APPENDIX A

ASSESSMENT PROTOCOL

RIVER CORRIDOR ASSESSMENT SHEET

Stream segment	
River miles (from/to)	
Date	

A. Channel assessment		1 to 2.9 Severely Degraded 3 to 4.9 Poor 5 to 6.9 Fair 7 to 8.9 Good 9 to 10 Excellent
A1. Current active/wet channel		
Bank erosion and stability		
Aggradation		
Degradation		
Revetment		
A2. Disturbed floodplain		
Bank erosion and stability		
Aggradation		
Degradation and headcutting		
A3. Existing overbanks		
Sediment deposition		
Headcutting		
Land use		
A4. Riparian condition		
A5. Presence of Barriers		
Sum of A elements		
Number of elements		
Channel Assessment Score		
B. Risk to structures and infrastructures		1 to 2.9 Severely Degraded 3 to 4.9 Poor 5 to 6.9 Fair 8 to 8.9 Good 9 to 10 Excellent
B1. Buildings		
B2. Utilities		
B3. Roads		
Sum of B elements		
Number of elements		
Structure and Infrastructure Score		

Element A1: Current active/wetted Channel			
Bank erosion and stability			
Banks are stable; protected by roots of natural vegetation, wood, and/or rock. No bank failures	Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials. Evidence of erosion or bank failures, some with reestab-lishment of vegetation.	Banks are moderately unstable; very little protection of banks by roots of natural wood, vegetation, or rock Moderate bank failures	Banks are unstable; no bank protection with roots, wood, rock, or vegetation Numerous bank failures
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Left Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Aggradation			
No excessive aggradation	Evidence of some aggradation	Evidence of moderate to severe aggradation	Evidence of severe aggradation
10 9	**8 7 6**	**5 4 3**	**2 1 0**
Degradation			
No excessive degradation	Evidence of some degradation	Evidence of moderate to severe degradation	Evidence of severe degradation
10 9	**8 7 6**	**5 4 3**	**2 1 0**
Channel revetment (riprap, concrete, gabions etc)			
No observed deterioration	Minor discontinuous cracks or displacement	Cracking or displacement in portions of the reach	Failed revetment throughout system
10 9	**8 7 6**	**5 4 3**	**2 1 0**
A2:Disturbed floodplain			
Bank erosion and stability			
Banks are stable; protected by roots of natural vegetation, wood, and/or rock. No bank failures	Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials Evidence of erosion or bank failures, some with reestablishment of vegetation	Banks are moderately unstable; very little protection of banks by roots of natural wood, vegetation, or rock Moderate bank failures	Banks are unstable; no bank protection with roots, wood, rock, or vegetation Numerous bank failures
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Left Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**

Aggradation			
No excessive aggradation	Evidence of some aggradation	Evidence of moderate to severe aggradation	Evidence of severe aggradation
10 9	**8 7 6**	**5 4 3**	**2 1 0**
Degradation and headcutting			
No excessive degradation or headcutting	Evidence of some degradation and headcutting	Evidence of moderate to severe degradation and headcutting	Evidence of severe degradation and headcutting
10 9	**8 7 6**	**5 4 3**	**2 1 0**
A3:Existing overbanks			
Bank erosion and stability			
Banks are stable; protected by roots of natural vegetation, wood, and/or rock. No bank failures	Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials Evidence of erosion or bank failures, some with reestablishment of vegetation	Banks are moderately unstable; very little protection of banks by roots of natural wood, vegetation, or rock Moderate bank failures	Banks are unstable; no bank protection with roots, wood, rock, or vegetation Numerous bank failures
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Left Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Sediment deposition			
No to little sediment deposition in overbanks; vegetation visible	Some sediment deposition in overbanks; vegetation mostly visible	Sediment deposition in overbanks; vegetation not visible	Sediment deposition in overbanks; vegetation not visible
10 9	**8 7 6**	**5 4 3**	**2 1 0**
Headcutting			
No headcutting into existing banks	Evidence of some headcutting into existing banks	Evidence of moderate to severe headcutting into existing banks	Evidence of severe headcutting into existing banks
10 9	**8 7 6**	**5 4 3**	**2 1 0**
Land Use			
Land uses do not negatively impact overbank condition	Land uses are contributing slightly to overbank instability	Land uses are contributing moderately to overbank instability	Land uses are contributing to overbank instability
10 9	**8 7 6**	**5 4 3**	**2 1 0**

A4: Riparian condition			
atural and diverse riparian vegetation with composition, density and age structure appropriate for the site No invasive species	Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site Invasive species present in small numbers(20% cover or less)	Natural vegetation compromised Invasive species common(>20% <50% cover)	Little or no natural vegetation Invasive species widespread(>50% cover)
10 9	**8 7 6**	**5 4 3**	**2 1 0**
A5: Presence of barriers to aquatic species movement			
No artificial barriers that prohibit movement of aquatic organisms during any time of the year	Physical structures, water withdrawals and/or water quality seasonally restrict movement of aquatic species	Physical structures, water withdrawals and/or water quality restrict movement of aquatic species throughout the year	Physical structures, water withdrawals and/or water quality prohibit movement of aquatic species
1 0 9	**8 7 6**	**5 4 3**	**2 1 0**

B1: Buildings			
Buildings not in flood corridor or appear to be sufficiently elevated above 2013 flood event and/or undamaged from flood event	Buildings present with possible evidence of inundation and damage during 2013 flood event Building appears to be in a location not subject to future flooding	Buildings present with possible evidence of inundation and damage during 2013 flood event Building appears to be in a location possibly subject to future flooding	Buildings present with possible evidence of inundation and damage during 2013 flood event Building appears to be in a location subject to future flooding
10 9	**8 7 6**	**5 4 3**	**2 1 0**
B2: Utilities (buried infrastructure, overhead power, other)			
Utilities not observed at site (not exposed or does not appear to be present).	Evidence of utility presence but does not appear to be currently at risk	Evidence of utility presence which could potentially be at risk with future flows	Evidence of utility presence and currently at risk
10 9	**8 7 6**	**5 4 3**	**2 1 0**
B3: Roads (buried infrastructure, overhead power, other)			
Roads not observed at site or within or near limits of flood damaged corridor.	Roads near flood damaged corridor but do not appear to be currently at risk	Roads near or across flood damaged corridor that could potential be at risk with future flows	Roads near of across flood damaged corridor that have been damaged and are at risk with future flows
10 9	**8 7 6**	**5 4 3**	**2 1 0**

SUMARY OF FIELD ASSESSMENTS

CHANNEL ASSESSMENT	Reach																						
	I		II			III				IV	V						VI			VII			
	I-1	I-2	II-1	II-2	II-3	III-1a	III-1b	III-1c	III-2	IV	V-1	V-2	V-3	V-4	Va-5	Va-6	VI-1	VI-2	VI-3	VII-1	VII-2	VIIa-3	VIIa-4a	VIIa-4b
	LTR Confluence with BT to CR 17	CR 17 to I25	I 25 to CR 7	CR 7 to CR 5 (DS at Koolstra Property)	CR 5 (DS at Koolstra property) to CR 1	CR 1 to Hwy 287	CR 1 to Hwy 287	CR 1 to Hwy 287	hwy 287 to Boulder Cty	Boulder Cty	Cty line to Roberts	Roberts to Stagecoach Rd	Stagecoad Rd to confluence NF	NF to Stagecoach Tr (Vancleve)	NF Stageoac Tr to confluence with Spruce	NF confluence with Spruce to Pole Hil	Confluence with NF to Pinewood	Pinewood	Pinewood to CR 47	CR 47 to confluence with Lyons Gulch	Confluence with Lyons Gulch to headwaters	WF CR 47	WF US of BEM	Deer Creek US of BEM
A. Channel assessment																								
A1. Current active/wet channel	**6.0**	**5.8**	**7.8**	**4.4**	**6.4**	**6.6**	**7.2**	**4.8**	**4.0**	**2.6**	**5.3**	**6.0**	**5.3**	**6.0**	**5.3**	**7.0**	**8.0**	**6.0**	**4.3**	**4.5**	**8.0**	**4.3**	**6.8**	**5.3**
Bank erosion and stability (left)	6.5	5.0	8.0	3.0	6.0	6.0	8.0	4.0	2.0	1.0	5.0	6.0	5.0	6.0	5.0	7.0	8.0	6.0	4.0	4.0	7.0	5.0	7.0	6.0
Bank erosion and stability (right)	6.5	5.0	8.0	2.0	6.0	6.0	8.0	4.0	2.0	1.0	5.0	6.0	5.0	6.0	5.0	7.0	8.0	6.0	4.0	4.0	7.0	5.0	7.0	6.0
Aggradation	5.0	6.0	7.0	4.0	6.0	5.0	4.0	6.0	3.0	3.0	2.0	6.0	6.0	6.0	6.0	7.0	8.0	7.0	5.0	6.0	10.0	2.0	8.0	2.0
Degradation	7.0	7.0	8.0	7.0	6.0	8.0	8.0	5.0	5.0	3.0	9.0	6.0	5.0	6.0	5.0	7.0	8.0	5.0	4.0	4.0	8.0	5.0	5.0	7.0
Revetment	5.0	6.0	8.0	6.0	8.0	8.0	8.0		8.0	5.0														
A2. Disturbed floodplain	**4.5**	**5.3**	**7.3**	**5.0**	**5.8**	**7.3**	**7.0**	**5.0**	**3.5**	**2.0**	**4.0**	**5.0**	**5.0**	**6.0**	**5.8**	**6.0**	**8.0**	**7.5**	**5.0**	**5.3**	**8.5**		**7.0**	**5.0**
Bank erosion and stability (left)	5.0	5.0	8.0	5.0	6.0	8.0	8.0	4.0	2.0	1.0	4.0	4.0	4.0	6.0	6.0	6.0	8.0	6.0	5.0	5.0	8.0		7.0	7.0
Bank erosion and stability (right)	5.0	5.0	8.0	5.0	6.0	8.0	8.0	4.0	2.0	1.0	4.0	4.0	4.0	6.0	6.0	6.0	8.0	6.0	5.0	5.0	8.0		7.0	7.0
Aggradation	3.0	5.0	6.0	4.0	5.0	5.0	4.0	6.0	4.0	4.0	2.0	6.0	6.0	6.0	6.0	6.0	8.0	8.0	5.0	6.0	10.0		8.0	2.0
Degradation and headcutting	5.0	6.0	7.0	6.0	6.0	8.0	8.0	6.0	6.0	2.0	6.0	6.0	6.0	6.0	5.0	6.0	8.0	10.0	5.0	5.0	8.0		6.0	4.0
A3. Existing overbanks	**5.5**	**6.5**	**7.7**	**7.7**	**5.6**	**7.7**	**6.7**	**5.6**	**5.8**	**4.3**	**6.3**										**8.6**			
Bank erosion and stability (left)	6.0	6.0			6.0			6.0	4.0	3.0											9.0			
Bank erosion and stability (right)					6.0			6.0													9.0			
Sediment deposition	3.0	7.0	7.0	7.0	4.0	7.0	4.0	6.0	4.0	3.0	9.0										10.0			
Headcutting	7.0	6.0	8.0	8.0	6.0	8.0	8.0	4.0	7.0	3.0	5.0										8.0			
Land use	6.0	7.0	8.0	8.0	6.0	8.0	8.0	6.0	8.0	8.0	5.0										7.0			
A4. Riparian condition	**5.0**	**7.0**	**6.0**	**5.0**	**6.0**	**7.0**	**6.0**	**6.0**	**6.0**	**6.0**		**2.0**	**2.0**	**6.0**	**6.0**	**8.0**	**8.0**	**7.0**	**5.0**	**5.0**	**8.0**	**5.0**	**9.0**	**7.0**
A5. Presence of Barriers	**5.0**	**8.0**	**2.0**	**8.0**	**4.0**	**5.0**	**5.0**	**4.0**	**4.0**	**1.0**	**4.0**	**8.0**	**8.0**	**10.0**	**9.0**	**10.0**	**8.0**	**7.0**	**7.0**	**7.0**	**8.0**	**1.0**	**8.0**	**8.0**
Sum of A elements	80.0	91.0	99.0	78.0	93.0	97.0	95.0	77.0	67.0	45.0	60.0	54.0	51	64.0	59.0	70.0	80.0	68.0	49.0	51.0	125.0	23.0	72.0	56.0
Number of elements	15	15	14	14	16	14	14	15	15	15	12	10	10	10	10	10	10	10	10	10	15	6	10	10
Channel assessment score	**5.3**	**6.1**	**7.1**	**5.6**	**5.8**	**6.9**	**6.8**	**5.1**	**4.5**	**3.0**	**5.0**	**5.4**	**5.1**	**6.4**	**5.9**	**7.0**	**8.0**	**6.8**	**4.9**	**5.1**	**8.3**	**3.8**	**7.2**	**5.6**
Reach averaged score	**5.7**		**6.2**			**5.8**				**3.0**	**5.8**						**6.6**			**6.0**				
Channel Assessment Description	**Fair**		**Fair**			**Fair**				**Poor**	**Fair**						**Fair**			**Fair**				
STRUCTURES ASSESSMENT																								
B. Risk to structures and infrastructures																								
B1. Buildings	4.0	4.0	-	8.0	5.0	8.0	8.0		2.0	1.0	1.0	1.0	1.0	1.0	4.0	4.0	-	3.0	5.0	3.0	4.0	3.0	-	-
B2. Utilities	5.0	8.0	-	-	5.0	7.0		2.0	5.0	2.0	3.0			3.0	8.0	8.0	-	2.0	-	5.0	5.0	3.0	-	-
B3. Roads	5.0	4.0	6.0	4.0	6.0	7.0	8.0		5.0	4.0	5.0	4.0	4.0	2.0	6.0	6.0	-	3.0	3.0	5.0	5.0	3.0	-	-
																							-	-
Sum of B elements	14.0	16.0	6.0	12.0	16.0	22.0	16.0	2.0	10.0	7.0	9.0	5.0	5.0	6.0	18.0	18.0	-	8.0	8.0	13.0	14.0	9.0	-	-
Number of elements	3.0	3.0	1.0	2.0	3.0	3.0	2.0	1.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	3.0	-	3.0	2.0	3.0	3.0	3.0	-	-
Structure and Infrastructure Score	**4.7**	**5.3**	**6.0**	**6.0**	**5.3**	**7.3**	**8.0**	**2.0**	**4.0**	**2.3**	**3.0**	**2.5**	**2.5**	**2.0**	**6.0**	**6.0**	-	**2.7**	**4.0**	**4.3**	**4.7**	**3.0**	-	-
Reach averaged score	**5.0**		**5.8**			**5.3**				**2.3**	**3.7**						**3.4**			**4.0**				
Structure and Infrastructure Description	**Fair**		**Fair**			**Fair**				**Severe**	**Poor**						**Poor**			**Poor**				

APPENDIX B

BRIDGE ASSESSMENTS

Little Thompson Bridge Assessment Summary					
Bridge Location	Type	Approx. Dimensions	Owner	Has the bridge been inspected?	Describe damage and repair work as of Summer 2014
LCR 47	Concrete	varies	Larimer County	NA	A series of four culvert crossings with 2 or 3 culverts estimated to be 36 to 48 inch dia were installed after the flood along CR47 as a temporary replacement of pre-flood structures. Planning and design for replacements have not yet begun.
Hwy 36-Pinewood	Concrete	Unknown	CDOT	Yes	Not required
Cree Bridge-Pinewood Spgs	Concrete	65-ft span	Larimer County	Yes	Bridge plugged with debris, flows flanked bridge and caused significant damage. Planning and design currently underway for repairs.
Kiowa Bridge-Pinewood Springs	unknown	35 ft span low water crossing	Larimer County	Yes	Bridge was totally destroyed by flood. Crossing is being replaced with new bridge designed to County Stds. Planning and design currently underway.
Stagecoach Road	Concrete	3-circular concrete culverts	Larimer County	Yes	Bridge plug with debris, flows flanked bridge and caused significant damage. Repairs are being planned to repair bridge to pre-flood condition.
BCR 23 (83rd)	Concrete	60 ft span 26 ft high	Boulder County	Yes	Bridge was washed out; design and planning currently underway.
LCR 21	Concrete	70 ft span 29 ft high	Larimer County	Yes	Bridge was washed out; repairs underway.
Green Monster	Steel Truss	Unknown	Private	Unknown	Bridge was overtopped but damage appears minimal. Capacity is likely less than County Stds.
LCR4	Concrete	70 ft span 37 ft high	Larimer County	Yes	Riprap placed on upper banks of all the abutments but may require additional toe protection.
HW287	Concrete	90 ft span 40 ft high	CDOT	Yes	Riprap placed on upper banks of all the abutments but may require additional toe protection.
LCR17	Concrete	53 ft span 37 ft high	Larimer County	Yes	Severe damage to left abutment of this bridge; repairs completed.
LCR4e	Concrete	58 ft span 23 ft high	Larimer County	Yes	Riprap placed on upper banks of all the abutments but may require additional toe protection.
LCR15a/RR	Concrete/Steel	54 ft span 13 ft high	Larimer County	Yes	Riprap placed on upper banks of all the abutments but may require additional toe protection.
LCR6c	Concrete	30 ft span 15 ft high	Larimer County	Unknown	Condition and state of repair unknown.
LCR1/County Line Rd	Concrete	99 ft span 32 ft high	Berthoud	Yes	The right abutment of the bridge was washed out during the flood. Right abutment has been repaired with new riprap bank protection and scour protection.
WCR3	Concrete	75 ft span 30 ft high	Weld County	Yes	Partial loss of roadway approach; riprap placed on upper banks of right abutment and in scour hole.

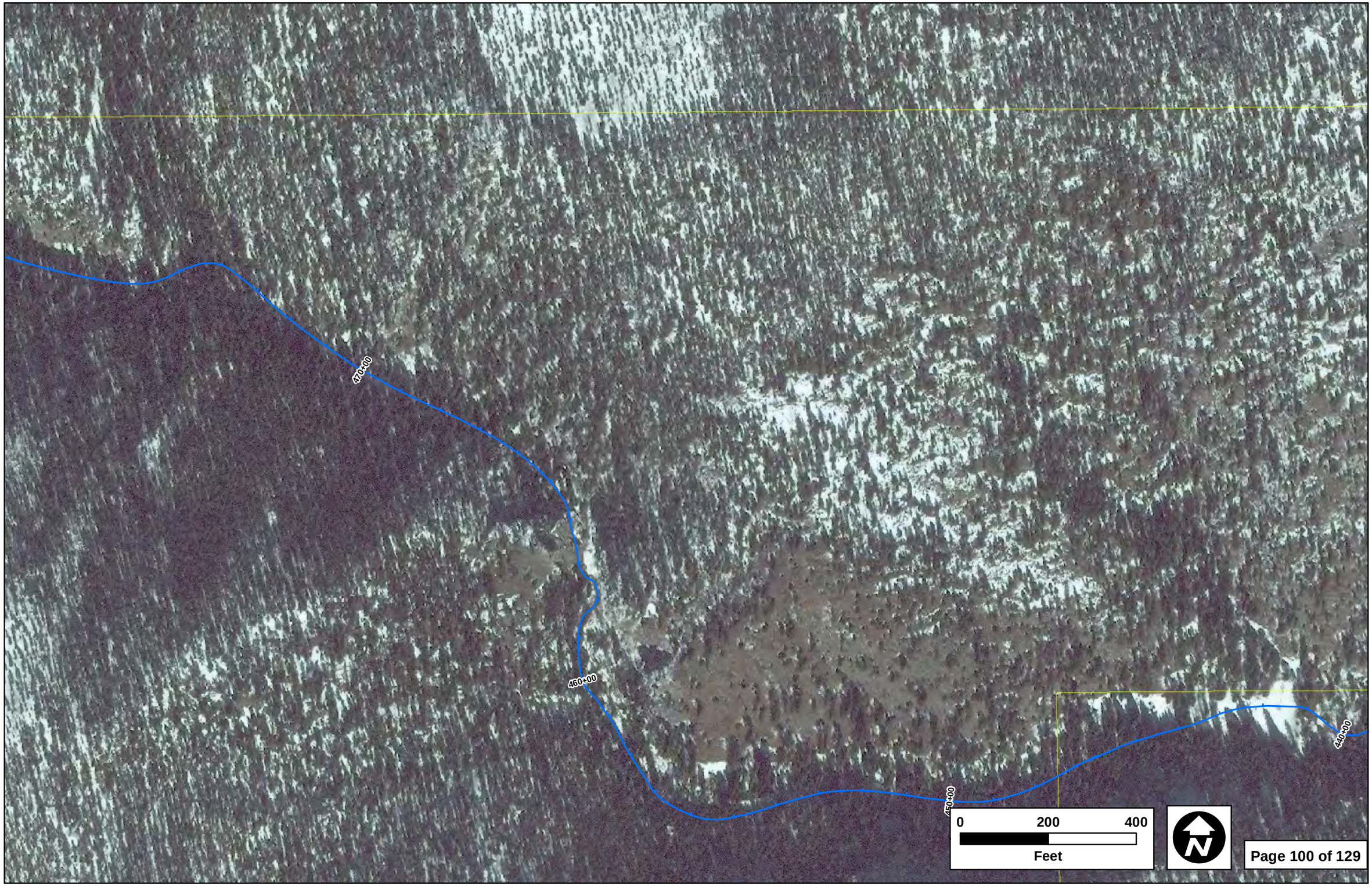
Little Thompson Bridge Assessment Summary					
Bridge Location	Type	Approx. Dimensions	Owner	Has the bridge been inspected?	Describe damage and repair work as of Summer 2014
WCR5	Concrete	65 ft span 30 ft high	Weld County	Yes	Riprap placed on upper banks of left abutment; additional riprap likely needed on right abutment and for scour toe protection.
WCR7	Concrete	50 ft span 25 ft high	Berthoud	Unknown	Riprap placed on upper banks of the abutments; may require additional toe protection.
I-25/Frontage Rd	Concrete	75 ft span 30 ft high	CDOT	Yes	Large head cut on upstream end of I-25 bridge and undermining of pier. CDOT performed some repairs following field assessments.
HW56/WCR44	Concrete	36 ft span 25 ft high	Berthoud	Not sure	Flood went over left bank tore out asphalt on road; Asphalt and bridge deck have been replaced. No riprap has been installed on abutments.
WCR13	Concrete	58 ft span 24 ft high	Weld County	Yes	Lost asphalt on bridge deck and asphalt on north side approach to bridge. Asphalt and bridge deck have been replaced. No riprap has been installed on abutments.
WCR15	Concrete	50 ft span 20 ft high	Johnstown	Unknown	It appears there was pretty severe bank erosion on the left bank both U/S and D/S of the bridge. Property owners have filled in material in the banks but no riprap protection present.
WCR17/Parish Ave	Concrete	50 ft span 20 ft high	Johnstown	Unknown	Some riprap placed on upper banks of the U/S abutments; may require additional scour protection.
WCR46.5/RR	Concrete/Steel	38 ft span 20 ft high	Johnstown	Unknown	Yes, riprap placed on upper banks of RR abutments, very little on road abutments; may require additional scour protection.
WCR19	Concrete	50 ft span 20 ft high	Weld County	Yes	Lost asphalt on bridge deck and erosion on U/S left bank; New asphalt on bridge deck and riprap has been place on left abutment.
HW60/RR	Concrete/Steel	40 ft span 20 ft high	CDOT/RR	Yes	There was significant washout of each abutment with exposed H piles and erosion of the left bank U/S of the bridge; CDOT backfilled the abutments and placed riprap on U/S and D/S ends of the abutments and added toe down protection. The RR also repaired their bridge.
HW257	Concrete	90 ft span 20 ft high	CDOT	Yes	The right abutment of the bridge was washed out during the flood; CDOT backfilled the right abutment and placed riprap on all the abutments/
RR Bridge	Steel Deck with Wooden Piers	Unknown	RR	Unknown	A lot of work has been done on the bridge, but no scour protection; may require additional toe protection

NEIGHBORHOOD: Big Elk Meadows
SHEET: 100
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon-bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.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Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 101
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon-bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

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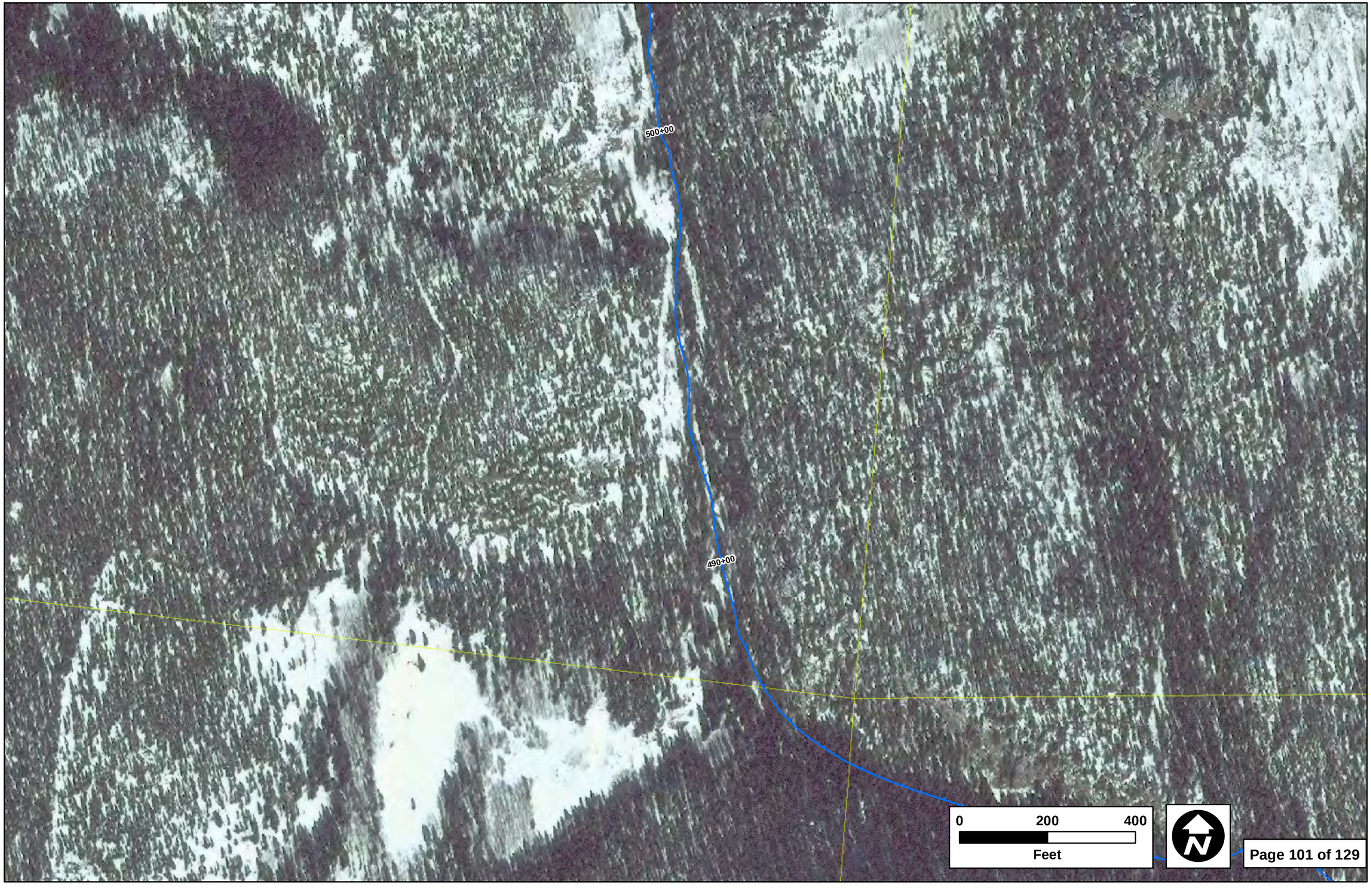
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NEIGHBORHOOD: Big Elk Meadows
SHEET: 102
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon-bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

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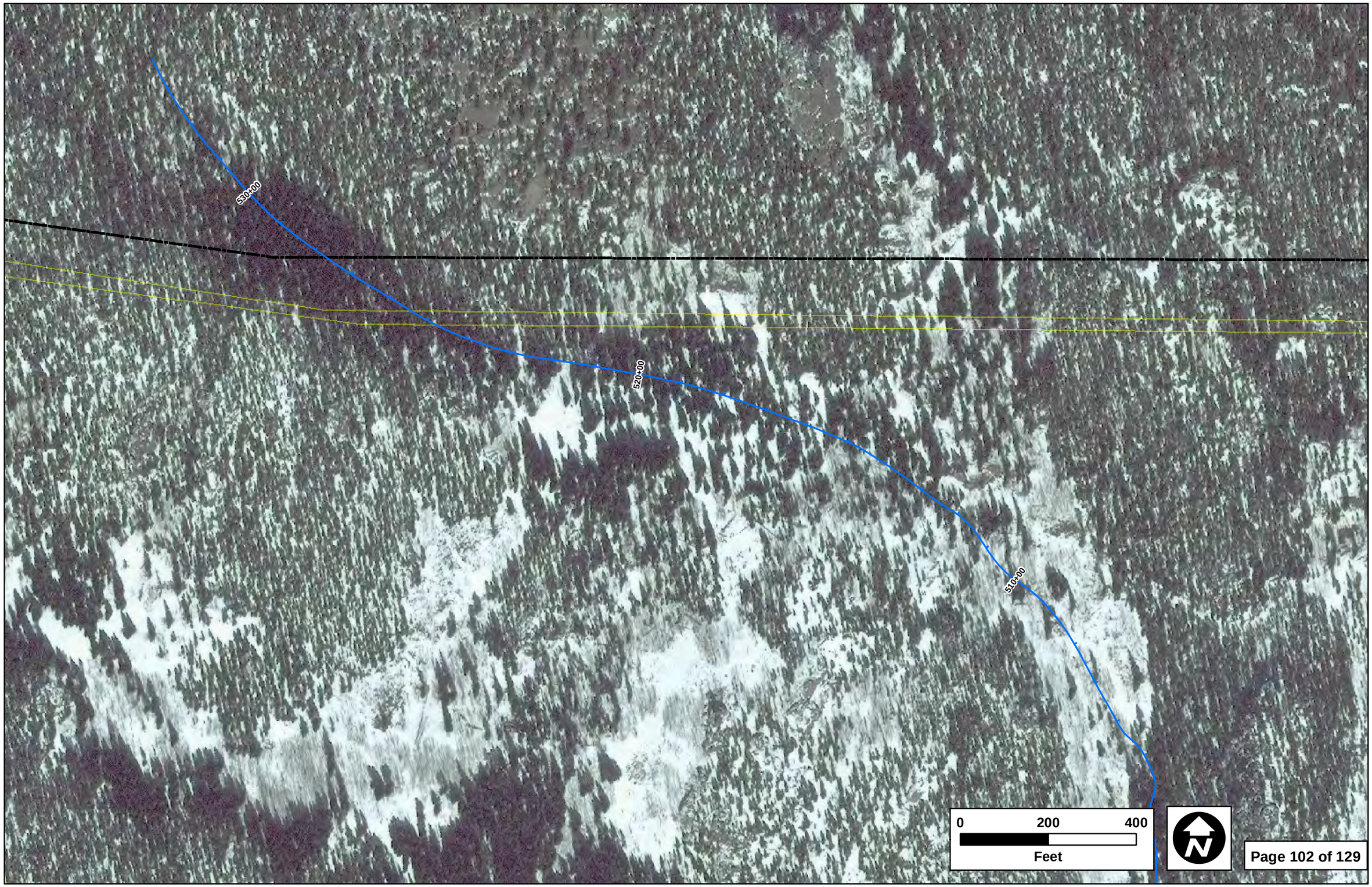
Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.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Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 103
STATION: North Fork—upstream of confluence

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is narrow and canyon bound, setting the sinuosity and river corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

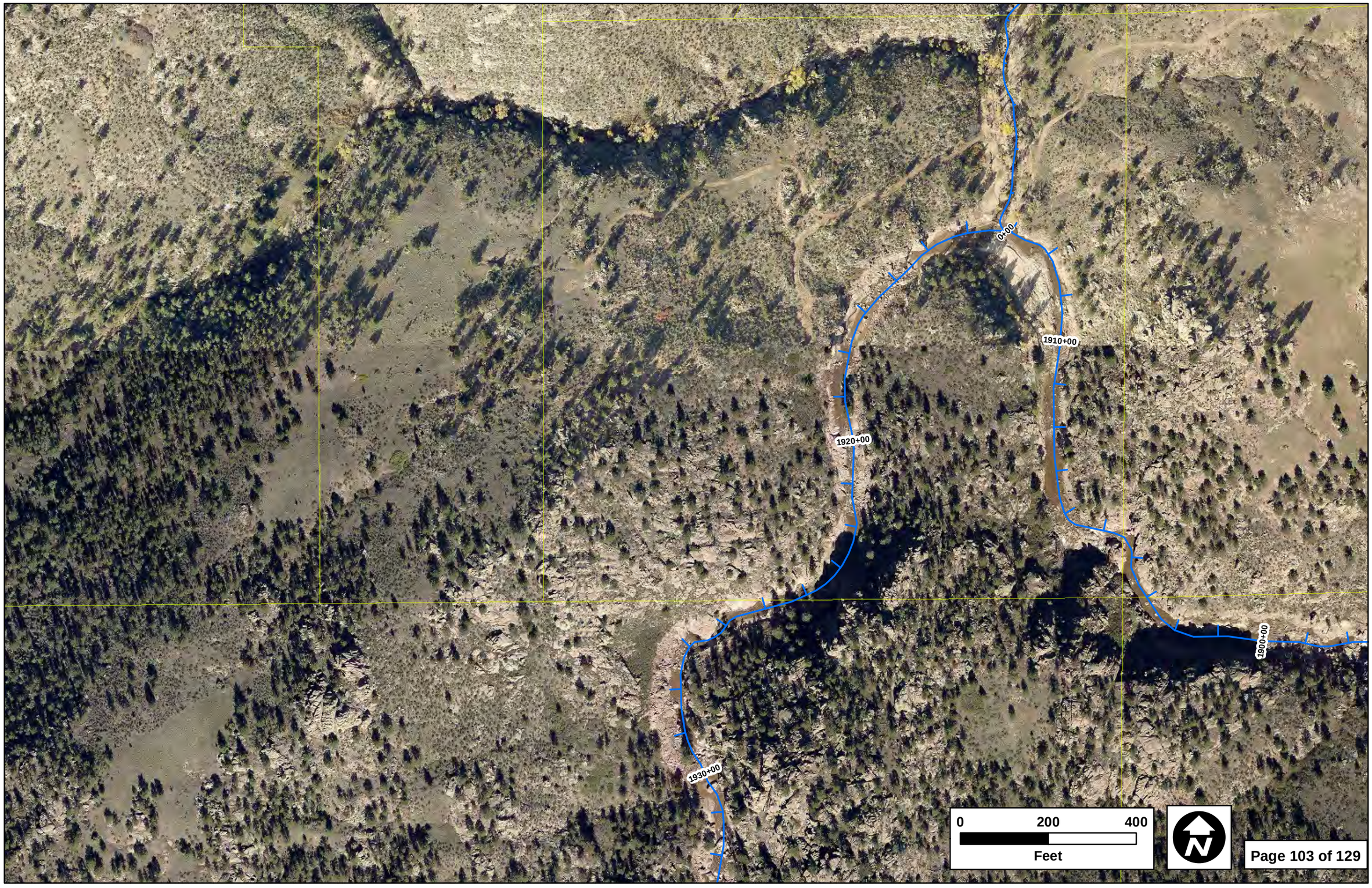
Based on field observations it appears this reach experienced some scour and pockets of deposition from the 2013 Flood as well as significant wood debris jams. Velocities were likely to have been relatively high as evidenced by the movement of debris, although because of the canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

Some restoration work was performed on the McGinnis property including debris removal, river reconstruction, drop structures and some bank protection.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.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0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 104
STATION: North Fork—upstream of Stagecoach Trail

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally canyon bound, setting the sinuosity and river corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears this reach experienced some scour from the 2013 flood. Velocities were likely to have been relatively high as evidenced by the movement of debris, although because of the canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The river generally experienced localized disturbance limited to areas with encroachments (culverts, roads etc.).

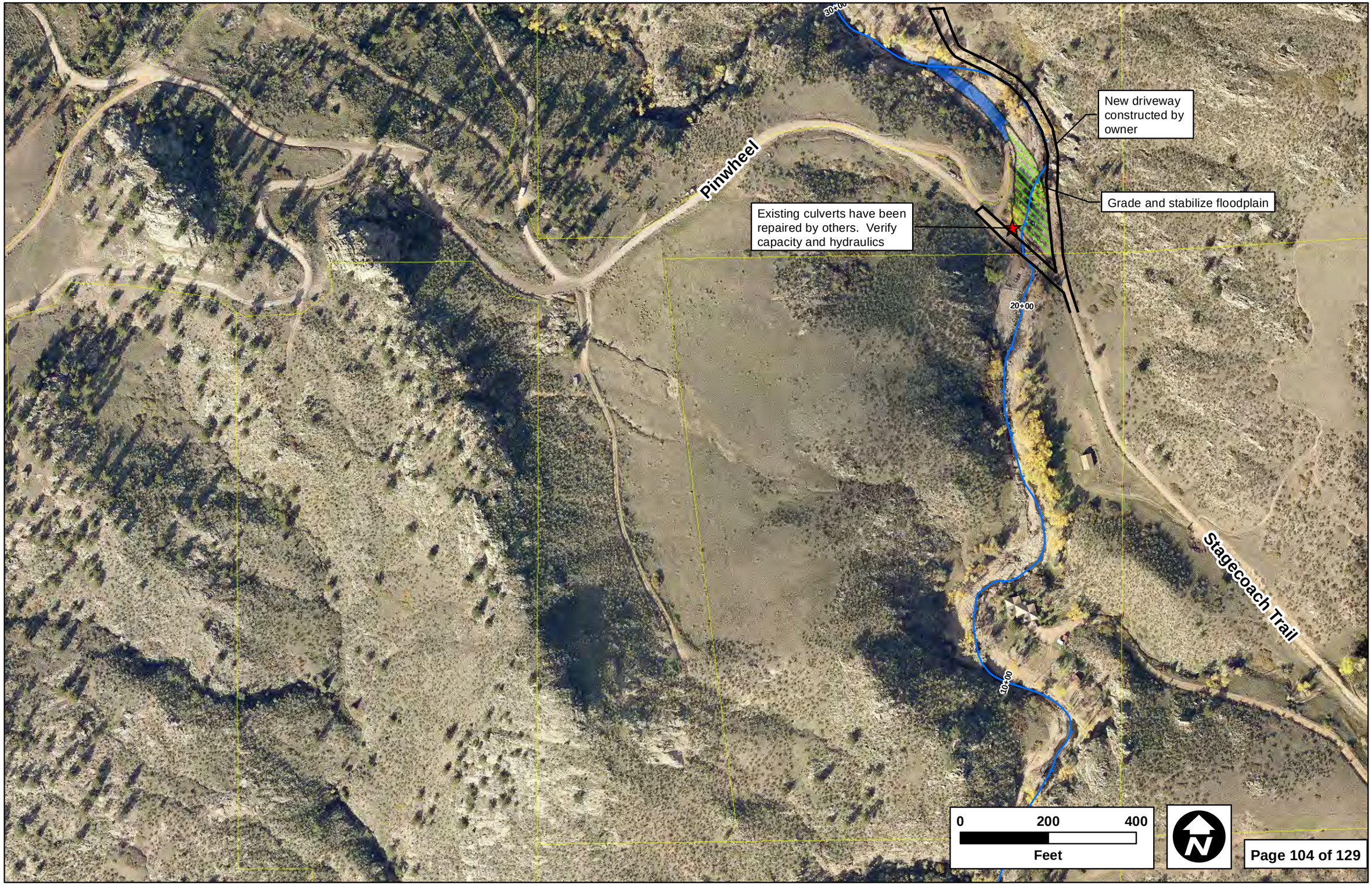
This specific reach includes a road crossing where Stagecoach Trail/Pinwheel Ranch Road crosses the river. The crossing was reportedly washed out but had been replaced prior to conducting the site assessments. The driveway to the one residence was also washed out but has since been replaced. The new driveway is located to the east of the river, thereby eliminating one culvert crossing. Additional recommendations are noted below.

RESTORATION RECOMMENDATIONS

1. Grade, stabilize and revegetate banks and floodplain.
2. Verify culvert capacity on Pinwheel.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	North Fk Sheet 104 Quantity	Cost
Mob/Demob	LS	$ 3,800	1	$ 3,800
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.25	$ 2,000
Floodplain Stabilization	AC	$ 8,100	0.25	$ 2,000
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0.25	$ 1,300
Temporary irrigation and weed management	LS	$ 1,000	1	$ 1,000
Site specific-Road and culvert replacement	LS	$ 70,000		$ -
SUBTOTAL				$ 10,100
Contingency, 15% of subtotal				$ 1,500
Permitting , 2.5% of subtotal				$ 300
Design, plans, specification, contract administration, 15%				$ 1,500
Supervision & Administration, 10%				$ 1,000
TOTAL				$ 14,000


Pinwheel
New driveway constructed by owner
Grade and stabilize floodplain
Existing culverts have been repaired by others. Verify capacity and hydraulics
30+00
20+00
10+00
Stagecoach Trail
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 105
STATION: North Fork upstream of Stagecoach

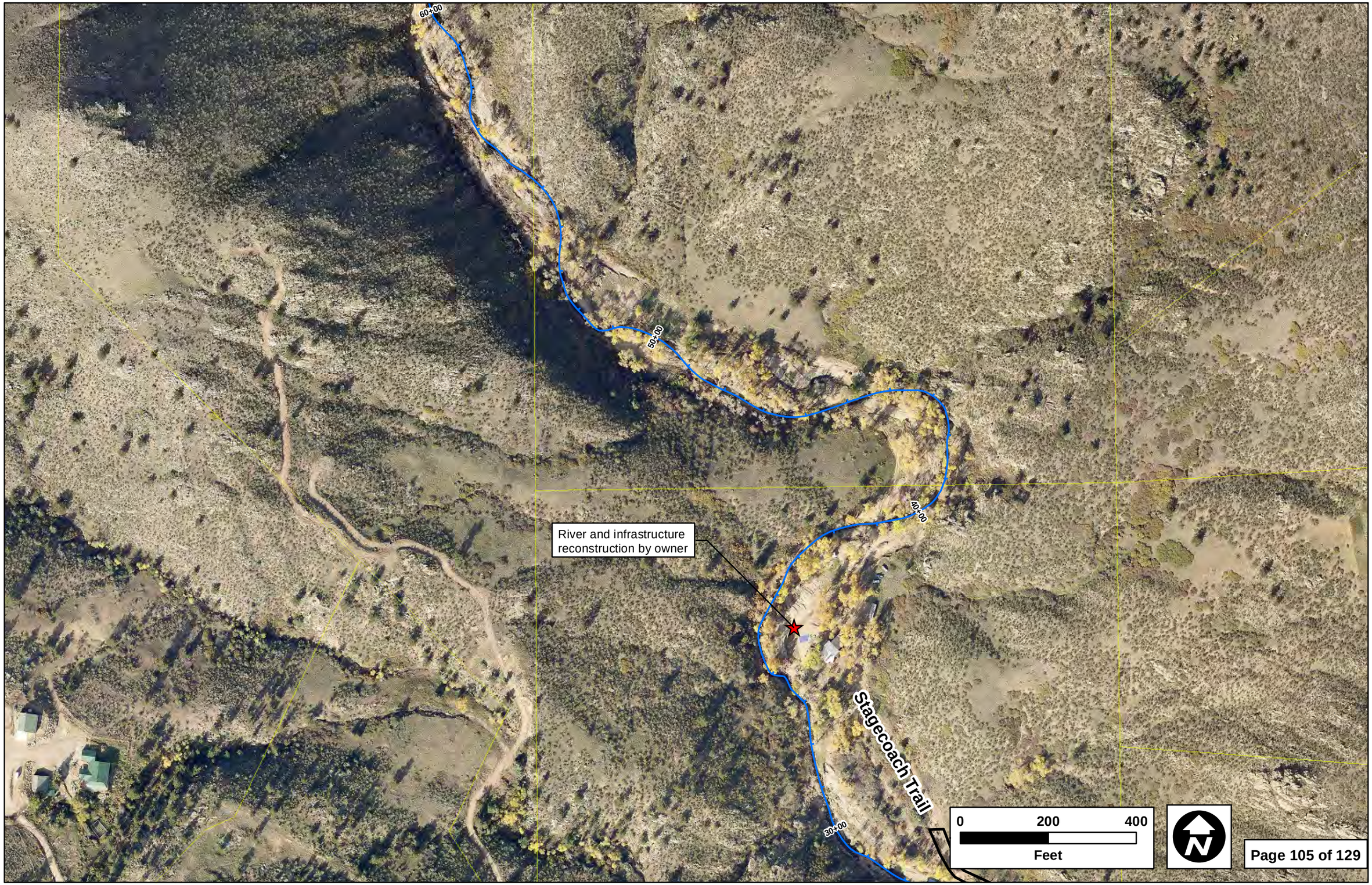
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by steep hillsides and rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears this reach experienced some scour from the 2013 Flood. Velocities were likely to have been relatively high as evidenced by the movement of rock and tree debris, although because of the canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

This specific reach includes a private residence (Vancleve/Larson) which was inundated during the 2013 Flood, sustaining primarily water damage. Other structures which were lost or damaged included a small bridge, several outbuildings, and two ponds. In addition the property experienced some erosion and debris accumulation. Flood related damage and debris clean up noted on this sheet are being, or have been, repaired or addressed by the property owner.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


60+00
50+00
40+00
30+00
River and infrastructure reconstruction by owner
Stagecoach Trail
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 106
STATION: North Fork upstream of Stagecoach

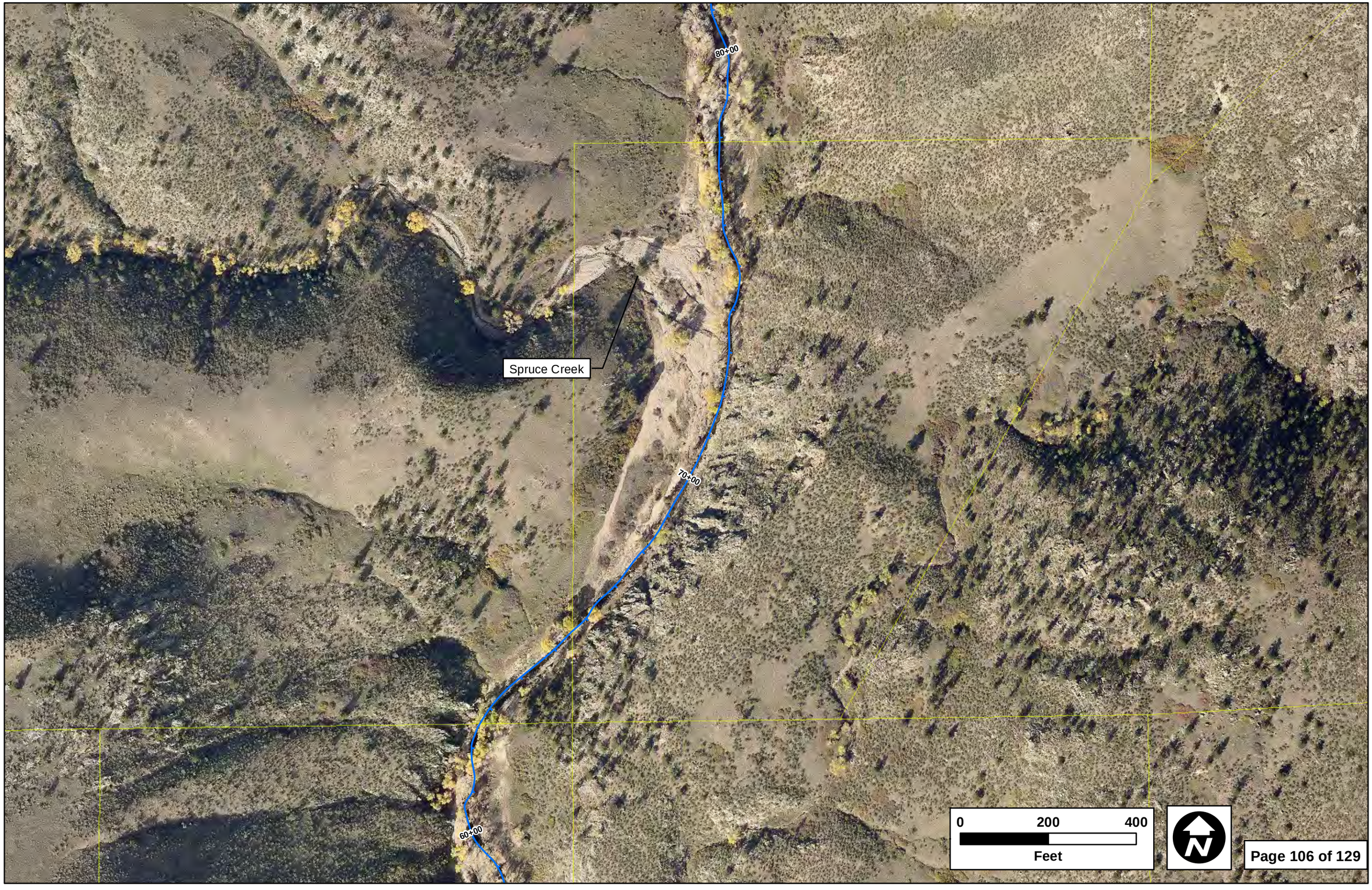
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, primarily larger cottonwood trees and willows. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Spruce Creek, a tributary to the North Fork, confluences at Sta 75+00. Spruce Creek appears to have been impacted by a mud and debris flow, likely the result of the 2013 flood, including a alluvial deposits and leveed channels typical of a mud and debris event. Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


80+00
Spruce Creek
70+00
60+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 107
STATION: North Fork—upstream of Stagecoach

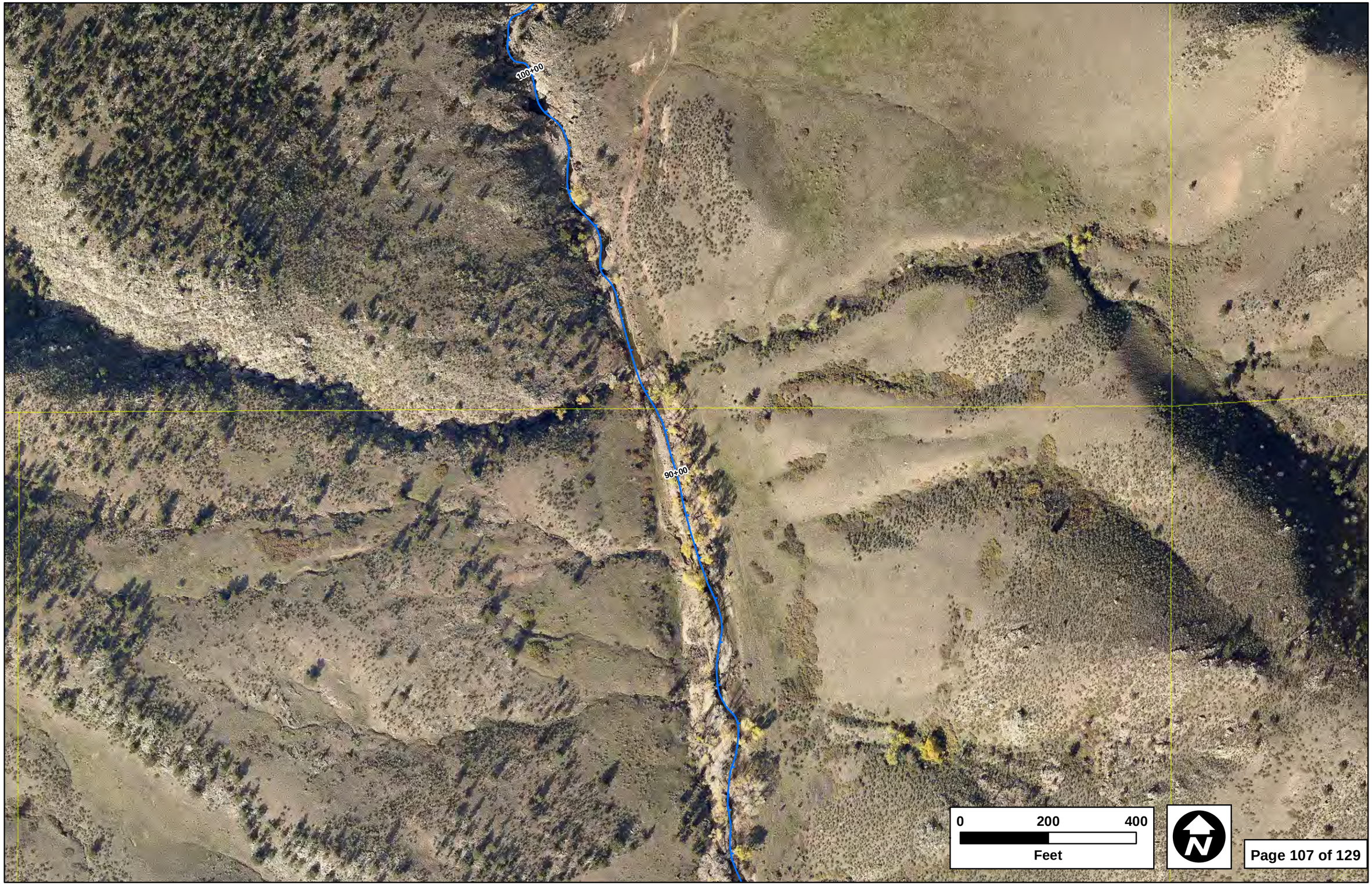
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a narrow vegetated riparian corridor, approximately 50 to 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


100+00
90+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 108
STATION: North Fork—upstream of Stagecoach

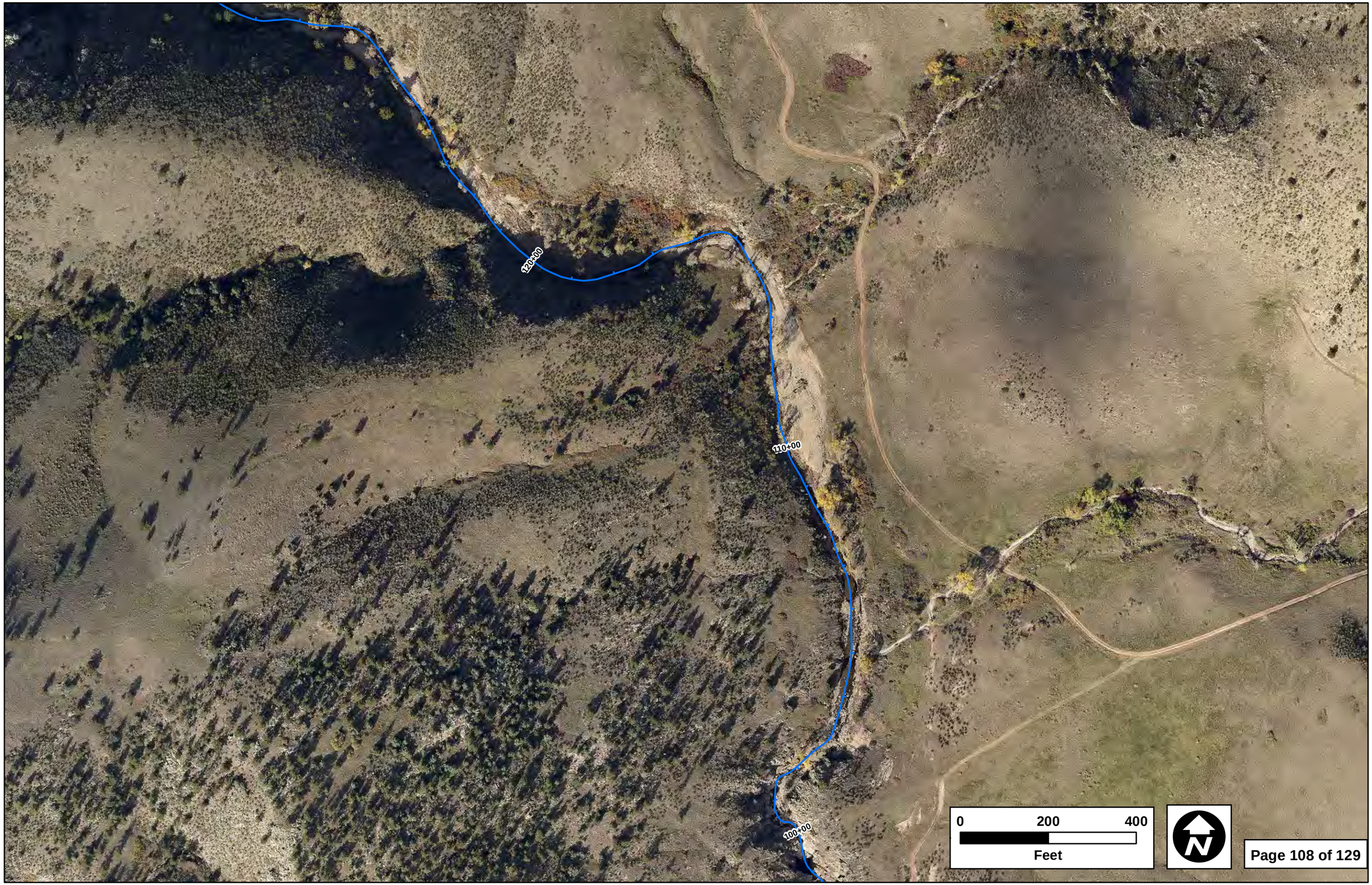
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a narrow vegetated riparian corridor, approximately 50 to 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


120+00
110+00
100+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 109
STATION: North Fork—upstream of Stagecoach

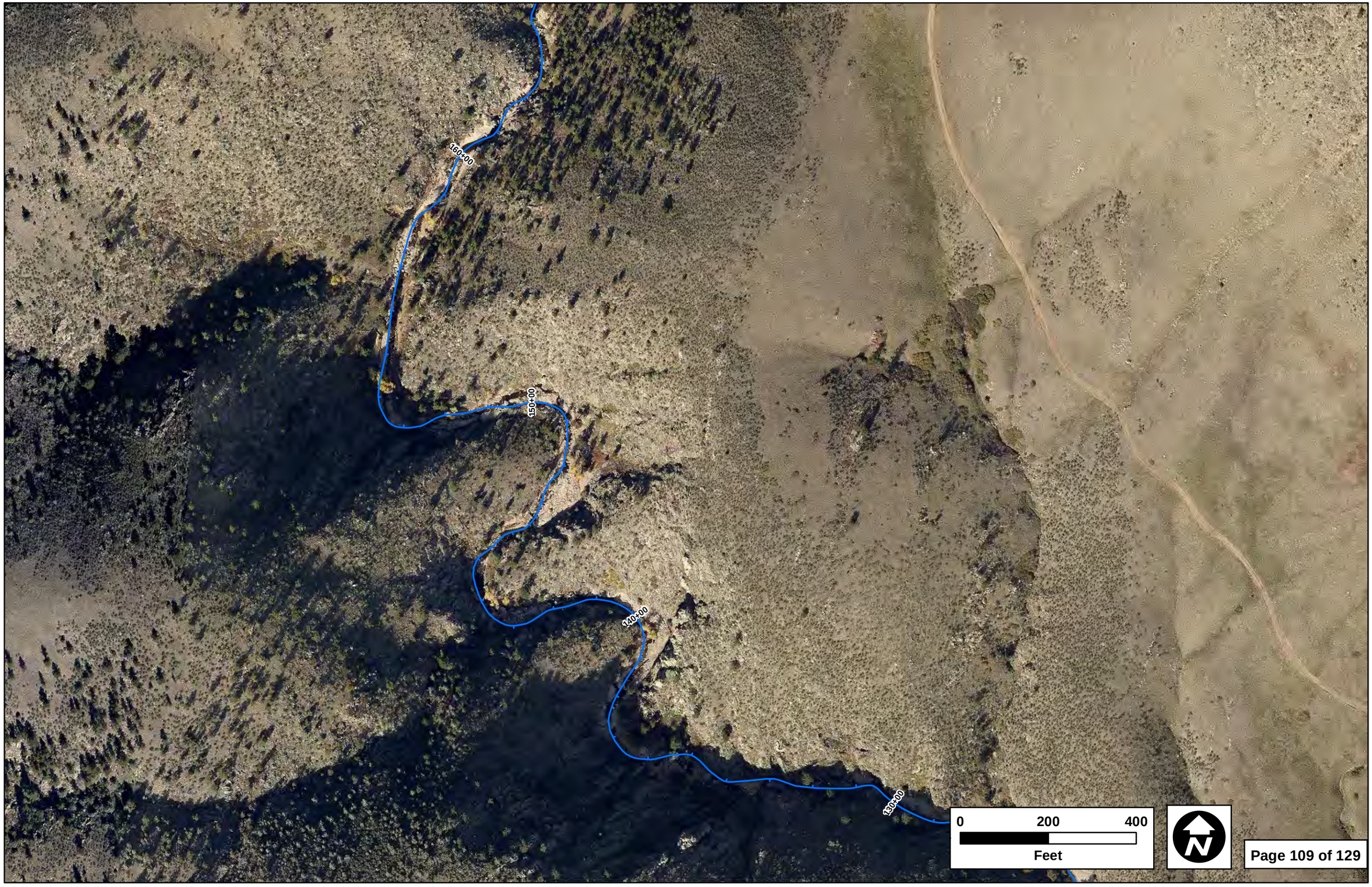
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a narrow vegetated riparian corridor, approximately 50 to 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


160+00
150+00
140+00
130+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 110
STATION: North Fork upstream of Stagecoach

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a narrow vegetated riparian corridor, approximately 50 to 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


200+00
190+00
180+00
170+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 111
STATION: North Fork—upstream of Stagecoach

POST-FLOOD CONDITIONS

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a narrow vegetated riparian corridor, approximately 50 to 100 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Hells Canyon, a tributary to the North Fork, confluences at Sta 207+00. Hells Canyon appeared to have been significantly impacted by high flows from the 2013 flood, evidenced by large boulder debris fields and significantly wider channels and the loss of its vegetative riparian corridor in many locations.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


220+00
Hells Canyon
210+00
200+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 112
STATION: North Fork—upstream of Stagecoach

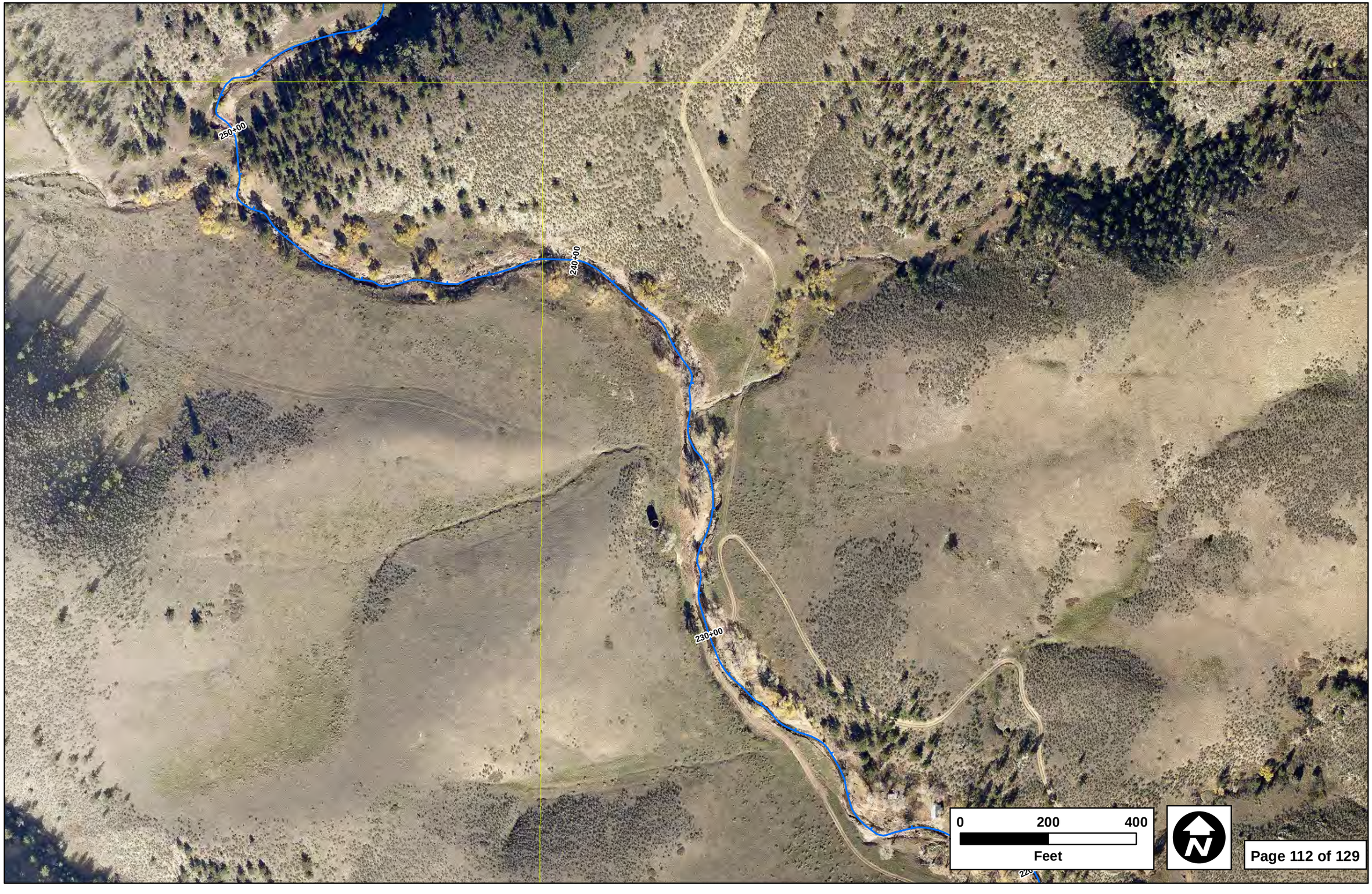
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 50 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, primarily larger cottonwood trees and willows. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


250+00
240+00
230+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 113
STATION: North Fork—upstream of Stagecoach

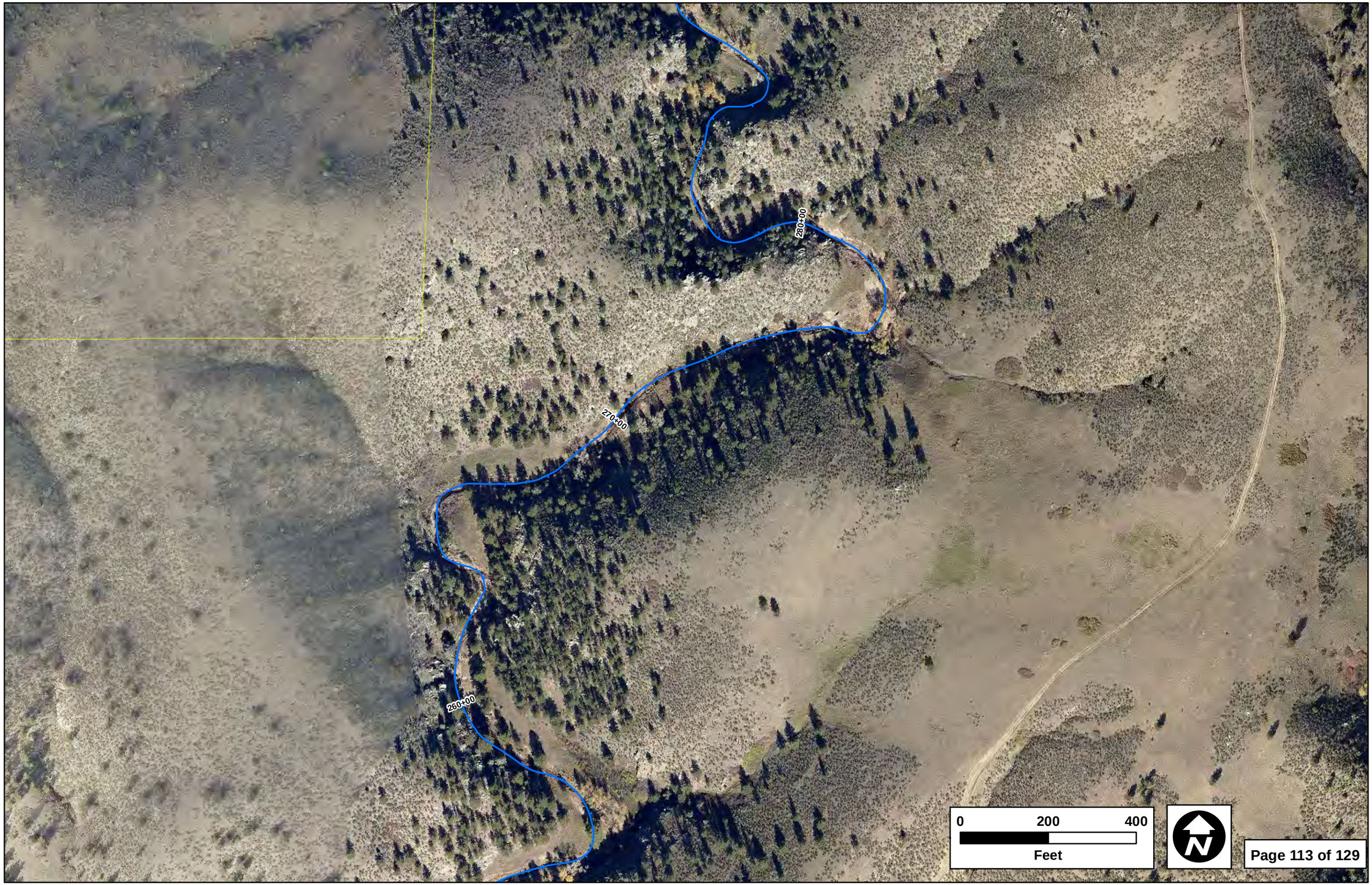
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 50 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, primarily larger cottonwood trees and willows. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


290+00
270+00
260+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 114
STATION: North Fork—upstream of Stagecoach

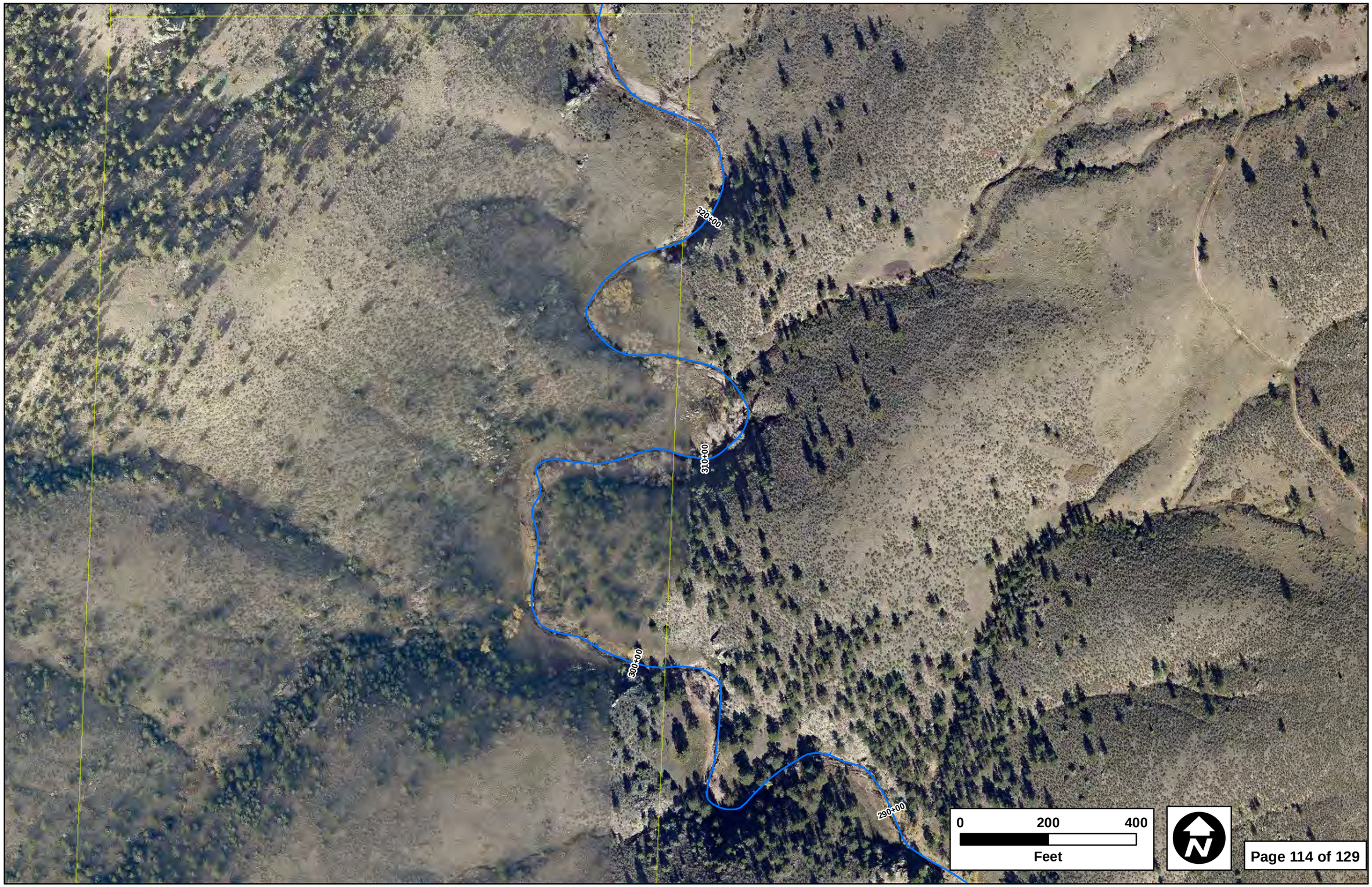
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 50 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, primarily larger cottonwood trees and willows. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Overall much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


320+00
310+00
300+00
290+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 115
STATION: North Fork—upstream of Stagecoach

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, approximately 50 feet wide, comprised primarily of cottonwoods and willows, some of which were torn out during the flood. The river is generally bound by hillsides and some rock outcrops, setting the riparian corridor alignment. The North Fork is a relatively small stream system that often goes dry by late summer.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, primarily larger cottonwood trees and willows. Grasses appear to be emerging at the time of the field visit. The channel bottom is composed of cobbles and boulders with a reformation of pools and riffles after the flood.

