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# UPPER FRENCH GULCH FISH PASSAGE AND RESTORATION PROJECT

## FINAL REPORT

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December 2022



Prepared for:

**DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION'S (DNRC)  
RECLAMATION AND DEVELOPMENT GRANTS PROGRAM (RDGP)**

Prepared by:



# UPPER FRENCH GULCH FISH PASSAGE AND RESTORATION PROJECT

**GRANT NUMBER:** RITP-22-8899  
**RDGP GRANT:** \$194,611.36  
**TOTAL PROJECT COSTS:** \$238,411.65

## PROJECT SPONSOR:

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Contact Ben LaPorte at [blaporte@bhwc.org](mailto:blaporte@bhwc.org) for inquiries.

## SUPPORTING DOCUMENTS/DELIVERABLES:

- Attachment A: Final Designs
- Attachment B: Upper French Gulch Hydrology and Hydraulics-Technical Memo
- Attachment C: MMI Upper French Gulch Final Construction Completion Report

## THANK YOU TO:

**Department of Natural Resources Conservation**  
Jorri Dyer, RDGP Program Manager



IN APPRECIATION

This project is the work of many hands over many years. With persuasion and perseverance, this project marched forward from early concepts in 2019 to completion in 2022. The results are attributed to the funding of both merit-based and generous sponsors, the commitment of the individuals representing the partners developing and completing the work, the quality and commitment of many outstanding contractors, and the support of the community, including many conservation organizations and groups.

A sincere thank you to those involved in the partnership effort that brought this project to completion in the name of conservation of water and habitat. The restored ecosystem of Upper French Gulch will benefit the land and people of the Big Hole River long into the future.

THANK YOU TO:

**Morrison Maierle, Inc.**

Christine Percy, Environmental Scientist

**Montana Fish, Wildlife and Parks**

Jim Olsen, Fisheries Biologist

Vanna Boccadori, Wildlife Biologist

**George Grant Trout Unlimited**

Forrest Jay, President

**Anonymous Private Donor**

**Big Hole Watershed Committee Conservation Fund**

**Watershed Consulting LLC**

Contractor



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## Project History

Since 2014, the Big Hole Watershed Committee (BHWC) has invested significant time and energy into the French Creek drainage, a major tributary to the Big Hole River. Restoration projects in adjacent tributaries and the nearby Superfund site have all worked toward the common goals of reducing sediment and improving habitat for native fish. The Upper French Gulch Fish Passage and Restoration Project achieved these shared goals and is seen as the last major restoration project in the drainage, which has seen over 3.5 million dollars invested in the last 10 years.

The Upper French Gulch Fish Passage and Restoration Project area was the location of the first gold strike in the Big Hole drainage in the 1860s, and mining occurred through the early 1900s. The project is located approximately 0.5 miles upstream from the confluence of Julius Gulch and represents the most heavily mined area in the drainage. At the head of the main mining area, there was a very large head-cut where the stream dropped approximately 30-40 feet from its former channel elevation to the elevation of the mining work downstream. This drop and a perched culvert immediately upstream formed a complete barrier to fish passage. Downstream of the fish barrier, the stream flows through approximately 2,000 feet of confinement, where the stream is bordered directly by rock walls and mine excavations, known as the "Chinese Wall." Below this point, several bare and erosive stream banks contributed to chronic sedimentation of the system, resulting in poor quality fish and spawning habitat for Westslope cutthroat trout and Arctic grayling.

In 2019, the Deer Lodge Valley Conservation District (DLVCD) and the BHWC received a Planning Grant (RITP-19-0155) from the Montana Department of Natural Resources and Conservation (DNRC) Renewable Resource Grant and Loan Program (RDGP) to conduct an alternatives analysis. The end goal of the alternatives analysis was to select an appropriate restoration action and develop preliminary designs to address the mining-related barriers to fish movement, degraded fish habitat and reduce sources of fine sediment to the system. A total of four alternatives with correlating conceptual designs and cost estimates were established. After review and analysis between Montana Fish, Wildlife and Parks (MFWP), Morrison and Maierle, Inc. (MMI), and the BHWC, the preferred action was chosen. Project partners agreed on the best method of stream reconnection based on multiple ecological, economic, and cultural factors. The funds from DNRC's RDGP Planning Grant allowed for the necessary steps and subsequent documents to come to this conclusion and were the foundation of the eventual project.

In 2021, the DLVCD, in partnership with the BHWC, received a DNRC RDGP Project grant with the primary goal of implementing the chosen alternative to restore fish passage and connect 1.7 miles of pristine stream to the upper reaches of French Gulch. The secondary goal was to restore two eroding streambanks downstream of the cascade by revegetating and applying bioengineering techniques with hand crews and equipment.

This project grant had six tasks and associated sub-tasks:

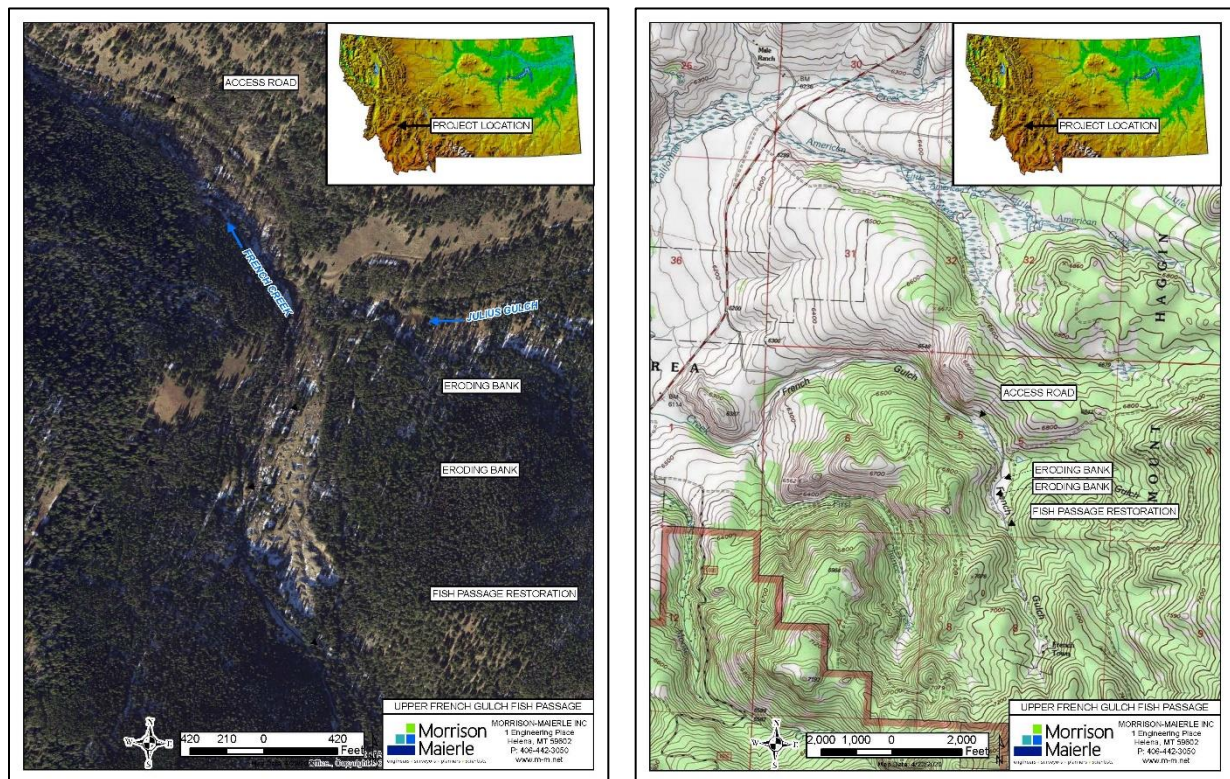
- **Task 1: Project Design**
  - Survey
  - Final Design

- **Task 2: Permitting**
- **Task 3: Bidding**
- **Task 4: Fish Passage Structure Construction**
  - Construction Cost plus Contingency Cost
  - Construction Oversight
- **Task 5: Low-Tech Restoration on Eroding Banks**
- **Task 6: Project Management**
  - Administration for DLVD at 3% of total
  - BHCW Project Coordination

This final report summarizes these tasks and identifies how they were completed throughout this project grant. Difficulties were encountered during the construction of the fish passage structure, but there were no deviations from the proposed scope of work and the final project results.

## Project Location

French Gulch is a headwater tributary of French Creek, which flows into Deep Creek, which feeds into the Big Hole River upstream of Dickie Bridge. French Gulch is located on the Mount Haggin Wildlife Management Area, approximately 17 miles southeast of Anaconda in Anaconda Deer Lodge County ([Figure 1](#)).



**Figure 1.** Upper French Gulch Fish Passage and Restoration Project site location.

## Project Purpose

There are no fish in Upper French Gulch above the Chinese Wall and cascade. It is very likely the fish existed upstream of the cascade before mining, given the size of the stream and the available habitat. Less impactful placer and hard-rock mining also occurred upstream of the cascade, which likely resulted in the extirpation of fish. However, as habitat conditions naturally improved, fish were not able to recolonize the stream because of the cascade and perched culvert fish barriers (Figure 2). Allowing fish access to this valuable habitat will aid in increasing and conserving the diminishing populations of native fish in the drainage. With the completion of this project, fish will once again be able to utilize the entirety of this headwater stream. Furthermore, the restoration of the eroding streambanks downstream of the Chinese Wall (Figure 2) will aid in improving water quality in French Gulch.

This project also coincides with Montana's second-largest native fish restoration project (2020 to 2025). The entire French Creek drainage is currently being restored to native species, including Arctic grayling and Westslope cutthroat trout. Once restored, the French Creek population will represent one of the largest interconnected populations of Westslope cutthroat trout in the upper Missouri River drainage and the only population of fluvial Arctic grayling in the absence of non-native species. Adding 2 miles in French Gulch will bring the total mileage of occupied stream to nearly 42 miles.



**Figure 2.** Fish barriers in the project area prior to restoration. This is the location where major mining activities stopped in French Gulch, creating the 30-foot-high, unnaturally steep cascade that plunged from the original valley height down to the current elevation. At the head of the cascade sat a perched culvert where an old road crossed the stream.





Figure 2. High eroding bank (left) and bare eroding bank (right) below the cascade.

## Project Planning

This project underwent a comprehensive multiyear planning process. The 2019 DNRC RDGP Planning Grant (RITP-19-0155) enabled project partners to establish the initial geomorphic site investigation, engineered survey, wetlands delineation, alternatives analysis, and conceptual designs/cost estimates. Those tasks and activities are summarized in the 2020 *Upper French Gulch Fish Passage and Restoration Project-Alternatives Analysis: Final Report* and set the stage for the eventual implementation and tasks provided by this Project Grant. Those tasks are detailed below.

## Tasks Accomplished

### Task 1: Project Design

#### Survey

This task was initially meant for MMI to physically gather a final survey of the cascade barrier and surrounding area needed for the final design and accurate earthwork quantities. The previous survey was completed with a drone and GPS equipment in which the vertical accuracy was less than typical for a design. Upon further investigation, the MMI engineering team was able to utilize free, publicly available LiDAR (DNRC's Montana LiDAR Inventory) to fill data gaps and ensure accurate earthwork quantities. This effort eliminated the need for an on-the-ground survey team and associated costs. The LiDAR data for the site was incorporated into the next phase of project designs.

## Hydrology and Hydraulics-Technical Memo

Because MMI did not need to send a survey crew up to the site and spend hours synthesizing the data, BHWC used the line item (\$2,602.00) to pay for MMI's *Upper French Gulch Hydrology and Hydraulics-Technical Memo* (Attachment B). The hydrology and hydraulics report was a required deliverable/stipulation to send to the DNRC before project implementation. The report details additional data and analysis (e.g., design discharges (hydrology), hydraulics at varying flows, bed and bank stability, and the comparison of hydraulic conditions to fish swimming and jumping ability) documenting the likely success of the step-pool structure. Before submission, MFWP and USFS personnel reviewed and approved the report.

