UPPER O'BRIEN CREEK RESTORATION PROJECT
100% DESIGN PLAN SET

PROJECT PARTNERS

CLARK FORK COALITION
P.O. BOX 7593
MISSOULA, MONTANA 59807

US FOREST SERVICE
LOLO NATIONAL FOREST
24 FORT MISSOULA ROAD
MISSOULA, MONTANA 59804

O'BRIEN CREEK WATERSHED DESCRIPTION

THE OBRIEN CREEK WATERSHED ENCOMPASSES 25.4 SQUARE MILES AND IS A MAJOR TRIBUTARY OF THE BITTERROOT RIVER UPSTREAM OF THE CONFLUENCE WITH THE CLARK FORK RIVER NEAR MISSOULA, MONTANA. O'BRIEN CREEK IS ONE OF THE MOST IMPORTANT TRIBUTARIES IN THE LOWER BITTERROOT RIVER FOR RAINBOW AND CUTTHROAT TROUT (MT FWP, 2019). LAND OWNERSHIP IN THE WATERSHED IS A MIX OF US FOREST SERVICE AND PRIVATE OWNERSHIP. SIMILAR TO MOST FORESTED WATERSHEDS IN THE REGION, O'BRIEN CREEK HAS EXPERIENCED HUMAN-CAUSED IMPACTS FROM FORESTRY, GRAZING, MILL OPERATIONS, DEWATERING, CHANNELIZATION, AND DEVELOPMENT. IN THE LOWER WATERSHED, WATER MANIPULATION AND WITHDRAWALS CREATED FLOW INTERMITTENCY AND CHANNEL DEWATERING. RECENT EFFORTS TO BRING AWRENESS TO THIS ISSUE, AND SENIOR WATER RIGHTS PURCHASES, HAVE RETURNED PERRENIAL OR YEAR-ROUND FLOW TO ALL REACHES OF O'BRIEN CREEK.

PROJECT BACKGROUND

STREAM INVENTORIES COMPLETED BY THE US FOREST SERVICE IN 2019 IDENTIFIED OPPORTUNITIES TO IMPROVE AQUATIC HABITAT AND STREAM CHANNEL CONDITIONS THROUGHOUT THE O'BRIEN CREEK WATERSHED (USFS, 2019). THESE EFFORTS WERE UNDERTAKEN, IN PART, TO SUPPORT TMDL SEDIMENT LOAD REDUCTION TARGETS FOR THE BITTERROOT RIVER, WHICH HAS BEEN IDENTIFIED AS AN IMPAIRED WATER BODY BY THE MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY. THE ENTIRE LENGTH OF O'BRIEN CREEK ROAD ENCROACHES ON O'BRIEN CREEK AND ITS FLOODPLAIN AND IS A CHRONIC SOURCE OF SEDIMENT TO THE CREEK. THE UPPER REACHES OF O'BRIEN CREEK ARE CHARACTERIZED BY EROISON OF ROAD PRISMS/FILLSLOPES AND NATIVE HIGH TERRACES, CHANNELIZATION, AND FLOODPLAIN DISCONNECTION. THE STREAM LACKS LARGE WOODY DEBRIS AND ASSOCIATED HABITAT DIVERSITY AND COMPLEXITY.

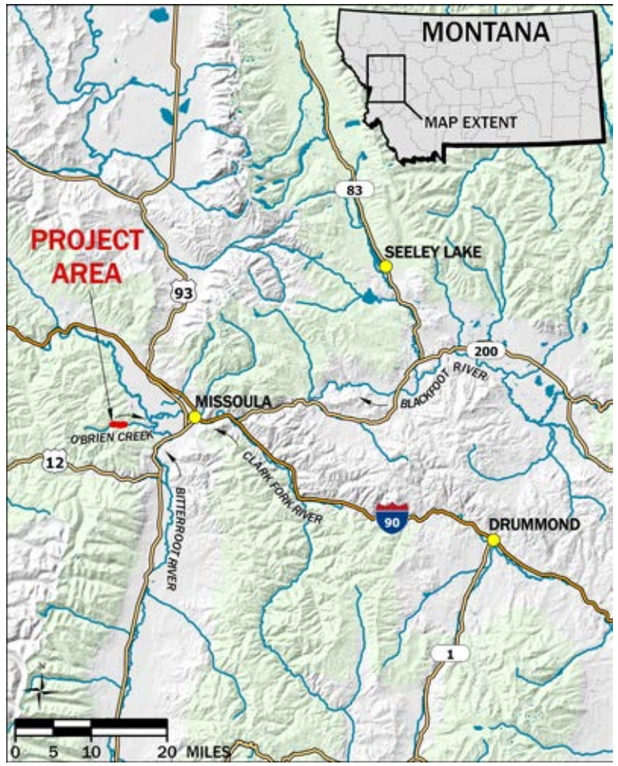
SWCA ENVIRONMENTAL CONSULTANTS (SWCA) WAS RETAINED BY CLARK FORK COALITION, IN PARTNERSHIP WITH LOLO NATIONAL FOREST, TO PREPARE A RESTORATION PLAN FOR A 2.2-MILE REACH OF UPPER O'BRIEN CREEK ON US FOREST SERVICE LAND. RESTORATION TREATMENTS AIM TO SUPPORT THE RECOVERY OF STREAM, FLOODPLAIN, AND AQUATIC HABITAT FUNCTIONALITY. RESTORATION ACTIONS INCLUDE REALIGNING O'BRIEN CREEK ROAD TO REDUCE SEDIMENTATION AND PROVIDE SPACE FOR O'BRIEN CREEK, INSTREAM LARGE WOOD TREATMENTS TO MITIGATE BANK EROSION, INCREASE POOL FREQUENCY AND PROMOTE HYDRAULIC COMPLEXITY, AND DEVELOPING INSET FLOODPLAINS AND REMOVING BERMS TO INCREASE FLOODPLAIN CONNECTIVITY.