Pole Hill Tunnel, a CBT power station, is located in this reach. Water from Lake Estes and some Big Thompson River floodwaters are conveyed by Olympus Siphon and Tunnel and Pole Hill Tunnel and Canal to a penstock through which the water drops 815 feet to Pole Hill Power plant. It is then routed through Pole Hill Power plant After-bay, Rattlesnake Tunnel, Pinewood Lake, and Bald Mountain Pressure Tunnel, and dropped 1,055 feet through two penstocks to Flatiron Power plant. An overflow system is located at the top of the penstock, which allows for the diversion of CBT water (approximately 500 to 600 cfs) into the North Fork should an emergency shut-off occur at the Pole Hill penstock and/or power plant. This abrupt change in flows can result in unexpected rises in the surface water elevations of the North Fork and to a lesser extent in the Little Thompson River. This overflow situation likely occurred during the 2013 flood event as evidenced by the stream and overbank scour and disturbance immediately downstream of the After-bay and diversion structure. Restoration of the channel and overbanks is recommended. In addition, an automated gage warning system is recommended to notify residences downstream of Pole Hill.

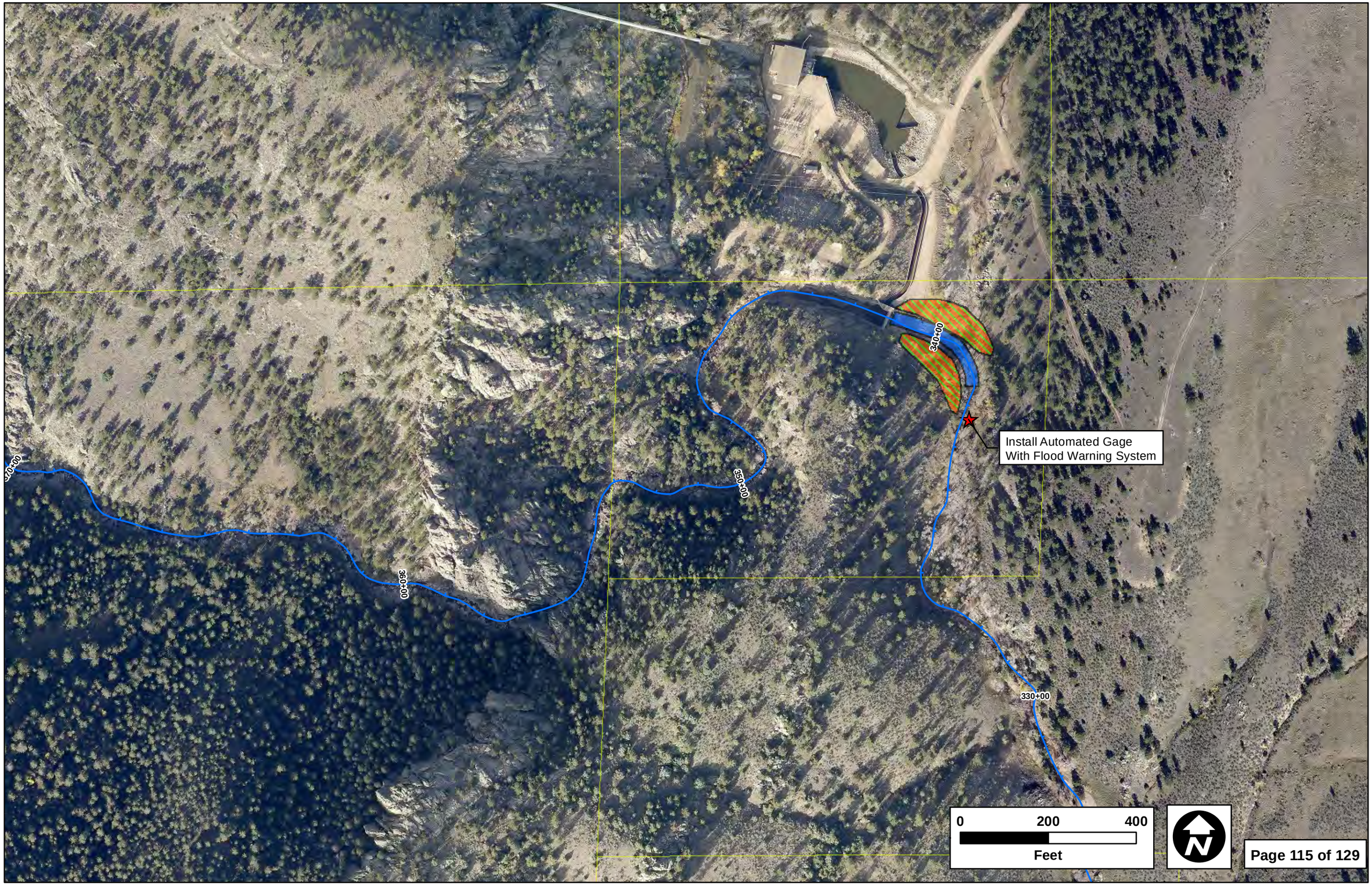
The remainder of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

1. Grade and stabilize the floodplain.
2. Reconstruct the low-flow channel.
3. Install automated flood-warning system.
4. In remaining sections, allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	North Fork Sheet 115 Quantity	North Fork Sheet 115 Cost
Mob/Demob	LS	$ 1,800	1	$ 1,800
Dewatering	LF	$ 14	300	$ 4,200
Create/refine Low Flow Channel	LF	$ 27	300	$ 8,100
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.5	$ 4,000
Floodplain Stabilization	AC	$ 8,100	0.5	$ 4,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	300	$ 1,500
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0.5	$ 2,500
Temporary irrigation and weed management	LS	$ 2,025	1	$ 2,000
Gage	LS	$ 10,000	1	$ 10,000
SUBTOTAL				$ 38,200
Contingency, 15% of subtotal				$ 5,700
Permitting , 2.5% of subtotal				$ 1,000
Design, plans, specification, contract administration, 15%				$ 5,700
Supervision & Administration, 10%				$ 3,800
TOTAL				$ 54,000


340+00
350+00
360+00
370+00
330+00
Install Automated Gage
With Flood Warning System
0
200
400
Feet
N

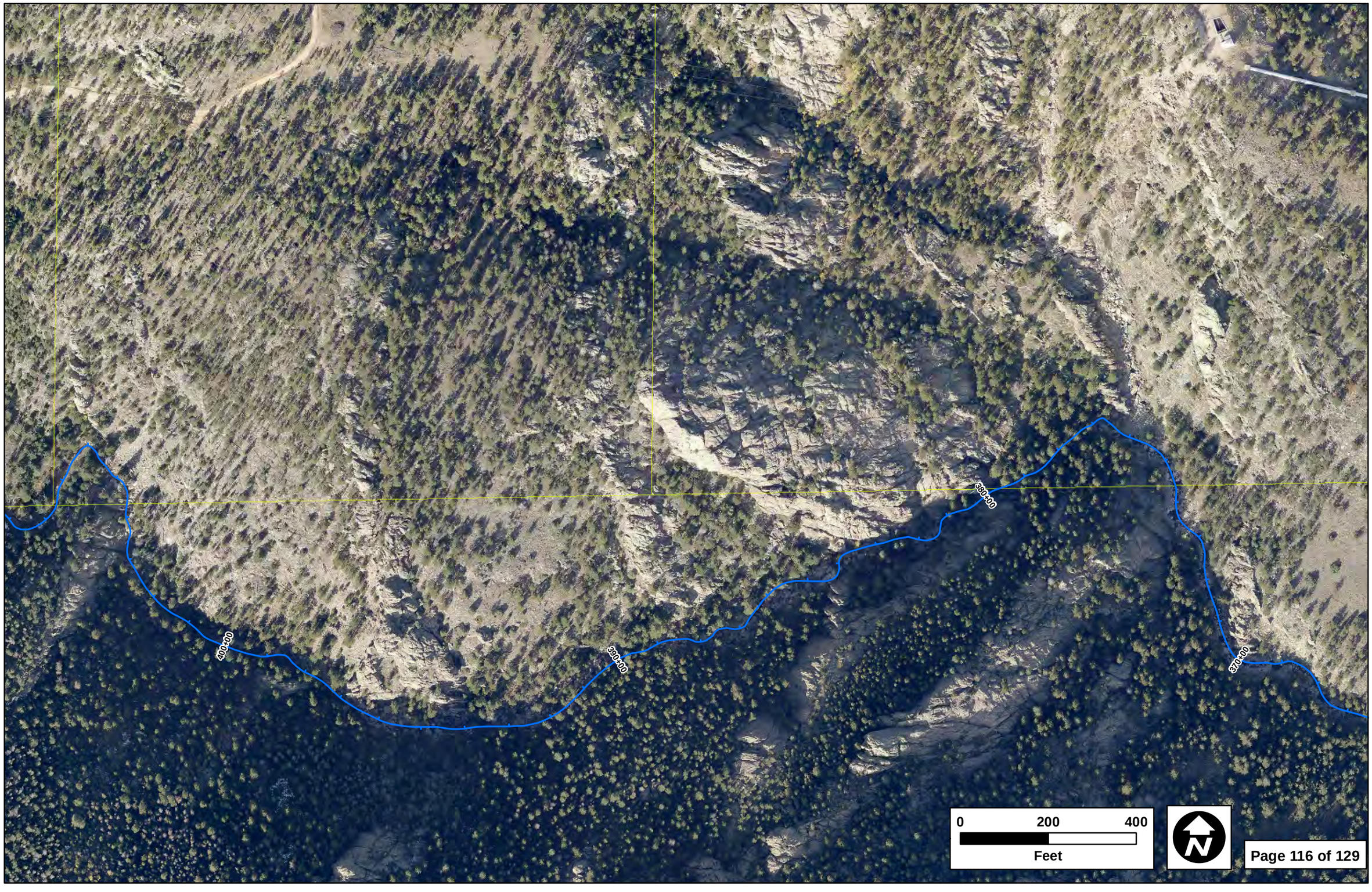
NEIGHBORHOOD: Blue Mountain
SHEET: 116
STATION: North Fork—upstream of Pole Hill

Aerial photos of pre-flood conditions and anecdotal information indicate this reach is extremely steep, canyon bound with little vegetation and rock outcrops controlling the river and its alignment. This section of the North Fork is within the boundaries of the Roosevelt National Forest and is difficult to access.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


400+00
390+00
380+00
370+00
0
200
400
Feet

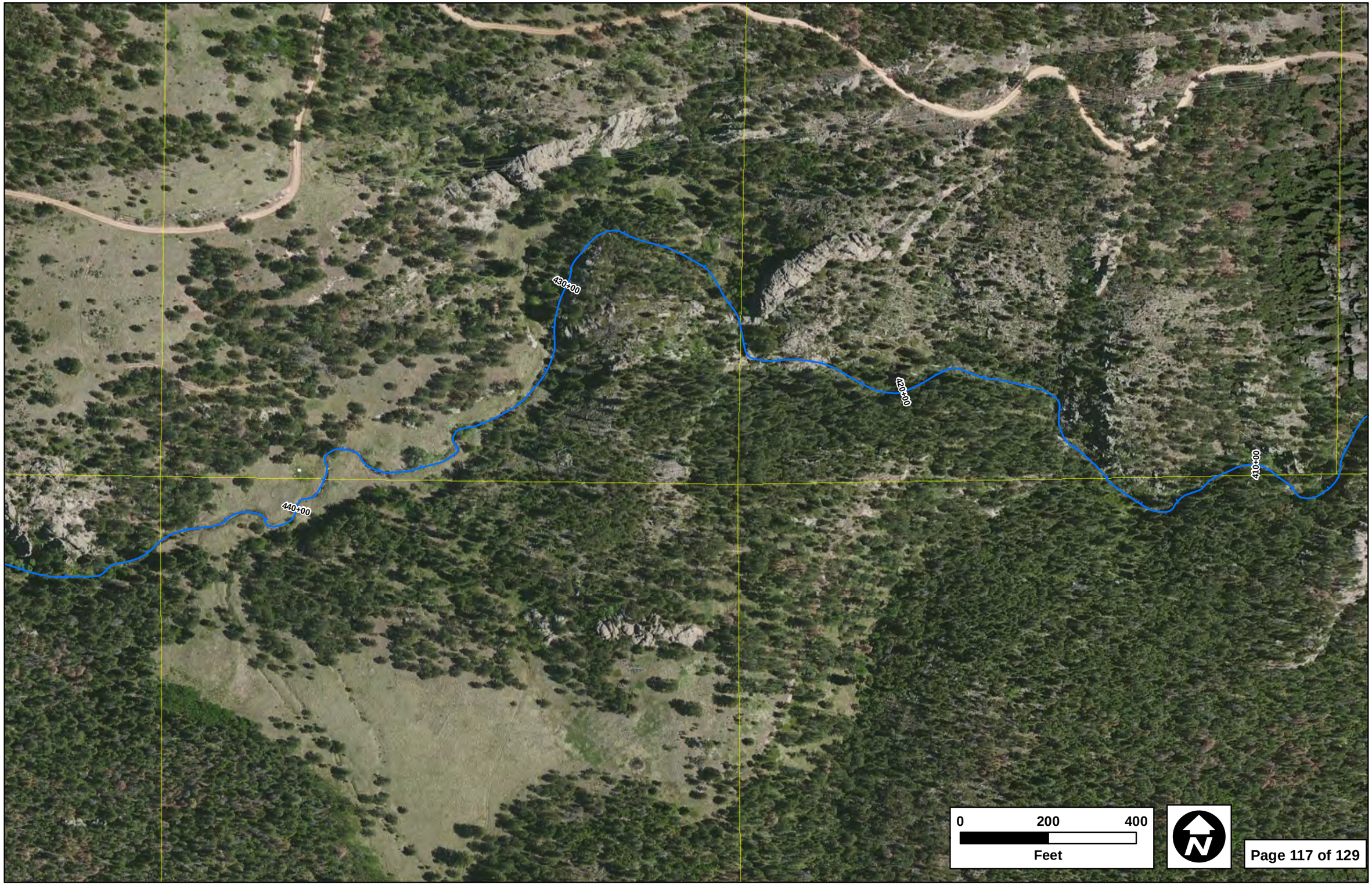
NEIGHBORHOOD: Blue Mountain
SHEET: 117
STATION: North Fork—upstream of Pole Hill

Aerial photos of pre-flood conditions and anecdotal information indicate this reach is extremely steep, canyon bound with little vegetation and rock outcrops controlling the river and its alignment. This section of the North Fork is within the boundaries of the Roosevelt National Forest and is difficult to access.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


430+00
420+00
410+00
440+00
0
200
400
Feet
N

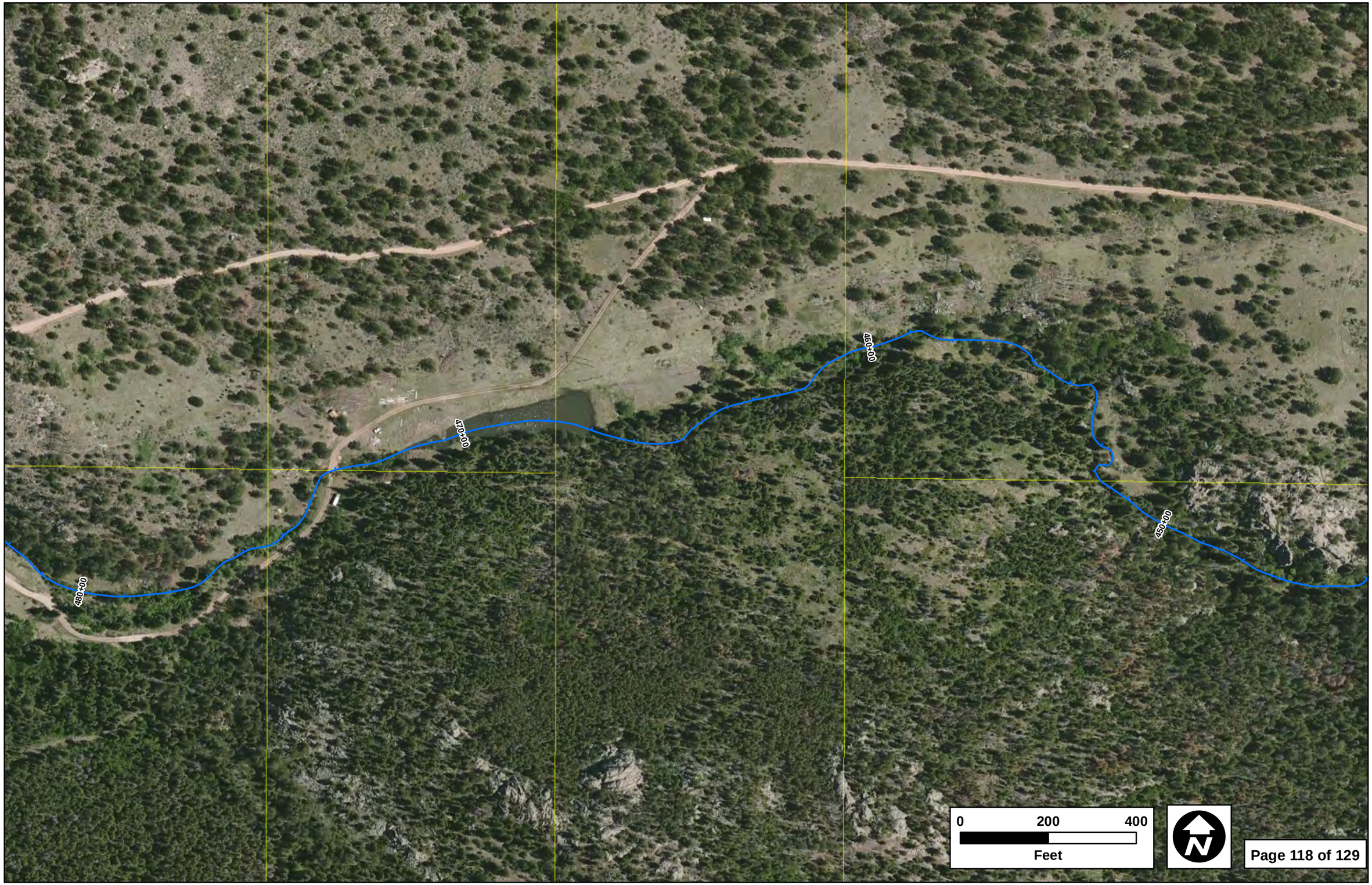
NEIGHBORHOOD: Blue Mountain
SHEET: 118
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is extremely steep, canyon bound with little vegetation and rock outcrops controlling the river and its alignment. The upper portion of this reach begins to flatten out and private land ownership checkerboards the watershed and riparian corridor.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


470+00
460+00
450+00
480+00
0
200
400
Feet
N

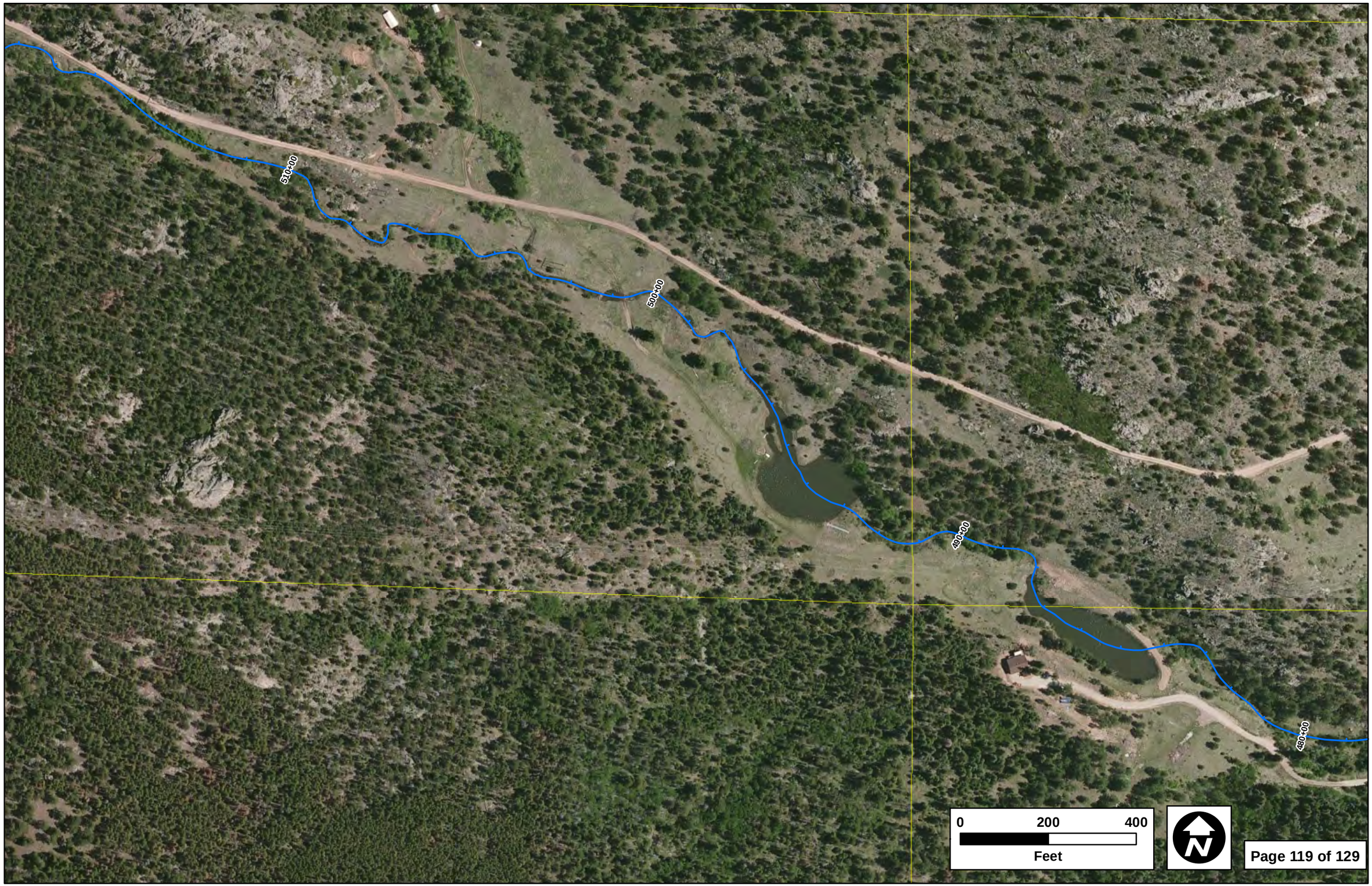
NEIGHBORHOOD: Blue Mountain
SHEET: 119
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest although some private land ownership exists. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is transitions between steep sections and meadows typical of headwater regions in the Rocky Mountains.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


510+00
500+00
490+00
480+00
0
200
400
Feet

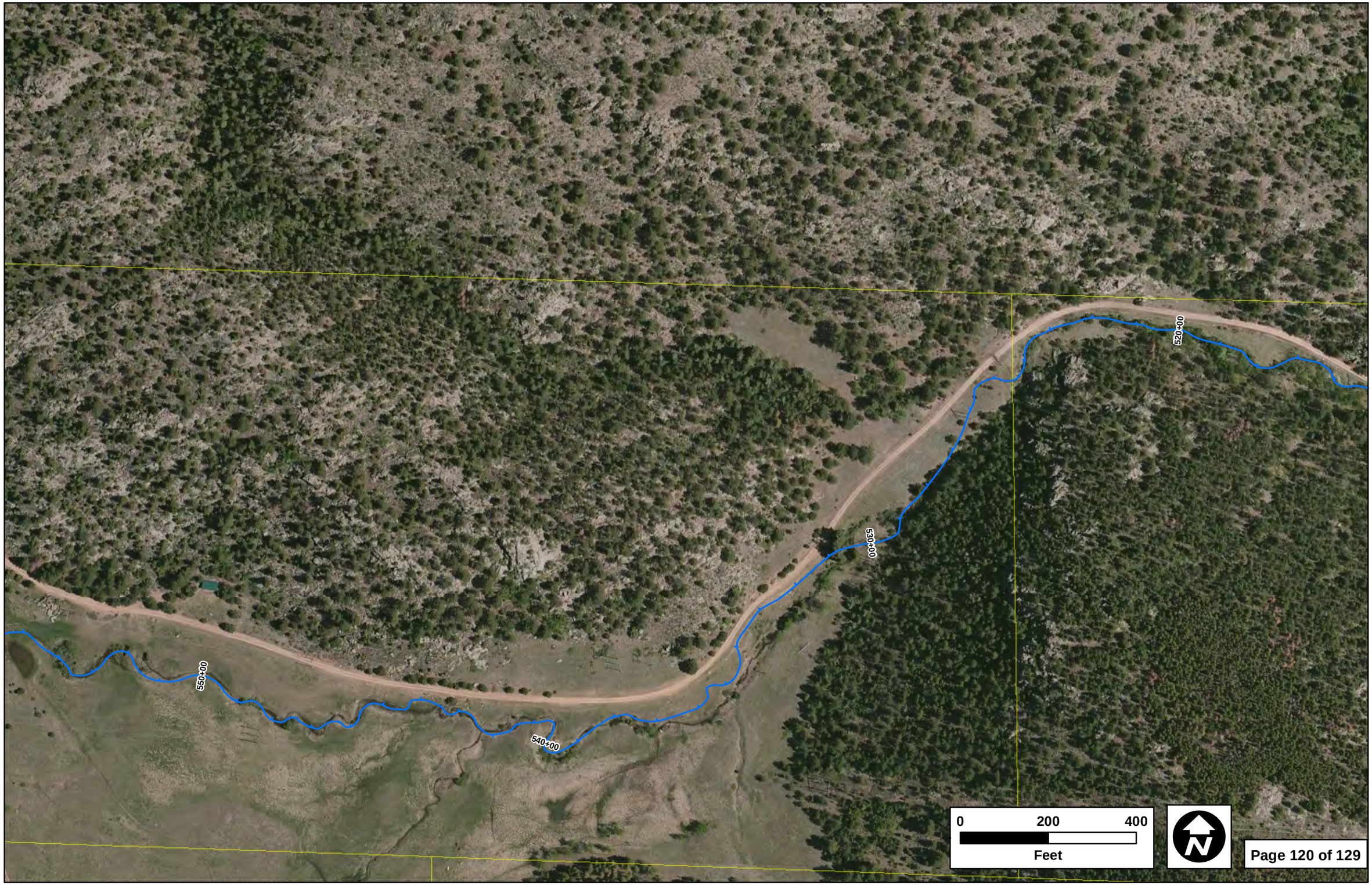
NEIGHBORHOOD: Blue Mountain
SHEET: 120
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest although some private land ownership exists. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is transitions between steep sections and meadows typical of headwater regions in the Rocky Mountains.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


520+00
530+00
540+00
550+00
0
200
400
Feet

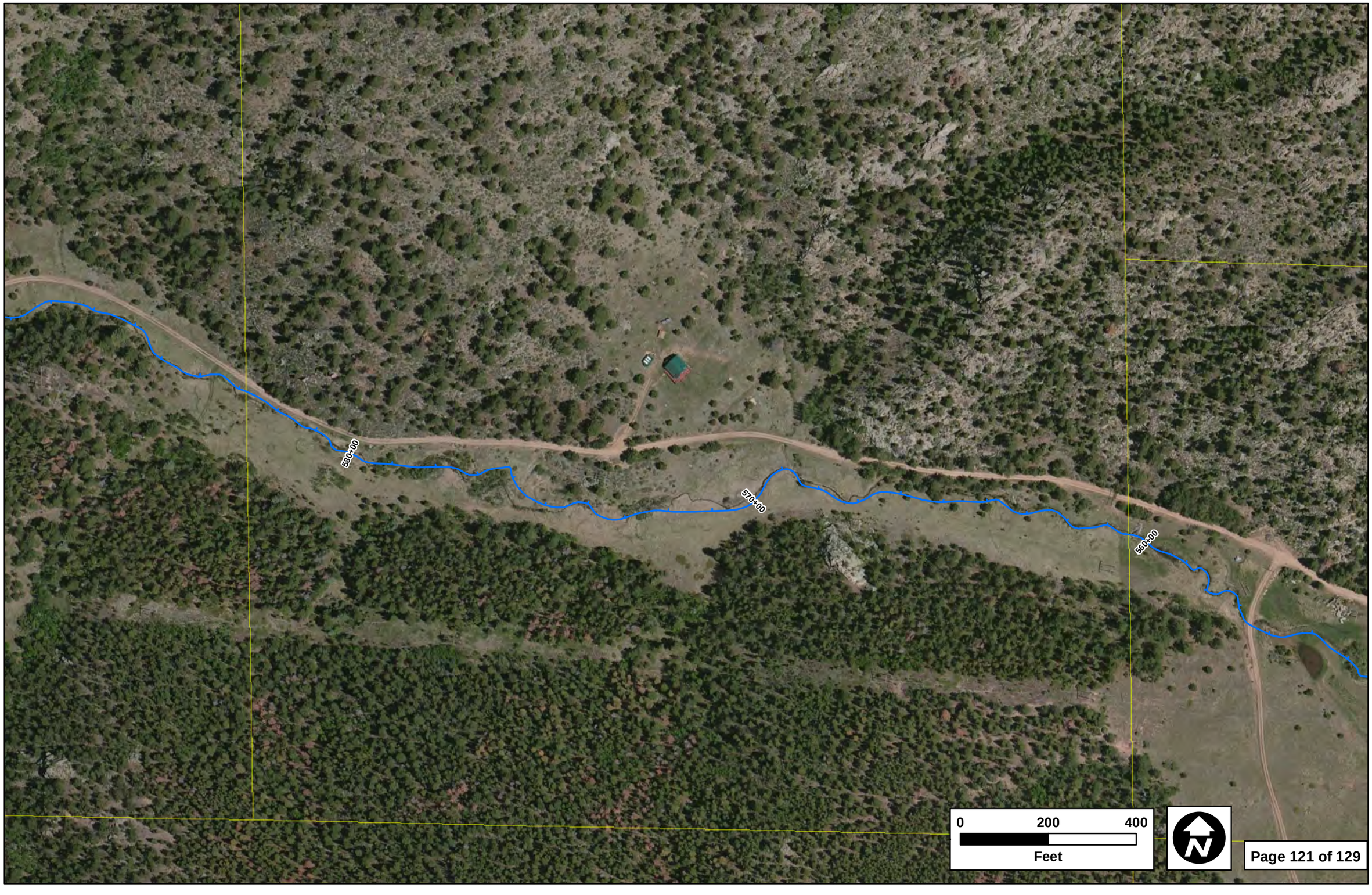
NEIGHBORHOOD: Blue Mountain
SHEET: 121
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest although some private land ownership exists. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is transitions between steep sections and meadows typical of headwater regions in the Rocky Mountains.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


580+00
570+00
560+00
0
200
400
Feet
N

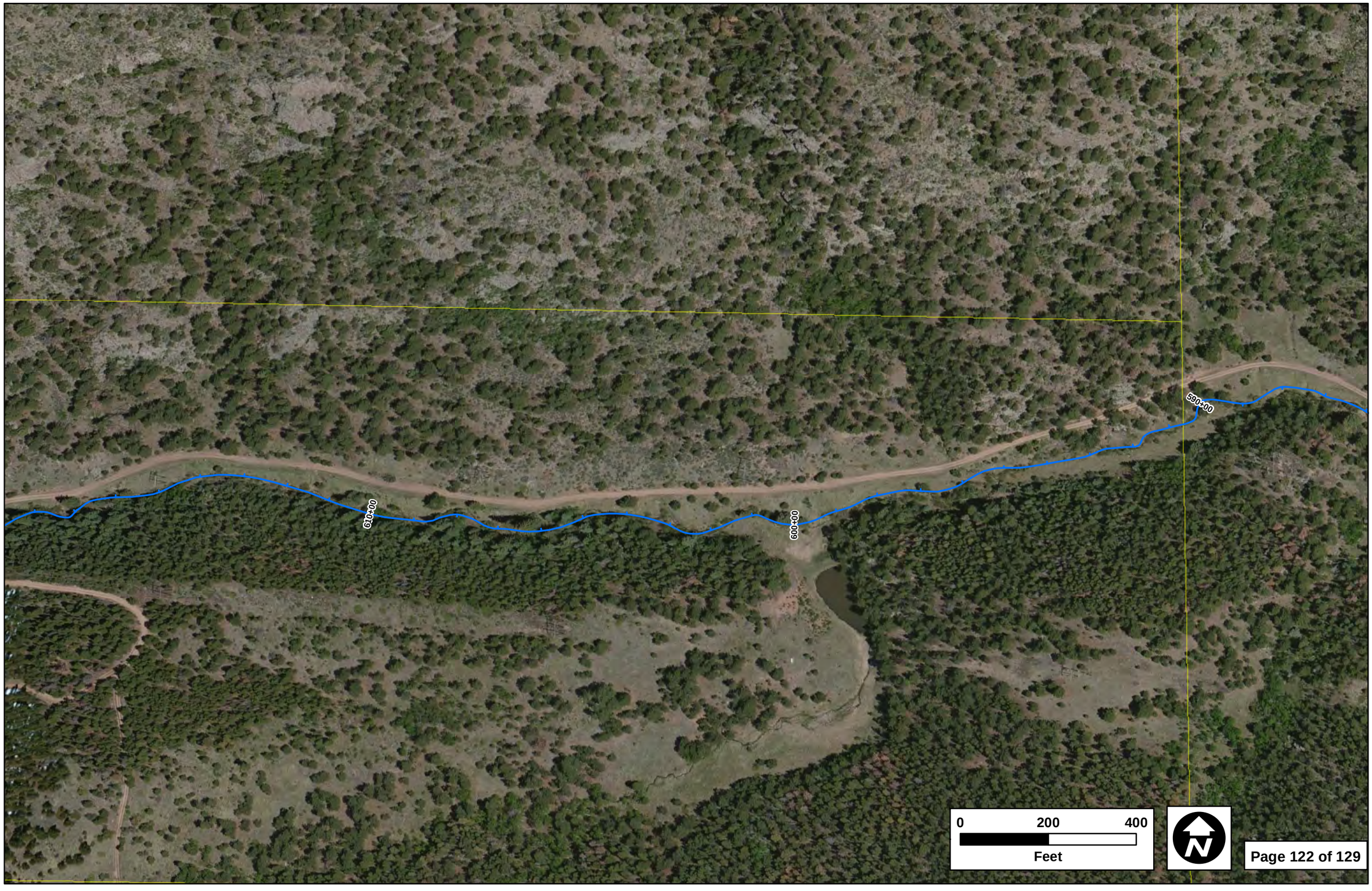
NEIGHBORHOOD: Blue Mountain
SHEET: 122
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest although some private land ownership exists. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is transitions between steep sections and meadows typical of headwater regions in the Rocky Mountains.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


590+00
600+00
610+00
0
200
400
Feet
N

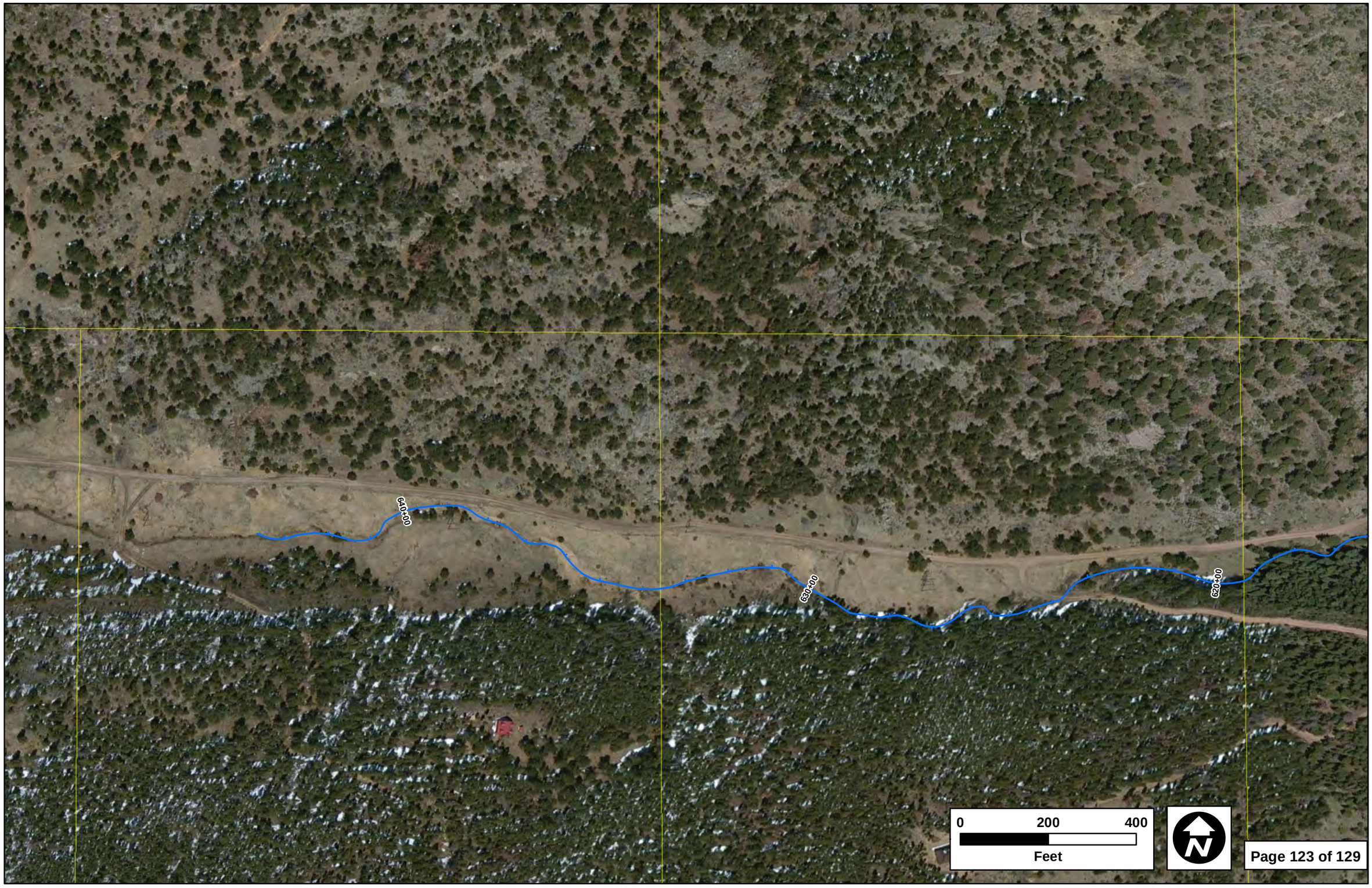
NEIGHBORHOOD: Blue Mountain
SHEET: 123
STATION: North Fork—upstream of Pole Hill

This section of the North Fork is within the boundaries of the Roosevelt National Forest although some private land ownership exists. Aerial photos of pre-flood conditions and anecdotal information indicate the lower portion of this reach is transitions between steep sections and meadows typical of headwater regions in the Rocky Mountains.

Based on field observations it appears the North Fork was somewhat disturbed from flooding but appears to have retained some vegetation, and is generally highly controlled by the rock canyons. Overall this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of riparian vegetation without active restoration. No further actions are suggested at this time.


640-00
630-00
630-00
0
200
400
Feet
N

APPENDIX C

SITE DESCRIPTIONS

NEIGHBORHOOD: Milliken
SHEET: 01
STATION: 0+00 to 23+00
RESTORATION RECOMMENATIONS: 0+00 to 23+00

This is the furthest downstream reach of the Little Thompson River at its confluence with the Big Thompson. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods, willows and grass. Grass and shrub vegetation in the first 1,600 feet appear to have been buried by sediment during the 2013 flood, likely the result of backwater at the confluence with the Big Thompson. The 2013 flood did not appear to alter the channel alignment or result in significant bank destabilization, although based on review of aerial photos it appears the low-flow channel has widened and aggraded, which could affect the channel capacity. Adjacent land use includes agriculture, rural development and a railroad bridge, all which control the lateral movement of the river and its planform.

Most of the river corridor in this reach is within the Town of Milliken and privately owned property. The Town of Milliken is currently completing a local storm water master plan. There are several recommended improvements that may be coordinated, in the future, with the LTWRC Master Plan including property acquisition, irrigation/stormwater crossing improvements, detention facilities designed with irrigation diversions or crossings, and channel improvements. One railroad bridge is within this reach. This bridge was inspected and repaired by the Railroad. Multiple properties were flooded with clusters of buildings in each property.

Flood-related impacts include deposition and channel widening. As the channel begins to recover and reset itself, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and planform. Much of this reach is relatively stable and expected to recover without restoration activities, although grading and stabilization activities, particularly the removal of sediment deposition will facilitate the natural regeneration of vegetation. Thus minor grading and stabilization are recommended in the lower portion of this reach. In addition, a review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

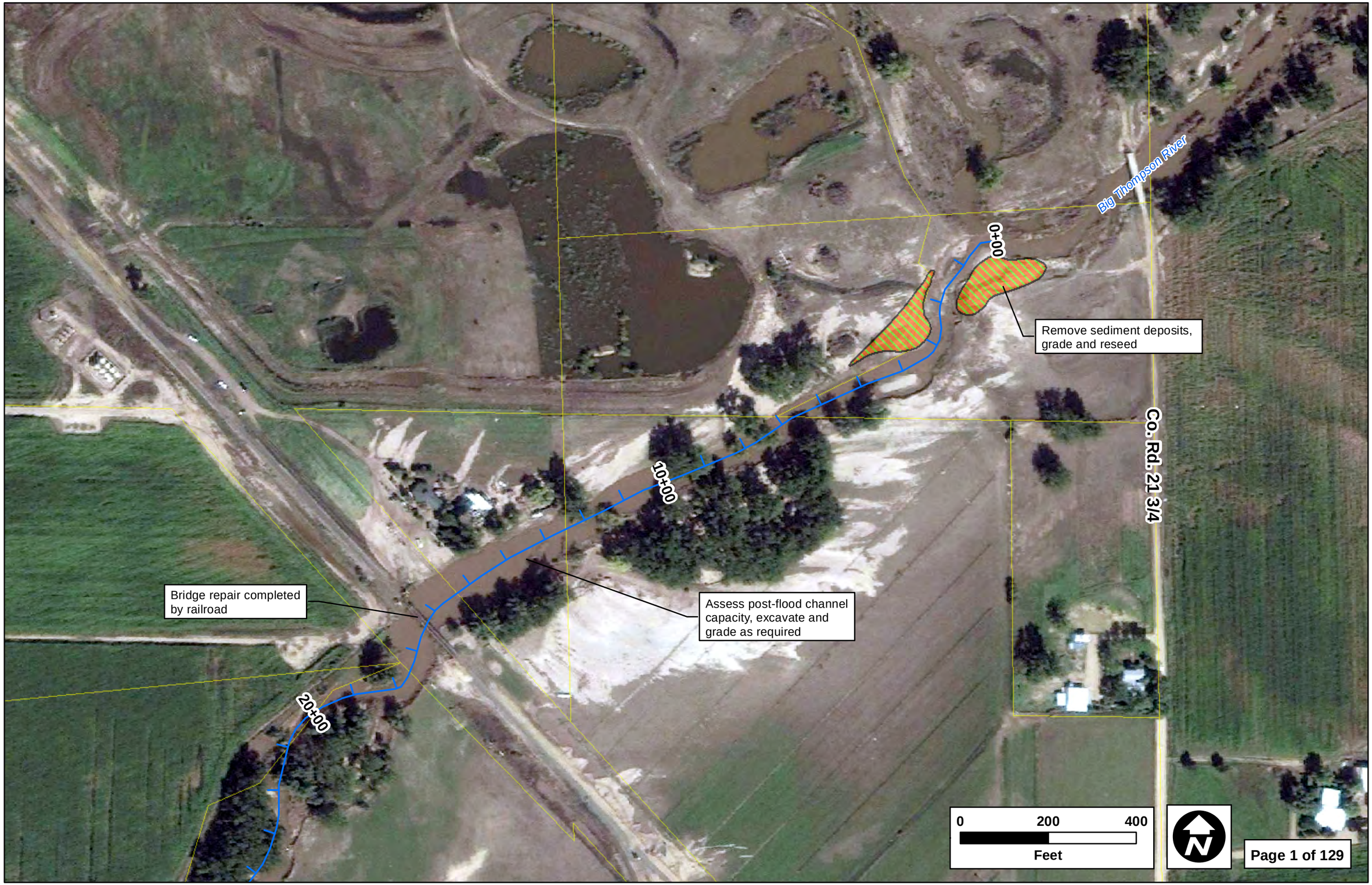
RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning with minor active restoration.

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Incorporate additional recommendations from the Town's Master Plan.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 0+00 to Sta 23+00 Sheet 1 Quantity	Cost
Mob/Demob	LS	$ 8,400	1	$ 8,400
Dewatering	LF	$ 14	2300	$ 32,200
Create/refine Low Flow Channel	LF	$ 27	0	$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	2300	$ 110,400
Grade Control	EA	$ -	0	$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100	1	$ 8,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	1	$ 5,000
Temporary irrigation and weed management	LS	$ 4,025	1	$ 4,000
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 176,100
Contingency, 15% of subtotal				$ 26,400
Permitting , 2.5% of subtotal				$ 4,400
Design, plans, specification, contract administration, 15%				$ 26,400
Supervision & Administration, 10%				$ 17,600
TOTAL				$ 251,000


Big Thompson River
0+00
10+00
20+00
Co. Rd. 21 3/4
Remove sediment deposits, grade and reseed
Assess post-flood channel capacity, excavate and grade as required
Bridge repair completed by railroad
0
200
400
Feet
N

NEIGHBORHOOD: Milliken
SHEET: 02
STATION: 23+00 to 50+00
RESTORATION RECOMMENDATIONS: 23+00 to 50+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of cottonwoods, willows and grass. The 2013 flood did not appear to alter the channel alignment or result in significant bank destabilization, although based on review of aerial photos it appears the low-flow channel has widened and likely aggraded. Adjacent land use includes agriculture, rural development and a railroad bridge, all which control the lateral movement of the river and its planform.

Most of the river corridor in this reach is within the Town of Milliken and privately owned property. The Town of Milliken is currently completing a local storm water master plan. There are several recommended improvements that may be coordinated, in the future, with the LTWRC Master Plan including property acquisition, irrigation/stormwater crossing improvements, detention facilities designed with irrigation diversions or crossings, and channel improvements.

There is one road crossing, State Highway 257, at Sta 48+00. Upstream of State Highway 257, the channel was aligned adjacent to Highways 257 and 60, creating an unnatural 90° bend and a corridor which with little to no trees prior to the 2013 flood. The U.S. Highway 257 bridge received some repair following the 2013 flood, and is currently is being assessed by CDOT for additional improvements. The Big Thompson and Platte River Ditch Company are currently repairing a diversion ditch and siphon at Sta 44+00. Several properties were flooded with clusters of buildings in each property.

Impacts to the river from the 2013 flood include deposition and channel widening, and impacts to diversion structures and bridges. A review should be conducted to assess the aggraded channel elevations and the impacts on the floodplain, both in terms of elevations and extent. If required, some excavation may be required to return the channel to pre-flood elevations. In other areas the channel will likely begin to recover without significant restoration activities.

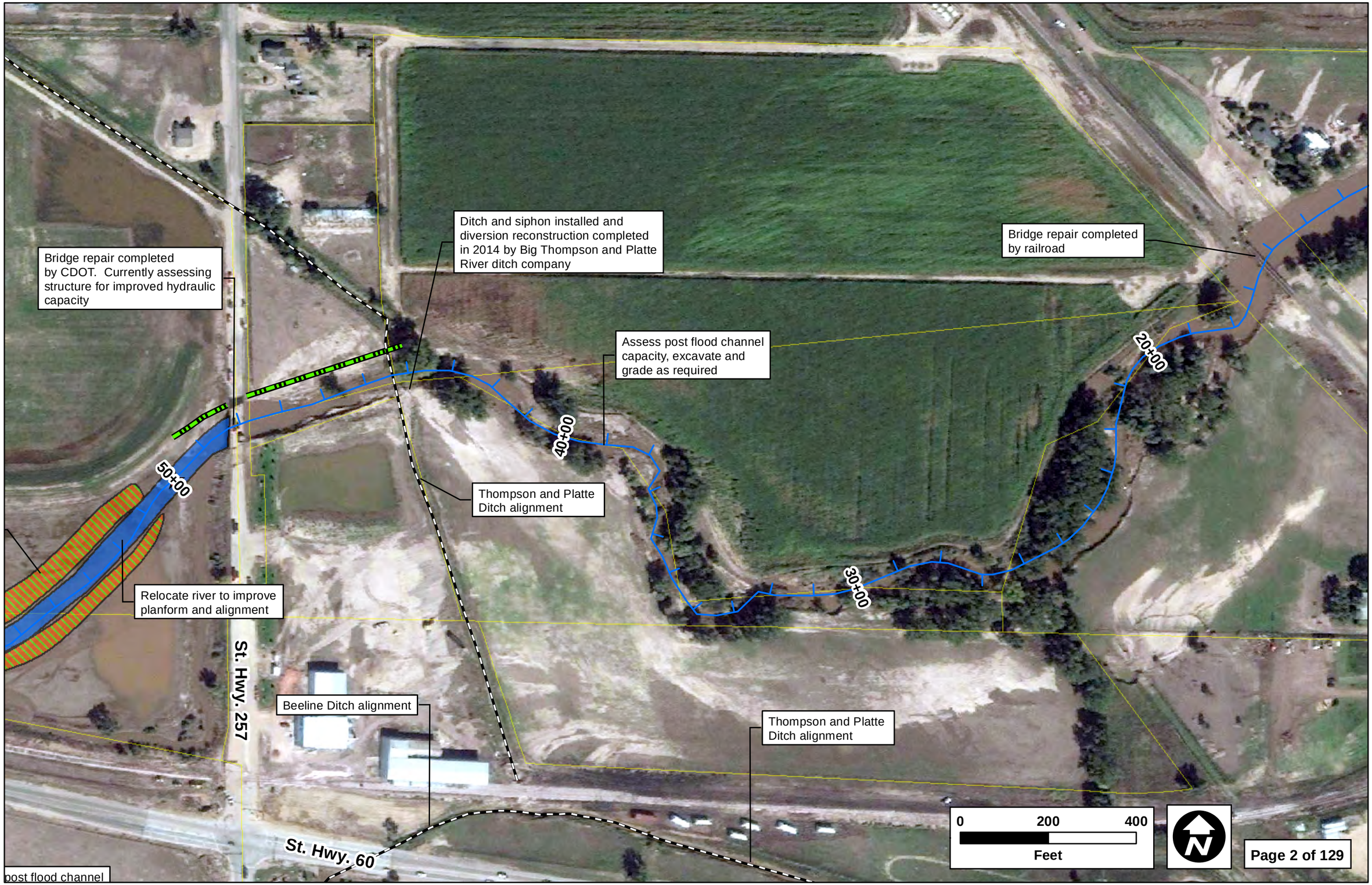
RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration.

1. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 23+00 to Sta 48+00 Sheet 2 Quantity	Sta 23+00 to Sta 48+00 Sheet 2 Cost
Mob/Demob	LS	$ 10,500	1	$ 10,500
Dewatering	LF	$ 14	3100	$ 43,400
Create/refine Low Flow Channel	LF	$ 27	0	$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	2700	$ 129,600
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	400	$ 30,000
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ 7,500	1	$ 7,500
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 221,000
Contingency, 15% of subtotal				$ 33,200
Permitting , 2.5% of subtotal				$ 5,500
Design, plans, specification, contract administration, 15%				$ 33,200
Supervision & Administration, 10%				$ 22,100
TOTAL				$ 315,000


Bridge repair completed by CDOT. Currently assessing structure for improved hydraulic capacity
Ditch and siphon installed and diversion reconstruction completed in 2014 by Big Thompson and Platte River ditch company
Bridge repair completed by railroad
Assess post flood channel capacity, excavate and grade as required
20+00
40+00
50+00
30+00
Thompson and Platte Ditch alignment
Relocate river to improve planform and alignment
St. Hwy. 257
Beeline Ditch alignment
Thompson and Platte Ditch alignment
St. Hwy. 60
0
200
400
Feet
N
post flood channel

NEIGHBORHOOD: Milliken
SHEET: 03
STATION: 50+00 to 76+00
RESTORATION RECOMMENDATIONS: 48+00 to 76+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a very limited vegetated riparian corridor and shows very little difference between pre- and post-flood conditions. There is one road crossing, State Highway 60, and one railroad crossing located within 150 feet of each other. The channel has been moved to run immediately adjacent to State Highway 60, creating an unnatural 90 degree bend and a corridor which had little to no vegetation before the flood. Adjacent land use includes agriculture, rural development and a railroad bridge, all which control the lateral movement of the river and its planform.

Highway 60 bridge received some repair following the 2013 flood, and is currently being assessed by CDOT for additional potential improvements. At Sta 72+00 is the headgate of the Bee Line ditch. This feature is being reviewed as part of a drainage master plan being prepared by the Town of Milliken. It is likely this feature will need repair from damage due to the 2013 flood.

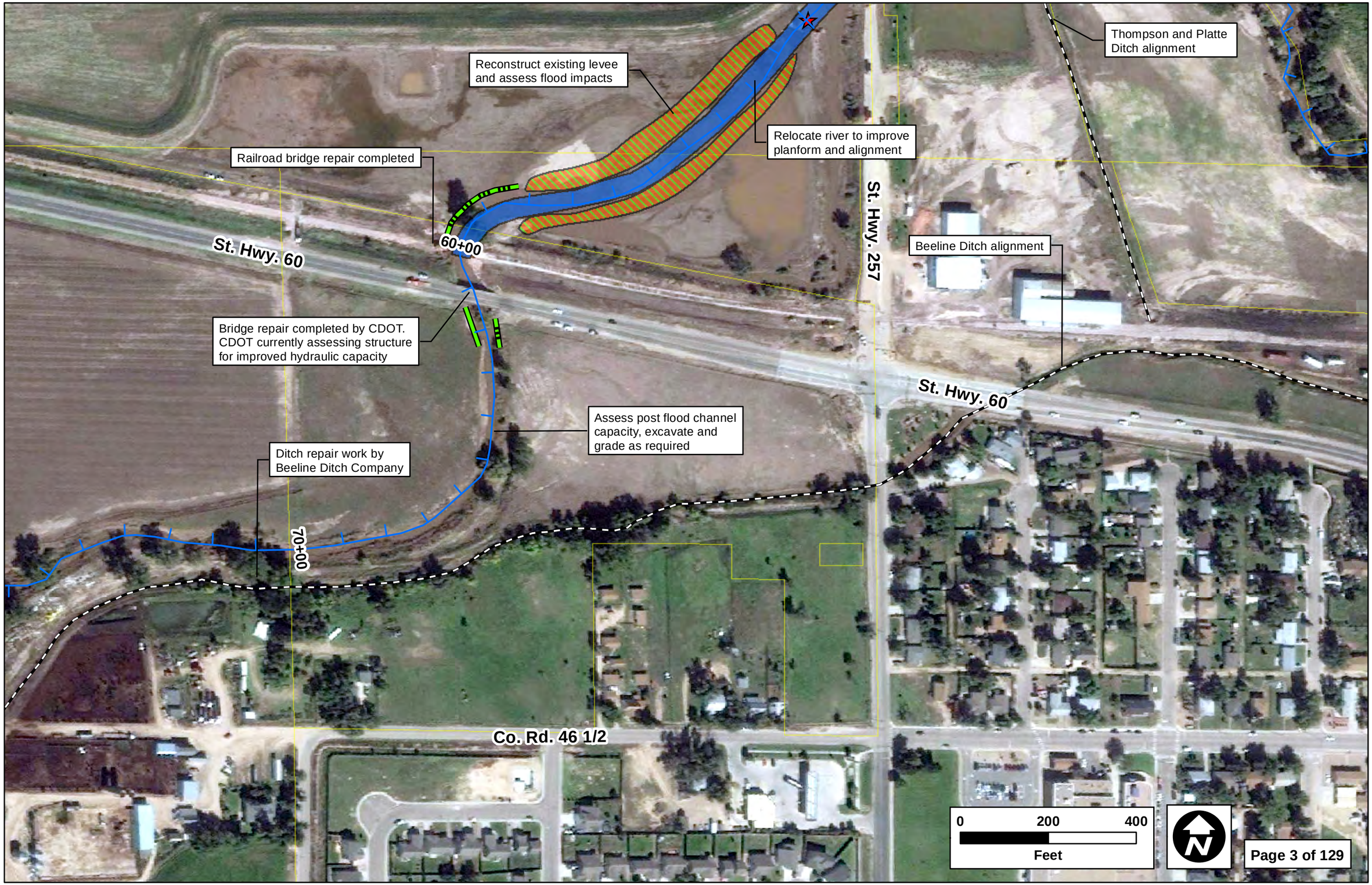
Several properties were flooded with clusters of buildings in each property. Most of the impacted area appears to be rural and agricultural. Evidence of backwater exists so most damage in the overbanks is likely from water. Flood related impacts to the river include deposition and channel widening. As the channel begins to recover and reset itself, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope, and planform. Much of this reach is relatively stable and expected to recover without restoration activities. A review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Incorporate additional recommendations from the Town's Master Plan and assess the possible realignment of the river at the corner of State Highways 257 and 60.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 48+00 to Sta 76+00 Sheet 2 and 3 Quantity	Cost
Mob/Demob	LS	$ 20,100	1	$ 20,100
Dewatering	LF	$ 14	3350	$ 46,900
Create/refine Low Flow Channel	LF	$ 27	1200	$ 32,400
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	1600	$ 76,800
Grade Control	EA	$ -	0	$ -
Grading	AC	$ 8,000	1.5	$ 12,000
Floodplain Stabilization	AC	$ 8,100	1.5	$ 12,200
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1200	$ 6,000
Bank Stabilization, Level 1	LF	$ 110	100	$ 11,000
Bank Stabilization, Level 2	LF	$ 75	450	$ 33,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	1.5	$ 7,500
Temporary irrigation and weed management	LS	$ 14,500	1	$ 14,500
Reconstruct levee	LS	$ 150,000	1	$ 150,000
SUBTOTAL				$ 423,200
Contingency, 15% of subtotal				$ 63,500
Permitting , 2.5% of subtotal				$ 10,600
Design, plans, specification, contract administration, 15%				$ 63,500
Supervision & Administration, 10%				$ 42,300
TOTAL				$ 603,000


Reconstruct existing levee and assess flood impacts
Relocate river to improve planform and alignment
Thompson and Platte Ditch alignment
Railroad bridge repair completed
St. Hwy. 60
60+00
St. Hwy. 257
Beeline Ditch alignment
Bridge repair completed by CDOT. CDOT currently assessing structure for improved hydraulic capacity
St. Hwy. 60
Assess post flood channel capacity, excavate and grade as required
Ditch repair work by Beeline Ditch Company
70+00
Co. Rd. 46 1/2
0
200
400
Feet
N

NEIGHBORHOOD: Milliken
SHEET: 04
STATION: 76+00 to 124+00
RESTORATION RECOMMENDATIOS: 76+00 to 124+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a very limited vegetated riparian corridor and shows very little difference between pre- and post-flood conditions. Adjacent land use includes agriculture, rural development and roads, all which control the lateral movement of the river and its planform. There is one road crossing at Sta 81+00 and the Thompson Platte ditch diversion at Sta 84+00.

The extent of flooding is not well defined so it is not possible to determine exactly how many buildings were flooded. It is likely several properties were flooded with clusters of buildings in each property. Most of the impacted area appears to be rural and agricultural. Flood-related impacts to the river include deposition and minor channel widening. As the channel begins to recover and reset itself, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope, and planform. Much of this reach is relatively stable and expected to recover without restoration activities. Deposition in the floodplain is evident although does not appear to be significant. Some clean up may be required for future agricultural uses. A review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Incorporate additional recommendations from the Town's Master Plan.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 76+00 to Sta124+00 Sheet 4	
			Quantity	Cost
Mob/Demob	LS	$ 14,900	1	$ 14,900
Dewatering	LF	$ 14	4800	$ 67,200
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	4800	$ 230,400
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 312,500
Contingency, 15% of subtotal				$ 46,900
Permitting , 2.5% of subtotal				$ 7,800
Design, plans, specification, contract administration, 15%				$ 46,900
Supervision & Administration, 10%				$ 31,300
TOTAL				$ 445,000


Assess post flood channel capacity, excavate and grade as required
120+00
110+00
100+00
90+00
80+00
0
200
400
Feet

NEIGHBORHOOD: Milliken
SHEET: 05
STATION: 124+00 to 162+00
RESTORATION RECOMMENDATIONS: 124+00 to 162+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a riparian corridor between 50 to 300 feet wide depending on the adjacent land use and encroachments. Adjacent land use includes agriculture, natural gas well pads, rural development and roads, all which control the lateral movement of the river and its planform. Weld County Road 19 crosses the river at Sta 129+00. Damage to this bridge from the 2013 flood event has been repaired by Larimer County.

The extent of flooding is not well defined so it is not possible to determine exactly how many structures were flooded. It is likely several properties were flooded with clusters of buildings in each property. Most of the impacted area appears to be rural and agricultural. Flood-related impacts to the river include deposition and channel widening. As the channel begins to recover and reset itself, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope, and planform. Much of this reach is relatively stable and expected to recover without restoration activities. Deposition in the floodplain is evident although does not appear to be significant and limited to the cottonwood understory. A review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Incorporate additional recommendations from the Town's Master Plan.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 124+00 to Sta 162+00 Sheet 5 Quantity	Sheet 5 Cost
Mob/Demob	LS	$ 11,800	1	$ 11,800
Dewatering	LF	$ 14	3800	$ 53,200
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3800	$ 182,400
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 247,400
Contingency, 15% of subtotal				$ 37,100
Permitting , 2.5% of subtotal				$ 6,200
Design, plans, specification, contract administration, 15%				$ 37,100
Supervision & Administration, 10%				$ 24,700
TOTAL				$ 353,000


160+00
140+00
130+00
Bridge repair completed by Larimer county
Assess post flood channel capacity, excavate and grade as required
Co. Rd. 46 1/2
Co. Rd. 19
0
200
400
Feet

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 6
STATION: 162+00 to 193+00
RESTORATION RECOMMENDATIONS: 162+00 to 193+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a riparian corridor between 50 and 100 feet wide upstream of County Road 46½. Downstream of County Road 46½, a dense riparian corridor of almost 500 feet in width exists. Adjacent land use includes agriculture, open space, natural gas well pads, rural development and roads. The vegetation was comprised of largely cottonwoods, willows and other riparian species.

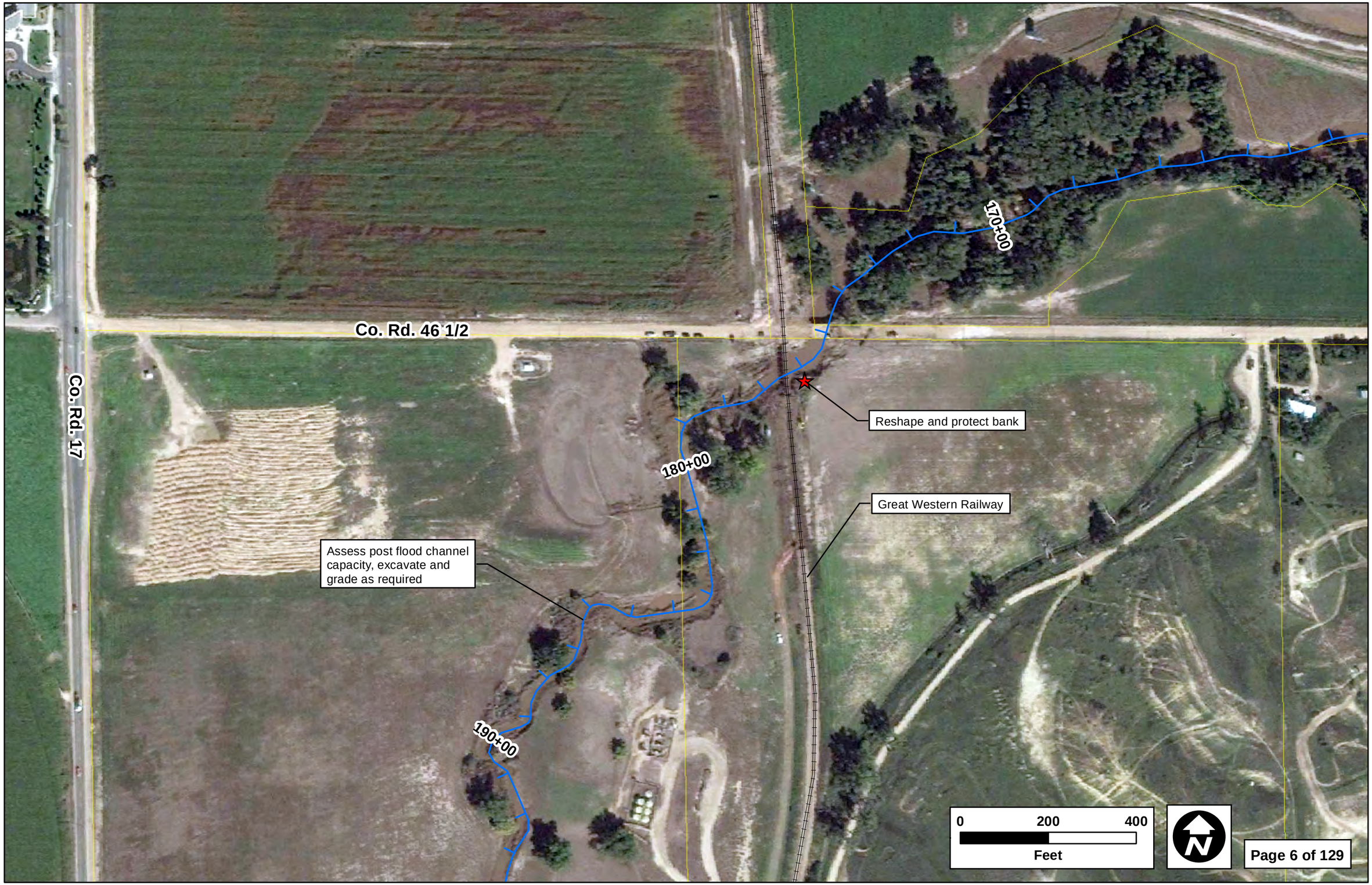
For the most part, the general channel planform appears to have remained relatively stable during the 2013 flood event. Some bank erosion was observed in localized areas, such as near bridge crossing. Minor sediment deposition along the channel margins and floodplains also occurred. The extent of flooding is not well defined so it is not possible to determine exactly how many structures were flooded. Most of the impacted area appears to be rural and agricultural. Much of this reach is relatively stable and expected to recover without restoration activities. There are two road crossings here, County Road 46½ and the Railroad between Sta 175+00 and Sta 177+00. Some riprap replacement was evident at the railroad bridge, but it was not clear if anything had been done at County Road 46 ½, which appeared to experience some toe scour. A review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Reshape and stabilize right channel bank on the downstream side of the railroad bridge near Sta 176+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 162+00 to Sta 193+00 Sheet 6	
			Quantity	Cost
Mob/Demob	LS	$ 11,100	1	$ 11,100
Dewatering	LF	$ 14	3100	$ 43,400
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3100	$ 148,800
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Reshape and protect bank	LF	$ 150	200	$ 30,000
SUBTOTAL				$ 233,300
Contingency, 15% of subtotal				$ 35,000
Permitting , 2.5% of subtotal				$ 5,800
Design, plans, specification, contract administration, 15%				$ 35,000
Supervision & Administration, 10%				$ 23,300
TOTAL				$ 332,000


Co. Rd. 46 1/2
Co. Rd. 17
170+00
180+00
190+00
Reshape and protect bank
Great Western Railway
Assess post flood channel capacity, excavate and grade as required
0
200
400
Feet

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 7
STATION: 193+00 to 224+00
RESTORATION RECOMMENDATIONS: 193+00 to 224+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a riparian corridor between 50 and 100 feet wide depending on the adjacent land use and encroachments. Adjacent land use includes agriculture, natural gas well pads, rural development and roads. The vegetation was comprised of cottonwoods and other riparian species.

For the most part, the general channel planform appears to have remained relatively stable during the 2013 flood event. Some bank erosion was observed in localized areas, and minor sediment deposition along the channel margins and floodplains also occurred. The extent of flooding is not well defined so it is not possible to determine exactly how many structures were flooded. It is likely several properties were flooded with clusters of buildings in each property. Most of the impacted area appears to be rural and agricultural. Much of this reach is relatively stable and expected to recover without restoration activities. A review should be conducted to assess the channel elevations and impacts on the floodplain and its elevations. If required, some excavation may be required to return the channel to pre-flood elevations.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 193+00 to Sta 224+00 Sheet 7 Quantity	Cost
Mob/Demob	LS	$ 9,600	1	$ 9,600
Dewatering	LF	$ 14	3100	$ 43,400
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3100	$ 148,800
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 201,800
Contingency, 15% of subtotal				$ 30,300
Permitting , 2.5% of subtotal				$ 5,000
Design, plans, specification, contract administration, 15%				$ 30,300
Supervision & Administration, 10%				$ 20,200
TOTAL				$ 288,000


Assess post flood channel capacity, excavate and grade as required
200+00
210+00
220+00
Co. Rd. 17
Co Rd 46
0
200
400
Feet

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 8
STATION: 224+00 to 279+00
RESTORATION RECOMMENDATIONS: 224+00 to 279+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparse riparian vegetation corridor, with limited canopy and widths ranging from about 50 to 100 feet. The vegetation was comprised of willows, grasses, and a few cottonwoods in addition to other riparian species. Limited vegetation was torn out during the flood, but what is still intact is somewhat buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Some bank erosion did occur in localized areas. In addition, general aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred.

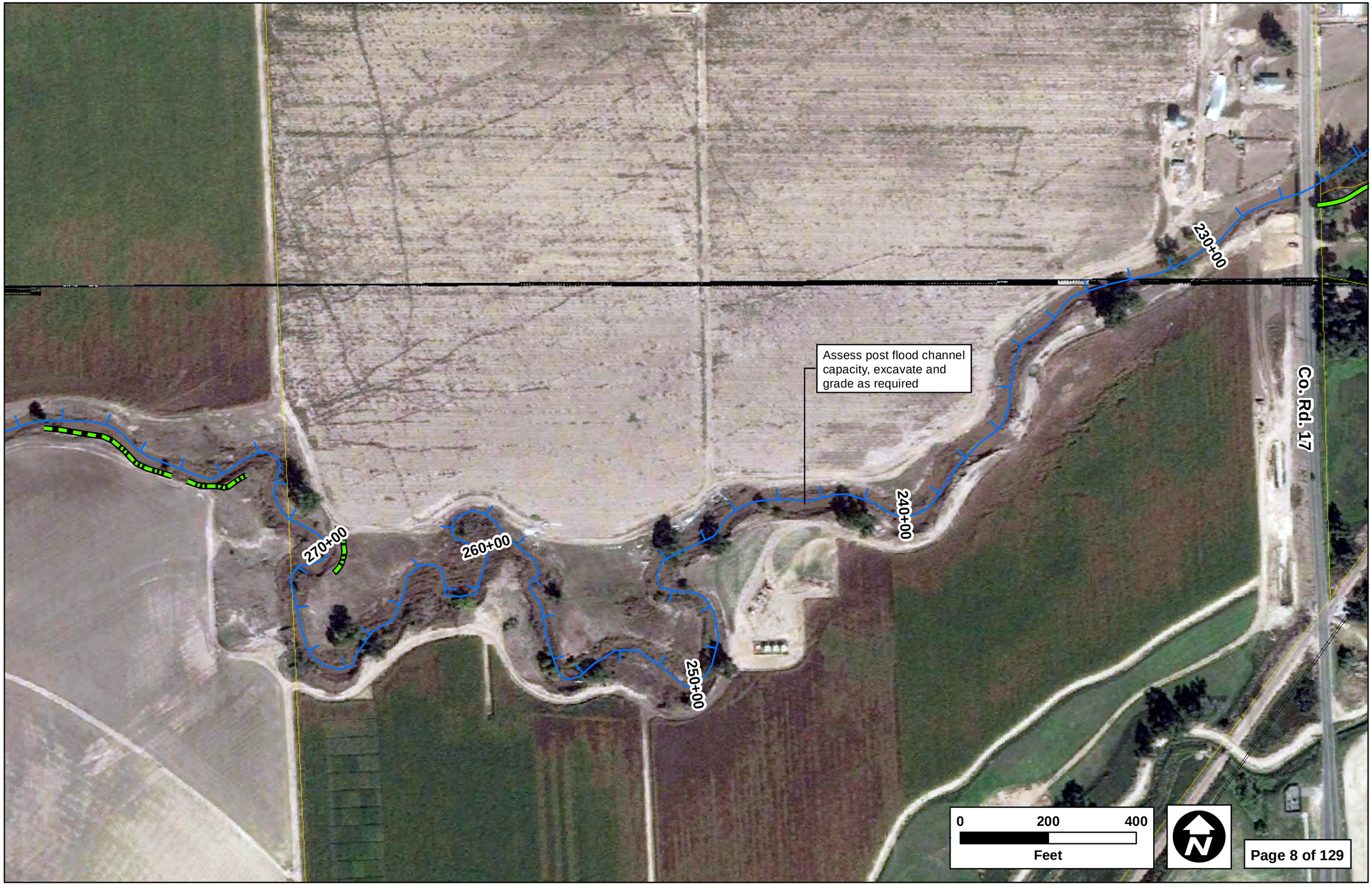
RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.