## Final Design

The originally proposed design consisted of a series of zig-zags/meanders built at a 14% slope. The thought was that building sinuosity into the design would eliminate the impact on the Chinese Wall and allow for the construction of large pools at 90-degree turns to allow energy to dissipate. Due to valid concerns of water seeping through and in between the meanders and the potential risk of losing surface flow during the summer and fall months, our team decided to eliminate the sinuosity in the step-pool system. Utilizing the LiDAR data, MMI found that we could extend the project footprint upstream to extend the length of the step-pool system required for a straight stream alignment. It was decided that the high-gradient creek naturally wants to go straight, and adding steep meanders wouldn't match the natural settings of the system. It was clear after more thought that we would be working very hard to keep the water in our step-pool system.

After the decision to move away from the sinuous alignment, project partners received a series of draft designs from MMI. After multiple rounds of feedback and comments from BHWC and MFWP, the final designs were officially completed in early March 2022. Updated design features included incorporating large and deep resting pools throughout the step-pool system, extending the project footprint upstream in order to extend the length of the step-pool system required for a straight stream alignment, and reducing the steepness of the "trough" side slopes (previously 1:1, now 2:1) to aid in vegetation establishment and soil stability. All of the access routes were agreed upon, and excess fill material (estimated ~4000 cubic yards of earthwork) zones were established.

## Task 2: Permitting

BHWC secured all the necessary permits and followed up with agencies and partners to secure all regulatory compliance. BHWC began the permitting process in March 2022. BHWC drafted the Joint Application document to be sent to local, state, and federal agencies and sent it to MMI for editing and additional narrative. MMI improved the document by giving specific details on the project dimensions, materials to be used, and planned efforts to minimize project impacts. The Joint Application was finalized and sent to Montana Fish, Wildlife and Parks (SPA 124), U.S. Army Corps of Engineers (Section 404), and the Department of Environmental Quality (318 Authorization and 401 Certification) on May 24, 2022. Cultural inventory and consultation with SHPO had already taken place under the previous RDGP Planning Grant (RITP-19-0155). BHWC received the SPA 124 and 318 Authorization from MFWP and DEQ on June 7, 2022, and the USACE 404 and DEQ 401 Authorization on July 22, 2022. All

required permits and compliance documents were sent to DNRC as part of the DNRC RDGP Grant Submittal Checklist on July 29, 2022.

### Task 3: Bidding

MMI, with BHWC consultation, developed a bid package (Invitation to Bid, Bid Form, Qualifications Required of Bidders, Measurement and Payment, and Contract and Agreement) to begin the bidding process. The project, with the correlating bid forms and final designs, was officially available to the public on March 23, 2022. Complete electronic Project Plans, Project Specifications, and Bid Proposal Packet were available at the Morrison-Maierle, Inc. website. The Montana Standard and Dillon Tribune also advertised the project for three consecutive weeks (Montana Standard – 3/26, 4/2, 4/9 and Dillon Tribune – 3/23, 3/30, 4/6).

BHWC held a mandatory pre-bid conference at 10:00 am on April 25, 2022. Roughly 9-10 contractors were present at the meeting. Construction bids were closed on May 2, 2022, at 12 pm. There was one qualified bidder. MMI reviewed the bid information submitted and found Watershed Consulting, LLC to be the lowest responsible bidder. The total bid was \$116,810.40. MMI sent Watershed Consulting an official Notice of Award and worked through the construction contracting and associated Agreement documentation. MMI, Watershed Consulting, and BHWC held a pre-construction meeting on-site on June 14, 2022 (Figure 3). All required bid and award documentation was sent to DNRC as part of the DNRC RDGP Grant Submittal Checklist on July 29, 2022.



Figure 3. MMI, Watershed Consulting and BHWC at the project site during the June 14, 2021 pre-construction meeting.

## Task 4: Fish Passage Structure Construction

### Construction Cost plus Contingency

Watershed Consulting started project implementation on July 28, 2022, and completed construction on October 6, 2022. Figure 4 shows the before and after photos looking upstream. The stream crossing and access routes were established first. Then, the project site was cleared of trees to make room for work. All slash and forest by-product material was stockpiled and set aside for later use. Next, the diversion ditch was constructed and activated to remove water from the active project site. Once the diversion ditch was activated, the main digging and construction began. On August 30, 2022, Watershed Consulting hit an unexpected impenetrable bedrock layer in the project alignment that halted operations until the arrival of a hydraulic jackhammer attachment. The hydraulic jackhammer attachment arrived on September 15, 2022, and was used on-site for seven days. Watershed Consulting broke through the hard rock vein and proceeded with normal construction operations once through the hard rock layer. Water was activated into the new channel on September 28, 2022. Watershed Consulting then decommissioned the diversion ditch, slashed the side slopes, and completed demobilization. In total, 31 step-pools were built to restore fish passage. All disturbed areas have been seeded using a native upland mix.



Figure 4. Before and after photo of the completed project, looking upstream.

Photos of the construction sequence are below:



*First stream crossing and straw wattle BMP entering the project area.*



*Second stream crossing and straw wattle BMP entering the staging area. Both stream crossings used 18" x 30 corrugated metal pipes.*



*Clearing the project area of trees to enable room to work.*



*Cleared project area. Slashed was stockpiled for later use.*



*Temporary diversion ditch construction prior to plastic lining.*



*Installation of 30mi PVC plastic lining in temporary stream diversion.*



*24" x 65' ADS culvert used at the bottom of stream diversion to direct streamflow from the ditch to inside the original channel.*



*Temporary diversion ditch next to project site before activation*



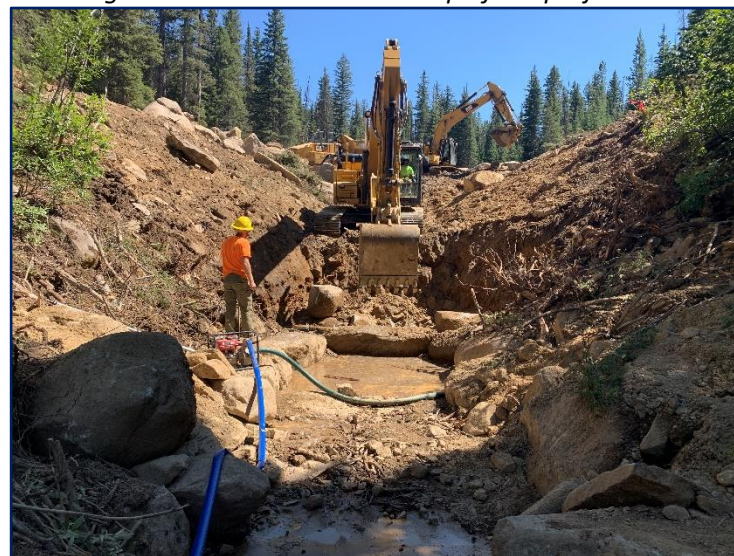
*Temporary diversion soon after stream flow was activated.*



*Subgrade excavation near the top of the project area.*



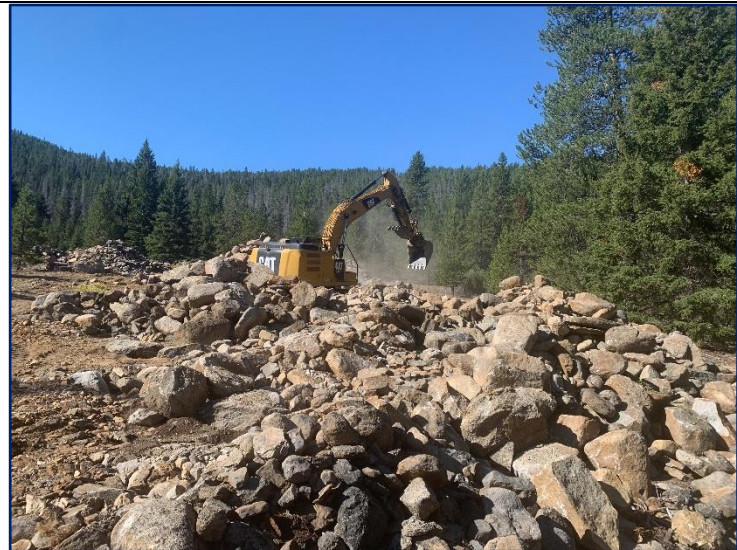
*Subgrade excavation and stockpiling of boulders used for step pool construction.*



*Construction of first step pool. Step pool construction began at the downstream tie-in point and extended to the upstream tie-in point.*



*Excavator loading haul truck to be sent to the fill area.*



*Excavator sorting and stockpiling in the salvage boulder area.*



*Roughly halfway through construction, before encountering the hard rock layer*

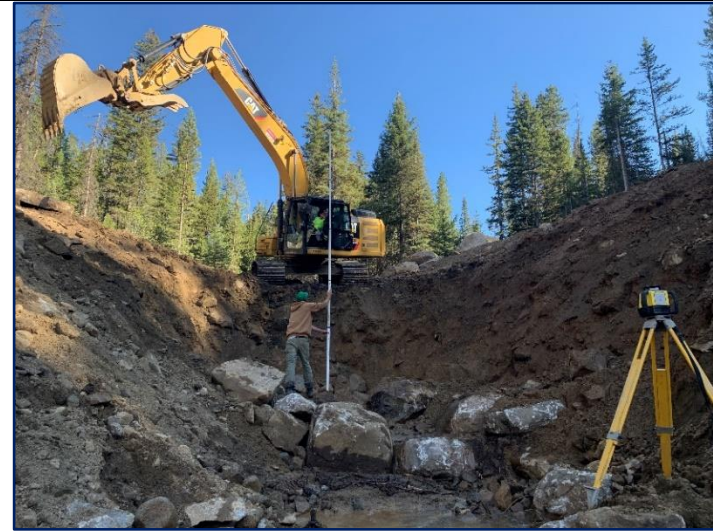


*Unexpected impenetrable bedrock layer in the project alignment.*





*Bedrock layer broken up after the first use of the hydraulic jackhammer attachment.*



*Step-pool construction behind and out of the hard rock layer.*



*Dry step-pool structure before stream activation.*



*Final and completed project after stream activation.*

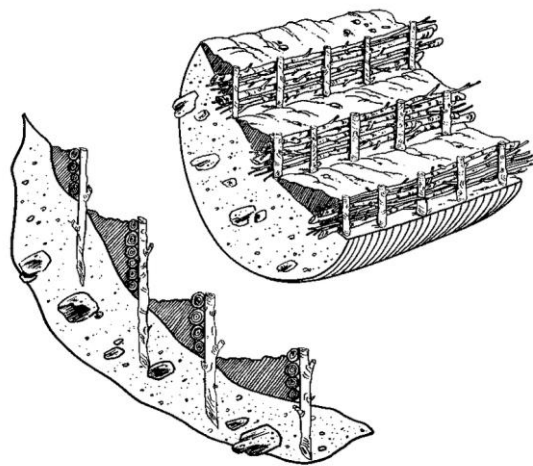
### Construction Oversight

Oversight by MMI and BHWC personnel was continuous throughout project construction. Scheduled check-in calls occurred weekly between MMI, BHWC, and Watershed Consulting to give updates on construction progress, problems encountered, and future phases. During and after construction, payment applications and submittals from Watershed Consulting were reviewed by MMI to ensure accurate tracking of progress, tracking of payments, and the construction was meeting project design requirements. MMI has developed the *Upper French Gulch Final Construction Completion Report* (Attachment C) that summarizes MMI's involvement during design, bidding and construction.

### Task 5 Low Tech Restoration on Eroding Banks

Restoration of eroding bank 1 (upper) and 2 (lower) are complete. A Montana Conservation Crew (MCC) performed the work on the upper bank from October 10-12, 2022. The work was focused on restoring/stabilizing the eroding streambank downstream of the cascade (now, the new fish passage step pools). The unnaturally steep and high eroding bank was caused by past mining and resource extraction. The bank was contributing to excessive sedimentation of the system, resulting in poor quality fish and spawning habitat. We used low-tech restoration and erosion control techniques, mainly wattle fences (Figure 5), to revegetate and spot-treat the eroding bank, reducing stream bank erosion and chronic sedimentation. Wattle fences are short retaining walls built out of live cuttings or logs. The walls take up the vertical component of the slope, reducing the effective slope angle and allowing vegetation to become established (Polster, 2015). After the wattle fences were installed, we seeded the bank to grow vegetation and establish roots.