GENERAL NOTES

1. SLOPES DESIGNATED AS 2:1, 1.5:1 ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
2. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
3. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE COORDINATED BY SWCA.
4. PROTECT ALL VEGETATION AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION, STAGING, OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
5. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
6. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK. THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
7. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 29 CFR PART 1926, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
8. SWCA WILL PROVIDE SURVEY CONTROL FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. SWCA SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION, INCLUDING HORIZONTAL CONSTRUCTION EXTENTS, SUBGRADE EXCAVATION EXTENTS, AND FINISHED GRADE ELEVATIONS.
9. ROAD REALIGNMENT CENTERLINES WILL BE STAKED PRIOR TO CONSTRUCTION.
10. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
11. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

DRAWING INDEX

UPPER O'BRIEN CREEK VICINITY MAP



SE¼ S26, T13N, R21W; AND S25, T13N, R21W
MISSOULA COUNTY, MONTANA

REUSE OF DRAWINGS

STANDARD OF PRACTICE

SWCA WORKS EXCLUSIVELY IN THE RIVER ENVIRONMENT AND UTILIZES THE MOST CURRENT AND ACCEPTED PRACTICES AVAILABLE FOR PLANNING AND DESIGN OF RIVER, FLOODPLAIN, AND AQUATIC HABITAT RESTORATION PROJECTS. CURRENT STANDARDS FOR THE DESIGN OF RESTORATION PROJECTS VARY DEPENDING ON PROJECT GOALS.