   Stabilize right bank between Sta 224+00 and Sta 227+00, Sta 273+50 and Sta 278+50 to protect adjacent roads.
3. Stabilize left bank near Sta 270+00.
4. Stabilize right channel bank downstream from County Road 17 near Sta 227+00 to protect house and property.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 224+00 to Sta 279+00 Sheet 8 Quantity	Cost
Mob/Demob	LS	$ 22,000	1	$ 22,000
Dewatering	LF	$ 14	6350	$ 88,900
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	5500	$ 264,000
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	400	$ 44,000
Bank Stabilization, Level 2	LF	$ 75	450	$ 33,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ 8,450	1	$ 8,500
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 461,200
Contingency, 15% of subtotal				$ 69,200
Permitting , 2.5% of subtotal				$ 11,500
Design, plans, specification, contract administration, 15%				$ 69,200
Supervision & Administration, 10%				$ 46,100
TOTAL				$ 657,000


Assess post flood channel capacity, excavate and grade as required
230+00
240+00
250+00
260+00
270+00
Co. Rd. 17
0
200
400
Feet

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 9
STATION: 279+00 to 317+00
RESTORATION RECOMMENDATIONS: 279+00 to 317+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a relatively dense riparian vegetation corridor, with widths ranging from about 50 to 100 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Vegetation that is still intact is somewhat buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

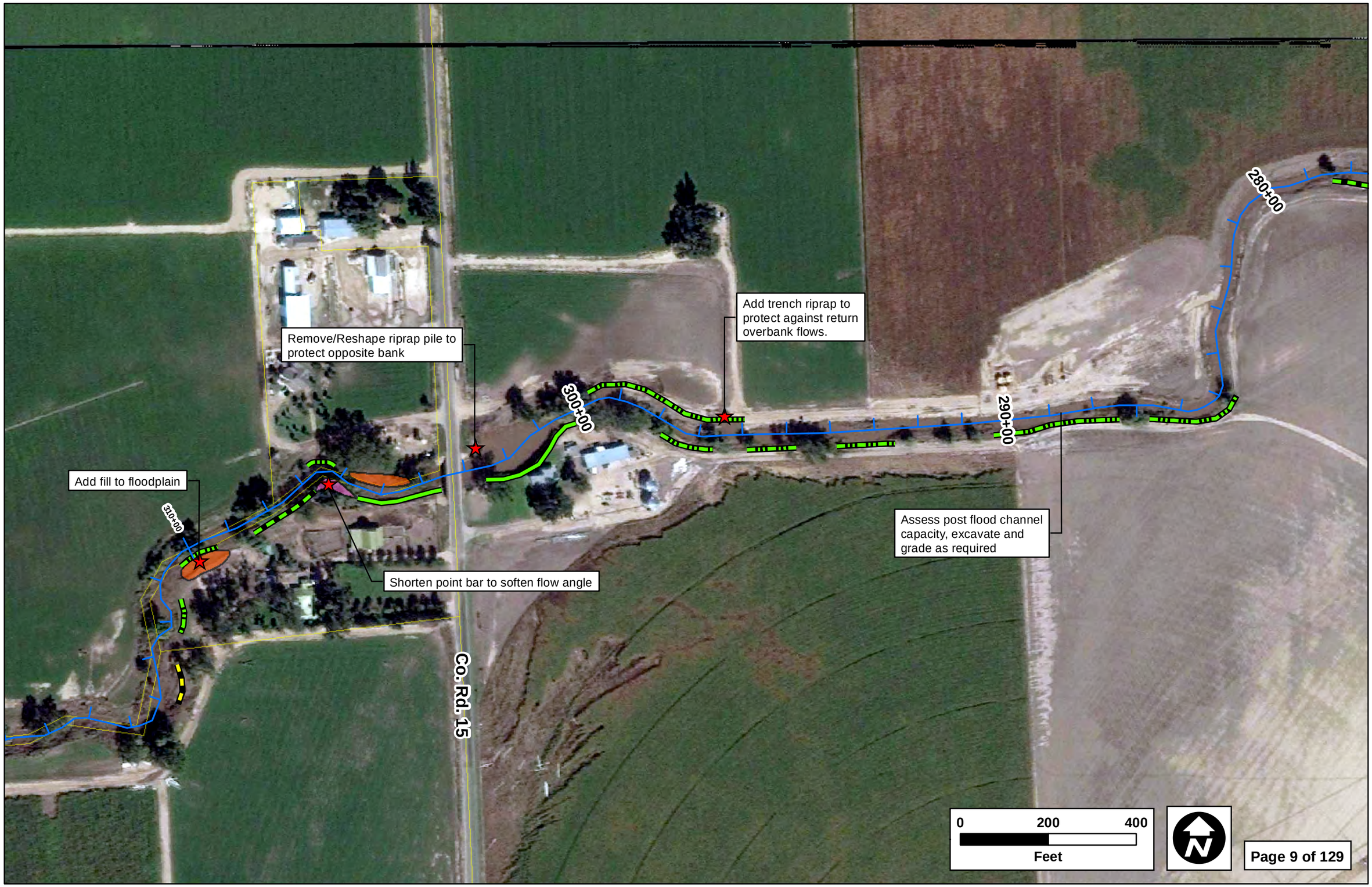
For the most part, the general channel planform was maintained during the 2013 flood event. Significant localized bank erosion did occur, especially along the right bank along the bend near Sta 301+50 and at County Road 15 Bridge. In addition, general aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred. A considerable amount of channel bank and overbank erosion threatens residential structures and property that are in close proximity to the river. Some work was performed at the County Road 15 Bridge, but no riprap was evident.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Stabilize channel banks between Sta 285+00 and Sta 300+00 to protect access roads.
4. Stabilize right channel bank near Sta 301+50 to protect house from additional erosion.
5. Stabilize right bank near Sta 304+50 and Sta 302+00.
6. Reshape riprap along toe of bank on downstream side of County Road 15 Bridge, which is currently directing flow directly at opposite bank (right bank) near Sta 301+50.
7. Stabilize right channel bank near Sta 304+50 to protect access road and County Road 15 Bridge.
8. Lower and shorten point bar near Sta 306+50 to reduce angle of flow at right bank downstream. Stabilize left bank at same location to reduce further channel migration, which would potentially tighten bend.
9. Grade left floodplain near Sta 305+00 to improve conveyance capacity.
10. Post-flood evidence indicates that overbank flows on the north side of the river immediately downstream of County Road 15 concentrated and returned to the river near Sta 296+50, which eroded a portion of the access road. Installation of trench fill riprap buried into the road is recommended to reduce damage to the road should overtopping flows occur again.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 279+00 to Sta 317+00 Sheet 9 Quantity	Cost
Mob/Demob	LS	$ 24,100	1	$ 24,100
Dewatering	LF	$ 14	6000	$ 84,000
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3800	$ 182,400
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.25	$ 2,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	0.1	$ 3,200
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	500	$ 55,000
Bank Stabilization, Level 2	LF	$ 75	1500	$ 112,500
Bank Stabilization, Level 3	LF	$ 45	200	$ 9,000
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	100	$ 500
Seeding	AC	$ 5,000	0.35	$ 1,800
Temporary irrigation and weed management	LS	$ 31,000	1	$ 31,000
Site Specific	LS	$ -	1	$ -
SUBTOTAL				$ 505,500
Contingency, 15% of subtotal				$ 75,800
Permitting , 2.5% of subtotal				$ 12,600
Design, plans, specification, contract administration, 15%				$ 75,800
Supervision & Administration, 10%				$ 50,600
TOTAL				$ 720,000


Remove/Reshape riprap pile to protect opposite bank
Add trench riprap to protect against return overbank flows.
300+00
290+00
280+00
Add fill to floodplain
310+00
Shorten point bar to soften flow angle
Assess post flood channel capacity, excavate and grade as required
Co. Rd. 15
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 10
STATION: 317+00 to 361+00
RESTORATION RECOMMENDATIONS: 317+00 to 361+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a dense riparian vegetation corridor, with average widths of about 250 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Some of the vegetation that is still intact is somewhat buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

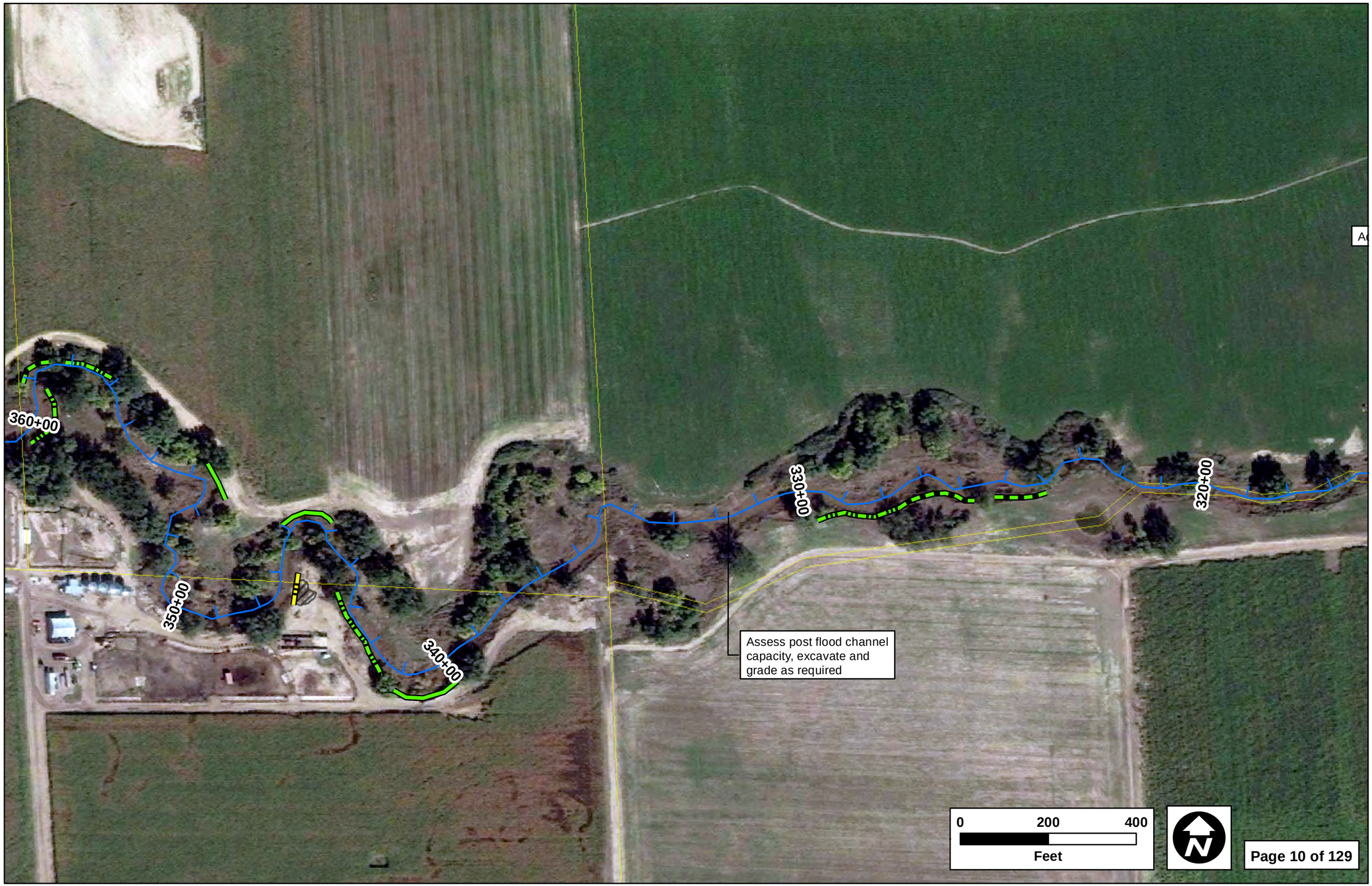
For the most part, the general channel planform was maintained during the 2013 flood event. Localized bank erosion did occur, and a few significant scour holes developed in conjunction with the bank scour in this reach. In addition, some generalized aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred. Significant ag-infrastructure was severely damaged during the flood along this reach. This reach also contains at least one utility pipeline buried below the channel bed near Sta 319+50, but the channel is relatively stable and does not appear to currently pose a threat to the pipeline.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Stabilize right bank between Sta 324+00 and Sta 330+00 to protect frequent use area.
4. Stabilize right channel banks between Sta 340+00 and Sta 343+50 to protect property, infrastructure, and access road.
5. Stabilize left channel banks near Sta 353+50 and Sta 345+50 to protect access road.
6. Stabilize banks near Sta 359+00 and Sta 361+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 317+00 to Sta 361+00 Sheet 10 Quantity	Cost
Mob/Demob	LS	$ 21,500	1	$ 21,500
Dewatering	LF	$ 14	5900	$ 82,600
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	4400	$ 211,200
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	400	$ 44,000
Bank Stabilization, Level 2	LF	$ 75	700	$ 52,500
Bank Stabilization, Level 3	LF	$ 45	400	$ 18,000
Land Reclamation Fill	AC	$ 20,200	0.04	$ 800
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15	100	$ 1,500
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0.04	$ 200
Temporary irrigation and weed management	LS	$ 18,200	1	$ 18,200
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 450,500
Contingency, 15% of subtotal				$ 67,600
Permitting , 2.5% of subtotal				$ 11,300
Design, plans, specification, contract administration, 15%				$ 67,600
Supervision & Administration, 10%				$ 45,100
TOTAL				$ 642,000


360+00
350+00
340+00
330+00
320+00
Assess post flood channel capacity, excavate and grade as required
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 11
STATION: 361+00 to 403+00
RESTORATION RECOMMENDATIONS: 361+00 to 403+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a dense riparian vegetation corridor, ranging in widths between about 50 and 150 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Some of the vegetation that is still intact is somewhat buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Localized bank erosion did occur along this reach, and a few significant scour holes developed in conjunction with the bank scour in this reach. In addition, some generalized aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred. The County Road 13 Bridge was significantly damaged during the flood, and most of the repairs are already complete. Two known houses were damaged, and those repairs were largely already complete at the time of the field reconnaissance, but significant ag-infrastructure was also severely damaged. This reach contains at least one utility pipeline hung above the channel near Sta 375+00, but the channel is relatively stable and does not appear to pose a threat to the pipeline.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Stabilize left bank near Sta 364+00 to protect access road.
4. Reclaim right overbank near Sta 366+00.
5. Grade floodplain near Sta 370+00 to improve conveyance.
6. Stabilize right bank near Sta 371+00 and Sta 368+00 to protect access road.
7. Stabilize upper bank near Sta 373+00.
8. Stabilize right bank to protect access road near Sta 400+00 and Sta 391+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 361+00 to Sta 403+00 Sheet 11 Quantity	Cost
Mob/Demob	LS	$ 19,800	1	$ 19,800
Dewatering	LF	$ 14	5200	$ 72,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	4200	$ 201,600
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.5	$ 4,000
Floodplain Stabilization	AC	$ 8,100	0.5	$ 4,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	450	$ 49,500
Bank Stabilization, Level 2	LF	$ 75	550	$ 41,300
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	0.2	$ 4,000
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	150	$ 800
Seeding	AC	$ 5,000	0.7	$ 3,500
Temporary irrigation and weed management	LS	$ 13,550	1	$ 13,600
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 415,000
Contingency, 15% of subtotal				$ 62,300
Permitting , 2.5% of subtotal				$ 10,400
Design, plans, specification, contract administration, 15%				$ 62,300
Supervision & Administration, 10%				$ 41,500
TOTAL				$ 592,000


County Road 13 bridge was damaged, but repairs have already occurred
390+00
380+00
370+00
360+00
400+00
Assess post flood channel capacity, excavate and grade as required
Co. Rd. 13
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 12
STATION: 403+00 to 456+00
RESTORATION RECOMMENDATIONS: 403+00 to 456+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had relatively dense riparian vegetation corridor, ranging in widths between about 50 and 250 feet. The vegetation consists largely of willows, riparian grasses (e.g., sedges), and cottonwoods. Much of the vegetation is still intact, but often somewhat buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

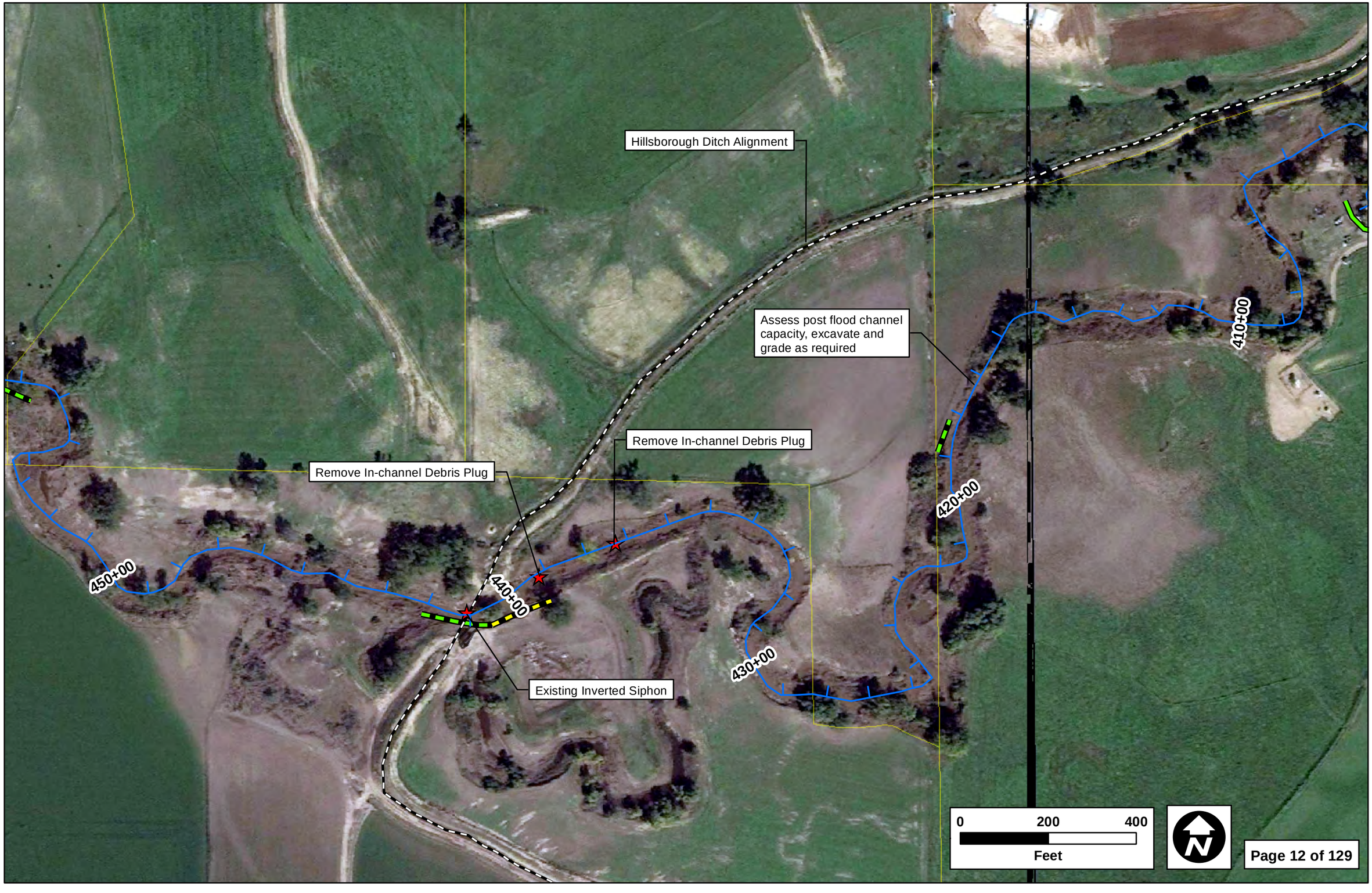
For the most part, the general channel planform was maintained during the 2013 flood event. Minor localized bank erosion did occur along this reach, and a few significant scour holes developed in conjunction with the bank scour in this reach. One scour hole is located near the inverted siphon crossing of the Hillsborough Ditch near Sta 441+00. In addition, some generalized aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Stabilize left bank near Sta 418+50.
4. Remove substantial in-channel debris plugs near Sta 439+00 and Sta 437+00.
5. Stabilize right bank near Sta 441+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 403+00 to Sta 456+00 Sheet 12 Quantity	Sheet 12 Cost
Mob/Demob	LS	$ 18,200	1	$ 18,200
Dewatering	LF	$ 14	5550	$ 77,700
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	5300	$ 254,400
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	250	$ 11,300
Land Reclamation Fill	AC	$ 20,200	0.05	$ 1,000
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	150	$ 800
Seeding	AC	$ 5,000	0.05	$ 300
Temporary irrigation and weed management	LS	$ 3,275	1	$ 3,300
Remove in-channel debris and plugs	LS	$ 15,000	1	$ 15,000
SUBTOTAL				$ 382,000
Contingency, 15% of subtotal				$ 57,300
Permitting , 2.5% of subtotal				$ 9,600
Design, plans, specification, contract administration, 15%				$ 57,300
Supervision & Administration, 10%				$ 38,200
TOTAL				$ 544,000


Hillsborough Ditch Alignment
Assess post flood channel capacity, excavate and grade as required
Remove In-channel Debris Plug
Remove In-channel Debris Plug
Existing Inverted Siphon
410+00
420+00
430+00
440+00
450+00
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 13
STATION: 456+00 to 493+00
RESTORATION RECOMMENDATIONS: 456+00 to 493+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a somewhat limited riparian corridor, consisting primarily of riparian grasses (e.g., sedges), willows, and a few cottonwoods. Much of the vegetation is still intact, but considerably buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Minor localized bank erosion did occur along this reach, and a few significant scour holes developed in conjunction with the bank scour in this reach. In addition, some generalized aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Stabilize right bank near Sta 458+00.
4. Stabilize upper right bank near Sta 471+00.
5. Stabilize left bank near Sta 485+50.
6. Stabilize right channel bank near Sta 491+00.
7. Floodplain grading near Sta 492+00 to improve conveyance and reduce future scour potential.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 456+00 to Sta 493+00 Sheet 13 Quantity	Cost
Mob/Demob	LS	$ 14,900	1	$ 14,900
Dewatering	LF	$ 14	4550	$ 63,700
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3700	$ 177,600
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.50	$ 4,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	850	$ 38,300
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	250	$ 1,300
Seeding	AC	$ 5,000	0.5	$ 2,500
Temporary irrigation and weed management	LS	$ 10,900	1	$ 10,900
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 313,200
Contingency, 15% of subtotal				$ 47,000
Permitting , 2.5% of subtotal				$ 7,800
Design, plans, specification, contract administration, 15%				$ 47,000
Supervision & Administration, 10%				$ 31,300
TOTAL				$ 446,000


460+00
470+00
480+00
490+00
Assess post flood channel capacity, excavate and grade as required
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 14
STATION: 493+00 to 512+00
RESTORATION RECOMMENDATIONS: 493+00 to 512+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a somewhat limited riparian corridor, consisting primarily of riparian grasses (e.g., sedges), some willows, and a few cottonwoods. Much of the vegetation is still intact, but considerably buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Minor localized bank erosion did occur along this reach, and a few significant scour holes developed in conjunction with the bank scour in this reach. In addition, some generalized aggradation, and moderate levels of localized sediment deposition along the channel margins and floodplains also occurred.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 493+00 to Sta 512+00 Sheet 14	
			Quantity	Cost
Mob/Demob	LS	$ 5,900	1	$ 5,900
Dewatering	LF	$ 14	1900	$ 26,600
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	1900	$ 91,200
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 123,700
Contingency, 15% of subtotal				$ 18,600
Permitting , 2.5% of subtotal				$ 3,100
Design, plans, specification, contract administration, 15%				$ 18,600
Supervision & Administration, 10%				$ 12,400
TOTAL				$ 176,000


500+00
Assess post flood channel capacity, excavate and grade as required
510+00
0
200
400
Feet
N

NEIGHBORHOOD: Johnstown & Milliken
SHEET: 15
STATION: 512+00 to 535+00
RESTORATION RECOMMENDATIONS: 512+00 to 535+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a somewhat limited riparian corridor, consisting primarily of riparian grasses (e.g., sedges), some willows, and a few cottonwoods. Much of the vegetation is still intact, but considerably buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

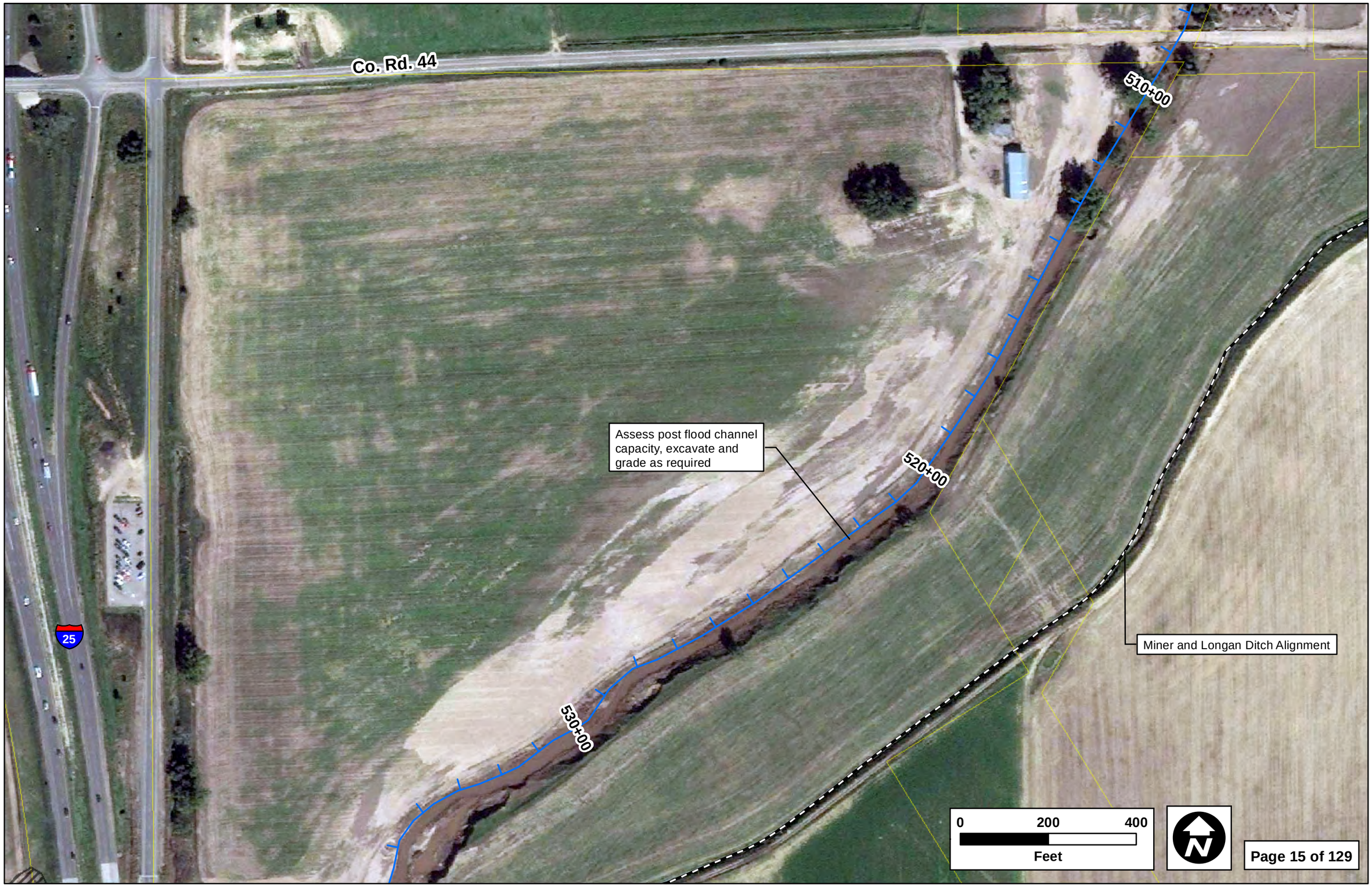
For the most part, the general channel planform was maintained during the 2013 flood event. Only minor localized bank erosion occurred along this reach. In addition, moderate levels of sediment deposition along the channel margins and floodplains also occurred.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 512+00 to Sta 535+00 Sheet 15 Quantity	Cost
Mob/Demob	LS	$ 7,100	1	$ 7,100
Dewatering	LF	$ 14	2300	$ 32,200
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	2300	$ 110,400
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 149,700
Contingency, 15% of subtotal				$ 22,500
Permitting , 2.5% of subtotal				$ 3,700
Design, plans, specification, contract administration, 15%				$ 22,500
Supervision & Administration, 10%				$ 15,000
TOTAL				$ 213,000


Co. Rd. 44
510+00
Assess post flood channel capacity, excavate and grade as required
520+00
530+00
25
Miner and Longan Ditch Alignment
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 16
STATION: 535+00 to 574+00
RESTORATION RECOMMENDATIONS: 535+00 to 574+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a scattered riparian corridor, generally ranging in width between about 50 and 75 feet. Willows are very common, but cottonwoods and other riparian species are evident as well. Much of the vegetation is still intact and dominated by willows, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Only minor localized bank erosion occurred along this reach. In addition, moderate levels of sediment deposition along the channel margins and floodplains also occurred.

Channel erosion and downcutting did expose many of the pier footings at the I-25 Bridge. Since the time of field assessments, CDOT has reportedly returned to repair and protect footings.

RESTORATION RECOMMENDATIONS

1. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Assess the channel elevations and impacts of floodplain elevations and excavate and grade if required to return the channel to pre-flood elevations.
2. Geomorphic functions of this reach are likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active revegetation.
3. Bank stabilization in vicinity and below I-25 Bridge near Sta 543+00.
4. Overbank fill and reclamation along left side of channel near Sta 551+50 and Sta 545+00.
5. Refinement of low flow channel downstream of the Miner and Longan Ditch diversion structure near Sta 555+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 535+00 to Sta 574+00 Sheet 16 Quantity	Cost
Mob/Demob	LS	$ 18,300	1	$ 18,300
Dewatering	LF	$ 14	4900	$ 68,600
Create/refine Low Flow Channel	LF	$ 27	200	$ 5,400
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	3900	$ 187,200
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	200	$ 1,000
Bank Stabilization, Level 1	LF	$ 110	800	$ 88,000
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	0.5	$ 10,100
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0.5	$ 2,500
Temporary irrigation and weed management	LS	$ 2,525	1	$ 2,500
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 383,600
Contingency, 15% of subtotal				$ 57,500
Permitting , 2.5% of subtotal				$ 9,600
Design, plans, specification, contract administration, 15%				$ 57,500
Supervision & Administration, 10%				$ 38,400
TOTAL				$ 547,000


25
550+00
540+00
560+00
570+00
Miner and Longan Ditch Alignment
Assess post flood channel capacity, excavate and grade as required
0
200
400
Feet

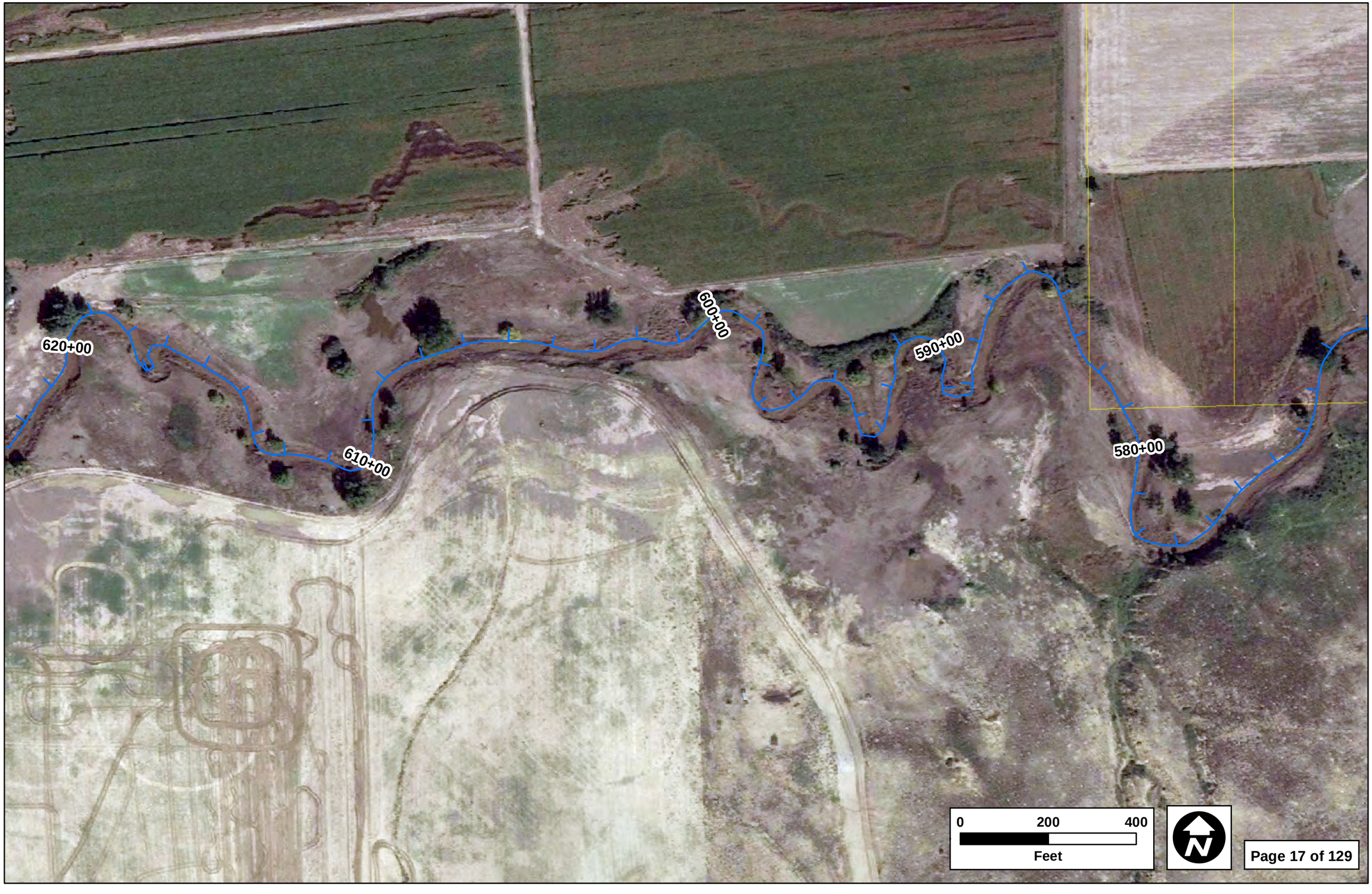
NEIGHBORHOOD: Berthoud
SHEET: 17
STATION: 571+00 to 622+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a scattered riparian corridor, ranging in width between about 50 and 75 feet. Willows are very common, but cottonwoods and other riparian species are evident as well. Much of the vegetation is still intact and dominated by willows, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Only minor localized bank erosion occurred along this reach. In addition, moderate levels of sediment deposition along the channel margins and floodplains also occurred. Beyond that, only limited damages occurred.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are fairly sufficient to convey flow and sediment, and to allow for the regeneration of riparian species through natural seeding and cloning without any further restoration. However, removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance.
2. No further actions are suggested at this time.


620+00
610+00
600+00
590+00
580+00
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 18
STATION: 622+00 to 668+00
RESTORATION RECOMMENDATIONS: 630+00 to 668+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense riparian corridor, ranging in width up to about 100 feet. Willows, cottonwoods, and wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact and dominated by willows, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. However, significant bank erosion and lateral migration did occur along this reach, especially near Sta 654+00 where lateral erosion severely damaged an access road, and near Sta 660+00 resulting in a pond breach. In addition to localized bank erosion, a significant and consistent problem through this reach appears to have been generalized aggradation and severe sediment deposition along the channel margins and floodplains, as well as accumulation of debris.

RESTORATION RECOMMENDATIONS

1. Stabilize banks near Sta 639+00, Sta 633+00, and Sta 631+50.
2. Lower and grade floodplain surfaces along channel margins between Sta 641+00 and Sta 651+00 to improve conveyance capacity.
3. Grade right floodplain near Sta 649+00.
4. Stabilize left bank between Sta 651+00 and 656+00 to protect access road (Access road has already been reconstructed and some bank protection has already been installed along the road).
5. Realign low flow channel near Sta 657+50 and Sta 655+00 to direct flows downstream rather than directly toward left bank.
6. Grade and stabilize right bank near Sta 659+00.
7. Stabilize left bank near Sta 660+00 to protect bank/berm shared by irrigation pond.
8. Stabilize left bank near Sta 668+00.
9. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Some of the woody debris could be used as bank and slope stabilization measures where recommended. Removal of the sandy material deposited in the overbanks may also be necessary at a number of locations to reclaim farmland.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 630+00 to Sta 668+00 Sheet 18 Quantity	Cost
Mob/Demob	LS	$ 13,900	1	$ 13,900
Dewatering	LF	$ 14	2250	$ 31,500
Create/refine Low Flow Channel	LF	$ 27	450	$ 12,200
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	1	$ 32,300
Point Bar Creation	LF	$ 5	450	$ 2,300
Bank Stabilization, Level 1	LF	$ 110	1450	$ 159,500
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	350	$ 15,800
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	2	$ 10,000
Temporary irrigation and weed management	LS	$ 5,950	1	$ 6,000
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 291,500
Contingency, 15% of subtotal				$ 43,700
Permitting , 2.5% of subtotal				$ 7,300
Design, plans, specification, contract administration, 15%				$ 43,700
Supervision & Administration, 10%				$ 29,200
TOTAL				$ 415,000

Some bank protection has already been installed

660+00

650+00

640+00

630+00

Co. Rd. 7

0 200 400

Feet

NEIGHBORHOOD: Berthoud
SHEET: 19
STATION: 661+00 to 708+00
RESTORATION RECOMMENDATIONS: 671+00 to 700+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense riparian corridor, ranging in width between 100 and 200 feet. Cottonwoods, willows, and wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Lateral migration, significant bank erosion, and channel downcutting are limited, although localized areas showing evidence of each of these items were observed. The most significant and consistent problem through this reach appears to have been aggradation in the main channel, along the channel margins, and in the overbanks, as well as accumulation of debris.

Bank erosion and lateral migration were limited due to the presence of historical bank protection (concrete rubble, automobiles, etc.). Some localized bank erosion that extended from toe to top of bank was observed locally. Upper bank erosion was observed in areas where overbank flows returned to the channel, but the bank toes in these areas appear stable. Downstream from County Road 5, the sharp bends did not erode significantly due to relief provided by flood conveyance over the inside bend, although the more moderate bends experienced some bank erosion that could threaten private drives and access roads.

RESTORATION RECOMMENDATIONS

1. Stabilize left bank near Sta 698+00, Sta 693+00, Sta 685+00, Sta 675+00, Sta 673+00, and Sta 667+00.
2. Stabilize right bank near Sta 705+00.
3. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Some of the woody debris could be used as bank and slope stabilization measures where recommended. Removal of the sandy material deposited in the overbanks may also be necessary at a number of locations to reclaim farmland.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 671+00 to Sta 700+00 Sheet 19 Quantity	Cost
Mob/Demob	LS	$ 3,300	1	$ 3,300
Dewatering	LF	$ 14	850	$ 11,900
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	150	$ 11,300
Bank Stabilization, Level 3	LF	$ 45	700	$ 31,500
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ 10,700	1	$ 10,700
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 68,700
Contingency, 15% of subtotal				$ 10,300
Permitting , 2.5% of subtotal				$ 1,700
Design, plans, specification, contract administration, 15%				$ 10,300
Supervision & Administration, 10%				$ 6,900
TOTAL				$ 98,000


670+00
680+00
690+00
700+00
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 20
STATION: 699+00 to 744+00
RESTORATION RECOMMENDATIONS: 704+00 to 742+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had scattered riparian vegetation, with a corridor width of typically less than about 100 feet. Cottonwoods, willows, and wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Lateral migration, significant bank erosion, and channel downcutting are limited, although localized areas showing evidence of each of these items were observed. The most significant and consistent problem through this reach appears to have been aggradation in the main channel, along the channel margins, and in the overbanks, as well as accumulation of debris.

Bank erosion and lateral migration were limited due to the presence of historical bank protection (concrete rubble, automobiles, etc.). Some localized bank erosion that extended from toe to top of bank was observed. Upper bank erosion was observed in areas where overbank flows returned to the channel, but the bank toes in these areas appear stable. Some remedial action has occurred at County Road 5 with the placement of riprap on the upper bank of the left abutment. Downstream from County Road 5, the sharp bends did not erode significantly due to relief provided by flood conveyance over the inside bend, although the more moderate bends experienced some bank erosion that could threaten private drives and access roads.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank near Sta 705+00.
2. Bank stabilization near Sta 741+00.
3. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Some of the woody debris could be used as bank and slope stabilization measures where recommended. Removal of the sandy material deposited in the overbanks may also be necessary at a number of locations to reclaim farmland.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 704+00 to Sta 742+00 Sheet 20	
			Quantity	Cost
Mob/Demob	LS	$ 700	1	$ 700
Dewatering	LF	$ 14	200	$ 2,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	200	$ 9,000
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ 2,250	1	$ 2,300
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 14,800
Contingency, 15% of subtotal				$ 2,200
Permitting , 2.5% of subtotal				$ 400
Design, plans, specification, contract administration, 15%				$ 2,200
Supervision & Administration, 10%				$ 1,500
TOTAL				$ 21,000


Co. Rd. 5
700+00
710+00
720+00
730+00
740+00
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 21
STATION: 728+00 to 783+00
RESTORATION RECOMMENDATIONS: 740+00 to 781+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had scattered riparian vegetation, with a corridor width of typically less than about 100 feet. Cottonwoods, willows, and significant quantities of wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Lateral migration, significant bank erosion, and channel downcutting are limited, although localized areas showing evidence of each of these items were observed. The most significant and consistent problem through this reach appears to have been aggradation in the main channel, along the channel margins, and in the overbanks, as well as accumulation of debris.

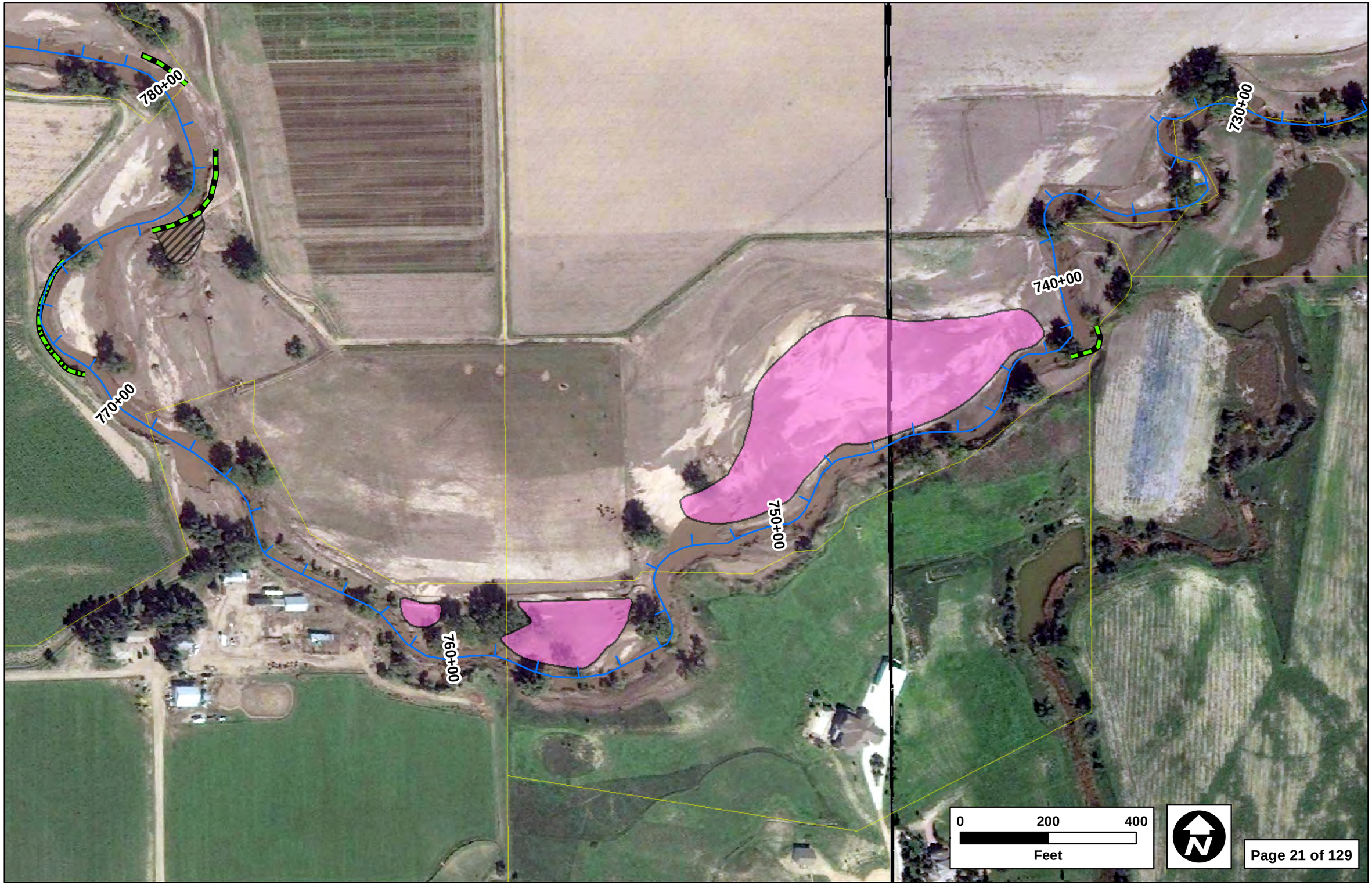
Bank erosion and lateral migration were limited due to the presence of historical bank protection (concrete rubble, automobiles, etc.). Some localized bank erosion that extended from toe to top of bank was observed locally. Upper bank erosion was observed in areas where overbank flows returned to the channel, but the bank toes in these areas appear stable.

RESTORATION RECOMMENDATIONS

1. Bank stabilization near Sta 741+00.
2. Stabilize right bank near Sta 773+00.
3. Bank stabilization and grading and lowering near Sta 779+00.
4. Removal of sediment deposition (grading and lowering) along the left overbanks between Sta 740+00 to Sta 762+00.
5. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Some of the woody debris could be used as bank and slope stabilization measures where recommended. Removal of the sandy material deposited in the overbanks may also be necessary at a number of locations to reclaim farmland.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 740+00 to 781+00 Sheet 21 Quantity	Cost
Mob/Demob	LS	$ 12,900	1	$ 12,900
Dewatering	LF	$ 14	840	$ 11,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	5	$ 161,500
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	330	$ 24,800
Bank Stabilization, Level 3	LF	$ 45	510	$ 23,000
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	5	$ 25,000
Temporary irrigation and weed management	LS	$ 11,950	1	$ 12,000
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 271,000
Contingency, 15% of subtotal				$ 40,700
Permitting , 2.5% of subtotal				$ 6,800
Design, plans, specification, contract administration, 15%				$ 40,700
Supervision & Administration, 10%				$ 27,100
TOTAL				$ 386,000


780+00
770+00
760+00
750+00
740+00
730+00
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 22
STATION: 766+00 to 815+00
RESTORATION RECOMMENDATIONS: 781+00 to 815+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had scattered riparian vegetation, with a corridor width ranging up to about 150 feet in some areas. In addition to cottonwoods and willows, significant quantities of wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Lateral migration, significant bank erosion, and channel downcutting are limited, although localized areas showing evidence of each of these items were observed. The most significant and consistent problem through this reach appears to have been aggradation in the main channel, along the channel margins, and in the overbanks, as well as accumulation of debris.

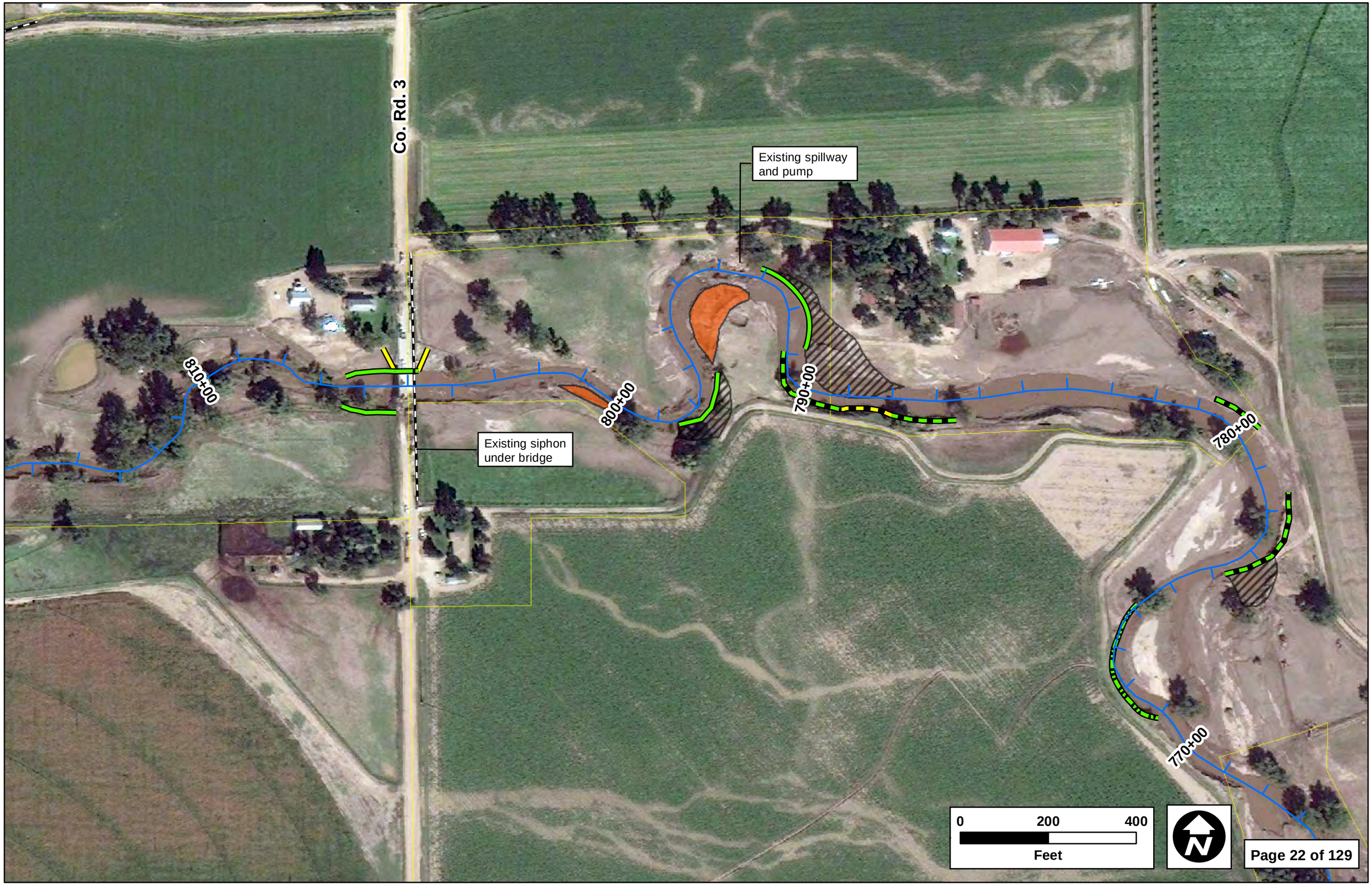
Bank erosion and lateral migration were limited due to the presence of historical bank protection (concrete rubble, automobiles, etc.). Some localized bank erosion that extended from toe to top of bank was observed locally, including in the vicinity of County Road 3. Upper bank erosion was observed in areas where overbank flows returned to the channel, but the bank toes in these areas appear stable. The most significant bank erosion was observed in the vicinity of County Road 3, especially in the reach between Sta 787+00 and Sta 796+00 and just upstream from County Road 3. Some repair work has occurred at the County Road 3 Bridge, including the placement of riprap on the upper banks of the right abutment and placement of riprap in a scour hole.

RESTORATION RECOMMENDATIONS

1. Stabilize banks in vicinity of County Road 3 Bridge to protect against flanking of the structure.
2. Siphon crossing below County Road 3 currently protected only by concrete rubble and may require additional stabilization.
3. Removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance. Some of the woody debris could be used as bank and slope stabilization measures where recommended. Removal of the sandy material deposited in the overbanks and grading may also be necessary at a number of locations to reclaim farmland.
4. Stabilize right bank near Sta 773+00.
5. Fill and stabilize upper banks near Sta 779+00.
6. Fill and stabilize upper banks between Sta 788+00 and Sta 801+00 and at Sta 798+00.
7. Bank stabilization near Sta 790+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 781+00 to 815+00 Sheet 22 Quantity	Cost
Mob/Demob	LS	$ 7,400	1	$ 7,400
Dewatering	LF	$ 14	1020	$ 14,300
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.5	$ 4,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	650	$ 71,500
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	370	$ 16,700
Land Reclamation Fill	AC	$ 20,200	1	$ 20,200
Upper Bank Stablization, Level 1	LF	$ 25	120	$ 3,000
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	130	$ 700
Seeding	AC	$ 5,000	1.5	$ 7,500
Temporary irrigation and weed management	LS	$ 10,400	1	$ 10,400
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 155,700
Contingency, 15% of subtotal				$ 23,400
Permitting , 2.5% of subtotal				$ 3,900
Design, plans, specification, contract administration, 15%				$ 23,400
Supervision & Administration, 10%				$ 15,600
TOTAL				$ 222,000


Co. Rd. 3
Existing spillway and pump
Existing siphon under bridge
810+00
800+00
790+00
780+00
770+00
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 23
STATION: 814+00 to 853+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, with an average width of about 150 feet. The gradient is slightly lower in this reach than upstream, and in addition to cottonwoods and willows, significant quantities of wetland grasses (e.g., sedges and cattails) are evident. Much of the vegetation is still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Lateral migration, significant bank erosion, and channel downcutting are limited, although localized areas showing evidence of each of these items were observed. The most significant and consistent problem through this reach appears to have been aggradation in the main channel, along the channel margins, and in the overbanks, well as accumulation of debris.

Bank erosion and lateral migration were limited due to the presence of historical bank protection (concrete rubble, automobiles, etc.). Upper bank erosion was observed in areas where overbank flows returned to the channel, but the bank toes in these areas appear stable.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are fairly sufficient to convey flow and to allow for the regeneration of riparian species through natural seeding and cloning without any further restoration. However, removal of debris is recommended along the channel and overbanks in areas where the debris could affect flood conveyance.
2. No further actions are suggested at this time.


hel and
875+00
Rockwell Ditch
alignment
850+00
E. Co. Rd. 6c
840+00
830+00
820+00
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 24
STATION: 851+00 to 900+00
RESTORATION RECOMMENDATIONS: 852+00 to 896+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, with an average width of about 75 feet. The vegetation was comprised of cottonwoods, willows, cattails, and other riparian species, some of which were torn out during the flood. Many of the cottonwoods remain, and many of the willows and cattails are still intact, but the stands are significantly buried with sediment. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. The issues along this reach primarily consist of localized bank erosion, some generalized aggradation, localized deposition (primarily in small floodplain surfaces on inside of bends), and debris jams. Bank erosion along reach is limited in many areas by the presence of concrete rubble and other buried bank protection measures that were installed prior to the flood (concrete rubble, automobiles, etc.). Some localized bank erosion that extended from toe to top of bank was observed locally, including an area just below County Road 1. Significant channel clean up, excavation, and reconstruction has occurred upstream of Sta 888+50. Seeding or planting of any reshaped channel banks would help accelerate vegetation recruitment.

The right abutment of County Road 1 was undermined during the 2013 flood event. This has been repaired with the placement of riprap. It is unknown at this time if any remedial work was performed at County Road 6.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are fairly sufficient to allow for the regeneration of riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along any bare or reconstructed channel banks and floodplain surfaces is recommended to accelerate revegetation and stability.
2. Stabilize right bank near Sta 854+00.
3. Stabilize left bank near Sta 876+00.
4. Stabilize banks near Sta 880+00 to protect and stabilize the Rockwell Ditch and the upstream side of the County Road 1 Bridge.
5. Lower and grade left floodplain surface near Sta 882+50.
6. Stabilize right bank near Sta 882+50 to protect local residence and property.
7. Stabilize right upper bank near Sta 885+00.
8. Stabilize channel banks in vicinity of County Road 6c Bridge.
9. Stabilize left and right banks between Sta 888+00 and Sta 895+50.
10. Upstream of Sta 885+50 the channel width is likely too wide to maintain transport of sediment through the system or possibly even efficient water conveyance at lower flows. It is likely that over time, the channel will adjust through either minor downcutting and/or more likely deposition along the wider channel bottom to naturally narrow the low flow channel. This process could be expedited via mechanical earthwork. Providing some low level vegetated benches will also improve environmental aspects of the channel.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 852+00 to 895+00 Sheet 24 Quantity	Cost
Mob/Demob	LS	$ 23,700	1	$ 23,700
Dewatering	LF	$ 14	4430	$ 62,000
Create/refine Low Flow Channel	LF	$ 27	2200	$ 59,400
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	0	$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100	1	$ 8,100
Lowering and Grading	AC	$ 32,300	1	$ 32,300
Point Bar Creation	LF	$ 5	2200	$ 11,000
Bank Stabilization, Level 1	LF	$ 110	350	$ 38,500
Bank Stabilization, Level 2	LF	$ 75	630	$ 47,300
Bank Stabilization, Level 3	LF	$ 45	1250	$ 56,300
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	900	$ 4,500
Seeding	AC	$ 5,000	20	$ 100,000
Temporary irrigation and weed management	LS	$ 31,050	1	$ 31,100
Remove debris from channel	LS	$ 20,000	1	$ 20,000
SUBTOTAL				$ 502,200
Contingency, 15% of subtotal				$ 75,300
Permitting , 2.5% of subtotal				$ 12,600
Design, plans, specification, contract administration, 15%				$ 75,300
Supervision & Administration, 10%				$ 50,200
TOTAL				$ 716,000

Remove debris from channel and floodplain, Sta 895+00 - 875+00

890+00

880+00

870+00

860+00

Remove debris in channel and floodplain, Sta 859+00 - 875+00

Rockwell Ditch alignment

900+00

Regrade bank upstream and downstream of bridge and stabilize.

E. Co. Rd. 6c

E. Co. R

Co.-Rd.-1

0 200 400

Feet

N

NEIGHBORHOOD: Berthoud
SHEET: 25
STATION: 894+00 to 901+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, with a width of less than 100 feet. The vegetation was comprised of cottonwoods, some willows, and other riparian species, a few of which were torn out during the flood. Many of the cottonwoods remain. Adjacent land use primarily includes agriculture, with some rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. The issues along this reach primarily consist of localized bank erosion, some generalized aggradation, localized deposition (primarily in small floodplain surfaces on inside of bends), and debris jams. Bank erosion along reach is limited in many areas by the presence of concrete rubble and other buried bank protection measures that were installed prior to the flood. Seeding or planting of any reshaped channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Stabilize channel banks in vicinity of County Road 6c Bridge.
2. Up-and downstream of County Road 6c, the channel width is likely too wide to maintain transport of sediment through the system or possibly even efficient water conveyance at lower flows. It is likely that over time, the channel will adjust through either minor downcutting and/or more likely deposition along the wider channel bottom to naturally narrow the low flow channel. This process could be expedited via mechanical earthwork. Providing some low level vegetated benches will also improve environmental aspects of the channel.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 895+00 to 900+00 Sheet 24 Quantity	Cost
Mob/Demob	LS	$ 4,100	1	$ 4,100
Dewatering	LF	$ 14	1050	$ 14,700
Create/refine Low Flow Channel	LF	$ 27	700	$ 18,900
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	0	$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0	$ -
Floodplain Stabilization	AC	$ 8,100	0	$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	700	$ 3,500
Bank Stabilization, Level 1	LF	$ 110	200	$ 22,000
Bank Stabilization, Level 2	LF	$ 75	0	$ -
Bank Stabilization, Level 3	LF	$ 45	150	$ 6,800
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	0	$ -
Seeding	AC	$ 5,000	2	$ 10,000
Temporary irrigation and weed management	LS	$ 1,700	1	$ 1,700
Remove debris from channel	LS	$ 2,500	1	$ 2,500
SUBTOTAL				$ 84,200
Contingency, 15% of subtotal				$ 12,600
Permitting , 2.5% of subtotal				$ 2,100
Design, plans, specification, contract administration, 15%				$ 12,600
Supervision & Administration, 10%				$ 8,400
TOTAL				$ 120,000


Rockwell Ditch alignment
900+00
Regrade bank upstream and downstream of bridge and stabilize.
Co. Rd. 1
E. Co. Rd. 6c
E. Co. R
County line
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 26
STATION: 894+00 to 933+00
RESTORATION RECOMMENDATIONS: 852+00 to 916+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, with an average width of about 100 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Many of the cottonwoods remain. Adjacent land use primarily includes agriculture, with some rural development, and roads.

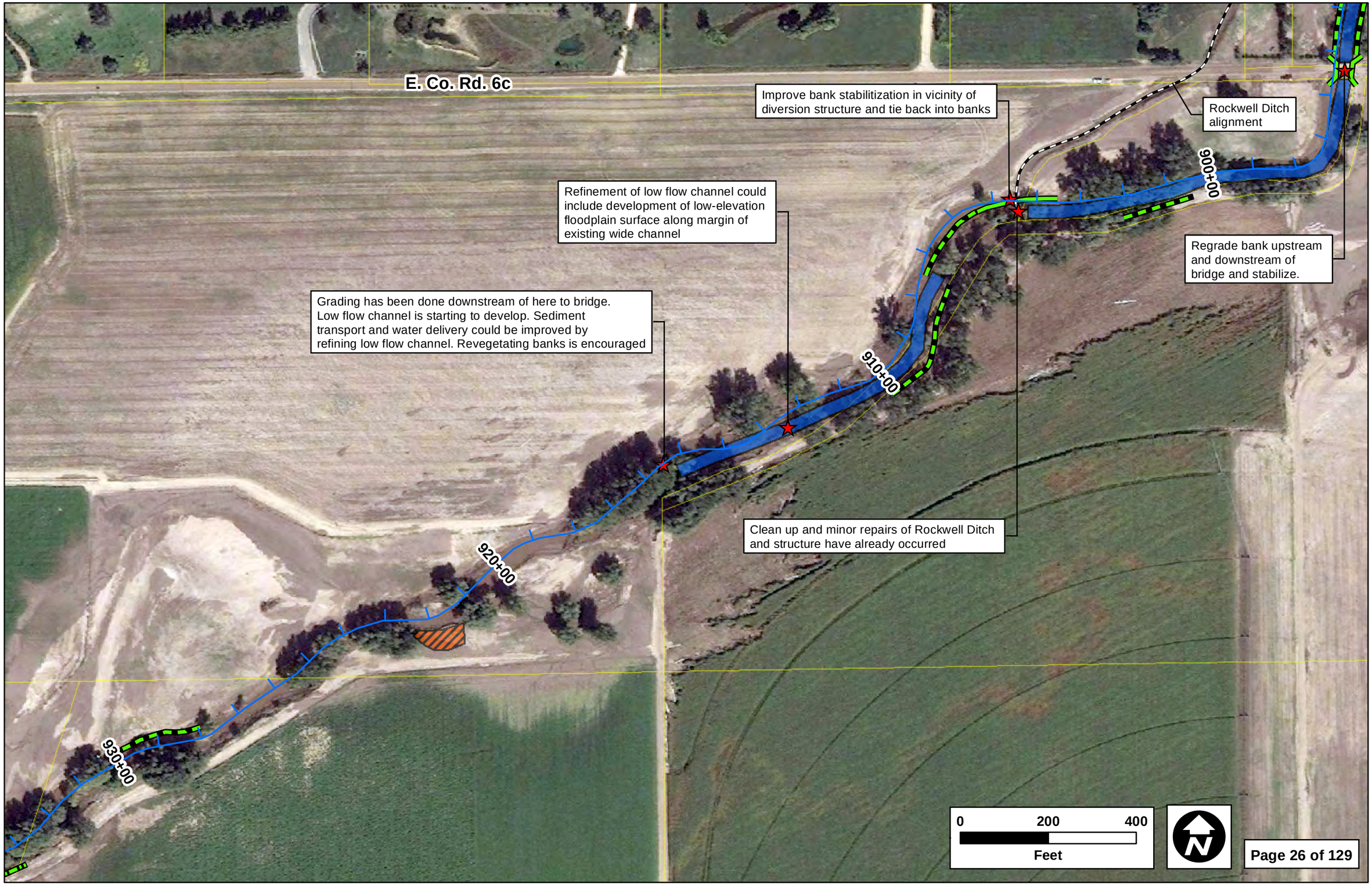
For the most part, the general channel planform was maintained during the 2013 flood event. The issues along this reach primarily consist of localized bank erosion, some generalized aggradation, localized deposition (primarily in small floodplain surfaces on inside of bends), and debris jams. Bank erosion along reach is limited in many areas by the presence of concrete rubble and other buried bank protection measures that were installed prior to the flood. Significant channel clean up, excavation, and reconstruction has occurred downstream of Sta 915+50. Seeding or planting of any reshaped channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are fairly sufficient to allow for the regeneration of riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along any bare or reconstructed channel banks and floodplain surfaces is recommended to accelerate revegetation and stability.
2. Stabilize channel banks in vicinity of County Road 6c Bridge.
3. Stabilize right bank near Sta 901+00.
4. Stabilize right bank near Rockwell Ditch Diversion Structure or tie diversion structure farther into the bank.
5. Stabilize left bank near Sta 906+00 and tie into Rockwell Ditch Diversion Structure.
6. Stabilize right bank near Sta 909+00.
7. Stabilize and grade floodplain near Sta 922+00.
8. Downstream of Sta 915+50 the channel width is currently likely too wide to maintain transport of sediment through the system or possibly even efficient water conveyance at lower flows. It is likely that over time, the channel will adjust through either minor downcutting and/or more likely deposition along the wider channel bottom to naturally narrow the low flow channel. This process could be expedited via mechanical earthwork. Providing some low level vegetated benches will also improve environmental aspects of the channel.
9. Stabilize left bank near Sta 929+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 900+00 to 930+00 Sheet 26 Quantity	Cost
Mob/Demob	LS	$ 14,300	1	$ 14,300
Dewatering	LF	$ 14	2500	$ 35,000
Create/refine Low Flow Channel	LF	$ 27	1500	$ 40,500
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	0	$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1500	$ 7,500
Bank Stabilization, Level 1	LF	$ 110	200	$ 22,000
Bank Stabilization, Level 2	LF	$ 75	0	$ -
Bank Stabilization, Level 3	LF	$ 45	800	$ 36,000
Land Reclamation Fill	AC	$ 20,200	0	$ 2,000
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	0	$ -
Seeding	AC	$ 5,000	15	$ 75,000
Temporary irrigation and weed management	LS	$ 9,500	1	$ 9,500
Remove debris from channel	LS	$ 15,000	1	$ 15,000
SUBTOTAL				$ 256,800
Contingency, 15% of subtotal				$ 38,500
Permitting , 2.5% of subtotal				$ 6,400
Design, plans, specification, contract administration, 15%				$ 38,500
Supervision & Administration, 10%				$ 25,700
TOTAL				$ 366,000


E. Co. Rd. 6c
Improve bank stabilitization in vicinity of diversion structure and tie back into banks
Rockwell Ditch alignment
900+00
Refinement of low flow channel could include development of low-elevation floodplain surface along margin of existing wide channel
Regrade bank upstream and downstream of bridge and stabilize.
Grading has been done downstream of here to bridge. Low flow channel is starting to develop. Sediment transport and water delivery could be improved by refining low flow channel. Revegetating banks is encouraged
910+00
Clean up and minor repairs of Rockwell Ditch and structure have already occurred
920+00
930+00
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 27
STATION: 927+00 to 964+00
RESTORATION RECOMMENDATIONS: 927+00 to 945+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, with an average width of about 100 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Many of the cottonwoods remain, and many of the willows are still intact, but the stands are significantly buried with sediment. Adjacent land use includes agriculture, rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Local scour along channel banks and debris and sediment deposition along the floodplain occurred during the flood. Seeding or planting of any reshaped channel banks would help accelerate vegetation recruitment.

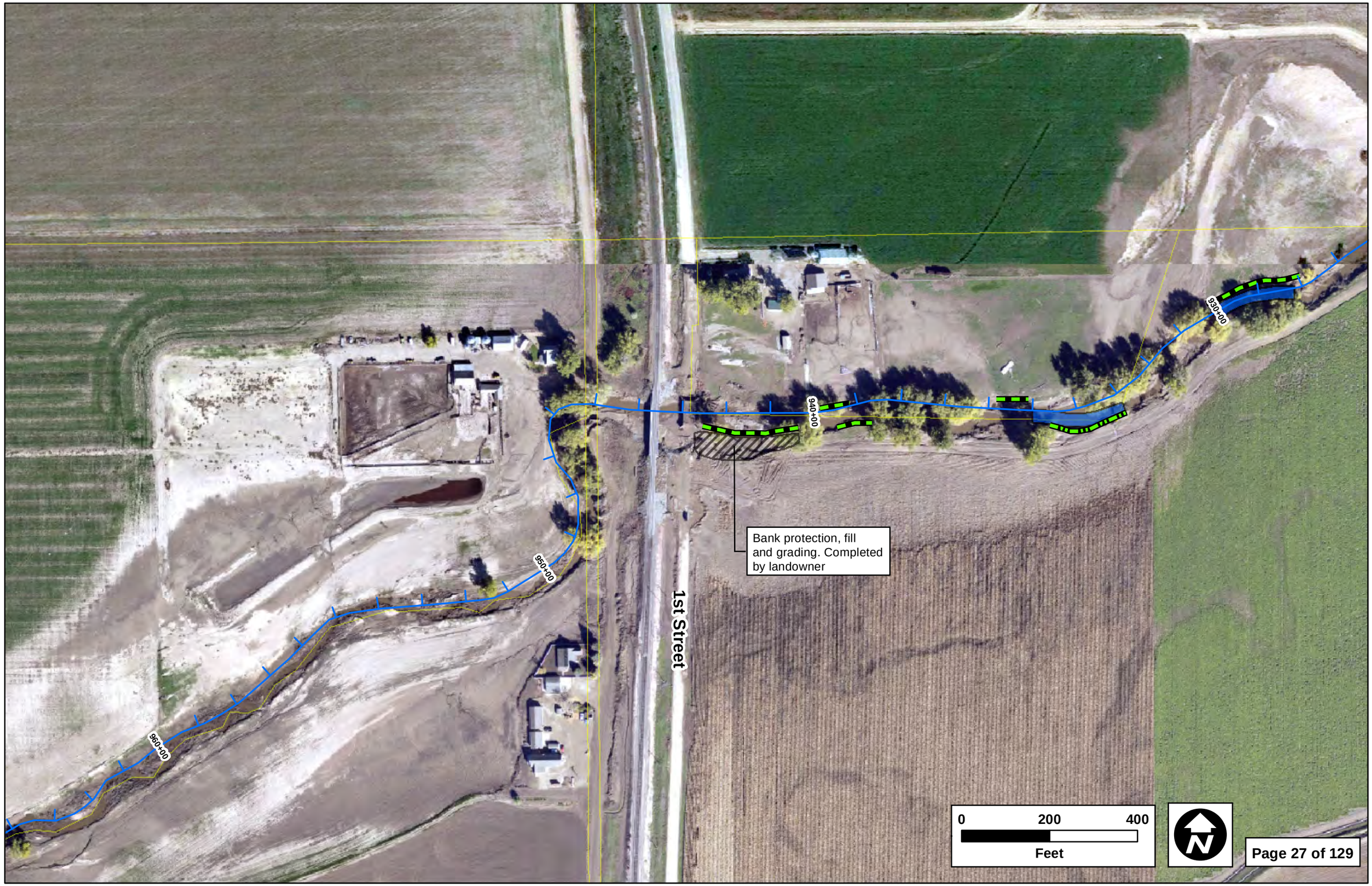
The landowner has placed riprap and graded along the right bank downstream of the bridge at 1st Street. Riprap on the right abutment has also been placed since the 2013 flood.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are fairly sufficient to allow for the regeneration of willow and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along any bare channel banks and floodplain surfaces is recommended to accelerate revegetation and stability.
2. Restore low-flow channel in several sections by removing debris and reconstructing single thread channel.
3. Stabilize left bank near Sta 929+00, Sta 935+00 and Sta 939+00.
4. Stabilize right bank near Sta 934+00
5. Stabilize right bank and reclaim right overbank near Sta 941+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 927+00 to 945+00 Sheet 27 Quantity	Cost
Mob/Demob	LS	$ 9,000	1	$ 9,000
Dewatering	LF	$ 14	1270	$ 17,800
Create/refine Low Flow Channel	LF	$ 27	400	$ 10,800
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	400	$ 2,000
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	200	$ 15,000
Bank Stabilization, Level 3	LF	$ 45	670	$ 30,200
Land Reclamation Fill	AC	$ 20,200	0.25	$ 5,100
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	17	$ 86,200
Temporary irrigation and weed management	LS	$ 12,575	1	$ 12,600
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 188,700
Contingency, 15% of subtotal				$ 28,300
Permitting , 2.5% of subtotal				$ 4,700
Design, plans, specification, contract administration, 15%				$ 28,300
Supervision & Administration, 10%				$ 18,900
TOTAL				$ 269,000


930+00
940+00
950+00
960+00
1st Street
Bank protection, fill and grading. Completed by landowner
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 28
STATION: 952+00 to 985+00
RESTORATION RECOMMENDATIONS: 952+00 to 984+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, with an average width of about 100 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Cottonwoods are primarily the only remaining vegetation at this time. Adjacent land use includes agriculture, rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Local scour along channel banks and debris and sediment deposition along the floodplain occurred during the flood. Seeding or planting of any reshaped channel banks would help accelerate vegetation recruitment. Dry Creek confluences with the Little Thompson River at Sta 972+00.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along any bare channel banks and floodplain surfaces is recommended to accelerate revegetation and stability.
2. Monitor the river in the vicinity of Dry Creek to ensure that future sediment loads do not impact flood-conveyance capacity.
3. No further actions are suggested at this time.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 952+00 to Sta 984+00 Sheet 28 Quantity	Cost
Mob/Demob	LS	$ 3,800	1	$ 3,800
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	15	$ 75,000
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 78,800
Contingency, 15% of subtotal				$ 11,800
Permitting , 2.5% of subtotal				$ 2,000
Design, plans, specification, contract administration, 15%				$ 11,800
Supervision & Administration, 10%				$ 7,900
TOTAL				$ 112,000


Dry Creek
960+00
970+00
980+00
W. Co. Rd. 4e
0
200
400
Feet
ck banks

NEIGHBORHOOD: Berthoud
SHEET: 29
STATION: 982+00 to 1011+00
RESTORATION RECOMMENDATIONS: 985+00 to 994+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had scattered areas of moderately dense riparian vegetation. The vegetation was comprised of cottonwoods, willows, and other riparian species, many of which were torn out during the flood. Cottonwoods are primarily the only remaining vegetation at this time. Adjacent land use includes agriculture, rural development, and roads.