The lower eroding bank was stabilized and revegetated using an excavator. This was the location of the second stream-crossing/culvert. During demobilization and pulling of the culvert, Watershed Consulting narrowed the over widened section of the channel, added large woody debris/root wads, and planted live willow clumps into the bank. MCC crews then came in and planted willow stakes near the water's edge and seeded with a native seed mix.



**Figure 5.** Illustration of wattle fences. Wattle fences have been successfully used on slopes as steep as 70 degrees (Polster, 2015).

Photos of the restoration of the eroding banks are below:



*First wattle fence at the toe of the steep eroding bank.*



*Wattle fence construction with the MCC crew.*



*Mid stabilization/wattle fence construction.*



*MCC crews working up high on the steep, eroding hillside/bank.*



*"Before" photo of the first high and eroding bank. Looking west.*



*"Before" photo of first high and eroding bank. Looking south.*



*"After" photo of first high and eroding bank post low-tech wattle fence installation. Looking west.*



*"After" photo of first high and eroding bank post low-tech wattle fence installation. Looking south.*



*“Before” photo of second eroding bank/stream crossing. Looking west*



*“After” photo of second eroding bank/stream crossing post-restoration. Looking west*



*Looking upstream at second eroding bank/stream crossing post-restoration. Note the large root was anchored in to both sides.*



*Looking downstream second eroding bank/stream crossing post-restoration. Note the large root was anchored into both sides.*

## **Task 4: Project Management**

The Deer Lodge Valley Conservation District was the lead applicant on this project and was responsible for all aspects of grant disbursement. The CD leaned heavily on its partnership with the Big Hole Watershed Committee who managed all aspects of the project reporting, accounting, and contracting for the CD. This same partnership has been used for recent DNRC projects since 2014, including French Gulch and Moose Creek placer mining reclamation, the Mt Haggin Uplands Restoration Project, and Phase 1 of Oregon Creek.

## **Goals and Objectives**

The goals and objectives of the project stated in the scope of work are:

### Goal 1: Restore Upstream Passage Connectivity for Native Fish

The first and primary goal of this project is to restore upstream passage connectivity for native fish. There are no fish in upper French Gulch above the Chinese Wall, likely due to the mining that occurred upstream and the subsequent lack of fish passage that precluded recolonization. Major mining stopped at the end of the Chinese Wall and created an unnaturally steep, 30-foot-high cascade. This cascade blocks all upstream fish passage. Additionally, at the head of the cascade, a road was built across French Gulch to access the mine. The concrete culvert below the road is perched roughly 2 feet above the bed of the stream. Additionally, there are boulders below with no jump pool to allow fish to jump into the culvert, which also creates a barrier to upstream fish passage.

### Objective 1: Construct Step-Pool Fish Passage System

Replace the existing cascade and culvert barrier with a constructed step-pool fish passage system providing immediate connectivity to approximately 1.7 miles of previously fishless habitat and restore the entire upper watershed of French Gulch to a connected fishery.

### Goal 2: Improve Water Quality

The second goal of this project is to improve water quality, by reducing fine sediment loading to the stream. Two large, bare, eroding stream banks exist below the cascade and Chinese Wall. These degraded banks exist due to past anthropogenic mining activities and are contributing excess sediment into French Gulch.

### Objective 2: Restore Two Eroding Streambanks

Restore two eroding streambanks downstream of the cascade. Low-tech restoration and erosion control techniques will be used to revegetate and spot-treat the eroding banks, reducing excess stream bank erosion.

## Goals and Objectives Discussion

Both of the project's goals and objectives have been delivered and accomplished. The only actual deviation was that we did not use hand crews with hand tools to restore *both* eroding banks. Bank 1 (upper) was treated entirely using hand crews and low-tech techniques. However, bank 2 (lower) was treated using a combination of large equipment and low-tech methods. Because bank 2 was the second temporary stream crossing location, we needed to decommission the culvert during demobilization. We took advantage of the excavator and operator during this task. After Watershed Consulting pulled the culvert, they used the excavator to install large wood and revegetate the bank with willow transplants and sod mats. MCC crews then came in after and planted willow stakes near the water's edge and seeded all disturbed areas with a native seed mix.

The newly constructed step-pool system will likely shift during the spring of 2023. Smaller rocks, boulders, wood, and sediment will move through the system. Minor tweaks (handwork) are expected after the spring 2023 run-off depending on subsequent conditions to maximize fish passage.

## Problems Encountered and Solutions Adopted

### Unexpected Hard Rock Layer

Watershed Consulting, our contractor, hit a very hard rock layer about halfway through construction. This was an unforeseen obstacle that shifted the logistics of the project, budgeting, and contracting. The chosen alternative required the use of a hydraulic jackhammer attached to the excavator to punch through the bedrock. This was not part of the original bid and required a significant change order. Change Order 2 was signed on September 19, 2022, which put the remaining time of the project into a daily burn rate.

After Watershed Consulting hit the hard rock layer and BHWC found out about higher-than-expected construction costs, we implemented an emergency fundraising campaign. MFWP was able to contribute \$10,000.00 in cash match funds. Additionally, a private donation of \$19,200.00 came to the BHWC to be used toward restoration work in the French Creek drainage. On October 27, BHWC was able to secure another \$7,500.00 from George Grant Trout Unlimited. Lastly, BHWC pulled \$2,500.00 from our Conservation Fund to go toward construction. That left \$4,600.29 left in remaining funds to negotiate with Watershed Consulting. After a series of conversations and negotiations, BHWC, MMI, and Watershed Consulting agreed that the misunderstanding and subsequent budget shortage behind Change Order 2 would be contributed by Watershed Consulting as in-kind match to the project.

### October 17 Survey and Out-of-Spec Pools

On October 17, 2022, MMI, with BHWC support, carried out a post-completion inspection. Measurements of each step-pool, including length, width, step height, and approximate depth were collected. Out of the 31 pools built, 6 pools were observed to have step heights exceeding the specification of two feet, as recorded in the as-built records (2 of those 6 pools were off specification by .06 and .03 inches). During construction, MFWP provided input that that step heights of up to two feet were acceptable (rather than the maximum step height of 1.5 feet originally specified); this specification was adopted throughout the project.

These out-of-spec pools were not identified or flagged during construction or construction oversight, because the contractor was building the pools to perceived specifications in a dry channel. It is very difficult to predict where the water would flow once activated into the new step-pools. For, example, once water was activated into the new step-pool system, water found a void and flowed under and around one of the boulders in pool 28, dropping the elevation of the pool and therefore making the step height much higher than expected. This phenomenon was present in multiple pools. BHWC and MFWP anticipate these pools will naturally adjust during the spring runoff in 2023 and meet specified design criteria. Interstitial spaces will be filled, boulders will shift and the freshly disturbed system will mature. If those adjustments do not occur naturally, manipulation of rocks in the six pools can easily be altered by hand during the summer of 2023 to meet fish passage criteria. Voids can be filled/plugged to bring pool elevations up (therefore lowering the step elevations), rocks manipulated and placed to push the thalweg to a desired elevation to bring up pool elevations (therefore lowering the step elevations), rocks and wood can be strategically added to make mini step-pools to gain desired elevations. These tweaks to the system are, and have been very much expected (if do not occur naturally) and were not completed before the October 17, 2022 survey. As reflected in MMI's Final Construction Completion Report (page 3), MMI concurs that natural adjustments or additional handwork can bring the pools within their design criteria.

As noted in MFWP's December 22, 2022 letter to the DNRC, MFWP and the BHWC are committed to monitoring these step pools in the coming years to ensure restoration efforts facilitate fish movements and meet design criteria.

Lastly, MMI identified 4 pools outside of the specified length and width criteria. The lengths and widths used in the design were meant to give the contractor a sense of desired widths and lengths. Those dimensions, unlike the step heights were expected to vary, aiming to simulate a natural system. MFWP is aware of these step-pools and are not concerned with them retarding fish passage movement.

## **Natural Resources and Public Benefits**

The direct benefits of this project are:

1. The restoration of upstream fish passage to the upper 1.7 miles of French Gulch that were previously inaccessible and;
2. The improvement of water quality and fish habitat by restoring the large, eroding streambanks.

The benefits of upstream fish passage will not be realized for at least five more years. In September 2022, FWP completed the first round of reintroductions of Artic grayling and Westslope Cutthroat trout in the French Creek drainage, with more scheduled in 2023. The newly introduced fish are juveniles. Only adult, mature trout have the ability to pass through the newly constructed step pools. The newly introduced fish will have to grow to maturity before the first fish take the journey up. The improvement of water quality is expected to be realized immediately.



## Natural Resource Benefits

All of the natural resource impacts stemming from this project are due to past placer mining in French Gulch. Millions of tons of fine sediment have been washed away from French Gulch from hydraulic placer mining that eventually created an unnaturally steep rock cascade at the head of the mining area. This cascade, in conjunction with the perched culvert, was impeding upstream fish passage and access to 1.7 miles of in-stream habitat. Fish were unable to migrate past these human-caused, mining-related impairments. This project restored fish passage to the upper reaches of the French Gulch watershed and gave complete connectivity for the first time in over 100 years. Mining activities also created a straightened and unnatural stream channel alignment that created multiple high-eroding stream banks. This project addressed those banks with both low-tech and machine-assisted restoration techniques, mitigating excess sediment inputs into the French Gulch system.

## Public Benefits

Montanans will directly benefit from this project through the restoration of aquatic and riparian habitat that belongs to them. Mount Haggin is a state-owned Wildlife Management Area. The natural resource damage that occurred in the French Gulch area occurred many decades before state ownership. The goals of the Wildlife Management Area are to conserve critical wildlife habitat for use by the hunters, anglers, and recreationists of Montana. Past mining and degradation in the project cut off fish passage to the rest of the stream. This restoration project repaired this impairment. Fish will now be able to utilize the entirety of habitat in the upper reaches of French Gulch.

Furthermore, because the project area is located on public property that is accessible year-round, all recreationists that recreate on the Mount Haggin Wildlife Management Area will be positively affected. Opportunities for both Montanans and visitors to observe and, in some cases, harvest these fish in this area will be increased because of this project. In addition, the landowners in the Deep and French Creek drainages downstream of the project area are affected by increased sediment loading and maintenance at irrigation diversions, which this project should address. This project also benefits the municipality of Butte, which obtains 40% of its water from the Big Hole River.

Montanans will indirectly benefit from this project through increased fish and wildlife populations in the French Gulch drainage. It is anticipated that the fish populations in French Gulch will increase substantially with the increased habitat and access to miles of upstream habitat. It is also anticipated that migratory fish from adjacent creeks will use the upper reaches of French Gulch for spawning and rearing. This project, in conjunction with MFWP's Westslope Cutthroat trout and Arctic grayling restoration project, will aid in conserving these species and lessen the chances that they will warrant listing as a Threatened or Endangered Species. Preventing the listing of these species will benefit all Montanans.

Wildlife habitat will also improve as a result of complete stream connectivity. Fish in the upper reaches of French Gulch will benefit multiple species such as moose, elk, deer, bear, ruffed grouse, and numerous songbirds that nest in riparian habitat.

## Grant Administration and Project Costs

Very few administration problems occurred in this project, and the schedule generally proceeded on time and was completed before the grant's life cycle. Project coordination and management between the Deer Lodge Valley Conservation District and BHWC was efficient, without any difficulties. The decision-making policy for the project team was consensus-based between the Conservation District, the Big Hole Watershed Committee, and MFWP.