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COVER PAGE

UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
1.0

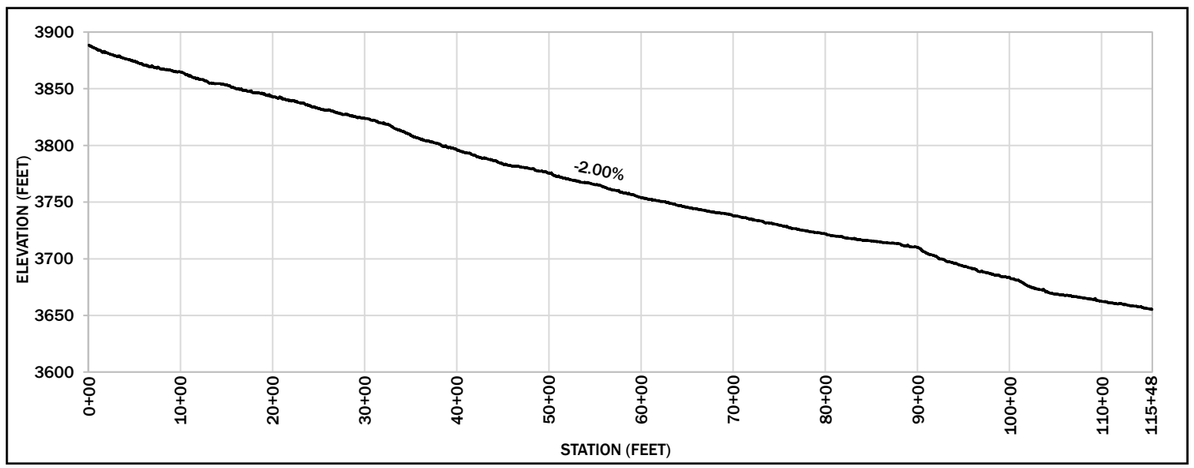
EXISTING CONDITIONS

THE PROJECT REACH BEGINS AT AN UNNAMED INTERMITTENT TRIBUTARY THAT IS THE SITE OF A FORMER BURNED AREA EMERGENCY RESPONSE (BAER) GULLY STABILIZATION PROJECT. THE TRIBUTARY FEATURES A 2.5-FOOT VERTICAL HEADCUT THAT LIKELY SERVES AS A CHRONIC SOURCE OF SEDIMENT TO O'BRIEN CREEK. O'BRIEN CREEK ROAD PARALLELS O'BRIEN CREEK AND ITS FLOODPLAIN FOR THE ENTIRE 2.2-MILE LENGTH OF THE PROJECT REACH AND IS A CHRONIC SOURCE OF SEDIMENT. THE LOWER 1.5 MILES OF ROAD WITHIN THE PROJECT AREA CONSISTS OF DOUBLE-TRACK WHICH TRANSITIONS TO A SINGLE-TRACK TRAIL FOR THE UPPER 0.4 MILES. WITHIN THE PROJECT REACH, O'BRIEN CREEK IS CHARACTERIZED BY LOCAL EROSION OF ROAD PRISMS/FILLSLOPES AND NATIVE TERRACES. HISTORIC MANIPULATION OF SECTIONS OF O'BRIEN CREEK HAS RESULTED IN A STRAIGHTENED, MODERATELY ENTRENCHED CHANNEL THAT IS LACKING LARGE WOOD AND ASSOCIATED HYDRAULIC AND GEOMORPHIC COMPLEXITY. RESULTING FLOODPLAIN DISCONNECTION HAS PRODUCED LIMITED ROBUST RIPARIAN VEGETATION AND RECRUITABLE WOOD. RELIC SIDE CHANNELS AND SWALES ATTEST TO A HISTORICALLY MORE COMPLEX, HYDROLOGICALLY CONNECTED CHANNEL AND FLOODPLAIN. THE PROJECT REACH ENDS AT A US FOREST SERVICE GATE AND TURNAROUND CHARACTERIZED BY EXTREME ROAD PRISM/FILLSLOPE EROSION.

LIMITING FACTORS AND CONSTRAINTS

LIMITING FACTORS AND CONSTRAINTS TO THE STREAM, FLOODPLAIN, AND AQUATIC HABITAT CONDITIONS IN UPPER O'BRIEN CREEK INCLUDE:

- SEDIMENT LOADING FROM ROAD PRISM/FILLSLOPE AND NATIVE TERRACE EROSION, ROAD SURFACE RUNOFF, AND HILLSOPE AND TRIBUTARY INPUTS;
- LACK OF INSTREAM LARGE WOOD AND ASSOCIATED HYDRAULIC AND GEOMORPHIC COMPLEXITY AND HABITAT BENEFITS;
- CHANNEL ENTRENCHMENT AND FLOODPLAIN DISCONNECTION; AND
- LIMITED AREAS OF ROBUST RIPARIAN VEGETATION AND RECRUITABLE WOOD.



EXISTING CONDITIONS
2021 LIDAR PROFILE

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EXISTING CONDITIONS PLAN AND PROFILE
UPPER O'BRIEN CREEK

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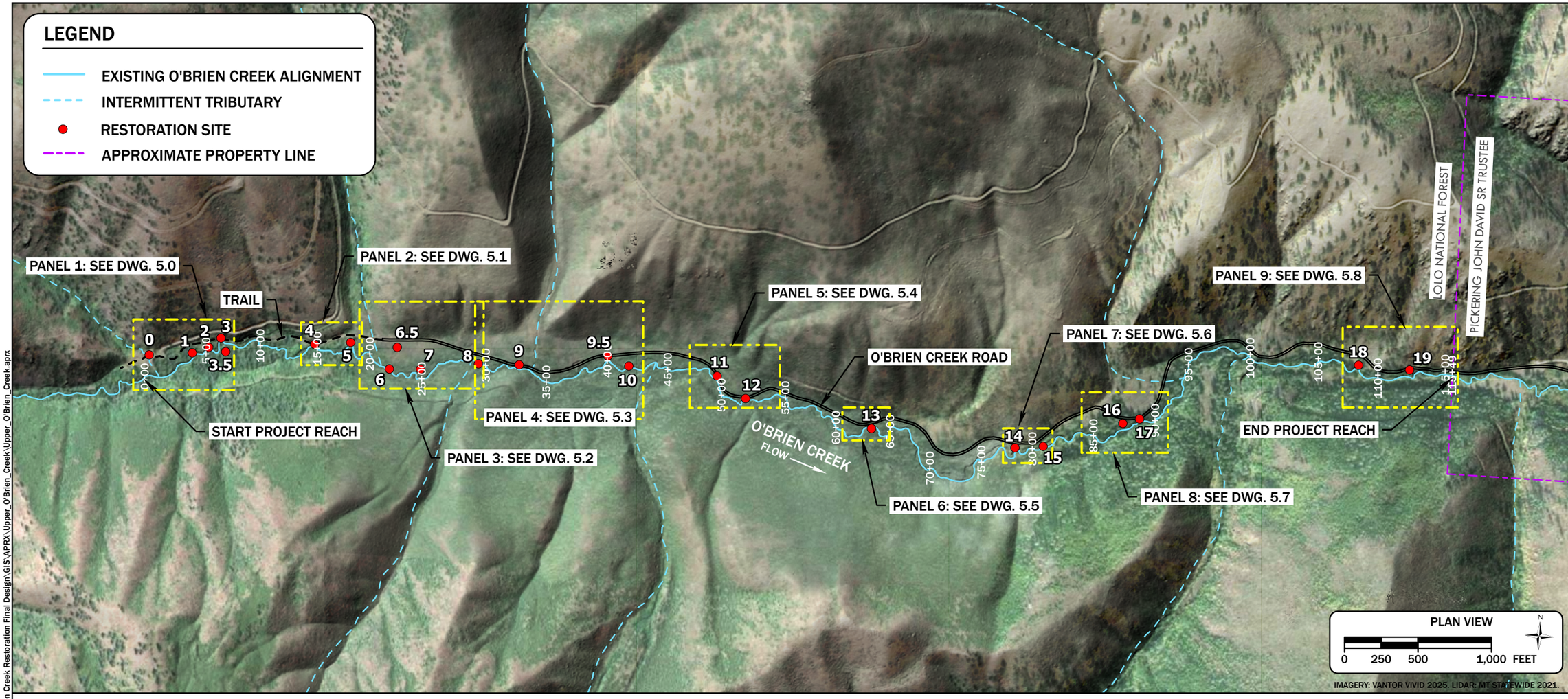
DRAWING NUMBER
2.0



