHANNEL CHANGE

= P.O.T. STA. 59+47.94, 1.0m LT. ASHLEY CREEK NORTH CHANNEL MODIFICATION

P.O.T. STA. 61+21.96 END SPRING CREEK CHANNEL CHANGE

SPRING CREEK CHANNEL CHANGE CURVE DATA

CURVE	P.I.	Δ	RADIUS (m)	T	L	E	BACK TANGENT	AHEAD TANGENT
DC	58+62.53	18° 41' 11" LT	25.00	4.11	8.15	0.34	N 8° 56' 29" E	N 9° 44' 43" W
DD	58+87.21	27° 41' 39" LT	20.00	4.93	9.67	0.60	N 9° 44' 43" W	N 37° 26' 22" W
DE	59+08.57	35° 03' 37" RT	30.00	9.48	18.36	1.46	N 37° 26' 22" W	N 2° 22' 45" W
DF	59+29.81	39° 53' 03" LT	20.00	7.26	13.92	1.28	N 2° 22' 45" W	N 42° 15' 47" W
DG	59+51.21	42° 02' 21" RT	25.00	9.61	18.34	1.78	N 42° 15' 47" W	N 0° 13' 27" W
DH	59+72.70	38° 12' 06" LT	20.00	6.93	13.33	1.17	N 0° 13' 27" W	N 38° 25' 32" W
DI	59+93.15	41° 36' 24" RT	25.00	9.50	18.15	1.74	N 38° 25' 32" W	N 3° 10' 51" E
DJ	60+14.67	35° 14' 09" LT	20.00	6.35	12.30	0.98	N 3° 10' 51" E	N 32° 03' 18" W
DK	60+34.50	30° 34' 15" RT	25.00	6.83	13.34	0.92	N 32° 03' 18" W	N 1° 29' 03" W
DL	60+55.73	22° 38' 42" LT	25.00	5.01	9.88	0.50	N 1° 29' 03" W	N 24° 07' 44" W
DM	60+97.04	71° 57' 42" RT	30.00	21.78	37.68	7.07	N 24° 07' 44" W	N 47° 49' 58" E



SE Sterling Engineers, Inc.