### Project Schedule

- **Task 1: Project Design**
  - Survey (exchanged for *Upper French Gulch Hydrology and Hydraulics-Technical Memo* (Attachment B): April 2022
  - Final Design: October 2021-March 2022
- **Task 2: Permitting:** April-July 2022
- **Task 3: Bidding:** April-May 2022
- **Task 4: Fish Passage Structure Construction**
  - Construction Cost plus Contingency Cost: July-October 2022
  - Construction Oversight: July-October 2022
- **Task 5: Low-Tech Restoration on Eroding Banks:** October 2022
- **Task 6: Project Management**
  - Administration for DLVD at 3% of total: July 2021-December 2022
  - BHWC Project Coordination: July 2021-December 2022

### Project Budget

\$194,611.36 was spent out of the awarded \$194,832.00, leaving \$220.64 unspent. The *BHWC Travel Costs* subtask went over budget by \$223.23. The *BHWC Misc. Materials* subtask was under budget by \$247.00. As mentioned above, because MMI did not need to send a survey crew up to the site and spend hours synthesizing the data, BHWC used the line item (\$2,602.00) to pay for MMI's *Upper French Gulch Hydrology and Hydraulics-Technical Memo* (Attachment B). All budgetary changes were first reviewed by DNRC and vetted before making final. The anticipated budget compared with the actual budget is shown below:

**Table 1. Tasks Expenditures Summary**

TASK	Total Grant Amount	Total Spent
1. Project Design	\$15,250.00	\$15,250.00
2. Permitting	\$3,136.00	\$3,136.00
3. Bidding	\$5,499.20	\$5,499.20
4. Fish Passage Construction	\$151,772.00	\$151,772.00
5. Low-Tech Restoration of Eroding Banks	\$2,000.00	\$2,000.00

6. RDGP Project Management	\$11,500.00	\$11,279.36
DLVCD Administration	\$5,674.80	\$5,674.80
<b>Total</b>	<b>\$194,832.00</b>	<b>\$194,611.36</b>

**Table 2. Budget Breakdown**

TASK	Total Grant Amount	Total Remaining	Total Spent
<b>1. Project Design</b>	<b>\$15,250.00</b>	<b>\$0.00</b>	<b>\$15,250.00</b>
<i>MMI Survey (changed to H and H memo)</i>	<i>\$2,602.00</i>	<i>\$0.00</i>	<i>\$2,602.00</i>
<i>MMI Final Design</i>	<i>\$12,648.00</i>	<i>\$0.00</i>	<i>\$12,648.00</i>
<b>2. Permitting</b>	<b>\$3,136.00</b>	<b>\$0.00</b>	<b>\$3,136.00</b>
MMI Permitting Support	\$2,456.00	\$0.00	\$2,456.00
BHWC Permitting Hours	\$680.00	\$0.00	\$680.00
<b>3. Bidding</b>	<b>\$5,499.20</b>	<b>\$0.00</b>	<b>\$5,499.20</b>
MMI Bidding Support	\$5,018.00	\$0.00	\$5,018.00
BHWC Bidding Hours	\$481.20	\$0.00	\$481.20
<b>4. Fish Passage Construction</b>	<b>\$151,722.00</b>	<b>\$0.00</b>	<b>\$151,722.00</b>
Construction Cost Plus Contingency Cost	\$134,880.00	\$0.00	\$134,880.00
MMI Construction Oversight	\$16,892.00	\$0.00	\$16,892.00
<b>5. Low-Tech Restoration on Eroding Banks</b>	<b>\$2,000.00</b>	<b>\$0.00</b>	<b>\$2,000.00</b>
<b>RDGP Project Management</b>	<b>\$11,500.00</b>	<b>\$220.64</b>	<b>\$11,279.36</b>
BHWC Personnel Hours	\$9,050.00	\$196.87	\$8,853.13
BHWC Travel Costs	\$1,450.00	<b>-\$223.23</b>	\$1,673.23
BHWC Misc. Materials	\$1,000.00	\$247.00	\$753.00
<i>Administration for DLVCD at 3% of total</i>	<i>\$5,674.80</i>	<i>\$0.00</i>	<i>\$5,674.80</i>
<b>Total</b>	<b>\$194,832.00</b>	<b>\$247.00</b>	<b>\$194,611.36</b>

## Match Funding

The awarded contractor, Watershed Consulting, LLC came in \$38,069.60 under our estimated construction cost (the estimated construction cost was \$154,880.00). At that time, BHWC/DLVCD had \$18,069.60 to use as contingency: \$134,880.00 (RDGP portion of construction cost)-\$116,810.40 (Watershed Consulting construction bid). That meant the \$20,000.00 BHWC and DLVCD anticipated for construction was no longer needed. That also meant that the anticipated \$20,000.00 was no longer required as a non-federal match.

Change Order 1 used \$5,679.60 of the \$18,069.69 contingency to extend the temporary diversion ditch to ensure the integrity of the “Chinese Wall.” That left \$12,390.00 remaining for the contingency budget. Due to the unexpected encounter with the hard rock layer and the necessity of bringing in the expensive jackhammer attachment, the construction cost unexpectedly increased by \$51,590.00. The remaining \$12,390.00 contingency budget was used toward this budget overage. That left BHWC to fundraise the remaining \$39,200.00. That \$39,200.00 is reported as non-federal cash match to this DNRC RDGP grant.

The match breakdown is below:

- Montana Fish Wildlife and Parks = \$10,000.00
- Private donation = \$19,200.00
- George Grant Trout Unlimited = \$7,500.00
- Big Hole Watershed Committee Conservation Fund = \$2,500
- Watershed Consulting = \$4,600.29

## Total Project Budget

**Table 3. Total Project Budget**

Category	RDGP Grant	Source MFWP	Source Private Donation	Source GGTU	Source BHWC Conservation Fund	Watershd Consulting	Total
<b>Administrative Costs</b>							
<b>Task 6: RDGP Project Management</b>							
<i>Administration for DLVD at 3% of total</i>	\$5,674.80						\$5,674.80
<b>Total Administrative Costs</b>	<b>\$5,674.80</b>						<b>\$5,674.80</b>
<b>Activity Costs</b>							
<b>Task 1: Project Design</b>	\$15,250.00						\$15,250.00
<b>Task 2: Permitting</b>	\$3,136.00						\$3,136.00
<b>Task 3: Bidding</b>	\$5,499.20						\$5,499.20
<b>Task 4: Fish Passage Construction</b>	\$151,772.00	\$10,000.00	\$19,200.00	\$7,500.00	\$2,500.00	\$4,600.29	\$195,572.29
<b>Task 5: Low Tech Restoration on Eroding Banks</b>	\$2,000.00						\$2,000.00
<b>Task 6: RDGP Project Management</b>	\$11,279.36						\$11,279.36
<b>Total Activity Costs</b>	<b>\$188,936.56</b>						<b>\$232,736.85</b>
<b>Total Project Costs</b>							
<b>TOTAL PROJECT COSTS</b>	<b>\$194,611.36</b>						<b>\$238,411.65</b>

## References

Polster, F. David. 2015. Natural Processes: Restoration of Drastically Disturbed Sites. Polster Environmental Services Ltd. Vancouver, B.C. Pg 52.

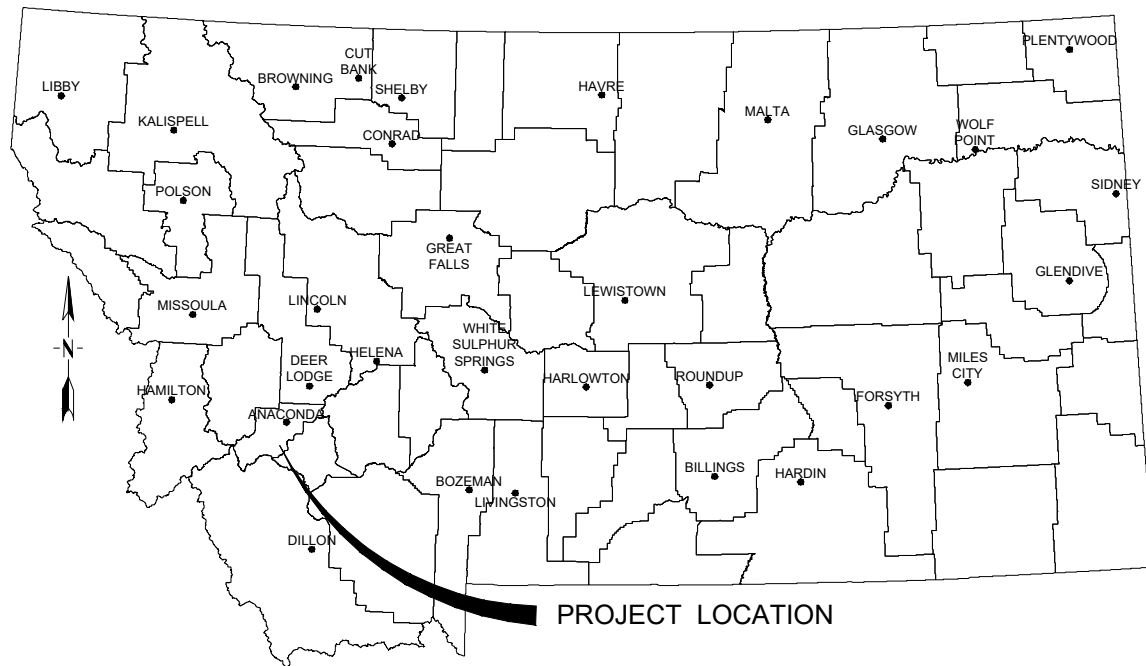
## **Attachment A: Final Designs**

# CONSTRUCTION DRAWINGS FOR UPPER FRENCH GULCH FISH PASSAGE PROJECT

DEER LODGE COUNTY, MONTANA  
MARCH 2022

PREPARED BY:  
**Morrison  
Maierle**  
engineers • surveyors • planners • scientists

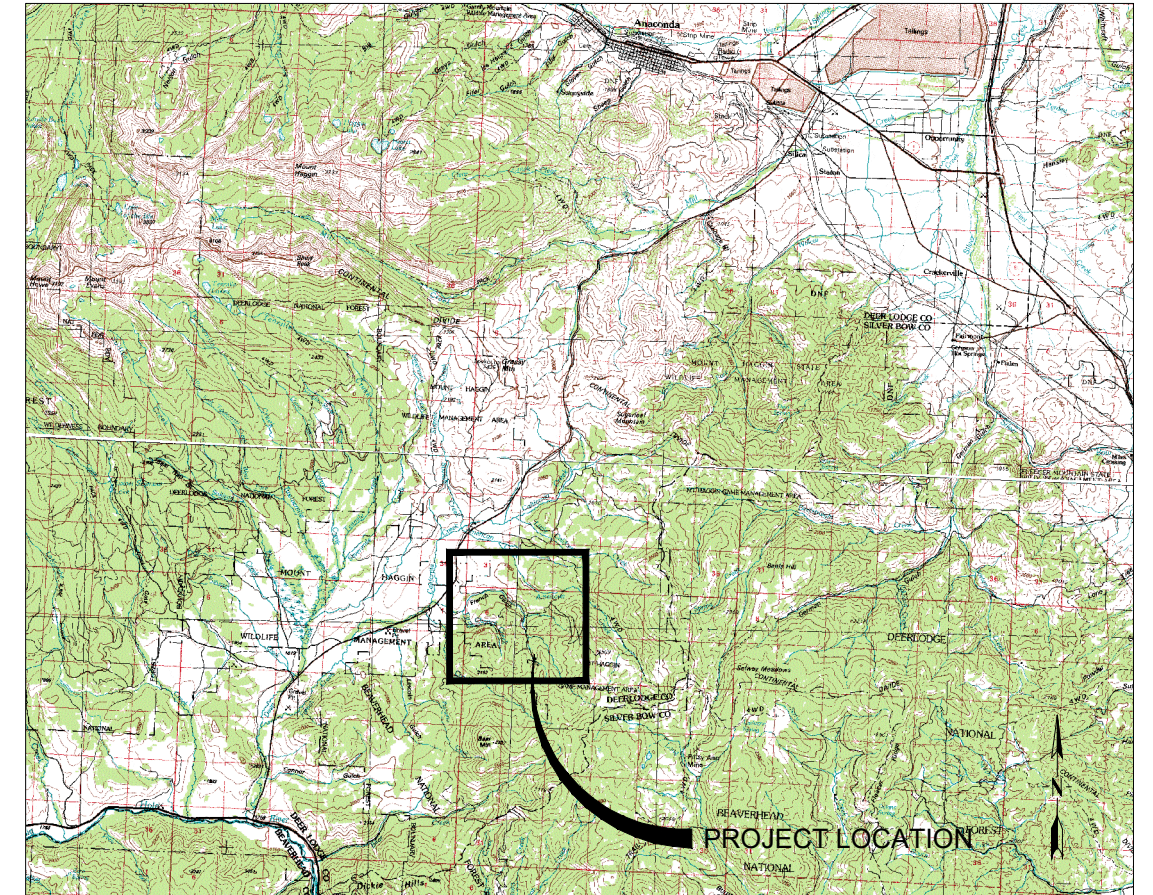
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**LOCATION MAP**  
NOT TO SCALE

