BEAVER CREEK RESTORATION PROJECT
FINAL DESIGN PLAN SET

PROJECT PARTNERS

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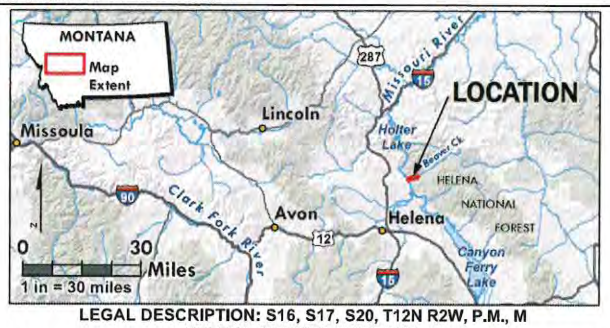
HELENA, MONTANA 59620

HELENA NATIONAL FOREST
2880 SKYWAY DRIVE
HELENA, MONTANA 59602

NORTHWESTERN ENERGY
6700 RAINBOW DAM ROAD
GREAT FALLS, MONTANA 59404

BEAVER CREEK VICINITY MAP



LEGAL DESCRIPTION: S16, S17, S20, T12N R2W, P.M., M
HELENA COUNTY, MONTANA

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STANDARD OF PRACTICE

RIVER DESIGN GROUP, INC. 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. STABILITY CRITERIA INCLUDE DESIGNING STREAMBED AND STREAMBANK STRUCTURES FOR THE 25-YR RECURRENCE INTERVAL DISCHARGE FLOOD. REGIONAL CURVES WERE USED TO EVALUATE BANKFULL DISCHARGE, AND HIGHER RETURN INTERVAL DISCHARGES INCLUDING THE 100-YEAR FLOW.

REUSE OF DRAWINGS

THESE DRAWINGS, THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF RIVER DESIGN GROUP, INC. (RDG) AND ARE NOT TO BE USED , IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF RDG. LIKEWISE, THESE DRAWINGS MAY NOT BE ALTERED OR MODIFIED WITHOUT AUTHORIZATION OF RDG. DRAWING DUPLICATION IS ALLOWED IF THE ORIGINAL CONTENT IS NOT MODIFIED.

PROJECT DESCRIPTION

THE BEAVER CREEK WATERSHED IS LOCATED IN THE MISSOURI RIVER WATERSHED APPROXIMATELY 14 MILES NORTHEAST OF HELENA, MONTANA. WITH A CONTRIBUTING AREA OF 73.3 SQUARE MILES, THE WATERSHED ORIGINATES ALMOST ENTIRELY ON HELENA NATIONAL FOREST, U.S. FOREST SERVICE (USFS) LAND AND FLOWS 18.6 MILES TO THE CONFLUENCE OF THE MISSOURI RIVER UPSTREAM FROM HOLTER DAM. BEAVER CREEK IS AN IMPORTANT TRIBUTARY TO THE MISSOURI RIVER AND HISTORICALLY SUPPORTED HEALTHY RUNS OF ADFLUVIAL RAINBOW TROUT. IN 1974, THE U.S. FOREST SERVICE PURCHASED A 3,355-ACRE PARCEL OF LAND HELD IN PRIVATE OWNERSHIP. THE PURCHASE ENCOMPASSED LANDS ALONG FIVE MILES OF LOWER BEAVER CREEK, INCLUDING THE 1.8 MILES OF BEAVER CREEK UPSTREAM OF THE CONFLUENCE WITH THE MISSOURI RIVER (PROJECT AREA). PAST STUDIES HAVE IDENTIFIED LOWER BEAVER CREEK AS IMPAIRED DUE TO DECADES OF ARTIFICIAL MANIPULATION AND DISTURBANCE OF THE CHANNEL AND ITS FLOODPLAIN (PORTAGE ENVIRONMENTAL 2006). APPROXIMATELY 1.2 MILES OF BEAVER CREEK WERE ASSESSED AS NONFUNCTIONING AND 0.5 MILES AS FUNCTIONING-AT-RISK. THE STUDY RECOGNIZED THAT DECADES OF HISTORICAL LAND USE PRACTICES INCLUDING GRAZING, RIP-RAP BANK STABILIZATION, CHANNELIZATION, OVERGRAZING, AND REMOVAL OF RIPARIAN VEGETATION HAD SIGNIFICANTLY ALTERED THE MORPHOLOGY OF LOWER BEAVER CREEK, AND ACTIVE INTERVENTION WAS NEEDED TO RESTORE PROPER CHANNEL, FLOODPLAIN, AND AQUATIC HABITAT CONDITIONS.

NORTHWESTERN ENERGY (NWE) IN PARTNERSHIP WITH USFS, COMMISSIONED RIVER DESIGN GROUP TO DEVELOP A FINAL RESTORATION PLAN FOR LOWER BEAVER CREEK. THIS PLAN SET PRESENTS A PREFERRED RESTORATION SCENARIO WITHIN THE LOWER 1.8 MILES OF BEAVER CREEK. THIS DESIGN ADDRESSES THE GOALS ESTABLISHED FOR THE STREAM AND DRAINAGE FOR THE MIDDLE TWO REACHES OF BEAVER CREEK AS FIRST PHASE OF RESTORATION. SPECIFICALLY ABOUT 6500 LINEAR FEET OF BEAVER CREEK WILL BE RESTORED WITH A VARIETY OF TREATMENTS AND STRATEGIES TO BEST MEET THE PROJECT GOALS.

THE FOLLOWING RESTORATION GOALS WERE DEVELOPED BY THE PROJECT STAKEHOLDERS AND USED TO DEVELOP THE RANGE OF TECHNIQUES, AND STRATEGIES:

- RESTORE FLOODPLAIN AND HYDROLOGIC PROCESSES;
- RECONSTRUCT THE STREAM CHANNEL AND FLOODPLAIN TO MORE NATURAL CONDITIONS THAT EMULATE THE HISTORICAL STREAM SINUOSITY AND MORPHOLOGY, GIVEN THE EXISTING CONSTRAINTS;
- INCREASE CHANNEL COMPLEXITY TO PROVIDE SPAWNING AND REARING HABITAT FOR NATIVE AND NON-NATIVE FISH SPECIES; AND
- RESTORE RIPARIAN AREAS.

GENERAL NOTES

1. CONTOUR INTERVAL IS NOTED ON DRAWINGS.
2. SLOPES DESIGNATED AS 2:1, 1.5:1, ET CETERA. ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
3. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
4. SURVEY DATA WAS COLLECTED UTILIZING SURVEY GRADE GPS IN MAY, 2017. THE COMPILED BATHYMETRIC SURFACE WAS MERGED INTO LIDAR DATA COLLECTED IN OCTOBER, 2016 TO COMPLETE THE EXISTING GROUND SURFACE. ALL SURVEY DATA WAS COORDINATED BY RDG.
5. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE MADE AS DIRECTED BY THE ENGINEER.
6. EXISTING PRIVATE IMPROVEMENTS, WHICH LIE WITHIN THE CONSTRUCTION LIMITS, UNLESS OTHERWISE NOTED WILL BE REMOVED BY THE OWNER PRIOR TO CONSTRUCTION, OR ABANDONED IN PLACE.
7. PROTECT ALL TREES 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.
8. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS AND EASEMENTS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
9. 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.
10. 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.
11. AT LEAST ONE EXCAVATOR SHALL BE EQUIPPED WITH MACHINE GRADE GPS ((L1/L2/GLONASS)). CONSTRUCTION AREAS WILL BE STAKED OUT PRIOR TO CONSTRUCTION USING SURVEY GRADE GPS (L1/L2/GLONASS).
12. ENGINEER WILL PROVIDE SURVEY CONTROL AND GRADING SURFACES FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. CONTRACTOR SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION.
13. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.3 FEET. HORIZONTAL TOLERANCE WILL BE 1.0 FEET.
14. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

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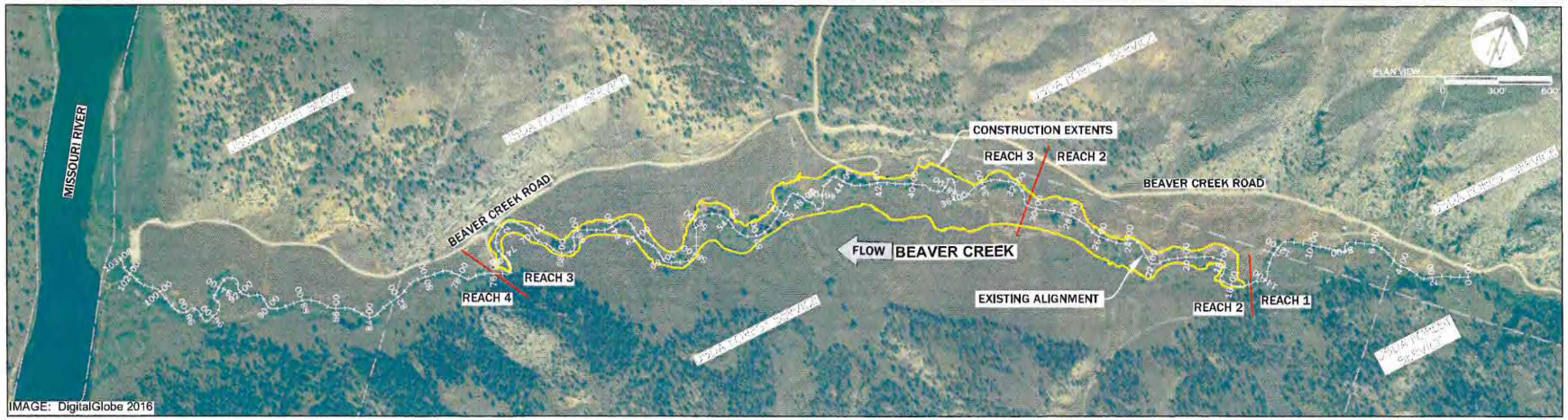
COVER SHEET AND NOTES
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
1.0



EXISTING CONDITIONS

BEAVER CREEK IS A HIGHLY-IMPAIRED SYSTEM FROM ANTHROPOGENIC IMPACTS INCLUDING GRAZING, CHANNELIZATION, IRRIGATION AND REMOVAL OF RIPARIAN VEGETATION. THESE IMPACTS HAVE LED TO A DEGRADATION OF CHANNEL FORM AND GEOMETRY, INCLUDING REDUCED BANK STABILITY AND CHANNEL INCISION. FOUR STREAM REACHES WERE DELINEATED IN THE PROJECT AREA. THIS DESIGN PACKAGE FOCUSES ON REACHES 2 AND 3.

REACH 2 INCLUDES 0.29 MILES (1,550 FEET) OF BEAVER CREEK AND IS CHARACTERIZED BY A BROAD VALLEY BOUNDED BY RIVER TERRACES AND DEPOSITIONAL LANDFORMS. INACTIVE ALLUVIAL FANS IMPINGE ON THE FLOODPLAIN IN THE MIDDLE AND LOWER SEGMENTS OF THE REACH AND LIMIT THE WIDTH OF THE CHANNEL MIGRATION ZONE. BEAVER CREEK CLASSIFIES AS MODERATELY ENTRENCHED B AND C STREAM TYPES, WITH A PREDOMINANTLY GRAVEL BED. AQUATIC HABITAT IS DOMINATED BY LONG, HOMOGENOUS RIFFLES LACKING BEDFORM DIVERSITY, AND INFREQUENT LATERAL SCOUR POOLS WITH LIMITED DEPTH. FLOODPLAIN CONNECTIVITY INCREASES SLIGHTLY IN REACH 2 COMPARED TO REACH 1, HOWEVER, FLOODPLAIN SURFACES ARE LIMITED TO NARROW RIPARIAN AREAS ADJACENT TO THE CHANNEL, AND OXBOWS OR RELICT CHANNELS, PROVIDING LIMITED FUNCTION. SEGMENTS OF THE REACH HAVE BEEN STRAIGHTENED AND CHANNELIZED.

REACH 3 INCLUDES 0.84 MILES (4,450 FEET) OF BEAVER CREEK. ALLUVIAL TERRACES AND FLOODPLAINS ARE THE PREDOMINANT LANDFORMS IN REACH 3. BEAVER CREEK CLASSIFIES AS A MODERATELY TO SLIGHTLY ENTRENCHED, C4 STREAM TYPE WITH A MEANDERING CHANNEL AND RIFFLE-POOL BEDFORMS. FLOODPLAIN CONNECTIVITY IS THE HIGHEST OF THE FOUR REACHES ANALYZED, PARTICULARLY IN THE UPPER PORTION OF THE REACH. HIGH FLOODPLAIN CONNECTIVITY IS A FUNCTION OF LOW BANK HEIGHTS AND THE PRESENCE OF CHANNEL-SPANNING BEAVER COMPLEXES THAT INCREASE WATER SURFACE ELEVATIONS AND FORCE OVERBANK FLOODING EVEN DURING LOW TO MODERATE DISCHARGES. PAST LAND MANAGEMENT PRACTICES INCLUDED PLACEMENT OF RIPRAP ALONG MEANDER BENDS IN THE LOWER PORTION OF REACH 3 TO REDUCE BANK EROSION AND PROPERTY LOSS. RIPRAP PLACEMENT CONTRIBUTED TO CHANNEL INSTABILITY, AND COMBINED WITH CHANNEL STRAIGHTENING, RESULTED IN INCISION, LOSS OF FLOODPLAIN CONNECTION, AND SIMPLIFIED AQUATIC HABITAT. THE LOWER PORTION OF REACH 3 TRANSITIONS TO MODERATELY TO HIGHLY ENTRENCHED, B AND F STREAM TYPES AND FLOODPLAIN CONNECTION IS LIMITED. AQUATIC HABITAT IS DOMINATED BY RIFFLES WITH INFREQUENT SCOUR POOLS ASSOCIATED WITH BEDROCK.

REGIONAL CURVES AND HYDRAULIC COMPUTATIONS OF CHANNEL CROSS SECTIONS WERE USED TO DETERMINE BANKFULL DISCHARGE. BANKFULL DISCHARGE WAS ESTIMATED TO BE IN THE 55-65 CFS RANGE BASED PRIMARILY ON CHANNEL CROSS SECTION ANALYSIS.