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

DESIGNED BY	
REVIEWED BY	
CHECKED BY	

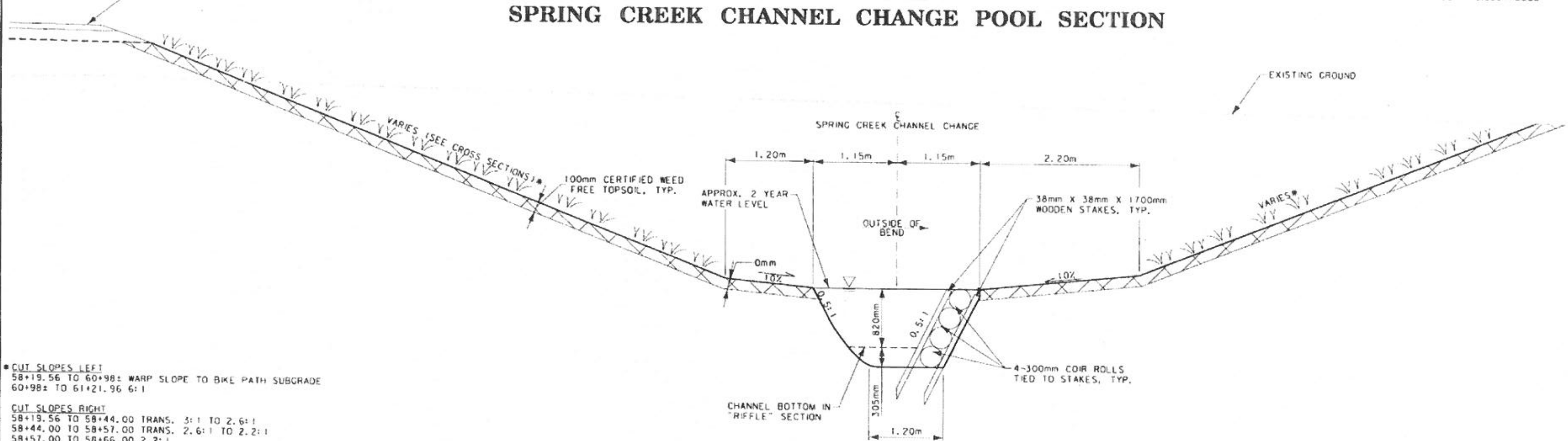
10/6/2009
11:16:35 AM
EPS - U2160

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	ARRA 15(92)	56

CSF = 0.999470385

DETAIL

SPRING CREEK CHANNEL CHANGE POOL SECTION

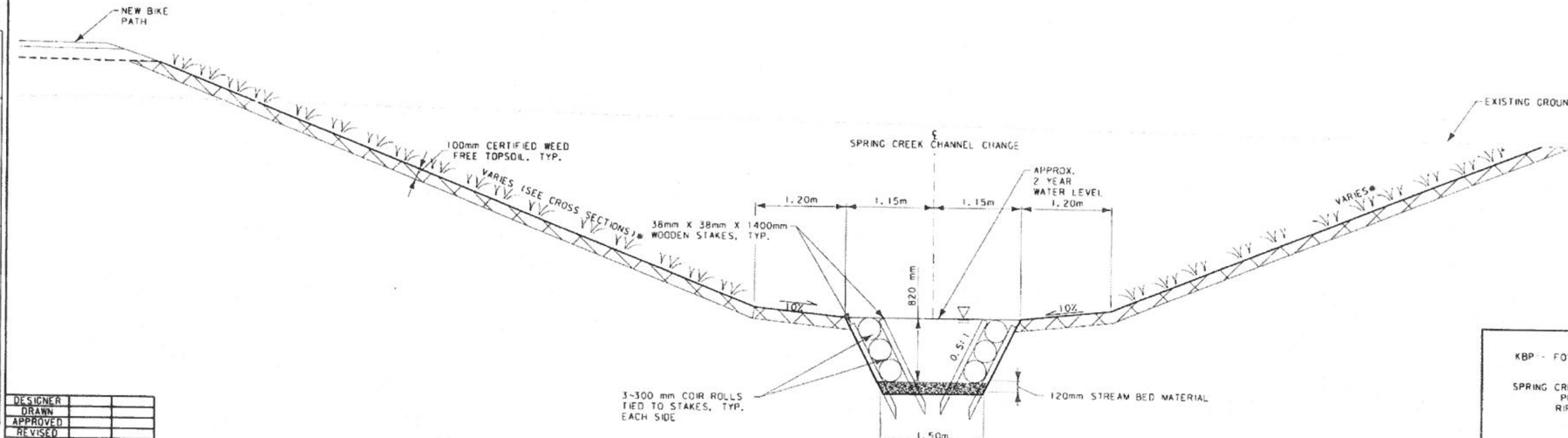

NEW BIKE PATH
EXISTING GROUND
SPRING CREEK CHANNEL CHANGE
1.20m
1.15m
1.15m
2.20m
VARIES (SEE CROSS SECTIONS)*
100mm CERTIFIED WEED FREE TOPSOIL, TYP.
APPROX. 2 YEAR WATER LEVEL
OUTSIDE OF BEND
38mm X 38mm X 1700mm WOODEN STAKES, TYP.
VARIES*
0mm
10%
10%
0.5:1
0.5:1
820mm
305mm
4-300mm COIR ROLLS TIED TO STAKES, TYP.
CHANNEL BOTTOM IN "RIFFLE" SECTION
1.20m

NOTE: SEE VEGETATION PLANS FOR SEEDING & PLANTINGS

* CUT SLOPES LEFT
58+19.56 TO 60+98± WARP SLOPE TO BIKE PATH SUBGRADE
60+98± TO 61+21.96 6:1

CUT SLOPES RIGHT
58+19.56 TO 58+44.00 TRANS. 3:1 TO 2.6:1
58+44.00 TO 58+57.00 TRANS. 2.6:1 TO 2.2:1
58+57.00 TO 58+66.00 2.2:1
58+66.00 TO 58+87.00 TRANS. 2.2:1 TO 2.8:1
58+87.00 TO 59+08.00 TRANS. 2.8:1 TO 2.6:1
59+08.00 TO 59+30.00 2.6:1
59+30.00 TO 59+51.00 TRANS. 2.6:1 TO 3:1
59+51.00 TO 60+65.00 3:1
60+65.00 TO 61+21.96 TRANS. 3:1 TO 6:1