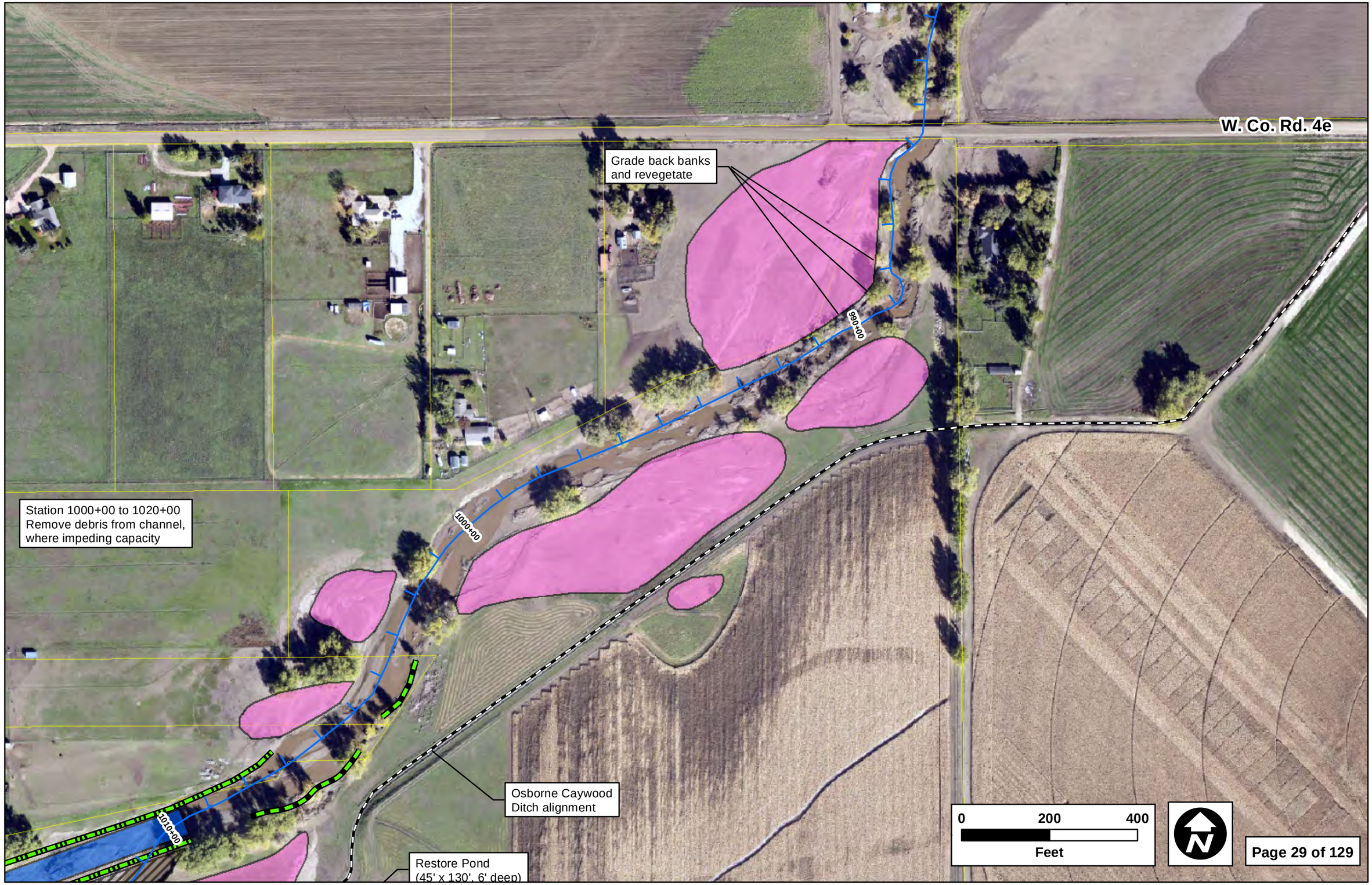
For the most part, the general channel planform was maintained during the 2013 flood event. Local scour along channel banks and debris and sediment deposition along the floodplain occurred during the flood. The most significant overbank sediment deposition occurred upstream (south) of the County Road 4E Bridge due to the constricting effects of the bridge, and was on the order of 4 to 6 feet. Riprap has been placed on the upper banks of this bridge.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along any bare channel banks and floodplain surfaces is recommended to accelerate revegetation and stability.
2. Lower and grade left floodplain near Sta 990+00 and the right overbank between Sta 990+00 to Sta 1000+00.
3. Stabilize right bank near Sta 1006+00, including fill/reclamation of right over bank.
4. Refinement of low-flow channel and stabilization of banks near Sta 1010+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 985+00 to 1001+50 Sheet 29 Quantity	Cost
Mob/Demob	LS	$ 13,700	1	$ 13,700
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	6	$ 193,800
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	16	$ 80,000
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 287,500
Contingency, 15% of subtotal				$ 43,100
Permitting , 2.5% of subtotal				$ 7,200
Design, plans, specification, contract administration, 15%				$ 43,100
Supervision & Administration, 10%				$ 28,800
TOTAL				$ 410,000


W. Co. Rd. 4e
Grade back banks and revegetate
000+00
1000+00
1010+00
Station 1000+00 to 1020+00
Remove debris from channel, where impeding capacity
Osborne Caywood Ditch alignment
Restore Pond (45' x 130', 6' deep)
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 30
STATION: 997+00 to 1029+00
RESTORATION RECOMMENDATIONS: 1000+00 to 1017+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had scattered areas of moderately dense riparian vegetation. The vegetation was comprised of cottonwoods, willows, and other riparian species, many of which were torn out during the flood. Adjacent land use includes agriculture, rural development, and roads. Flood flows caused significant bank erosion in certain locations, such as along the left bank near Sta 1025+00. Significant bank erosion also occurred along the right bank near Sta 1013+00, which was largely due to scour that flanked the Osborne Caywood Ditch Diversion Structure and directed flows directly at the right overbank. Flood flows also deposited significant amounts of sediment and debris along the channel and floodplain. Overbank and floodplain sedimentation and channel bank erosion are the dominant flood impacts in this reach.

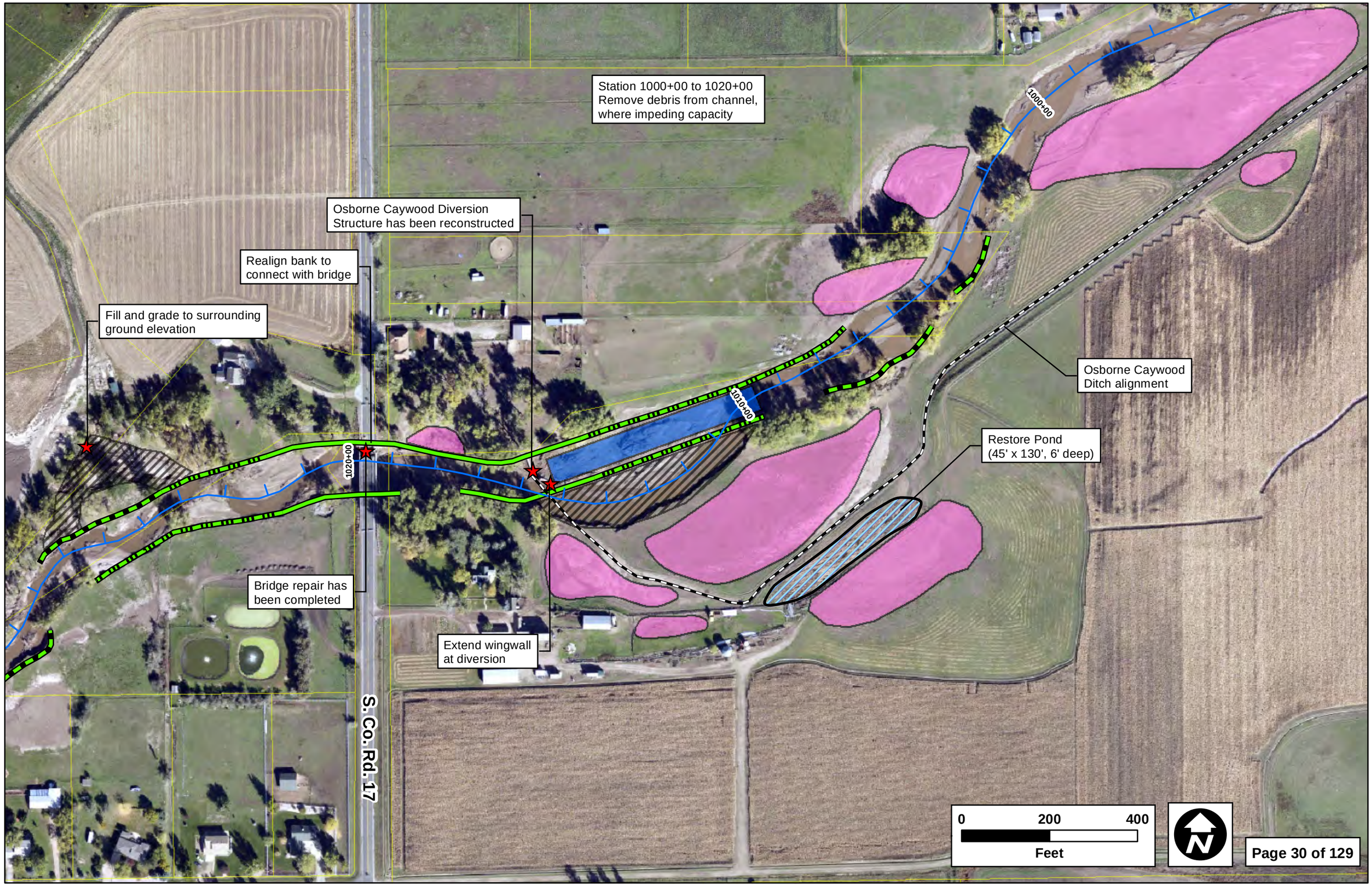
The County Road 17 Bridge and the Osborne Caywood Ditch Diversion Structure was severely damaged during the flood. To date, most of the repairs have been made to both structures.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank near Sta 1006+00.
2. Stabilize the banks in the vicinity of the Osborne Caywood Ditch Diversion Structure to reduce potential for future failure due to flanking of the structure. Extend left bank stabilization, (level 1) between the Osborne Caywood Diversion Structure at Sta 1018+00 to the bridge at County Road 17.
3. Extend wingwall and add bank protection at the right upstream end of the diversion structure at Sta 1016+00.
4. Refinement of low-flow channel and reclamation of right overbank immediately downstream from Osborne Caywood Ditch Diversion Structure at approximately Sta 1013+00.
5. Overbank reclamation between Sta 1010+00 to Sta 1015+00 and near Sta 1025+00.
6. Stabilize banks upstream of County Road 17 to about Sta 1028+00.
7. Grading and lowering (removal of sediment) along both overbanks in numerous locations between Sta 1000+00 to Sta 1019+00.
8. Restore pond in the overbanks opposite Sta 1010+00.
9. In general, clearing of primary low flow channel, removal of significant sediment deposits along the floodplain, and grading of floodplain surfaces to ensure proper connectivity and drainage with river is recommended.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1001+50 to 1028+00 Sheet 30 Quantity	Cost
Mob/Demob	LS	$ 35,800	1	$ 35,800
Dewatering	LF	$ 14	3770	$ 52,800
Create/refine Low Flow Channel	LF	$ 27	500	$ 13,500
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	8	$ 258,400
Point Bar Creation	LF	$ 5	500	$ 2,500
Bank Stabilization, Level 1	LF	$ 110	670	$ 73,700
Bank Stabilization, Level 2	LF	$ 75	1800	$ 135,000
Bank Stabilization, Level 3	LF	$ 45	800	$ 36,000
Land Reclamation Fill	AC	$ 20,200	2	$ 40,400
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	10	$ 50,000
Temporary irrigation and weed management	LS	$ 52,850	1	$ 52,900
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 751,000
Contingency, 15% of subtotal				$ 112,700
Permitting , 2.5% of subtotal				$ 18,800
Design, plans, specification, contract administration, 15%				$ 112,700
Supervision & Administration, 10%				$ 75,100
TOTAL				$ 1,070,000


Station 1000+00 to 1020+00
Remove debris from channel, where impeding capacity
Osborne Caywood Diversion Structure has been reconstructed
Realign bank to connect with bridge
Fill and grade to surrounding ground elevation
1000+00
1010+00
1020+00
Osborne Caywood Ditch alignment
Restore Pond (45' x 130', 6' deep)
Bridge repair has been completed
Extend wingwall at diversion
S. Co. Rd. 17
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 31
STATION: 1028+00 to 1063+00
RESTORATION RECOMMENDATIONS: 1028+00 to 1060+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging from 100 to 300 feet wide. The vegetation was comprised of cottonwoods, willows, and other riparian species, many of which were torn out during the flood. Flood flows caused some significant bank scour in certain locations. Flood flows also deposited significant amounts of sediment and debris along the channel and floodplain. Sedimentation and bank erosion are the dominant flood impacts in this reach. Adjacent land use includes agriculture, rural development, and roads.

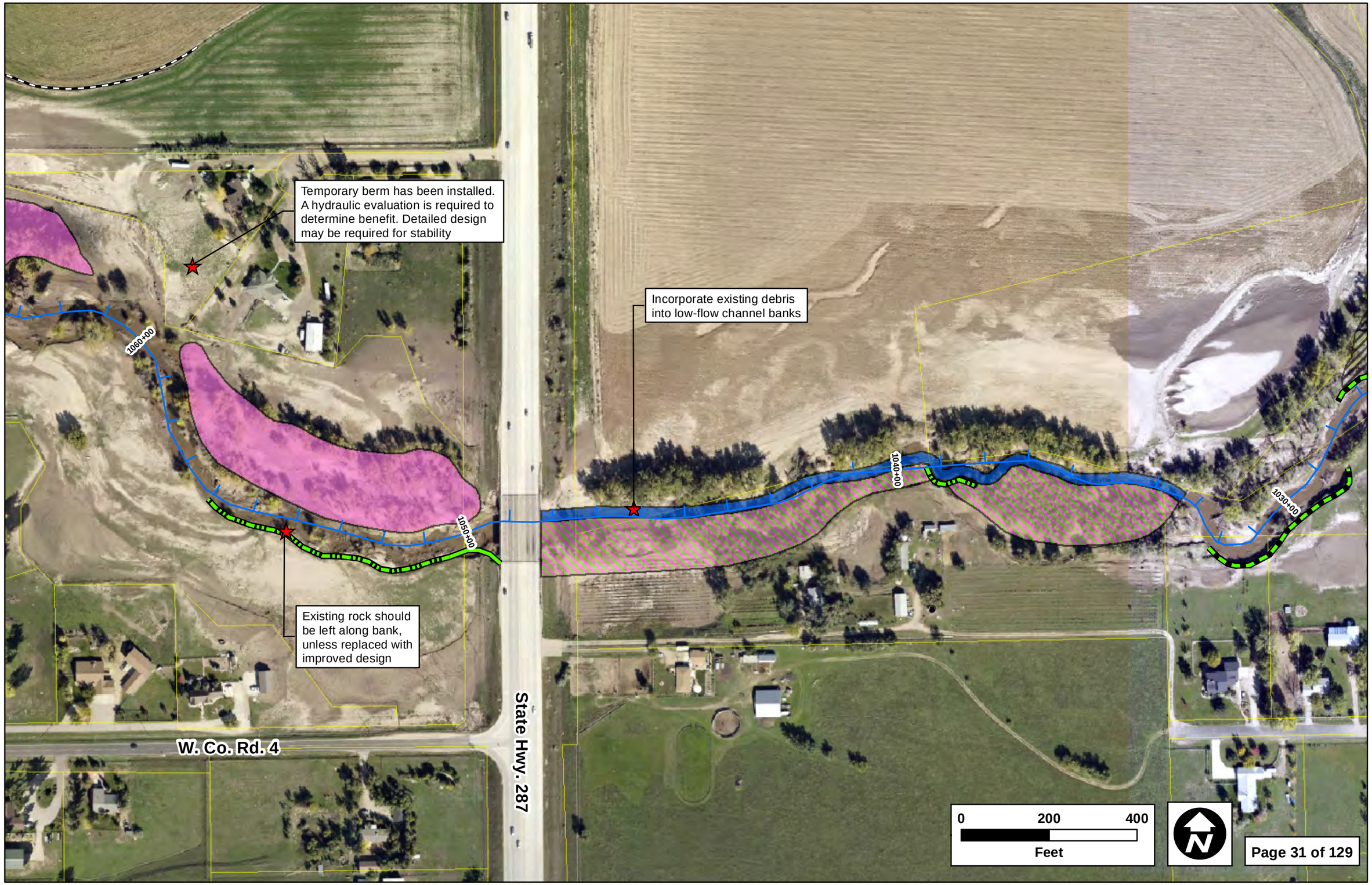
Riprap has been placed on the upper banks adjacent to State Highway 287.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank near Sta 1038+00 and Sta 1032+00.
2. Lowering and grading of the floodplain near Sta 1055+00.
3. Stabilize right bank near Sta 1055+00, including immediately upstream of State Highway 287 Bridge.
4. In general, clearing of primary low-flow channel, removal of significant sediment deposits along the floodplain, and grading of floodplain surfaces to ensure proper connectivity and drainage with river is recommended.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1028+00 to 1060+00 Sheet 31 Quantity	Cost
Mob/Demob	LS	$ 22,700	1	$ 22,700
Dewatering	LF	$ 14	2850	$ 39,900
Create/refine Low Flow Channel	LF	$ 27	1500	$ 40,500
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100	3	$ 24,300
Lowering and Grading	AC	$ 32,300	6	$ 193,800
Point Bar Creation	LF	$ 5	1500	$ 7,500
Bank Stabilization, Level 1	LF	$ 110	150	$ 16,500
Bank Stabilization, Level 2	LF	$ 75	750	$ 56,300
Bank Stabilization, Level 3	LF	$ 45	450	$ 20,300
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	6	$ 30,000
Temporary irrigation and weed management	LS	$ 25,225	1	$ 25,200
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 477,000
Contingency, 15% of subtotal				$ 71,600
Permitting , 2.5% of subtotal				$ 11,900
Design, plans, specification, contract administration, 15%				$ 71,600
Supervision & Administration, 10%				$ 47,700
TOTAL				$ 680,000


Temporary berm has been installed. A hydraulic evaluation is required to determine benefit. Detailed design may be required for stability
Incorporate existing debris into low-flow channel banks
Existing rock should be left along bank, unless replaced with improved design
1060+00
1050+00
1040+00
1030+00
W. Co. Rd. 4
State Hwy. 287
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 32
STATION: 1057+00 to 1094+00
RESTORATION RECOMMENDATIONS: 1060+00 to 1094+00

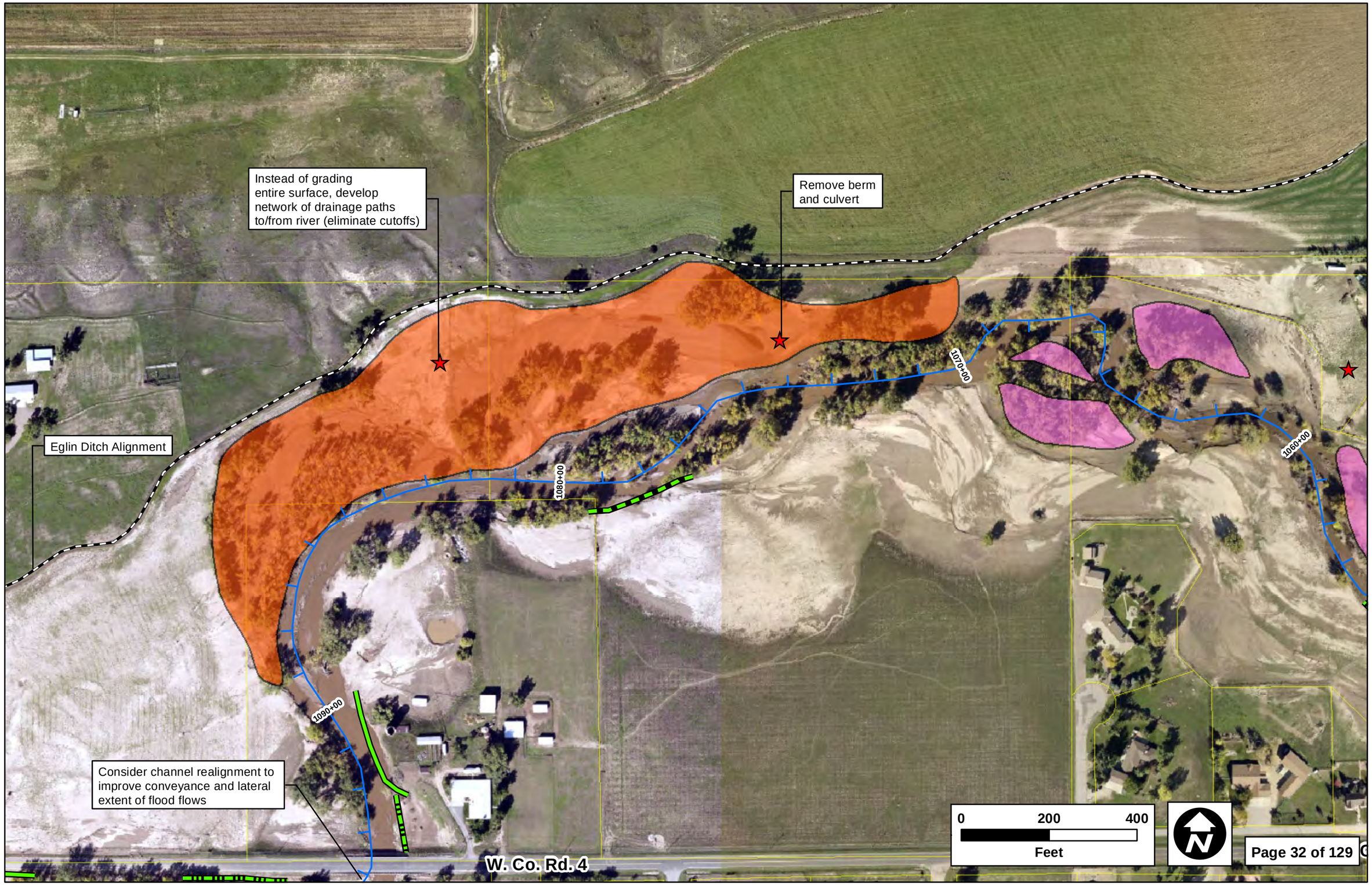
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging from 100 to 250 feet wide, but with local floodplain areas expanding the width to as much as 400 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, many of which were torn out during the flood. Flood flows caused some significant bank scour in certain locations, such as along the right bank downstream from County Road 4 near Sta 1091+00. Flood flows also deposited significant amounts of sediment and debris along the channel and floodplain. Sedimentation and bank erosion are the dominant flood impacts in this reach. Adjacent land use includes agriculture, rural development, and roads.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank near Sta 1091+00 and extend to County Road 4.
2. Grading along wide floodplain adjacent to left channel bank downstream from Sta 1088+00.
3. Stabilize right bank near Sta 1078+00.
4. Lowering and grading of the floodplain near Sta 1065+00.
5. In general, clearing of primary low-flow channel (including removal of large tree at Sta 1091+00), removal of significant sediment deposits along the floodplain, and grading of floodplain surfaces to ensure proper connectivity and drainage with river is recommended.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1060+00 to Sta 1094+00 Sheet 32 Quantity	Cost
Mob/Demob	LS	$ 14,600	1	$ 14,600
Dewatering	LF	$ 14	700	$ 9,800
Grading	AC	$ 8,000	11	$ 88,000
Lowering and Grading	AC	$ 32,300	1.5	$ 48,500
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	300	$ 33,000
Bank Stabilization, Level 2	LF	$ 75	150	$ 11,300
Bank Stabilization, Level 3	LF	$ 45	250	$ 11,300
Seeding	AC	$ 5,000	12.5	$ 62,500
Temporary irrigation and weed management	LS	$ 27,650	1	$ 27,700
SUBTOTAL				$ 306,700
Contingency, 15% of subtotal				$ 46,000
Permitting , 2.5% of subtotal				$ 7,700
Design, plans, specification, contract administration, 15%				$ 46,000
Supervision & Administration, 10%				$ 30,700
TOTAL				$ 437,000


Instead of grading entire surface, develop network of drainage paths to/from river (eliminate cutoffs)
Remove berm and culvert
Eglin Ditch Alignment
Consider channel realignment to improve conveyance and lateral extent of flood flows
1070+00
1080+00
1090+00
1060+00
W. Co. Rd. 4
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 33
STATION: 1178+00 to 1120+00
RESTORATION RECOMMENDATIONS: 1094+00 to 1120+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, with average widths of less than about 100 feet. The alignment appears highly altered due to roads and buildings with the river running parallel and south of County Road 4, then turning 90 degrees to the north, crossing under County Road 4. The vegetation was comprised of cottonwoods, willows, and other riparian species, many of which were torn out during the flood. Flood flows caused some localized scour of the floodplain and overbank surfaces in some areas. Flood flows also deposited significant amounts of sediment and debris along the channel and floodplain. Sedimentation and bank erosion are the dominant flood impacts in this reach. Adjacent land use includes agriculture, rural development, and roads.

Significant flooding issues associated, in part, by the limited capacity of the Mountain River Road Bridge, and the 90-degree turn the river makes at County Road 4 occurred within the area. This resulted in significant infrastructure and residential damages. Sedimentation caused the channel to avulse, drastically changing the planform. Low-flow channel upstream of Sta 1103+00 does not have adequate sediment transport capacity at low to moderate flows, and flood flow capacity in this area is severely diminished.

Between Sta 1085+00 and Sta 1110+00, the FIS effective floodplain and floodway follow a straight alignment rather than paralleling County Road 4 and turning 90° at the bridge. The alignment and road overtopping are likely both contributing to the very wide floodplain in this area, which is at least 1,250 feet spanning northward to about the Eglin Ditch. Field observations and aerial images indicate the flood pattern from the 2013 event followed a similar alignment.

RESTORATION RECOMMENDATIONS

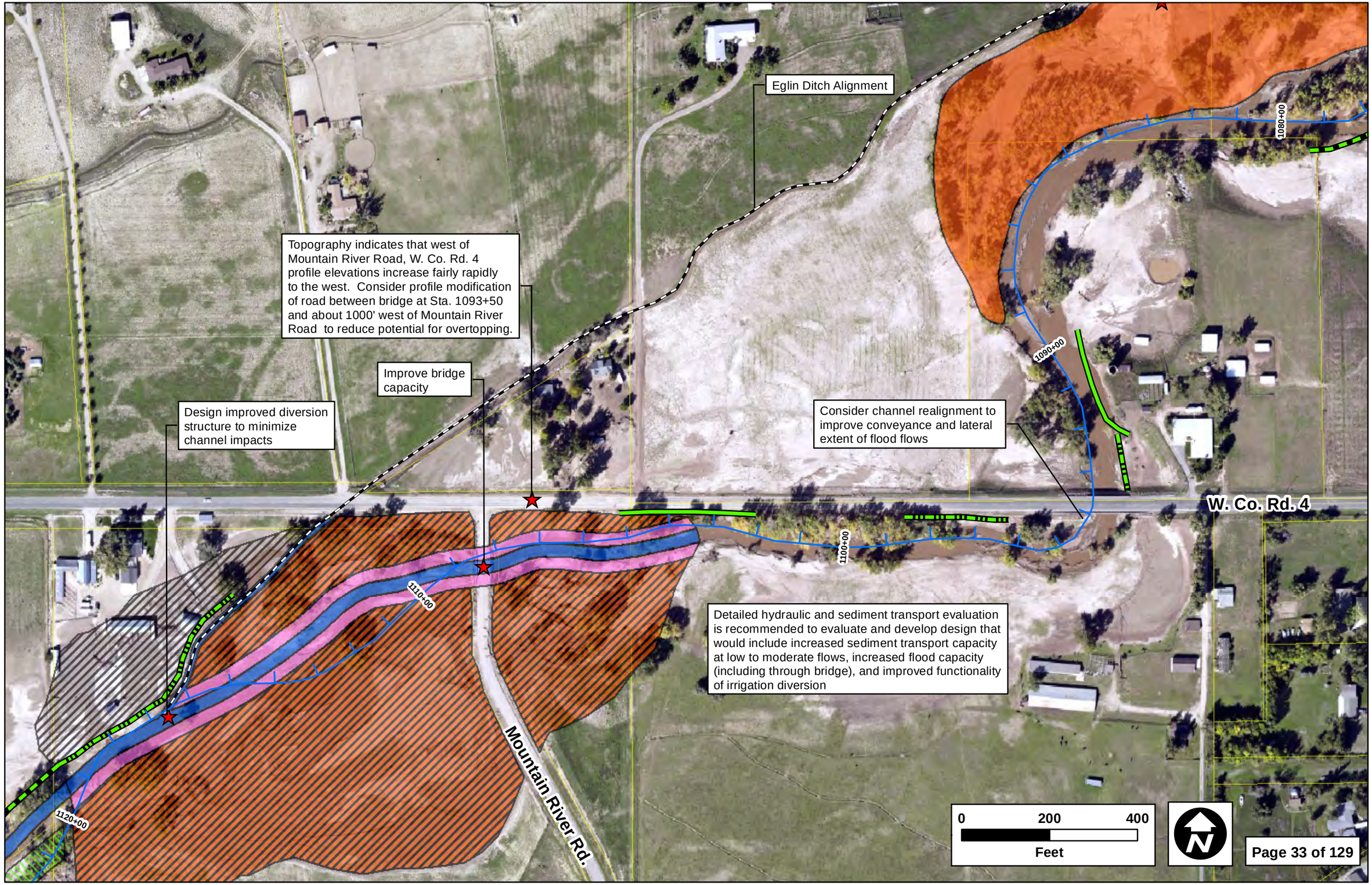
1. A detailed hydraulic and sediment transport evaluation of this area is recommended to analyze and develop a design that would improve sediment transport capacity at low to moderate flows, increase flood capacity (including through Mountain River Road Bridge), and improve functionality of Eglin Ditch diversion structure.
2. Grade near-channel floodplain from Sta 1103+00 near Mountain River Road upstream to about Sta 1120+00.
3. Refine low-flow channel upstream from Sta 1103+00 near Mountain River Road. This refinement includes lowering of the channel bed profile.
4. Stabilize left channel bank from Sta 1114+00 to Sta 1127+00.
5. Reclaim overbank and grade along both sides of the channel from Mountain River Road upstream to about Sta 1120+00. The overbank grading should be done in conjunction with the near-channel floodplain grading to provide surfaces and conveyance at various flow levels. Overbank reclamation and fill will, in part, help improve sediment transport capacity, but design should include analysis of associated flood-flow impacts.
6. Seeding or planting of any reworked channel banks to help accelerate vegetation recruitment.
7. Develop design for new Eglin Ditch Diversion Structure headgate.
8. Stabilize left bank near Sta 1104+00. Stabilize right bank near Sta 1091+00.
9. Grading along wide floodplain adjacent to left channel bank downstream from Sta 1088+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1094+00 to Sta 1120+00 Sheet 33 and 34	
			Quantity	Cost
Mob/Demob	LS	$ 55,400	1	$ 55,400
Dewatering	LF	$ 14	2760	$ 38,600
Create/refine Low Flow Channel	LF	$ 27	1600	$ 43,200
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	15	$ 120,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	2	$ 64,600
Point Bar Creation	LF	$ 5	1600	$ 8,000
Bank Stabilization, Level 1	LF	$ 110	310	$ 34,100
Bank Stabilization, Level 2	LF	$ 75	850	$ 63,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	20	$ 404,000
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	37	$ 185,000
Temporary irrigation and weed management	LS	$146,950	1	$ 147,000
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 1,163,700
Contingency, 15% of subtotal				$ 174,600
Permitting , 2.5% of subtotal				$ 29,100
Design, plans, specification, contract administration, 15%				$ 174,600
Supervision & Administration, 10%				$ 116,400
TOTAL				$ 1,658,000

Additional improvements which are strongly encouraged to consider are noted below:

1. Construct a new bridge under W. County Road 4 with greater capacity and to the west of the existing bridge to help alleviate the sharp bend in the river at the bridge.
2. Modify the channel alignment between Sta 1085+00 to Sta 1105+00 by moving the channel westerly (to the new bridge location) and reducing the bend at the bridge to potentially improve conveyance and reduce the lateral extent of flood flows (and potentially the lateral extent of the FIS effective floodplain and floodway). This realignment would also alleviate the scour pressures noted at the silo located at Sta 1091+00.
3. Consider modifying the elevation profile of West County Road 4 by shifting rise in road elevations farther east than existing in order to reduce potential for overtopping of road under flood conditions.
4. Modify or replace Mountain River Road Bridge to increase flow capacity.


Eglin Ditch Alignment
Topography indicates that west of Mountain River Road, W. Co. Rd. 4 profile elevations increase fairly rapidly to the west. Consider profile modification of road between bridge at Sta. 1093+50 and about 1000' west of Mountain River Road to reduce potential for overtopping.
Improve bridge capacity
Design improved diversion structure to minimize channel impacts
Consider channel realignment to improve conveyance and lateral extent of flood flows
1080+00
1090+00
1100+00
1110+00
1120+00
W. Co. Rd. 4
Mountain River Rd.
Detailed hydraulic and sediment transport evaluation is recommended to evaluate and develop design that would include increased sediment transport capacity at low to moderate flows, increased flood capacity (including through bridge), and improved functionality of irrigation diversion
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 34
STATION: 1120+00 to 1150+00
RESTORATION RECOMMENDATIONS: 1120+00 to 1164+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging up to about 150 feet in width. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Flood flows caused some localized scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the bends near Sta 1126+00 and Sta 1138+00. Flood flows also deposited large amounts of sediment and debris along the channel and floodplain. Adjacent land use includes agriculture, rural development, and roads.

Upstream of about Sta 1130+00, except for the channel erosion at the bend at Sta 1138+00, the channel planform did not change significantly during the 2013 flood event. General scour enlarged the channel size, local bank scour occurred, and debris and sediment deposition impacted both the channel, floodplain, and overbank areas. Seeding or planting of any reworked channel banks would help accelerate vegetation recruitment.

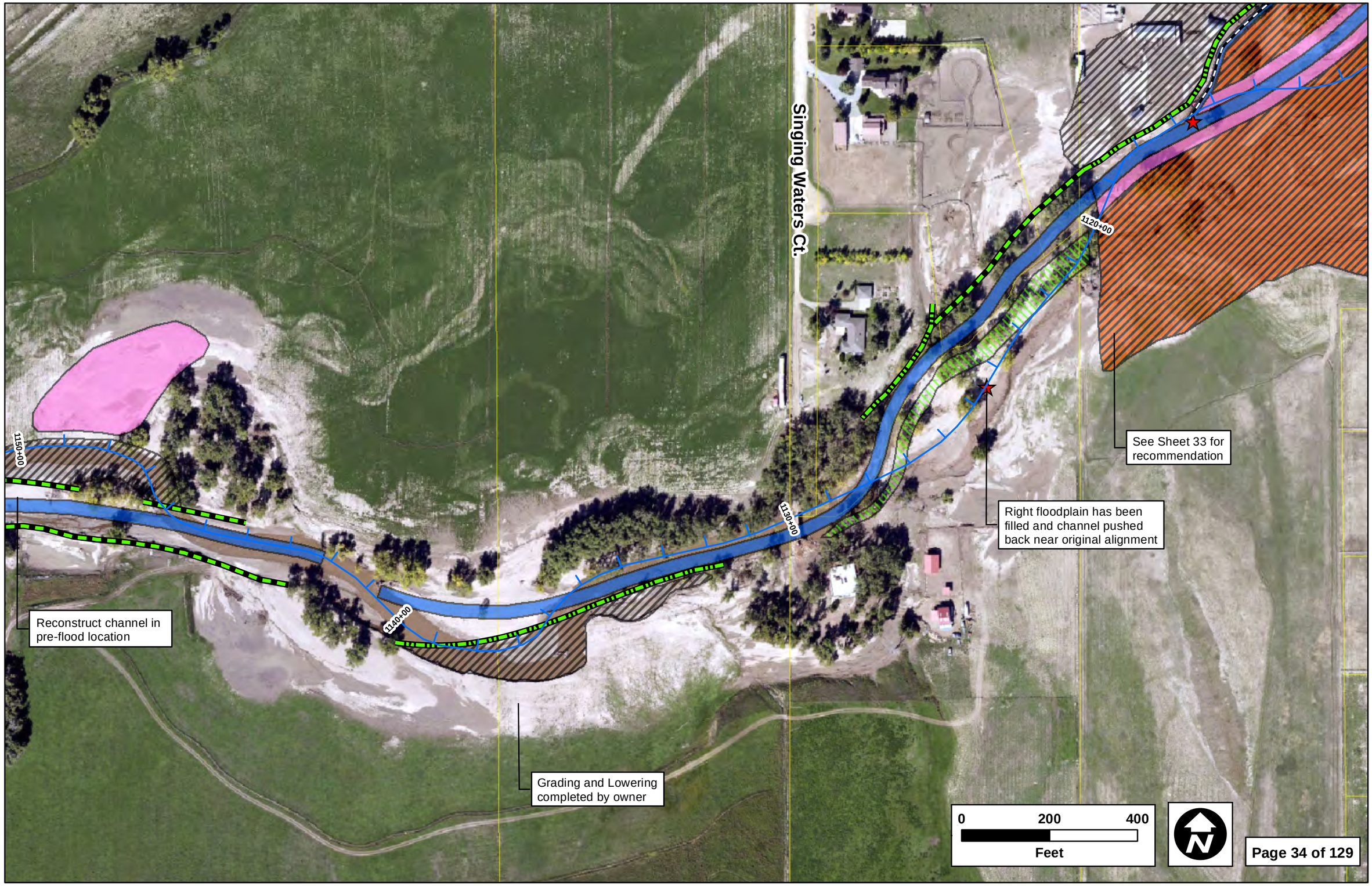
Downstream of Sta 1130+00, significant flooding issues associated, in part, by the limited capacity of the Mountain River Road Bridge, occurred within the area. This resulted in significant infrastructure and residential damages. Sedimentation caused the channel to avulse, drastically changing the planform. Low-flow channel does not have adequate sediment-transport capacity at low to moderate flows, and flood-flow capacity in this area is severely diminished.

RESTORATION RECOMMENDATIONS

1. See sheet 33 for recommendations downstream of Sta 1120+00.
2. Stabilize left channel bank from Sta 1120+00 to Sta 1127+00.
3. Floodplain stabilization between Sta 1120+00 and Sta 1130+00.
4. Stabilize right bank between Sta 1132+00 and Sta 1150+00.
5. Realign river to pre-flood alignment between Sta 1134+00 to Sta 1140+00.
6. Overbank reclamation near Sta 1136+00.
7. Stabilize left bank near Sta 1149+00.
8. Seeding or planting of any reworked channel banks would help accelerate vegetation recruitment.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1120+00 to 1164+00 Sheet 34 and 35 Quantity	Cost
Mob/Demob	LS	$ 34,900	1	$ 34,900
Dewatering	LF	$ 14	6550	$ 91,700
Create/refine Low Flow Channel	LF	$ 27	2000	$ 54,000
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100	1	$ 8,100
Lowering and Grading	AC	$ 32,300	2	$ 64,600
Point Bar Creation	LF	$ 5	2000	$ 10,000
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	2300	$ 172,500
Bank Stabilization, Level 3	LF	$ 45	2250	$ 101,300
Land Reclamation Fill	AC	$ 20,200	0.5	$ 10,100
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	22.5	$ 112,500
Temporary irrigation and weed management	LS	$ 73,000	1	$ 73,000
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 732,700
Contingency, 15% of subtotal				$ 109,900
Permitting , 2.5% of subtotal				$ 18,300
Design, plans, specification, contract administration, 15%				$ 109,900
Supervision & Administration, 10%				$ 73,300
TOTAL				$ 1,044,000


Singing Waters Ct.
1120+00
1130+00
1140+00
1150+00
See Sheet 33 for recommendation
Right floodplain has been filled and channel pushed back near original alignment
Reconstruct channel in pre-flood location
Grading and Lowering completed by owner
0
200
400
Feet
N

NEIGHBORHOOD: Berthoud
SHEET: 35
STATION: 1144+00 to 1180+00
RESTORATION RECOMMENDATIONS: 1168+00 to 1179+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging from 150 to 250 feet wide, but with local floodplain areas expanding the width to as much as 400 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, some of which were torn out during the flood. Flood flows caused some localized scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1162+00. Flood flows also deposited large amounts of sediment and debris along the channel and floodplain. Adjacent land use includes agriculture, rural development, and roads.

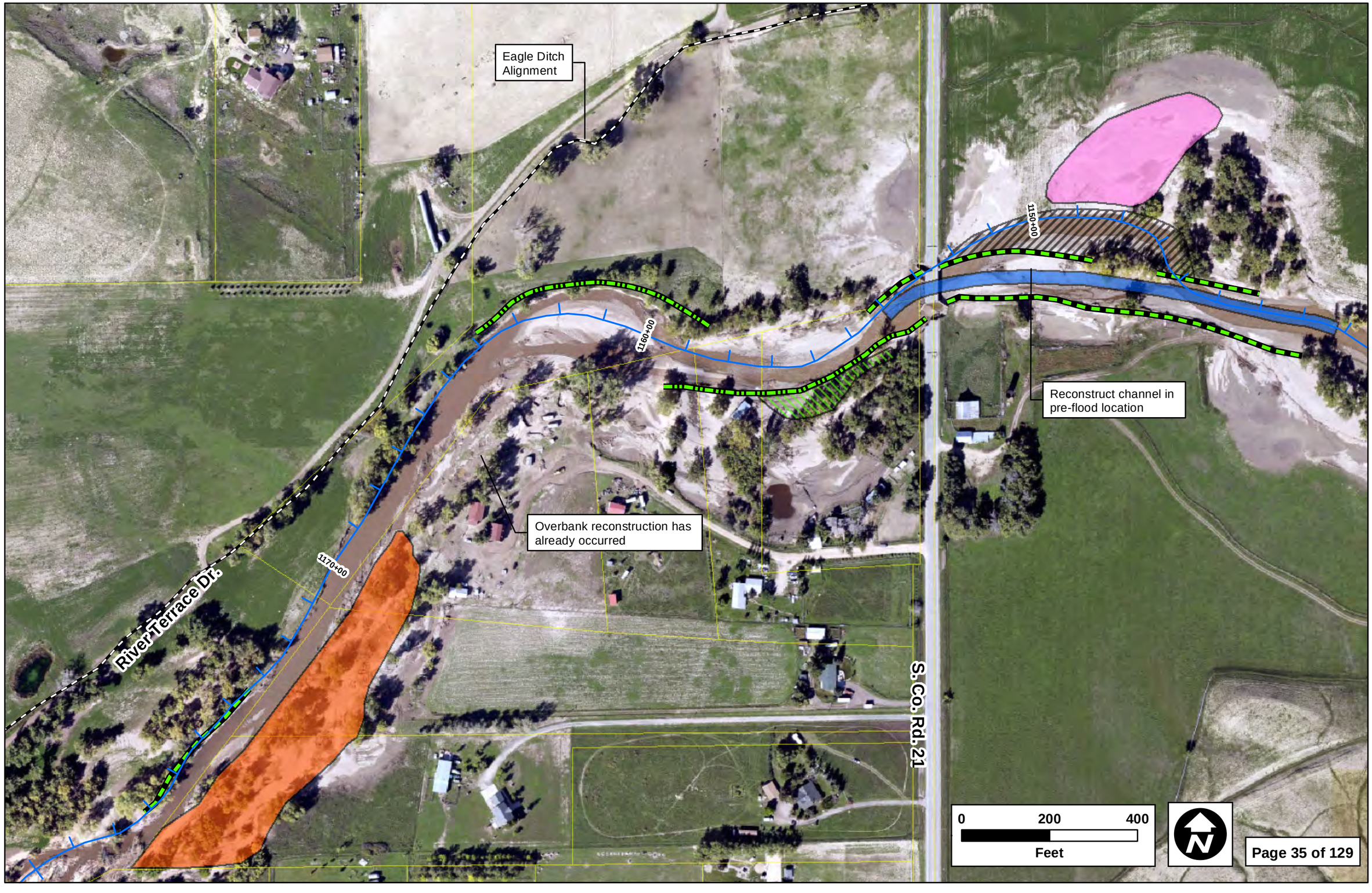
Except for the channel erosion at the bend near Sta 1162+00, the channel planform did not change significantly during the 2013 flood event. General scour enlarged the channel size, local bank scour occurred, and debris and sediment deposition impacted both the channel, floodplain, and overbank areas. The channel avulsed immediately downstream of County Road 21 due to debris blockage. Seeding or planting of any reworked channel banks would help accelerate vegetation recruitment. Significant channel widening occurred downstream of County Road 21. The bridge at County Road 21 was significantly damaged during the flood and is being repaired as of early Summer 2014.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks and floodplain.
2. Realign river to pre-flood alignment between Sta 1144+00 to Sta 1153+00.
3. Stabilize right channel bank and floodplain surface near Sta 1154+00.
4. Stabilize banks downstream of County Road 21.
5. Left channel bank near Sta 1162+00 eroded approximately 130 feet to the north. Current channel geometry has an improved conveyance capacity, and should also provide adequate surface for regeneration of riparian vegetation. It is, however, recommended that the left channel bank be stabilized to reduce chance for further erosion.
6. Floodplain grading near Sta 1175+00.
7. Stabilize left bank near Sta 1175+00.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1168+00 to 1179+00 Sheet 35 and 36 Quantity	Cost
Mob/Demob	LS	$ 5,700	1	$ 5,700
Dewatering	LF	$ 14	400	$ 5,600
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	3.5	$ 28,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	400	$ 18,000
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	8.5	$ 42,500
Temporary irrigation and weed management	LS	$ 11,500	1	$ 11,500
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 111,300
Contingency, 15% of subtotal				$ 16,700
Permitting , 2.5% of subtotal				$ 2,800
Design, plans, specification, contract administration, 15%				$ 16,700
Supervision & Administration, 10%				$ 11,100
TOTAL				$ 159,000


Eagle Ditch Alignment
1150+00
1160+00
Reconstruct channel in pre-flood location
Overbank reconstruction has already occurred
1170+00
River Terrace Dr.
S. Co. Rd. 21
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 36
STATION: 1169+00 to 1195+00
RESTORATION RECOMMENDATIONS: 1179+00 to 1199+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging from 200 to 300 feet wide, but with local areas containing additional vegetation somewhat set back from the channel. The vegetation was comprised of cottonwoods, willows, and other riparian species, a few of which were torn out during the flood. Significant channel and floodplain reconstruction has already occurred, and cottonwoods are primarily the only remaining vegetation at this time. Adjacent land use includes agriculture, rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. General scour that enlarged the channel, local scour and bank retreat, and debris and sediment deposition occurred during the flood, but due to channel reconstruction, some post-flood impacts were not identifiable. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks and floodplain.
2. Stabilize left bank near Sta 1175+00.
3. Floodplain grading near Sta 1175+00.
4. Stabilize floodplain in areas where channel has been reconstructed.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1179+00 to Sta 1199+00 Sheet 36 and 37	
			Quantity	Cost
Mob/Demob	LS	$ 3,800	1	$ 3,800
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100	2.5	$ 20,300
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	10	$ 50,000
Temporary irrigation and weed management	LS	$ 5,075	1	$ 5,100
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 79,200
Contingency, 15% of subtotal				$ 11,900
Permitting , 2.5% of subtotal				$ 2,000
Design, plans, specification, contract administration, 15%				$ 11,900
Supervision & Administration, 10%				$ 7,900
TOTAL				$ 113,000

River Terrace Dr.

River Terrace Dr.

1170+00

1180+00

1190+00

Eagle Ditch Alignment

Overbank reconstruction completed by owner in general conformance with this master plan.

0 200 400

Feet

NEIGHBORHOOD: Berthoud
SHEET: 37
STATION: 1184+00 to 1220+00
RESTORATION RECOMMENDATIONS: 1199+00 to 1211+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 200 feet wide, with localized areas of vegetation somewhat set back from the channel. The vegetation was comprised of cottonwoods, willows, and other riparian species, only a few of which were torn out during the flood. Adjacent land use includes agriculture, rural development, and roads. For the most part, the general channel planform was maintained during the 2013 flood event. Local scour, bank retreat, and debris and sediment deposition occurred during the flood, but due to channel reconstruction, some post-flood impacts were not identifiable.

Significant work has been accomplished by the landowner, with input and guidance from the NRCS. This work included the removal of significant amounts of debris, grading the overbanks, bank stabilization and reseeding, all in general conformance with this Master Plan. Additional seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

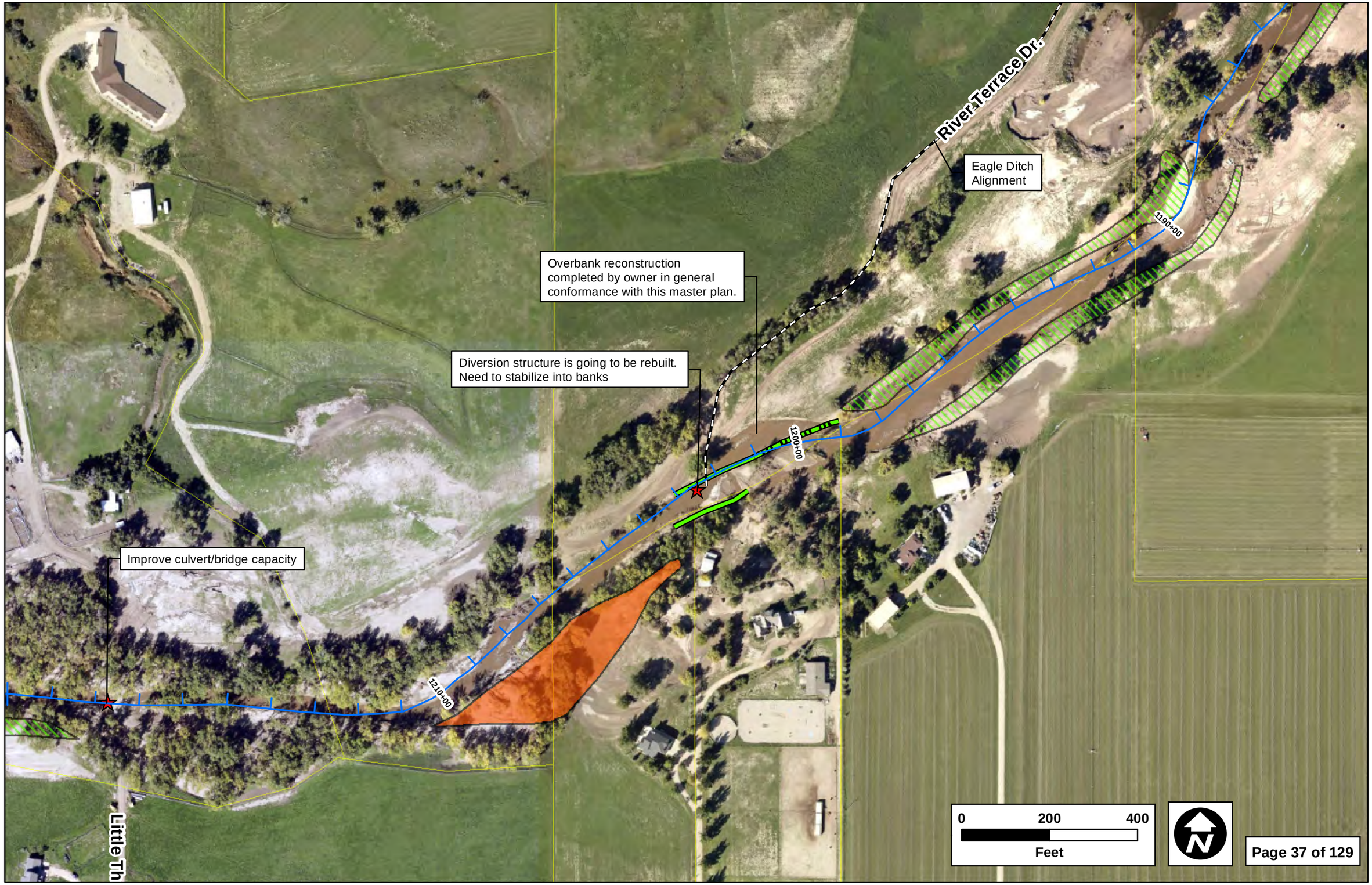
Additional recommendations for this area are provided below.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks and floodplain.
2. Stabilize banks in vicinity of diversion near Sta 1201+50. Diversion structure should also be tied into the bank an adequate distance to reduce the chance of erosion that could flank the structure.
3. Floodplain grading near Sta 1208+00.
4. Stabilize floodplain in areas where channel has been reconstructed.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1199+00 to 1211+00 Sheet 37 Quantity	Cost
Mob/Demob	LS	$ 9,800	1	$ 9,800
Dewatering	LF	$ 14	650	$ 9,100
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	1.5	$ 12,000
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	400	$ 44,000
Bank Stabilization, Level 2	LF	$ 75	250	$ 18,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	6	$ 30,000
Temporary irrigation and weed management	LS	$ 7,700	1	$ 7,700
Improve culvert capacity on Little Thompson Rd	LS	$ 75,000	1	$ 75,000
SUBTOTAL				$ 206,400
Contingency, 15% of subtotal				$ 31,000
Permitting , 2.5% of subtotal				$ 5,200
Design, plans, specification, contract administration, 15%				$ 31,000
Supervision & Administration, 10%				$ 20,600
TOTAL				$ 294,000


River Terrace Dr.
Eagle Ditch Alignment
Overbank reconstruction completed by owner in general conformance with this master plan.
Diversion structure is going to be rebuilt. Need to stabilize into banks
Improve culvert/bridge capacity
1190+00
1200+00
1210+00
Little Th
0
200
400
Feet

NEIGHBORHOOD: Berthoud
SHEET: 38
STATION: 1212+00 to 1245+00
RESTORATION RECOMMENDATIONS: 1218+00 to 1239+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, with a relatively consistent width of almost 400 feet. The vegetation was comprised of cottonwoods, willows, and other riparian species, a few of which were torn out during the flood. Adjacent land use includes agriculture, rural development, and roads.

For the most part, the general channel planform was maintained during the 2013 flood event. Some local scour and debris and sediment deposition occurred during the flood, but due to the channel reconstruction, detailed post-flood impacts were not identifiable. County Road 2, a low water culvert crossing, reportedly plugged and overtopped.

Significant work has been accomplished by the landowner, with input and guidance from the NRCS. This work included the removal of significant amounts of debris, grading the overbanks, bank stabilization and reseeding, all in general conformance with this Master Plan. Additional seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

Additional recommendations for this area are provided below.

RESTORATION RECOMMENDATIONS

1. Geomorphic functions of this reach are likely sufficient to allow for the regeneration of willow, and other riparian species through natural seeding and cloning without any further restoration. However, seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks and floodplain.
2. Stabilize floodplain.
3. Stabilize banks along channel bends near Sta 1224+00.
4. Assess and consider improvements to the culvert/bridge at County Road 2.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1218+00 to 1239+00 Sheet 38 Quantity	Cost
Mob/Demob	LS	$ 6,700	1	$ 6,700
Dewatering	LF	$ 14	700	$ 9,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100	3.5	$ 28,400
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	700	$ 31,500
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	10	$ 50,000
Temporary irrigation and weed management	LS	$ 14,975	1	$ 15,000
Site Specific	LS	$ -	1	$ -
SUBTOTAL				$ 141,400
Contingency, 15% of subtotal				$ 21,200
Permitting , 2.5% of subtotal				$ 3,500
Design, plans, specification, contract administration, 15%				$ 21,200
Supervision & Administration, 10%				$ 14,100
TOTAL				$ 201,000


Floodplain and bank reconstruction completed by owner in general conformance with this master plan.
Improve culvert/bridge capacity
1220+00
1230+00
Little Thompson Dr.
W. Co. Rd. 2
W. Co. Rd. 2
1240+00
County line
Significant channel reconstruction has already occurred
0
200
400
Feet

NEIGHBORHOOD: Boulder County
SHEET: 39
STATION: 1238+00 to 1273+00
RESTORATION RECOMMENDATIONS: 1239+00 to 1282+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, ranging in widths up to about 200 feet. The vegetation is comprised primarily of cottonwoods, some willows, and other riparian species, some of which were torn out during the flood. Flood flows caused considerable scour and shifting of the floodplain and overbank surfaces in some areas. Localized sediment and debris deposits are considerable in this area.

During the 2013 flood, the original channel breached to the north near Sta 1272+00, and a secondary channel developed along that north side and somewhat parallel to the original channel, which ultimately filled in with sediment. This new channel ultimately eroded into and undercut a house near Sta 1266+00. Just upstream of the 83rd Street Bridge, the flood channel turns abruptly to the south, rejoining the original channel.

The 83rd Street Bridge failed during the 2013 flood, and high flows were also directed over the lowest section of the road profile, which is about 200 feet north of the bridge. These road overtopping flows entered the overbank surface on the downstream side of the road, which resulted in a significant headcut channel that developed along the full length of the channel between 83rd Street and West County Line Road. Significant damage occurred to property and houses both upstream and downstream of 83rd Street.

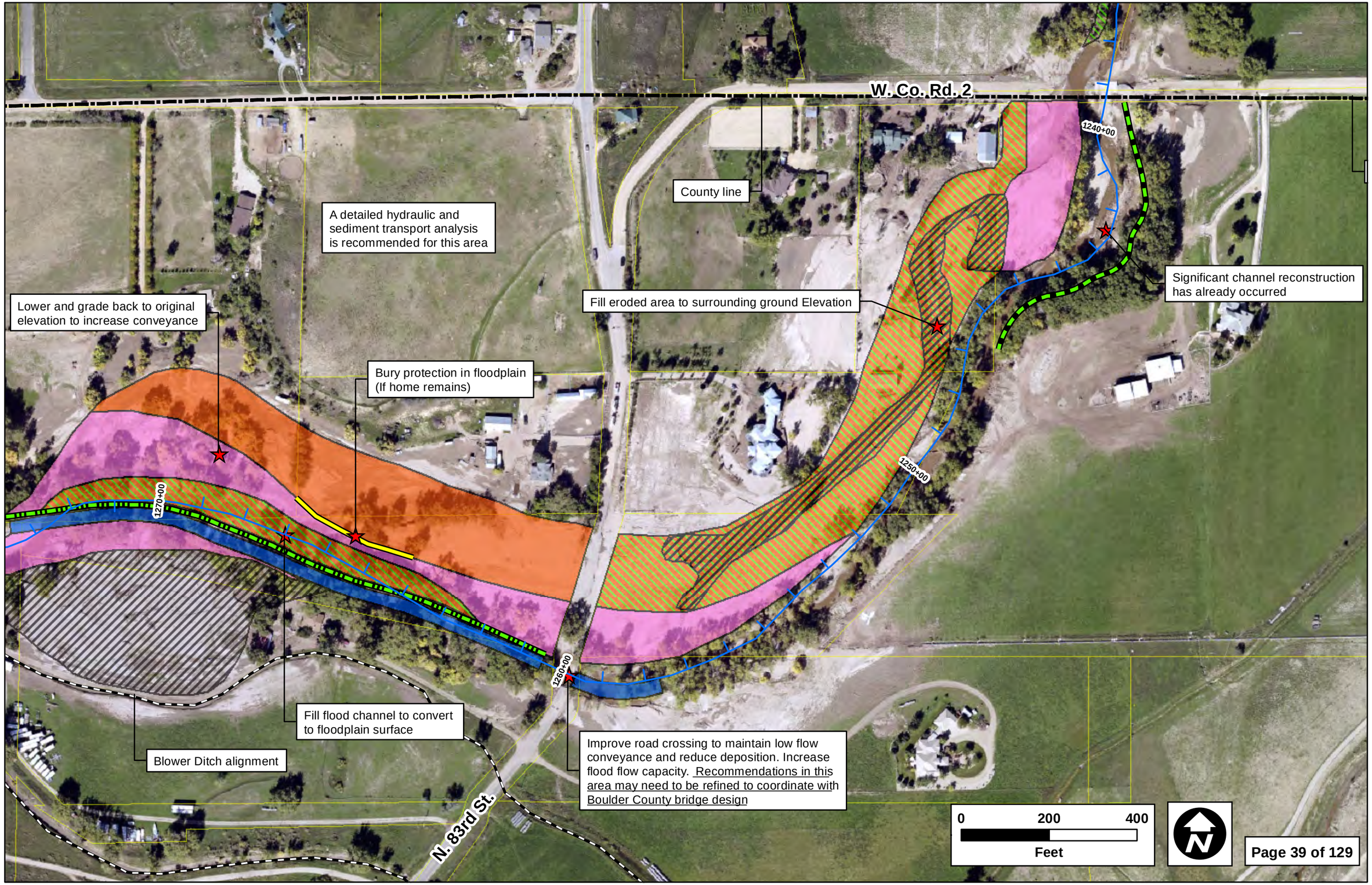
Considerable channel repairs have already occurred, especially between Sta 1239+00 and Sta 1250+00. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment. Boulder County is current assessing and designing a new bridge at 83rd Street, sized to convey the 100-year flows without overtopping.

RESTORATION RECOMMENDATIONS

1. Lower and grade floodplain surfaces upstream and downstream of 83rd Street to improve conveyance capacity and drainage.
2. Reclaim eroded overbank surfaces, especially on the south side of the river near Sta 1272+00.
3. Reconstruct original channel alignment upstream of 83rd Street, and add fill to flood channel to convert to a stable floodplain surface and direct overtopping flows to the bridge.
4. Provide buried rock for stabilization in reconstructed floodplain surface along south side of house near Sta 1266+00 (if house remains). This will provide additional protection in case future floods cause another channel breach.
5. Fill in headcut channel along left (north) overbank area between 83rd Street and West County Line Road. Add floodplain stabilization measures throughout this area.
6. Stabilize right bank between Sta 1239+00 and Sta 1247+00 to protect newly constructed bank.
7. Specific areas are not shown, but seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks.
8. All recommendations for areas near 83rd Street may need to be refined in coordination with future Boulder County Bridge designs.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1239+00 to 1282+00 Sheet 39 and 40 Quantity	Cost
Mob/Demob	LS	$ 43,740	1	$ 43,700
Dewatering	LF	$ 14	4250	$ 59,500
Create/refine Low Flow Channel	LF	$ 27	1350	$ 36,500
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	10	$ 80,000
Floodplain Stabilization	AC	$ 8,100	5.5	$ 44,600
Lowering and Grading	AC	$ 32,300	6	$ 193,800
Point Bar Creation	LF	$ 5	1350	$ 6,800
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	1350	$ 101,300
Bank Stabilization, Level 3	LF	$ 45	1550	$ 69,800
Land Reclamation Fill	AC	$ 20,200	4	$ 80,800
Upper Bank Stablization, Level 1	LF	$ 25	300	$ 7,500
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	20	$ 100,000
Temporary irrigation and weed management	LS	$ 94,125	1	$ 94,100
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 918,400
Contingency, 15% of subtotal				$ 137,800
Permitting , 2.5% of subtotal				$ 23,000
Design, plans, specification, contract administration, 15%				$ 137,800
Supervision & Administration, 10%				$ 91,800
TOTAL				$ 1,309,000


W. Co. Rd. 2
1240+00
County line
A detailed hydraulic and sediment transport analysis is recommended for this area
Significant channel reconstruction has already occurred
Fill eroded area to surrounding ground Elevation
Lower and grade back to original elevation to increase conveyance
Bury protection in floodplain (If home remains)
1250+00
1270+00
1260+00
Fill flood channel to convert to floodplain surface
Blower Ditch alignment
Improve road crossing to maintain low flow conveyance and reduce deposition. Increase flood flow capacity. Recommendations in this area may need to be refined to coordinate with Boulder County bridge design
N. 83rd St.
0
200
400
Feet

NEIGHBORHOOD: Boulder County
SHEET: 40
STATION: 1267+00 to 1304+00
RESTORATION RECOMMENDATIONS: 1284+00 to 1308+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, ranging from 150 feet directly along the river corridor to 400 feet wide in areas with expanded floodplain surfaces. The vegetation is comprised primarily of cottonwoods, some willows, and other riparian species, some of which were torn out during the flood. Flood flows caused considerable scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1302+00. Due to the significant scour upstream, large sediment deposits, including coarse grained channel bed material, also exist in this area.

Significant overbank flows breached the left channel bank near about Sta 1296+00, which primarily reentered the channel corridor near Sta 1284+00. Significant bank scour and severe damage occurred to the Blower Ditch and associated diversion structure at Sta 1284+00.

The 2013 flood event caused some of the larger channel bends to erode laterally into overbank surfaces that have primarily been used as cropland, and sinuosity of the channel was also generally reduced as flood flows scoured a more direct flowpath along the floodplain. However, relatively high overbank and terrace surfaces limited the amount of lateral channel erosion.

Although significant geomorphic changes have occurred in this reach as a result of the 2013 flood, much of the current channel and floodplain is relatively stable, and expected to recover without significant restoration activities. However, there are some notable overbank areas that require some fill and reclamation along with some bank stabilization. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

The Boulder Larimer (Ish) Irrigation Ditch runs parallel to the Little Thompson River along much of this portion of the river. The Blower Ditch diversion structure creates a grade control for the river at Sta 1284+00. Channel reconstruction in the vicinity of the Blower Ditch diversion structure, as well as significant infrastructure repair and stabilization has occurred for both the Blower and Boulder Larimer Ditches at this location.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank between Sta 1298+00 and Sta 1304+00 to protect irrigation ditch.
2. Stabilize left bank near Sta 1302+00.
3. Lower channel bed profile as appropriate between Sta 1284+00 and about Sta 1308+00 to help reduce water-surface elevations.
4. Left bank between Sta 1290+00 and Sta 1300+00 experienced significant overtopping flows during the 2013 flood. This may have been primarily due to the significant amount of debris and backwater conditions along this portion of the river. Removal of large sediment and debris deposits as well as possible rising of left bank elevation may help prevent future overtopping. Furthermore, the Blower Ditch diversion structure also acts as a grade control for upstream flows. A more detailed study of the bed profile, hydraulic channel capacity, and potential alternatives for relocating the Blower Ditch diversion is recommended. Relocation of the Blower Ditch diversion would also help reduce future damages to this structure and associated ditch infrastructure.
5. Bank stabilization near Sta 1279+00.
6. Lowering and grading of floodplain surfaces to improve conveyance capacity and drainage.
7. A detailed hydraulic analysis of channel and floodplain capacity is recommended for this area.

   Recommendations shown between Sta 1267+00 to Sta 1285+00 should be constructed with improveemnts shown on Sheet 39. Likewise, recommendations from Sta 1285+00 to Sta 1304+00 should be constructed with improvements shwon on Sheet 41.

OPINION OF PROBABLE COST

See sheet 39 for opinion of probable costs for recommendations from Sta 1267+00 to Sta 1285+00. See sheet 41 for opinion of probable costs for recommendations from Sta 1285+00 to Sta 1304+00.

W. Co. Rd. 2

County line

Focus of initial channel refinement is to lower bed profile elevation where appropriate

Lower and grade back to original elevation to increase conveyance

1300+00

1290+00

1280+00

1270+00

A detailed hydraulic analysis of channel and floodplain capacity is recommended for this area

Boulder - Larimer (Ish) Ditch alignment

Blower Ditch diversion structure has been reconstructed

Blower Ditch alignment

0 200 400

Feet

N

NEIGHBORHOOD: Boulder County
SHEET: 41
STATION: 1299+00 to 1333+00
RESTORATION RECOMMENDATIONS: 1308+00 to 1326+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, ranging from 150 feet directly along the river corridor to more than 550 feet wide in areas with expanded floodplain surfaces. The vegetation is comprised primarily of cottonwoods, some willows, and other riparian species, many of which were torn out during the flood. Flood flows caused considerable scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1325+00 and Sta 1302+00. Due to the significant scour upstream, including significant sediment and debris transported through the upstream canyon, large sediment deposits, including coarse material, also exist in this area.

The 2013 flood caused many of the significant channel bends to erode laterally into overbank surfaces that have primarily been used as cropland. Sinuosity of the channel was also generally reduced as flood flows scoured a more direct flow path along the floodplain.

Although significant geomorphic changes have occurred in this reach as a result of the 2013 flood, much of the current channel and floodplain is relatively stable, and expected to recover without significant restoration activities. However, there are some overbank areas that require some fill and reclamation along with some bank stabilization. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

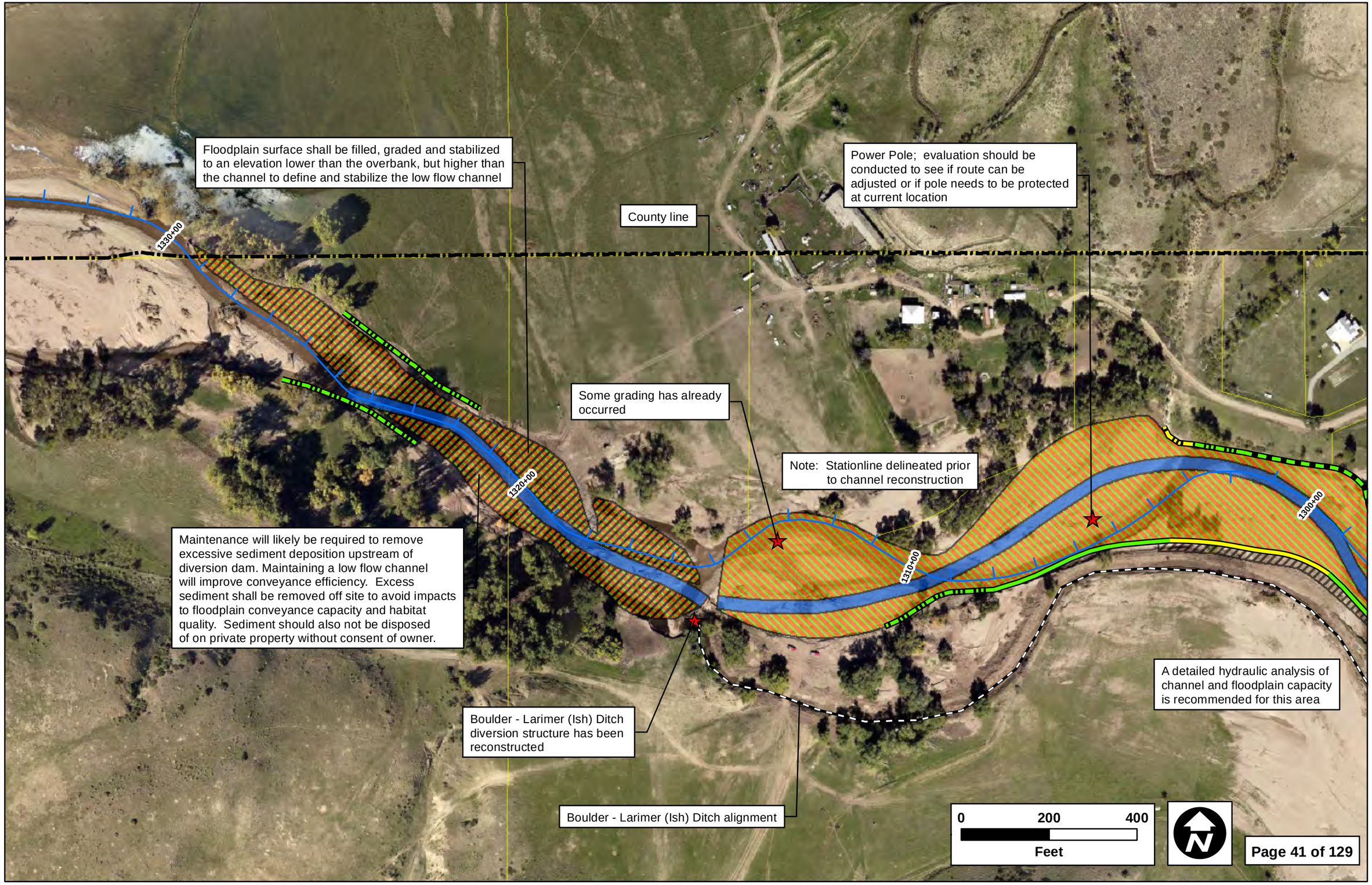
The Boulder Larimer (Ish) Irrigation Ditch diversion structure has been reconstructed, and significant channel reconstruction both upstream and downstream of the diversion dam has occurred.