BEAVER CREEK IS AN IMPORTANT TRIBUTARY TO THE MISSOURI RIVER, AND HISTORICALLY SUPPORTED HEALTHY RUNS OF ADFLUVIAL RAINBOW TROUT, THE FOCAL SPECIES OF THE BEAVER CREEK RESTORATION PROJECT. CURRENTLY, LACK OF STREAM-FLOODPLAIN CONNECTION AND INCISED CHANNEL MORPHOLOGY HAVE RESULTED IN DEGRADED FISH HABITAT, INTERMITTENT FLOW, AND LACK OF DIVERSE, MATURE RIPARIAN VEGETATION ON STREAMBANK AND FLOODPLAIN SURFACES. PAST SURVEYS HAVE NOTED INTERMITTENT FLOW CONDITIONS IN THE LOWER ONE-QUARTER MILE OF BEAVER CREEK BEFORE THE SPRING FRESHET, AND DURING LOW FLOW PERIODS DURING THE FALL. FLOW INTERMITTENCY AFFECTS BOTH ADFLUVIAL RAINBOW TROUT AND BROWN TROUT RETURNS (USFS, PERSONAL COMMUNICATION, AUGUST 2016). SPAWNING RETURNS IN YEARS 2014 THROUGH 2016 REPEAT A PATTERN OBSERVED SINCE 1998 WHEN THE NUMBERS AND EXTENT OF ADFLUVIAL RAINBOW TROUT REDDS IN THE INDEX REACH FROM THE MOUTH OF BEAVER CREEK TO NELSON EXPERIENCED DECLINES. FACTORS LIKELY CONTRIBUTING TO THE OBSERVED DECLINE IN RAINBOW TROUT RETURNS TO THE LOWER THREE MILES OF BEAVER CREEK ARE PROLONGED DROUGHT CONDITIONS, INCREASED FISHING PRESSURE, HABITAT DEGRADATION, AND WHIRLING DISEASE.

LIMITING FACTORS

AQUATIC LIMITING FACTORS INCLUDE LACK OF HIGH QUALITY POOLS DUE TO THE STRAIGHTENED, ENTRENCHED CHANNEL AND LACK OF HIGH QUALITY RIPARIAN HABITAT. ADDITIONALLY, LACK OF DIVERSITY DUE TO ALTERED STREAM MORPHOLOGY LIMITS COVER AND COMPLEXITY OF HABITAT. MUCH OF THE HABITAT CONSISTS OF RIFFLES AND RUNS WITHOUT COMPLEXITY PREFERRED BY THE FOCAL SPECIES. SUITABLE SPAWNING AND JUVENILE REARING HABITATS ARE LACKING DUE TO THE SIMPLIFIED HABITAT.

MORPHOLOGICAL LIMITING FACTORS INCLUDE CHANNEL ENTRENCHMENT, WHICH LIMITS FLOODPLAIN CONNECTION, FLOOD DISSIPATION, AND RIPARIAN VEGETATION. INCREASED ENERGY ALSO INCREASES BANK EROSION AND LIMITS SEDIMENT DEPOSITION AND SORTING. THE CHANNEL PATTERN IS STRAIGHTER THAN TYPICAL FOR THIS GEOMORPHIC SETTING AND BED MATERIAL IS COARSER AND MORE HOMOGENOUS. POOL DEVELOPMENT IS LIMITED DUE TO STRAIGHTENED CHANNEL AND LACK OF POOL FORMING STRUCTURE SUCH AS LARGE WOOD. WITH HIGHLY LIMITED FLOODPLAIN ACCESS, WATER STORAGE DURING HIGH FLOWS AND RELEASE DURING LOW FLOW PERIODS IS LIMITED. THE WATER TABLE IS LOWER THAN HISTORICAL CONDITIONS WITH THE ENTRENCHED CHANNEL.

VEGETATION CLEARING AND AGRICULTURAL LAND USES ADJACENT TO BEAVER CREEK DISPLACED NATIVE RIPARIAN AND UPLAND VEGETATION. SHADING OF THE STREAM, BIOMASS AND LACK OF BANK STABILITY ARE ALL LIMITING FACTORS BY THE EXISTING CONDITIONS.

BEAVER ARE ACTIVE THROUGHOUT LOWER BEAVER CREEK AND WOULD HAVE HISTORICALLY BEEN ONE OF THE GREATEST INFLUENCES ON CHANNEL FORM, AQUATIC HABITAT AND RIPARIAN VEGETATION COMMUNITY STRUCTURE AND DISTRIBUTION.

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EXISTING CONDITIONS

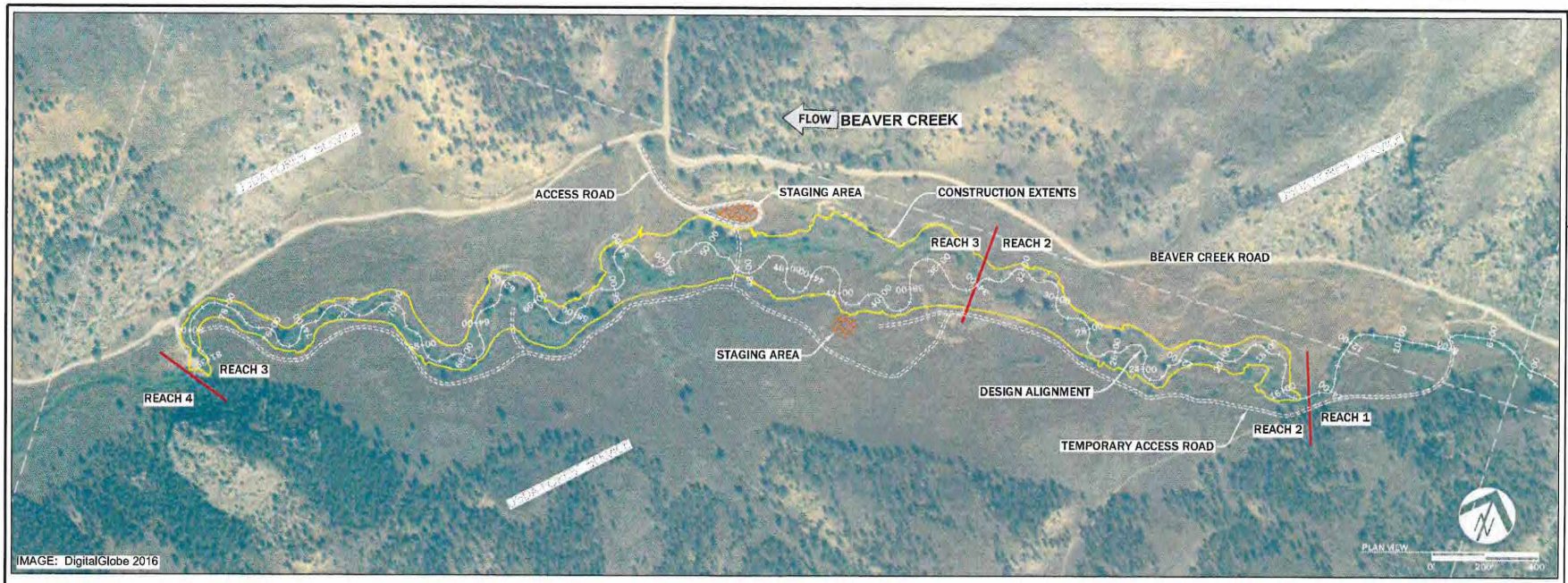
BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
2.0



RESTORATION ALTERNATIVES

RESTORATION ALTERNATIVES FOR THE BEAVER CREEK RESTORATION PROJECT AREA WERE DEVELOPED BY A MULTI-DISCIPLINARY TEAM CONSISTING OF RESOURCE PROFESSIONALS FROM NORTHWEST ENERGY, THE US FOREST SERVICE, MONTANA FISH WILDLIFE AND PARKS AND RIVER DESIGN GROUP, INC. ALTERNATIVES RANGED FROM:

1. RESTORING THE CHANNEL AND FLOODPLAIN AT HISTORICAL FLOODPLAIN ELEVATIONS;
2. RESTORING THE CHANNEL AT ITS PRESENT ELEVATION AND LOCATION WHILE EXPANDING THE FLOODPLAIN WHERE POSSIBLE.

A PREFERRED RESTORATION SCENARIO WAS DEVELOPED FOR THE PROJECT AREA BY ASSIGNING THE ALTERNATIVES TO EACH REACH BASED ON REACH-SPECIFIC LIMITING FACTORS, CONSTRAINTS, AND RESTORATION FEASIBILITY. THE SELECTED RESTORATION STRATEGY WAS A COMBINATION OF THE TWO ALTERNATIVE STRATEGIES, SPECIFICALLY:

1. ALTERNATIVE 2 FOR REACHES 1 AND 4 DUE TO THE LIMITED OPPORTUNITY TO RESTORE THE CHANNEL AND FLOODPLAIN AT ITS HISTORICAL ELEVATION AND THE EXISTING SPAWNING IN THE LOWER REACH 4;
2. ALTERNATIVE 1 FOR REACHES 2 AND 3 BECAUSE THERE WAS AMPLE OPPORTUNITY TO RAISE THE GRADE OF THE CHANNEL AND RE-ACTIVATE THE HISTORICAL FLOODPLAIN.

THIS RESTORATION DESIGN WILL BE DIVIDED INTO TWO PHASES. THE FIRST PHASE OF THIS DESIGN WILL FOCUS ON REACH 2 AND THE SECOND PHASE WILL ADDRESS REACH 3. PHASE 3 WILL INCLUDE REACHES 1 AND 4 AND WILL BE ADDRESSED WITH FUTURE ACTIONS.

RESTORATION OBJECTIVES

THE BEAVER CREEK RESTORATION PLAN ADDRESSES LIMITING FACTORS IDENTIFIED BY PROJECT STAKEHOLDERS BASED ON PREVIOUS STUDIES AND FIELD INVESTIGATIONS. THE PRIMARY GOAL OF THE PROJECT IS TO RESTORE CHANNEL AND FLOODPLAIN CONDITIONS THAT SUPPORT HIGH QUALITY AQUATIC HABITAT CONDITIONS, PROMOTE THE ESTABLISHMENT OF EMERGENT AND SCRUB SHRUB WETLANDS FOR THE BENEFIT OF RIPARIAN DEPENDENT WILDLIFE SPECIES, AND HIGH WATER QUALITY.

SPECIFIC OBJECTIVES FOR REACHES 2 AND 3 INCLUDE:

- RAISING THE ELEVATION OF BEAVER CREEK TO RECONNECT FORMER FLOODPLAIN SURFACES;
- RECONNECTING ABANDONED OXBOW CHANNELS, WHERE PRESENT, TO INCREASE STREAM LENGTH AND REDUCE CHANNEL SLOPE;
- CONSTRUCTING A NEW SLIGHTLY ENTRENCHED, RIFFLE-POOL, C4 STREAM TYPE WITHIN A TERRACED VALLEY, WITH A BROAD, CONNECTED BANKFULL FLOODPLAIN;
- TRANSITIONING TO REACHES 1 AND 4 WITH A MODERATELY ENTRENCHED B4 STREAM TYPE BY INCREASING FLOODPLAIN WIDTH AND INCORPORATING MORE SINUOSITY;
- CONVERTING THE EXISTING CHANNEL TO OFF-CHANNEL WETLANDS AND/OR SIDE CHANNEL HABITAT; AND
- IMPLEMENTING STREAMBANK, BANKFULL FLOODPLAIN, AND RIPARIAN UPLAND REVEGETATION PRESCRIPTIONS TO INCREASE THE COVER OF WOODY RIPARIAN SHRUBS AND TREES.

RESTORATION TREATMENTS

RESTORATION WORK WILL OCCUR ALONG APPROXIMATELY 6,500 FEET OF CHANNEL (1.23 MILES). RESTORATION WORK WILL BE COMPLETED MOSTLY IN THE DRY DURING SUMMER OF 2019 AND WILL BE CLOSELY INTEGRATED WITH THE HELENA NATIONAL FOREST, NORTHWEST ENERGY, AND PERMITTING AGENCIES. FOR THOSE SHORT REACHES THAT MUST BE CONSTRUCTED IN THE WET, BMP'S WILL BE IMPLEMENTED TO ROUTE OR PUMP WATER AROUND THE CONSTRUCTION TO MINIMIZE TURBIDITY. THE EXISTING CHANNEL AND FLOODPLAIN MORPHOLOGY WILL BE MODIFIED TO INCLUDE RIFFLE AND POOL STREAM TYPES DEVELOPED WITHIN A BROAD, WELL VEGETATED RIPARIAN FLOODPLAIN CORRIDOR. IN LOCATIONS, THE CHANNEL BED WILL BE RAISED TO RECONNECT HISTORICAL VEGETATED TERRACE SURFACES. A VARIETY OF STREAMBED, STREAMBANK, FLOODPLAIN, AND REVEGETATION TREATMENTS WILL BE IMPLEMENTED TO SUPPORT THE RESTORATION OBJECTIVES AND DESIRED OUTCOMES. TREATMENTS WILL BE NATIVE MATERIALS BASED AND DESIGNED TO MIMIC NATURALLY OCCURRING COMPONENTS OF A HEALTHY, FUNCTIONING STREAM CHANNEL AND FLOODPLAIN ECOSYSTEM. STREAMBED TREATMENTS WILL CONSIST OF COMPLEX AQUATIC HABITAT COMPONENTS INCLUDING, RIFFLE, RUN, POOL AND GLIDE FEATURES. STREAMBANK TREATMENTS WILL BE COMPOSED OF WOOD, ALLUVIUM, NATIVE ROCK AND VEGETATION, AND WILL INCREASE BANK RESISTANCE TO EROSION. PROVIDING SHORT-TERM STREAMBED AND STREAMBANK STABILITY IS REQUIRED TO SUPPORT THE VEGETATION DESIGN WHICH EMPHASIZES CREATING A SELF-SUSTAINING MOSAIC OF RIPARIAN AND WETLAND COMMUNITIES ON A FLOODPLAIN SURFACE THAT IS HYDROLOGICALLY CONNECTED TO THE CHANNEL. FLOODPLAIN TREATMENTS INCLUDE A VARIETY OF VEGETATION COVER TYPES THAT INTEGRATE PLANT SPECIES COMPOSITION WITH GEOMORPHOLOGY AND HYDROLOGY, AND ACCOUNT FOR ECOLOGICAL PROCESSES THAT SUPPORT PLANT COMMUNITY DEVELOPMENT OVER TIME. FLOODPLAIN TREATMENTS WILL INCLUDE THE USE OF SWALES, SIDE CHANNELS, OFF-CHANNEL WETLANDS, MICROTOPOGRAPHY, COARSE WOOD, PLANTINGS, SEEDING, SALVAGING EXISTING VEGETATION AND TREATING INVASIVE PLANTS.