SPRING CREEK CHANNEL CHANGE RIFFLE SECTION


NEW BIKE PATH
EXISTING GROUND
SPRING CREEK CHANNEL CHANGE
100mm CERTIFIED WEED FREE TOPSOIL, TYP.
VARIES (SEE CROSS SECTIONS)*
APPROX. 2 YEAR WATER LEVEL
1.20m
1.15m
1.15m
1.20m
38mm X 38mm X 1400mm WOODEN STAKES, TYP.
VARIES*
10%
10%
820 mm
0.5:1
3-300 mm COIR ROLLS TIED TO STAKES, TYP. EACH SIDE
120mm STREAM BED MATERIAL
1.50m

NOTE: SEE VEGETATION PLANS FOR SEEDING & PLANTINGS

KBP - FOYS LAKE RD TO US 2

SPRING CREEK CHANNEL CHANGE
POOL SECTION
RIFFLE SECTION

NO SCALE

	INITIALS	DATE
DESIGNER		
DRAWN		
APPROVED		
REVISED		

MONTANA DEPARTMENT OF TRANSPORTATION
MONTANA CADD
SE Stelling Engineers, Inc.

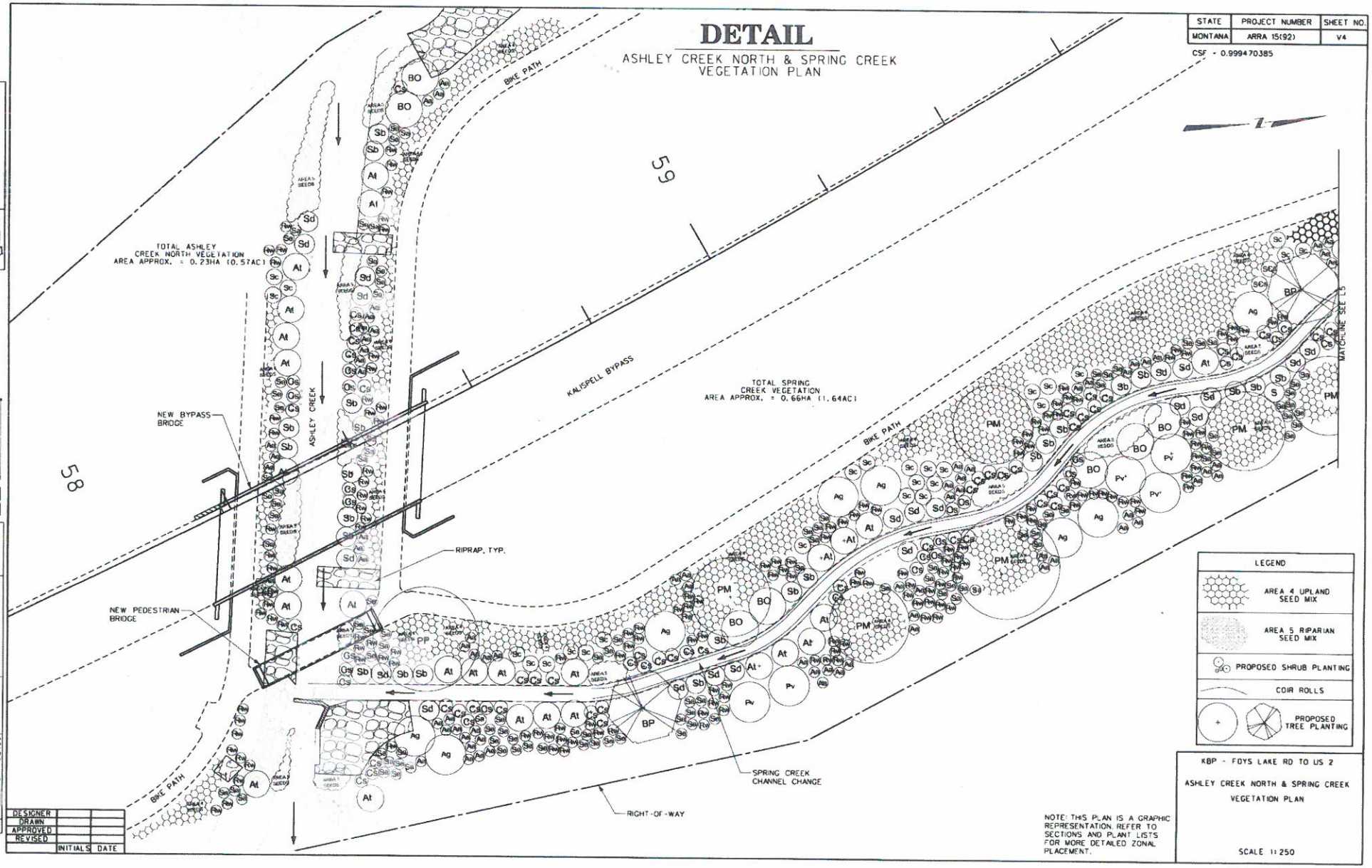
DESIGNED BY
REVIEWED BY
CHECKED BY
10/6/2009
11:16:40 AM