RESTORATION RECOMMENDATIONS

1. Stabilize right bank between Sta 1298+00 and Sta 1310+00 to protect irrigation ditch.
2. Stabilize left bank near Sta 1302+00.
3. Create and/or refine low-flow channel upstream of Boulder Larimer (Ish) Irrigation Ditch diversion dam (near Sta 1315+00) to improve conveyance and sediment transport in this area. Floodplain surface shall also be filled and graded to further define and stabilize low-flow channel. Effects of low-flow channel will be limited at downstream end due to the diversion dam.
4. Stabilize banks near Sta 1324+00.
5. Develop low-flow channel below diversion dam and grade adjacent floodplain surfaces (some of this work has already occurred, but an alternate channel alignment is recommended).
6. A detailed hydraulic analysis of channel and floodplain capacity is recommended for this area.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1284+00 to 1329+00 Sheet 40 and 41 Quantity	Cost
Mob/Demob	LS	$ 47,700	1	$ 47,700
Dewatering	LF	$ 14	7210	$ 100,900
Create/refine Low Flow Channel	LF	$ 27	4000	$ 108,000
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	11	$ 88,000
Floodplain Stabilization	AC	$ 8,100	11	$ 89,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	4000	$ 20,000
Bank Stabilization, Level 1	LF	$ 110	1100	$ 121,000
Bank Stabilization, Level 2	LF	$ 75	1110	$ 83,300
Bank Stabilization, Level 3	LF	$ 45	1000	$ 45,000
Land Reclamation Fill	AC	$ 20,200	3.5	$ 70,700
Upper Bank Stablization, Level 1	LF	$ 25	380	$ 9,500
Upper Bank Stablization, Level 2	LF	$ 15	90	$ 1,400
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	24.5	$ 122,500
Temporary irrigation and weed management	LS	$ 94,375	1	$ 94,400
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 1,001,500
Contingency, 15% of subtotal				$ 150,200
Permitting , 2.5% of subtotal				$ 25,000
Design, plans, specification, contract administration, 15%				$ 150,200
Supervision & Administration, 10%				$ 100,200
TOTAL				$ 1,427,000


Floodplain surface shall be filled, graded and stabilized to an elevation lower than the overbank, but higher than the channel to define and stabilize the low flow channel
Power Pole; evaluation should be conducted to see if route can be adjusted or if pole needs to be protected at current location
County line
1330+00
Some grading has already occurred
Note: Stationline delineated prior to channel reconstruction
1320+00
1300+00
1310+00
Maintenance will likely be required to remove excessive sediment deposition upstream of diversion dam. Maintaining a low flow channel will improve conveyance efficiency. Excess sediment shall be removed off site to avoid impacts to floodplain conveyance capacity and habitat quality. Sediment should also not be disposed of on private property without consent of owner.
A detailed hydraulic analysis of channel and floodplain capacity is recommended for this area
Boulder - Larimer (Ish) Ditch diversion structure has been reconstructed
Boulder - Larimer (Ish) Ditch alignment
0
200
400
Feet
N

NEIGHBORHOOD: Boulder County
SHEET: 42
STATION: 1331+00 to 1365+00
RESTORATION RECOMMENDATIONS: 1339+00 to 1346+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, ranging up to 500 feet wide, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. This section of the river is located about one mile downstream of the canyon mouth. High-velocity flows exiting the canyon mouth caused considerable scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1354+00. Flood flows exiting the canyon also carried significant amounts of sediment and debris, which were deposited in large quantities throughout this area.

The valley along this section of the river is slightly wider than the canyon upstream, which has allowed the channel sinuosity to increase (pre-flood). The 2013 flood event caused many of the significant channel bends to erode laterally into overbank surfaces that have primarily been used as cropland, changing the channel planform, and typically reducing the sinuosity.

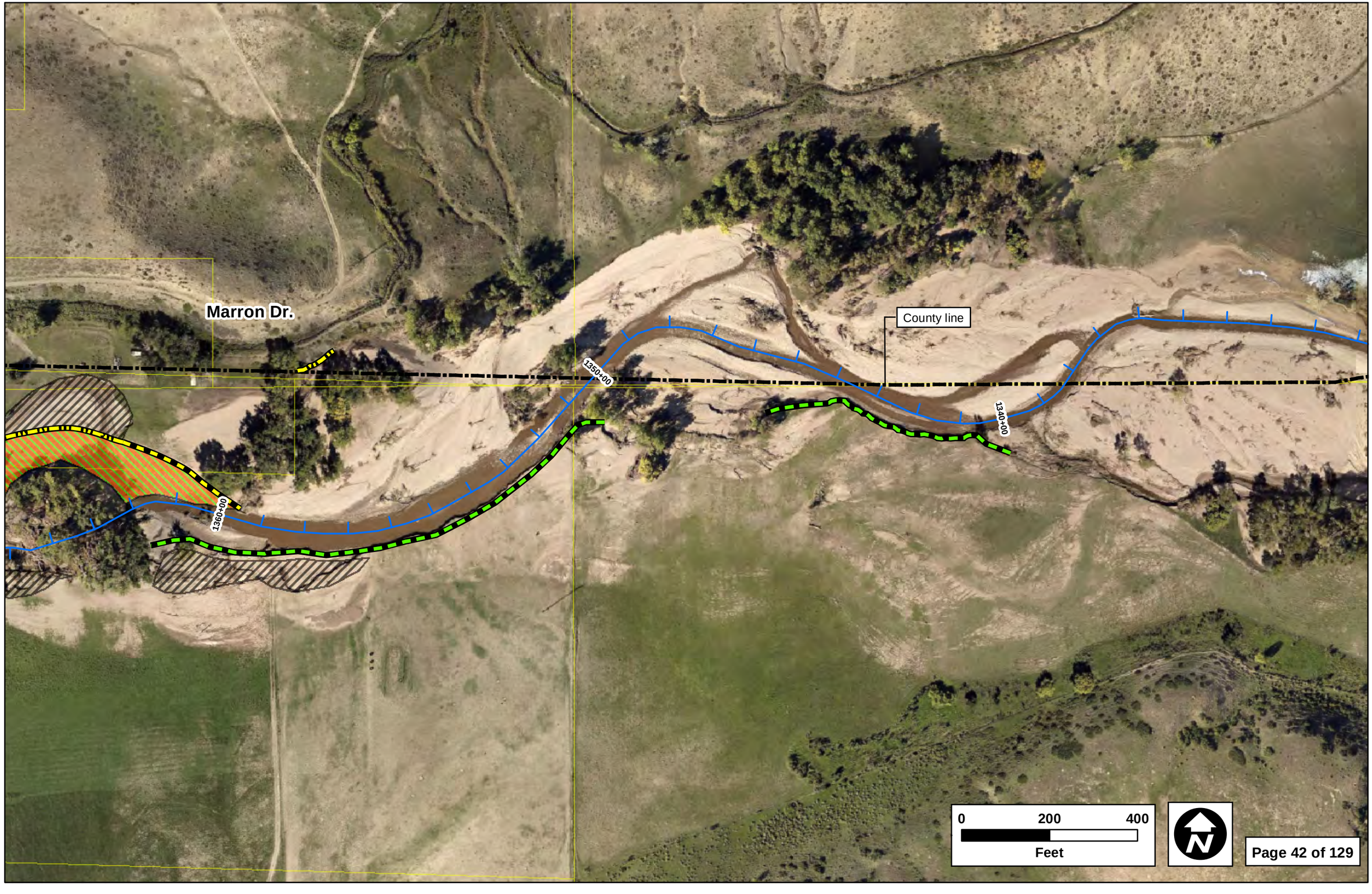
Although significant changes have occurred in this reach as a result of the 2013 flood, much of the current channel and floodplain is relatively stable, and expected to recover without significant restoration activities. However, there are some overbank areas that require some fill and reclamation along with some bank stabilization. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Stabilize right banks near Sta 1355+00 and Sta 1343+00.
2. Stabilize left upper bank near Sta 1358+00.
3. Fill and reclaim overbanks along right bank near Sta 1360+00.
4. Fill and reclaim north overbank area and stabilize upper bank along new alignment near Sta 1365+00. Grade and stabilize floodplain area along north high-flow channel and south of reclaimed overbank. The floodplain should be graded as to tie into and maintain a high-flow channel surface along north edge of cottonwood stand.
5. Specific areas are not shown, but seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1339+00 to 1370+00 Sheet 42 Quantity	Cost
Mob/Demob	LS	$ 19,300	1	$ 19,300
Dewatering	LF	$ 14	2200	$ 30,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	2	$ 16,000
Floodplain Stabilization	AC	$ 8,100	2	$ 16,200
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	2200	$ 99,000
Land Reclamation Fill	AC	$ 20,200	2	$ 40,400
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15	500	$ 7,500
Upper Bank Stablization, Level 3	LF	$ 5	300	$ 1,500
Seeding	AC	$ 5,000	26	$ 130,000
Temporary irrigation and weed management	LS	$ 45,150	1	$ 45,200
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 405,900
Contingency, 15% of subtotal				$ 60,900
Permitting , 2.5% of subtotal				$ 10,100
Design, plans, specification, contract administration, 15%				$ 60,900
Supervision & Administration, 10%				$ 40,600
TOTAL				$ 578,000


Marron Dr.
County line
1350+00
1340+00
1360+00
0
200
400
Feet

NEIGHBORHOOD: Boulder County
SHEET: 43
STATION: 1363+00 to 1399+00
RESTORATION RECOMMENDATIONS: 1375+00 to 1385+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, ranging from 150 to 350 feet wide, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. This section of the river is located immediately downstream of the canyon mouth. High-velocity flows exiting the canyon mouth caused significant scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1387+00. Flood flows exiting the canyon also carried significant amounts of sediment and debris, which were deposited in large quantities throughout this area.

The valley along this section of the river is slightly wider than the canyon upstream, which has allowed the channel sinuosity to increase (pre-flood). The 2013 Flood caused many of the significant channel bends to erode laterally into overbank surfaces that have primarily been used as cropland, changing the channel planform, and typically reducing the sinuosity.

There is a low water or 'dip' crossing with culverts in this reach, located on the Parrish Ranch property. The crossing is used to access the south side of Boulder County Open Space (under contract to the Parrish Ranch for agricultural use) and by the Northern Colorado Water Conservancy District to access the CBT system at the St. Vrain Supply canal. The crossing suffered minor damage during the 2013 flood, requiring debris removal and bank stabilization. However, overall the crossing is in good condition and did not appear to cause significant degradation or aggradation, when compared to the conditions overall in this reach, indicating that it functioned adequately under flood conditions. No further recommendations are made for modifying the dip crossing.

Although significant changes have occurred in this reach as a result of the 2013 flood, much of the current channel and floodplain is relatively stable, and expected to recover without significant restoration activities. However, there are some overbank areas that require fill and reclamation along with some bank stabilization. Seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Stabilize right channel bank near Sta 1368+00.
2. Fill and reclaim north overbank area and stabilize upper bank along new alignment near Sta 1365+00. Grade and stabilize floodplain area along north high flow channel and south of reclaimed overbank. The floodplain should be graded as to tie into and maintain a high-flow channel surface along north edge of cottonwood stand.
3. Stabilize left channel bank near Sta 1377+00.
4. Provide bank stabilization at the dip crossing structure near Sta 1384+00. Work will need to be coordinated or conducted by Northern Colorado Water Conservancy District, as they maintain this road crossing.
5. Numerous rock vanes were constructed along the channel downstream of the Culver Ditch headgate. Tying these structures farther back into the bank to prevent erosion from flanking the structures is recommended.
6. Specific areas are not shown, but seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1375+00 to Sta 1385+00 Sheet 43	
			Quantity	Cost
Mob/Demob	LS	$ 4,500	1	$ 4,500
Dewatering	LF	$ 14	450	$ 6,300
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	200	$ 15,000
Bank Stabilization, Level 3	LF	$ 45	250	$ 11,300
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	5	$ 25,000
Temporary irrigation and weed management	LS	$ 6,575	1	$ 6,600
Tie vanes and bank protection into bank	LS	$ 25,000	1	$ 25,000
SUBTOTAL				$ 93,700
Contingency, 15% of subtotal				$ 14,100
Permitting , 2.5% of subtotal				$ 2,300
Design, plans, specification, contract administration, 15%				$ 14,100
Supervision & Administration, 10%				$ 9,400
TOTAL				$ 134,000

Parrish Ranch Rd.

Marron Dr.

Parrish Rd.

County line

Note: Stationline delineated prior to channel reconstruction

Land reclamation and fill has already occurred

Dip crossing

1380+00

Culver Ditch pre-flood alignment

1390+00

Channel reconstruction has already occurred

Headgate, weir and irrigation canal have been reconstructed

Bank stabilization at dip crossing will require coordination with Northern Colorado Water Conservancy District

Tie existing rock vanes into bank

Tie existing bank protection back into bank

1370+00

Grade and stabilize floodplain surface, while maintaining existing high flow channel along north end of cottonwood stand

0 200 400

Feet

N

NEIGHBORHOOD: Boulder County
SHEET: 44
STATION: 1383+00 to 1428+00
RESTORATION RECOMMENDATIONS: **1394+00 to 1405+00**

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, up to 350 feet wide in some areas, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. This section of the river borders, and is immediately downstream of, the mouth of the canyon. High-velocity flows exiting the canyon mouth caused significant scour of the floodplain and overbank surfaces in some areas, including significant lateral channel migration in the large bend near Sta 1405+00. Flood flows exiting the canyon also carried significant amounts of sediment and debris, which were deposited in large quantities throughout this area. The severe deposition that occurred also completely buried the weir, headgate, and irrigation canal for the Culver Irrigation Ditch.

The valley along this section of the river is slightly wider than the canyon upstream, which has allowed the channel sinuosity to increase. The 2013 Flood caused many of the significant channel bends to erode laterally, slightly changing the channel planform.

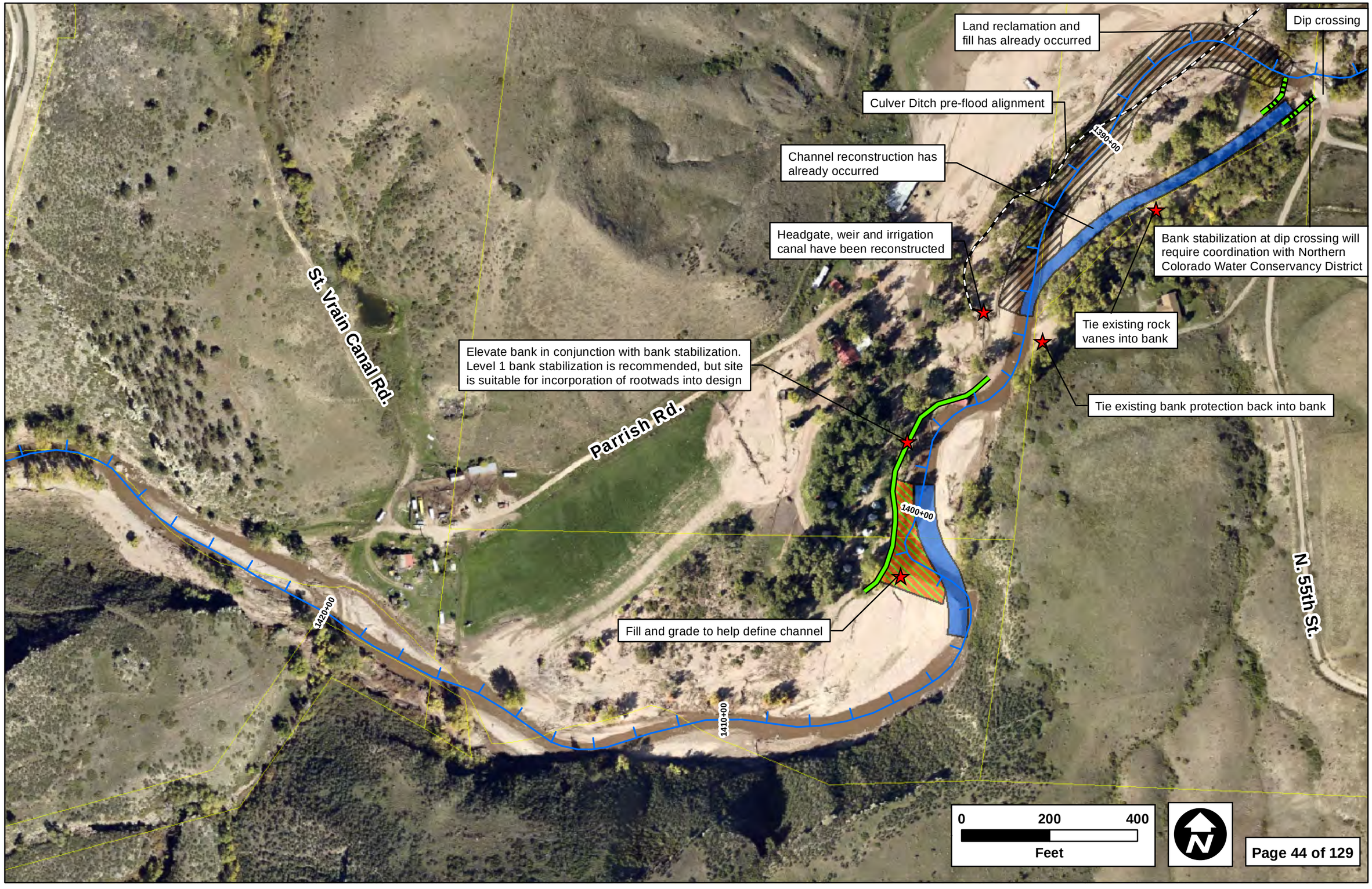
Although significant changes have occurred in this reach as a result of the 2013 Flood, much of the current channel and floodplain is relatively stable, and expected to recover without significant restoration activities. However, there are some notable areas that require some stabilization, especially in the vicinity of the campground and ranch buildings, and seeding or planting of the reworked channel banks would help accelerate vegetation recruitment.

RESTORATION RECOMMENDATIONS

1. Realign short section of channel to reduce threat to campground and facilities area.
2. Elevate and stabilize the left channel bank between Sta 1396+00 and Sta 1404+00.
3. Provide bank stabilization at the dip crossing structure near Sta 1384+00.
4. Numerous rock vanes were constructed along the channel downstream of the Culver Ditch headgate. Tying these structures farther back into the bank to prevent erosion from flanking the structures is recommended.
5. Specific areas are not shown, but seeding or planting of riparian vegetation along the bare reworked channel banks is recommended to accelerate revegetation and stability of the banks.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1394+00 to Sta 1405+00 Sheet 44 Quantity	Cost
Mob/Demob	LS	$ 9,000	1	$ 9,000
Dewatering	LF	$ 14	1050	$ 14,700
Create/refine Low Flow Channel	LF	$ 27	400	$ 10,800
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	0.5	$ 4,000
Floodplain Stabilization	AC	$ 8,100	0.5	$ 4,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	400	$ 2,000
Bank Stabilization, Level 1	LF	$ 110	650	$ 71,500
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	14	$ 70,000
Temporary irrigation and weed management	LS	$ 2,025	1	$ 2,000
Site Specific	LS	$ -	1	$ -
SUBTOTAL				$ 188,100
Contingency, 15% of subtotal				$ 28,200
Permitting , 2.5% of subtotal				$ 4,700
Design, plans, specification, contract administration, 15%				$ 28,200
Supervision & Administration, 10%				$ 18,800
TOTAL				$ 268,000


Land reclamation and fill has already occurred
Dip crossing
Culver Ditch pre-flood alignment
1390+00
Channel reconstruction has already occurred
Headgate, weir and irrigation canal have been reconstructed
Bank stabilization at dip crossing will require coordination with Northern Colorado Water Conservancy District
St. Vrain Canal Rd.
Tie existing rock vanes into bank
Elevate bank in conjunction with bank stabilization. Level 1 bank stabilization is recommended, but site is suitable for incorporation of rootwads into design
Parrish Rd.
Tie existing bank protection back into bank
1400+00
N. 55th St.
Fill and grade to help define channel
1420+00
1410+00
0
200
400
Feet

NEIGHBORHOOD: Boulder County
SHEET: 45
STATION: 1421+00 to 1452+00
RESTORATION RECOMMENDATIONS: 1444+00 to 1450+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. The river is generally canyon bound, which controls the sinuosity and river corridor alignment. Aerial mapping and field reconnaissance reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic function of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. Except for the following recommendation, no further actions are suggested at this time:

1. Stabilize the left channel bank between Sta 1444+00 and Sta 1460+00. A level 3 bank protection is recommended except along upstream portion of bank where a level 2 is recommended due to the close proximity of the bank to access road, which was lost during the 2013 Flood.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1444+00 to Sta 1450+00 Sheet 45 and 46	
			Quantity	Cost
Mob/Demob	LS	$ 7,400	1	$ 7,400
Dewatering	LF	$ 14	650	$ 9,100
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	650	$ 29,300
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation	LS	$ 7,325	1	$ 7,300
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 53,100
Contingency, 15% of subtotal				$ 8,000
Permitting , 2.5% of subtotal				$ 1,300
Design, plans, specification, contract administration, 15%				$ 8,000
Supervision & Administration, 10%				$ 5,300
TOTAL				$ 76,000


W. Co Rd 2
1450+00
1440+00
W. Co Rd 2
1430+00
0
200
400
Feet
N

NEIGHBORHOOD: Boulder County
SHEET: 46
STATION: 1444+00 to 1465+00
RESTORATION RECOMMENDATIONS: 1450+00 to 1461+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. The river is generally canyon bound, which controls the sinuosity and river corridor alignment. Aerial mapping and field reconnaissance reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic function of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. Except for the following recommendation, no further actions are suggested at this time:

1. Stabilize the left channel bank between Sta 1444+00 and Sta 1460+00. A level 3 bank protection is recommended except along upstream portion of bank where a level 2 is recommended due to the close proximity of the bank to access road, which was lost during the 2013 Flood.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1450+00 to Sta 1461+00 Sheet 45 and 46	
			Quantity	Cost
Mob/Demob	LS	$ 7,400	1	$ 7,400
Dewatering	LF	$ 14	950	$ 13,300
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	950	$ 71,300
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation	LS	$ 17,825	1	$ 17,800
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 109,800
Contingency, 15% of subtotal				$ 16,500
Permitting , 2.5% of subtotal				$ 2,700
Design, plans, specification, contract administration, 15%				$ 16,500
Supervision & Administration, 10%				$ 11,000
TOTAL				$ 157,000


County line
1460+00
1450+00
W. Co Rd 2
0
200
400
Feet

NEIGHBORHOOD: Boulder County
SHEET: 47
STATION: 1465+00 to 1497+00
RESTORATION RECOMMENDATIONS: 1474+00 to 1483+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and other riparian species, many of which were torn out during the flood. The river is generally canyon bound, which controls the sinuosity and river corridor alignment. Aerial mapping and field reconnaissance reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation. Some sedimentation is evident on the upper left bank near a home site.

Because of the canyon bound valley formation, much of this reach is relatively stable and expected to recover without restoration activities.

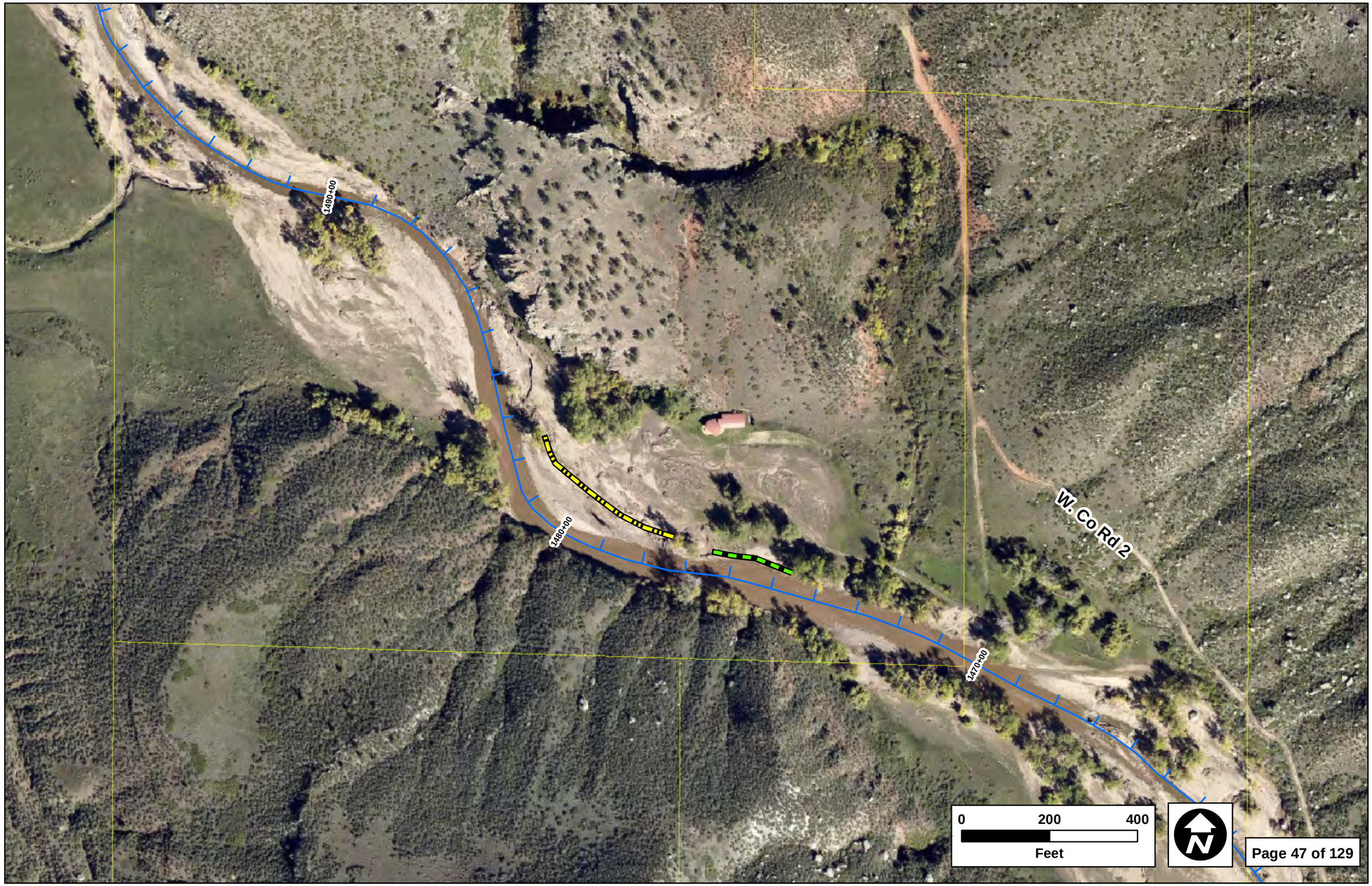
RESTORATION RECOMMENDATIONS

Geomorphic function of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. Except for the following recommendation, no further actions are suggested at this time:

1. Stabilize the left channel bank between Sta 1474+00 and Sta 1483+00 to protect the house.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1474+00 to Sta 1483+00 Sheet 47 Quantity	Cost
Mob/Demob	LS	$ 1,100	1	$ 1,100
Dewatering	LF	$ 14	200	$ 2,800
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	200	$ 9,000
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15	400	$ 6,000
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ 3,750	1	$ 3,800
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 22,700
Contingency, 15% of subtotal				$ 3,400
Permitting , 2.5% of subtotal				$ 600
Design, plans, specification, contract administration, 15%				$ 3,400
Supervision & Administration, 10%				$ 2,300
TOTAL				$ 32,000


1490+00
1480+00
1470+00
W. Co Rd 2
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 48
STATION: 1497+00 to 1531+00
RESTORATION RECOMMENDATIONS: 1501+00 to 1528+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor overbanks vary from rock walls to pasture or ranch lands along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment. Between Sta 1500+00 and Sta 1516+00 the canyon walls open, particularly to the south, leaving a wider floodplain corridor which is used for agricultural purposes.

This is a single family home site with multiple buildings all which were flooded from the 2013 flood. Pasture and/or farm land overbanks eroded vertically where the floodwaters extended beyond the riparian corridor and there were damages incurred to the irrigation system. The driveway was also destroyed. Deposition of sediments is significant at this site and recommendations include stabilization or removal of some of these sediments to (1) minimize the excessive transport of sediment downstream, and (2) aid in the vegetative recovery of the exposed banks. Debris was also relatively significant. As of July 1, 2014, western Wheatgrass appears to be colonizing the sand areas very effectively.

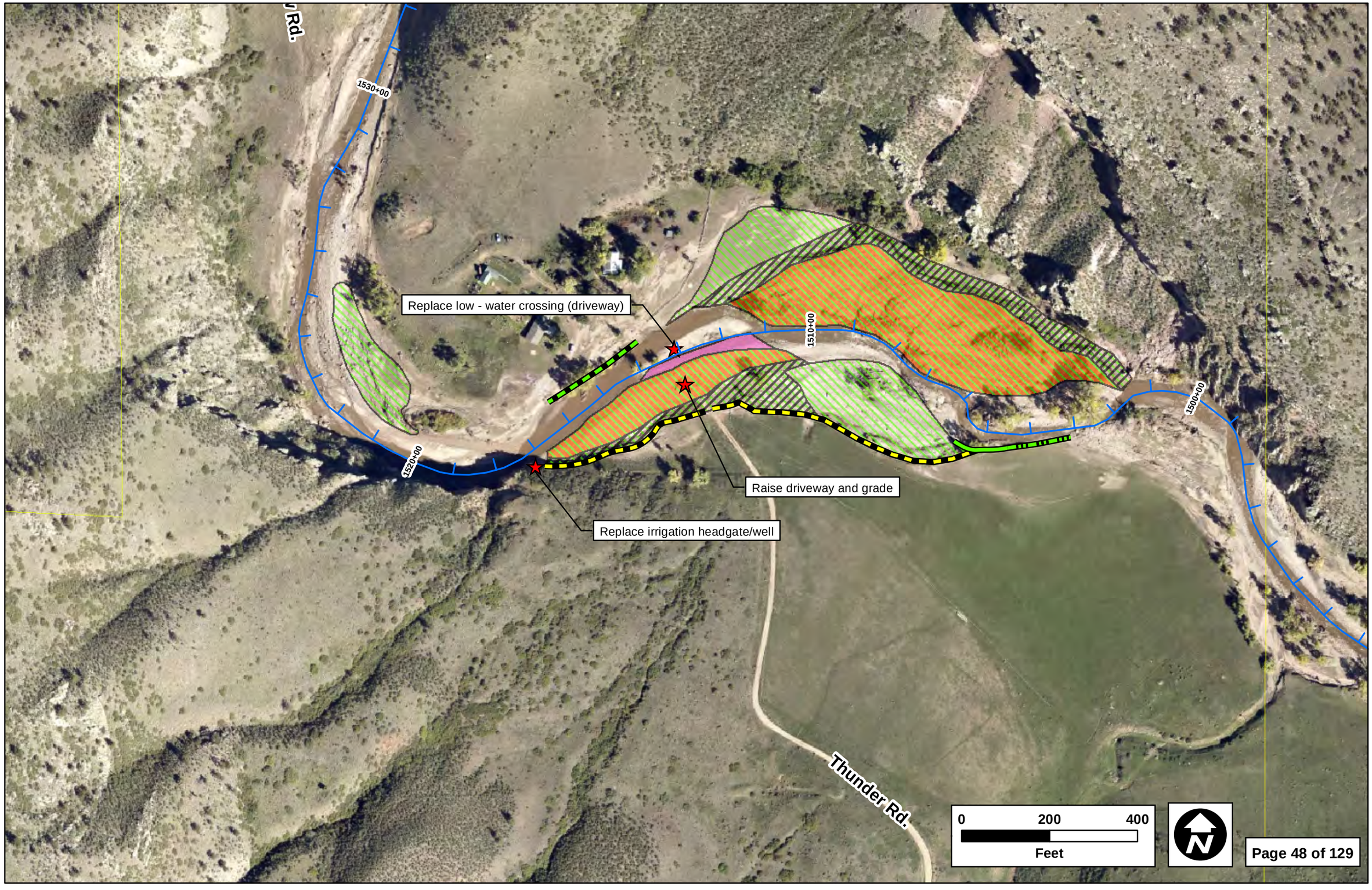
As the channel begins to recover and reset itself from the 2013 flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander. Because of the property-related issues here, and potential for movement of sediment, recommendations include stabilization and grading of the floodplain areas, bank stabilization, and floodplain reconstruction, grading and stabilization.

RESTORATION RECOMMENDATIONS

1. Bank stabilization along the left bank at Sta. 1504+00 and left overbank stabilization at Sta 1510+00.
2. Lowering and grading the channel at Sta 1513+00.
3. Floodplain stabilization and grading.
4. Overbank fill and reclamation.
5. Raise driveway and replace low-water crossing driveway.
6. Replace irrigation headgate/well.
7. Remove debris.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1501+00 to Sta 1526+00 Sheet 48	
			Quantity	Cost
Mob/Demob	LS	$ 24,600	1	$ 24,600
Dewatering	LF	$ 14	440	$ 6,200
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	4	$ 32,000
Floodplain Stabilization	AC	$ 8,100	8	$ 64,800
Lowering and Grading	AC	$ 32,300	0.5	$ 16,200
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	150	$ 16,500
Bank Stabilization, Level 2	LF	$ 75	150	$ 11,300
Bank Stabilization, Level 3	LF	$ 45	140	$ 6,300
Land Reclamation Fill	AC	$ 20,200	2	$ 40,400
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	1055	$ 5,300
Seeding	AC	$ 5,000	6.5	$ 32,500
Temporary irrigation and weed management	LS	$ 40,025	1	$ 40,000
Driveway, culvert and headgate	LS	$ 220,000	1	$ 220,000
SUBTOTAL				$ 516,100
Contingency, 15% of subtotal				$ 77,400
Permitting , 2.5% of subtotal				$ 12,900
Design, plans, specification, contract administration, 15%				$ 77,400
Supervision & Administration, 10%				$ 51,600
TOTAL				$ 735,000


Rd.
1530+00
Replace low - water crossing (driveway)
1510+00
1500+00
1520+00
Raise driveway and grade
Replace irrigation headgate/well
Thunder Rd.
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 49
STATION: 1531+00 to 1552+00

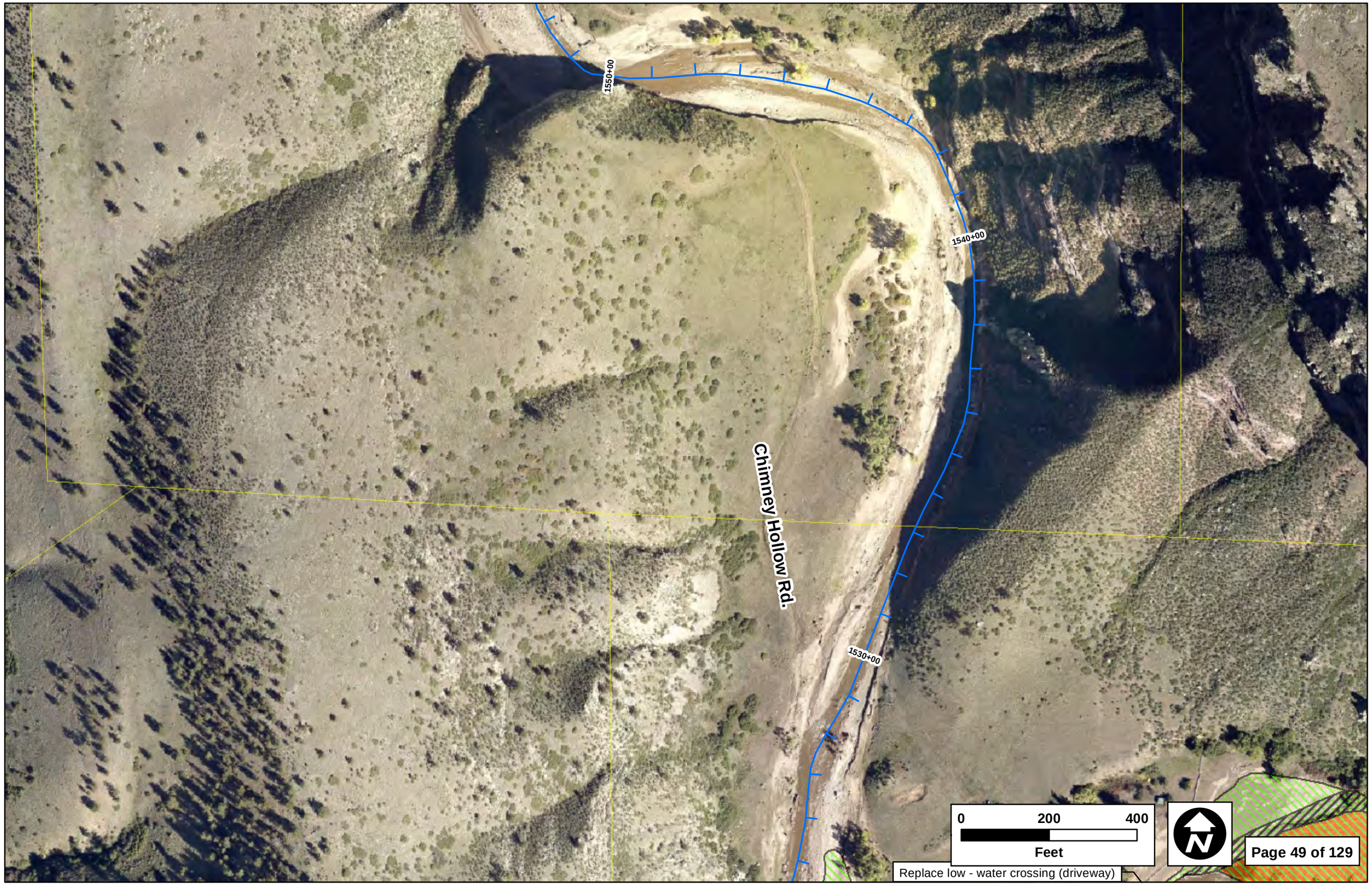
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor overbanks vary from rock walls to meadows along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment.

The channel is slightly steeper than downstream and velocities were likely high during the 2013 Flood as evident by relatively significant scour. As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1550+00
1540+00
Chimney Hollow Rd.
1530+00
0
200
400
Feet
Replace low - water crossing (driveway)

NEIGHBORHOOD: Blue Mountain
SHEET: 50
STATION: 1552+00 to 1570+00

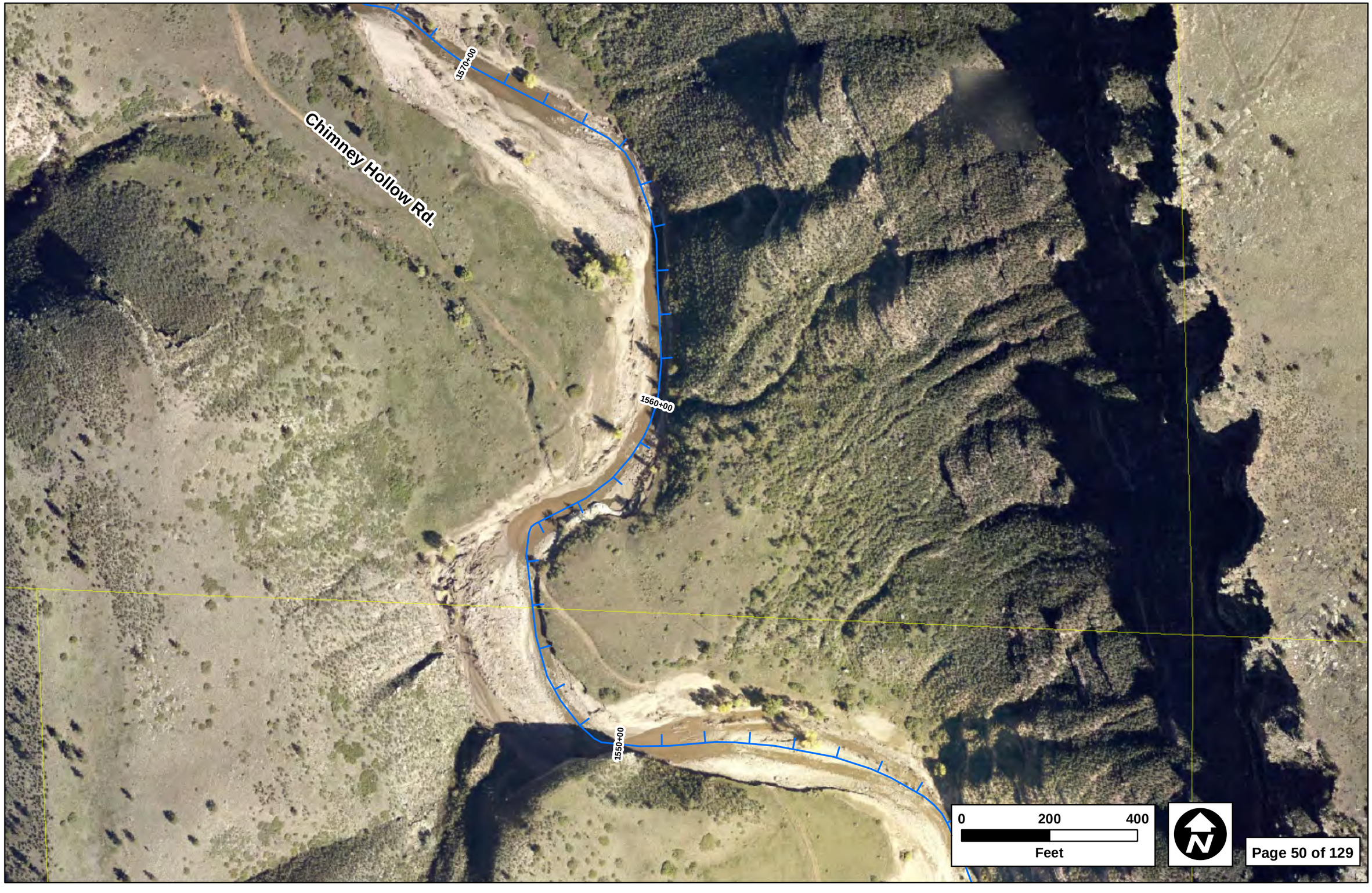
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor overbanks vary from rock walls to meadows along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment.

The channel is slightly steeper than downstream and velocities were likely high during the 2013 Flood as evident by relatively significant scour. As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


Chimney Hollow Rd.
1570+00
1560+00
1550+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 51
STATION: 1552+00 to 1616+00

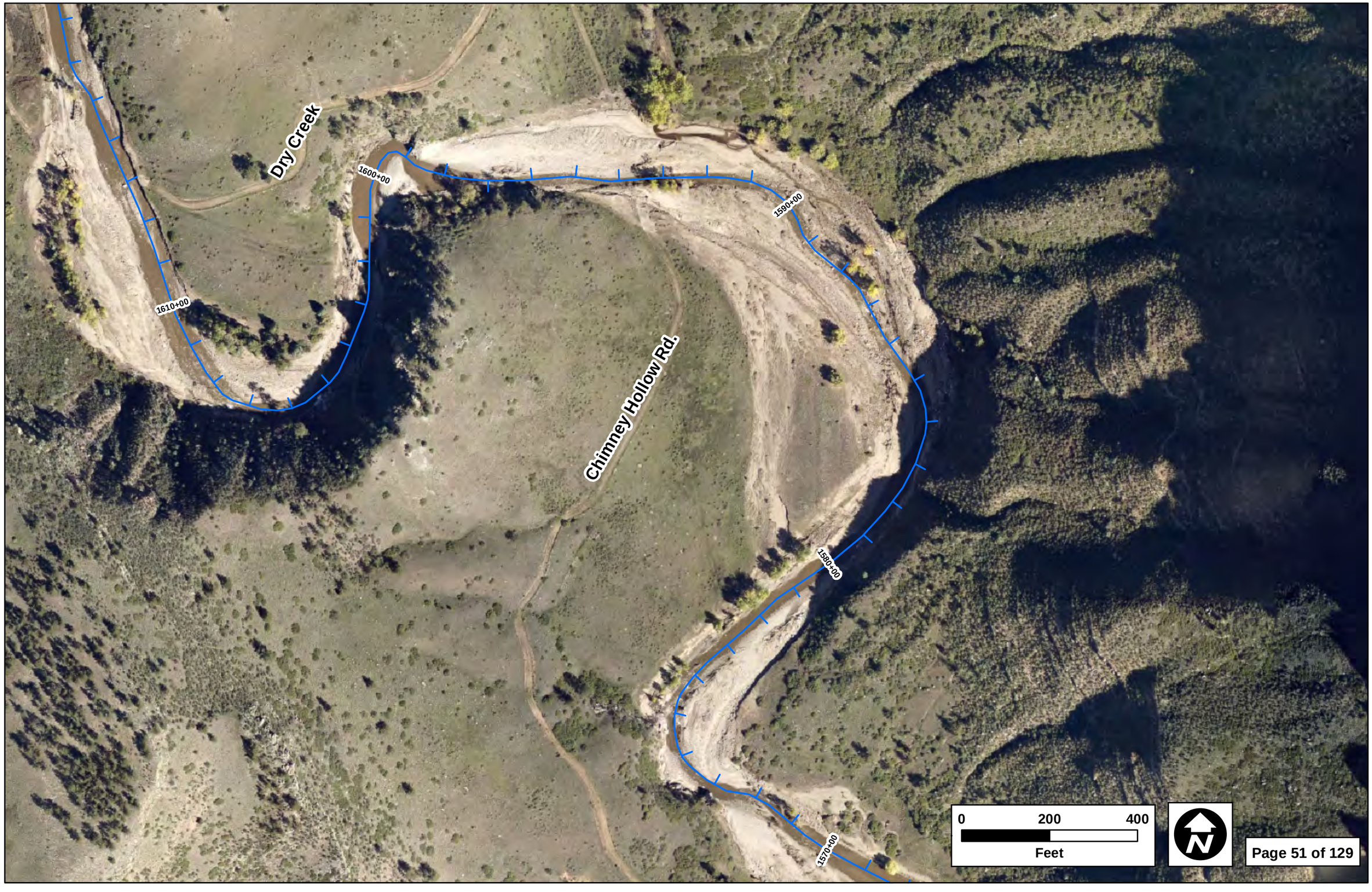
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor overbanks vary from rock walls to meadows along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment.

The channel is slightly steeper than downstream and velocities were likely high during the 2013 Flood as evident by relatively significant scour. As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


Dry Creek
1600+00
1590+00
1610+00
Chimney Hollow Rd.
1580+00
1570+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 52
STATION: 1616+00 to 1648+00
RESTORATION RECOMMENDATIONS: 1624+00 to 1639+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor is slightly wider here than up- and down-stream allowing for lateral movement of the river at the bend centered at Sta 1628+00. The river corridor overbanks vary from rock walls to floodplain benches and narrow meadows along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment. At the channel bend the canyon walls widen slightly, leaving a wider floodplain corridor which is used for agricultural purposes.

This is a family home site with multiple buildings, many of which were flooded from the 2013 Flood. The property included a bridge, which was totally destroyed from the 2013 Flood, reportedly from debris jams. Vegetation was scoured and torn out along the inside of the large bend. Deposition of large size debris was observed.

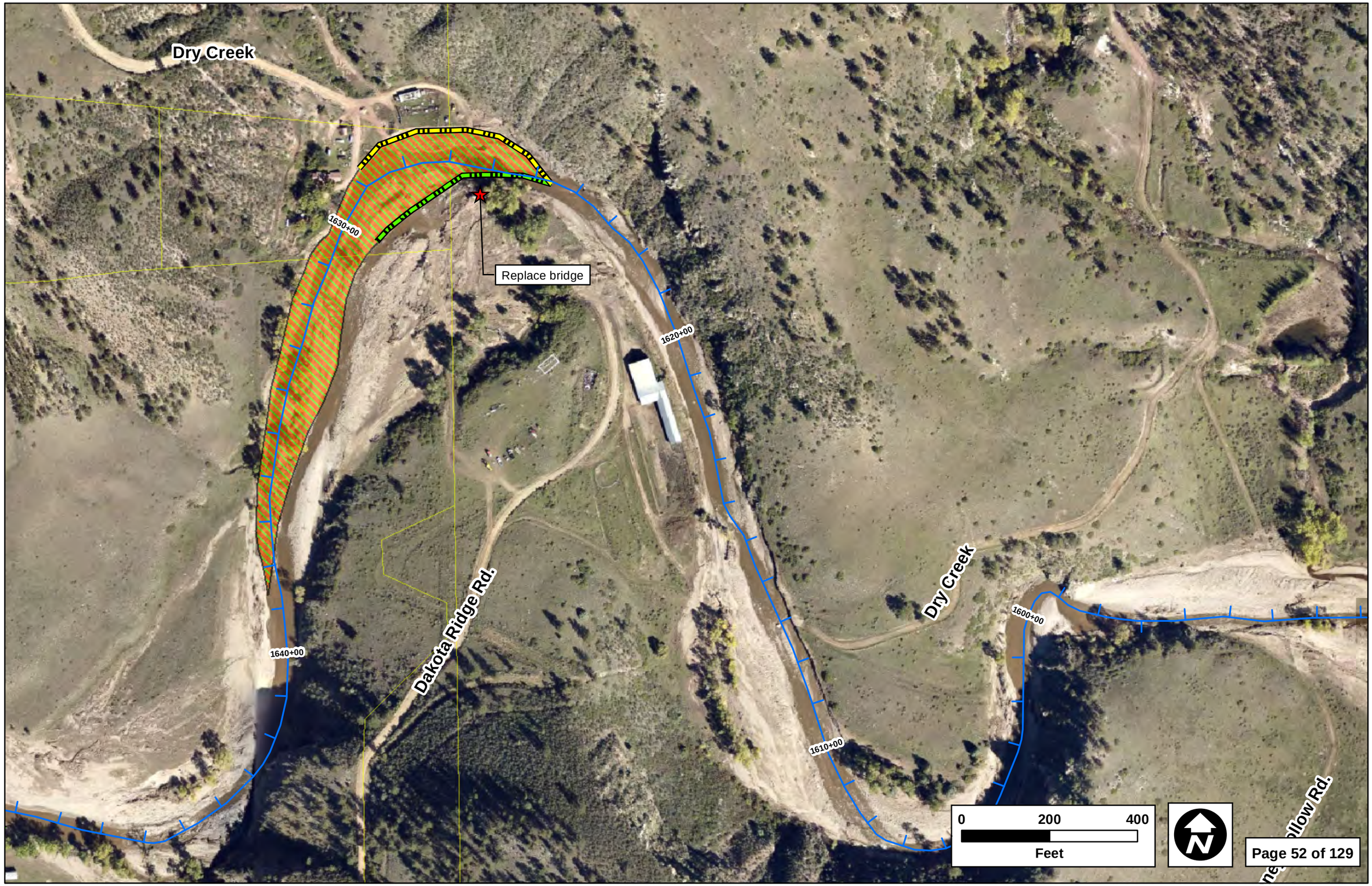
As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander. Because of the property-related issues here, and potential for additional damages should additional scour and bank erosion occur, recommendations include the reconstruction of the pre-flood channel alignment, including bank stabilization, and floodplain reconstruction, grading and stabilization. The floodplain benches will likely require fill material as the entire channel valley experienced scour.

RESTORATION RECOMMENDATIONS

1. Bank stabilization along the left bank at Sta. 1627+00.
2. Overbank stabilization along the left bank at Sta 1628+00.
3. Floodplain stabilization and grading.
4. Replace bridge (driveway crossing).

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1624+00 to Sta 1639+00 Sheet 52 Quantity	Cost
Mob/Demob	LS	$ 14,000	1	$ 14,000
Dewatering	LF	$ 14	450	$ 6,300
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	3	$ 24,000
Floodplain Stabilization	AC	$ 8,100	3	$ 24,300
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	450	$ 33,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15	550	$ 8,300
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	3	$ 15,000
Temporary irrigation and weed management	LS	$ 22,600	1	$ 22,600
Bridge and driveway	LS	$ 145,000	1	$ 145,000
SUBTOTAL				$ 293,300
Contingency, 15% of subtotal				$ 44,000
Permitting , 2.5% of subtotal				$ 7,300
Design, plans, specification, contract administration, 15%				$ 44,000
Supervision & Administration, 10%				$ 29,300
TOTAL				$ 418,000


Dry Creek
1630+00
Replace bridge
1620+00
1640+00
Dakota Ridge Rd.
Dry Creek
1600+00
1610+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 53
STATION: 1648+00 to 1684+00
RESTORATION RECOMMENDATIONS: 1649+00 to 1664+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, approximately 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. A slightly wider corridor exists at approximately Sta 1656+00 in which a cottonwood gallery developed, pre-flood. The river corridor overbanks vary from rock walls to floodplain benches and narrow meadows along this corridor. The rock walls and canyon setting control the channel sinuosity and alignment.

This is a family home site with multiple buildings, some of which were flooded from the 2013 Flood. The property included a small on-line pond, which was totally destroyed from the 2013 Flood. The cottonwood gallery had less damage and many trees survived. Sediment deposition is evident along the right overbank in the area of the surviving cottonwood trees. Vegetation closer to the river was scoured and torn out. Deposition of large size debris and boulders were observed.

As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over time, the geomorphic tendency will be to reestablish its equilibrium slope and meander. Because of the property-related issues here, and potential for additional damages should additional scour and bank erosion occur, recommendations include the construction of a low-flow channel, and floodplain grading and stabilization. Grading should also be performed on the floodplain bench to remove excess deposition from the root zone of the surviving cottonwood trees.

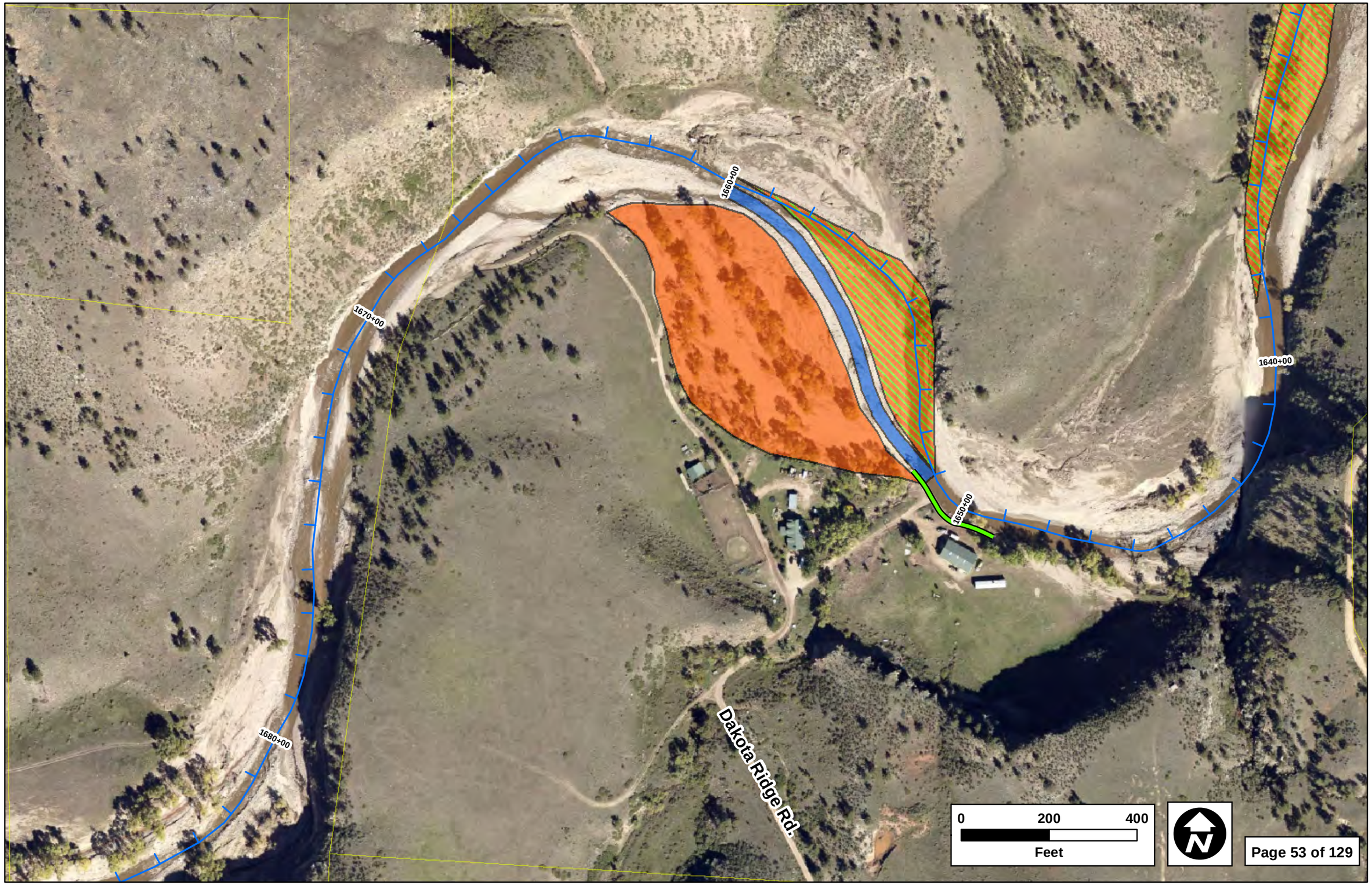
RESTORATION RECOMMENDATIONS

1. Low-flow channel reconstruction.
2. Floodplain stabilization and grading (left bank).
3. Grading and removal of fill in the cottonwood gallery along the right bank.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1649+00 to Sta 1664+00 Sheet 53 Quantity	Cost
Mob/Demob	LS	$ 9,400	1	$ 9,400
Dewatering	LF	$ 14	1100	$ 15,400
Create/refine Low Flow Channel	LF	$ 27	850	$ 23,000
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	6.5	$ 52,000
Floodplain Stabilization	AC	$ 8,100	2	$ 16,200
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	850	$ 4,300
Bank Stabilization, Level 1	LF	$ 110	250	$ 27,500
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	6.5	$ 32,500
Temporary irrigation and weed management	LS	$ 17,050	1	$ 17,100
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 197,400
Contingency, 15% of subtotal				$ 29,600
Permitting , 2.5% of subtotal				$ 4,900
Design, plans, specification, contract administration, 15%				$ 29,600
Supervision & Administration, 10%				$ 19,700
TOTAL				$ 281,000




1660+00
1670+00
1640+00
1650+00
1680+00
Dakota Ridge Rd.
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 54
STATION: 1684+00 to 1707+00

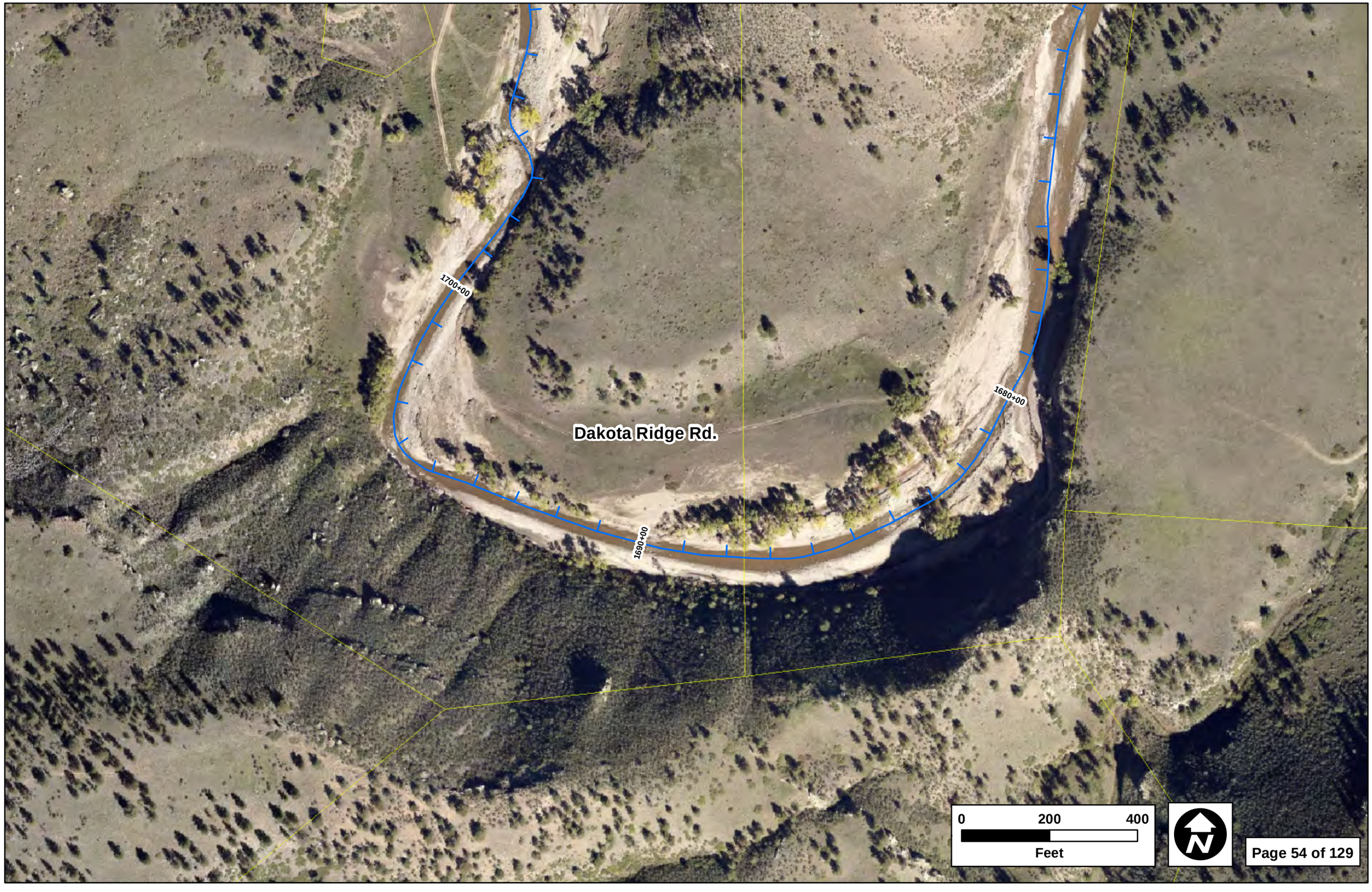
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and willows, many of which were torn out during the flood, although there are surviving cottonwood trees. The river is generally canyon bound, setting the sinuosity and river corridor alignment. Aerial mapping reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1700+00
Dakota Ridge Rd.
1690+00
1680+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 55
STATION: 1707+00 to 1718+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood, although there are a few surviving cottonwood trees. The river is generally canyon bound, setting the sinuosity and river corridor alignment. Aerial mapping reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


Dakota Ridge Rd.
1710+00
1700+00
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 56
STATION: 1718+00 to 1732+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a moderately dense vegetated riparian corridor, 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood, although there are a few surviving cottonwood trees. The river is generally canyon-bound, setting the sinuosity and river corridor alignment. Aerial mapping reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1740+00
1730+00
1720+00
Dakota Ridge Rd.
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 57
STATION: 1732+00 to 1772+00
RESTORATION RECOMMENDATIONS: 1742+00 to 1761+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river corridor is wider here than up- and downstream allowing for lateral movement of the river at the bend centered at Sta 1754+00. The 2013 flood event moved the channel from the center of the bend to the far outer edge (river left) scouring material to an estimated 8 feet, as seen by an exposed water well (photo below). This resulted in the loss of multiple buildings at one property (Buster Property) at Sta 1758+00 and the near loss of the Hoag residence at Sta 1748+00.

As the channel begins to recover and reset itself from the 2013 flood, it's likely that over-time, the geomorphic tendency will be to reestablish its equilibrium slope and meander. Currently, however, the channel is perched above the left overbank/floodplain near Sta 1748+00. Thus, one recommendation is to elevate the left overbank and slope it back toward the river. Other recommendations include grading the overbank and upper bank to meet in a blended, gentle slopes for ease in landscaping, and the creation of a series of pools on the upstream channel approach, designed to mimic pre-flood beaver ponds and to provide energy dissipation as flows enter the canyon bend. Minor improvements in the low-flow channel banks are also recommended, however, the low-flow channel will not be reconfigured in this restoration effort.

In addition, bank protection is recommended along the upper banks at Station 1748+00 to protect the residence. Recommendations include the installation of launch-style buried riprap on the upper bank. This riprap will be buried and set back from the river by several hundred feet and should therefore not be seen or interfere with the biologic and geomorphic functions of the bank full channel and associated floodplain being restored.

RESTORATION RECOMMENDATIONS

1. Maintain existing (post flood) channel alignment; shape point bars on the inside bends.
2. Create low-laying floodplain overbank with gentle slope toward the river.
3. Create bank along the channel using level 3 bank protection including rootwads combined with coir lift/willow plug banks at the bends and native cobble with sedges along the channel banks in the straight sections.
4. Install and bury launch style riprap immediately adjacent to the intact, upper banks and bury.
5. Blend improvements with newly reconstructed bank (completed by owner) and blend upper and lower benches using slopes that are plant-able (3 horizontal to 1 vertical or flatter).
6. Create a series of pools on the upstream channel approach, designed to mimic pre-flood beaver ponds and to provide energy dissipation as flows enter the canyon bend.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1742+00 to 1764+00 Sheet 57 Quantity	Cost
Mob/Demob	LS	$ 42,100	1	$ 42,100
Dewatering	LF	$ 14	2100	$ 29,400
Create/refine Low Flow Channel	LF	$ 27	400	$ 10,800
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	3	$ 24,000
Floodplain Stabilization	AC	$ 8,100	4	$ 32,400
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1800	$ 9,000
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45	1700	$ 76,500
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25	430	$ 10,800
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	3	$ 15,000
Temporary irrigation and weed management	LS	$ 33,225	1	$ 33,200
Site Specific	LS	$ 600,000	1	$ 600,000
SUBTOTAL				$ 883,200
Contingency, 15% of subtotal				$ 132,500
Permitting , 2.5% of subtotal				$ 22,100
Design, plans, specification, contract administration, 15%				$ 132,500
Supervision & Administration, 10%				$ 88,300
TOTAL				$ 1,259,000



River Way

Add fill to increase height of floodplain

Bury riprap immediately adjacent to upper bank

Blend upper and lower banks at 3:1 or flatter.

Create low floodplain overbank with gentle slope toward river.

1750+00

1760+00

1740+00

Maintain existing post-flood channel alignment: shape point bars on interior bends.

Create a series of pools to mimic pre-flood beaver ponds to provide energy dissipation.

Dakota Ridge Rd.

dd fill to increase eight of floodplain

0 200 400

Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 58
STATION: 1772+00 to 1799+00
RESTORATION RECOMMENDATIONS: 1776+00 to 1792+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 to 200 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river channel alignment had, pre-flood, two large bends centered at Sta 1780+00 and Sta 1788+00, respectively. The flood avulsed through both bends resulting in a straightening of the channel which moved the channel flow line alignments between 150 to 200 feet from its pre-flood alignment. This resulted in the total destruction of one home (Campassi residence) at Sta 1780+00, and the loss of river front property at the second home (Sandford residence) at Sta 1788+00.

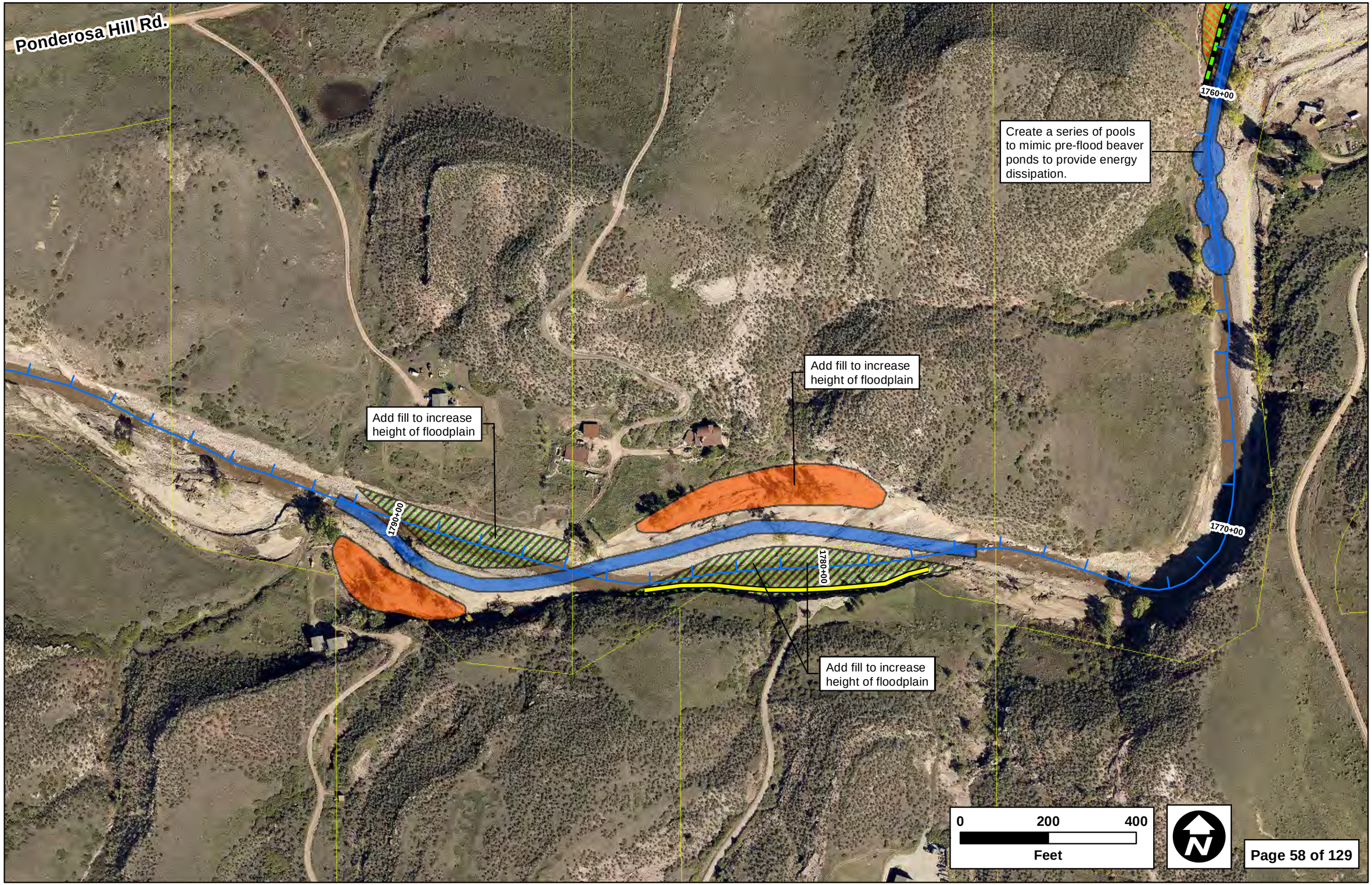
As the channel begins to recover and reset itself from the 2013 Flood, it is likely that over-time the geomorphic tendency will be to reestablish its equilibrium slope and meander. However, because of the property-related issues here, and in particular the losses experienced at both residences, recommendations include the reconstruction of the pre-flood meanders, including bank stabilization, low-flow channel reconfiguration, and floodplain reconstruction, grading and stabilization. Both bends should be constructed together as the two bends work in concert in terms of conveyance and geomorphic impacts. The floodplain benches will likely require fill material as the entire channel valley experienced significant scour.