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SITE PLAN

BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

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PROJECT NUMBER
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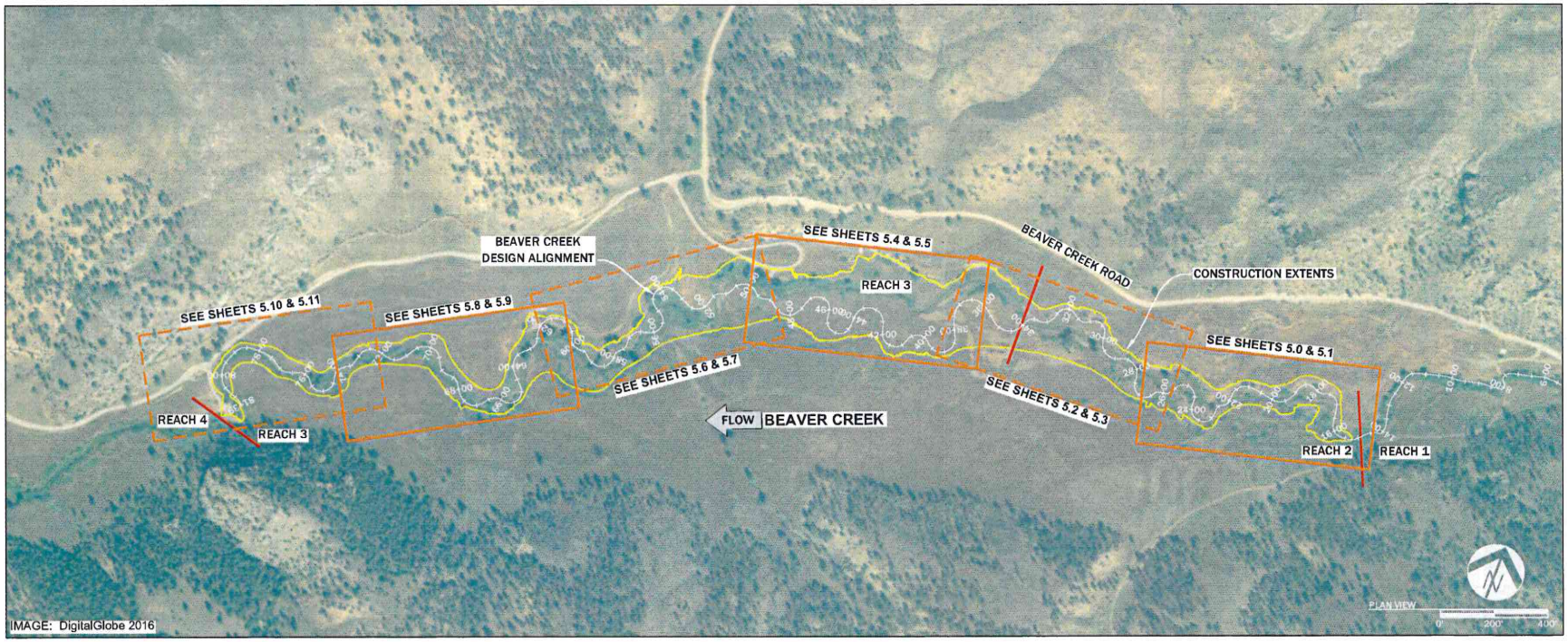
SHEET NUMBER
3.0



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PLAN VIEW INDEX

BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

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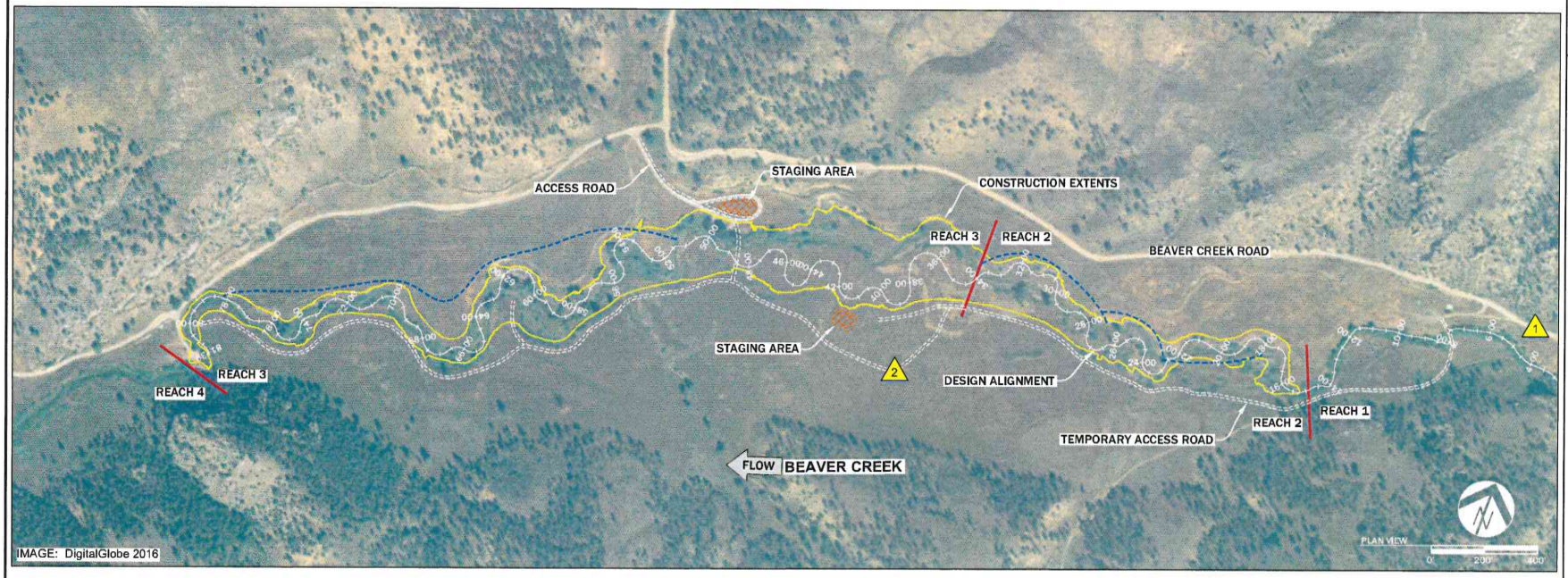
SHEET NUMBER
3.1



ACCESS AND STAGING

1. DIRECTIONS TO THE SITE - BEGIN AT THE SMALL TOWN OF YORK, MT. FROM YORK HEAD NORTH ON NELSON ROAD FOR APPROXIMATELY 7.9 MILES. TURN LEFT AND HEAD WEST ON BEAVER CREEK ROAD. AFTER 4.5 MILES TURN LEFT INTO AN EXISTING RIVER ACCESS LOOP. THIS LOCATION WILL SERVE AS THE NORTH SIDE ACCESS AND STAGING SITE.

2. A TEMPORARY HAUL ROAD WILL BE CONSTRUCTED ALONG THE SOUTH SIDE OF THE RIVER. ACCESS WILL BE FROM AN EXISTING BRIDGE AT THE BEGINNING OF REACH 1. SOUTH SIDE STAGING WILL OCCUR AT THE SITE(S) DESIGNATED ON THE PLAN VIEW.

LEGEND

- CLEARWATER DIVERSION CHANNEL
- TEMPORARY HAUL ROAD
- STAGING AREA

NOTES: CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ACCESS ROADS AND TEMPORARY HAUL ROADS. EQUIPMENT, MAINTENANCE AND MATERIALS TO BE STAGED MINIMUM 150' FROM RIVER

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ACCESS, STAGING AND DEWATERING PLAN

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3.2

GENERAL SPECIFICATIONS

1. THE PROJECT SHALL BE CONSTRUCTED ACCORDING TO THE PLAN SET. THE CONTRACTOR SHALL NOTIFY THE CONSTRUCTION MANAGER OF ANY CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER FOR THIS PROJECT SHALL BE A DESIGNATED RIVER DESIGN GROUP REPRESENTATIVE.

2. IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION. CALL U-DIG PRIOR TO CONSTRUCTION.

3. COSTS INCURRED DUE TO PROJECT DELAYS RESULTING FROM FAILURE OF THE CONTRACTOR TO MEET THE REQUIREMENTS OF THE GENERAL SPECIFICATIONS, CONTRACTOR QUALIFICATIONS, CONSTRUCTION SPECIFICATIONS, MATERIALS SPECIFICATIONS AND REVEGETATION SPECIFICATIONS SHALL BE THE EXPENSE OF THE CONTRACTOR.

CONTRACTOR QUALIFICATIONS

1. THE CONTRACTOR SHALL HAVE AT LEAST TWO (2) YEARS OF RIVER RESTORATION CONSTRUCTION EXPERIENCE AND SHALL HAVE COMPLETED AT LEAST FIVE (5) RIVER RESTORATION PROJECTS. OR, THE CONTRACTOR SHALL HAVE AT LEAST ONE (1) YEAR OF RIVER RESTORATION EXPERIENCE, SHALL HAVE COMPLETED AT LEAST THREE (3) RIVER RESTORATION PROJECTS, AND SHALL HAVE COMPLETED AN APPROVED RIVER RESTORATION TRAINING CLASS. APPROVED TRAINING CLASSES INCLUDE THOSE SPONSORED BY WILDLAND HYDROLOGY, INC., OR A SIMILARLY QUALIFIED PRACTITIONER OF NATURAL CHANNEL DESIGN STREAM RESTORATION PRINCIPLES.

2. IF THE CONTRACTOR CHOOSES TO DESIGNATE AN EMPLOYEE WITHOUT QUALIFIED STREAM RESTORATION EXPERIENCE, THE CONTRACTOR SHALL BE ON-SITE AT ALL TIMES WHEN THE EMPLOYEE IS PERFORMING RIVER RESTORATION WORK. FAILURE TO ABIDE BY THIS CONDITION WITHOUT PREVIOUS AGREEMENT WITH THE CONSTRUCTION MANAGER WOULD BE GROUNDS FOR TERMINATION.

3. THE CONTRACTOR SHALL MAINTAIN AT LEAST $2,000,000 IN LIABILITY INSURANCE AND HAVE PROOF OF LIABILITY INSURANCE ON-SITE DURING THE ENTIRETY OF PROJECT CONSTRUCTION.

4. THE CONTRACTOR SHALL HAVE PROOF OF WORKER'S COMPENSATION INSURANCE ON-SITE DURING THE ENTIRETY OF PROJECT CONSTRUCTION.

5. COPIES OF ALL PROJECT PERMITS SHALL BE POSTED ON-SITE IN A VISIBLE LOCATION. THE CONTRACTOR SHALL COMPLY WITH THE PROVISIONS OF THE PERMITS. THE CONTRACTOR SHALL NOTIFY THE CONSTRUCTION MANAGER OF ANY KNOWN CHANGES OR ACTIVITIES THAT COULD VIOLATE PERMIT REQUIREMENTS PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER SHALL BE RESPONSIBLE FOR ALL CORRESPONDENCE WITH PERMIT AGENCIES.

TEMPORARY DIVERSION PROCEDURES

1. USFWS SHALL BE NOTIFIED AT LEAST 72 HOURS PRIOR TO ACTIVATION OR DEACTIVATION OF ALL TEMPORARY BYPASS CHANNELS. THE PHONE NUMBER FOR THE USFWS OFFICE IS 406-449-5225. USFWS SHALL DETERMINE IF IT IS NECESSARY TO CONDUCT A FISH RESCUE.

2. TEMPORARY DIVERSIONS SHALL BE ACTIVATED OR DEACTIVATED INCREMENTALLY IN TWO STAGES TO ALLOW RESIDENT AQUATIC LIFE TO EXIT THE DEWATERED AREA.

3. A PERIOD OF APPROXIMATELY ONE HOUR SHALL BE ALLOWED BETWEEN THE TWO STAGES.

4. FWP AND USFS SHALL CONDUCT FISH RESCUES DURING THE ONE HOUR PERIOD.

5. EFFORTS SHALL BE MADE TO LIMIT TURBIDITY DURING DIVERSION ACTIVATION AND DEACTIVATION. MATERIAL USED TO DIVERT FLOW DURING STAGED DIVERSIONS SHALL BE CLEAN AND DEVOID OF FINES.

6. EFFORTS SHALL BE MADE TO LIMIT DISTURBANCE TO VEGETATION.

7. EFFORTS SHALL BE MADE TO AVOID FATALITIES OF AQUATIC LIFE.

MATERIALS SPECIFICATIONS

1. THE CONTRACTOR SHALL FURNISH ALL MATERIALS NECESSARY TO CONSTRUCT THE PROJECT. THE CONTRACTOR SHALL DELIVER ALL MATERIALS TO THE DESIGNATED STOCKPILE LOCATIONS LABELED ON THE PLAN SET OR TO A LOCATION SPECIFIED BY THE CONSTRUCTION MANAGER. IF A MATERIAL SOURCE HAS BEEN PRE-DETERMINED, THE CONSTRUCTION MANAGER SHALL PROVIDE DIRECTIONS TO THE CONTRACTOR.

2. MATERIAL QUANTITIES, DIMENSIONS AND SIZES SHALL CONFORM TO THE NOTES AND SPECIFICATIONS PROVIDED ON THE PLAN SET OR ON THE MATERIALS LIST.

3. THE CONSTRUCTION MANAGER SHALL INSPECT AND APPROVE ALL MATERIALS PRIOR TO CONSTRUCTION. IF MATERIALS DO NOT MEET THE MINIMUM REQUIREMENTS SPECIFIED IN THE PLAN SET OR MATERIAL LIST, THE CONSTRUCTION MANAGER SHALL REJECT THE MATERIALS.

EQUIPMENT SPECIFICATIONS

1. THE CONTRACTOR SHALL FURNISH ALL EQUIPMENT NECESSARY TO CONSTRUCT THE PROJECT. THE CONTRACTOR SHALL MOBILIZE ALL EQUIPMENT TO THE PROJECT AREA AS DIRECTED BY THE CONSTRUCTION MANAGER.

2. AT A MINIMUM, THE CONTRACTOR SHALL PROVIDE THE FOLLOWING EQUIPMENT FOR THIS PROJECT:

EXCAVATOR - TWO (2) EXCAVATOR(S) SHALL BE REQUIRED. THE EQUIPMENT SHALL BE MINIMUM 200 CLASS. ONE EXCAVATOR SHALL BE EQUIPPED WITH MACHINE GRADE GPS (L1/L2/GLONASS). THE BUCKET VOLUME SHALL BE MINIMUM OF ONE (1) CUBIC YARD. THE BUCKET SHALL BE EQUIPPED WITH A HYDRAULIC THUMB FOR GRASPING LOGS, ROCKS, AND OTHER MATERIALS. THE EQUIPMENT MUST BE CAPABLE OF CROSSING WATER AND WORKING ON OR ADJACENT TO STEEP SLOPES. A CHAIN OR STRAP SHALL BE AVAILABLE FOR ATTACHING CULVERTS, PUMPS AND OTHER EQUIPMENT OR MATERIALS TO THE BUCKET FOR TRANSPORT ON-SITE.