DETAIL

ASHLEY CREEK NORTH & SPRING CREEK
VEGETATION PLAN

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	ARRA 15(92)	V4

CSF - 0.999470385



LEGEND

- AREA 4 UPLAND SEED MIX
- AREA 5 RIPARIAN SEED MIX
- PROPOSED SHRUB PLANTING
- COIR ROLLS
- PROPOSED TREE PLANTING

NOTE: THIS PLAN IS A GRAPHIC REPRESENTATION. REFER TO SECTIONS AND PLANT LISTS FOR MORE DETAILED ZONAL PLACEMENT.

KBP - FOYS LAKE RD TO US 2

ASHLEY CREEK NORTH & SPRING CREEK VEGETATION PLAN

SCALE 1:250

	INITIALS	DATE
DESIGNER		
DRAWN		
APPROVED		
REVISED		

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

SE Stalling Engineers, INC.

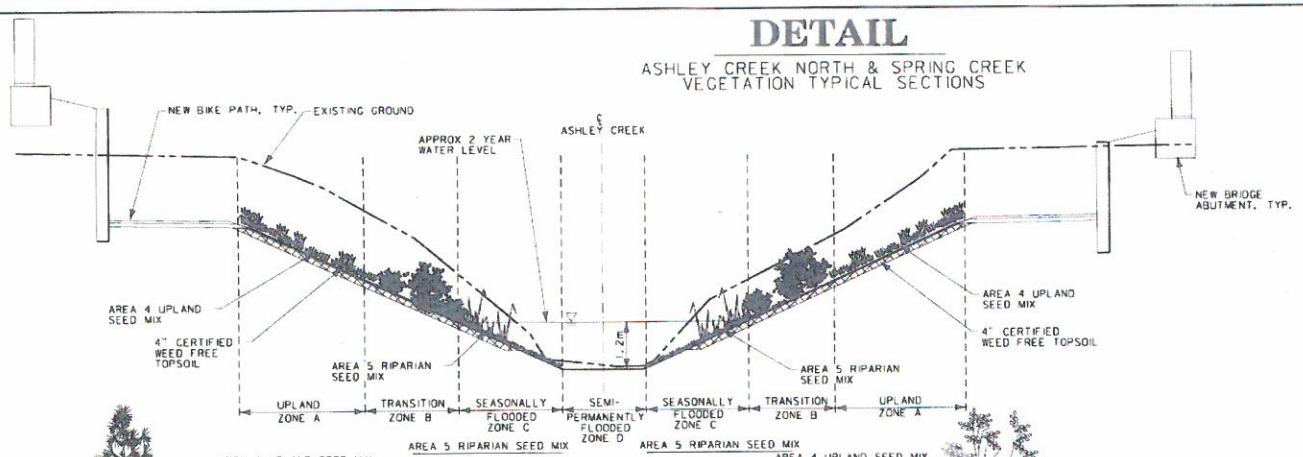
DETAIL

ASHLEY CREEK NORTH & SPRING CREEK VEGETATION TYPICAL SECTIONS