RESTORATION RECOMMENDATIONS

1. Reconstruct low-flow channel.
2. Construct bank stabilization using buried riprap along Sta 1780+00 immediately adjacent to the upper banks. Backfill and extend the lower floodplain bench.
3. Fill and recreate the floodplain bench at other sections as shown.
4. Grade and stabilize floodplain.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1776+00 to Sta 1792+00 Sheet 58 Quantity	Cost
Mob/Demob	LS	$ 35,100	1	$ 35,100
Dewatering	LF	$ 14	2700	$ 37,800
Create/refine Low Flow Channel	LF	$ 27	2700	$ 72,900
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	2	$ 16,000
Floodplain Stabilization	AC	$ 8,100	2	$ 16,200
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	2700	$ 13,500
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	2	$ 40,400
Upper Bank Stablization, Level 1	LF	$ 25	650	$ 16,300
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	4	$ 20,000
Temporary irrigation and weed management	LS	$ 18,150	1	$ 18,200
Site Specific	LS	$ 450,000	1	$ 450,000
SUBTOTAL				$ 736,400
Contingency, 15% of subtotal				$ 110,500
Permitting , 2.5% of subtotal				$ 18,400
Design, plans, specification, contract administration, 15%				$ 110,500
Supervision & Administration, 10%				$ 73,600
TOTAL				$ 1,049,000


Ponderosa Hill Rd.
1760+00
Create a series of pools to mimic pre-flood beaver ponds to provide energy dissipation.
Add fill to increase height of floodplain
Add fill to increase height of floodplain
1790+00
1780+00
1770+00
Add fill to increase height of floodplain
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 59
STATION: 1799+00 to 1836+00
RESTORATION RECOMMENDATIONS: 1810+00 to 1836+50

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 to 150 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The 100 to 150 foot wide riparian corridor is generally canyon bound, setting the sinuosity and river corridor alignment. Comparison of the pre-and post-2013 flood mapping reveals a trend in the location of the wet channel moving from inside or middle of bends to outside of bends, typically scouring out the entire corridor, limited in many places by the width between canyon walls.

Based on field observations it appears this reach experienced signification scour from the 2013 flood event and velocities were high as indicated by the conveyance of an automobile over a half-mile in length from its pre-flood location and the total destruction a home (Lewis residence) at Sta 1820+00. The crossing on Stagecoach Trail, comprised of three concrete culverts, plugged with debris during the event causing water to overtop the road, rendering it unusable. A temporary culvert crossing was constructed immediately to the north of the existing bridge crossing. An existing concrete dip, installed by the NRCS in 1995, served to transport overtopping flows over the road. Flows overtopping the road scoured a secondary channel to the north of the main channel.

Because of the canyon-bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. In the area of Stagecoach Trail crossing, however, there is some notable disturbance from the flood, including wide-spread riparian disturbance and loss of vegetation, channel avulsion, the destruction of a home (beyond repair), damage to three outbuildings and the total loss of four additional outbuildings that where completely washed away all on the Lewis property immediately downstream of the road crossing. Approximately 1000 feet upstream of the road crossing the existing fire station was also swept away, in its entirety (see Sheet 60).

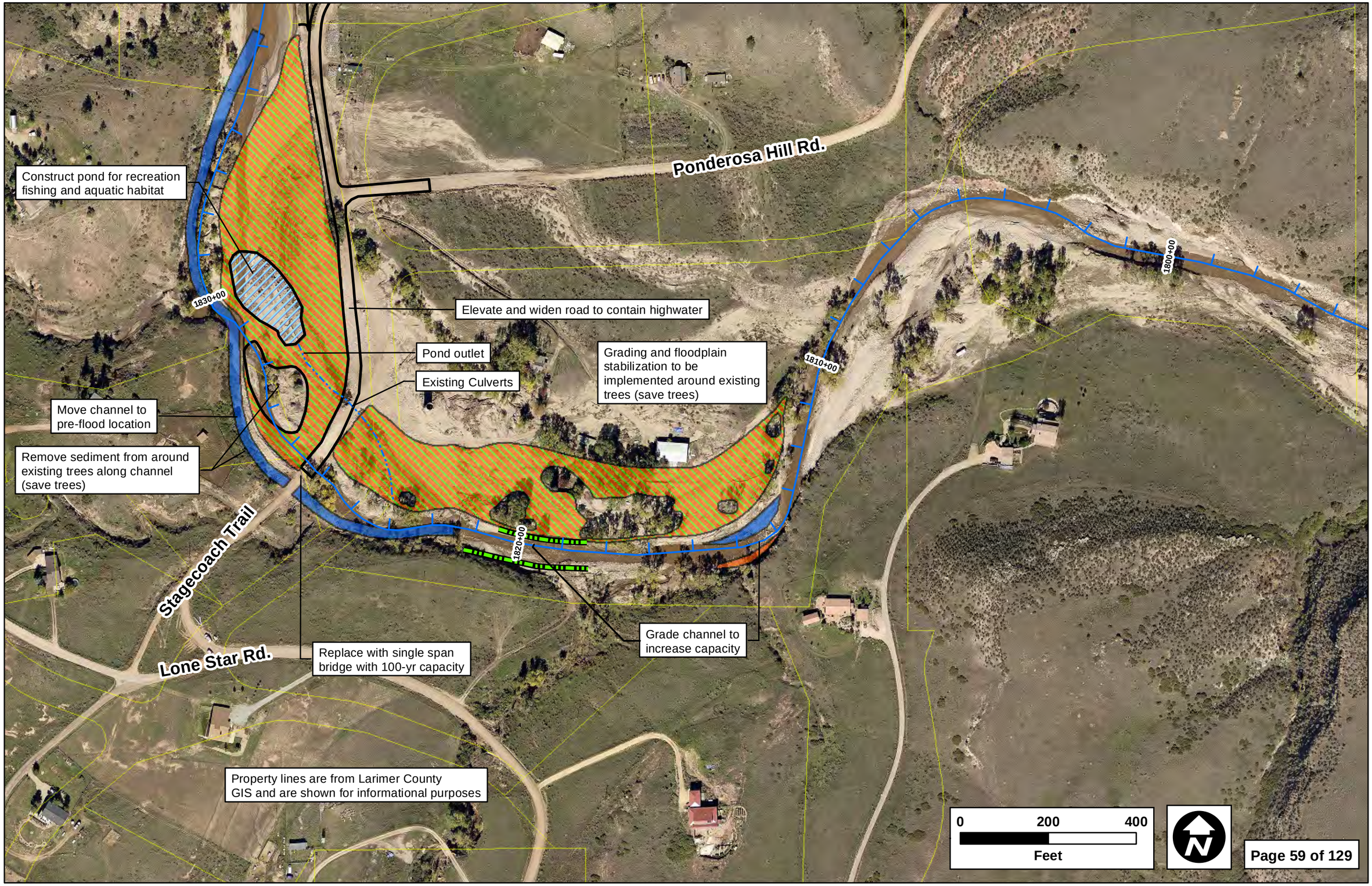
Larimer County has indicated they will be repairing the existing crossing at Stagecoach Trail. The standards for repair are reportedly to return the crossing to pre-flood conditions. However, anecdotal information indicates this crossing has overtopped several times in recent history, indicating that it is undersized to meet current County criteria. In 1995, NRCS reportedly constructed a concrete dip over the top of the crossing to help channelize overtopping flows. Because this existing crossing is likely undersized, and prone to plugging with debris, a bridge replacement is recommended, sized appropriately for current criteria and with provisions for blockage from debris.

RESTORATION RECOMMENDATIONS

1. Replace the existing culverts at Sta 1820+55 with a bridge to provide increased capacity and to reduce the potential for debris blockage.
2. Elevate Stagecoach Trail upstream of the bridge crossing from Sta 1820+55 to Sta 1830+80 to confine flood flows to the river corridor and to minimize overtopping flows and the passage of shallow flooding outside of the river corridor.
3. Reconstruct the low flow channel as indicated.
4. Stabilize the floodplain including headcut areas. Grading and floodplain stabilization shall be implemented around existing trees and in some cases done by hand to minimize disturbance and save the trees that survived the flood.
5. Provide bank stabilization at the Lewis property.
6. Increase channel capacity downstream of the new bridge to maintain capacity continuity downstream past the Lewis property to approximately Sta 1810+00.
7. Create pond for fish refugia and fire-fighting water source. Construct outlet using temporary culverts and align outlet to run through the Lewis property as shown.
8. Grade and vegetate floodplain as shown.
9. Add park elements upstream of the bridge for HOA use including trails, parking, picnic areas, and a small boat launch.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 1810+00 to 1836+50 Sheet 59 Quantity	Cost
Mob/Demob	LS	$ 37,900	1	$ 37,900
Dewatering	LF	$ 14	2050	$ 28,700
Create/refine Low Flow Channel	LF	$ 27	1640	$ 44,300
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	7.5	$ 60,000
Floodplain Stabilization	AC	$ 8,100	7.5	$ 60,800
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1640	$ 8,200
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	410	$ 30,800
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	7.5	$ 37,500
Temporary irrigation and weed management	LS	$ 37,900	1	$ 37,900
Site specific-Elevate road, pond, headgate	LS	$ 450,000	1	$ 450,000
SUBTOTAL				$ 796,100
Contingency, 15% of subtotal				$ 119,400
Permitting , 2.5% of subtotal				$ 19,900
Design, plans, specification, contract administration, 15%				$ 119,400
Supervision & Administration, 10%				$ 79,600
TOTAL				$ 1,134,000


Construct pond for recreation fishing and aquatic habitat
Ponderosa Hill Rd.
1830+00
Elevate and widen road to contain highwater
Pond outlet
Existing Culverts
Grading and floodplain stabilization to be implemented around existing trees (save trees)
1810+00
1800+00
Move channel to pre-flood location
Remove sediment from around existing trees along channel (save trees)
Stagecoach Trail
1820+00
Grade channel to increase capacity
Lone Star Rd.
Replace with single span bridge with 100-yr capacity
Property lines are from Larimer County GIS and are shown for informational purposes
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 60
STATION: 1836+00 to 1848+00
RESTORATION RECOMMENDATIONS: 1836+50 TO 1839+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 to 150 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river is generally canyon bound, setting the sinuosity and river corridor alignment. Comparison of the pre-and post-flood mapping reveal a trend in the location of the wet channel moving from inside or middle of bends to outside of bends, typically scouring out a 150- to 400-foot wide corridor, limited in many places by the width between canyon walls.

Based on field observations it appears this reach experienced signification scour from the 2013 flood event and velocities were high as evidenced by the total destruction the fire station. What remains of the fire station includes the building pad and a cistern. The fire department will repair and maintain the cistern. Parking and access improvements are recommended as shown. The fire station has been relocated to the southwest of the river.

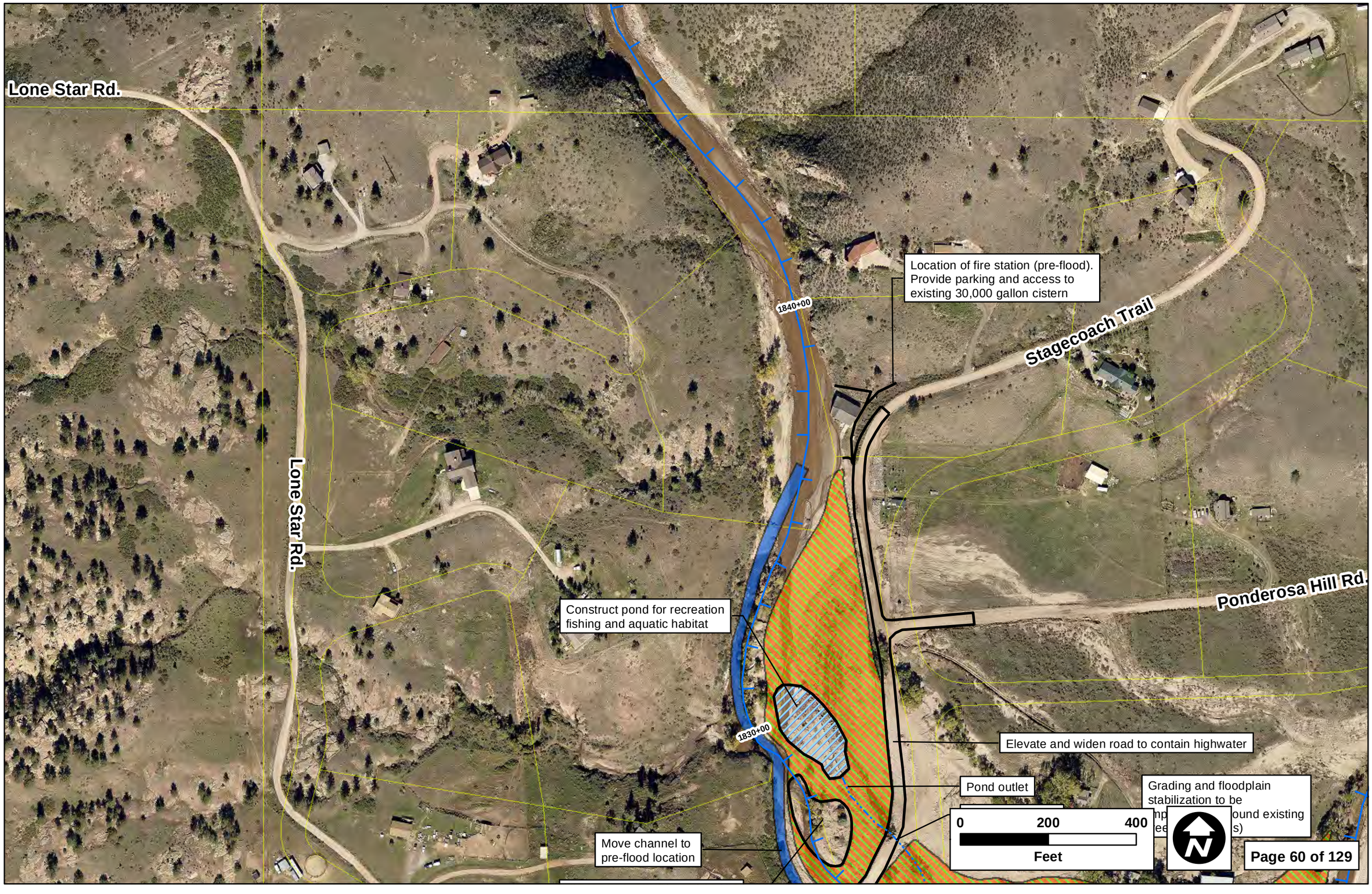
Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. In the area of Stagecoach Road crossing, however, there is some notable disturbance as shown on Sheet 59. Recommendations for Sheet 60 are noted below.

RESTORATION RECOMMENDATIONS

1. Utilize the existing building pad to provide a parking area and to access to the existing cistern.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 1836+50 to Sta 1839+00 Sheet 60 Quantity	Cost
Mob/Demob	LS	$ 6,300	1	$ 6,300
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -		$ -
Parking and access to cistern	LS	$ 125,000	1	$ 125,000
SUBTOTAL				$ 131,300
Contingency, 15% of subtotal				$ 19,700
Permitting , 2.5% of subtotal				$ 3,300
Design, plans, specification, contract administration, 15%				$ 19,700
Supervision & Administration, 10%				$ 13,100
TOTAL				$ 187,000


Lone Star Rd.
Location of fire station (pre-flood). Provide parking and access to existing 30,000 gallon cistern
1840+00
Stagecoach Trail
Lone Star Rd.
Ponderosa Hill Rd.
Construct pond for recreation fishing and aquatic habitat
1830+00
Elevate and widen road to contain highwater
Pond outlet
Grading and floodplain stabilization to be
ound existing
s)
Move channel to pre-flood location
0
200
400
Feet
N

NEIGHBORHOOD: Blue Mountain
SHEET: 61
STATION: 1848+00 to 1874+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river is generally canyon bound, setting the sinuosity and river corridor alignment. Aerial mapping reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1870+00
1860+00
1850+00
Stagecoach Trail
Lone Star Rd.
0
200
400
Feet

NEIGHBORHOOD: Blue Mountain
SHEET: 62
STATION: 1874+00 to 1909+00

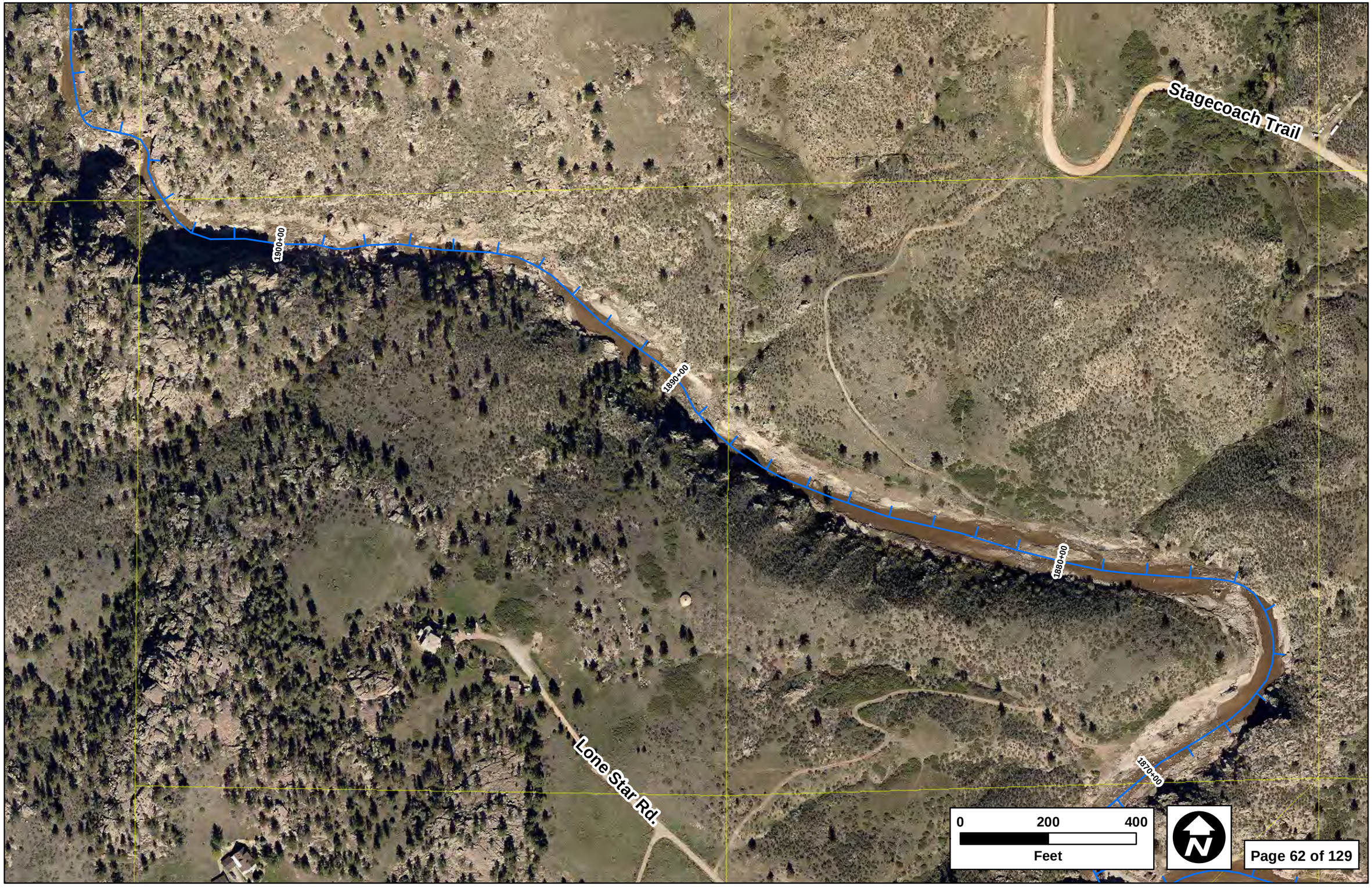
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a densely vegetated riparian corridor, 100 feet wide, comprised primarily of cottonwoods and willows, most of which were torn out during the flood. The river is generally canyon bound, setting the sinuosity and river corridor alignment. Aerial mapping reveals observable areas of riffle pool complexes.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood and velocities were high as evidenced by the loss of riparian vegetation.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


Stagecoach Trail
1900+00
1890+00
1880+00
1870+00
Lone Star Rd.
0
200
400
Feet
N

NEIGHBORHOOD: Pinewood Springs to Blue Mountain
SHEET: 63
STATION: 1932+00 to 1973+00

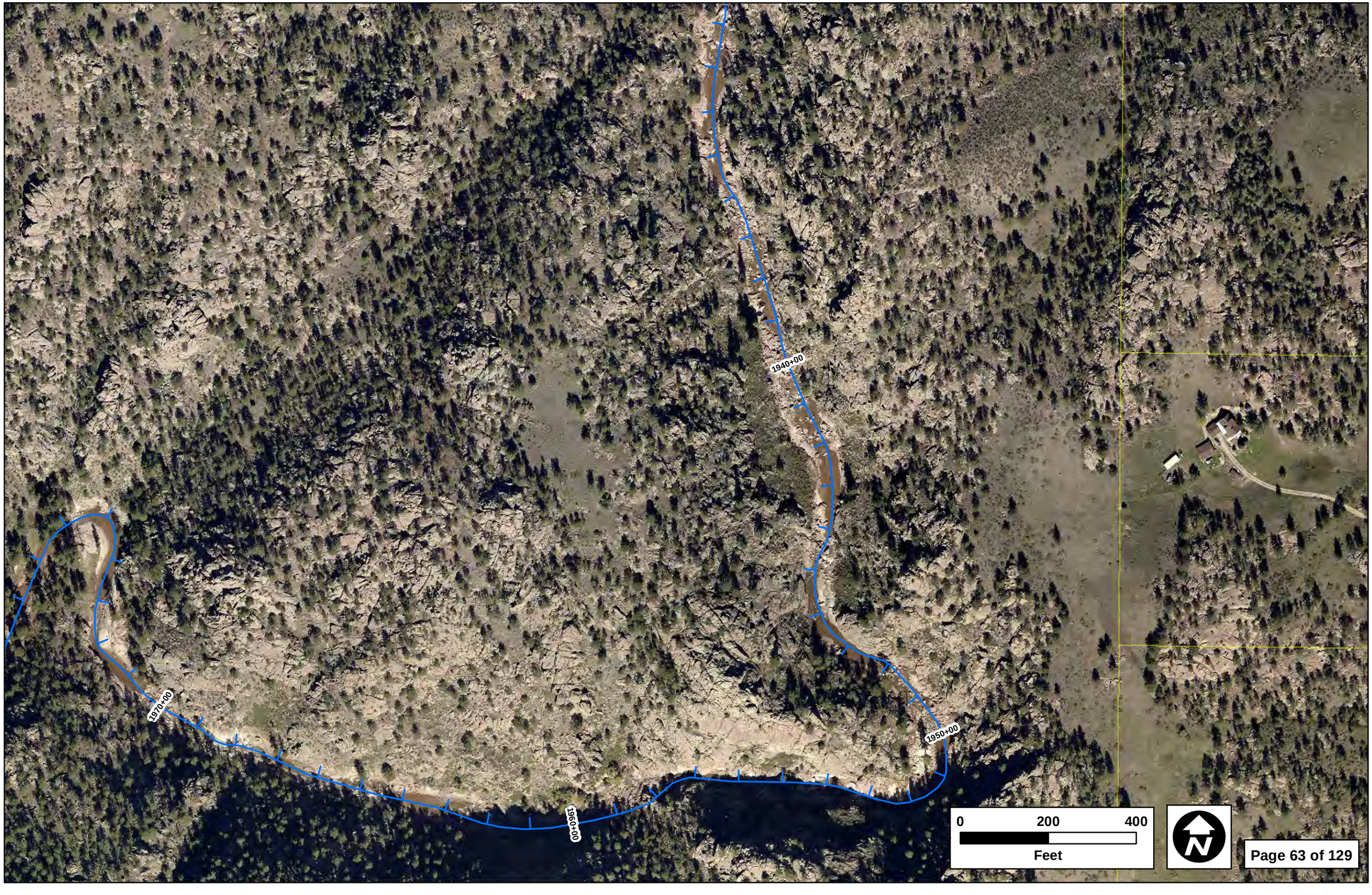
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment. This reach is just upstream of the confluence with the North Fork.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood. The river corridor is narrow and steep with rock outcroppings along the steep walls and controlling the bed. Most of this reach is USFS lands with isolated private land ownership and minimal development.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1940+00
1950+00
1960+00
1970+00
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs to Blue Mountain
SHEET: 64
STATION: 1973+00 to 2033+00

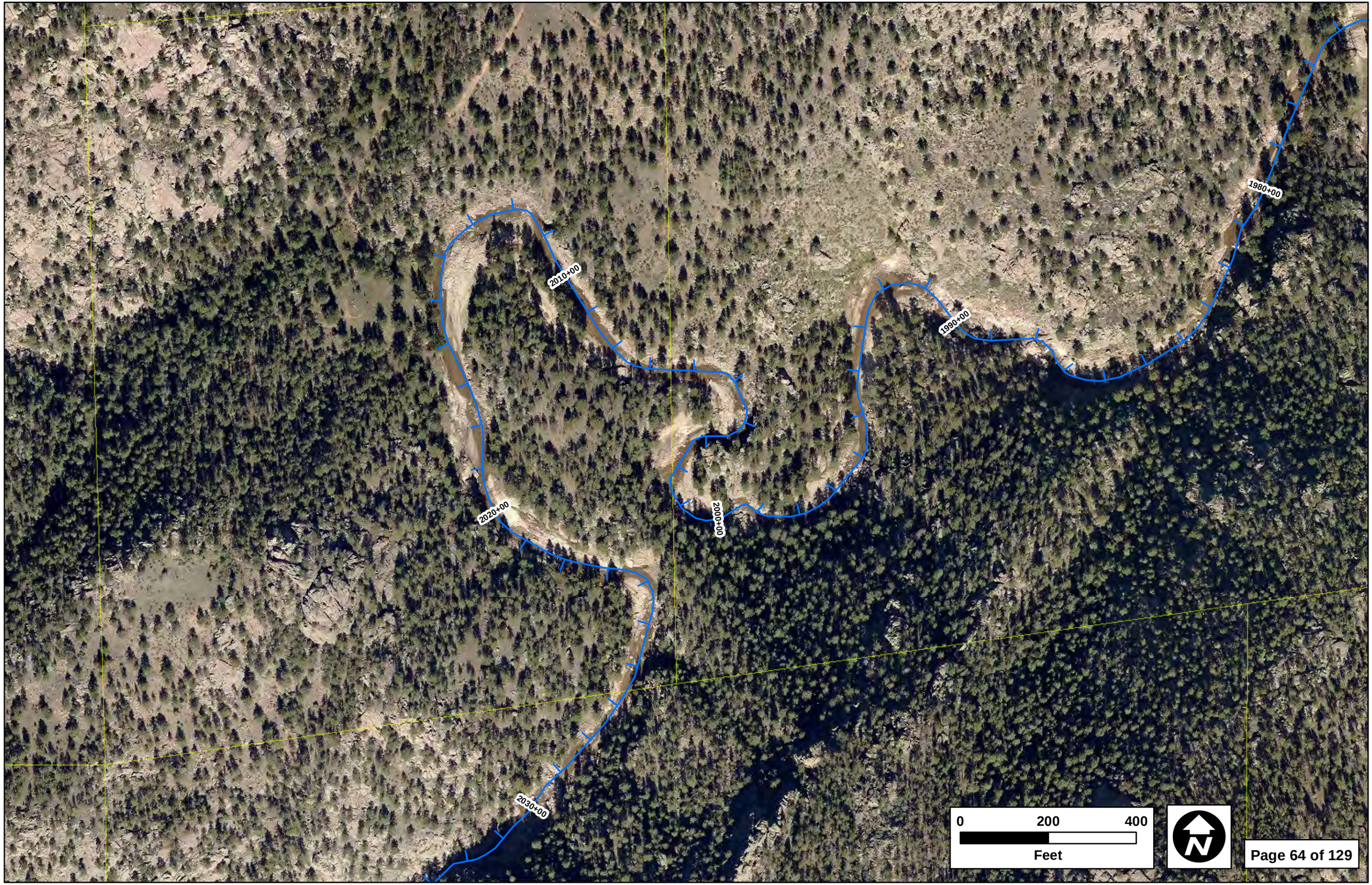
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood. The river corridor is narrow and steep with rock outcroppings along the steep walls and controlling the bed. Most of this reach is USFS lands with isolated private land ownership and minimal development.

Because of the canyon bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


1980+00
1990+00
2000+00
2010+00
2020+00
2030+00
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs to Blue Mountain
SHEET: 65
STATION: 2033+00 to 2070+00

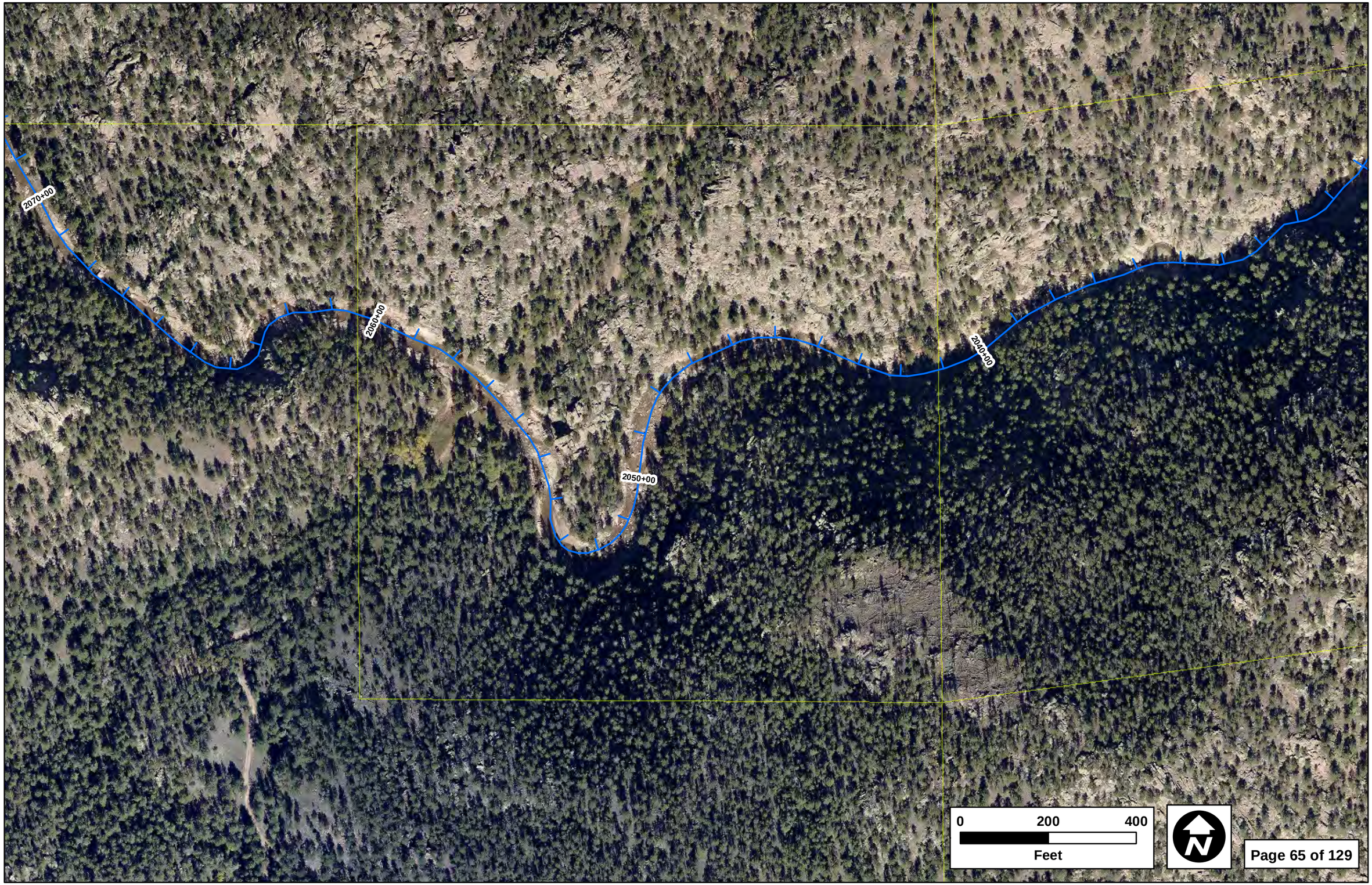
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood. The river corridor is narrow and steep with rock outcroppings along the steep walls and controlling the bed. Most of this reach is USFS lands with isolated private land ownership and minimal development.

Because of the canyon-bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2070+00
2060+00
2050+00
2040+00
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs to Blue Mountain
SHEET: 66
STATION: 2070+00 to 2110+00

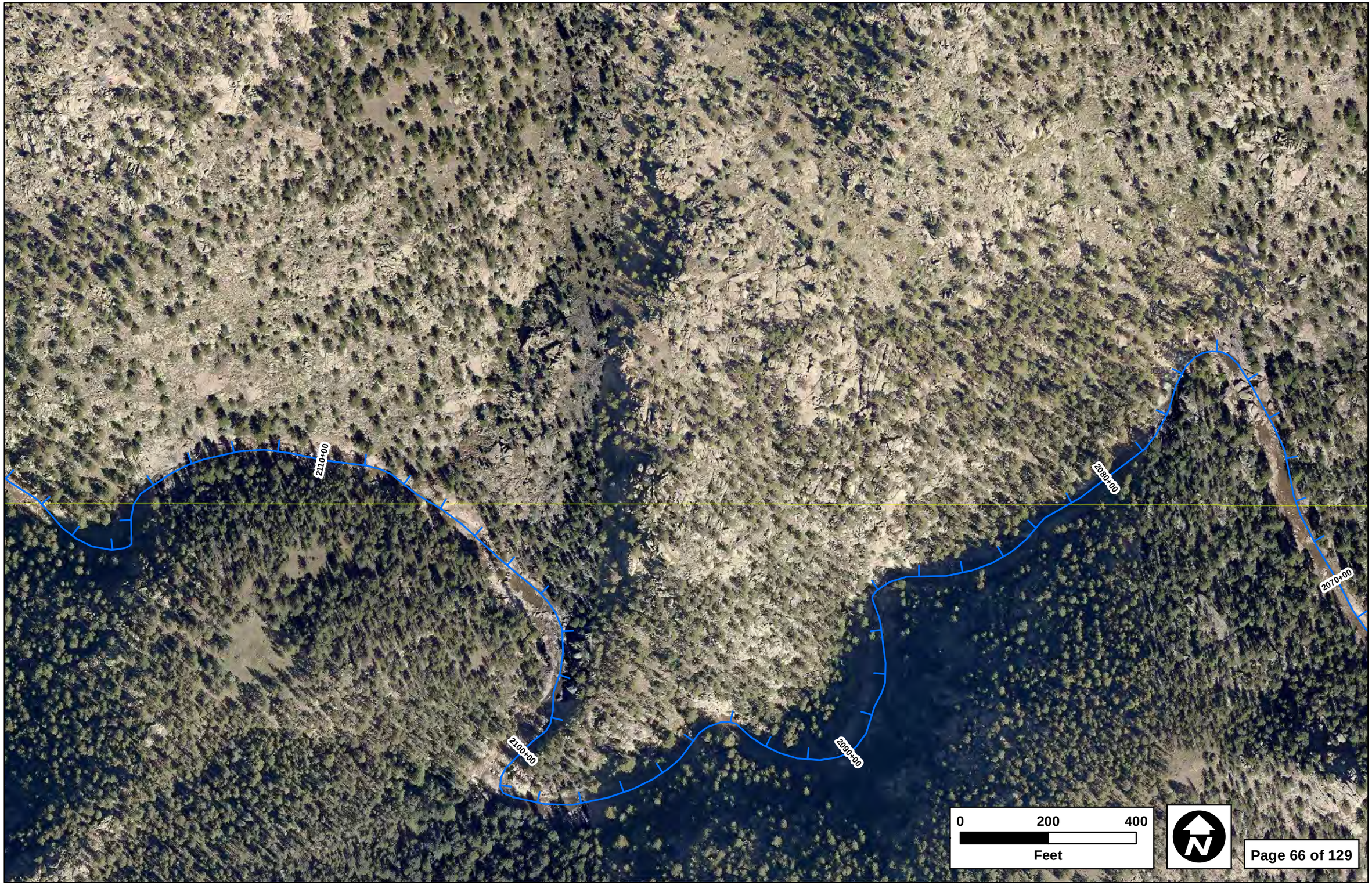
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood. The river corridor is narrow and steep with rock outcroppings along the steep walls and controlling the bed. Most of this reach is USFS lands with isolated private land ownership and minimal development.

Because of the canyon-bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2110+00
2100+00
2090+00
2080+00
2070+00
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs to Blue Mountain
SHEET: 67
STATION: 2110+00 to 2140+00

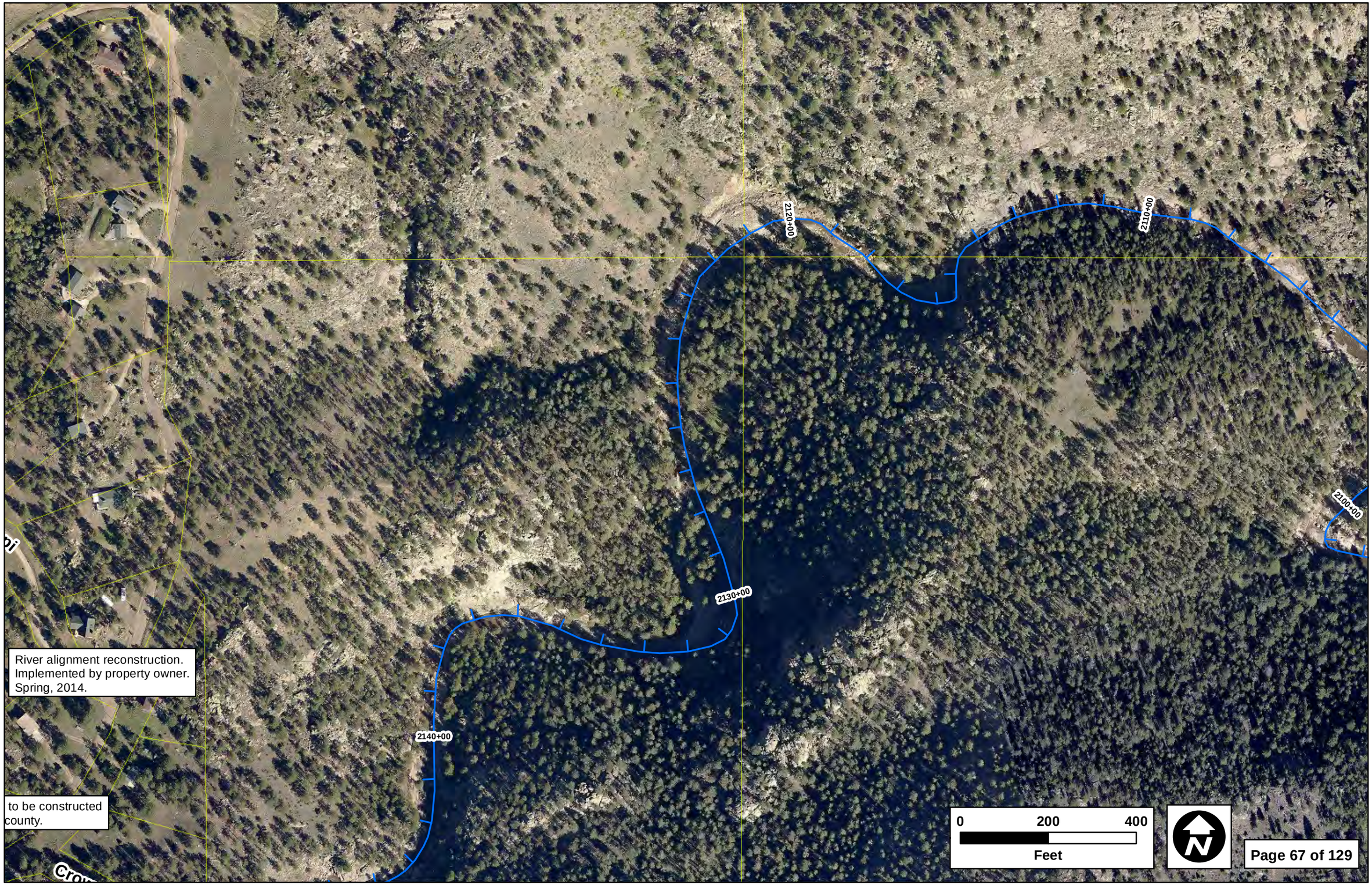
Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Based on field observations it appears this reach experienced signification scour from the 2013 Flood. The river corridor is narrow and steep with rock outcroppings along the steep walls and controlling the bed. Most of this reach is USFS lands with isolated private land ownership and minimal development.

Because of the canyon-bound valley formation and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2120+00
2110+00
2100+00
2130+00
2140+00
River alignment reconstruction.
Implemented by property owner.
Spring, 2014.
to be constructed
county.
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs
SHEET: 68
STATION: 2140+00 to 2190+00
RESTORATION RECOMMENDATIONS: 2160+00 to 2175+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 150 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Because of the rock outcrops, canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities except for the area near Kiowa bridge crossing and the area immediately downstream, as described below. Debris removal by neighborhood residences and volunteers has been extensive. A small portion of the river shown on this sheet is within USFS (specifically downstream of Sta 2106+00). The USFS has no plans for debris removal or restoration activities.

Near the Kiowa Bridge crossing the river experienced signification scour from the 2013 flood. Velocities were high as evident by the loss of the bridge on Kiowa at Sta 2170+10, the significant loss of shrubs and grasses and the removal and transport of large fir trees. The crossing on Kiowa was a low-water crossing which failed as a result of flanking flows around the abutments. A temporary culvert crossing exists today and Larimer County is planning to replace the culverts with a new bridge in accordance with the County criteria. Upstream of Kiowa, there is a residence that was flooded with significant property damage. This property was restored by the owner prior to the field assessments conducted for this Master Plan.

Crescent Lake was an off-line, man-made waterbody, located immediately downstream of Kiowa Bridge. It was a multi-purpose water body providing the community with (1) a water supply for firefighting and fire suppression, (2) water storage, (3) road maintenance, and (4) community recreation. The lake was owned and maintained by the Pinewood Springs Property Owners Association. Reconstructing this lake is a high priority for the residences, not only for safety purposes in fighting fires, but also to replace the lost resource and amenity.

During the 2013 flood, the channel thalweg moved to the outside, or right bend which through the center of Crescent Lake and as a result, created a lower flow line elevation as compared to the inside or left bend. Since the 2013 flood, the local residences have reconstructed the low-flow channel downstream of Kiowa to the USFS property line, along the inside or left bend, creating a perched-channel configuration could avulse under runoff or flood conditions without implementation of the additional recommendations presented here.

Note that the pre-flood channel alignment was on the inside bend with Crescent Lake located on the outside bend. This is likely the opposite of a preferred condition where the river would be located on the outside bend and the lake in the inside. However, residences have indicated a preference for the pre-flood configuration with an added flood overflow channel along the outside bend downstream of Crescent Lake, as shown on the drawing.

RESTORATION RECOMMENDATIONS

1. Coordinate with Larimer County on bridge alignment.
2. Reconstruct headgate and intake located upstream of Kiowa Bridge; investigate the possibility to move it closer to Crescent Lake.
3. Replace dry-hydrant and construct a parking platform for the fire department to access the lake and hydrant. Include parking for residences.
4. Reconstruct Crescent Lake. Include a flood overflow outlet on the downstream end to alleviate flood conditions from the lake. Consider an overflow from the currently configured channel to the outside flood overflow channel.
5. Assess channel stability and design the lake berm between the channel and lake for appropriate scour and overtopping.
6. Stabilize and vegetate floodplain below Crescent Lake.
7. Reconstruct low-flow channel as required to define the low-flow channel along the left valley.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 2160+00 to Sta 2175+00 Sheet 68 Quantity	Cost
Mob/Demob	LS	$ 39,800	1	$ 39,800
Dewatering	LF	$ 14	2000	$ 28,000
Create/refine Low Flow Channel	LF	$ 27	1500	$ 40,500
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100	1	$ 8,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1500	$ 7,500
Bank Stabilization, Level 1	LF	$ 110	500	$ 55,000
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	1	$ 5,000
Temporary irrigation and weed management	LS	$ 4,025	1	$ 4,000
Access, hydrant, pond, headgate and pipe, outlet	LS	$ 640,000	1	$ 640,000
SUBTOTAL				$ 835,900
Contingency, 15% of subtotal				$ 125,400
Permitting , 2.5% of subtotal				$ 20,900
Design, plans, specification, contract administration, 15%				$ 125,400
Supervision & Administration, 10%				$ 83,600
TOTAL				$ 1,191,000

Cree

2190+00

Provide subgrade drainage for groundwater discharge

Pima

Dredge river to pre-flood elevation (approx. 4ft)

2180+00

Hopi

River alignment reconstruction. Implemented by property owner. Spring, 2014.

Reconstruct existing headgate and pipeline

Fire truck access

New bridge to be constructed by Larimer county.

2140+00

Crow

2170+00

Reconstruct Crescent Lake up to 9 or 10 feet depth, with berm to separate river.

Cheyenne

Cree

Sta 2173+00 to 2164+00 (approx). Reconstruct channel low flow to left valley.

Add flood overflow at downstream embankment.

River alignment reconstruction. Implemented by property owners. Spring, 2014.

2150+00

Wichita

Kiowa

2160+00

0 200 400

Feet

NEIGHBORHOOD: Pinewood Springs
SHEET: 69
STATION: 2190+00 to 2210+00
RESTORATION RECOMMENDATIONS: 2196+00 to 2204+00

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, 50 to 100 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Because of the rock outcrops, canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities except for the area near the Cree bridge crossing and the area immediately up- and downstream area as described below. Debris removal by neighborhood residences and volunteer help has been extensive.

Near the Cree Bridge crossing the river experienced signification lateral scour from the 2013 flood. Velocities were high as evidenced by the damage to the bridge on Cree (Sta 2190+90), the significant loss of vegetation, bank degradation at the Sherman residence, the channel avulsion at the water treatment plan and the transport and removal of large fir trees. The crossing on Cree was a single-span bridge, which reportedly failed as a result of debris plugging and subsequent flanking of flows around the northwest abutment. This flanking is also the likely cause of significant erosion and loss of river bank at the Sherman residence. Additional erosion or loss of bank at the Sherman residence will likely result in structural failure of the home. Downstream of the Cree Bridge immediately the river aggraded by an estimated four (4) feet based on anecdotal information from Jeff Sherman who lives immediately adjacent to the aggraded area. The elevated stream bed may be contributing to high groundwater condition that exists today.

A temporary culvert crossing exists today and Larimer County is planning to repair the bridge in accordance with the County criteria for bridges. Recommendations include an analysis of overtopping flows and consideration of the grades along the approach roads as a perched bridge may result in the same bank erosion should another overtopping event occur.

The Pinewood Springs Water District water treatment plant is located upstream of the Cree Bridge. The plant is located on the right, or south bank and an intake vault located in the old channel centerline. As of June 2014 this vault was being reconstructed. In terms of master planning, the request of the Pinewood Springs Water District is to ensure the river is relocated back to the left bank at the same location as pre-flood conditions and over the location of the new vault.

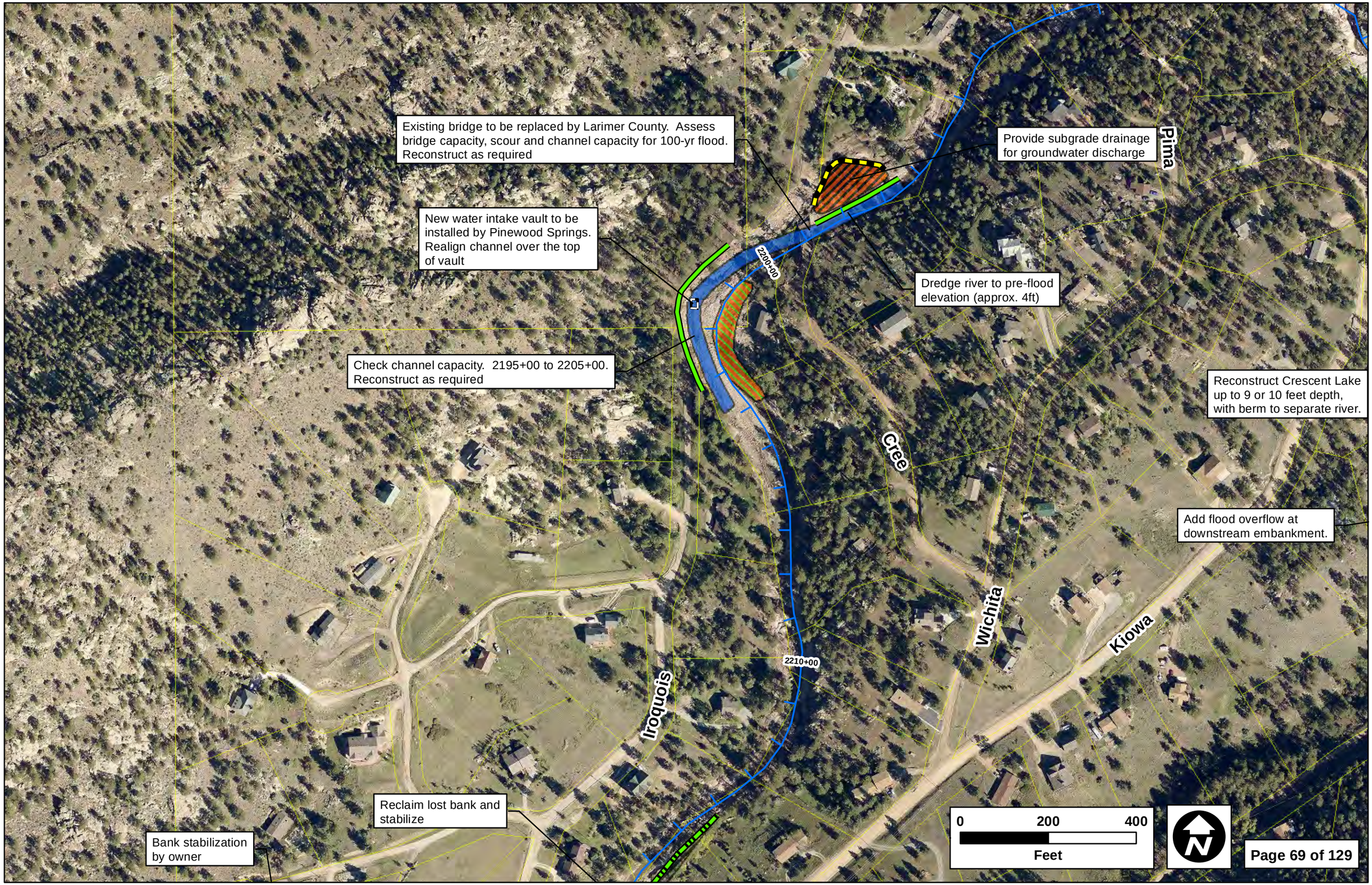


RESTORATION RECOMMENDATIONS

1. Coordinate with Larimer County on bridge reconstruction. Evaluate for higher flows than the county design standard of 25 years and assess overtopping flow to ensure the bridge is not perched compared to the approach roads.
2. Coordinate with Pinewood Springs Water District to align river with vault location.
3. Assess channel stability immediately up- and downstream of the Cree Bridge.
4. Backfill and stabilize the banks adjacent to Sherman residence.
5. Verify channel elevations and to the extent possible, lower the channel reach immediately adjacent to Sherman residence to conform to pre-flood elevations. Verify adequacy of channel capacity.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta2196+00 to Sta 2204+00 Sheet 69 Quantity	Cost
Mob/Demob	LS	$ 13,000	1	$ 13,000
Dewatering	LF	$ 14	2000	$ 28,000
Create/refine Low Flow Channel	LF	$ 27	1000	$ 27,000
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48	400	$ 19,200
Grade Control	EA	$ -	1	$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100	0.3	$ 2,400
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	1000	$ 5,000
Bank Stabilization, Level 1	LF	$ 110	600	$ 66,000
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	0.3	$ 6,100
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5	250	$ 1,300
Seeding	AC	$ 5,000	1.3	$ 6,500
Temporary irrigation and weed management	LS	$ 4,450	1	$ 4,500
Approach road, subgrade drainage, water intake	LS	$ 85,000	1	$ 85,000
SUBTOTAL				$ 272,000
Contingency, 15% of subtotal				$ 40,800
Permitting , 2.5% of subtotal				$ 6,800
Design, plans, specification, contract administration, 15%				$ 40,800
Supervision & Administration, 10%				$ 27,200
TOTAL				$ 388,000


Existing bridge to be replaced by Larimer County. Assess bridge capacity, scour and channel capacity for 100-yr flood. Reconstruct as required
New water intake vault to be installed by Pinewood Springs. Realign channel over the top of vault
Check channel capacity. 2195+00 to 2205+00. Reconstruct as required
Provide subgrade drainage for groundwater discharge
Dredge river to pre-flood elevation (approx. 4ft)
Reconstruct Crescent Lake up to 9 or 10 feet depth, with berm to separate river.
Add flood overflow at downstream embankment.
Reclaim lost bank and stabilize
Bank stabilization by owner
2200+00
2210+00
Pima
Cree
Iroquois
Wichita
Kiowa
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs
SHEET: 70
STATION: 2210+00 to 2249+00
RESTORATION RECOMMENDATIONS: 2214+00 to 2230+00



Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

Because of the rock outcrops, canyon bound valley formation, and limited encroachment on the river corridor, much of this reach is relatively stable and expected to recover without restoration activities except for the area near the Seneca bridge crossing and the area immediately up- and downstream area as described below. Debris removal by Larimer County, neighborhood residences and volunteer help has been extensive.

Near the Seneca Bridge the river experienced some scour from the 2013 flood, along with debris accumulation at the bridge, bank scour downstream and degradation along the channel flow line. Velocities were high as evidenced by the size and amount of debris that snagged in the bridge structure, the transport of large boulder and cobble material and loss of vegetation. The crossing on Seneca is a truss bridge with two spans both which experienced significant debris accumulation and some undermining of a mid-channel footing. Larimer County is planning to repair the bridge.

Upstream of the Seneca Bridge the channel makes a significant bend at Sta 2220+35. During the 2013 flood, flows reportedly overtopped the bar at this bend, alternating in waves of deposition and degradation. At the time of the site assessment the property owner had already removed debris and cleared the bar. The channel adjacent to the bar may have accumulated material and subsequently lost capacity. Immediately upstream, near Sta 2220+80 the property owner had already reconstructed the riverbanks, although channel deposition has likely reduced the capacity of this reach, which could result in increased frequency of bank overtopping.

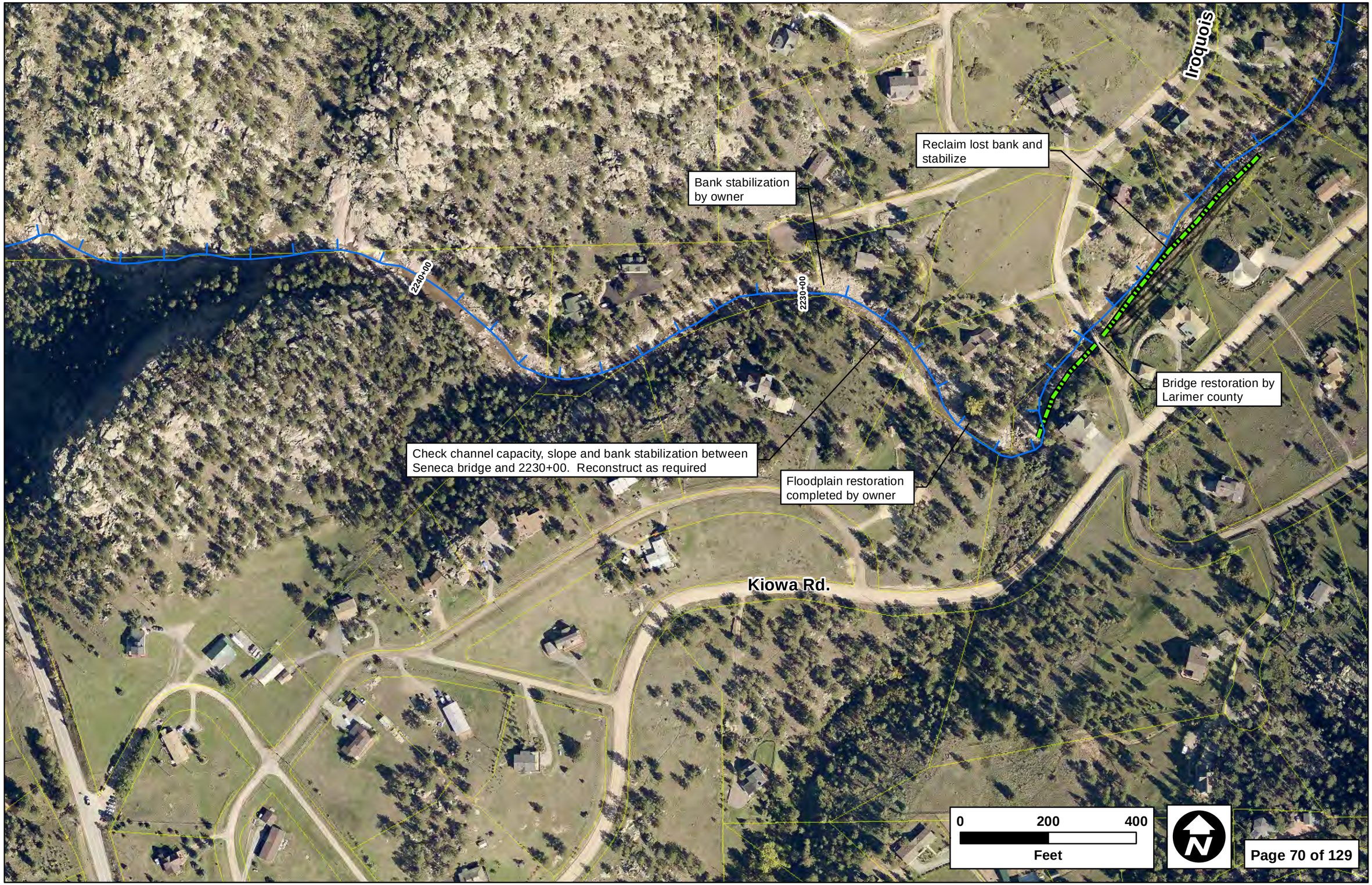
Existing boulders located downstream of the Seneca Bridge should remain in place as requested by the property owner.

RESTORATION RECOMMENDATIONS

1. Coordinate with Larimer County on bridge repair and debris removal.
2. Assess channel capacity and bank stabilization upstream of the Seneca Bridge along portions of the channel that have already been repaired and reconstructed. Also assess for reduced capacity due to deposition. Excavate and/or upsize the channel as required.
3. Stabilize the banks downstream of Seneca Bridge for 50 to 75 feet.
4. Reseed overbank areas particularly upstream of Seneca Bridge to help stabilize the large exposed bars.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 2214+00 to 2230+00 Sheet 70 Quantity	Cost
Mob/Demob	LS	$ 7,000	1	$ 7,000
Dewatering	LF	$ 14	800	$ 11,200
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75	800	$ 60,000
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200	0.5	$ 10,100
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0.5	$ 2,500
Temporary irrigation and weed management	LS	$ 17,525	1	$ 17,500
Reconstruct channel	LF	$ 48	800	$ 38,400
SUBTOTAL				$ 146,700
Contingency, 15% of subtotal				$ 22,000
Permitting , 2.5% of subtotal				$ 3,700
Design, plans, specification, contract administration, 15%				$ 22,000
Supervision & Administration, 10%				$ 14,700
TOTAL				$ 209,000


Iroquois
Reclaim lost bank and stabilize
Bank stabilization by owner
2240+00
2230+00
Bridge restoration by Larimer county
Check channel capacity, slope and bank stabilization between Seneca bridge and 2230+00. Reconstruct as required
Floodplain restoration completed by owner
Kiowa Rd.
0
200
400
Feet

NEIGHBORHOOD: Pinewood Springs
SHEET: 71
STATION: 2249+00 to 2280+00
RESTORATION RECOMMENDATIONS: 2253+00 to 2255+00

Most of this reach runs immediately adjacent to U.S. Highway 36. The river traverses land owned by both CDOT and the USFS. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon bound, setting the sinuosity and river corridor alignment.

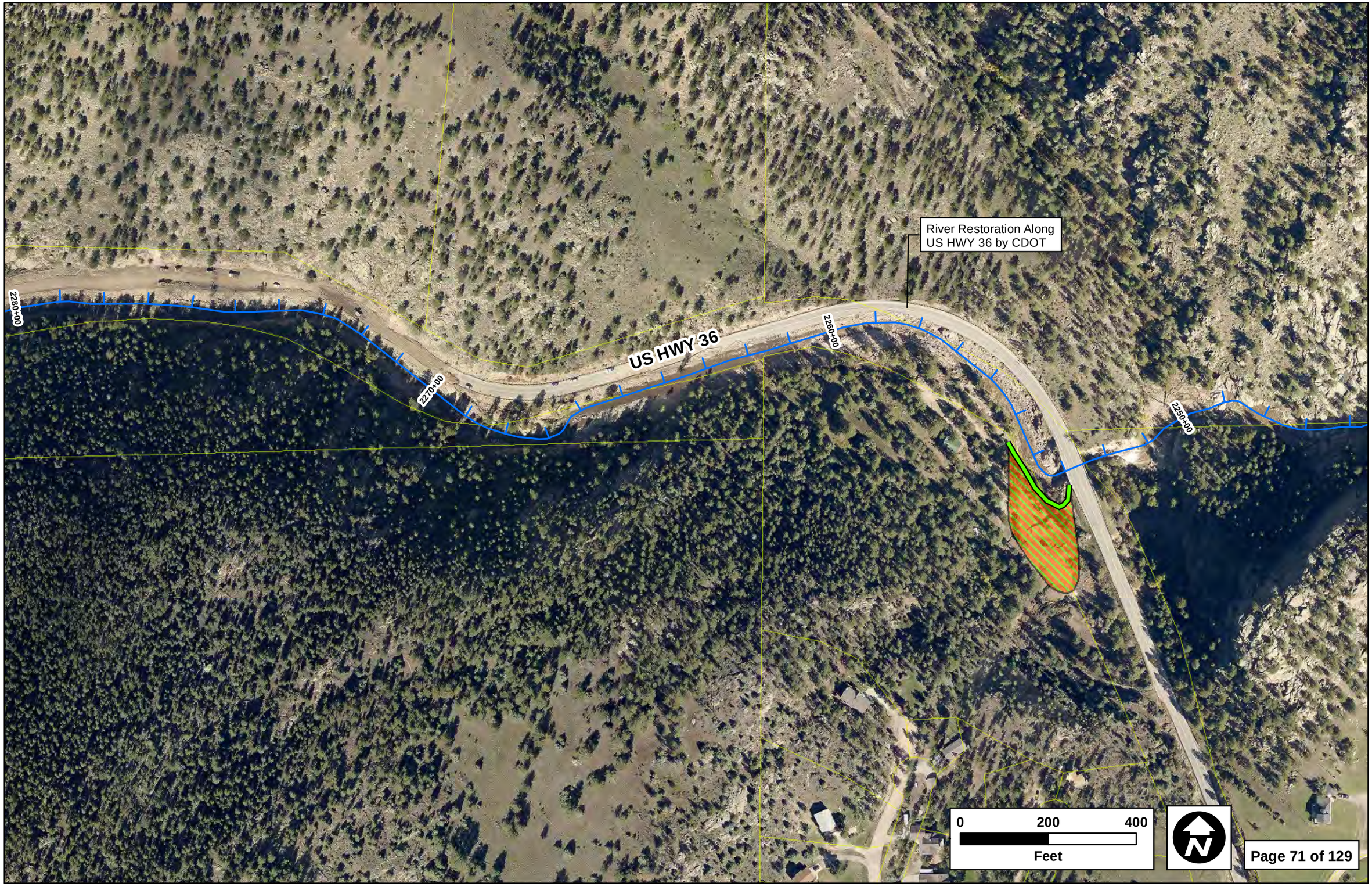
Highway damage was extensive as well as property damage at the Lucero residence, including bank degradation, loss of a driveway and significant deposition in the field immediately south of the channel bend and inlet to the U.S. Highway 36 Bridge. Channel restoration is being undertaken by CDOT in conjunction with the U.S. Highway 36 reconstruction and in collaboration with the USFS. River improvements consist of the construction a low-flow channel, and the reconnection to the floodplain corridor. Restoration plans for the Lucero residence river bank property is unclear, but should include, as a minimum, bank stabilization and protection on the upstream banks of the U.S. Highway 36 Bridge (Sta 2250+30). Capacity of both the channel and bridge should also be assessed and considered in the reconstructed accordingly. Restoration not implemented as part of CDOT improvements should be considered in the master plan, except for the driveway, which was reconstructed by the Lucero's.

RESTORATION RECOMMENDATIONS

1. Coordinate with CDOT and the USFS on reconstruction at Lucero residence.
2. Assess channel capacity upstream of the U.S. Highway 36 Bridge and design restoration accordingly.
3. Stabilize the banks upstream of U.S. Highway 36 at Sta 2250+30 and, grade and stabilize floodplain.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Sta 2253+00 to Sta 2255+00 Sheet 71	
			Quantity	Cost
Mob/Demob	LS	$ 2,800	1	$ 2,800
Dewatering	LF	$ 14	250	$ 3,500
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000	1	$ 8,000
Floodplain Stabilization	AC	$ 8,100	1	$ 8,100
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110	250	$ 27,500
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	1	$ 5,000
Temporary irrigation and weed management	LS	$ 4,025	1	$ 4,000
Site Specific	LS	$ -	1	$ -
SUBTOTAL				$ 58,900
Contingency, 15% of subtotal				$ 8,800
Permitting , 2.5% of subtotal				$ 1,500
Design, plans, specification, contract administration, 15%				$ 8,800
Supervision & Administration, 10%				$ 5,900
TOTAL				$ 84,000


River Restoration Along
US HWY 36 by CDOT
US HWY 36
2280+00
2270+00
2260+00
2250+00
0
200
400
Feet
N

NEIGHBORHOOD: Pinewood Springs
SHEET: 72
STATION: 2280+00 to 2302+00 (Main Stem)
0+00 to 30+00 (West Fork)
RESTORATION RECOMMENDATIONS: 2286+00

MAIN STEM

Most of the Main Stem runs immediately adjacent to U.S. Highway 36. The river traverses land owned by both CDOT and the USFS, except for approximately 500 feet where the river crosses the Larson property (Sta 2280+50). Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is narrow and canyon-bound, setting the sinuosity and river corridor alignment.

This reach also includes the confluence area with the West Fork and intersection of County Road 47. Here the Highway and County Road alignments are being implemented to improve river connectivity at the confluence area, including the reduction of one river crossing.

Highway damage was extensive as well as bank damage and the loss of a driveway crossing at the Larson property. Channel restoration is being undertaken by CDOT in conjunction with the U.S. Highway 36 reconstruction and in collaboration with the USFS. River improvements consist of the construction a low-flow channel, and the reconnection to the floodplain corridor. Restoration plans by CDOT do not include access improvements to the Larson residence. Thus, a crossing to access the property is recommended herein. Capacity of both the channel and the crossing should also be assessed and considered in the culvert design

WEST FORK

The West Fork runs immediately adjacent to County Road 47, crossing it five times in less than 2 miles. These crossing were all destroyed during the 2013 flood and field evidence indicates the road was likely overtopped, with the road and canyon walls conveying floodwater. Larimer County replaced the culverts shortly after the flood. The USFS has expressed an interest in replacing the culverts with culverts of increased capacity and culverts that can provide connectivity for aquatic species. As of the fall of 2014 Larimer County, FEMA, the USFS and Central Federal Lands are working to repair the road and permanently replace the culverts.

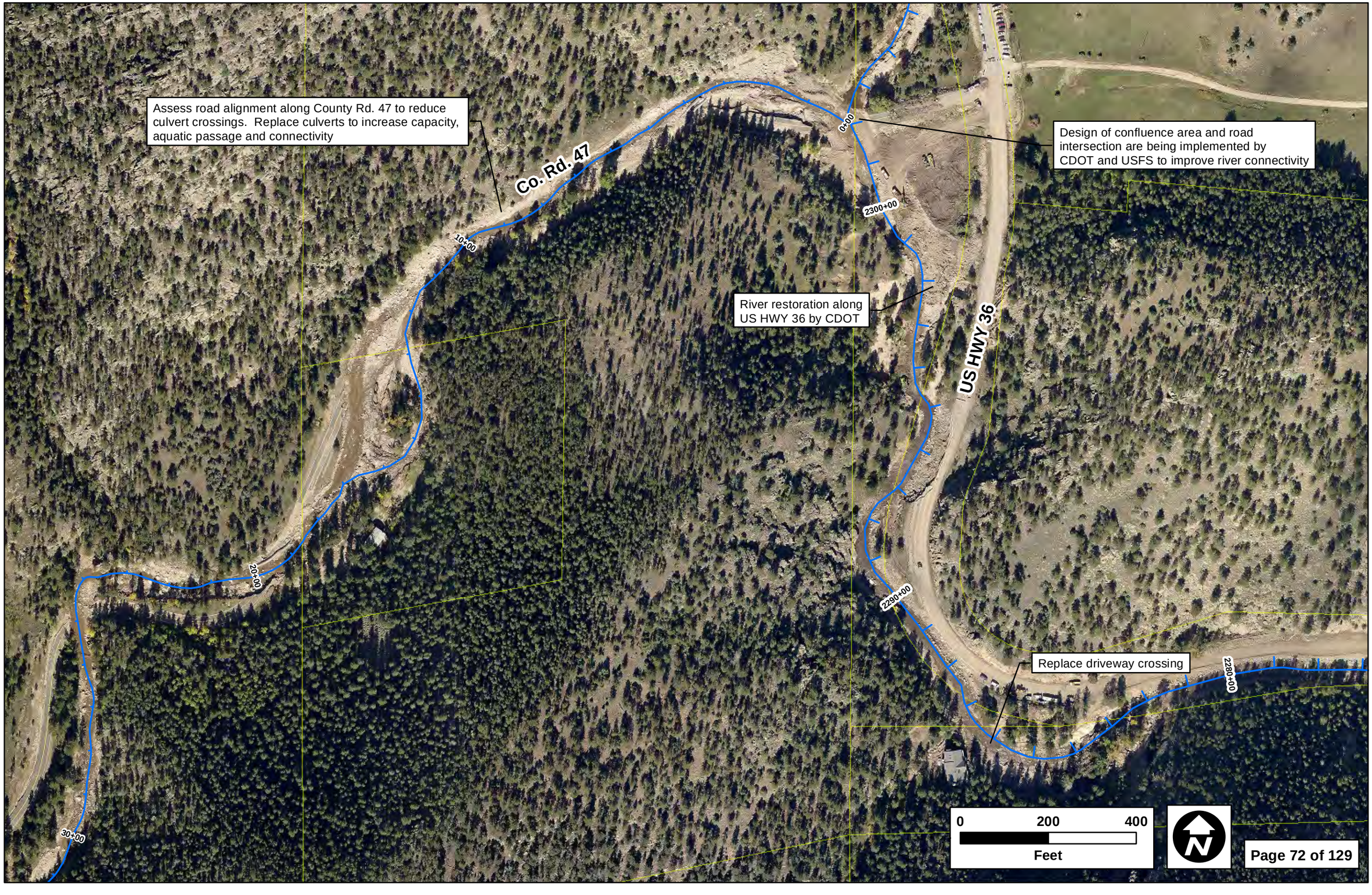
Field observations indicate that the channel size was insufficient for the flood event. As the event is estimated to be in excess of the 500-year flood, this is understandable the channel capacity was exceeded, however, a channel assessment for capacity as well as bank stability under design flood conditions may be warranted along with the implementation of site specific improvements where required.