DUMP TRUCK - TWO (2) DUMP TRUCK(S) SHALL BE REQUIRED FOR THIS PROJECT. ONE TRACKED TRUCK AND ONE ON-ROAD OR OFF-ROAD TRUCK.

BULL DOZER - ONE (1) BULL DOZER IS RECOMMENDED FOR THIS PROJECT. THE EQUIPMENT SHALL BE A MINIMUM OF CAT D5 OR EQUIVALENT.

ALL SURFACE VEHICLE - ONE (1) ALL-SURFACE VEHICLE (ASV) SHALL BE REQUIRED. THE EQUIPMENT SHALL BE EQUIPPED WITH SOD TRACKS TO MINIMIZE DISTURBANCE TO FRAGILE AREAS. ONE TREE SPADE SHALL BE PROVIDED AND BE OF SUFFICIENT SIZE TO TRANSPLANT LARGE, MATURE WILLOWS. A HARROW RAKE OR SIMILAR ATTACHMENT SHALL BE AVAILABLE TO RIP COMPACTED SURFACES AND TEMPORARY CONSTRUCTION ACCESS ROADS AT THE TERMINATION OF THE PROJECT.

CHAINSAW - TWO (2) CHAINSAW SHALL BE REQUIRED. THE CHAINSAW MUST BE CAPABLE OF COMPLETELY SAWING LOGS OF THE DIAMETER SPECIFIED IN THE MATERIAL SPECIFICATIONS. ALSO, THE CHAINSAW MUST BE CAPABLE OF SAWING HDPE OR PVC CULVERTS OR PIPES AS NOTED IN THE MATERIAL SPECIFICATIONS.

3. ALL EQUIPMENT SHALL BE WASHED PRIOR TO MOBILIZATION TO THE SITE TO MINIMIZE THE INTRODUCTION OF FOREIGN MATERIALS AND FLUIDS TO THE PROJECT SITE. ALL EQUIPMENT SHALL BE FREE OF OIL, HYDRAULIC FLUID, AND DIESEL FUEL LEAKS. TO PREVENT INVASION OF NOXIOUS WEEDS OR THE SPREAD OF WHIRLING DISEASE SPORES, ALL EQUIPMENT SHALL BE POWER WASHED OR CLEANED TO REMOVE MUD AND SOIL PRIOR TO MOBILIZATION INTO THE PROJECT AREA. IT WILL BE THE CONTRACTOR'S RESPONSIBILITY TO INSURE THAT ADEQUATE MEASURES HAVE BEEN TAKEN.

4. EQUIPMENT SHALL BE IN A WELL-MAINTAINED CONDITION TO MINIMIZE THE LIKELIHOOD OF A FLUID LEAK. IF A FLUID LEAK DOES OCCUR, THE CONSTRUCTION MANAGER SHALL BE NOTIFIED IMMEDIATELY, AND ALL WORK CEASED UNTIL THE LEAK HAS BEEN RECTIFIED. AT ALL TIMES DURING THE CONSTRUCTION PHASE, FLUID SPILL CONTAINMENT EQUIPMENT SHALL BE PRESENT ON-SITE AND READY FOR DEPLOYMENT SHOULD AN ACCIDENTAL SPILL OCCUR.

5. THE CONTRACTOR SHALL MAINTAIN A COMPLETE TOOL SET WITH COMMONLY REPLACED PARTS (E.G. O-RINGS) TO MINIMIZE DOWNTIME IN THE EVENT OF EQUIPMENT MALFUNCTION. THE CONTRACTOR SHALL HAVE AN EMERGENCY SPILL KIT ON SITE DURING THE PROJECT.

CONSTRUCTION SPECIFICATIONS

1. CONSTRUCTION SHALL OCCUR IN ACCORDANCE WITH THE PLAN SET, CONSTRUCTION SPECIFICATIONS, EQUIPMENT SPECIFICATIONS, MATERIAL SPECIFICATIONS, REVEGETATION SPECIFICATIONS AND GENERAL SPECIFICATIONS.

2. CONSTRUCTION ACCESS SHALL BE DETERMINED BY THE CONSTRUCTION MANAGER. THE CONTRACTOR SHALL LEAVE ALL GATES, WHETHER OPEN OR CLOSED, AS FOUND.

3. STREAM CROSSINGS SHALL BE MINIMIZED DURING CONSTRUCTION. KNOWN STREAM CROSSINGS AND CULVERT RECOMMENDATIONS ARE FOUND ON SHEET 8.4 SO THAT EQUIPMENT CAN CROSS THE STREAM WITHOUT GENERATING EXCESS TURBIDITY.

4. STRAW BALES AND SILT FENCING SHALL BE AVAILABLE AND INSTALLED BY THE CONTRACTOR IF DEEMED NECESSARY BY THE CONSTRUCTION MANAGER. CONSTRUCTION FENCING (LIMITS OF DISTURBANCE) SHALL BE INSTALLED BY THE CONTRACTOR IF DEEMED NECESSARY BY THE CONSTRUCTION MANAGER.

5. INITIALLY, THE CONTRACTOR SHALL EXCAVATE THE CHANNEL TO APPROXIMATE DESIGN DIMENSIONS. EXCAVATION SHALL COMPLY WITH CONSTRUCTION STAKES AND THE PLAN SET. EXCAVATION SHALL ESTABLISH CHANNEL ELEVATIONS WITHIN ONE-HALF FOOT OF FINAL ELEVATIONS. THE CONSTRUCTION MANAGER SHALL INSPECT THE CHANNEL EXCAVATION FOR COMPLIANCE WITH THE PLAN SET. ALL EXCAVATED MATERIALS SHALL BE STOCKPILED ON-SITE, ABOVE THE BANKFULL CHANNEL UNTIL HAULED OFF-SITE OR USED ON-SITE. DISTURBANCE TO RIPARIAN VEGETATION, CHANNEL BANKS AND SOD SHALL BE MINIMIZED. EXCAVATED SOD AND RIPARIAN SHRUB TRANSPLANTS SHALL BE CAREFULLY STOCKPILED AND REUSED FOR PLANTING FLOODPLAINS OR STREAM BANKS.

6. AFTER EXCAVATING THE CHANNEL, THE CONTRACTOR SHALL INSTALL BANK STABILIZATION AND HABITAT STRUCTURES USING THE EXCAVATOR. EACH STRUCTURE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE LOCATIONS AND SPECIFICATIONS PROVIDED IN THE PLAN SET. THE CONSTRUCTION MANAGER SHALL INSPECT AND APPROVE ALL STRUCTURES PRIOR TO BACKFILLING.

7. AFTER ALL STRUCTURES ARE INSTALLED, THE CHANNEL WILL BE SHAPED TO WITHIN 0.3 FEET OF THE FINAL ELEVATIONS SPECIFIED ON THE PLAN SET USING AN EXCAVATOR. THE CONSTRUCTION MANAGER SHALL CHECK THE FINAL ELEVATIONS FOR COMPLIANCE WITH THE PLAN SET. ALL EXCAVATED MATERIALS SHALL BE STOCKPILED ON-SITE, ABOVE THE BANKFULL CHANNEL UNTIL HAULED TO AN ON-SITE REPOSITORY DESIGNATED BY THE CONSTRUCTION MANAGER. DISTURBANCE TO RIPARIAN VEGETATION, CHANNEL BANKS AND SOD SHALL BE MINIMIZED.

8. THE CONTRACTOR SHALL REMOVE EXCESS MATERIALS, TEMPORARY CULVERTS AND EQUIPMENT FROM THE SITE. THE CONTRACTOR SHALL REGRADE DISTURBED AREAS AND CONSTRUCTION ACCESS ROADS TO THEIR ORIGINAL GRADES. THE CONTRACTOR SHALL TREAT COMPACTED SOIL AREAS INCLUDING ACCESS ROADS AND MATERIAL STOCKPILE AREAS. THE CONTRACTOR SHALL REMOVE SOIL FROM THE PROJECT SITE IF THE SOIL IS TAINTED WITH PETROLEUM-BASED FLUIDS.

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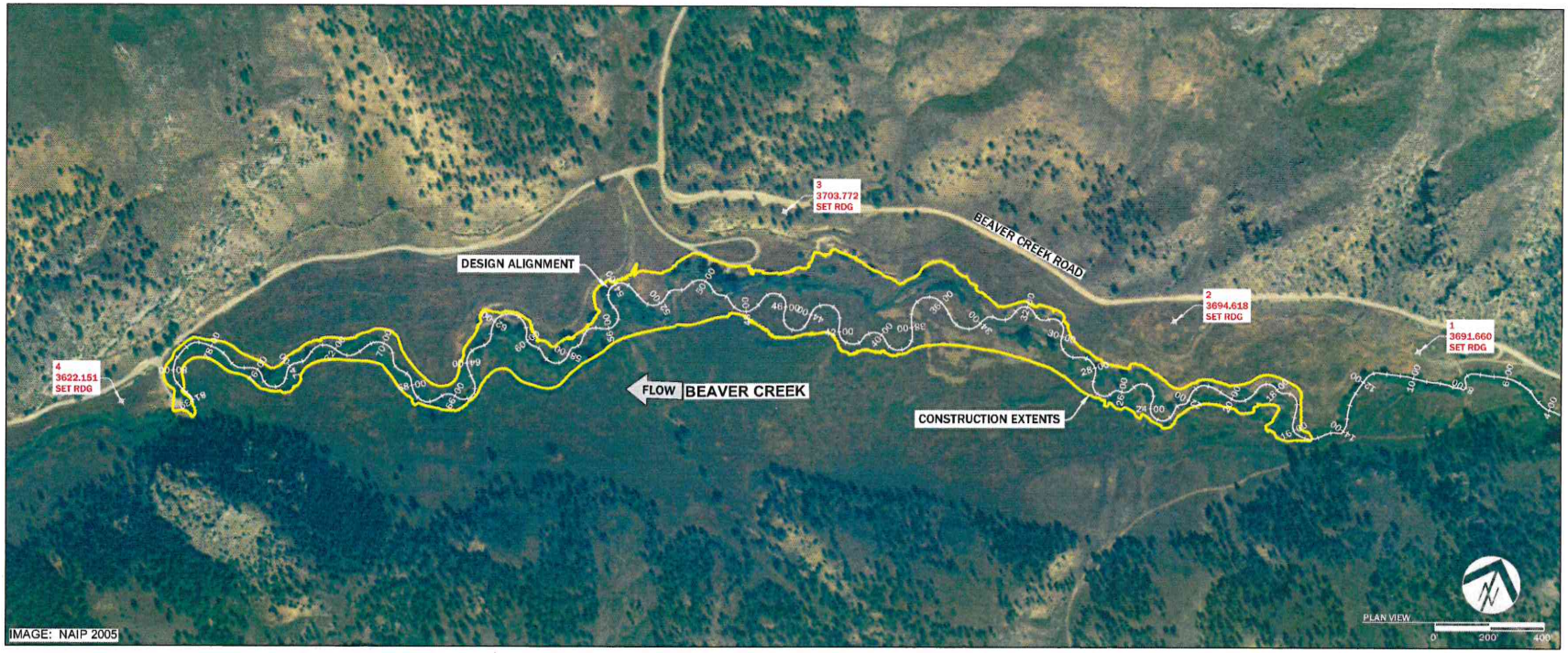
SPECIFICATIONS
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
3.3



PROJECT DATUM

THE PROJECT COORDINATES ARE BASED ON THE FOLLOWING:	
HORIZONTAL PROJECTION:	MONTANA STATE PLANE
HORIZONTAL DATUM:	NAD83 (CORS96 2002.00)
UNITS:	US SURVEY FEET
VERTICAL DATUM:	NAVD88 (GEOID 9)

CONTROL POINTS

POINT NUMBER	EASTING	NORTHING	POINT ELEVATION	RAW DESCRIPTION
1	1373786.3680'	935601.8700'	3691.660'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"
2	1372892.3820'	935465.5700'	3694.618'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"
3	1371400.5140'	935462.5460'	3703.772'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"
4	1369241.2480'	934121.9760'	3622.151'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"

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SURVEY CONTROL SHEET

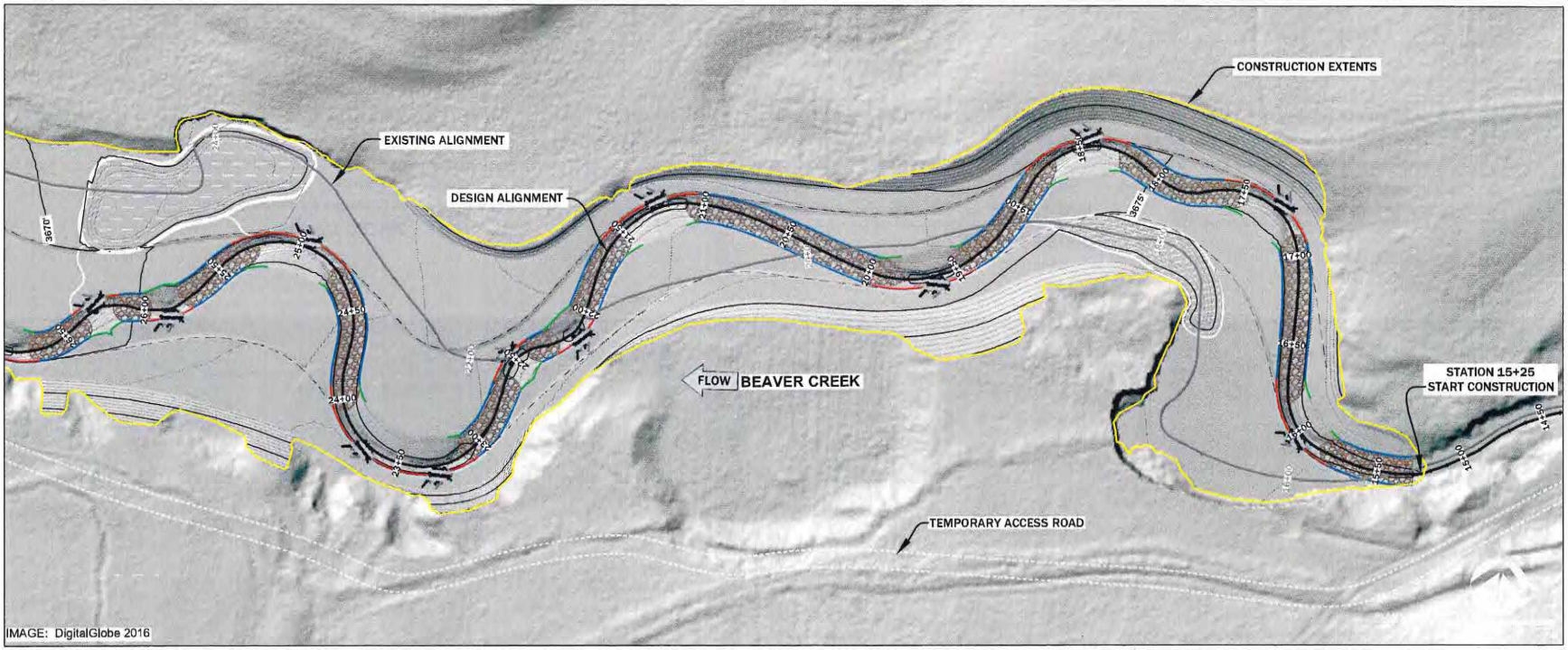
BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
4.0