RESTORATION GOALS

THE GOALS OF THE UPPER O'BRIEN CREEK RESTORATION PROJECT WERE DEVELOPED BY PROJECT STAKEHOLDERS BASED ON PREVIOUS STUDIES AND SITE VISITS, AND INCLUDE:

- IMPROVE SPAWNING AND REARING HABITAT FOR RAINBOW AND CUTTHROAT TROUT BY ENHANCING HYDRAULIC AND GEOMORPHIC COMPLEXITY, INCREASING COVER AND SHADE, AND PROMOTING GRAVEL RETENTION;
- REDUCE SEDIMENT LOADING, PARTICULARLY COARSE SEDIMENT SUPPLY, FROM TRIBUTARIES AND EROSION ASSOCIATED WITH O'BRIEN CREEK ROAD AND HIGH-ELEVATION TERRACES; AND
- RESTORE FLOODPLAIN CONNECTIVITY WHERE FEASIBLE BY RECONNECTING AND CREATING FLOODPLAIN SURFACES, INCLUDING SIDE CHANNELS, WETLANDS, AND HIGH-QUALITY RIPARIAN HABITATS.

RESTORATION TREATMENTS

SPECIFIC RESTORATION TREATMENTS FOR THE 2.2-MILE PROJECT REACH OF UPPER O'BRIEN CREEK INCLUDE:

- REALIGNING AND RECONTOURING SECTIONS OF O'BRIEN CREEK ROAD AND PARKING AREA TO REDUCE SEDIMENTATION FROM EROSION AND ROAD RUNOFF;
- REDUCE SEDIMENT CONTRIBUTIONS TO O'BRIEN CREEK FROM THE UPSTREAM-MOST TRIBUTARY BY STABILIZING THE EXISTING HEADCUT AND ADDING PASSIVE LARGE WOOD TO THE CHANNEL TO INCREASE ROUGHNESS, REDUCE SHEAR STRESS, AND ENCOURAGE COARSE SEDIMENT DEPOSITION;
- STABILIZING ERODING, HIGH-ELEVATION TERRACES BY LOWERING TERRACES TO FLOODPLAIN ELEVATION TO CREATE AN INSET FLOODPLAIN, INCORPORATING VEGETATED BANK STRUCTURES AND FLOODPLAIN TREATMENTS;
- REALIGNING SHORT SECTIONS OF O'BRIEN CREEK AWAY FROM ERODING BANKS AND BUILDING AN INSET FLOODPLAIN SURFACE DAYLIGHTING TO THE EXISTING TOP OF BANK, INCORPORATING VEGETATED BANK STRUCTURES AND FLOODPLAIN TREATMENTS;
- PLACING PASSIVE LARGE WOOD OR INSTALLING LARGE WOOD STRUCTURES AT THE TOE OF ERODING TERRACES TO REDIRECT FLOW PATHS AND REDUCE NEAR-BANK STRESS;
- ENCOURAGING SHALLOW EMERGENT WETLAND DEVELOPMENT BY REDIRECTING TRIBUTARY FLOWS TO A TOPOGRAPHIC DEPRESSION IN A DRY FLOODPLAIN AND USING SELECTIVE GRADING;
- OPPORTUNISTICALLY PLACING PASSIVE LARGE WOOD OR INSTALLING LARGE WOOD STRUCTURES IN THE CHANNEL TO INCREASE POOL FREQUENCY, ENHANCE HYDRAULIC AND GEOMORPHIC COMPLEXITY, ADD COVER, AND PROMOTE GRAVEL RETENTION;
- INSTALLING CHANNEL-SPANNING, LOW-PERMEABILITY LARGE WOOD STRUCTURES WHERE APPROPRIATE TO INCREASE FLOODPLAIN CONNECTIVITY, PARTICULARLY WHERE RELIC SIDE CHANNELS CAN BE REACTIVATED; AND
- LOWERING EXISTING BERMS TO FLOODPLAIN ELEVATION TO INCREASE FLOODPLAIN CONNECTIVITY.