RESTORATION RECOMMENDATIONS

1. Coordinate with CDOT and the USFS on reconstruction at Larson residence.
2. Coordinate with Larimer County, FEMA, the USFS and Central Federal Lands on culvert replacements along County Road 47.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	Station 2286+00 Sheet 72 Quantity	Cost
Mob/Demob	LS	$ 6,200	1	$ 6,200
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -		$ -
Culvert replacement	LS	$ 125,000	1	$ 125,000
SUBTOTAL				$ 131,200
Contingency, 15% of subtotal				$ 19,700
Permitting , 2.5% of subtotal				$ 3,300
Design, plans, specification, contract administration, 15%				$ 19,700
Supervision & Administration, 10%				$ 13,100
TOTAL				$ 187,000


Assess road alignment along County Rd. 47 to reduce culvert crossings. Replace culverts to increase capacity, aquatic passage and connectivity
Co. Rd. 47
10+00
20+00
30+00
Design of confluence area and road intersection are being implemented by CDOT and USFS to improve river connectivity
0+00
2300+00
River restoration along US HWY 36 by CDOT
US HWY 36
2290+00
Replace driveway crossing
2280+00
0
200
400
Feet

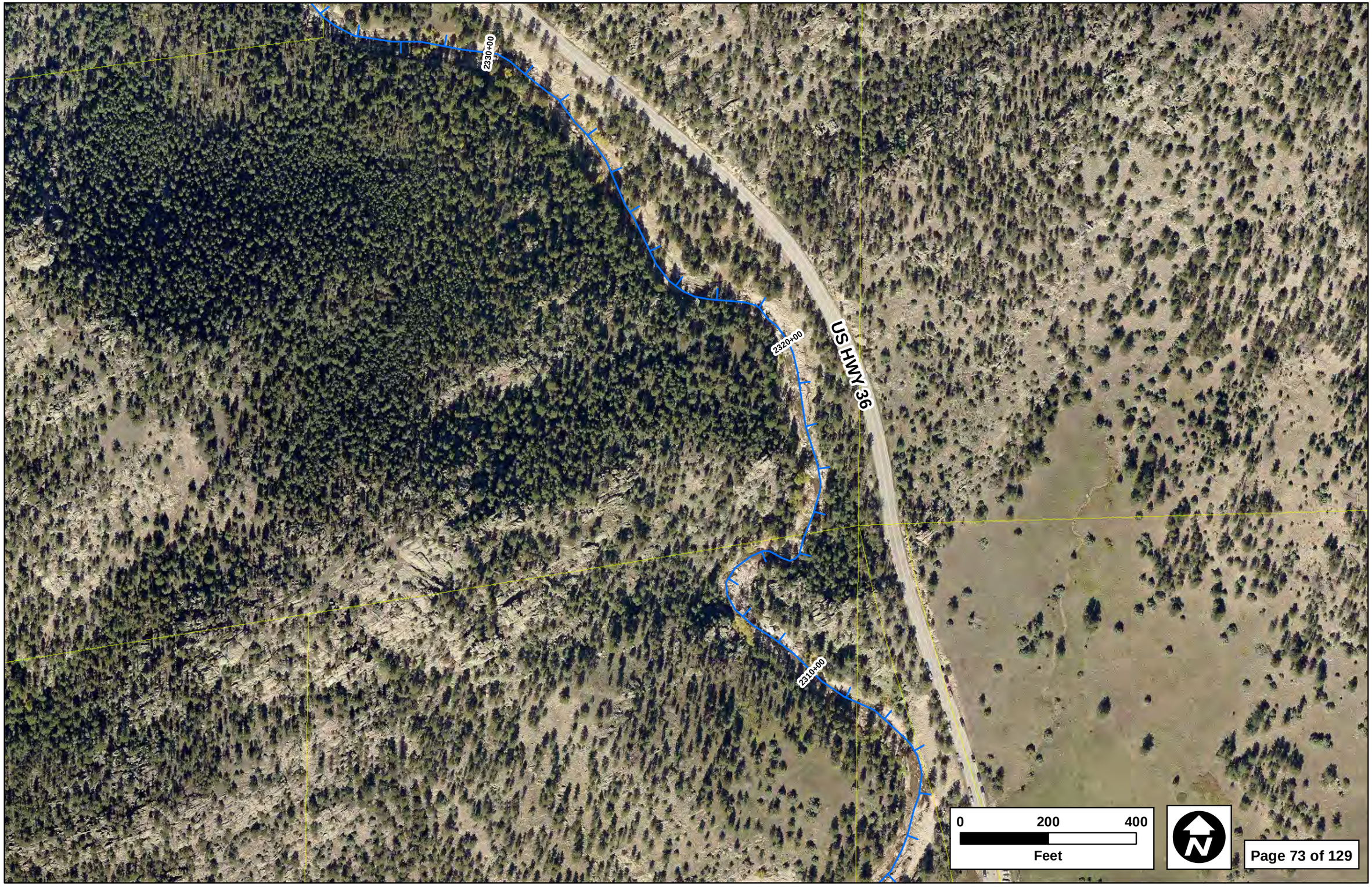
NEIGHBORHOOD: Headwaters
SHEET: 73
STATION: 2302+00 to 2334+00

This portion of the LT runs immediately adjacent to U.S. Highway 36. The river traverses land owned privately and land managed by the USFS. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent), narrow, and canyon bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at culvert crossings or where the floodplain had been encroached by anthropogenic activities. Neither the USFS nor private property owners have indicated any desire to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2330+00
2320+00
US HWY 36
2310+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 74
STATION: 2334+00 to 2361+00

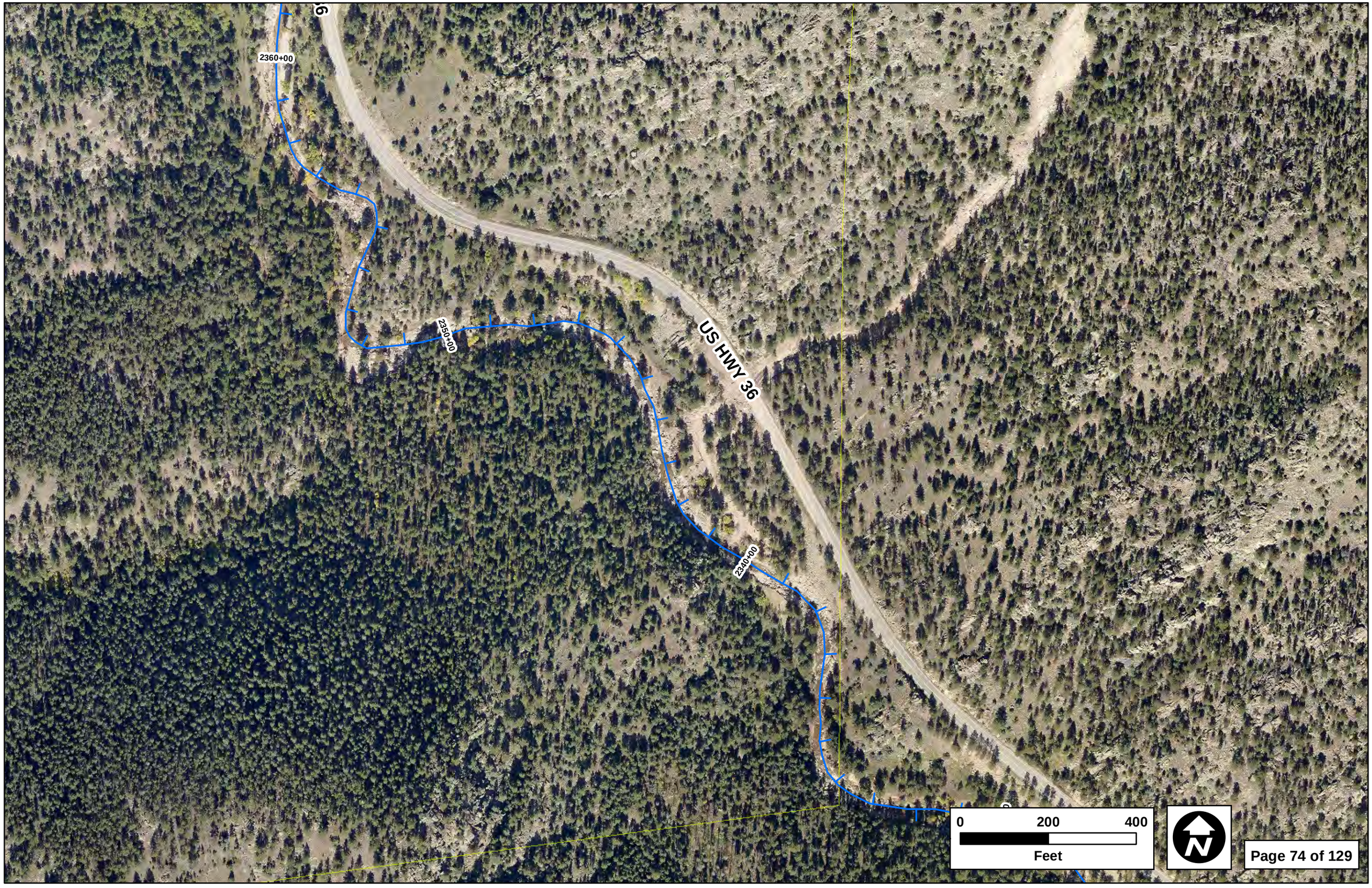
This portion of the Little Thompson River runs immediately adjacent to U.S. Highway 36. The river traverses land owned privately and land managed by the USFS. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent) narrow, and canyon bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at culvert crossings or where the floodplain had been encroached by anthropogenic activities. Evidence of mud and debris flow was observed from an unnamed tributary from the northwest, crossing under U.S. Highway 36.

Much of this reach is on property managed by USFS with some private land ownership. Neither the USFS, nor private property owners have indicated any desire to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2360+00
2350+00
2340+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 75
STATION: 2361+00 to 2385+00

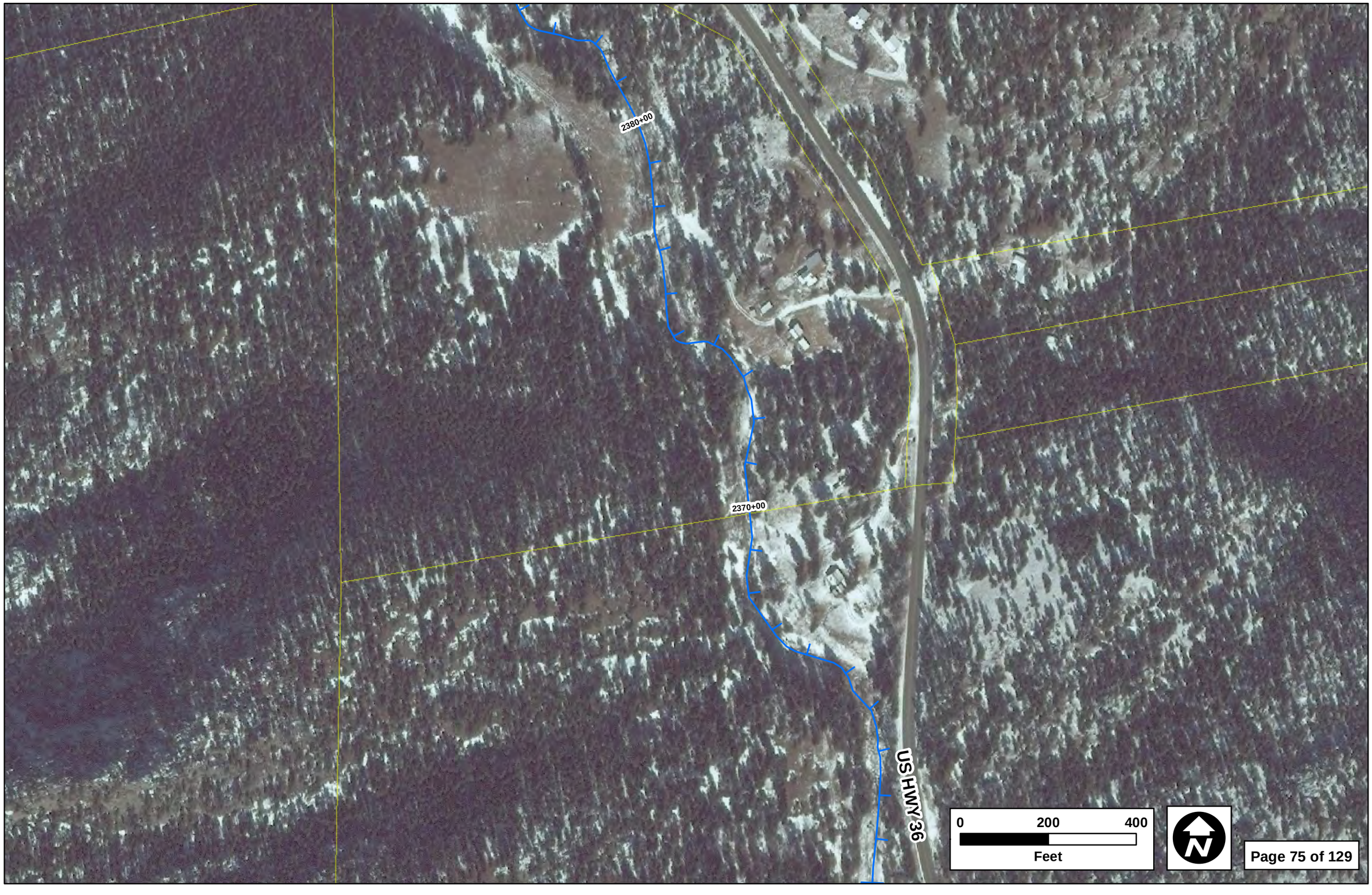
This portion of the Little Thompson River runs parallel to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses land owned privately. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent) narrow, and canyon bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at culvert crossings or where the floodplain had been encroached by anthropogenic activities.

The private property owners have indicated any desire to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2380+00
2370+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 76
STATION: 2385+00 to 2419+00

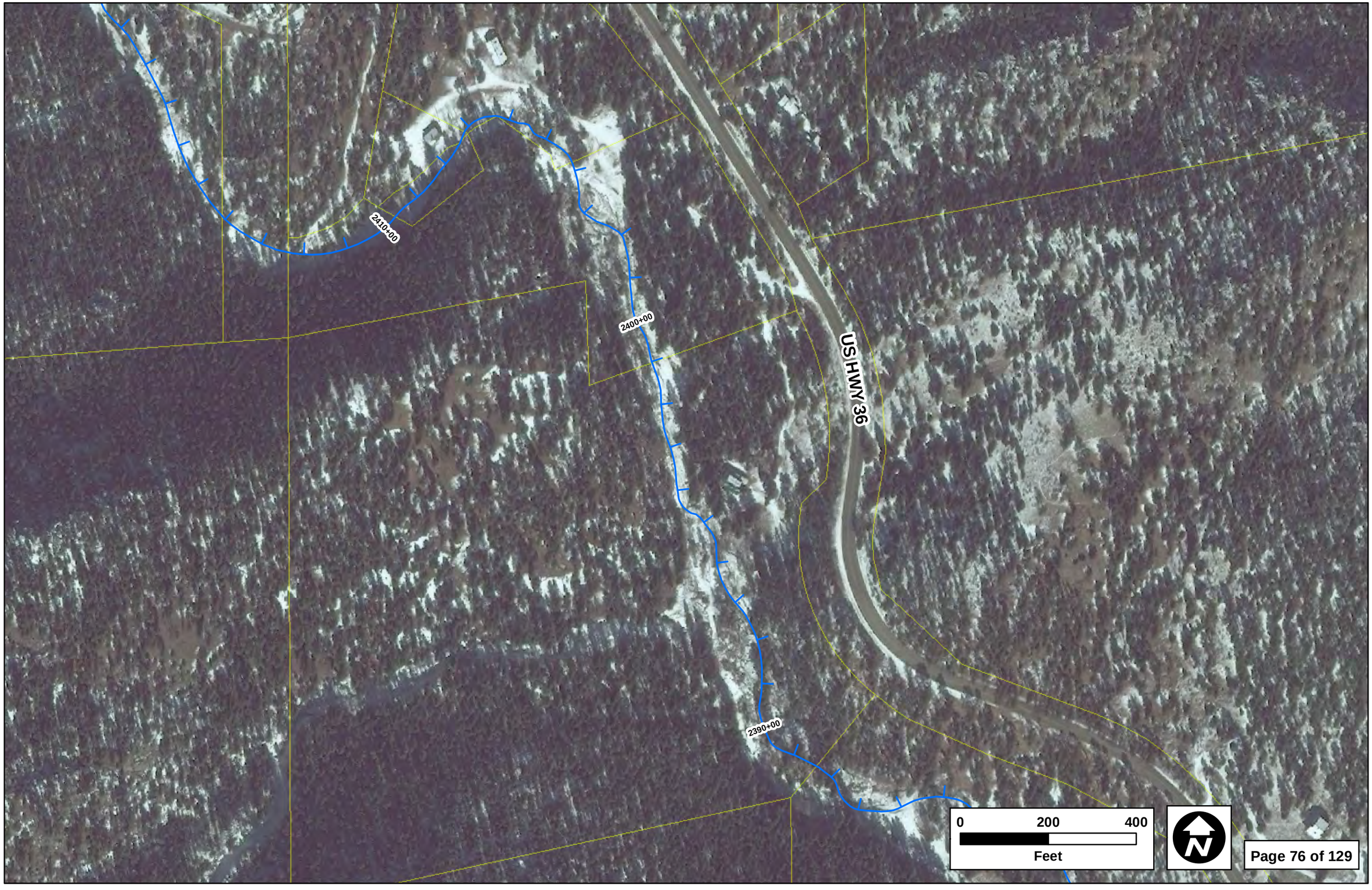
This portion of the Little Thompson River runs parallel to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses land owned privately. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent) narrow, and canyon bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at culvert crossings or where the floodplain had been encroached by anthropogenic activities.

The private property owners have indicated any desire to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2410+00
2400+00
2390+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 77
STATION: 2419+00 to 2454+00

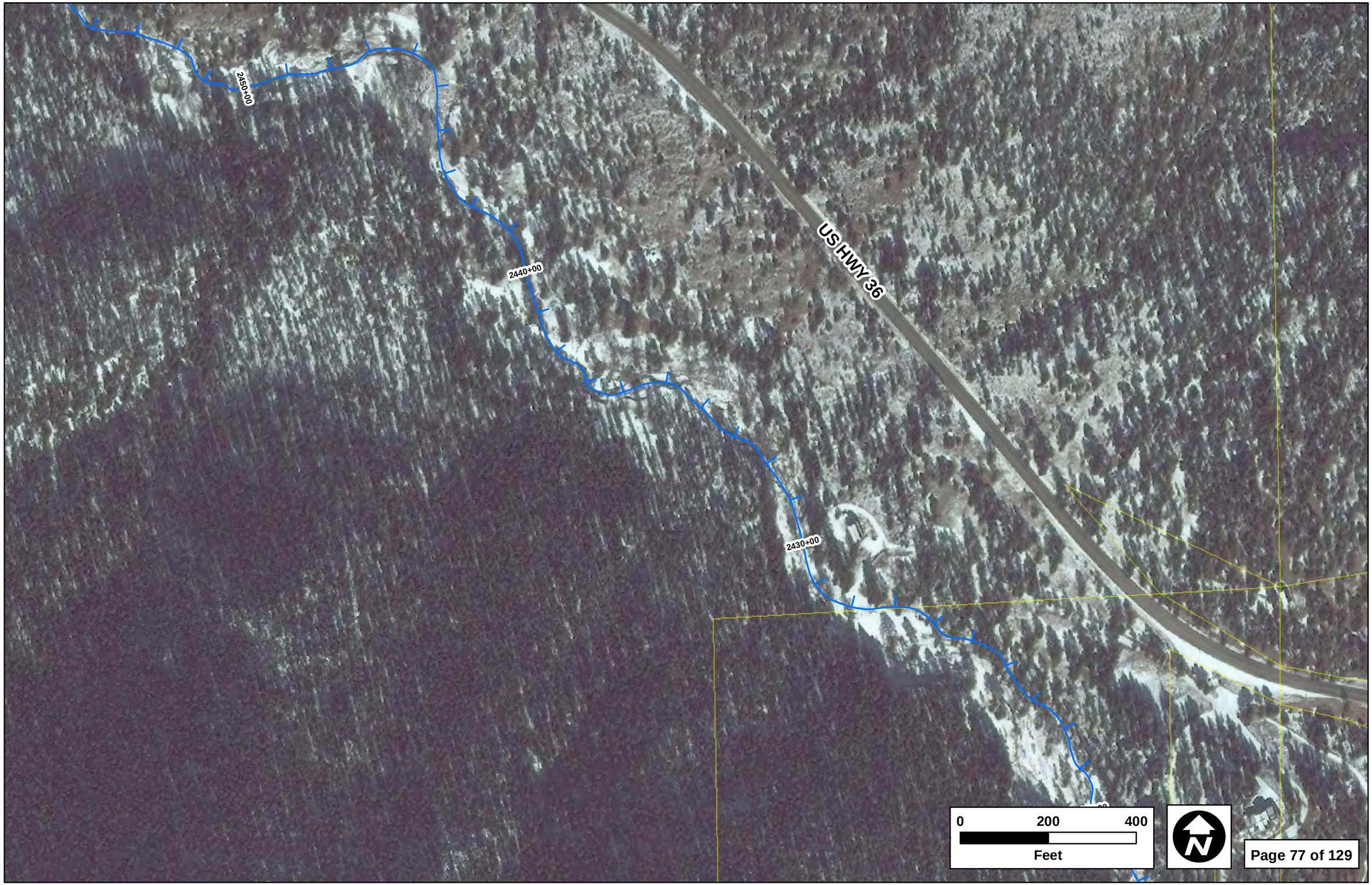
This portion of the Little Thompson River runs parallel to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses land owned privately and lands managed by the USFS. Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent) narrow, and canyon-bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at culvert crossings or where the floodplain had been encroached by anthropogenic activities.

Much of this reach is on property managed by USFS with some private land ownership. Neither the USFS nor private property owners have indicated any desire to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2450+00
2440+00
2430+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 78
STATION: 2454+00 to 2487+00

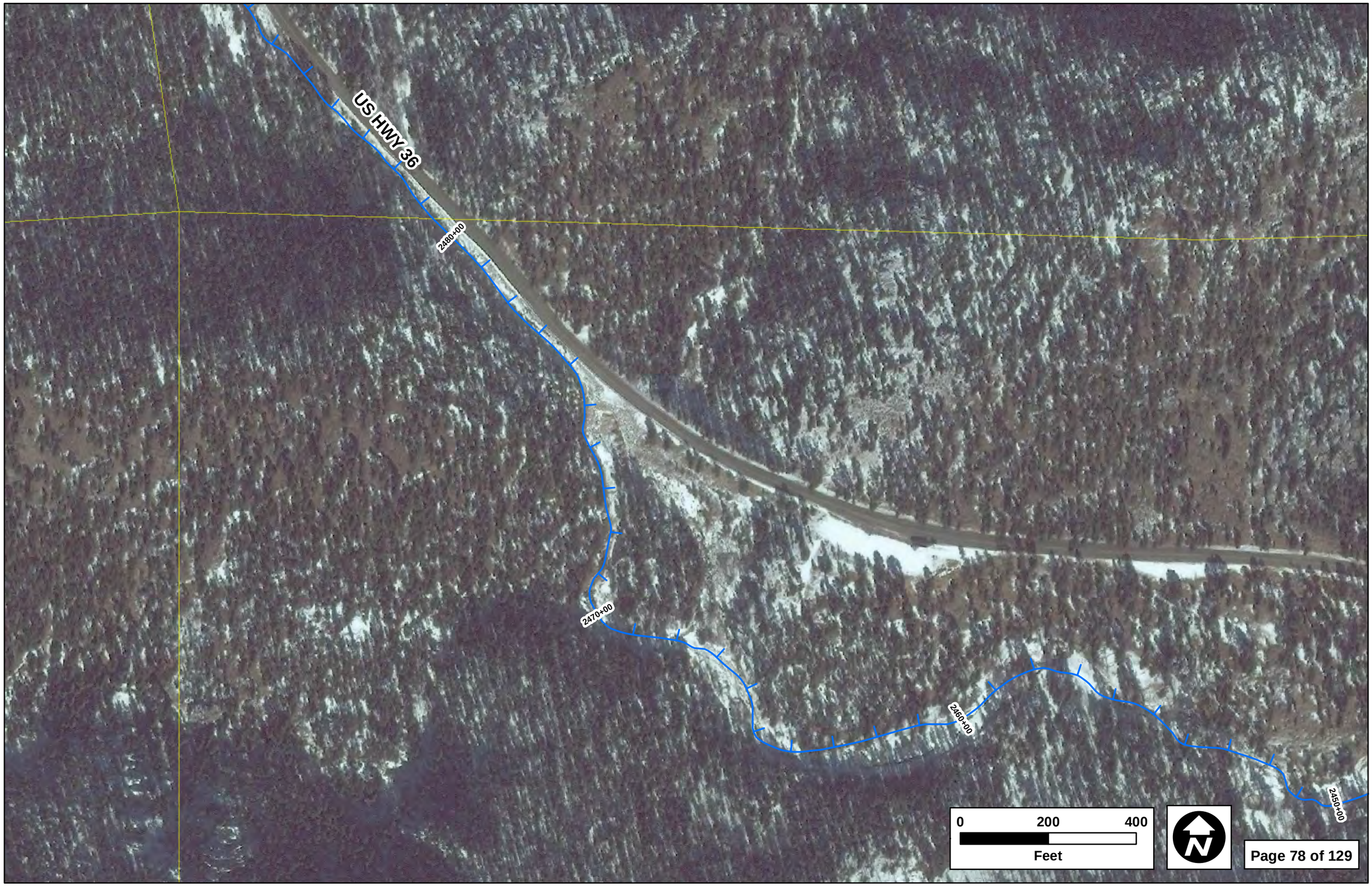
This portion of the Little Thompson River runs parallel to U.S. Highway 36, approximately 200 to 400 feet south-southwest until Sta 2475+00, after which the river returns to an alignment that is closer and adjacent to the highway. The river traverses land managed by the USFS. Lyons Gulch tributary confluences at approximately Sta 2470+00. The Lyons Gulch Trailhead is also in this reach. From Sta 2472+00 to Sta 2476+00, the channel drops an average of o4.4 percent with some sections nearly vertical.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of fir trees and willows, much of which were torn out during the flood. The river corridor is steep (in excess of 3 percent to almost vertical as described above) narrow, and canyon-bound, setting the sinuosity and river corridor alignment.

This reach sustained flood-related damage primarily due to large debris and boulders moving through the system and significant scour and loss of soils and vegetation. The most severe damage appeared to occur at the vertical portion of the river upstream of Lyons Gulch confluence where the floodplain had been encroached by the highway. Here the flood remove soil to bedrock, scoring what appeared to be significant depths. The USFS has not indicated any plans to restore or reconstruct this reach of the river.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


US HWY 36
2480+00
2470+00
2460+00
2450+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 79
STATION: 2487+00 to 2523+00

The river runs adjacent to U.S. Highway 36, approximately 100 to 400 feet south-southwest. The river traverses privately owned land and lands managed by the USFS. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 2 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood.

This reach sustained flood-related damage typically related to culvert crossings and at private residences. In addition there is some evidence of deposition upstream of a large bend at Sta 2510+80.
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RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


US HWY 36
2510+00
2520+00
2500+00
2490+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 80
STATION: 2523+00 to 2552+00

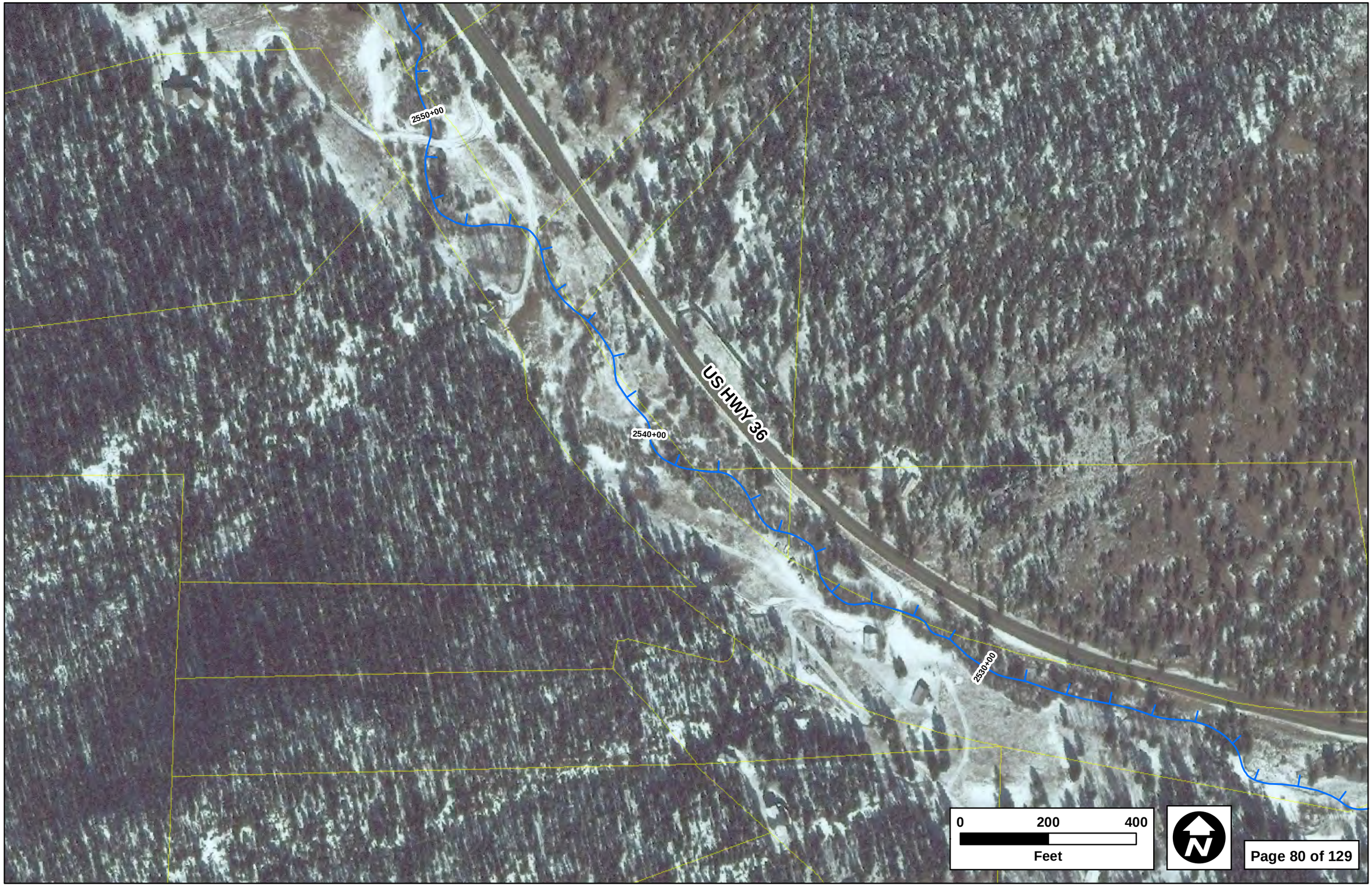
The river runs adjacent to U.S. Highway 36, approximately 100 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 2 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood.

This reach sustained very little flood-related damage typically related to culvert crossings and at private residences.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2550+00
US HWY 36
2540+00
2530+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 81
STATION: 2552+00 to 2574+00

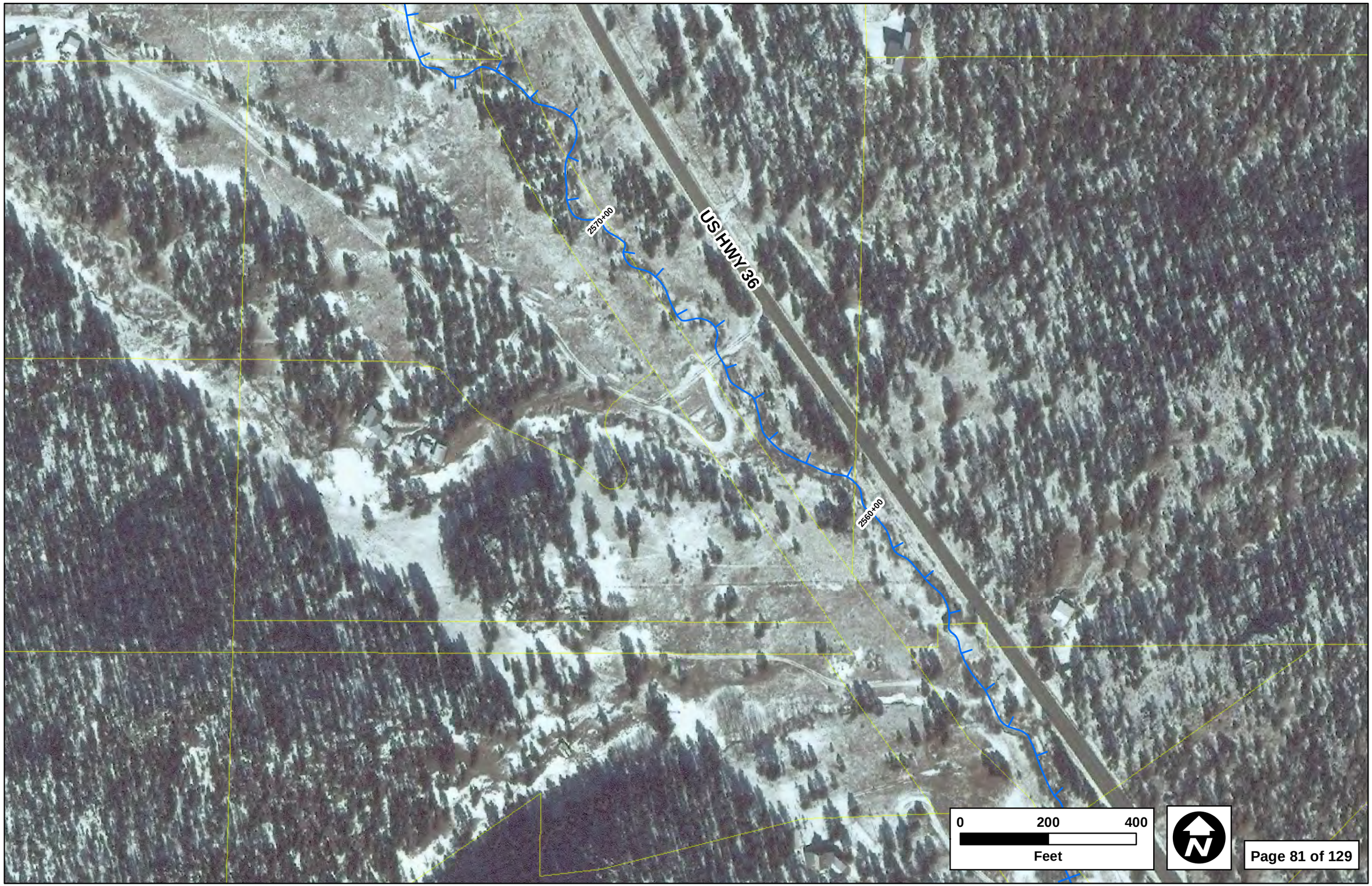
This is the headwaters of the Little Thompson. The river runs adjacent to U.S. Highway 36, approximately 50 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 2 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood.

This reach sustained very little flood-related damage typically related to culvert crossings and at private residences.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


US HWY 36
2570+00
2560+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 82
STATION: 2574+00 to 2597+00

This is the headwaters of the Little Thompson River. The river runs adjacent to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 2 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood. This reach sustained very little flood-related damage typically related to culvert crossings and at private residences.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2590+00
US HWY 36
2580+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 83
STATION: 2597+00 to 2617+00

This is the headwaters of the Little Thompson River. The river runs adjacent to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 3.1 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood. This reach sustained very little flood-related damage typically related to culvert crossings and at private residences.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


US HWY 36
2610+00
2600+00
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 84
STATION: 2617+00 to 2643+00

This is the headwaters of the Little Thompson River. The river runs adjacent to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 3.1 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of willows, much of which remains post-flood. This reach sustained very little flood-related damage.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2640+00
2630+00
2620+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 85
STATION: 2643+00 to 2669+00

This is the headwaters of the Little Thompson River. The river runs adjacent to U.S. Highway 36, approximately 200 to 400 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 3.1 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, typically less than 50 feet wide, comprised primarily of grassess, much of which remains post-flood. This reach sustained very little flood-related damage.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


2660+00
2650+00
US HWY 36
0
200
400
Feet

NEIGHBORHOOD: Headwaters
SHEET: 86
STATION: 2669+00 to 2698+00

This is the headwaters of the Little Thompson River. The river runs adjacent to U.S. Highway 36, approximately 200 feet south-southwest. The river traverses privately owned land. The river corridor is wider than the downstream sections, with less canyon and rock formations controlling the vertical and horizontal alignments. The average channel slope through this reach is 3.1 percent.

Aerial photos of pre-flood conditions and anecdotal information indicate this reach had a sparsely vegetated riparian corridor, comprised primarily of grasses, much of which remains post-flood. This reach sustained very little flood-related damage.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of cottonwood, willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


US HWY 36
2690+00
2680+00
2670+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 87
STATION: 30+00 to Big Elk Meadows (West Fork)

The West Fork runs immediately adjacent to County Road 47, crossing it 5 times in less than 2 miles. These crossing were all destroyed during the 2013 flood and field evidence indicates the road was likely overtopped, with the road and canyon walls conveying floodwater. Larimer County replaced the culverts shortly after the flood. The USFS has expressed an interest in replacing these with culverts of increased capacity and culverts that can provide connectivity for aquatic species. As of the fall of 2014 Larimer County, FEMA, the USFS and Central Federal Lands are working to repair the road and possibly replace the culverts. Since this work in not complete, the recommendations and costs for the recommended work remain a part of this Master Plan.

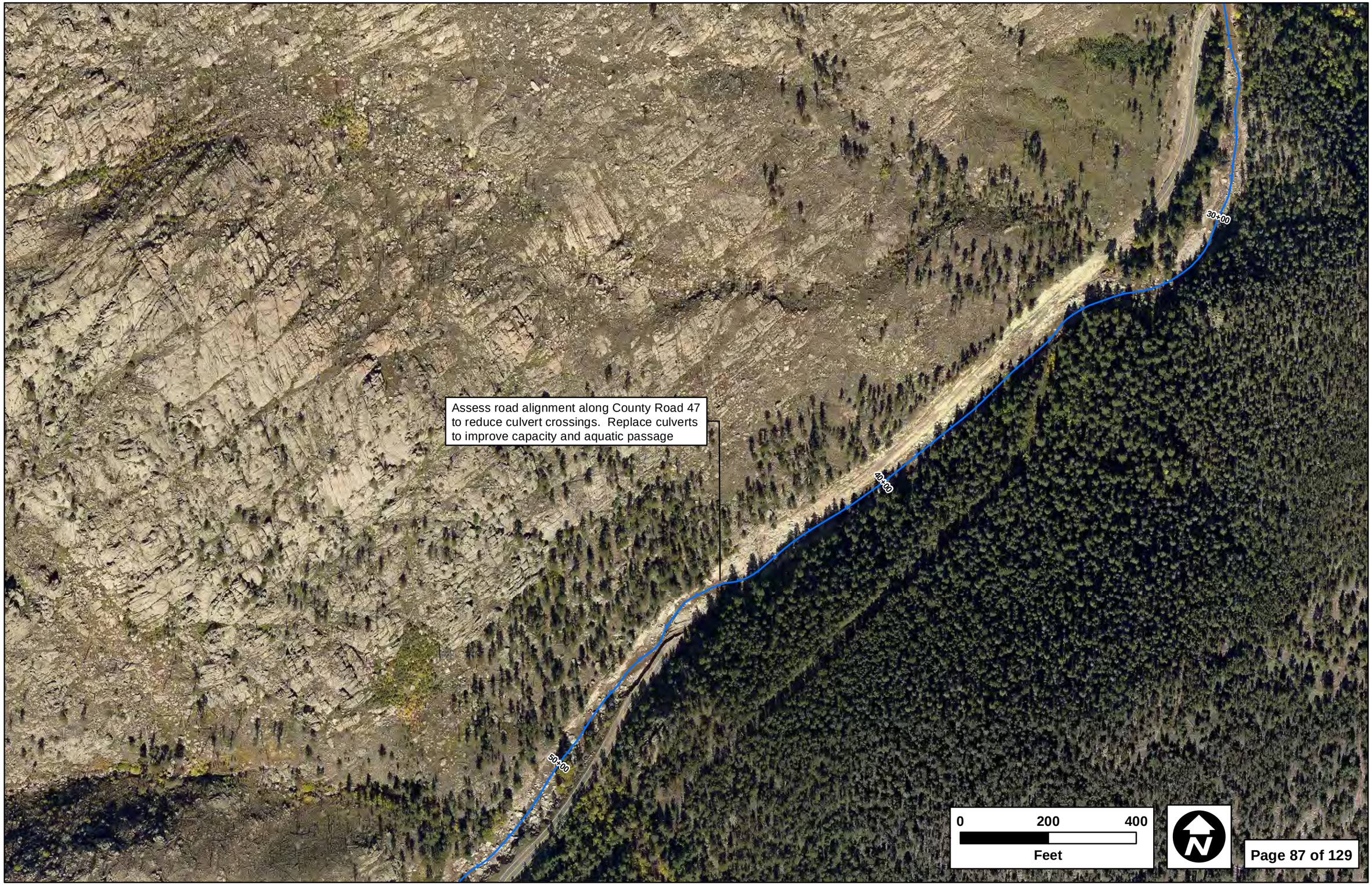
Field observations indicate that the channel size was insufficient for the flood event. As the event was estimated to be in excess of the 500-year flood, it is understandable the channel capacity was exceeded, however, a channel assessment for capacity as well as bank stability under design flood conditions may be warranted along with the implementation of site-specific improvements and culvert replacements noted above.

RESTORATION RECOMMENDATIONS

1. Larimer County, FEMA, the USFS and Central Federal Lands should coordinate with the LTWRC regarding the designs and decisions for evaluating County Road 47 along the West Fork including the assess for the potential to reduce the number of crossings.
2. Assess channel capacity and culvert capacities; design and replace crossings.
3. Improve channel capacity and stabilize banks where required.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	West Fk Sheets 87, 88, 89 and 90 Quantity	Cost
Mob/Demob	LS	$ 38,800	1	$ 38,800
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300		$ -
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	0	$ -
Temporary irrigation and weed management	LS	$ -	1	$ -
Culverts and road realignment	LS	$ 775,000	1	$ 775,000
SUBTOTAL				$ 813,800
Contingency, 15% of subtotal				$ 122,100
Permitting , 2.5% of subtotal				$ 20,300
Design, plans, specification, contract administration, 15%				$ 122,100
Supervision & Administration, 10%				$ 81,400
TOTAL				$ 1,160,000


Assess road alignment along County Road 47 to reduce culvert crossings. Replace culverts to improve capacity and aquatic passage
30+00
40+00
50+00
0
200
400
Feet

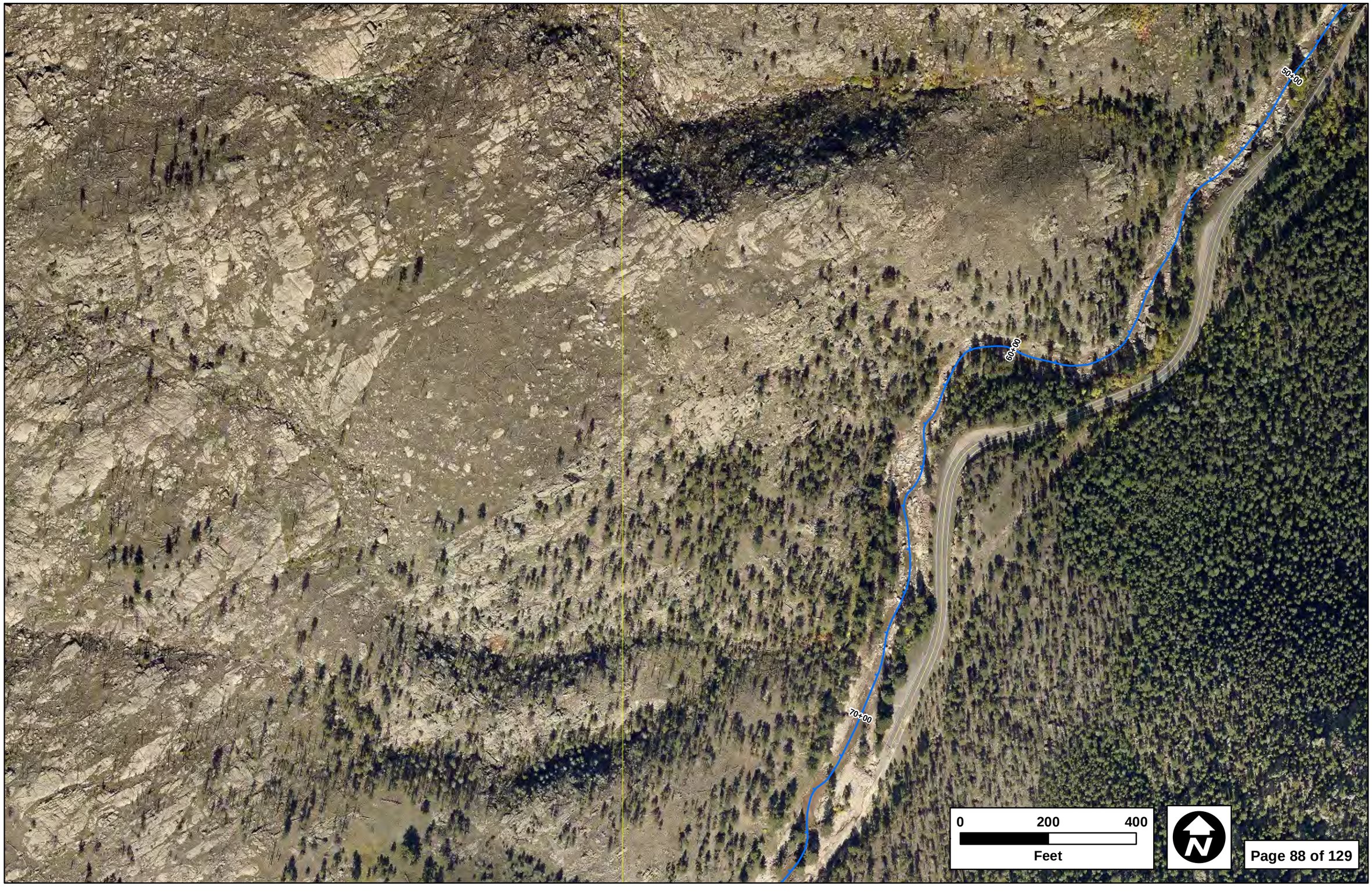
NEIGHBORHOOD: Pinewood Springs
SHEET: 88
STATION: West Fork below Big Elk Meadows

The West Fork runs immediately adjacent to County Road 47, crossing it 5 times in less than 2 miles. These crossing were all destroyed during the 2013 flood and field evidence indicates the road was likely overtopped, with the road and canyon walls conveying floodwater. Larimer County replaced the culverts shortly after the flood. The USFS has expressed an interest in replacing these with culverts of increased capacity and culverts that can provide connectivity for aquatic species. As of the fall of 2014 Larimer County, FEMA, the USFS and Central Federal Lands are working to repair the road and possibly replace the culverts. Since this work in not complete, the recommendations and costs for the recommended work remain a part of this Master Plan.

Field observations indicate that the channel size was insufficient for the flood event. As the event was estimated to be in excess of the 500-year flood, it is understandable the channel capacity was exceeded, however, a channel assessment for capacity as well as bank stability under design flood conditions may be warranted along with the implementation of site-specific improvements and culvert replacements noted above.

RESTORATION RECOMMENDATIONS

1. See recommendations on Sheet 87.


50+00
60+00
70+00
0
200
400
Feet

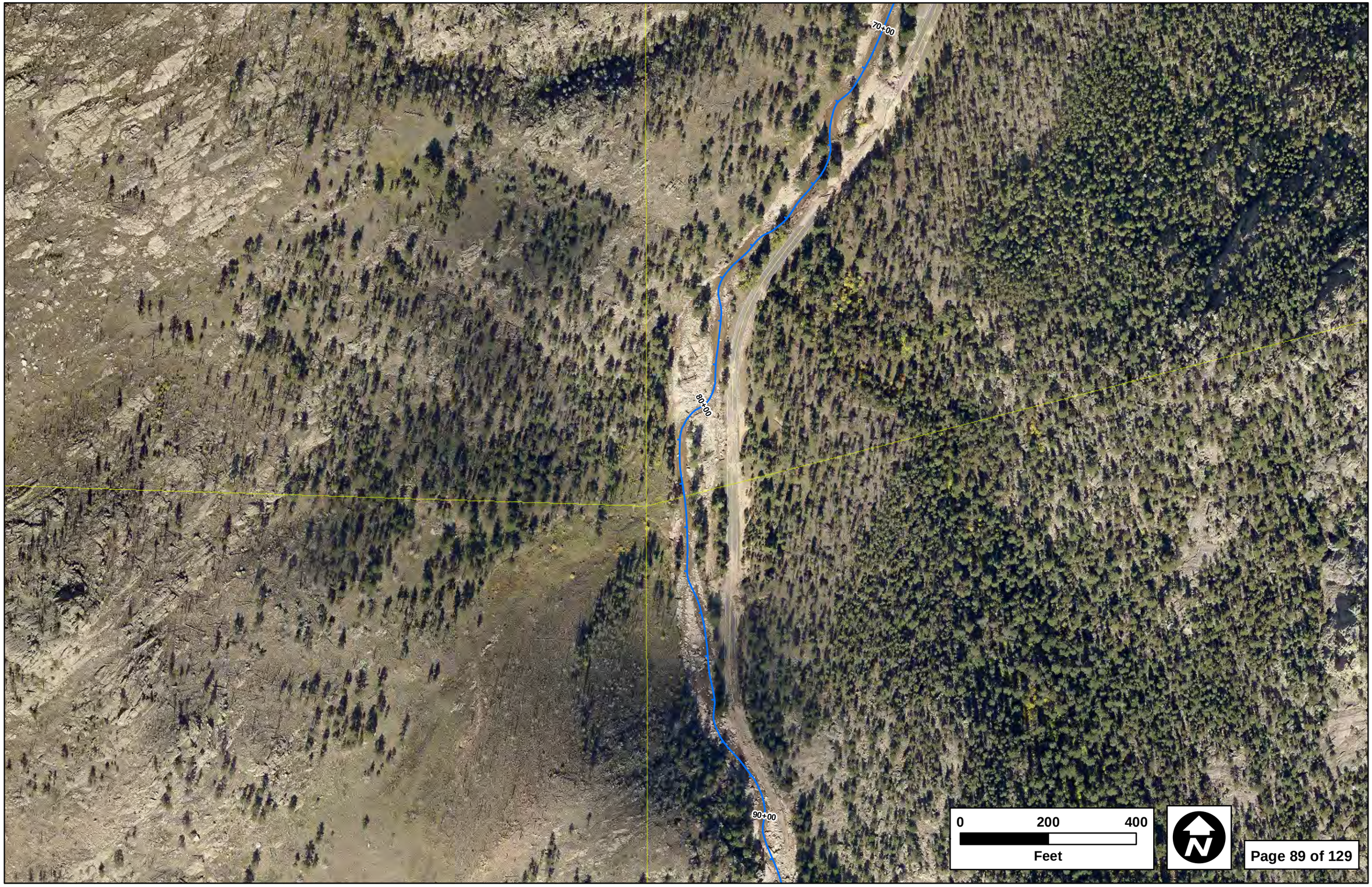
NEIGHBORHOOD: Big Elk Meadows
SHEET: 89
STATION: West Fork below Big Elk Meadows

The West Fork runs immediately adjacent to County Road 47, crossing it 5 times in less than 2 miles. These crossing were all destroyed during the 2013 flood and field evidence indicates the road was likely overtopped, with the road and canyon walls conveying floodwater. Larimer County replaced the culverts shortly after the flood. The USFS has expressed an interest in replacing these with culverts of increased capacity and culverts that can provide connectivity for aquatic species. As of the fall of 2014 Larimer County, FEMA, the USFS and Central Federal Lands are working to repair the road and possibly replace the culverts. Since this work in not complete, the recommendations and costs for the recommended work remain a part of this Master Plan.

Field observations indicate that the channel size was insufficient for the flood event. As the event was estimated to be in excess of the 500-year flood, it is understandable the channel capacity was exceeded, however, a channel assessment for capacity as well as bank stability under design flood conditions may be warranted along with the implementation of site-specific improvements and culvert replacements noted above.

RESTORATION RECOMMENDATIONS

1. See recommendations on Sheet 87.


70+00
80+00
90+00
0
200
400
Feet

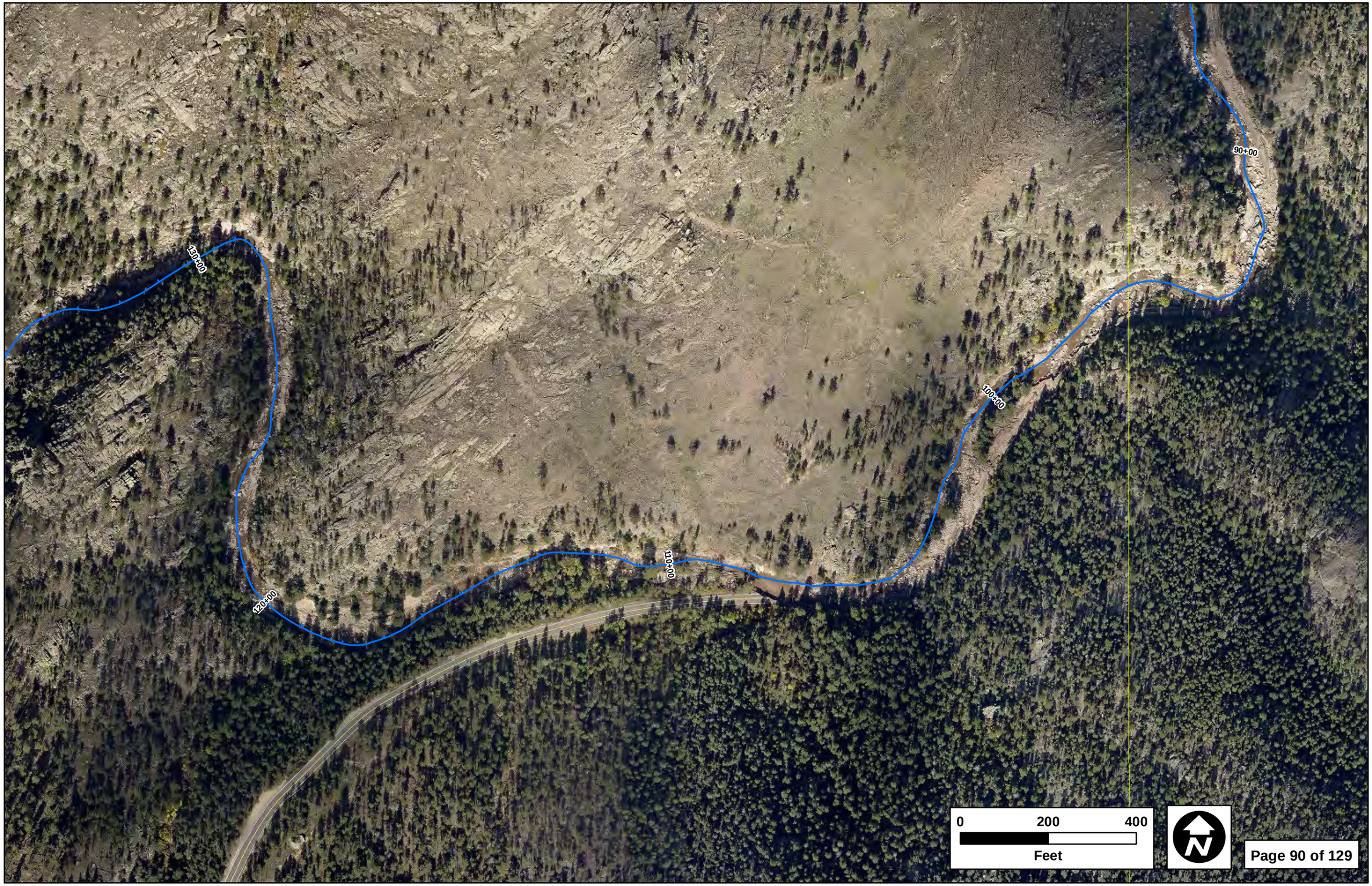
NEIGHBORHOOD: Pinewood Springs
SHEET: 90
STATION: West Fork below Big Elk Meadows

The West Fork runs immediately adjacent to County Road 47, crossing it 5 times in less than 2 miles. These crossing were all destroyed during the 2013 flood and field evidence indicates the road was likely overtopped, with the road and canyon walls conveying floodwater. Larimer County replaced the culverts shortly after the flood. The USFS has expressed an interest in replacing these with culverts of increased capacity and culverts that can provide connectivity for aquatic species. As of the fall of 2014 Larimer County, FEMA, the USFS and Central Federal Lands are working to repair the road and possibly replace the culverts. Since this work in not complete, the recommendations and costs for the recommended work remain a part of this Master Plan.

Field observations indicate that the channel size was insufficient for the flood event. As the event was estimated to be in excess of the 500-year flood, it is understandable the channel capacity was exceeded, however, a channel assessment for capacity as well as bank stability under design flood conditions may be warranted along with the implementation of site-specific improvements and culvert replacements noted above.

RESTORATION RECOMMENDATIONS

1. See recommendations on Sheet 87.

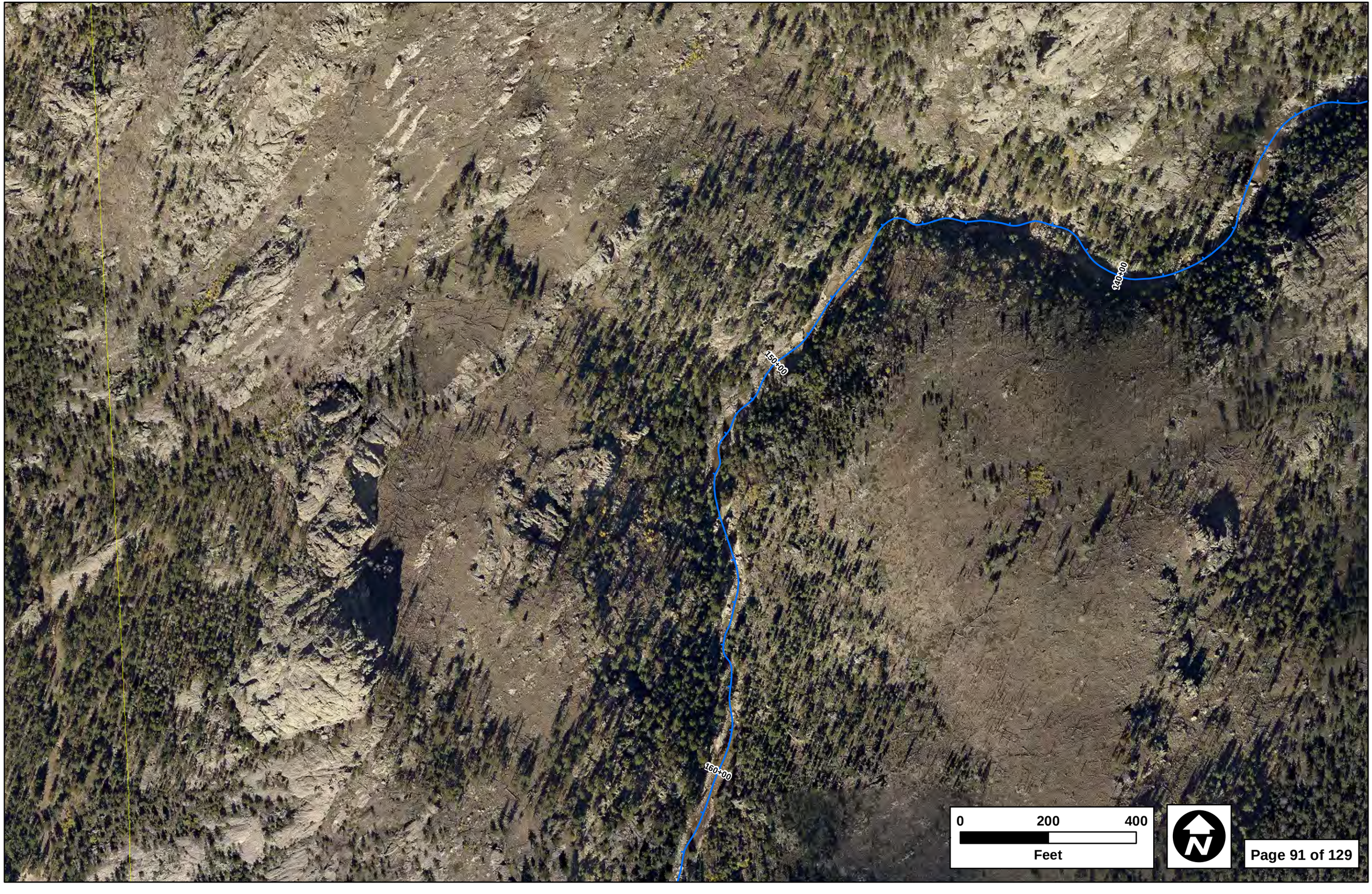

90+00
100+00
110+00
120+00
130+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 91
STATION: West Fork below Big Elk Meadows

The West Fork downstream of Big Elk Meadows is generally canyon bound with rock outcrop and walls. In portions of the reach with limited encroachment on the river corridor, the reach appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities outside of the County Road 47 corridor. Thus, no action is recommended outside of the river corridor.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


140+00
150+00
160+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 92
STATION: West Fork below Big Elk Meadows

The West Fork downstream of Big Elk Meadows is generally canyon bound with rock outcrop and walls. In portions of the reach with limited encroachment on the river corridor, the reach appears relatively stable and expected to recover without restoration activities.

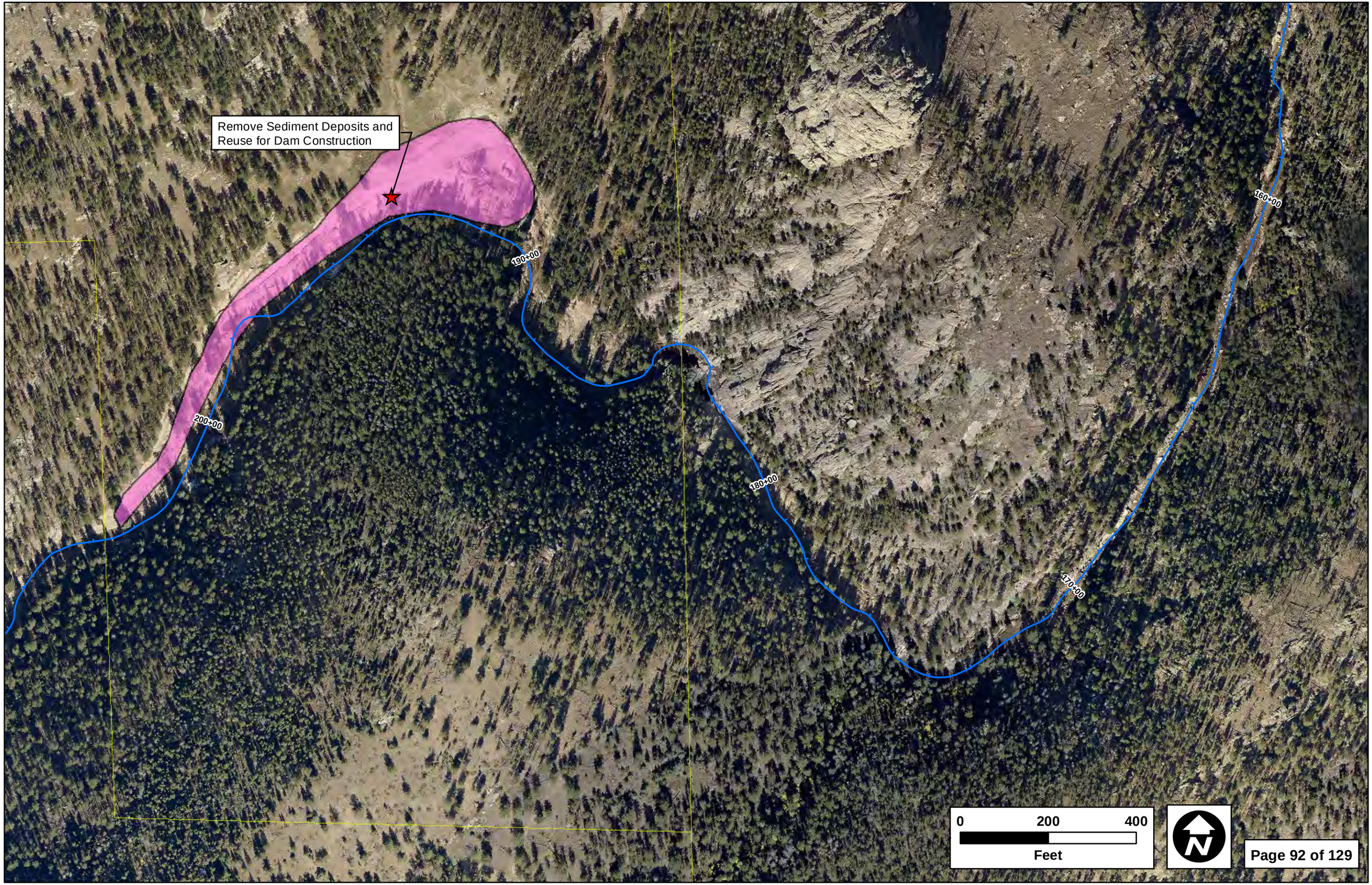
Immediately downstream of Big Elk Meadows, there are sediment and debris deposits from the dam failures. Most of this is located on USFS property. Some of these sediment deposits may be usable for the proposed dam reconstruction in Big Elk Meadows. Although the USFS prefers a 'natural' approach to recovery, the area immediately downstream of Meadow Lake (the most downstream dam) is unnaturally impacted by deposition due to the dam failures. Thus, some removal of deposits may be warranted in that it could help the recovery of vegetation and it also could provide some building material for the dams. The suitability of the material and ease of access for removal requires detailed evaluation prior to implementation.

RESTORATION RECOMMENDATIONS

1. Coordinate with the USFS and State Engineers office on suitability and ease of access for removal and reuse of sediment in the reconstruction of the Big Elk Meadows Dams.
2. Coordinate with Big Elk Meadows Association for removal and reuse of sediment in the reconstruction of the Big Elk Meadows Dams.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	West Fork Sheet 92 Quantity	West Fork Sheet 92 Cost
Mob/Demob	LS	$ 5,600	1	$ 5,600
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	3	$ 96,900
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	3	$ 15,000
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 117,500
Contingency, 15% of subtotal				$ 17,600
Permitting , 2.5% of subtotal				$ 2,900
Design, plans, specification, contract administration, 15%				$ 17,600
Supervision & Administration, 10%				$ 11,800
TOTAL				$ 167,000


Remove Sediment Deposits and Reuse for Dam Construction
200+00
190+00
180+00
170+00
160+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 93
STATION: West Fork below Big Elk Meadows

The West Fork downstream of Big Elk Meadows is generally canyon bound with rock outcrop and walls. In portions of the reach with limited encroachment on the river corridor, the reach appears relatively stable and expected to recover without restoration activities.

Immediately downstream of Big Elk Meadows, there are large sediment and debris deposits from the dam failures. Most of this is located on USFS property. Some of these sediment deposits may be usable for the proposed dam reconstruction in Big Elk Meadows. Although the USFS prefers a 'natural' approach to recovery, the area immediately downstream of Meadow Lake (the most downstream dam) is unnaturally impacted by deposition due to the dam failures. Thus some removal of deposits may be warranted in that it could help the recovery of vegetation and it also could provide some building material for the dams. The suitability of the material and ease of access for removal requires detailed evaluation prior to implementation.

Within the footprint of Big Elk Meadows, the West Fork was configured into five reservoirs spanning a distance of 1 mile. The dams are owned by the Big Elk Meadows Association and provide a water source for the residence of Big Elk Meadows. All five dams failed during the 2013 Flood. No restoration recommendations are proposed as the dams will likely be reconstructed.

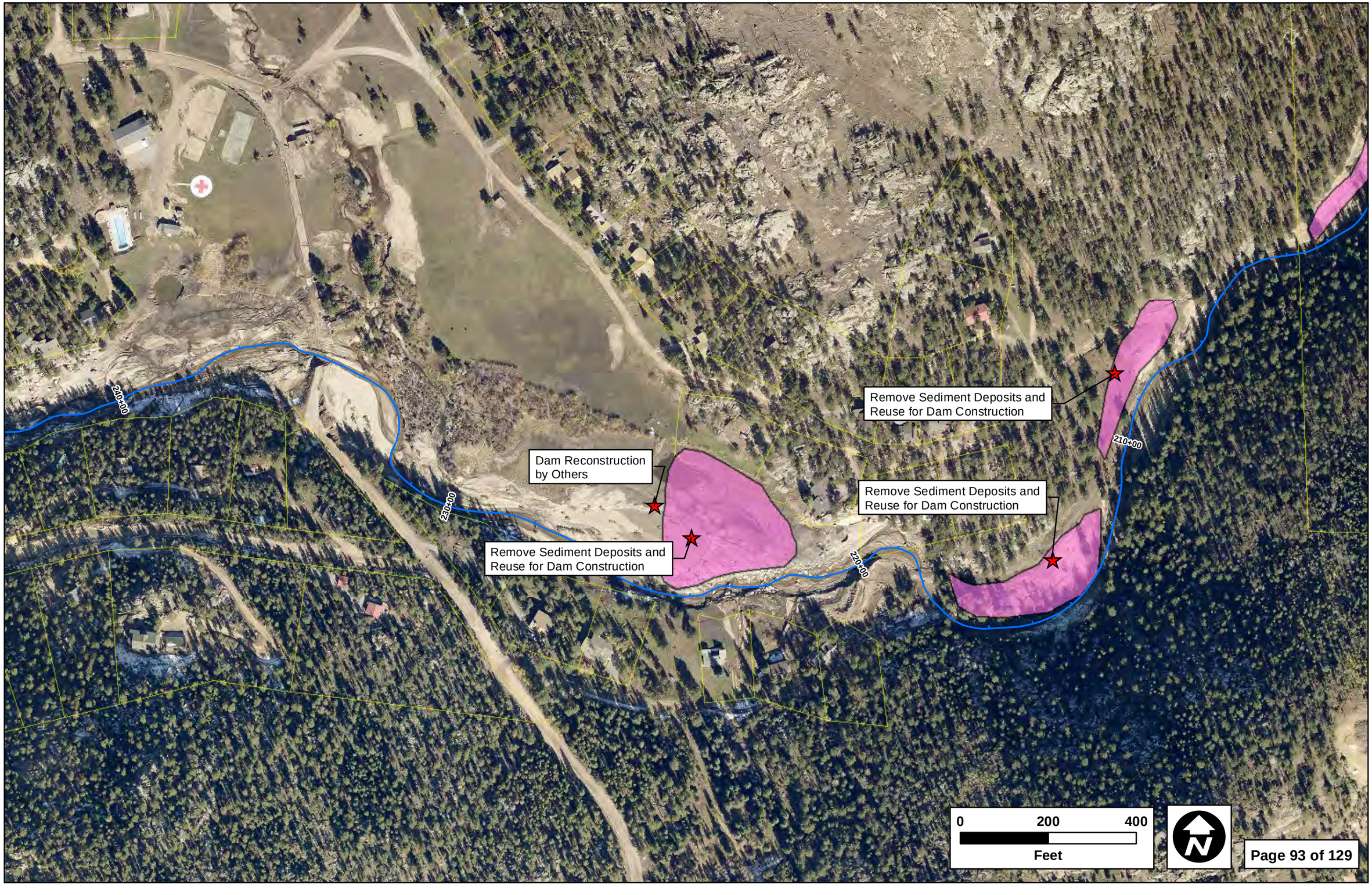
Deer Creek is tributary to the West Fork, immediately upstream of Meadow Lake. Field observations indicate Deer Creek received heavy flooding as evidenced by the multiple debris flows and buried vegetation. Most of Deer Creek, particularly upstream of Big Elk Meadows, has limited encroachment on the river corridor, appears relatively stable and is expected to recover without restoration activities. Within Big Elk Meadows, the Association has cleaned most of the debris is contemplating the replacement of a sixth smaller pond.

RESTORATION RECOMMENDATIONS

1. Coordinate with the USFS and State Engineers office on suitability and ease of access for removal and reuse of sediment in the reconstruction of the Big Elk Meadows Dams.
2. Coordinate with Big Elk Meadows Association for removal and reuse of sediment in the reconstruction of the Big Elk Meadows Dams.