LEGEND

BANK STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	8.0
VEGETATED WOOD MATRIX TYPE 1 (VWM 1)	8.1
VEGETATED WOOD MATRIX TYPE 2 (VWM 2)	8.1
VEGETATED WOOD MATRIX TYPE 3 (VWM 3)	8.1
CHANNEL STRUCTURES	
CONSTRUCTED RIFFLE (CR)	8.2
FLOODPLAIN FEATURES	
OFF-CHANNEL EMERGENT WETLAND	
ALCOVE / CONNECTOR CHANNEL	

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)	STATION	ELEVATION (FT)
15+30	3676.70	21+00	3673.15
16+00	3676.26	22+00	3672.53
17+00	3675.64	23+00	3671.90
18+00	3675.02	24+00	3671.28
19+00	3674.40	25+00	3670.66
20+00	3673.77	26+00	3670.04

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
15+30	15+86	C	CR	18+23	18+32	L	VWM 1	21+46	22+07	C	CR	23+93	24+08	R	VWM 1
15+30	15+86	R	VWM 1	18+23	18+41	R	VWM 3	21+46	21+61	L	VWM 1	24+08	24+69	L	VWM 2
15+30	15+77	L	VWM 2	18+41	18+51	R	LWS	21+61	22+01	R	VWM 2	24+08	24+69	R	VWM 2
15+77	15+92	L	VWM 3	18+51	18+81	R	VWM 3	21+81	22+01	L	VWM 1	24+69	24+78	L	VWM 1
15+92	16+02	L	LWS	18+66	19+49	C	CR	22+01	22+07	L	VWM 2	24+69	24+91	R	VWM 3
16+02	16+30	L	VWM 3	18+66	18+81	L	VWM 1	22+07	22+17	L	LWS	24+91	25+01	R	LWS
16+15	17+14	C	CR	18+81	19+40	L	VWM 2	22+17	22+28	L	VWM 2	25+01	25+37	R	VWM 3
16+15	16+30	R	VWM 1	18+81	19+40	R	VWM 2	22+20	22+45	C	CR	25+22	25+80	C	CR
16+30	17+06	L	VWM 2	19+40	19+49	R	VWM 1	22+28	22+45	R	VWM 2	25+22	25+37	L	VWM 1
17+06	17+14	L	VWM 1	19+40	19+57	L	VWM 3	22+45	22+55	R	LWS	25+37	25+74	R	VWM 2
17+06	17+06	R	VWM 2	19+57	19+67	L	LWS	22+55	23+06	R	VWM 2	25+56	25+74	L	VWM 1
17+06	17+21	R	VWM 3	19+67	19+97	L	VWM 3	22+58	23+15	C	CR	25+74	25+80	L	VWM 2
17+21	17+31	R	LWS	19+82	21+12	C	CR	22+66	23+06	L	VWM 2	25+80	25+90	L	LWS
17+31	17+61	R	VWM 3	19+82	19+97	R	VWM 1	23+06	23+15	R	VWM 1	25+90	26+00	L	VWM 2
17+46	18+32	C	CR	19+97	21+03	L	VWM 2	23+06	23+24	L	VWM 3	25+93	26+20	C	CR
17+46	17+61	L	VWM 1	19+97	21+03	R	VWM 2	23+24	23+34	L	LWS	26+00	26+14	L	VWM 2
17+61	17+80	L	VWM 2	21+03	21+12	L	VWM 1	23+34	23+67	L	VWM 3	26+00	26+20	R	VWM 2
17+61	18+23	R	VWM 2	21+03	21+20	R	VWM 3	23+67	23+77	L	LWS	26+20	26+30	R	LWS
17+80	17+90	L	LWS	21+20	21+30	R	LWS	23+77	24+08	L	VWM 3	26+30	26+68	R	VWM 2
17+90	18+23	L	VWM 2	21+30	21+61	R	VWM 3	23+93	24+78	C	CR				

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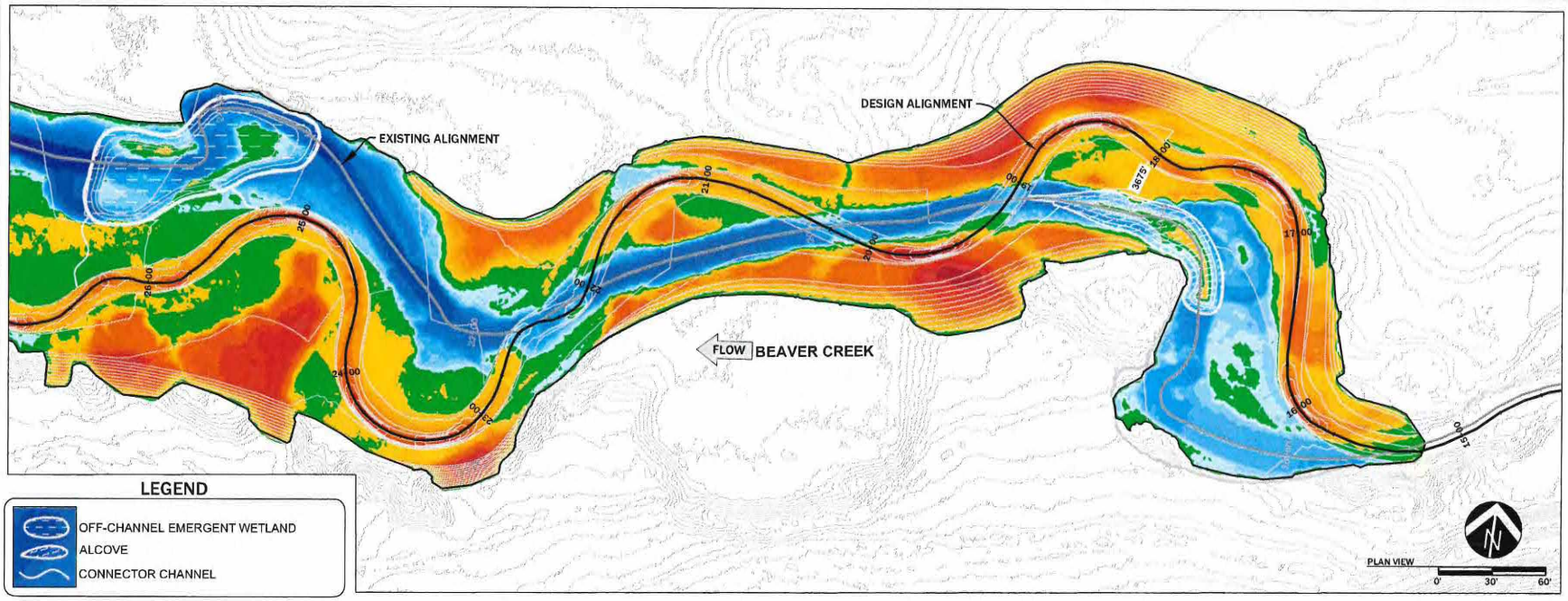
PLAN VIEW AND STRUCTURE LAYOUT

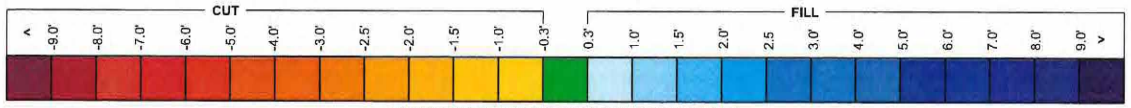
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

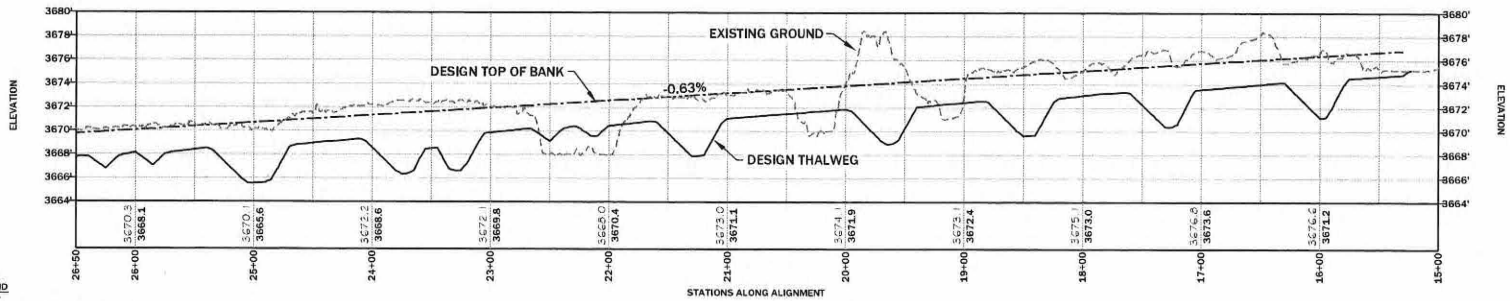
NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

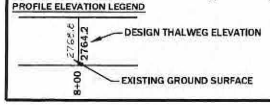
SHEET NUMBER
5.0







PROFILE ELEVATION LEGEND



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GRADING PLAN AND PROFILE

BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
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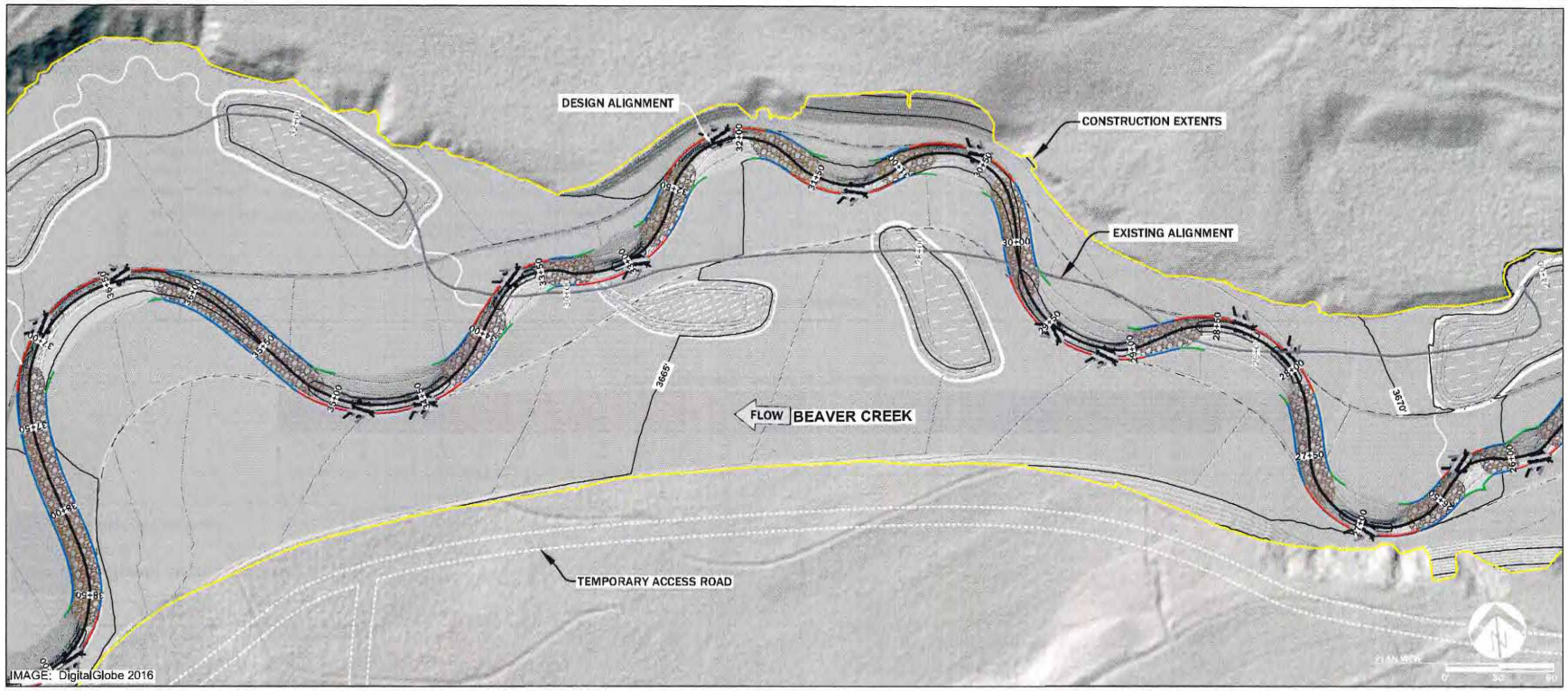
PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.1



LEGEND

	DETAIL SHEET #
BANK STRUCTURES	
LARGE WOOD STRUCTURE (LWS)	8.0
VEGETATED WOOD MATRIX TYPE 1 (VWM 1)	8.1
VEGETATED WOOD MATRIX TYPE 2 (VWM 2)	8.1
VEGETATED WOOD MATRIX TYPE 3 (VWM 3)	8.1
CHANNEL STRUCTURES	
CONSTRUCTED RIFFLE (CR)	8.2
FLOODPLAIN FEATURES	
OFF-CHANNEL EMERGENT WETLAND	
ALCOVE / CONNECTOR CHANNEL	

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)	STATION	ELEVATION (FT)
27+00	3669.41	32+00	3665.00
28+00	3668.54	33+00	3664.11
29+00	3667.66	34+00	3663.23
30+00	3666.77	35+00	3662.34
31+00	3665.89	36+00	3661.46