**DRAWING INDEX**

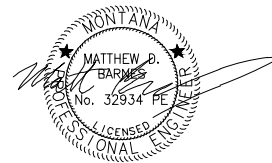
SHEET No.	DRAWING No.	SHEET TITLE
0	-	COVER AND INDEX TO DRAWINGS
1	G-1	EXISTING SITE AND ACCESS MAP
2	C-1	OVERALL SITE PLAN
3	C-2	PLAN AND PROFILE
4	C-3	GRADING PLAN
5	C-4	TEMPORARY DIVERSION PLAN AND PROFILE
6	D-1	DETAILS



**VICINITY MAP**  
NOT TO SCALE



APPROVED BY: MATTHEW BARNES, PE  
Project Manager



**BASIS OF DESIGN:**

THIS PROJECT IS BEING COMPLETED TO RESTORE UPSTREAM FISH PASSAGE IN FRENCH GULCH. THE STREAM CHANNEL DESIGN GOALS ARE TO:


1. PROVIDE UPSTREAM PASSAGE FOR ADULT FISH SPECIES AT OR BELOW THE ESTIMATED BANKFULL FLOWRATE OF 10.4 CFS.
2. MAINTAIN STABILITY OF THE CHANNEL AND POOLS UP TO THE 1% ANNUAL-CHANCE ( $Q^{100}$ ) FLOWRATE OF 82.2 CFS.
3. PRESERVE HISTORIC MINING FEATURES PRESENT IN THE AREA.

THE STREAM CHANNEL AND FISH PASSAGE DESIGN USES CURRENT STANDARD OF PRACTICE AND GUIDANCE TO CREATE HYDRAULIC CONDITIONS AND STABILITY TO MEET THESE GOALS.

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VERIFY COLOR!  
THIS SHEET IS INTENDED TO BE IN COLOR. RED, GREEN AND BLUE WILL BE VISIBLE IF REPRODUCED CORRECTLY.



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QUALITY ASSURANCE	
MATT BARNES, PE PROJECT MANAGER	3/22/2022 Q.A. APPROVAL DATE
WILLIAM WIEGAND JR., PE OFFICE QUALITY ASSURANCE COORDINATOR	000112-22-09 Q.A. PROJECT NUMBER
KEN SALO, PE PEER REVIEWER	

SET NO. \_\_\_\_\_

MORRISON-MAIERLE PROJECT NO. 5406.00501

**CONTROL POINT TABLE**

POINT No.	NORTHING	EASTING	ELEVATION	DESCRIPTION
100	643073.690	1076008.296	6310.39	CP MMI 2" AC
101	638682.083	1079784.806	6560.58	CP AERIAL TARGET
102	638470.486	1079618.207	6591.86	CP AERIAL TARGET
103	638945.099	1079410.004	6536.50	CP AERIAL TARGET
104	639418.802	1079419.328	6513.21	CP AERIAL TARGET
105	639449.909	1079760.683	6500.58	CP AERIAL TARGET
106	639893.417	1079696.166	6482.88	CP AERIAL TARGET

DRONE AERIAL IMAGE COORDINATE SYSTEM: WGS 84 (EGM 96 GEOID)  
 GROUND CONTROL POINT (GCP) COORDINATE SYTEM: NAD83 / MONTANA (FT) (EGM96 GEOID)  
 TOPOGRAPHIC DATA: DNRC LIDAR DATA COLLECTED JUNE 2019.

**GENERAL NOTES:**

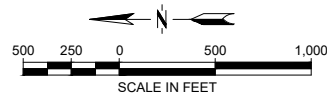
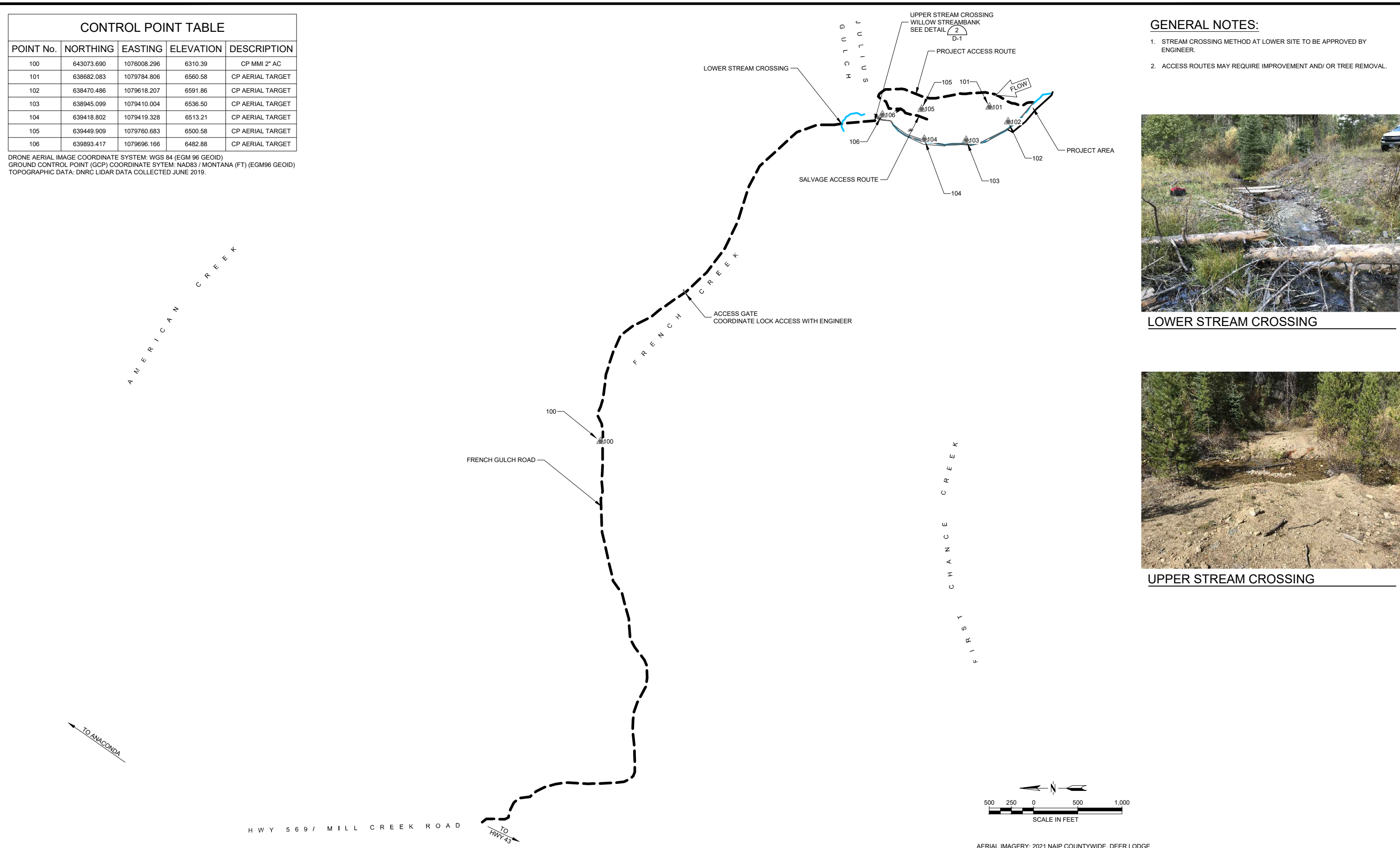
1. STREAM CROSSING METHOD AT LOWER SITE TO BE APPROVED BY ENGINEER.
2. ACCESS ROUTES MAY REQUIRE IMPROVEMENT AND/ OR TREE REMOVAL.



**LOWER STREAM CROSSING**



**UPPER STREAM CROSSING**



AERIAL IMAGERY: 2021 NAIP COUNTYWIDE, DEER LODGE

R:\0408\BHW00050 UPPER FRENCH GULCH\CAD\SHETS\G-1 EXIST SITE AND ACCESS.DWG

VERIFY SCALE!		REVISIONS			
NO.	DESCRIPTION	BY	DATE		

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**MONTANA**  
 MATTHEW P. BARNES  
 No. 32934 PE  
 LICENSED PROFESSIONAL ENGINEER