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SITE PLAN AND INDEX

UPPER O'BRIEN CREEK

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DRAWING NUMBER
3.0

TREATMENT QUANTITY BY CATEGORY AND SITE

SITE NUMBER	VEGETATED WOOD MATRIX (LF)	LARGE WOOD STRUCTURES	LARGE WOOD AGGREGATE	CHANNEL-SPANNING LOG ARRAY	PASSIVE LARGE WOODY DEBRIS	FLOODPLAIN TREATMENT (AC)	CONSTRUCTED CHANNEL STREAMBED (LF)	BERM REMOVAL (SQ YD)	ROAD CONSTRUCTION (LF)	ROAD RECONTOURING (LF)	WETLAND CREATION (AC)
0	-	-	-	-	12	-	-	-	-	-	-
1	-	-	4	-	-	-	-	-	-	-	-
2	-	-	2	-	-	-	-	-	-	-	-
3	69	1	-	1	-	0.02	60	-	-	-	-
3.5	-	-	-	-	1	-	-	-	-	-	-
4	-	-	-	-	2	-	-	-	-	-	-
5	34	1	-	-	-	0.02	-	-	-	-	-
6	-	-	3	2	1	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	145	-	177	0.30
7	-	-	3	1	2	-	-	-	-	-	-
8	-	-	2	-	5	-	-	-	-	-	-
9	127	-	-	-	-	0.03	-	-	768	559	-
9.5	-	-	1	-	-	-	-	-	-	-	-
10	71	1	-	-	-	0.03	-	-	-	-	-
11	190	1	-	-	-	0.05	-	-	550	586	-
12	75	1	-	-	-	0.04	-	-	-	-	-
13	-	-	1	-	-	-	-	-	247	220	-
14	60	1	-	-	-	0.02	52	-	-	-	-
15	-	-	-	-	-	-	-	48	-	-	-
16	-	-	3	-	1	-	-	-	-	-	-
17	-	-	-	-	1	-	-	-	340	343	-
18	93	1	-	-	-	0.04	-	-	-	-	-
19	-	-	2	-	-	-	-	-	299	-	-
TOTAL	**719**	**7**	**21**	**4**	**25**	**0.25**	**112**	**193**	**2,204**	**1,885**	**0.30**

MATERIAL SPECIFICATIONS

ITEM	QUANTITY	DIAMETER
CATEGORY 1 WOOD	177	10" - 14"
CATEGORY 2 WOOD	316	6" - 12"
CATEGORY 3 WOOD	1,571	< 2"
CATEGORY 4 WOOD	189	2-4"
WILLOW CUTTINGS	7,335	0.25" - 1"
STREAMBANK ALLUVIUM (CY)	216	6" MINUS
STREAMBED ALLUVIUM (CY)	39	10" MINUS
BARRIER ROCKS	50	2' PLUS

TOTAL MATERIALS

SITE NUMBER	CATEGORY 1 WOOD	CATEGORY 2 WOOD	CATEGORY 3 WOOD	CATEGORY 4 WOOD	WILLOW CUTTINGS	STREAMBANK ALLUVIUM (CY)	STREAMBED ALLUVIUM (CY)	BARRIER ROCKS
0	24	24	0	0	0	0	0	0
1	16	40	0	0	0	0	0	0
2	8	20	0	0	0	0	0	0
3	7	11	153	18	715	21	21	0
4	2	2	0	0	0	0	0	0
4	4	4	0	0	0	0	0	0
5	5	4	83	9	340	10	0	0
6	18	46	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
7	18	41	0	0	0	0	0	0
8	18	30	0	0	0	0	0	0
9	0	0	262	33	1,285	38	0	0
10	4	10	0	0	0	0	0	0
10	5	4	160	19	725	21	0	0
11	5	4	403	49	1,920	57	0	0
12	5	4	170	20	795	23	0	0
13	4	10	0	0	0	0	0	0
14	5	4	135	16	620	18	18	0
15	0	0	0	0	0	0	0	0
16	14	32	0	0	0	0	0	0
17	2	2	0	0	0	0	0	0
18	5	4	206	25	935	28	0	0
19	8	20	0	0	0	0	0	50
TOTAL	**177**	**316**	**1,571**	**189**	**7,335**	**216**	**39**	**50**