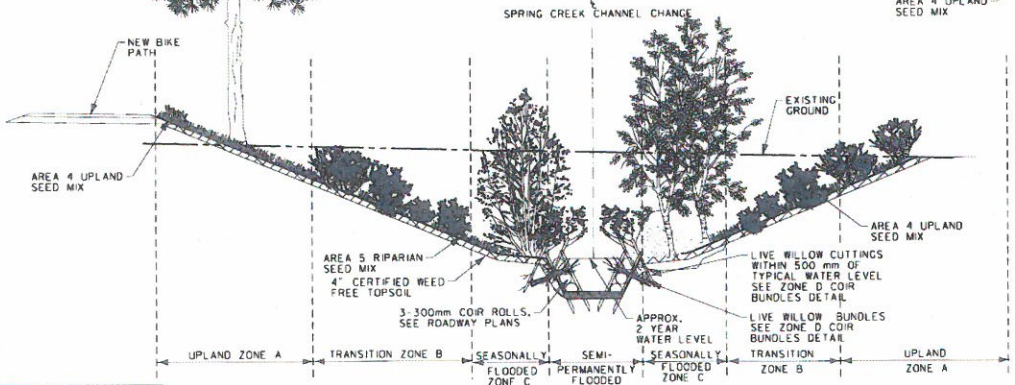
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	ARRA 15(92)	V3

CSF = 0.999470385

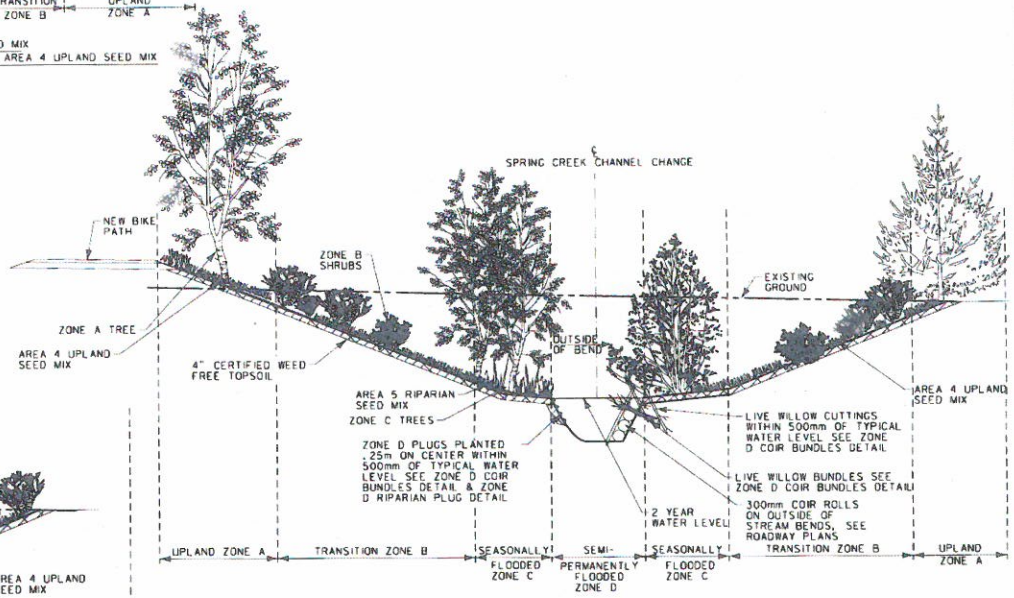
NOTES: 1. SEE ROADWAY PLANS FOR CHANNEL CONSTRUCTION DETAILS.
2. TYPICAL SECTIONS ARE GENERAL CONCEPTUAL DESIGN. FOR INFORMATION ONLY



ASHLEY CREEK NORTH BRIDGE TYPICAL SECTION
SCALE: NOT TO SCALE



SPRING CREEK CHANNEL CHANGE RIFFLE TYPICAL SECTION
SCALE: NOT TO SCALE



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

KBP - FOYS LAKE RD TO US 2

ASHLEY CREEK NORTH & SPRING CREEK VEGETATION TYPICAL SECTIONS

NO SCALE

DESIGNER		
DRAWN		
APPROVED		
REVISED		
	INITIALS	DATE

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

SE Stalling Engineering, Inc.