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
26+33	26+77	C	CR	28+93	29+11	L	VWM 3	31+48	31+96	C	CR	33+44	33+60	R	VWM 3
26+41	26+68	L	VWM 2	29+11	29+21	L	LWS	31+48	31+63	R	VWM 1	33+60	33+70	R	LWS
26+68	26+77	R	VWM 1	29+21	29+42	L	VWM 3	31+63	31+87	L	VWM 2	33+70	33+98	R	VWM 3
26+68	26+91	L	VWM 3	29+42	29+52	L	LWS	31+63	31+87	R	VWM 2	33+84	34+36	C	CR
26+91	27+01	L	LWS	29+52	29+83	L	VWM 3	31+87	31+96	L	VWM 1	33+84	33+98	L	VWM 1
27+01	27+36	L	VWM 3	29+68	30+39	C	CR	31+87	32+05	R	VWM 3	33+98	34+27	L	VWM 2
27+21	27+92	C	CR	29+68	29+83	R	VWM 1	32+05	32+15	R	LWS	33+98	34+27	R	VWM 2
27+21	27+36	R	VWM 1	29+83	30+30	L	VWM 2	32+15	32+47	R	VWM 3	34+27	34+36	R	VWM 1
27+36	27+83	L	VWM 2	29+83	30+30	R	VWM 2	32+32	32+85	C	CR	34+27	34+45	L	VWM 3
27+36	27+83	R	VWM 2	30+30	30+39	L	VWM 1	32+32	32+47	L	VWM 1	34+45	34+55	L	LWS
27+83	27+92	L	VWM 1	30+30	30+49	R	VWM 3	32+47	32+76	L	VWM 2	34+55	34+79	L	VWM 3
27+83	28+01	R	VWM 3	30+49	30+59	R	LWS	32+47	32+76	R	VWM 2	34+79	34+89	L	LWS
28+01	28+11	R	LWS	30+59	30+91	R	VWM 3	32+76	32+85	R	VWM 1	34+89	35+20	L	VWM 3
28+11	28+16	R	VWM 3	30+76	31+17	C	CR	32+76	32+92	L	VWM 3	35+05	36+25	C	CR
28+32	28+42	R	LWS	30+76	30+91	L	VWM 1	32+92	33+02	L	LWS	35+05	35+20	R	VWM 1
28+42	28+73	R	VWM 3	30+91	31+08	L	VWM 2	33+02	33+30	L	VWM 3	35+20	36+17	L	VWM 2
28+58	29+02	C	CR	30+91	31+08	R	VWM 2	33+15	33+53	C	CR	35+20	36+17	R	VWM 2
28+58	28+73	L	VWM 1	31+08	31+17	R	VWM 1	33+15	33+30	R	VWM 1	36+17	36+25	L	VWM 1
28+73	28+93	L	VWM 2	31+08	31+24	L	VWM 3	33+30	33+44	L	VWM 2	36+17	36+38	R	VWM 3
28+73	28+93	R	VWM 2	31+24	31+34	L	LWS	33+30	33+44	R	VWM 2	36+38	36+48	R	LWS
28+93	29+02	R	VWM 1	31+34	31+63	L	VWM 3	33+44	33+53	L	VWM 1				

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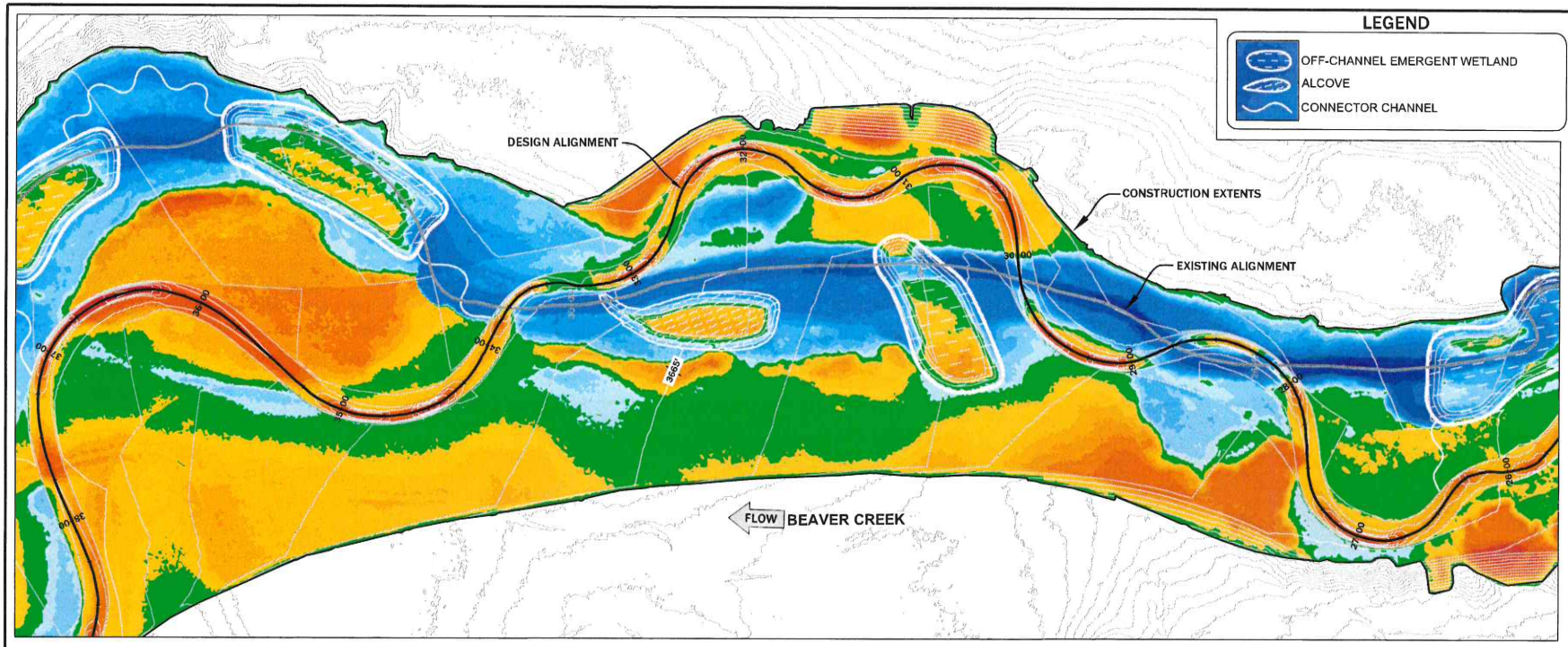
PLAN VIEW AND STRUCTURE LAYOUT

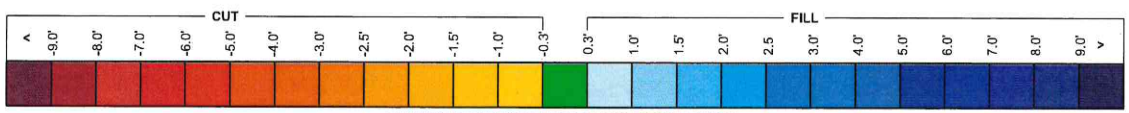
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

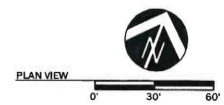
PROJECT NUMBER
RDG-17-006

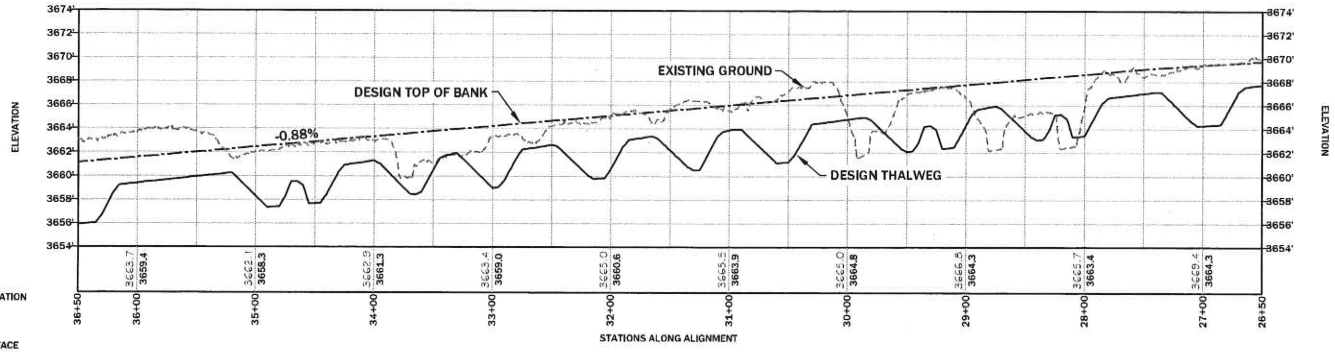
SHEET NUMBER
5.2

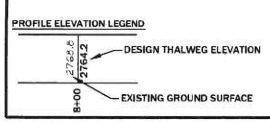




EXISTING GROUND COMPARED TO RDG DESIGN SURFACE







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GRADING PLAN AND PROFILE

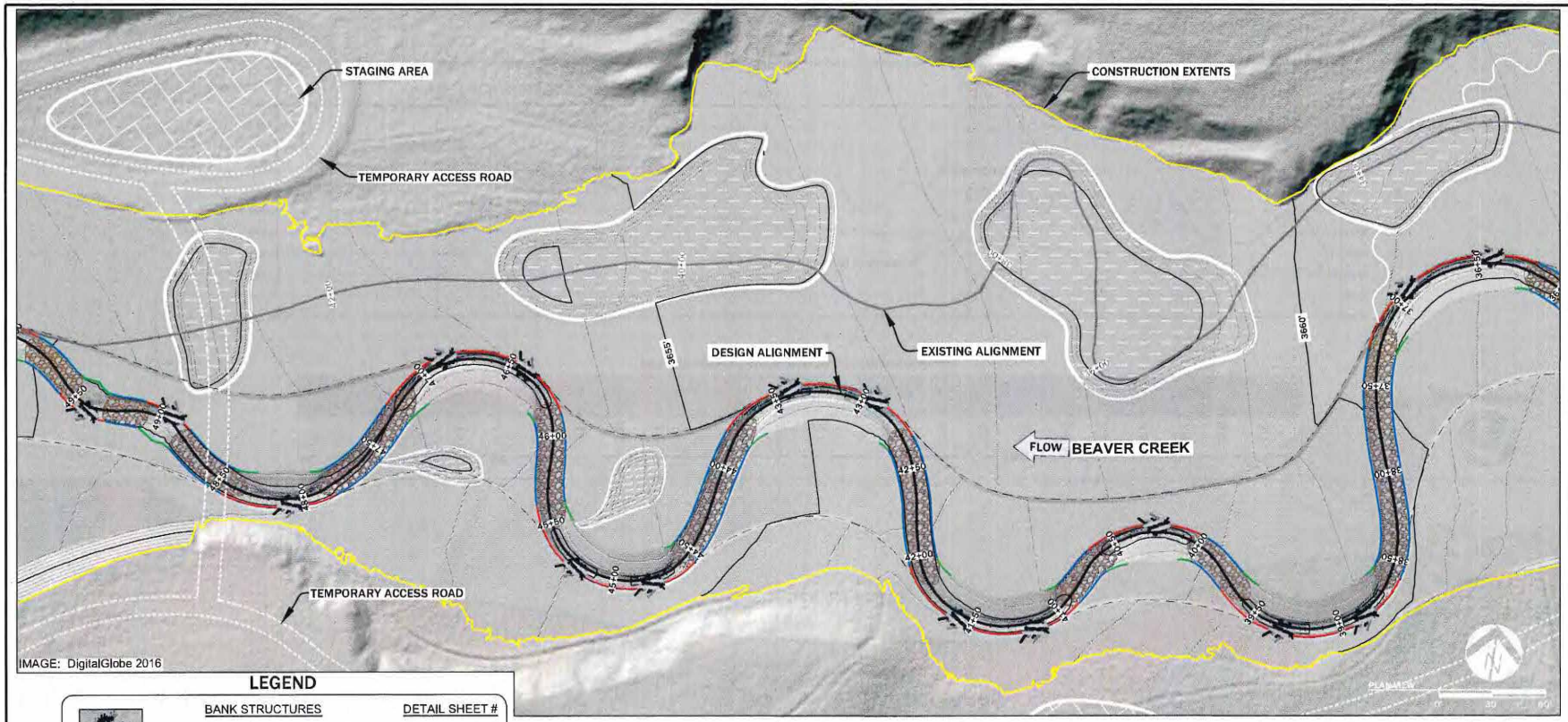
BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.3



LEGEND

BANK STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	8.0
VEGETATED WOOD MATRIX TYPE 1 (VWM 1)	8.1
VEGETATED WOOD MATRIX TYPE 2 (VWM 2)	8.1
VEGETATED WOOD MATRIX TYPE 3 (VWM 3)	8.1
CHANNEL STRUCTURES	
CONSTRUCTED RIFFLE (CR)	8.2
FLOODPLAIN FEATURES	
OFF-CHANNEL EMERGENT WETLAND	
ALCOVE	
CONNECTOR CHANNEL	

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)	STATION	ELEVATION (FT)
37+00	3660.57	43+00	3655.26
38+00	3659.69	44+00	3654.49
39+00	3658.80	45+00	3653.71
40+00	3657.91	46+00	3652.94
41+00	3657.03	47+00	3652.16
42+00	3656.14	48+00	3651.39
		49+00	3650.62

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
36+48	36+85	R	VWM 3	40+49	40+98	C	CR	43+66	43+81	L	VWM 1	47+27	47+82	L	VWM 2
36+85	36+95	R	LWS	40+49	40+64	L	VWM 1	43+81	44+54	L	VWM 2	47+27	47+82	R	VWM 2
36+95	37+30	R	VWM 3	40+64	40+89	L	VWM 2	43+81	44+54	R	VWM 2	47+82	47+91	R	VWM 1
37+15	38+67	C	CR	40+64	40+89	R	VWM 2	44+54	44+63	R	VWM 1	47+82	48+02	L	VWM 3
37+15	37+30	L	VWM 1	40+89	40+98	R	VWM 1	44+54	44+74	L	VWM 3	48+02	48+12	L	LWS
37+30	38+58	L	VWM 2	40+89	41+09	L	VWM 3	44+74	44+84	L	LWS	48+12	48+46	L	VWM 3
37+30	38+58	R	VWM 2	41+09	41+19	L	LWS	44+84	45+17	L	VWM 3	48+31	48+89	C	CR
38+58	38+67	R	VWM 1	41+19	41+52	L	VWM 3	45+17	45+27	L	LWS	48+31	48+46	R	VWM 1
38+58	38+80	L	VWM 3	41+52	41+62	L	LWS	45+27	45+61	L	VWM 3	48+46	48+83	L	VWM 2
38+80	38+90	L	LWS	41+62	41+96	L	VWM 3	45+46	46+21	C	CR	48+46	48+83	R	VWM 2
38+90	39+27	L	VWM 3	41+81	42+75	C	CR	45+46	45+61	R	VWM 1	48+83	48+89	R	VWM 3
39+27	39+37	L	LWS	41+81	41+96	R	VWM 1	45+61	46+12	L	VWM 2	48+89	48+99	R	LWS
39+37	39+73	L	VWM 3	41+96	42+66	L	VWM 2	45+61	46+12	R	VWM 2	48+99	49+10	R	VWM 3
39+58	40+09	C	CR	41+96	42+66	R	VWM 2	46+12	46+21	L	VWM 1	49+02	49+36	C	CR
39+58	39+73	R	VWM 1	42+66	42+75	L	VWM 1	46+12	46+35	R	VWM 3	49+10	49+36	L	VWM 2
39+73	40+00	L	VWM 2	42+66	42+89	R	VWM 3	46+35	46+45	R	LWS	49+10	49+30	R	VWM 2
39+73	40+00	R	VWM 2	42+89	42+99	R	LWS	46+45	46+82	R	VWM 3	49+36	49+46	L	LWS
40+00	40+09	L	VWM 1	42+99	43+35	R	VWM 3	46+82	46+92	R	LWS	49+46	49+57	L	VWM 2
40+00	40+20	R	VWM 3	43+35	43+45	R	LWS	46+92	47+27	R	VWM 3				
40+20	40+30	R	LWS	43+45	43+81	R	VWM 3	47+12	47+91	C	CR				
40+30	40+64	R	VWM 3	43+66	44+63	C	CR	47+12	47+27	L	VWM 1				