OPINION OF PROBABLE COST

Item Description	Unit	Unit Price	West Fork Sheet 93 Quantity	West Fork Sheet 93 Cost
Mob/Demob	LS	$ 5,600	1	$ 5,600
Dewatering	LF	$ 14	0	$ -
Create/refine Low Flow Channel	LF	$ 27		$ -
Excavate, Grade Low Flow Channel (capacity)	LF	$ 48		$ -
Grade Control	EA	$ -		$ -
Grading	AC	$ 8,000		$ -
Floodplain Stabilization	AC	$ 8,100		$ -
Lowering and Grading	AC	$ 32,300	3	$ 96,900
Point Bar Creation	LF	$ 5	0	$ -
Bank Stabilization, Level 1	LF	$ 110		$ -
Bank Stabilization, Level 2	LF	$ 75		$ -
Bank Stabilization, Level 3	LF	$ 45		$ -
Land Reclamation Fill	AC	$ 20,200		$ -
Upper Bank Stablization, Level 1	LF	$ 25		$ -
Upper Bank Stablization, Level 2	LF	$ 15		$ -
Upper Bank Stablization, Level 3	LF	$ 5		$ -
Seeding	AC	$ 5,000	3	$ 15,000
Temporary irrigation and weed management	LS	$ -	1	$ -
Site Specific	LS	$ -		$ -
SUBTOTAL				$ 117,500
Contingency, 15% of subtotal				$ 17,600
Permitting , 2.5% of subtotal				$ 2,900
Design, plans, specification, contract administration, 15%				$ 17,600
Supervision & Administration, 10%				$ 11,800
TOTAL				$ 167,000

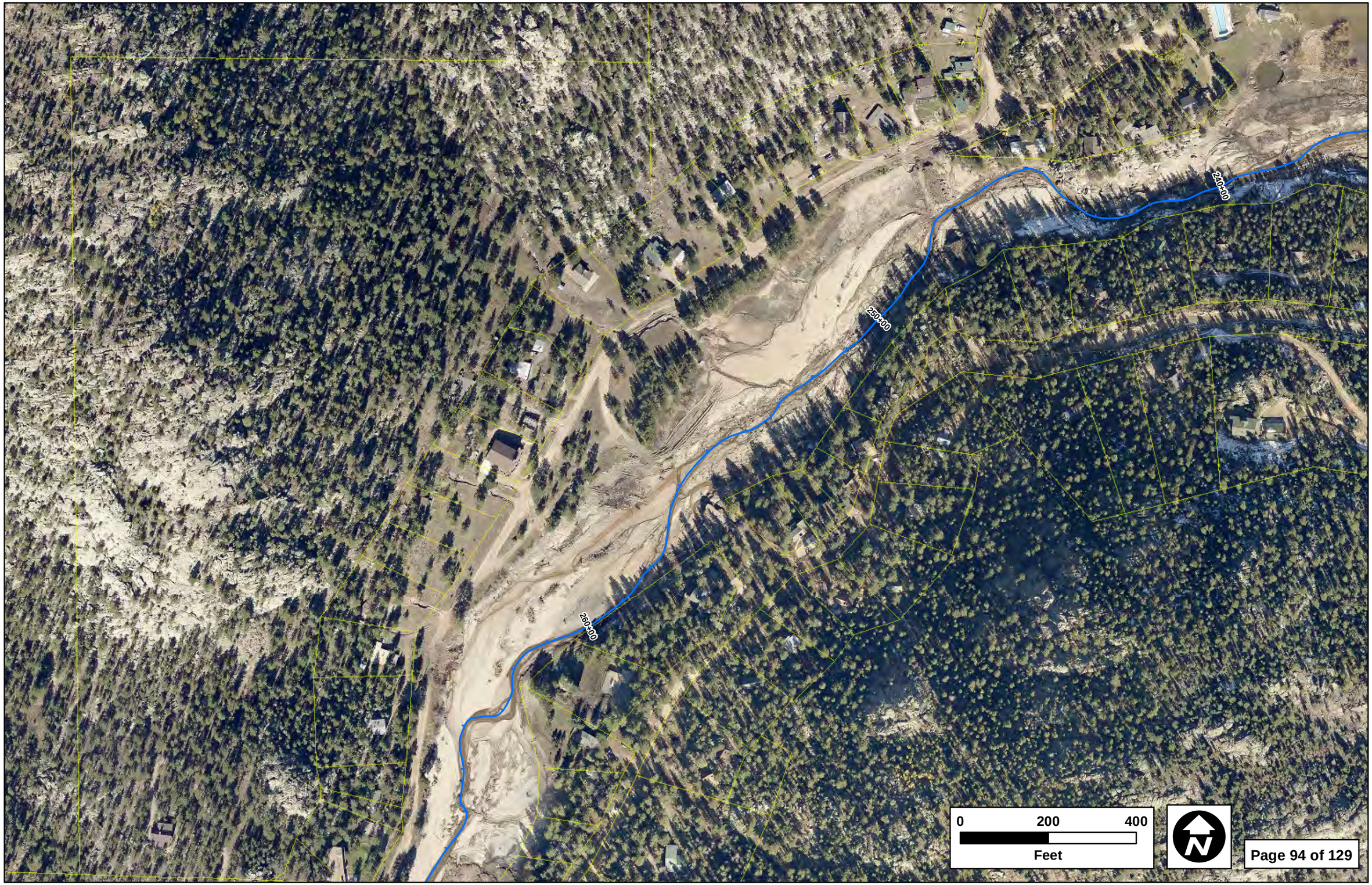

240+00
230+00
220+00
210+00
Dam Reconstruction by Others
Remove Sediment Deposits and Reuse for Dam Construction
Remove Sediment Deposits and Reuse for Dam Construction
Remove Sediment Deposits and Reuse for Dam Construction
0
200
400
Feet
N

NEIGHBORHOOD: Big Elk Meadows
SHEET: 94
STATION: West Fork at Big Elk Meadows

Within the footprint of Big Elk Meadows, the West Fork was configured into five reservoirs spanning a distance of 1 mile. The dams are owned by the Big Elk Meadows Association and provide a water source for the residence of Big Elk Meadows. All five dams failed during the 2013 Flood. No restoration recommendations are proposed as the dams will likely be reconstructed.

RESTORATION RECOMMENDATIONS

No restoration recommendations are proposed as the dams will likely be reconstructed by Big Elks Meadows Association.


240+00
250+00
260+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 95
STATION: West Fork at Big Elk Meadows

Within the footprint of Big Elk Meadows, the West Fork was configured into five reservoirs spanning a distance of 1 mile. The dams are owned by the Big Elk Meadows Association and provide a water source for the residence of Big Elk Meadows. All 5 dams failed during the 2013 Flood. No restoration recommendations are proposed as the dams will likely be reconstructed.

RESTORATION RECOMMENDATIONS

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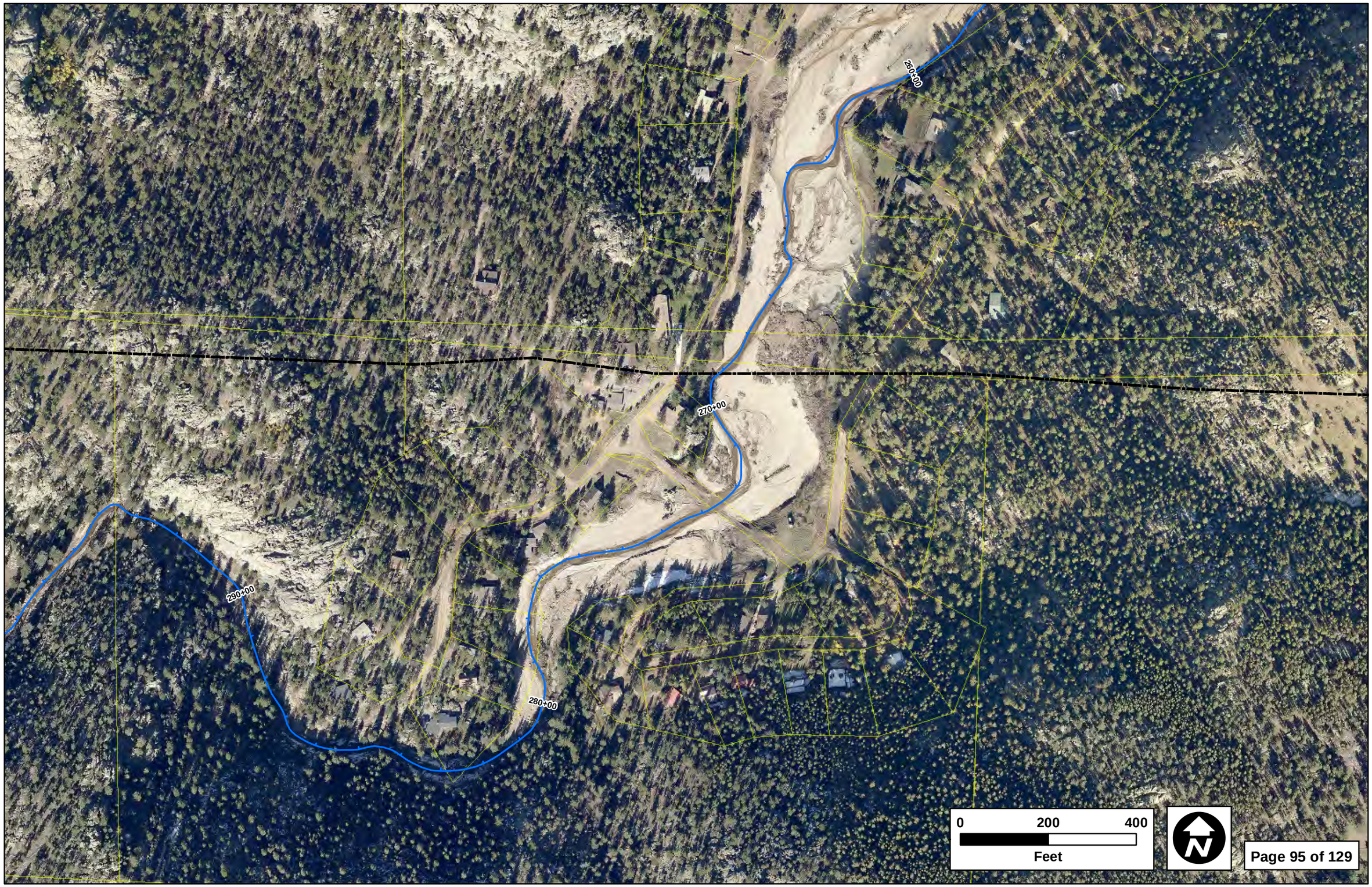
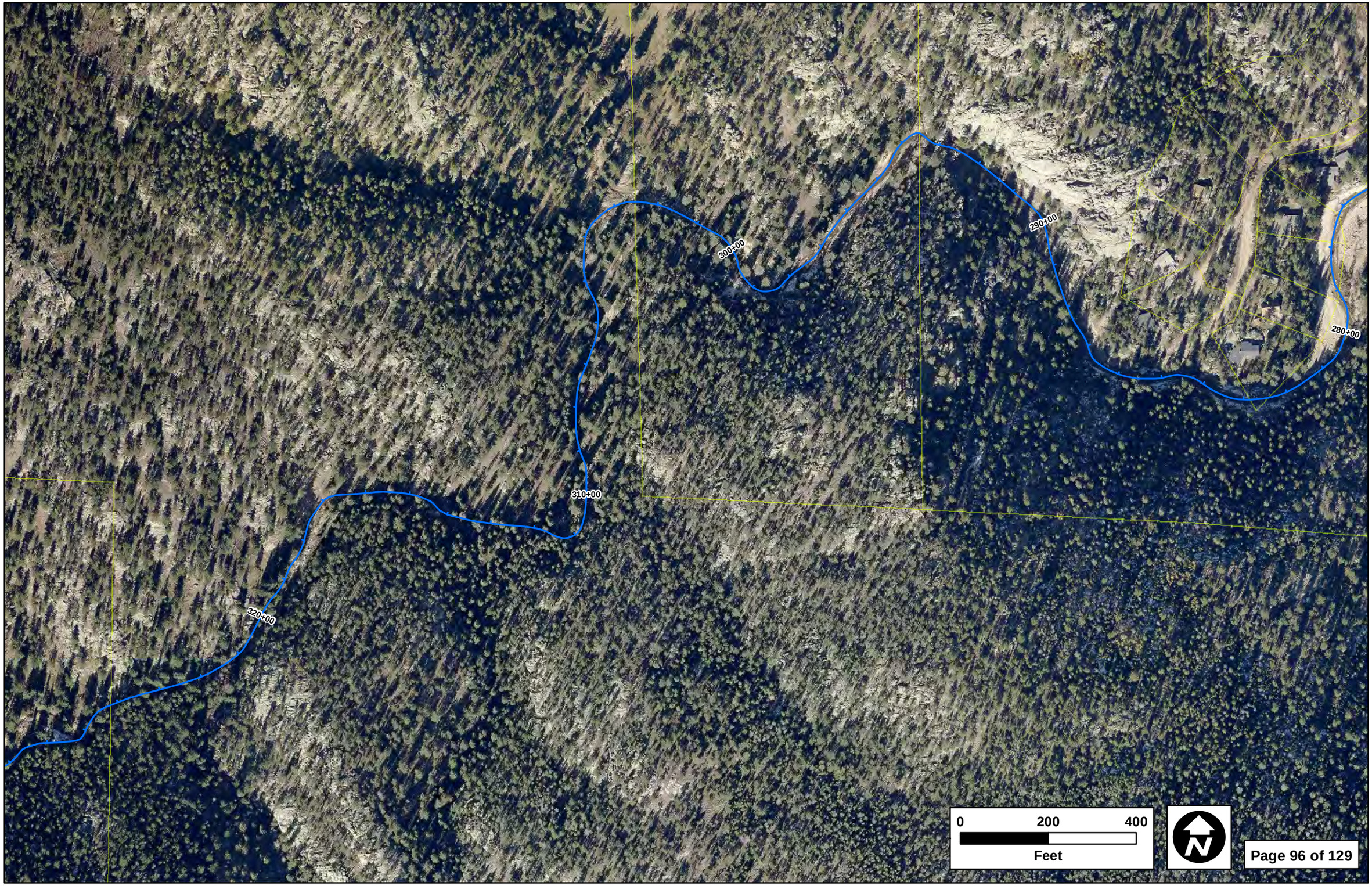

260+00
270+00
280+00
290+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 96
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


300+00
290+00
280+00
310+00
320+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 97
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

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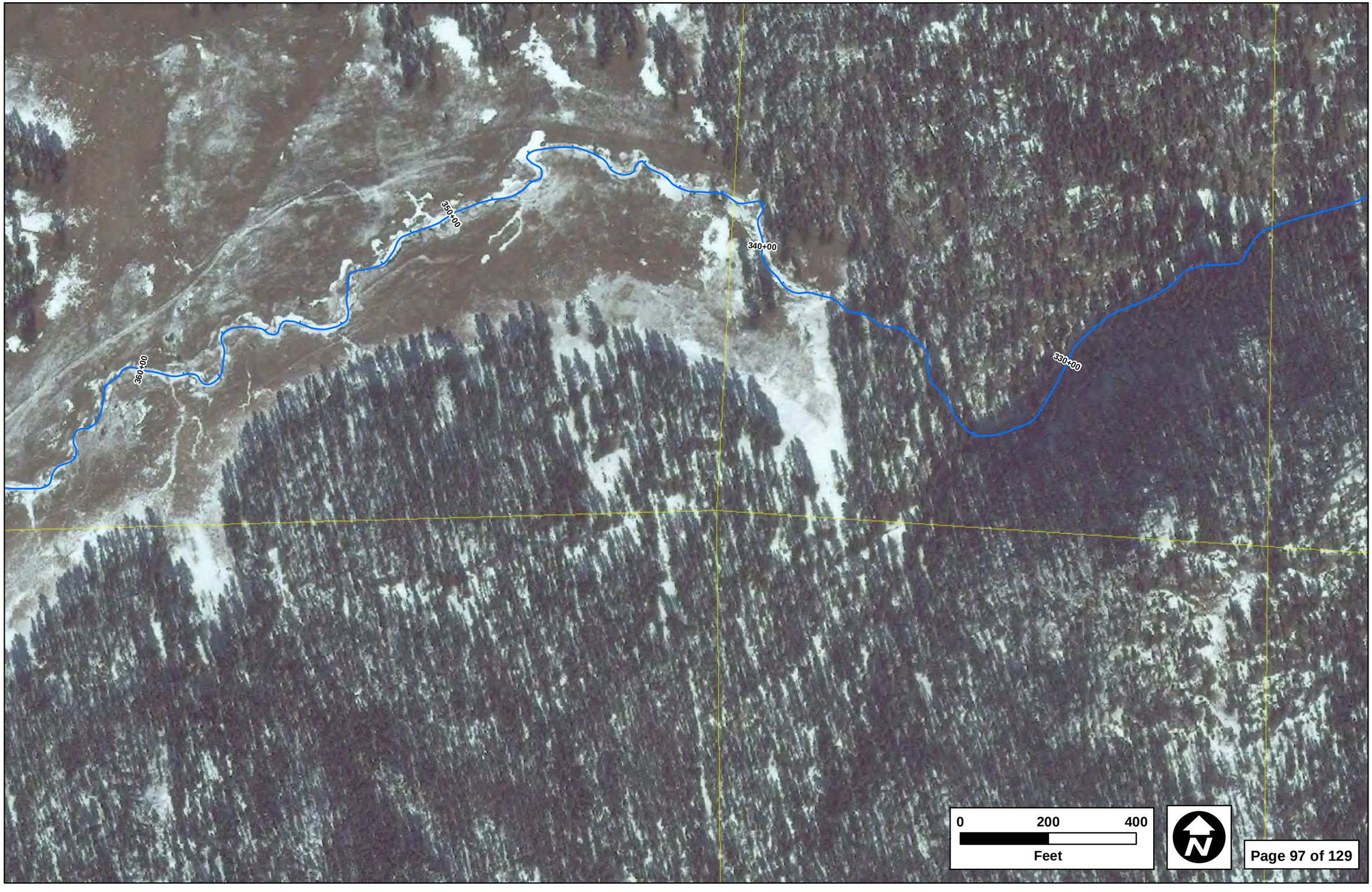
Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.

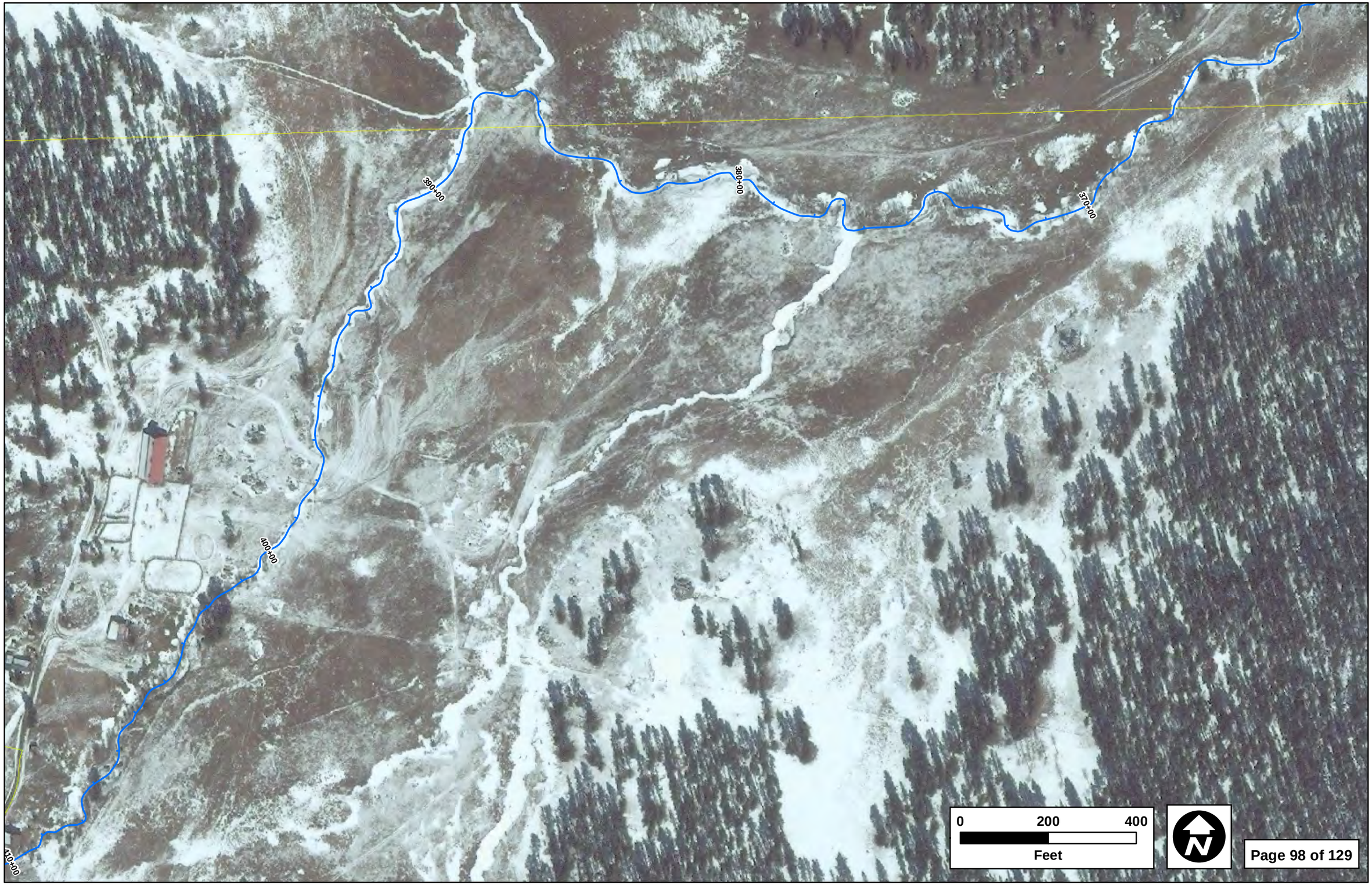

350+00
340+00
360+00
330+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 98
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon-bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


390+00
380+00
370+00
400+00
410+00
0
200
400
Feet

NEIGHBORHOOD: Big Elk Meadows
SHEET: 99
STATION: West Fork above Big Elk Meadows

The West Fork upstream of Big Elk Meadows is generally canyon-bound with rock outcrop and walls. This reach is isolated with very limited encroachment on the river corridor. Aerial images indicate a potential debris flow in the upper watershed that may have contributed to the deposition observed in the portions of the West Fork in and near Big Elk Meadows. However, the river appears relatively stable and expected to recover without restoration activities. The USFS has no plans for debris removal or restoration activities.

RESTORATION RECOMMENDATIONS

Geomorphic functions of this reach is likely sufficient to allow for the natural regeneration of willow, and other riparian species through seeding and cloning without active restoration. No further actions are suggested at this time.


440+00
430+00
420+00
410+00
0
200
400
Feet
N

APPENDIX D

RIPARIAN VEGETATION

RIPARIAN RE-VEGETATION

1.1 General Recommendations

For restoration from an ecological stand point revegetation should be performed using a mix of trees and shrubs, with grasses and forbs as appropriate for site conditions. Trees and shrubs should be planted within the riparian area to a depth that establishes a connection between the roots and the subsurface flows to/from the river (e.g., pole plantings at a depth to hit groundwater). This will reduce a need for irrigation and help their survival rate. Seeding should be done in the early spring to benefit from late winter snow and spring rains, or in late summer when temperatures drop and fall moisture increases. There is risk that the rainfall is not sufficient and irrigation would be beneficial.

The best restoration method should be based on conditions such as the severity of damage, slope, aspect, and soil type. Only native seed should be used for restoration projects in order to prevent the spread of invasive plant species. Several suggested seed mixes for various areas are provided in **Tables D-1** and **D-2** at the end of this appendix.

The type of desired vegetation should be considered before starting re-vegetation. For example, the desired vegetation is cottonwood and/or willow, or the desired vegetation is mostly varied low laying grasses and forbs. Generally, grasses and forbs are at the toe of the stream and cottonwood and willow are further up the bank.

1.2 Avoiding Weeds

It is important to realize that most invasive plant species (weeds) threatening restoration projects in Colorado easily invade established native plant communities, particularly following disturbance in the existing vegetation from such things as floods and fires. Weed management is an on-going process that can have varying results (Colorado Natural Areas Program 2000). Landowners should prioritize weeds that are already established, difficult to control, or have the greatest impact (Colorado Natural Areas Program 2000).

It is important when buying seed to ensure that there are no invasive species within the seed mix (Forest Service 2004). While many mixes say that they are weed free, there could still be some species of noxious weeds. A complete list of species listed as noxious weeds can be found at: http://www.colorado.gov/cs/Satellite/ag_Conservation/CBON/1251618874438.

Prevention of the spread of weeds is the easiest and most cost effective method of controlling weeds. If weeds are found in the restoration area, immediate removal/treatment will reduce the spread of seeds to surrounding areas. Hand pulling, digging, and spot herbicide treatments should be used to eradicate weeds before seeding to prevent spread (Forest Service 2004). Chemical or mechanical control can also be used to disrupt weed growth. These techniques should be used in conjunction with other treatments and only certain herbicide products should be used for week management prior to revegetation in order to minimize soil persistence, which can lower establishment rates of seeded vegetation.

The Colorado Weed Management Association publishes a field guide of noxious weeds including photos to help with identification. The guide can be purchased from CWMA at http://www.shop.cwma.org/. Also available is the Larimer County Week Management Guide and Weed District website www.larimer.org/weeds/.

1.3 Seeding

Time of Seeding

Seeding success is influenced by the temperature and precipitation at the time of seeding. Seeding should not be done while the ground is frozen. For cool season species (applies to grasses, such as wheatgrass), early spring and late fall usually have characteristics that support germination (CPW 1998). For warm season species (such as buffalo grass, blue grama, big and little blue stem), seeding in late spring or early summer is conducive to support germination. Warm season grasses should only be seeded in the upland areas not in the riparian areas.

Site Preparation

A well-prepared site is a critical step in a seeding restoration project. This step will prepare the soil for seeding. Soil may be too compacted (firm) or too loose. The soil should be firm enough that the seed is in contact with the soil and the soil will not be easily blown or washed away. Additionally, the soil should be loose enough for the sprout to penetrate the soil.

If the soil is too loose, actions should be taken to compact the soil to prevent erosion. If soil is too compacted, the topsoil should be ripped, chiseled, or broken up by raking the soil surface. Site preparation should be done across the slope to prevent soil erosion from surface water runoff.

Seeding generally works best when buried under 0.13 to 0.5 inch of soil (CPW 1998). Therefore, soil should be raked or otherwise prepared to create an enhanced location that seeds can fall into. Without seedbed preparation, seeds would be vulnerable to grazing by small mammals and birds.

Seeding

Broadcast seeding is the best method for most land owners, though site preparation is especially important (CPW 1998). During broadcast seeding, seed is distributed by hand or a handheld seed dispenser. This method can be used on slopes, somewhat rocky areas, and remote or inaccessible areas. The suggested seed mixes are recommended at a rate of 120 seeds per square foot (Big Thompson River Restoration Coalition 2014). After broadcasting the seed, cover the seed by immediately raking or using a similar technique. Raking and other soil-disturbing activities should be done across the slope to prevent soil erosion from surface water runoff. Drilling can also be used to seed and will typically have a higher success rate as compared to broadcasting, but it is labor intensive and more expensive than broadcasting.

Soil Amendments

The Colorado State University (CSU) Extension has had success without using fertilizer and suggests it may not always be necessary. CSU Extension and Pawnee Butte Seeding recommend using compost and manure versus traditional fertilizers. It is less costly and equally effective as traditional fertilizers. Use of manure and composts will improve water retention and potentially improve seeding success, however, these substances can have high salt content which can prevent water from entering the root of the plants. Additionally, these substances may contain weed seed so weeding practices should be utilized. If using fertilizer when seeding, an organic natural fertilizer is recommended such as Biosol. Commercial fertilizer isn't recommended until grass is mature.

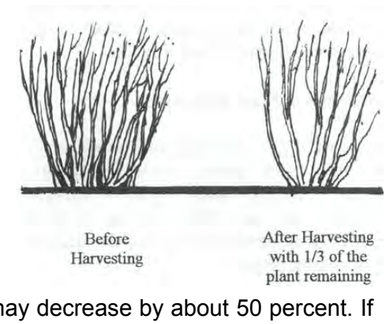
The use of soil amendments are recommended on sand bars in particular, although it is not necessary, is recommended given the loss of organics in these features.

Post Seeding Care

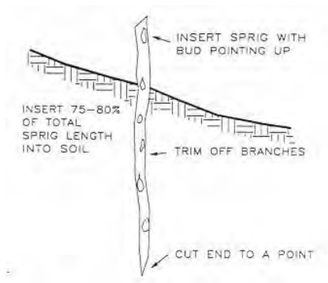
After seeding, many locations will benefit from placement of a protective cover, such as mulch. This will protect soil and seeds from wind and water erosion while conserving soil moisture. Mulches or hay can be used cover the ground completely and have sufficient durability to survive until the seeds germinate (CPW 1998). Care should be taken to avoid mulches and hay with seeds as this can introduce weeds into the restoration site. It is suggested that native woody debris left from the flood are used as mulch. Additionally, the restoration site should be monitored for weeds and actions should be taken to eradicate or control weeds if necessary.

1.4 Cottonwood and Willow Woodlands

Cottonwood and willow germinate on the bare sandbars formed by meandering streams. These are used extensively for revegetation on stream banks because they are easily established from stem cuttings. Stem cuttings and purchased container stock are both appropriate for most revegetation projects, though stem cuttings are more cost effective. Additionally, stem cuttings from cottonwood or willow stands near the restoration site have adapted to local conditions.



Establishment of cottonwoods and willows is most successful when cuttings are taken from dormant plants, meaning either after leaf fall in late fall, winter, or very early spring before budding. Cuttings may be harvested when plants are in full leaf, though the establishment rate may decrease by about 50 percent. If cuttings are taken during full leaf, consider planting more cuttings to compensate for the lower establishment rate.



Wood that is two years to seven years old with smooth bark is best for cutting. No more than one third of any individual plant should be used, and no more than 40 to 50 percent of a stand should be used (CPW 1998). Branches that would impair the source willows health should not be used, and cuttings from inside of the crown are preferred over the more obvious exterior area. Depending on the species, cuttings should be 0.75 inch diameter or larger. All side branches should be removed so the cutting is a single stem. Larger diameter cuttings have more energy and stored reserves than smaller cuttings. Larger diameter and longer cuttings should be used for more severely eroding sites and areas where the water table is deeper. When planting in rockier areas, cuttings should be at least three to five inches in diameter. Additionally, cutting length should be long enough to reach into the mid-summer water table and cuttings should extend two to three feet above the ground so it leafs out (Colorado Parks and Wildlife 1998). This will help reduce bank erosion.

Prior to planting, cuttings can be soaked for a minimum of 24 hours and as long as 14 days to improve root and shoot production (Colorado Parks and Wildlife 1998). During this time, the entire cutting should be covered with water. Soaking can occur anywhere water is deep enough to cover as long as cuttings are protected from sun and wind exposure.

When planting cuttings, identify the top of the cutting. The top of the cutting can be identified by looking at the emerging buds. These will point up and the stem is usually smaller in diameter near the top of the cutting. If the top of the cutting is misidentified establishment rate will greatly decreased. Plant cuttings should be planted approximately one to two feet apart for creeping species to maximize bank stabilization, and three to eight feet apart for cottonwoods (CPW 1998). Multiple stems may be planted together.

After planting, management of land should allow for long-term restoration, and the site should be monitored annually. Replanting in succeeding years may be necessary. Monitoring of the site is also necessary to remove any in-stream dead organic material that has accumulated at the restoration site. If livestock grazing occurs near the restoration site, proper management techniques should be developed to allow for further growth. These techniques may include fencing with water gaps to allow for access to the stream or reduced grazing near the stream.

Trees and shrubs such as cottonwood and willow can be established from seed. Seeds should be collected from parent plants in locations with several plants of the same species because cottonwood and willow species rely on cross pollination for reproduction (Gough 1996).

Cottonwood and willow seeds should be collected by hand in the spring. Broadcast seeding can be used to establish cottonwood and willow species. Cottonwood seed germination generally occurs within 24 hours on moist surfaces. Seeding will likely fail if the upper layer of soil dries within the first three weeks and remain vulnerable to drought in the first year following establishment (Oregon State Extension Service 2002). Once roots have established, cottonwood and willow become more resistant of flooding and drought.

1.5 Irrigation

One of the challenges the landowners will all be facing in the re-vegetation of the river corridor will be irrigating the revegetated lands particularly in the overbank sections. Although some property owners with areas designated for reseeding will have access to irrigation water, most will not. Where possible the use of temporary irrigation water should be considered. Although this is a highly regulated river system, there are periods of the year with no calls, or 'free water' during which it may be possible to use the flows for irrigation. There may also be opportunities for people to shift their water rights to the river corridor on a short term basis (legal hurdles may be required). The LTWRC may be able to help coordinate this effort.

1.6 Tree Seeding

Landowners can purchase tree seedlings through the Big Thompson Water Conservation District who offers low-cost trees & shrubs. Proceeds from this program will help support the Conservation District. Visit their website at www.bigthompson .org for order forms and prices. Landowners can also purchase tree seedlings through CSU Extension Survive and Colorado State Forest Service. Landowners need to fill out an Application for Seedlings form. The only requirement for tree seedling purchase is that the trees be used for conservation purposes, such as windbreaks, preventing erosion, or to enhance wildlife habitat. Trees purchased from CSU Extension Service offices are usually lower in price than trees from private nurseries, but are limited in quantity. CSU Extension Service publishes a tree buyer's guide and a species suitability guide for Colorado. A list of the local contacts for CSU Extension Service tree buying is listed in the **Suggested Vendors** below. **Wildlands Restoration Volunteers** may be able to help coordinate volunteer efforts for revegetation projects and assist with technical restoration questions (www.wlrv.org/).

1.7 Grazing Management

In general, grazing should be restricted from riparian areas using fencing. Often ranchers will construct fencing to move livestock to focal access points in the river. These access points usually have a low grade to minimize erosion and are devoid of much vegetation due to use. Traditionally salt cedar and Russian olive have been used to plant in areas occupied by livestock as the animals will not eat either plant. However, both are non-native invasive species that provide limited habitat and have relatively high evapotranspiration rates. These species are not recommended. Native riparian species, such as willows and cottonwoods, can tolerate south facing exposures and heat as long as their roots are able to access the water table. Cows will feed on young plants but once mature, most bushes will be resistant or able to survive mild grazing. Thus, young plantings should be fenced off from grazing until mature. Chokecherry and wild plums should be avoided because they contain low concentrations of cyanide. Other good references include the following:

- EPA Guide to Grazing in Riparian Areas.
- NRCS Chapter 5: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/?cid=stelprdb1045811).

Table D.1. Suggested Seed Mixes for Little Thompson River Re-Vegetation*

Foothills and Plains Reaches		
Common Name	Scientific Name	Percent of Mix
Blue grama	Chondrosum gracile	5
Canada wildrye	Elymus canadensis	6
bottlebrush squirreltail	Elymus elymoides	7
prairie sandreed	*Calamovilfa longifolia*	15
sand bluestem	*Andropogon hallii*	15
yellow indiangrass	*Sorghastrum nutans*	10
slender wheatgrass	*Elymus trachycaulus*	11
alkali sacaton	*Sporobolus airoides*	5
switchgrass	*Panicum virgatum*	8
western wheatgrass	*Pascopyrum smithii*	9
little bluestem	*Schizachyrium scoparium*	5
Triticale		4
Foothills and Plains Reaches		
Western yarrow	*Achillea lanulosa*	4
smooth blue aster	*Aster laevis*	4
fringed brome	*Bromus ciliatus*	9
blue grama	*Chondrosum gracile*	6
Canada wildrye	*Elymus canadensis*	10
bottlebrush squirreltail	*Elymus elymoides*	8
thickspike wheatgrass	*Elymus lanceolatus*	8
Slender Wheatgrass	*Elymus trachycaulus*	11
Arizona fescue	*Festuca arizonica*	7
prairie junegrass	*Koeleria macrantha*	7
Western wheatgrass	*Pascopyrum smithii*	7
little bluestem	*Schizachyrium scoparium*	7
green needlegrass	*Stipa viridula*	7
Triticale		5
Canyon Reach		
Western yarrow	*Achillea lanulosa*	4
Aster laevis	*smooth blue aster*	4
fringed brome	*Bromus ciliatus*	9
blue grama	*Chondrosum gracile*	6
Canada wildrye	*Elymus canadensis*	10
bottlebrush squirreltail	*Elymus elymoides*	8
thickspike wheatgrass	*Elymus lanceolatus*	8
slender wheatgrass	*Elymus trachycaulus*	11
Festuca arizonica	*Arizona fescue*	7
prairie junegrass	*Koeleria macrantha*	7
Western wheatgrass	*Pascopyrum smithii*	7
little bluestem	*Schizachyrium scoparium*	7
green needlegrass	*Stipa viridula*	7
Triticale		5

*Seed mixes compiled from Wildlands Restoration Volunteers, NRSI, and Big Thompson River Restoration Coalition 2014

Table D.2. Suggested Seed Mixes for Little Thompson River Re-Vegetation.
Seed mixes provided by Pawnee Buttes Seed Inc.

Common Name	*Scientific Name*	*% of Mix*	*Cool/Warm*	*Ht (ft)*
Blue Grama	*Bouteloua gracilis*	10	Warm	<2′
Sand Dropseed	*Sporobolus cryptandrus*	5	Warm	2-3′
Little Bluestem	*Schizachyrium scoparium*	15	Warm	1-4′
Sideoats Grama	*Bouteloua curtipendula*	15	Warm	1-3′
Big Bluestem	*Andropogon gerardii*	10	Warm	3-6′
Switchgrass	*Panicum virgatum*	25	Warm	2-4′
Western Wheatgrass	*Pascopyrum smithii*	15	Cool	1-3′
Sand Lovegrass	*Eragrostis tricodes*	5	Warm	1-3′

Percentages of species and/or species may change somewhat due to availability.

Seeding rate:
3.7-7.4 PLS lb / acre drilled
7.4-14.8 PLS lb / acre broadcast seeded
0.5 PLS lb/1000 sq. ft. for smaller areas

Notes on Pawnee Buttes Seed Inc, Flood Recovery Mix

Blue Grama is one of the most widely distributed of all native grasses. It is very drought tolerant and works well in areas with good drainage. This warm season, perennial grass is an open sod forming short grass.

Sand Dropseed is widely distributed throughout the United States. It occurs naturally on sandy open sites and is drought tolerant. This native, warm season, perennial bunch grass establishes quickly.

Little Bluestem grows on thins soil, steeps slopes, and does very well on gravel and sand. It is a primary species of midwestern prairies. Little Bluestem is a native, warm season, long-lived, perennial bunchgrass.

Sideoats Grama grows on thins soil, steeps slopes, and does very well on gravel and sand. It is native to U.S. and widely distributed eastward from Rocky Mountains. Sideoats Grama is a warm season, bunchy sod forming grass.

Big Bluestem is native to most areas east of the Rocky Mountains and a primary species of tall grass prairies. This tall, long-lived, warm season, bunchy sod former grows well in a variety of situations.

1.8 Suggested Vendors

Pawnee Buttes Seed Co.
PO Box 100
Greeley, CO 80632
800-782-5947
www.pawneebuttesseed.com

Western Native Seed
PO Box 188
Coaldale 81222
719-942-3935
www.westernnativeseed.com

Southwest Seed
13260 County Road 29
Dolores, CO 81323
800-543-1279

Sharp Brothers Seed Co.
104 East 4th Street Rd.
Greeley, CO 80631
970-356-4710
www.sharpseed.com

Arkansas Valley Seed Co.
4625 Colorado Blvd.
Denver, CO 80216
877-957-3337
peck@avseeds.com

Applewood Seed Co
5380 Vivian St.
Arvada, CO 80002
303-431-7333
www.applewoodseed.com

The Tree Farm
11868 Mineral Rd
Longmont, CO 80504
303-652-2961
www.thetreefarm.com

Loveland Garden Center & Nursery
1801 S Lincoln Ave
Loveland, CO 80537
970-669-3577
www.lovelandgardencenter.com

Creekside Tree Nursery
3283 61st St
Boulder, CO 80301
303-668-7647
www.creeksideboulder.com

CSU Extension Tree Seedings

Boulder County Residents

Longmont Conservation District http://www.longmontcd.org/
Boyd Byelich
9595 Nelson Road Suite D
Longmont, CO 80501
303-776-4034

Larimer Count Residents

CSFS Nursery http://csfs.colostate.edu/pages/seedling-tree-nursery.html
5060 Campus Delivery Building 1060
Fort Collins, CO 80524
Big Thompson Conservation District http://www.bigthompson.org/
PO Box 441
Berthoud, CO 80513
970-667-1052
Fort Collins Conservation District http://www.ftcollinscd.org/
1415 N. College Avenue#3
Fort Collins, CO 80524
970-221-0611

Weld County Residents

West Adams Conservation District
57 West Bromley Ln
Brighton, CO 80601
303-637-8157

West Greely Conservation District http://www.wgcd.org/
4302 W 9th St Rd
Greeley, CO 80634
970-356-8097

APPENDIX E

PERMITTING

1. PERMITTING

The purpose of requiring permits for development in the floodplain is to ensure all construction complies with federal, state, and local requirements specified in current codes, standards, flood ordinances and recommended construction techniques to help prevent damage in future flood events. If your property is located in a Federal Emergency Management Agency (FEMA) floodplain and you have a federally-backed mortgage loan, you are required by your lending institution to purchase flood insurance. Flood insurance is generally expensive or unavailable through private-sector insurance companies therefore the federal government has created the National Flood Insurance Program (NFIP) which is under the jurisdiction of FEMA, to provide property owners with flood insurance at subsidized rates. Participating communities must meet or exceed state and federal floodplain management regulations to remain in the NFIP.

In addition to the minimum standards set by the federal government through the NFIP, Colorado has adopted higher floodplain standards, which apply to all Colorado communities regardless of their participation status in the NFIP. The Colorado Water Conservation Board (CWCB) formally adopted higher standards that apply throughout the state under the 2010 Rules and Regulations for Regulatory Floodplains in Colorado.

Permitting processes, requirements and standards that guide development in the floodplain vary from jurisdiction to jurisdiction. Some communities have adopted ordinances that enforce more stringent standards than the minimums specified by FEMA and CWCB, while others have developed additional permits to help streamline relief efforts. The following narrative highlights common permits and certificates that may be required when (re)building in the floodplain, as well as a table that outlines local agency contact information for related permits. Permitting requirements vary according to the work being performed, therefore contact your local jurisdiction prior to commencing work or purchasing any materials for a complete list of requirements that are specific to your project.

2. LOCAL PERMITS

Building Permit

In general, building permits are required if the work involves:

1. Structural repairs
2. Repairs to your electrical, mechanical (heating, cooling, HVAC) or plumbing system
3. Replacement of siding or re-roofs
4. New and replacement of bridges
5. Replacement of windows of the same size
6. Replacement of drywall

Most permits will likely require some type of planning process as well as building and grading permits, Applicant are strongly encouraged to meet with the planning staff in the County or municipalities where the work will be performed. Improvements related to restoration will require some or all of the following permits.

Electrical Permit

If electrical work is being conducted, an electrical permit is required. The process by which one has to go to obtain an electrical permit varies by jurisdiction. See table below on how to obtain an electrical permit within your jurisdiction.

Temporary and Emergency Building/Repair Permit

Emergency Building Permits are granted when immediate action is necessary to protect public health, safety, welfare, property and the environment. They are not intended to make a structure habitable, and are not considered permanent permits. They are limited to the minimum work necessary to prevent an imminent unsafe condition that my harm the environment or threaten people or property. These permits are issued in Boulder and Larimer Counties; Weld County does not issue emergency building permits. Temporary permits are issued in Boulder County for such work as emergency stabilization.

Floodplain Development Permit

If you are located within or near a floodplain, you may need a Floodplain Development Permit in addition to a Building Permit. This permit must be obtained before construction commences and may require stamped drawings by a professional engineer. As part of the permit there may be associated requirements, such as drawings or reports created by a professional engineer, floodproofing certificates, and elevation certificates, and other related planning processes. Minor work or routine maintenance to homes, stores and other buildings may be exempt from obtaining a Floodplain Development Permit. Contact your local jurisdiction to see if you require a Floodplain Development Permit. Work performed that may require a Floodplain Development Permit includes:

1. New construction
2. Modifications , improvements, and repairs to homes, stores and other buildings
3. Excavation, filling and paving
4. Drilling, driving of piles, mining and dredging
5. Land clearing and grading
6. Permanent storage of materials and/or equipment
7. New and replacement of culverts measuring 30" in diameter

1041 Permit

A 1041 permit from Larimer, Weld or Boulder County may be required for the purposes of identifying, designating, and regulating areas and activities of state interest through their local permitting process. This would typically apply to larger projects covering multiple reaches.

Septic

Prior to applying for a building permit, your septic system must be evaluated and approved by the Health Department. Based on state and county laws, all septic system repairs require repair permits. These permits need to be accompanied with a percolation test/ soil analysis with original stamp and signature from a registered professional engineer or geologist. Construction or repair of septic systems located in the floodplain require a floodplain development permit.

Temporary and Emergency Building Permit

Emergency Building Permits are granted when immediate action is necessary to protect public health, safety, welfare, property and the environment. They are not intended to make a structure habitable, and are not considered permanent permits. They are limited to the minimum work necessary to prevent an imminent unsafe condition that my harm the environment or threaten people or property. These permits are issued in Boulder and Larimer Counties; Weld County does not issue emergency building permits. Temporary permits are issued in Boulder County for such work as emergency stabilization.

Boulder County

Boulder County permits for flood-related work is summarized below. This information is available from the Boulder County Flood Rebuilding & Permit Information Center (FRPIC).

- *For minor flood repairs and restoration* - A Flood Recovery, Restoration and Repair Permit is available for flood repairs and restoration of flood-damaged (not destroyed or severely damaged) buildings to pre-flood configuration. Eligible flood-damaged components include replacement of drywall and insulation, doors, windows, siding, roof recovering, replacement of furnaces, boilers, water heaters, electrical wiring and equipment, gas piping, and plumbing.
- *To repair or rebuild private roads, driveways, culverts and bridges* - Residents, who need to repair or rebuild private roads or driveways to public roads, including culvert replacement and temporary waterway crossings, need to obtain a Flood Recovery Access Permit. Property owners who have repaired or rebuilt accesses to properties without a Flood Recovery Access Permit are encouraged to contact/come into the FRPIC.
- *For work in the floodplain* - Most work, including earthwork, in a floodplain requires a Floodplain Development Permit. Property owners who have moved earth or made repairs to a structure in a floodplain, or property owners who are considering these types of projects are encouraged to contact/come into the FRPIC for assistance.
- *Residents who did work during or after the flood event* - Boulder County recognizes that during a flood or other emergency and times of imminent danger property owners may decide to do what they determine is necessary to protect their property. An emergency does not remove the property owner's responsibility to obtain necessary permits following the immediate emergency situation. Please come in/contact the FRPIC to identify how to bring your property into compliance.
- *To rebuild or repair severely damaged or destroyed structures*, a Hazard Mitigation Review (HMR) is required. This includes structures impacted by flooding, debris flows, mudslides, slope instability, drainage channel shifts, drainage system impairments or failures, or other hazards. Hazard Mitigation Review will help property owners evaluate and design safer, more resilient redevelopment which takes into account probable hazards. To apply for Hazard Mitigation Review, contact the FRPIC.

See also:

http://www.bouldercounty.org/doc/landuse/b73temporaryemergencypermit.pdf

http://www.bouldercounty.org/flood/property/pages/hmr.aspx

http://www.bouldercounty.org/flood/property/pages/rebuilding.aspx

- *Stormwater Quality Management Permit*-Property owners that are located in Boulder County will need a Stormwater Quality Management Permit for construction related activities to control (reduce) stormwater-conveyed pollutants. This may be achieved through the installation of temporary and permanent stormwater runoff controls and best management practices (BMPs) to prevent the deterioration of water quality related to stormwater discharges from construction sites and activities. Monitoring and maintenance of the BMPs will be required. The County Engineer administers and enforces the provisions of the stormwater permit and should be consulted during the initial design phases of any projects to identify the specific permit requirements. In general permit requirements can be summarized as follows and as outlined in Boulder County Land Use Code Article 7-904.:

  - Permits are required for construction activity that disturbs one acre or more, or if the disturbed area is adjacent to a watercourse or wetlands.
  - Some land uses may be exempt, as determined by the County Engineer.
  - An application and plans are required for the permit.
  - All BMPs shall comply with the Urban Drainage and Flood Control District's Urban Storm Drainage Criteria Manual, Volume 3-Best Management Practices, the Colorado Department of Transportation Erosion Control and Stormwater Quality Guide or other similar document with proven effective methodologies.
  - A fee will be required.
  - The County will have up to 30 days to take action on the permit application.

Contact information

Contact information for local permitting requirements is provided in Table E1.

Table E1. Local Permits and Contacts.

Larimer County Building Permit (2 Locations)	Contact
Unincorporated	Fort Collins Office Larimer County Building Department 200 W. Oak Street, Third Floor P.O. Box 1190 Fort Collins, CO 80522-1190 (970) 498-7700 (office) (970) 498-7667 (fax)
Unincorporated	Estes Park Office Larimer County Building Department 1601 Brodie Avenue Estes Park, CO 80517 (970) 577-2100 (office) (970) 577-2102 (fax)
Loveland	City of Loveland Building Division 500 E. 3rd Street, Suite 110 Loveland, CO 80537 (970) 962-2505 BldDiv@CityofLoveland.org www.ci.loveland.co.us
Estes Park	Estes Park Building Safety Department 170 MacGregor Avenue Estes Park, CO 80517 (970) 577-3726 building@estes.org
Electrical Permit	
Unincorporated and Incorporated	State Electrical Board 1560 Broadway, Suite 1350 Denver, CO 80202 (303) 894-2300 – Phone (303) 894-2310 - Fax DORA_ElectricalBoard@state.co.us
Estes Park Area Only	855-451-9790 or 303-894-2980
Emergency Repair Permit	
Unincorporated/ Loveland	Larimer County Building Department 970.498.7699
Estes Park	Floodplain Manager 970.577.3721

Table E1. Local Permits and Contacts.	
Floodplain Development Permit	
Unincorporated	Larimer County Engineering Department 970.498.5700
Loveland	City of Loveland Building Division (970) 962-2505
Estes Park	Estes Park Building Safety Department (970) 577-3726
Septic Permit	
Unincorporated and Incorporated	Department of Health and Environment 970.498.6775
Boulder County	**Contact**
Building Permit	
Unincorporated	Boulder County Building Department 303.441.3925
Electrical Permit	
Unincorporated	Boulder County Building Safety and Inspection Services Team 303.441.3925
Emergency Repair Permit	
Unincorporated	Boulder County Building Safety and Inspection Services Team 303.441.3925
Floodplain Development Permit	
Unincorporated	Boulder County Floodplain Administrator 303.441.3900 floodplainadmin@bouldercounty.org
Flood Recovery Access Permit	
Unincorporated	Boulder County 303.441.4581
Flood Recovery, Restoration and Repair Permit Form	
Unincorporated	Boulder County Land use 303.441.3900 floodplainadmin@bouldercounty.org
Septic Permit	
Unincorporated	Boulder County Public Health, Environmental Health Division 303.441.1190
Weld County	**Contact**
Building Permit	
Unincorporated	Weld County Department of Planning Services 970.353.6100
Johnstown	Johnstown Building Department 970.587.4664
Milliken	Milliken Building and Planning Department 970.660.5046
Berthoud	Berthoud Town Hall 970.532.0640
Electrical Permit	
Unincorporated	Weld County Department of Planning Services 970.353.6100

Table E1. Local Permits and Contacts.	
Johnstown	Johnstown Building Department 970.587.4664
Milliken	Milliken Building and Planning Department 970.660.5046
Berthoud	Berthoud Town Hall 970.532.0640
Floodplain Development Permit	
Unincorporated	Weld County Department of Planning Services 970.353.6100
Johnstown	Johnstown Building Department 970.587.4664
Milliken	Milliken Building and Planning Department 970.660.5046
Berthoud	Berthoud Town Hall 970.532.0640
Septic Permit	
Unincorporated/ Incorporated	Environmental Health Department 970.304.6415

3. STATE PERMITS

Construction Stormwater Permit (Section 401)

Water-quality regulation for construction footprints over one (1) acre is overseen by the Colorado Department of Public Health and Environment CDPHE. Activities would require a permit for Stormwater management for protection of water quality under Section 401 Certification. The State Section 401 Certification and the federal Section 404 Permit could be integrated as these regulations are related.

4. FEDERAL PERMITS/ CERTIFICATES

Some restoration/ construction activities may require federal certificates or permits. **Contact your local jurisdiction prior to commencing work to obtain a complete list of permitting requirements that are specific to your project needs.**

FEMA Elevation Certificate

Elevation Certificates are used to ensure compliance with community floodplain management ordinances, support FEMA Letter of Map Amendment or Revision applications, and determine insurance premium rates. This certificate is often required in association with floodplain development permits and requires a professional surveyor or engineer to complete the application process. Permits that include an elevation certificate can provide a permanent record of compliance with elevation and/or retrofitting requirements, which is useful information for flood insurance ratings, and when selling your home. Elevation certificates can be downloaded at the following website: http://www.fema.gov/media-library-data/20130726-1437-20490-0725/f_053_elevcertif_30nov12_fillable.pdf

FEMA No-Rise Certificate

No-Rise Certificates are required for projects in the floodway to determine if the project will increase flood heights. For most projects, stamped drawings and analyses from a professional engineer are required with the application. For more information, see:

http://www.fema.gov/floodplain-management/no-rise-certification-floodways

FEMA Floodproofing Certificate

Documentation of certification by a registered professional engineer or architect that the design and methods of construction of a non-residential building are in accordance with accepted practices for meeting the floodproofing requirements in the community's floodplain management ordinance. Floodproofing of residential buildings is not allowed under the NFIP in any communities in Colorado. This documentation is required for both floodplain management requirements and insurance rating purposes for floodproofed non-residential buildings. FEMA Floodproofing certificates can be downloaded at the following website:

Non-residential Floodproofing Certificate: https://s3-us-gov-west-1.amazonaws.com/dam-production/uploads/1406304445858-0888f8ef5a3bd55ff1815962caa9a12c/F-056_Floodproofing_NonRes_Jul12.pdf

United States Army Corps of Engineers (USACE) Section 404 Permit

A Section 404 Permit is required if work performed involves the discharge of dredged or fill material into the nation's navigable waters, including wetlands. Upon applying you must demonstrate steps have been taken to avoid impacts to wetlands, streams and other aquatic resources; that potential impacts have been minimized; and that compensation will be provided for all remaining unavoidable impacts. Permits could be sought on a site by site (or project by project) basis, some of which may be adequately covered by a Nationwide (NWP) or Regional Permit. Nationwide and Regional permits are often used for smaller projects and include limits on the amount of disturbance or fill being requested.

On average, individual permit decisions (standard permits and letters of permission) are made within 2 to 6 months and require a public review process. Often the public review process can extend the decision time period. Individual permits are more complex and time intensive to prepare but provide flexibility compared to the NWP or Regional Permits since they do not need to conform to pre-set conditions. Individual permits are typically good for 5 years and require follow-up monitoring. Individual permits will also 'trigger' the need for a 401 water quality permit from the State of Colorado Department of Public Health and Environment. Information on current Nationwide permits follow. To initiate the process and obtain a permit visit:

http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/ObtainaPermit.aspx

For more information contact:

US Army Corps of Engineers

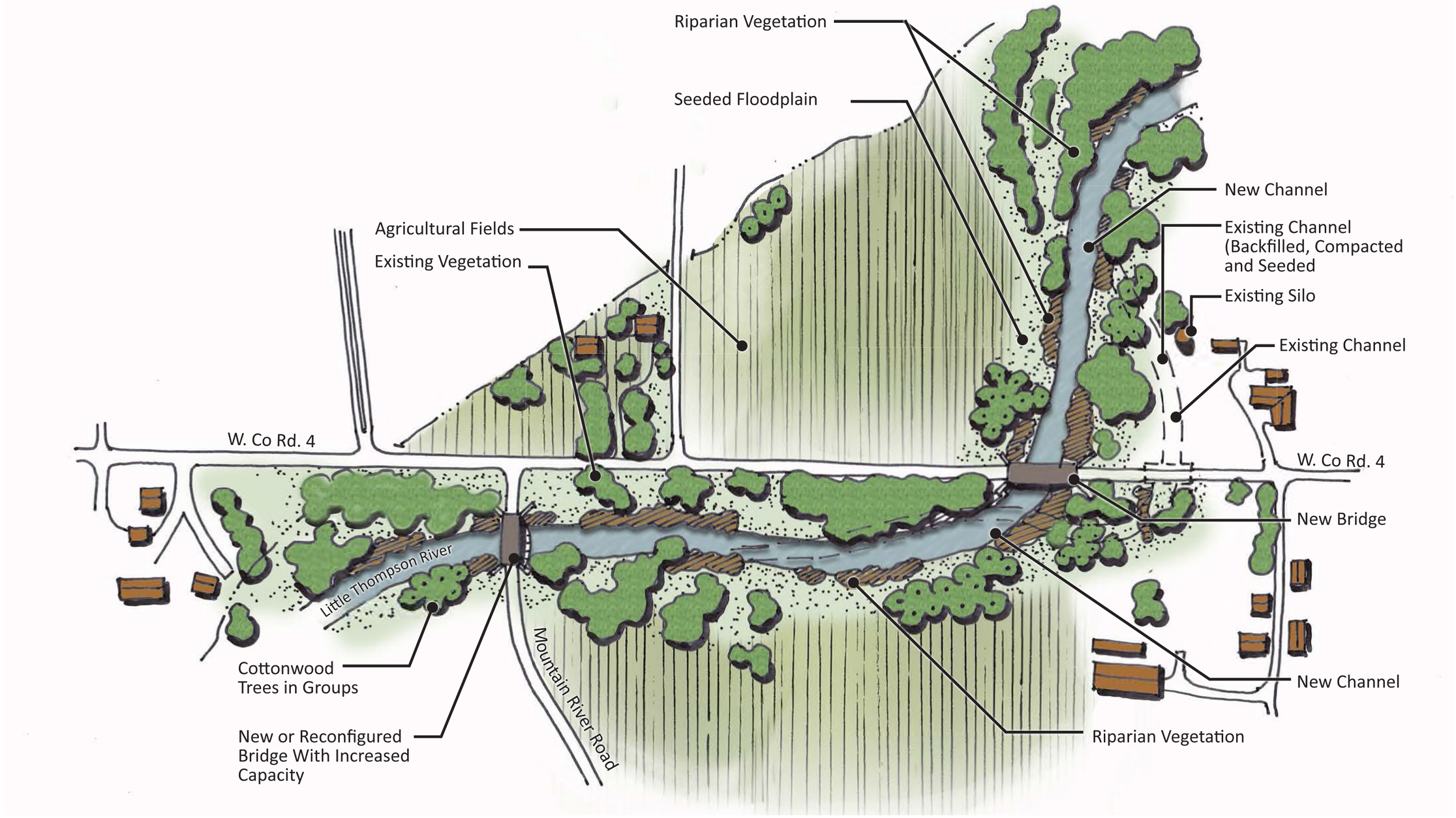
303.979.4120

National Environmental Policy Act (NEPA)

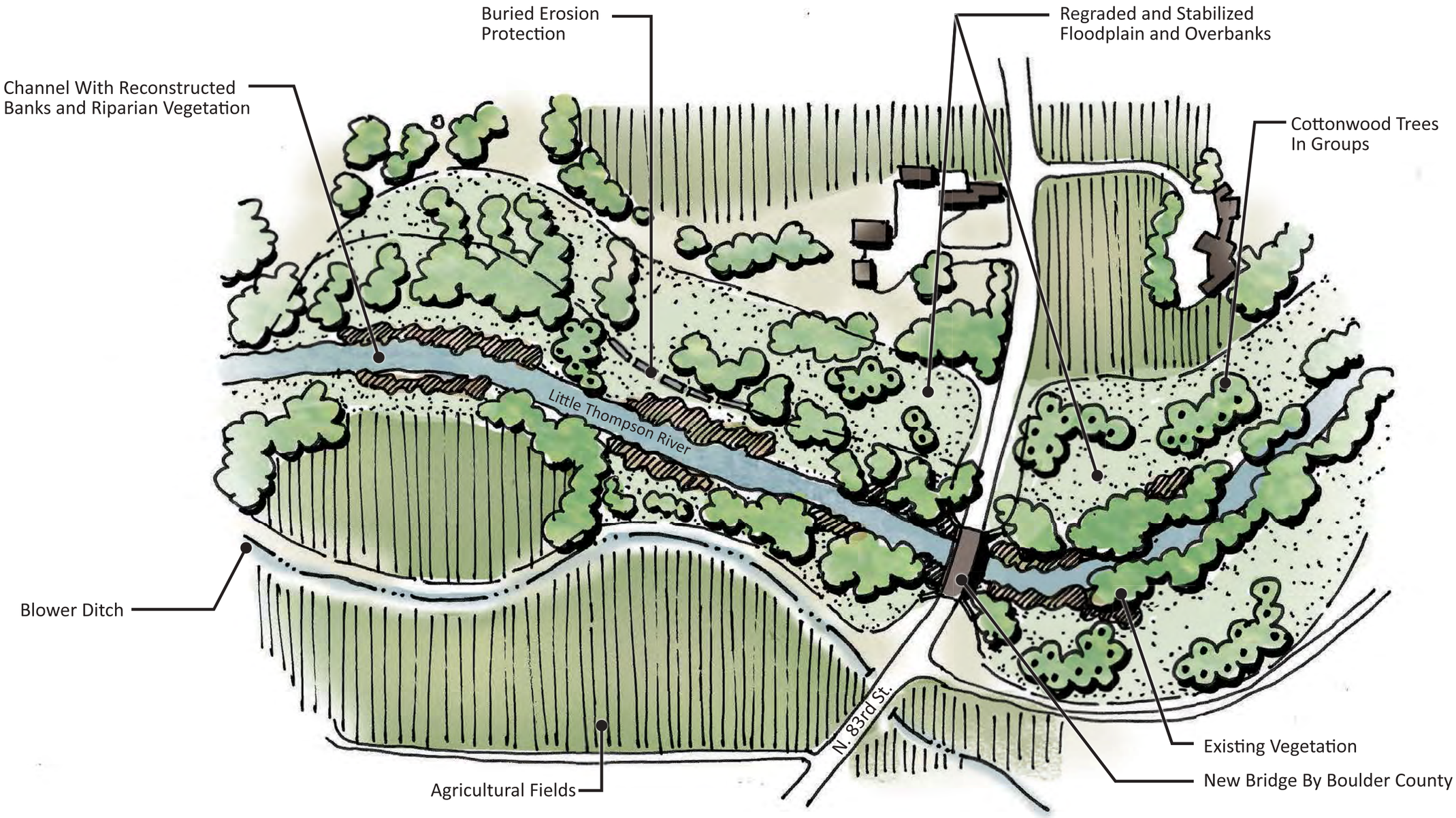
NEPA compliance (Environmental Impact Statement (EIS) or Environmental Assessment (EA)) should be reviewed for applicability for the proposed restoration. Given the project objectives it is unlikely a full EIS would be required, and in some cases, depending on funding source, a categorical exclusion may apply. However, notification of appropriate government regulatory and natural resource agencies is recommended to confirm requirements for implementation. NEPA compliance activities would typically be performed in conjunction with more detailed engineering analyses.

APPENDIX F

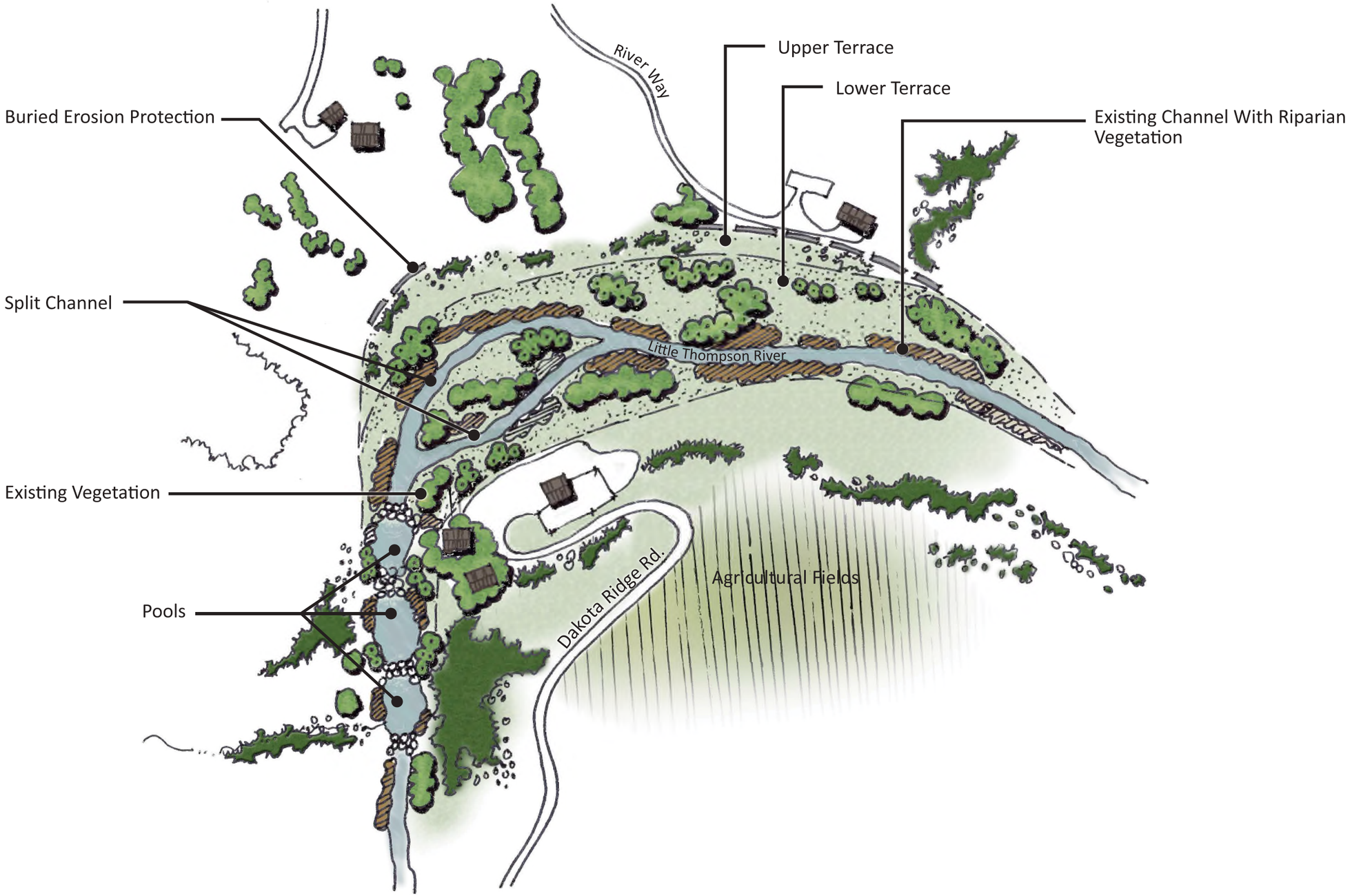
ILLUSTRATIVES



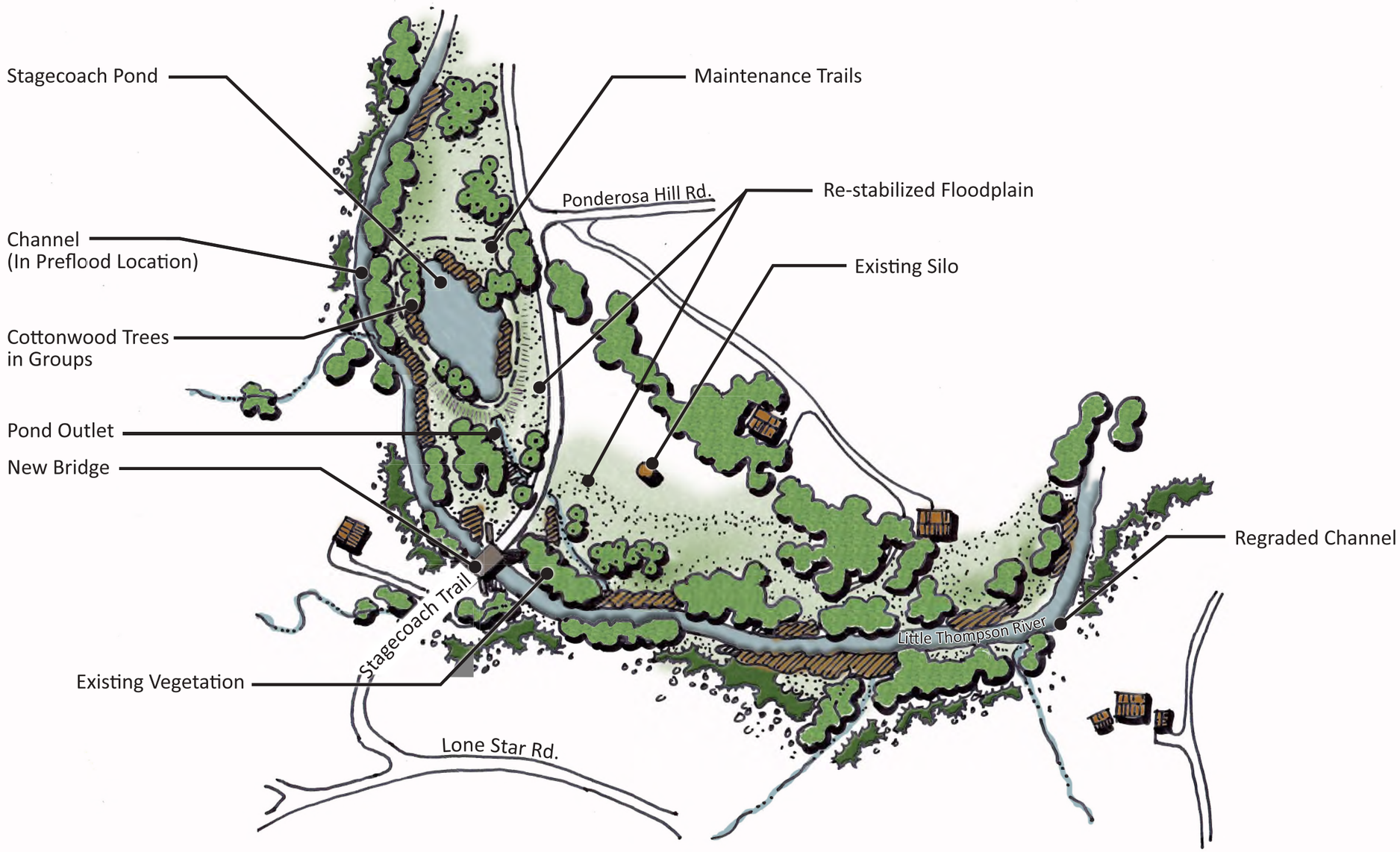
W. Co Rd 4 And Mountain River Road
Berthoud (CR23 to CLR)



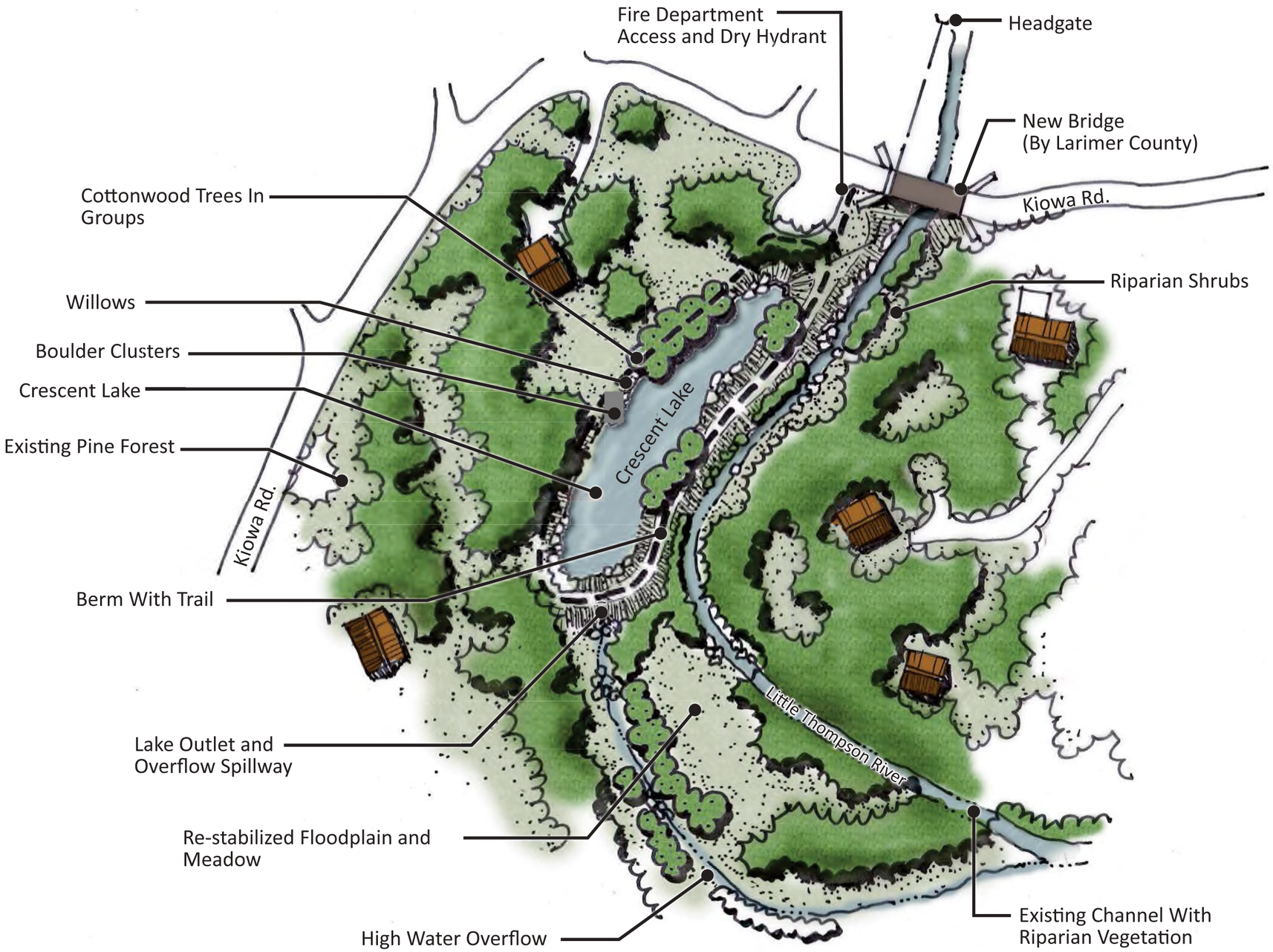
North 83rd Street
Boulder (SH 39)



Riverway
Blue Mountain (SH 57)



Stagecoach Trail
Blue Mountain (SH 59)



Crescent Lake
Pinewood Springs (SH 68)