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	ARRA 15(92)	V2

CSF • 0.999470385

DETAIL

ASHLEY CREEK NORTH & SPRING CREEK VEGETATION SUMMARY & DETAILS

CHANNEL PLANTING SEQUENCE

1. PLACE COIR ROLL AS PER COIR ROLLS DETAIL IN ROADWAY PLANS AND SPECIAL PROVISIONS.
2. INSTALL PLANTS BETWEEN THE DATES OF OCTOBER 1 AND NOVEMBER 15 OR APRIL 30 AND JUNE 1 PROVIDED THE GROUND IS NOT FROZEN.
3. PLANT RIPARIAN PLUGS AS PER PLANTING DETAIL. INSTALL CUTTINGS BETWEEN APRIL 15 AND MAY 1.
4. PLANT WILLOW CUTTINGS AND BUNDLES AS PER PLANTING DETAIL.
5. INSTALL JUTE NETTING ON SLOPES GREATER THAN 3:1 AS PER SPECIAL PROVISIONS.
6. SEED UPLAND AREA 4 AND RIPARIAN AREA 5 AS PER SEEDING SPECIAL PROVISIONS.
7. PLANT TREES AND SHRUBS AS PER PLANTING DETAILS.
8. APPLY WEED FREE ORGANIC COMPOST MULCH AS PER SPECIAL PROVISIONS.

ASHLEY CREEK NORTH & SPRING CREEK CHANNEL CHANGE PLANT LIST *

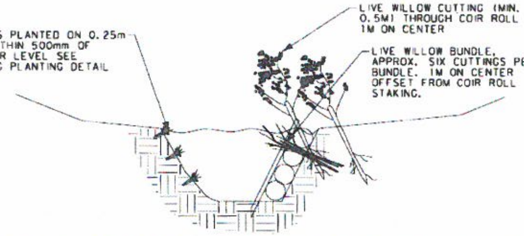
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
ZONE A UPLAND				
TREES				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
BP	BETULA PAPYRIFERA	PAPER BIRCH	4	10' B&B
PP	PINUS PONDEROSA	PONDEROSA PINE	3	7' B&B
PM	PSEUDOTSUGA MENZIESII	DOUGLAS FIR	8	6' B&B
ZONE B TRANSITIONAL				
SHRUBS				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
Aa	AMELANCHIER ALNIFOLIA	SASKATOON SERVICEBERRY	108	1 GAL.
Pv	PRUNUS VIRGINIANA	COMMON CHOKECHERRY	8	5 GAL.
Rw	ROSA WOODSII	WOODS ROSE	243	1 GAL.
Sc	SHEPHERDIA CANADENSIS	CANADA BUFFALOBERRY	41	1 GAL.
Sa	SYMPHORICARPOS ALBUS	SNOWBERRY	156	1 GAL.
ZONE C SEASONALLY FLOODED				
TREES				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
BO	BETULA OCCIDENTALIS	WATER BIRCH	11	15 GAL.
SHRUBS				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	SIZE
At	ALNUS INCANA SSP. TENUIFOLIA	THIN-LEAF ALDER	43	5 GAL.
Cs	CORNUS STOLONIFERA/SERICEA	RED-OSIER DOGWOOD	102	1 GAL.
Sb	SALIX BEBBIANA	BEBB WILLOW	38	5 GAL.
Sd	SALIX DRUMMONDIANA	DRUMMOND WILLOW	33	5 GAL.
ZONE D SEMI-PERMANENTLY FLOODED				
COIR ROLL STAKING SPACE @ 1m ON CENTER				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	
Sb	SALIX DRUMMONDIANA	DRUMMOND WILLOW	500	CUTTINGS
Sb	SALIX EXIGUA	SANDBAR WILLOW	500	CUTTINGS
COIR ROLL LAYERING SPACE 6 CUTTINGS PER BUNDLE @ 1m ON CENTER				
TYPE	BOTANICAL NAME	COMMON NAME	QNTY	
Sb	SALIX DRUMMONDIANA	DRUMMOND WILLOW	1500	CUTTINGS
Sb	SALIX EXIGUA	SANDBAR WILLOW	1500	CUTTINGS
STREAMBANK PLUGS				
	BOTANICAL NAME	COMMON NAME	QNTY	
	CAREX NEBRASCENSIS	NEBRASKA SEDGE	288	PLUGS
	CAREX UTRICULATA	BEAKED SEDGE	403	PLUGS
	CAREX VESICARIA	INFLATED SEDGE	288	PLUGS
	GLYCERIA ELATA (STRIATA)	FOWL MANNAGRASS	173	PLUGS