EARTHWORK CALCULATIONS

SITE NUMBER	INSET FLOODPLAIN EXCAVATION (CY)	FLOODPLAIN BACKSLOPE CUT (CY)	FLOODPLAIN BACKSLOPE FILL (CY)	EXISTIING CHANNEL FILL (CY)	CONSTRUCTED CHANNEL EXCAVATION (CY)	BERM REMOVAL (CY)	WETLAND EXCAVATION (CY)	ROAD CUT (CY)	ROAD FILL (CY)	TOTAL CUT (CY)	TOTAL FILL (CY)	NET (CY)
0	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	246	82	38	-	-	-	-	**38**	**327**	**290 FILL**
3.5	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	80	41	-	-	-	-	-	-	-	**121**	**0**	**121 CUT**
6	-	-	-	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	101	1,238	-	92	**1,340**	**92**	**1,248 CUT**
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	211	95	-	-	-	-	-	-	-	**307**	**0**	**307 CUT**
9.5	-	-	-	-	-	-	-	-	-	-	-	-
10	201	74	-	-	-	-	-	-	-	**275**	**0**	**275 CUT**
11	223	65	-	-	-	-	-	-	-	**288**	**0**	**288 CUT**
12	113	11	-	-	-	-	-	-	-	**124**	**0**	**124 CUT**
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	39	83	33	-	-	-	-	**33**	**122**	**89 FILL**
15	-	-	-	-	-	23	-	-	-	**23**	**0**	**23 CUT**
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	229	84	-	-	-	-	-	-	-	**313**	**0**	**313 CUT**
19	-	-	-	-	-	-	-	171	18	**171**	**18**	**153 CUT**
									TOTAL	**3,030**	**559**	**2,471 CUT**

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PROJECT MATERIALS AND QUANTITIES
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
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PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
4.0

SHEET 4 OF 34

LEGEND

- EXISTING BANK EROSION
- VEGETATED WOOD MATRIX
- INSET FLOODPLAIN
- PASSIVE LARGE WOODY DEBRIS (LWD)
- LARGE WOOD AGGREGATE
- LARGE WOOD STRUCTURE
- CHANNEL-SPANNING LOG ARRAY
- CHANNEL REALIGNMENT

EXISTING HEADCUT - REGRADE CHANNEL TO EQUILIBRIUM SLOPE AND STABILIZE WITH BOULDERS AND LARGE WOOD

REALIGN CHANNEL & CONSTRUCT INSET FLOODPLAIN, DAYLIGHT TO TOP OF ERODING ROAD PRISM, INTEGRATE STREAMBANK TREATMENTS

FILL SLOPE

SITE 3

SITE 3.5

SITE 2

SITE 1

SITE 0

TRAIL

PLACE PASSIVE LWD AT TOE OF ERODING TERRACE

INSTALL LOW-PERMEABILITY CHANNEL-SPANNING LOG ARRAY TO ACTIVATE RELIC SIDE CHANNEL

INSTALL LARGE WOOD AGGREGATES AT TOE OF ERODING TERRACE

PLACE PASSIVE LWD IN TRIBUTARY CHANNEL

O'BRIEN CREEK FLOW

START PROJECT REACH

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00

PLAN VIEW

0 20 40 80 FEET

N

LIDAR: MT STATEWIDE 2021.

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PANEL 1
RESTORATION PLAN
UPPER O'BRIEN CREEK

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DRAWING NUMBER
5.0

LEGEND

- EXISTING BANK EROSION
- VEGETATED WOOD MATRIX
- INSET FLOODPLAIN
- PASSIVE LARGE WOODY DEBRIS (LWD)
- LARGE WOOD STRUCTURE

TRAIL

CONSTRUCT INSET FLOODPLAIN, DAYLIGHT TO TOP OF TERRACE, INTEGRATE STREAMBANK TREATMENTS

SITE 5

CUT SLOPE

SITE 4

PLACE PASSIVE LWD AT TOE OF ERODING ROAD PRISM

O'BRIEN CREEK
FLOW

14+00

15+00

16+00

17+00

18+00

19+00

PLAN VIEW

0 12.5 25 50 FEET

N

LIDAR: MT STATEWIDE 2021.

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PANEL 2
RESTORATION PLAN
UPPER O'BRIEN CREEK

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103361-000-CRB

DRAWING NUMBER
5.1

LEGEND

- EXISTING BANK EROSION
- PASSIVE LARGE WOODY DEBRIS (LWD)
- LARGE WOOD AGGREGATE
- CHANNEL-SPANNING LOG ARRAY
- ROAD RECONTOURING
- WETLAND EXCAVATION
- BERM REMOVAL

EXCESS EXCAVATION MATERIAL REPOSITORY

TRAIL

RAISE ROAD BED 1'

SITE 6.5 (SEE DWG. 5.9)