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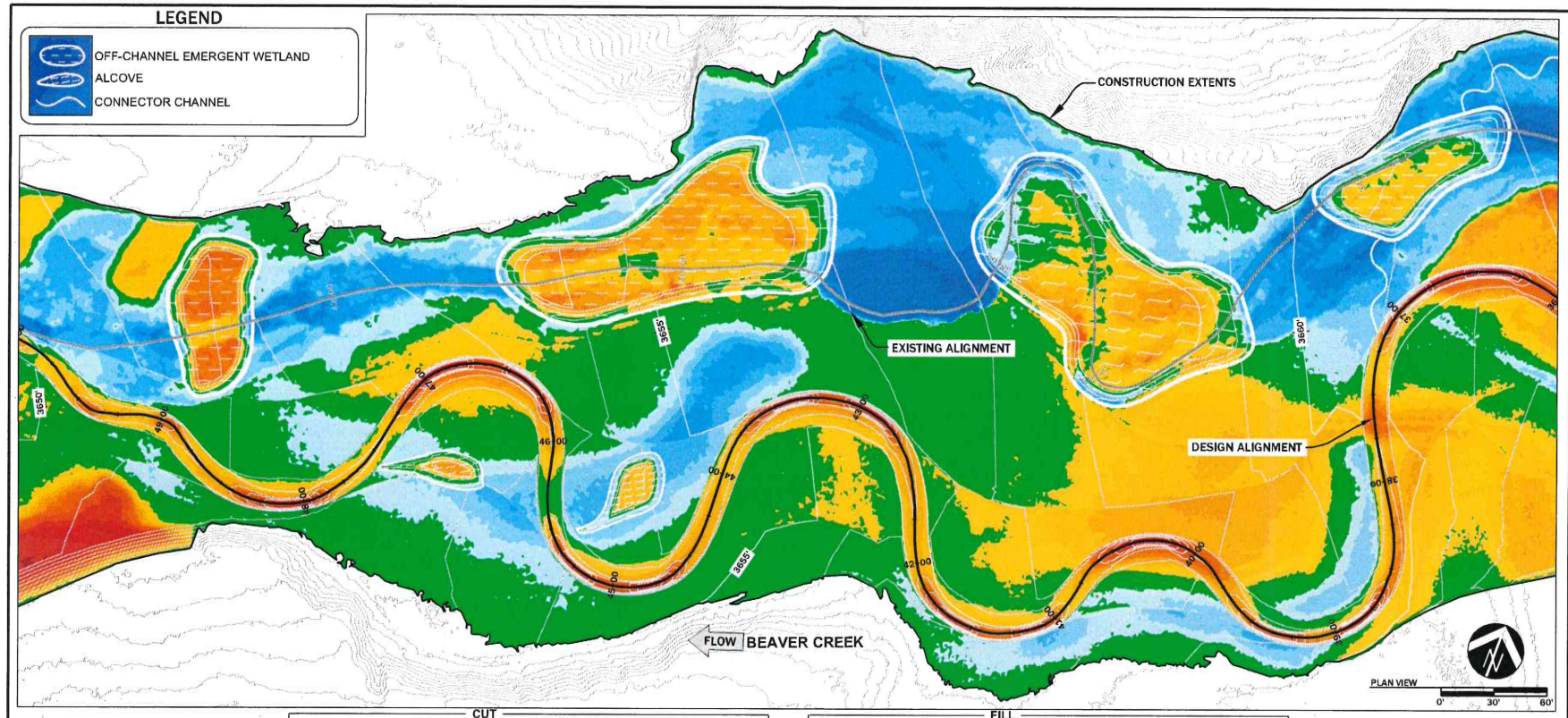
PLAN VIEW AND STRUCTURE LAYOUT

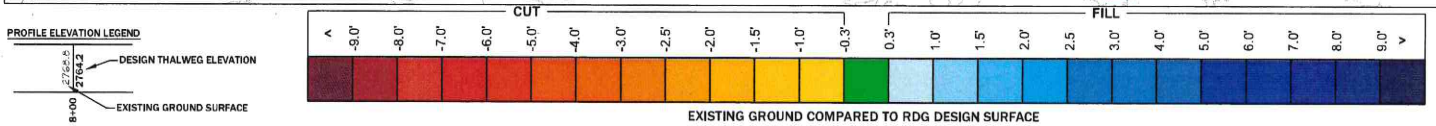
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

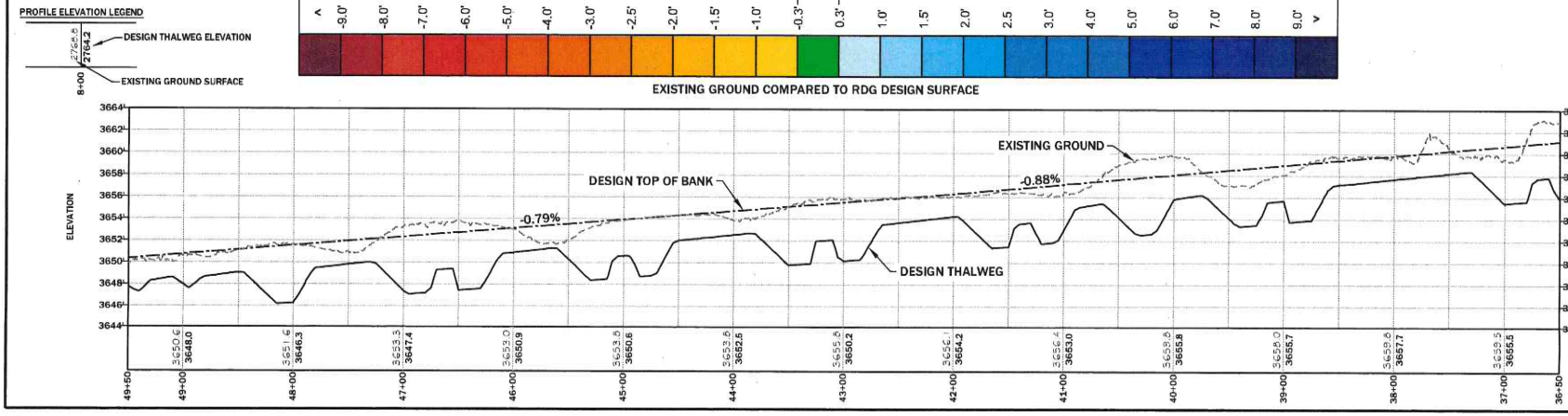
NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.4







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GRADING PLAN AND PROFILE

BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

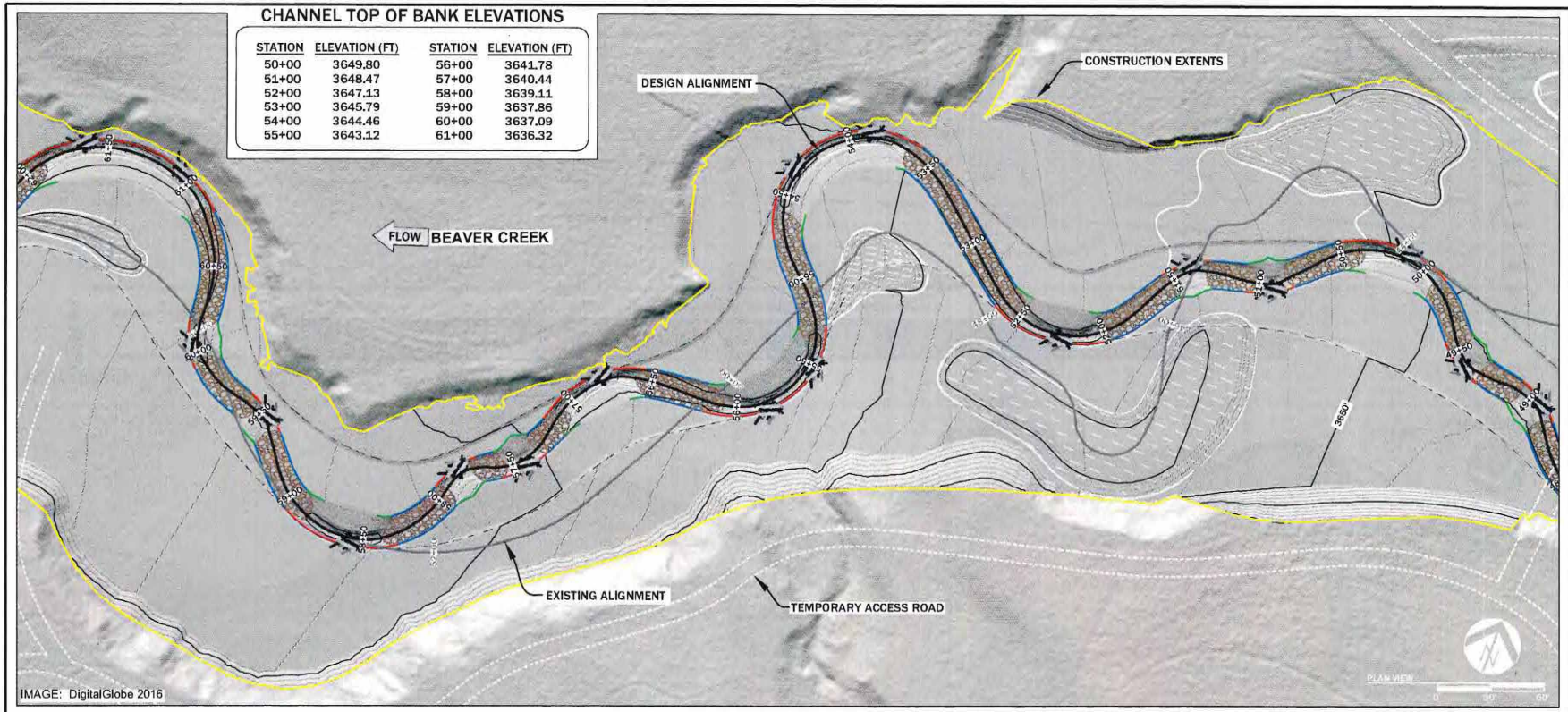
NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.5

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)	STATION	ELEVATION (FT)
50+00	3649.80	56+00	3641.78
51+00	3648.47	57+00	3640.44
52+00	3647.13	58+00	3639.11
53+00	3645.79	59+00	3637.86
54+00	3644.46	60+00	3637.09
55+00	3643.12	61+00	3636.32



LEGEND

BANK STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	8.0
VEGETATED WOOD MATRIX TYPE 1 (VWM 1)	8.1
VEGETATED WOOD MATRIX TYPE 2 (VWM 2)	8.1
VEGETATED WOOD MATRIX TYPE 3 (VWM 3)	8.1
CHANNEL STRUCTURES	
CONSTRUCTED RIFFLE (CR)	8.2
FLOODPLAIN FEATURES	
OFF-CHANNEL EMERGENT WETLAND	
ALCOVE	
CONNECTOR CHANNEL	

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
49+49	49+96	C	CR	52+29	52+64	L	VWM 3	56+19	56+54	L	VWM 2	58+52	58+62	L	LWS
49+57	49+96	L	VWM 1	52+49	53+68	C	CR	56+19	56+54	R	VWM 2	58+62	58+96	L	VWM 3
49+57	49+88	R	VWM 2	52+49	52+64	R	VWM 1	56+54	56+63	L	VWM 1	58+81	59+41	C	CR
49+88	50+07	R	VWM 3	52+64	53+60	L	VWM 2	56+54	56+75	R	VWM 3	58+81	58+96	R	VWM 1
50+07	50+17	R	LWS	52+64	53+60	R	VWM 2	56+75	56+85	R	LWS	58+96	59+35	L	VWM 2
50+17	50+51	R	VWM 3	53+60	53+68	L	VWM 1	56+85	57+18	R	VWM 3	58+96	59+35	R	VWM 2
50+36	50+87	C	CR	53+60	53+82	R	VWM 3	57+04	57+37	C	CR	59+35	59+41	R	VWM 3
50+36	50+51	L	VWM 1	53+82	53+92	R	LWS	57+04	57+18	L	VWM 1	59+41	59+51	R	LWS
50+51	50+87	L	VWM 2	53+92	54+29	R	VWM 3	57+18	57+37	L	VWM 2	59+51	59+61	R	VWM 3
50+51	50+81	R	VWM 2	54+29	54+39	R	LWS	57+18	57+31	R	VWM 2	59+54	59+97	C	CR
50+87	50+97	L	LWS	54+39	54+75	R	VWM 3	57+31	57+31	R	VWM 1	59+61	59+97	L	VWM 2
50+97	51+28	L	VWM 2	54+60	55+37	C	CR	57+37	57+47	L	LWS	59+61	59+92	R	VWM 2
51+00	51+34	C	CR	54+60	54+75	L	VWM 1	57+47	57+69	L	VWM 2	59+97	60+07	L	LWS
51+08	51+28	R	VWM 2	54+75	55+28	L	VWM 2	57+50	57+75	C	CR	60+07	60+79	L	VWM 2
51+28	51+34	R	VWM 3	54+75	55+28	R	VWM 2	57+58	57+69	R	VWM 2	60+11	60+88	C	CR
51+34	51+44	R	LWS	55+28	55+37	R	VWM 1	57+69	57+75	R	VWM 3	60+19	60+79	R	VWM 2
51+44	51+55	R	VWM 3	55+28	55+46	L	VWM 3	57+75	57+85	R	LWS	60+79	60+88	L	VWM 1
51+47	52+07	C	CR	55+46	55+56	L	LWS	57+85	57+96	R	VWM 3	60+79	61+01	R	VWM 3
51+55	51+98	L	VWM 2	55+56	55+78	L	VWM 3	57+88	58+40	C	CR	61+01	61+11	R	LWS
51+55	51+98	R	VWM 2	55+78	55+88	L	LWS	57+96	58+31	L	VWM 2	61+11	61+58	R	VWM 3
51+98	52+07	R	VWM 1	55+88	56+19	L	VWM 3	57+96	58+31	R	VWM 2	61+58	61+68	R	LWS
51+98	52+19	L	VWM 3	56+04	56+63	C	CR	58+31	58+40	R	VWM 1				
52+19	52+29	L	LWS	56+04	56+19	R	VWM 1	58+31	58+52	L	VWM 3				