DRAWN BY: DAH  
 DSGN BY: ZMC  
 APPR BY: MDB  
 DATE: 03/2022

Q.C. REVIEW BY: \_\_\_\_\_ DATE: \_\_\_\_\_

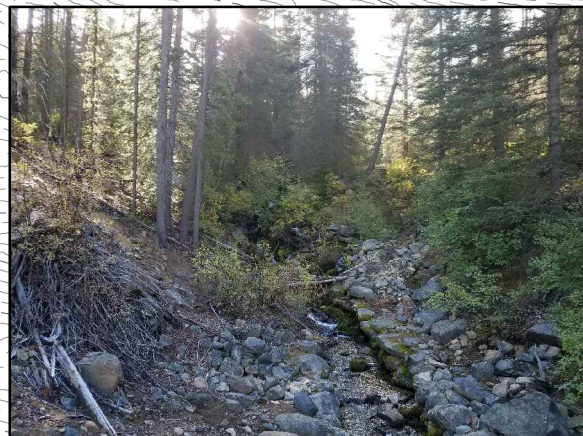
UPPER FRENCH GULCH FISH PASSAGE PROJECT  
 DEER LODGE COUNTY MONTANA

EXISTING SITE AND ACCESS MAP

PROJECT NUMBER 5406.00501  
 SHEET NUMBER 1  
 DRAWING NUMBER G-1



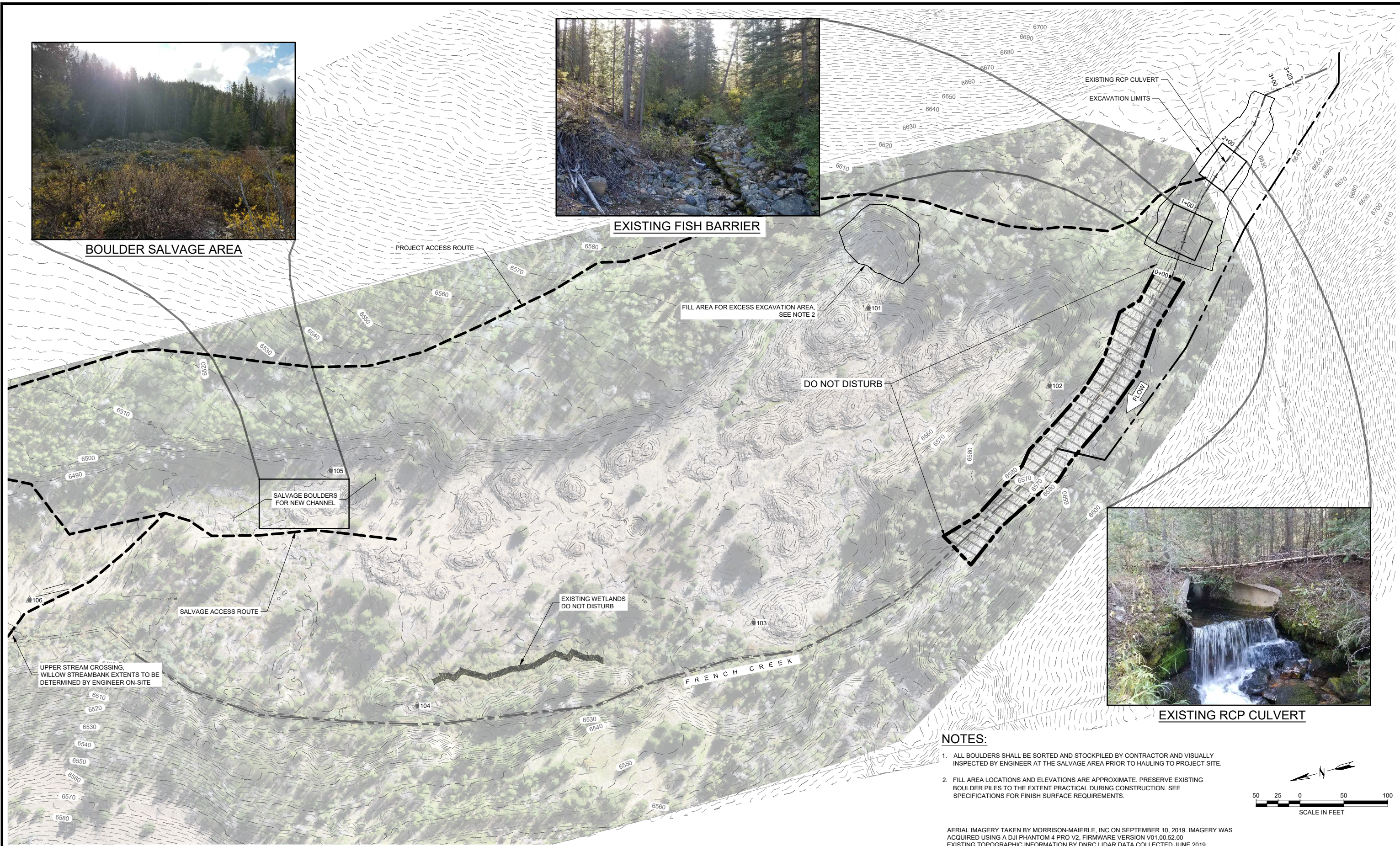
**BOULDER SALVAGE AREA**



**EXISTING FISH BARRIER**

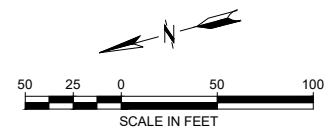


**EXISTING RCP CULVERT**



**NOTES:**

1. ALL BOULDERS SHALL BE SORTED AND STOCKPILED BY CONTRACTOR AND VISUALLY INSPECTED BY ENGINEER AT THE SALVAGE AREA PRIOR TO HAULING TO PROJECT SITE.
2. FILL AREA LOCATIONS AND ELEVATIONS ARE APPROXIMATE. PRESERVE EXISTING BOULDER PILES TO THE EXTENT PRACTICAL DURING CONSTRUCTION. SEE SPECIFICATIONS FOR FINISH SURFACE REQUIREMENTS.



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R:\406\BHW\00500 UPPER FRENCH GULCH\CAD\SHETS\C-1 EXIST SITE AND CONTROL.DWG

VERIFY SCALE!		REVISIONS		
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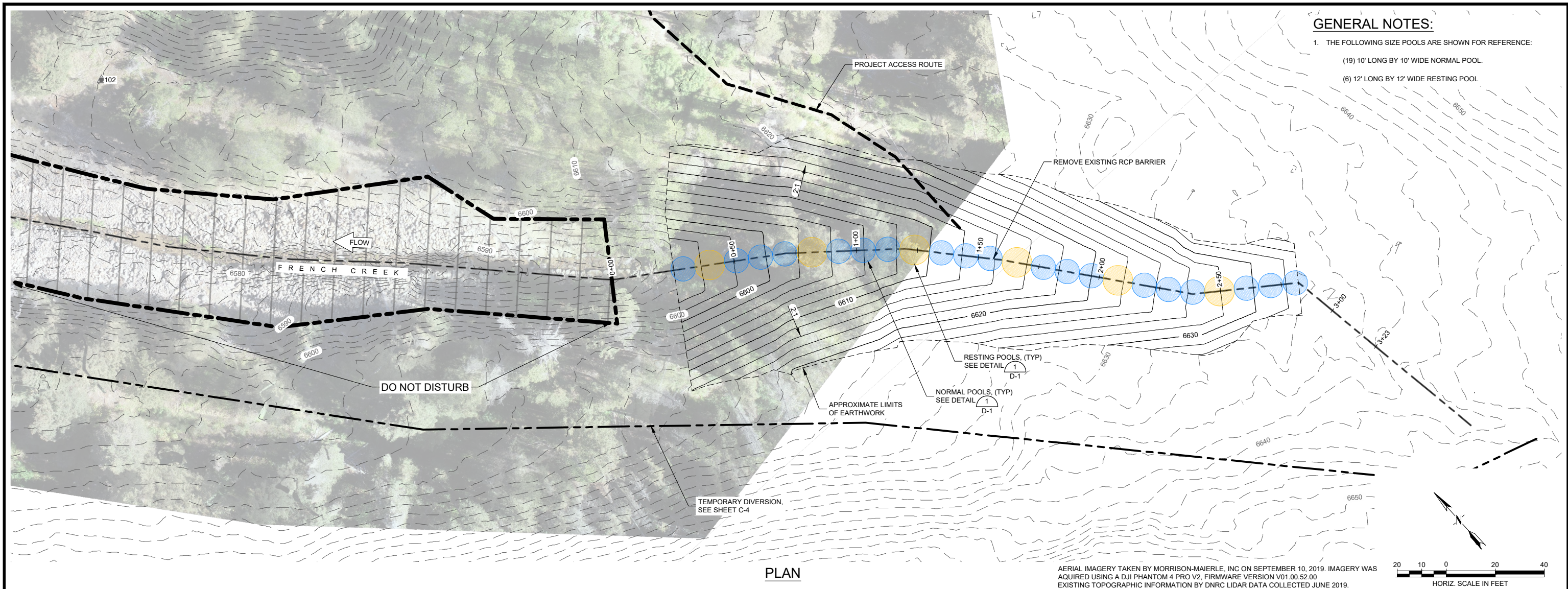
**MATTHEW P. BARNES**  
No. 32934 PE  
MONTANA  
LICENSED PROFESSIONAL ENGINEER

DRAWN BY: DAH	UPPER FRENCH GULCH FISH PASSAGE PROJECT	PROJECT NUMBER
DSGN BY: ZMC		5406.00501
APPR BY: MDB	DEER LODGE COUNTY	SHEET NUMBER
DATE: 03/2022	MONTANA	2
Q.C. REVIEW	OVERALL SITE PLAN	DRAWING NUMBER
BY:		C-1
DATE:		

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PLOTTED BY: DAVID A. HALLSTEN ON Jun/24/2022

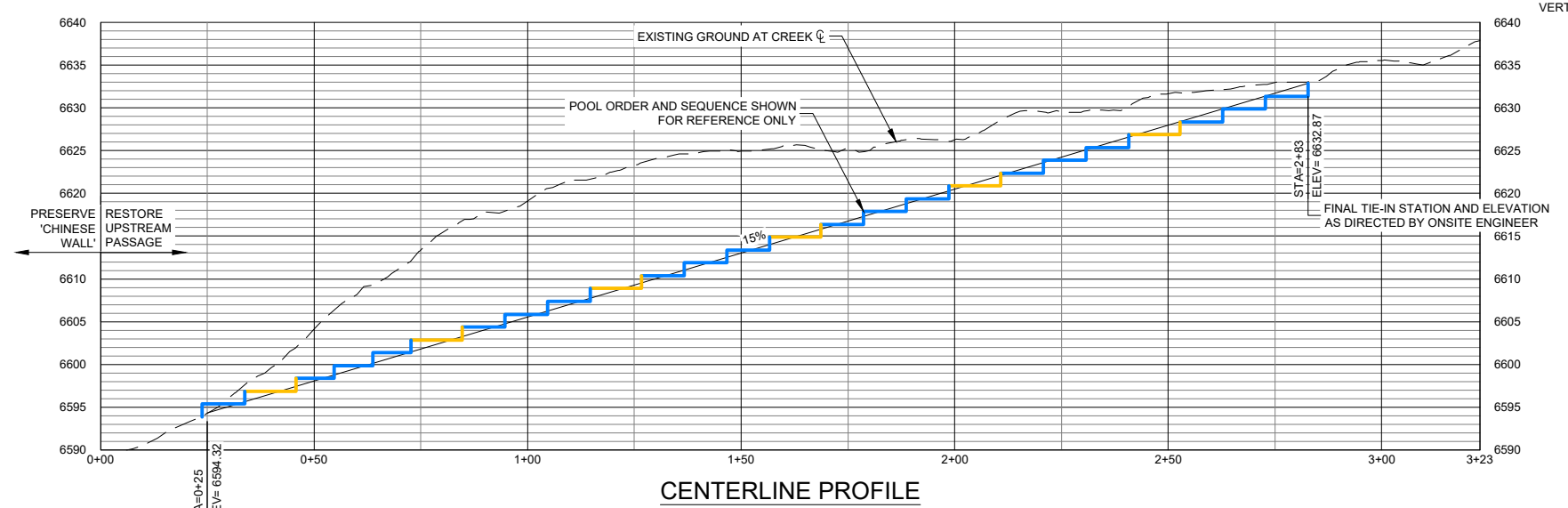
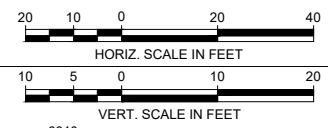




**GENERAL NOTES:**  
 1. THE FOLLOWING SIZE POOLS ARE SHOWN FOR REFERENCE:  
 (19) 10' LONG BY 10' WIDE NORMAL POOL  
 (6) 12' LONG BY 12' WIDE RESTING POOL

**PLAN**

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**CENTERLINE PROFILE**

FINAL TIE-IN STATION AND ELEVATION AS DIRECTED BY ONSITE ENGINEER

R:\5406\BHW\0050\UPPER FRENCH GULCH\CAD\SHETS\C2 PLAN AND PROFILE.DWG

VERIFY SCALE!		REVISIONS		
NO.	DESCRIPTION	BY	DATE	

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 LICENSED PROFESSIONAL ENGINEER