GRADE BERMS TO MATCH ADJACENT TOPOGRAPHY, USE MATERIAL TO PLUG TRIBUTARY CHANNEL

O'BRIEN CREEK ROAD

SELECTIVELY GRADE TOPOGRAPHICALLY LOW AREA TO ENCOURAGE PONDING AND SHALLOW EMERGENT WETLAND DEVELOPMENT

SELECTIVELY GRADE EXISTING SWALE TO DIVERT FLOW TO WETLAND

20+00

21+00

SITE 6

22+00

23+00

24+00

SITE 7

25+00

26+00

27+00

28+00

29+00

SITE 8

O'BRIEN CREEK FLOW

PLACE PASSIVE LWD AT TOE OF ERODING TERRACE; IF FEASIBLE/ PRACTICAL, LOWER BANK ANGLE BY CUTTING INTO TERRACE

OPPORTUNISTICALLY INSTALL LARGE WOOD AGGREGATES OR PLACE PASSIVE LARGE WOODY DEBRIS TO INCREASE POOL FREQUENCY AND HABITAT COMPLEXITY FROM SITE 6 TO SITE 8; INSTALL LOW-PERMEABILITY CHANNEL-SPANNING LOG ARRAYS TO ACTIVATE RELIC SIDE CHANNELS

PLAN VIEW

N

0 25 50 100 FEET

LIDAR: MT STATEWIDE 2021.

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PANEL 3
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
5.2

SHEET 7 OF 34

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LEGEND

- EXISTING BANK EROSION
- VEGETATED WOOD MATRIX
- INSET FLOODPLAIN
- LARGE WOOD AGGREGATE
- LARGE WOOD STRUCTURE
- ROAD RECONTOURING
- CONSTRUCTED ROAD CENTERLINE

INSTALL LARGE WOOD AGGREGATE AT TOE OF ERODING TERRACE, INCORPORATE 1-3 CHANNEL-SPANNING MEMBERS INTO STRUCTURE; IF FEASIBLE/PRACTICAL, LOWER BANK ANGLE BY CUTTING INTO TERRACE

PROPOSED ROAD CENTERLINE

O'BRIEN CREEK ROAD

CUT SLOPE

SITE 10

SITE 9

SITE 9.5

30+00

31+00

32+00

33+00

34+00

35+00

36+00

37+00

38+00

39+00

40+00

41+00

42+00

RECONTOUR ROAD TO MATCH ADJACENT TOPOGRAPHY; WHERE FEASIBLE/PRACTICAL, CREATE INSET FLOODPLAIN, DAYLIGHT TO HILLSLOPE. INTEGRATE STREAMBANK TREATMENTS

CONSTRUCT INSET FLOODPLAIN, DAYLIGHT TO TOP OF TERRACE, INTEGRATE STREAMBANK TREATMENTS

MAINTAIN ACCESS TO EXISTING BRIDGE

O'BRIEN CREEK FLOW

PLAN VIEW

N

0 25 50 100 FEET

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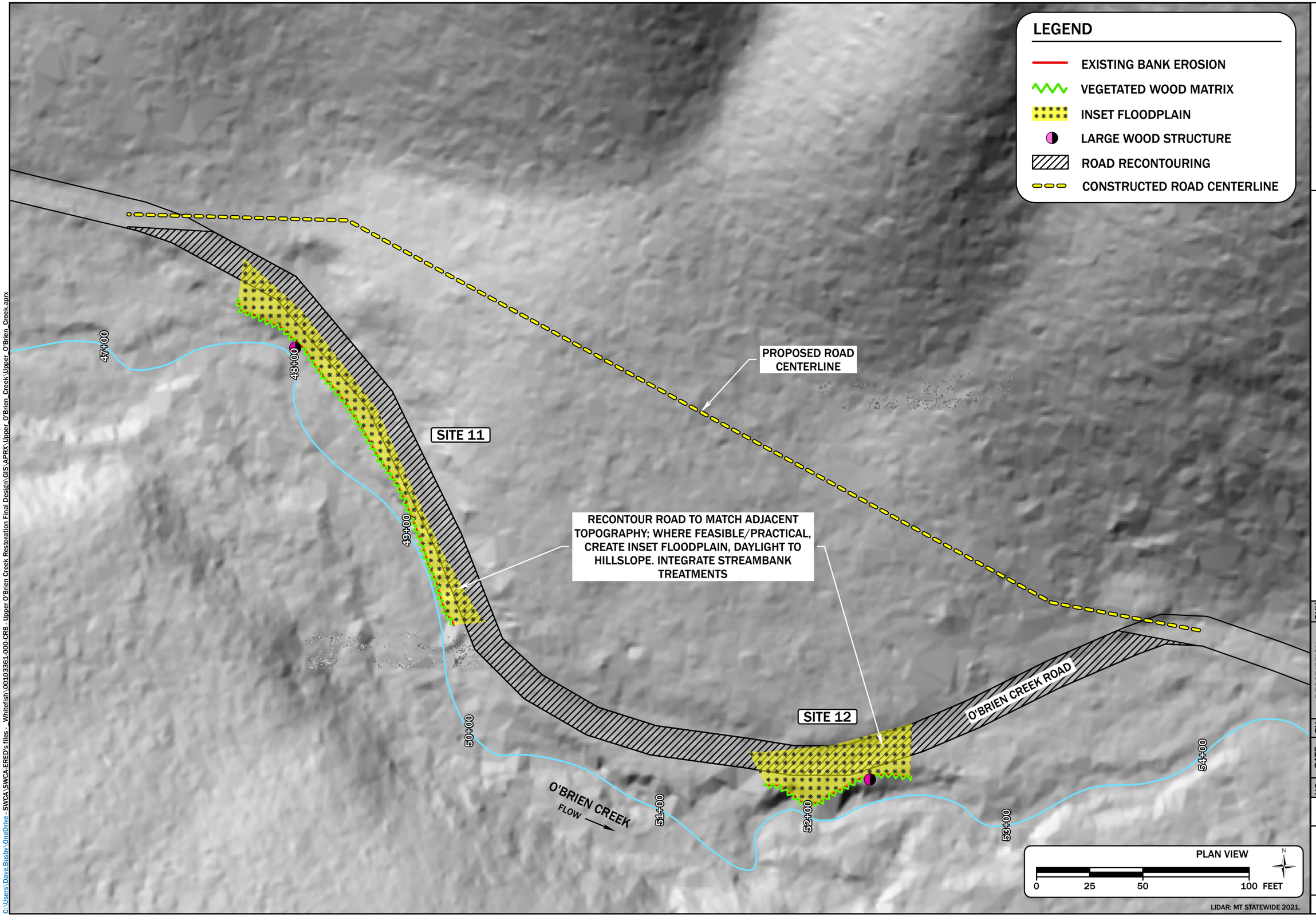
PANEL 4
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
5.3