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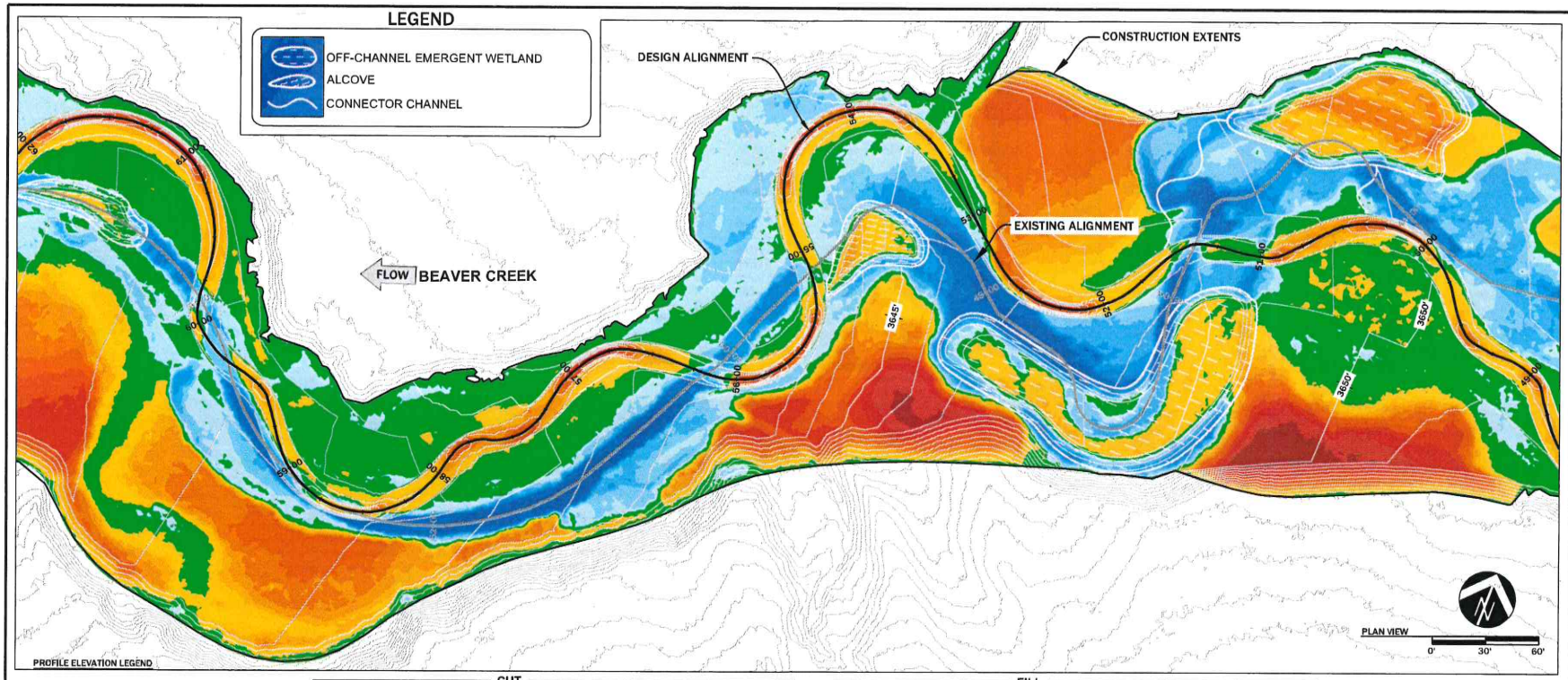
PLAN VIEW AND STRUCTURE LAYOUT

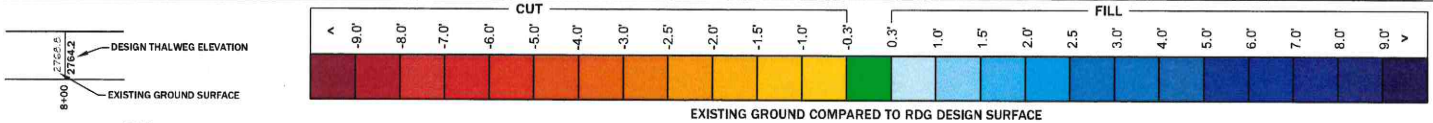
BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

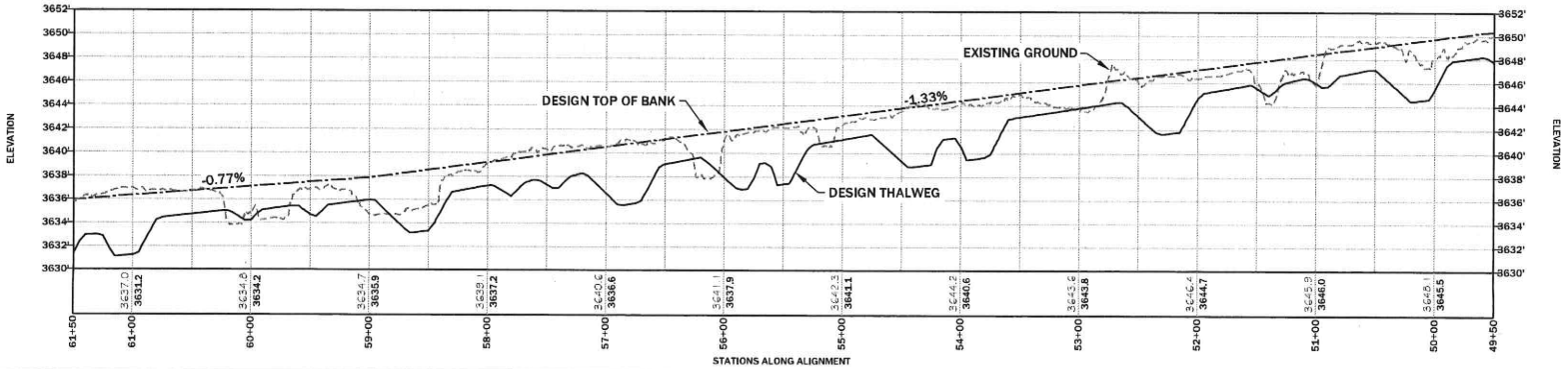
NO.	DATE	BY	DESCRIPTION	CHK
1	11-6-18	NW	FINAL DESIGN	JM

PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.6







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GRADING PLAN AND PROFILE

BEAVER CREEK RESTORATION PROJECT

NEAR YORK, MONTANA

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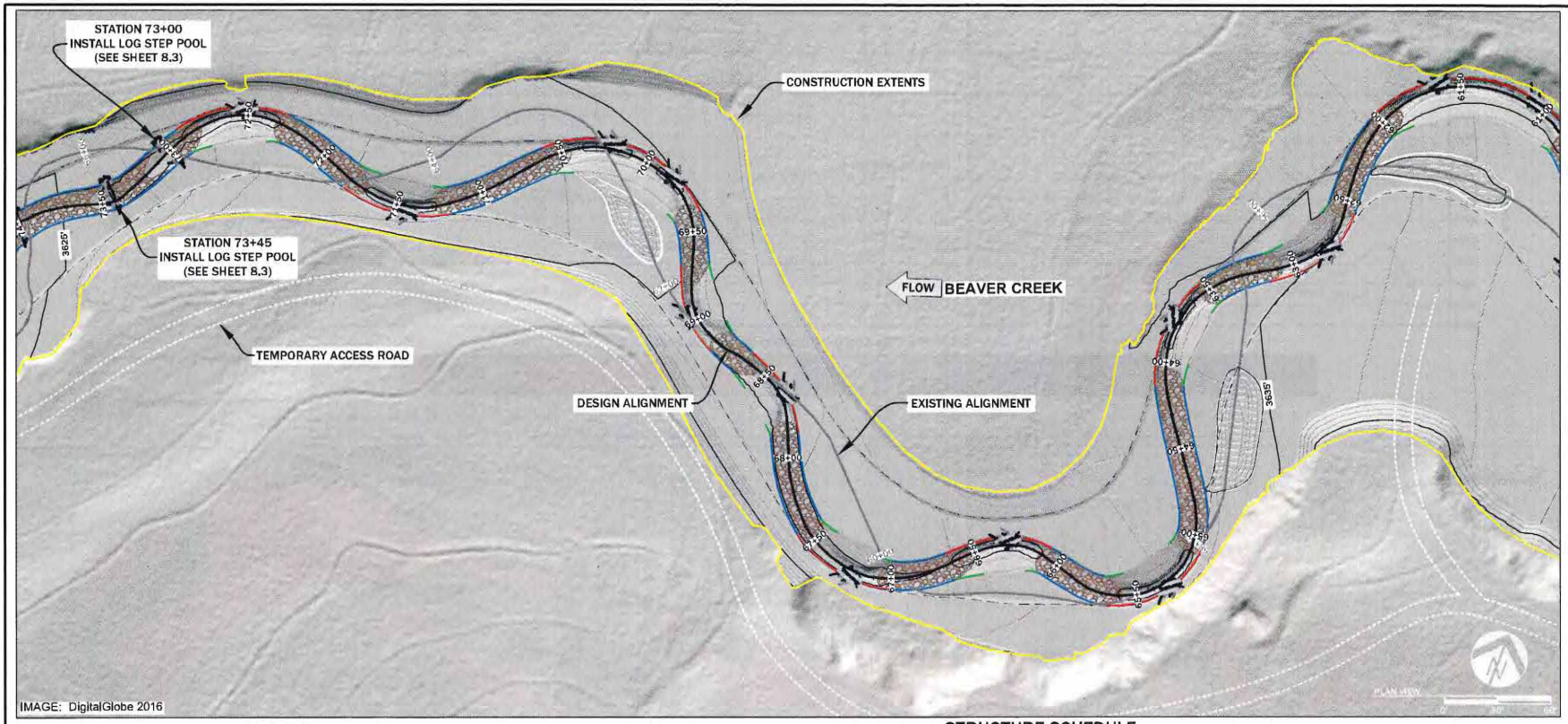
PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.7



LEGEND

BANK STRUCTURES	DETAIL SHEET #
LARGE WOOD STRUCTURE (LWS)	8.0
VEGETATED WOOD MATRIX TYPE 1 (VWM 1)	8.1
VEGETATED WOOD MATRIX TYPE 2 (VWM 2)	8.1
VEGETATED WOOD MATRIX TYPE 3 (VWM 3)	8.1
CHANNEL STRUCTURES	
CONSTRUCTED RIFFLE (CR)	8.2
LOG STEP POOL	8.3
FLOODPLAIN FEATURES	
ALCOVE	

CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)	STATION	ELEVATION (FT)
62+00	3635.55	68+00	3630.94
63+00	3634.79	69+00	3630.17
64+00	3634.02	70+00	3629.40
65+00	3633.25	71+00	3628.64
66+00	3632.48	72+00	3627.87
67+00	3631.71	73+00	3626.51

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
61+68	62+03	R	VWM 3	65+02	65+25	L	VWM 3	67+58	68+14	R	VWM 2	70+25	70+59	R	VWM 3
61+88	62+64	C	CR	65+25	65+35	L	LWS	68+14	68+22	L	VWM 1	70+44	71+28	C	CR
61+88	62+03	L	VWM 1	65+35	65+70	L	VWM 3	68+14	68+31	R	VWM 3	70+44	70+59	L	VWM 1
62+03	62+55	L	VWM 2	65+55	66+17	C	CR	68+31	68+41	R	LWS	70+59	71+20	L	VWM 2
62+03	62+55	R	VWM 2	65+55	65+70	R	VWM 1	68+41	68+64	R	VWM 3	70+59	71+20	R	VWM 2
62+55	62+64	R	VWM 1	65+70	66+08	L	VWM 2	68+53	68+90	C	CR	71+20	71+28	R	VWM 1
62+55	62+74	L	VWM 3	65+70	66+08	R	VWM 2	68+53	68+64	L	VWM 1	71+20	71+39	L	VWM 3
62+74	62+84	L	LWS	66+08	66+17	L	VWM 1	68+64	68+81	L	VWM 2	71+39	71+49	L	LWS
62+84	63+16	L	VWM 3	66+08	66+26	R	VWM 3	68+64	68+81	R	VWM 2	71+49	71+81	L	VWM 3
63+01	63+58	C	CR	66+26	66+36	R	LWS	68+81	68+90	R	VWM 1	71+66	72+36	C	CR
63+01	63+16	R	VWM 1	66+36	66+66	R	VWM 3	68+81	68+99	L	VWM 3	71+66	71+81	R	VWM 1
63+16	63+49	L	VWM 2	66+51	67+10	C	CR	68+99	69+09	L	LWS	71+81	72+28	L	VWM 2
63+16	63+49	R	VWM 2	66+51	66+66	L	VWM 1	69+09	69+32	L	VWM 3	71+81	72+28	R	VWM 2
63+49	63+58	L	VWM 1	66+66	67+01	L	VWM 2	69+21	69+68	C	CR	72+28	72+36	L	VWM 1
63+49	63+70	R	VWM 3	66+66	67+01	R	VWM 2	69+21	69+32	R	VWM 1	72+28	72+47	R	VWM 3
63+70	63+80	R	LWS	67+01	67+10	R	VWM 1	69+32	69+59	L	VWM 2	72+47	72+57	R	LWS
63+80	64+14	R	VWM 3	67+01	67+18	L	VWM 3	69+32	69+59	R	VWM 2	72+57	72+90	R	VWM 3
63+99	65+11	C	CR	67+18	67+28	L	LWS	69+59	69+68	L	VWM 1	72+75	73+00	C	CR
63+99	64+14	L	VWM 1	67+28	67+58	L	VWM 3	69+59	69+79	R	VWM 3	72+75	72+90	L	VWM 1
64+14	65+02	L	VWM 2	67+43	68+22	C	CR	69+79	69+89	R	LWS				
64+14	65+02	R	VWM 2	67+43	67+58	R	VWM 1	69+89	70+15	R	VWM 3				
65+02	65+11	R	VWM 1	67+58	68+14	L	VWM 2	70+15	70+25	R	LWS				

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PLAN VIEW AND STRUCTURE LAYOUT

BEAVER CREEK RESTORATION PROJECT
NEAR YORK, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
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PROJECT NUMBER
RDG-17-006

SHEET NUMBER
5.8