DRAWN BY: DAH  
 DSGN BY: ZMC  
 APPR BY: MDB  
 DATE: 03/2022

Q.C. REVIEW BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

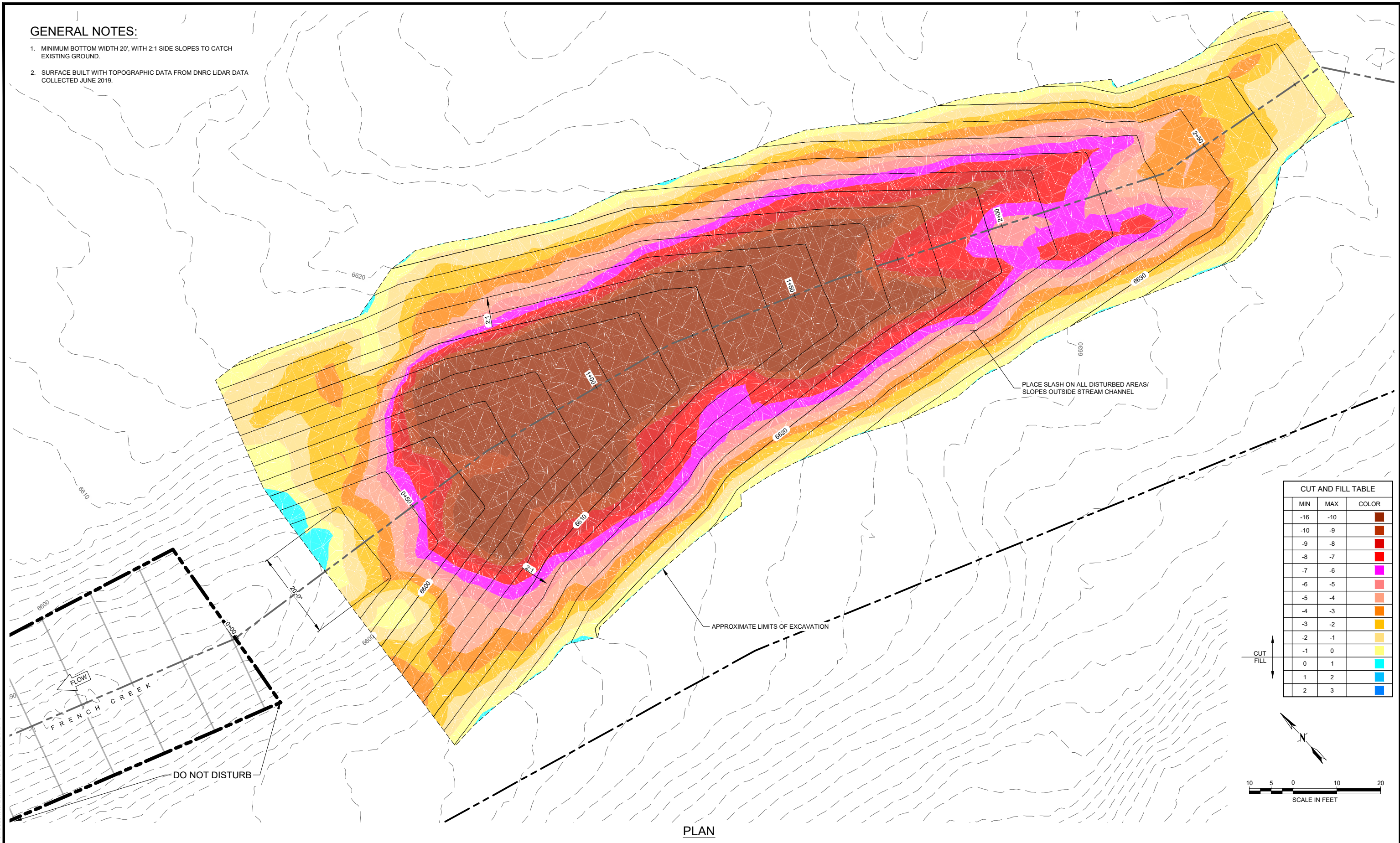
UPPER FRENCH GULCH FISH PASSAGE PROJECT  
 DEER LODGE COUNTY MONTANA

PLAN AND PROFILE

PROJECT NUMBER 5406.00501  
 SHEET NUMBER 3  
 DRAWING NUMBER C-2

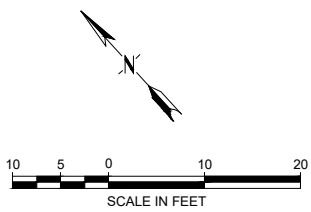
**GENERAL NOTES:**

1. MINIMUM BOTTOM WIDTH 20', WITH 2:1 SIDE SLOPES TO CATCH EXISTING GROUND.
2. SURFACE BUILT WITH TOPOGRAPHIC DATA FROM DNRC LIDAR DATA COLLECTED JUNE 2019.



CUT AND FILL TABLE		
MIN	MAX	COLOR
-16	-10	Dark Brown
-10	-9	Brown
-9	-8	Red
-8	-7	Red-Orange
-7	-6	Orange
-6	-5	Light Orange
-5	-4	Yellow-Orange
-4	-3	Yellow
-3	-2	Light Yellow
-2	-1	Yellow-Green
-1	0	Light Green
0	1	Green
1	2	Dark Green
2	3	Dark Green

CUT  
↑  
FILL  
↓



PLAN

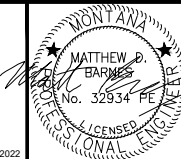
R:\406\BHW\00501 UPPER FRENCH GULCH\CAD\SHETS\C3 GRADING PLAN.DWG

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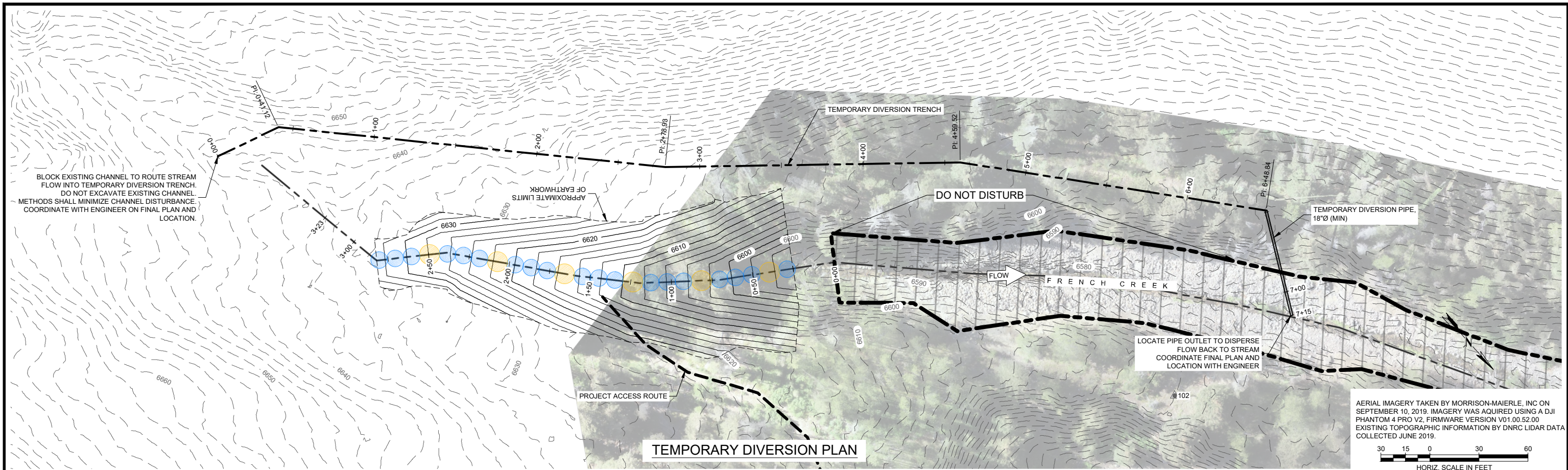
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DSGN BY: ZMC  
APPR BY: MDB  
DATE: 03/2022  
Q.C. REVIEW BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

UPPER FRENCH GULCH FISH PASSAGE PROJECT  
DEER LODGE COUNTY MONTANA  
GRADING PLAN

PROJECT NUMBER 5406.00501  
SHEET NUMBER 4  
DRAWING NUMBER C-3

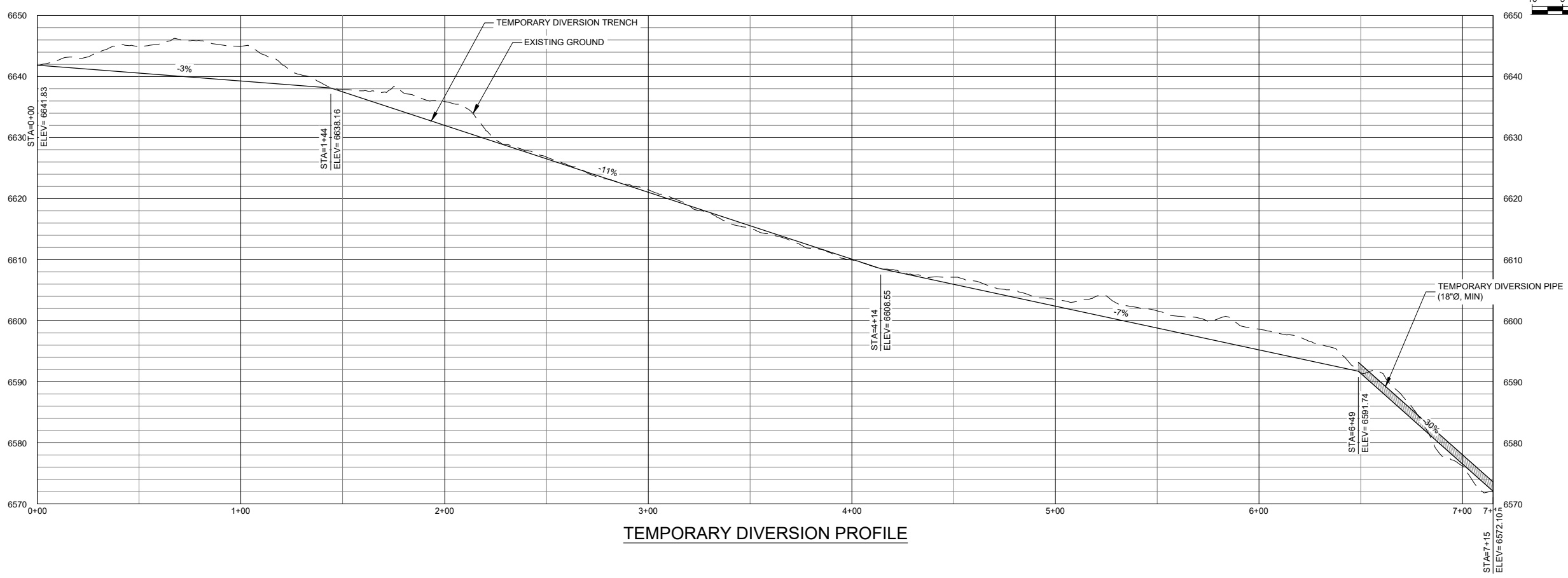
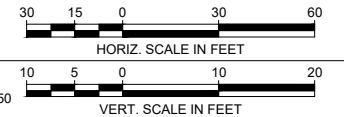
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TEMPORARY DIVERSION PLAN

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TEMPORARY DIVERSION PROFILE

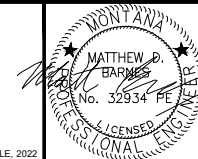
R:\5406-BHW\00500 UPPER FRENCH GULCH\ACAD\SHETS\C4-TEMPDIVERSION.DWG

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MODIFY SCALE ACCORDINGLY!