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PANEL 5
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
5.4

SHEET 9 OF 34

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LEGEND

- EXISTING BANK EROSION
- LARGE WOOD AGGREGATE
- ROAD RECONTOURING
- CONSTRUCTED ROAD CENTERLINE

PROPOSED ROAD CENTERLINE

O'BRIEN CREEK ROAD

RECONTOUR ROAD TO MATCH ADJACENT TOPOGRAPHY

SITE 13

00+63

INSTALL LARGE WOOD AGGREGATE AT TOE OF ERODING ROAD PRISM; IF FEASIBLE/PRACTICAL, LOWER BANK ANGLE BY CUTTING INTO TERRACE

00+64

00+62

00+61

O'BRIEN CREEK
FLOW →

PLAN VIEW

N

0 12.5 25 50 FEET

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PANEL 6
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
5.5

SHEET 10 OF 34

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LEGEND

- EXISTING BANK EROSION
- VEGETATED WOOD MATRIX
- INSET FLOODPLAIN
- LARGE WOOD STRUCTURE
- CHANNEL REALIGNMENT
- BERM REMOVAL

O'BRIEN CREEK ROAD

GRADE BERM WHERE POORLY VEGETATED TO MATCH ADJACENT TOPOGRAPHY

SITE 15

SITE 14

FILL SLOPE

REALIGN CHANNEL & CONSTRUCT INSET FLOODPLAIN, DAYLIGHT TO TOP OF ERODING TERRACE, INTEGRATE STREAMBANK TREATMENTS

00+77

00+78

00+79

00+80

00+81

O'BRIEN CREEK
FLOW

PLAN VIEW

0 12.5 25 50 FEET

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PANEL 7
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER

5.6

SHEET 11 OF 34

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LEGEND

- EXISTING BANK EROSION
- PASSIVE LARGE WOODY DEBRIS (LWD)
- LARGE WOOD AGGREGATE
- ROAD RECONTOURING
- CONSTRUCTED ROAD CENTERLINE

PROPOSED ROAD CENTERLINE

O'BRIEN CREEK ROAD

RECONTOUR ROAD TO MATCH ADJACENT TOPOGRAPHY

SITE 17

SITE 16

PLACE PASSIVE LWD AT TOE OF ERODING TERRACE; LOWER BANK ANGLE BY CUTTING INTO TERRACE

OPPORTUNISTICALLY INSTALL LARGE WOOD AGGREGATES OR PLACE PASSIVE LARGE WOODY DEBRIS TO INCREASE POOL FREQUENCY AND HABITAT COMPLEXITY

O'BRIEN CREEK FLOW

91+00

90+06

89+00

88+00

87+00

85+00

84+00

PLAN VIEW

0 15 30 60 FEET

N

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PANEL 8
RESTORATION PLAN
UPPER O'BRIEN CREEK

NO.	DATE	BY	DESCRIPTION	CHK
1	02-01-24	DB	PRELIMINARY DESIGN	JM
2	02-15-24	DB	PRELIMINARY DESIGN	JM
3	03-13-26	DB	FINAL DESIGN	JM

PROJECT NUMBER
103361-000-CRB

DRAWING NUMBER
5.7

SHEET 12 OF 34

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