* 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		square meters
FROM	TO	
58+19.56	61+31.96	6372
TOTAL		6372

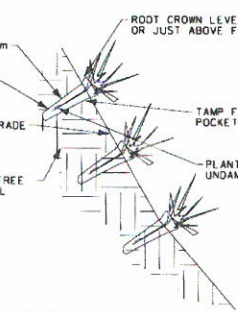
* FOR INFORMATION ONLY. INCLUDE ALL COSTS AND INCIDENTAL ITEMS ASSOCIATED WITH THE INSTALLATION OF THIS ITEM IN THE LUMP SUM BID PRICE FOR "VEGETATION".


ZONE D PLUGS PLANTED ON 0.25m ON CENTER WITHIN 500mm OF TYPICAL WATER LEVEL SEE RIPARIAN PLUG PLANTING DETAIL
LIVE WILLOW CUTTING (MIN. 0.5M) THROUGH COIR ROLL @ 1M ON CENTER
LIVE WILLOW BUNDLE. APPROX. SIX CUTTINGS PER BUNDLE. 1M ON CENTER OFFSET FROM COIR ROLL STAKING.

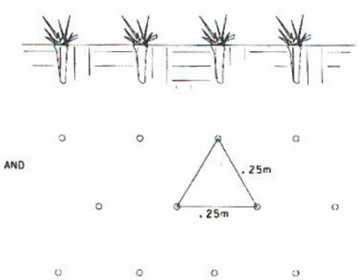
ZONE D COIR BUNDLES WITH WILLOW CUTTINGS AND LAYERING
SCALE: NOT TO SCALE

HARVESTING AND INSTALLATION NOTE:

1. HARVEST AND PLANT CUTTINGS DURING DORMANT SEASON.
2. USE HEALTHY STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
3. MAKE CLEAN CUTS AND DO NOT DAMAGE CUTTINGS OR SPLIT ENDS DURING INSTALLATION.
4. BRIEFLY SOAK CUTTINGS IN WATER AND ROOTING HORMONE PRIOR TO INSTALLATION.
5. FOR LAYERING, BUNDLE 6 CUTTINGS TOGETHER AND BIND WITH BIODEGRADABLE JUTE STRING.
6. INSTALL WILLOW CUTTING AND WILLOW BUNDLE LAYERING DURING BANK GRADING AND COIR PLACEMENT.
7. WILLOW CUTTING AND WILLOW BUNDLES SHALL EXTEND INTO EXPECTED MOISTURE SOIL ZONES.
8. IF NECESSARY, CUT SMALL HOLES IN COIR ROLLS AND INSERT LIVE WILLOW CUTTING.
9. INSERT BUNDLES INTO SOIL BETWEEN COIR ROLLS.


MINIMUM BURIAL 150mm INTO SOIL
CREATE PLANTING HOLE WITH DIVET OR SPIKE INTO SOIL AND WORK TO WIDEN HOLE
FINISHED GRADE
WEED FREE TOPSOIL
ROOT CROWN LEVEL WITH OR JUST ABOVE FINISHED GRADE
TAMP FIRMLY TO ELIMINATE AIR POCKETS IN PLANTING HOLE
PLANT ROOTS TO BE STRAIGHT AND UNDAMAGED BY INSTALLATION

ZONE D RIPARIAN PLUG PLANTING
FOR INSIDE BEND OF SPRING CREEK POOLS
SCALE: NOT TO SCALE



SPACING

KBP - FOYS LAKE RD TO US 2

ASHLEY CREEK NORTH & SPRING CREEK VEGETATION SUMMARY & DETAILS

NO SCALE

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

SE Stelling Engineers, Inc.

DESIGNER		
DRAWN		
APPROVED		
REVISED		
	INITIALS	DATE

DESIGNED BY / REVIEWED BY / CHECKED BY

CPS - U2160