REVISIONS				
NO.	DESCRIPTION	BY	DATE	

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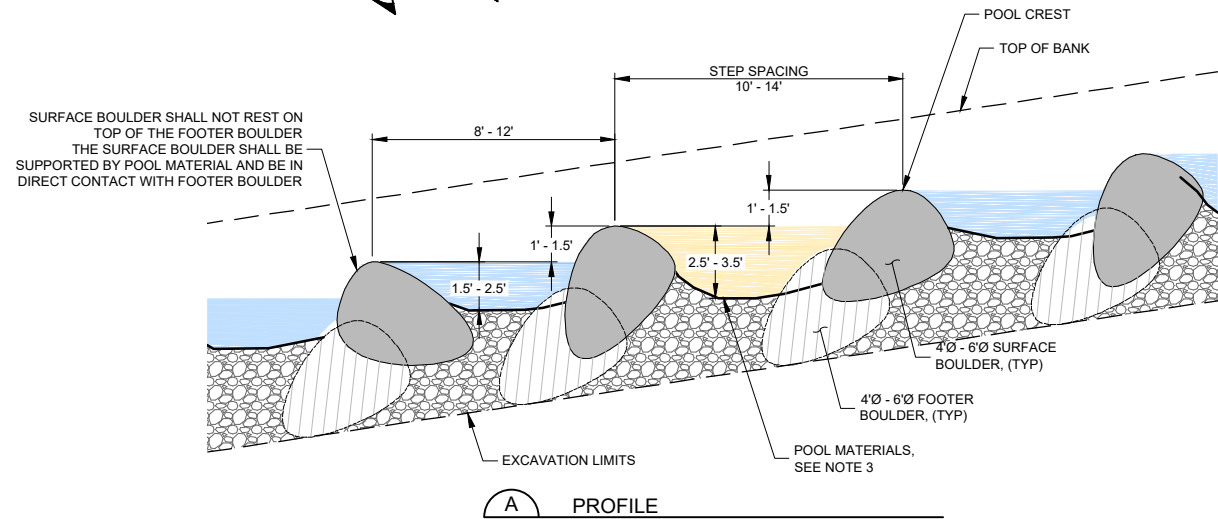
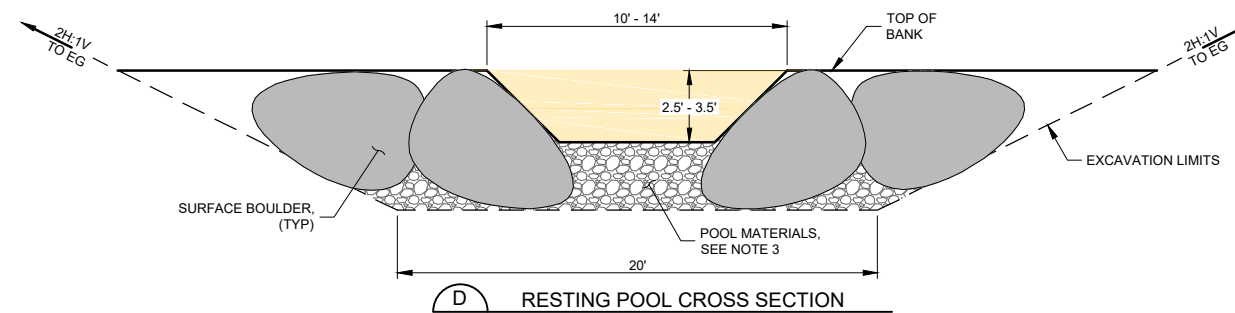
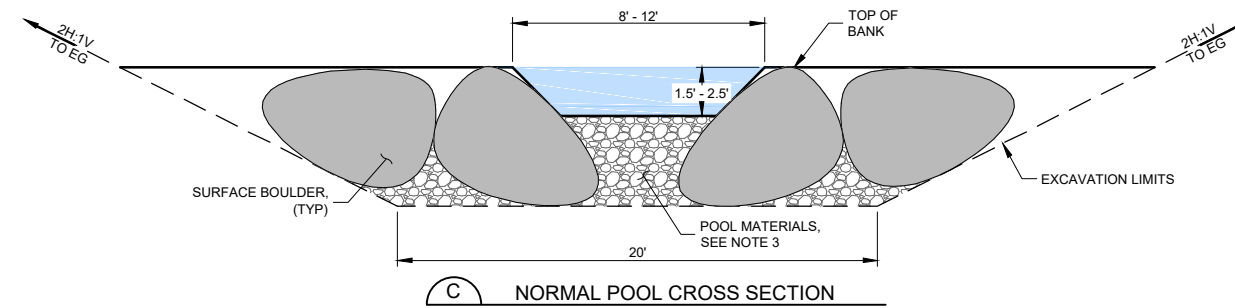
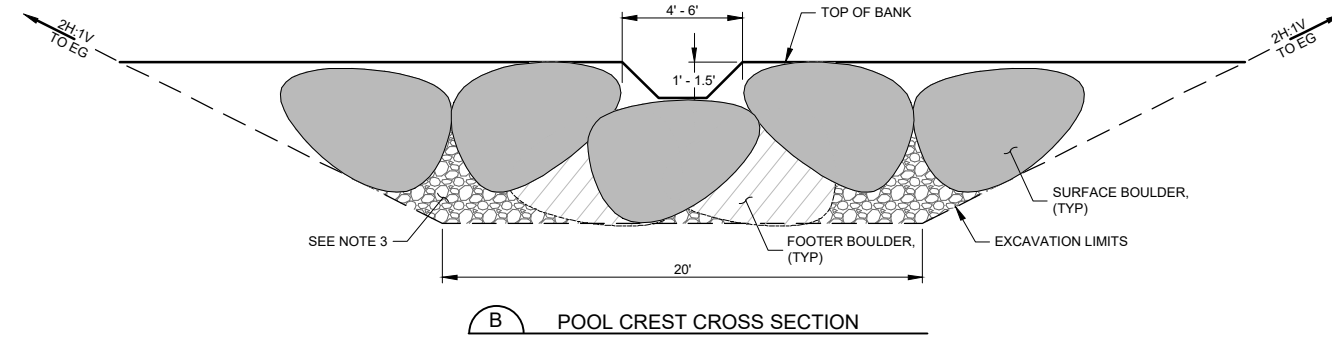
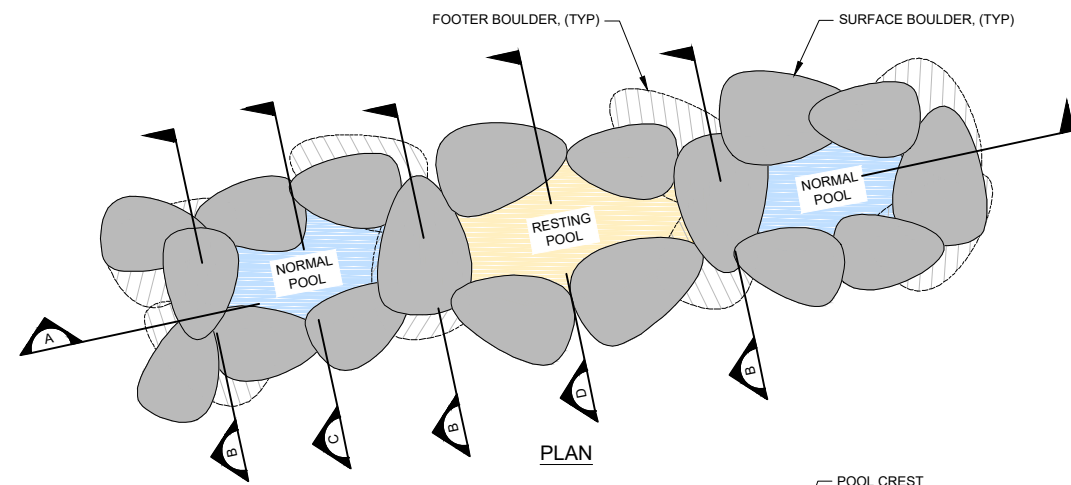
1 Engineering Place  
Helena, MT 59602  
406.442.3050  
www.m-m.net



DRAWN BY: DAH  
DSGN BY: ZMC  
APPR BY: MDB  
DATE: 03/2022  
Q.C. REVIEW BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

UPPER FRENCH GULCH FISH PASSAGE PROJECT  
DEER LODGE COUNTY MONTANA  
TEMPORARY DIVERSION PLAN AND PROFILE

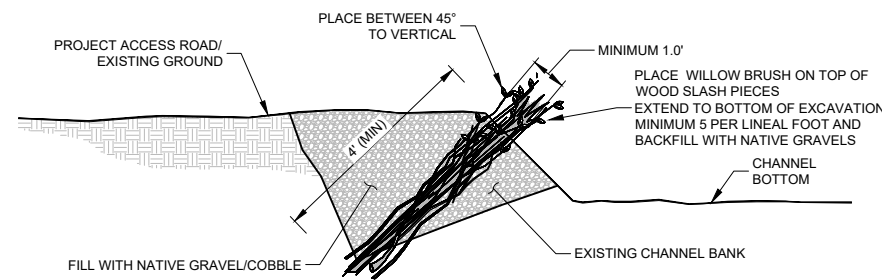
PROJECT NUMBER 5406.00501  
SHEET NUMBER 5  
DRAWING NUMBER C-4



**NOTES:**

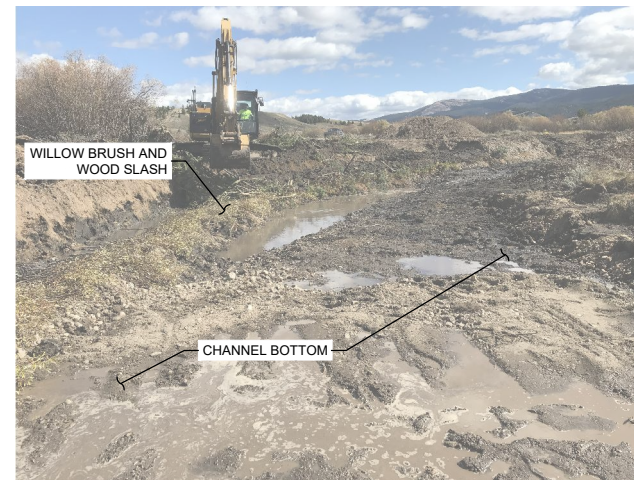
1. CONTRACTOR SHALL SORT AND STOCKPILE ON-SITE BOULDERS. SEE SHEET C-1 FOR APPROXIMATE LOCATION.
2. BOULDERS TO BE USED IN CONSTRUCTION SHALL BE APPROVED BY ENGINEER AT SALVAGE AREA PRIOR TO HAULING.
3. SUBSURFACE CONDITIONS UNKNOWN. POOL BOTTOM AND ALL OTHER BACKFILL AROUND BOULDERS SHALL BE WELL-GRADED COBBLE-GRAVEL ALLUVIUM MIX. ENGINEER SHALL DETERMINE SUITABILITY OF EXCAVATED MATERIALS VISUALLY ON-SITE. IF MATERIALS ARE UNSUITABLE, ENGINEER AND CONTRACTOR SHALL LOCATE SUITABLE BORROW SOURCE IN OR NEAR THE BOULDER SALVAGE AREA.

**1**  
**C-2** **STEP POOL DETAILS**  
SCALE: NTS



**NOTES:**

1. CREATE TOE PROTECTION WHERE SHOWN WITH MATRIX OF WOODY STEMS/LIVE WILLOWS/BRANCHES WITH MAXIMUM 6-INCH DIAMETER STEM, MINIMUM LENGTH AS SPECIFIED, AND INTER-WOVEN TO CREATE A CONTINUOUS MAT. BACKFILL AND MECHANICALLY WORK NATIVE GRAVEL/COBBLE MIX OF WELL GRADED SUBSTRATE TO CREATE A COMPACTED LIFT UNTIL ELEVATION IS AT GRADE WITH THE PROJECT ACCESS ROAD.



**2**  
**G-1** **WILLOW STREAM BANK DETAIL (UPPER STREAM CROSSING)**  
SCALE: NTS

R:\0406\BHW\00500 UPPER FRENCH GULCH\CAD\SHETS\SD-1 DETAILS.DWG

VERIFY SCALE!		REVISIONS	
NO.	DESCRIPTION	BY	DATE

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.  
MODIFY SCALE ACCORDINGLY!

**Morrison Maierle**  
engineers • surveyors • planners • scientists

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**MONTANA**  
MATTHEW P. BARNES  
No. 32934 PE  
LICENSED PROFESSIONAL ENGINEER

DRAWN BY: DAH  
DSGN BY: ZMC  
APPR BY: MDB  
DATE: 03/2022  
Q.C. REVIEW BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

UPPER FRENCH GULCH FISH PASSAGE PROJECT  
DEER LODGE COUNTY MONTANA

PROJECT NUMBER 5406.00501  
SHEET NUMBER 6  
DRAWING NUMBER D-1

DETAILS

**Attachment B: Upper French Gulch Hydrology and  
Hydraulics-Technical Memo**

# Technical Memo

**TO:** Montana Department of Natural Resources and Conservation  
**FROM:** Zachariah Campbell, EI  
**DATE:** 4/18/2022  
**JOB NO.:** 5406.00501  
**RE:** Upper French Gulch – Hydrology and Hydraulics  
**CC:** File; Christine Pearcy, MMI; Ben LaPorte, BHWC; Pedro Marques, BHWC;  
Jim Olsen, MT FWP

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Urgent       For Review       Please Comment       Please Reply       For Your Use

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## 1. Introduction

This memo presents the results of the hydraulic analysis performed on Upper French Gulch in Deer Lodge County, Montana to inform and support restoration design. This project is located on the Mount Haggin Wildlife Management Area shown in Figure 1. The impaired reach was identified by Montana Fish, Wildlife & Parks (FWP) and Big Hole Watershed Committee (BHWC) for restoration. This impaired reach shows impacts from mining practices that have impaired fish passage to the upper limits of French Creek. This project addresses fish passage concerns for native fish while keeping the historical vertical boulder-wall known as the “Chinese Wall” intact.

Upper French Gulch – Hydrology and Hydraulics

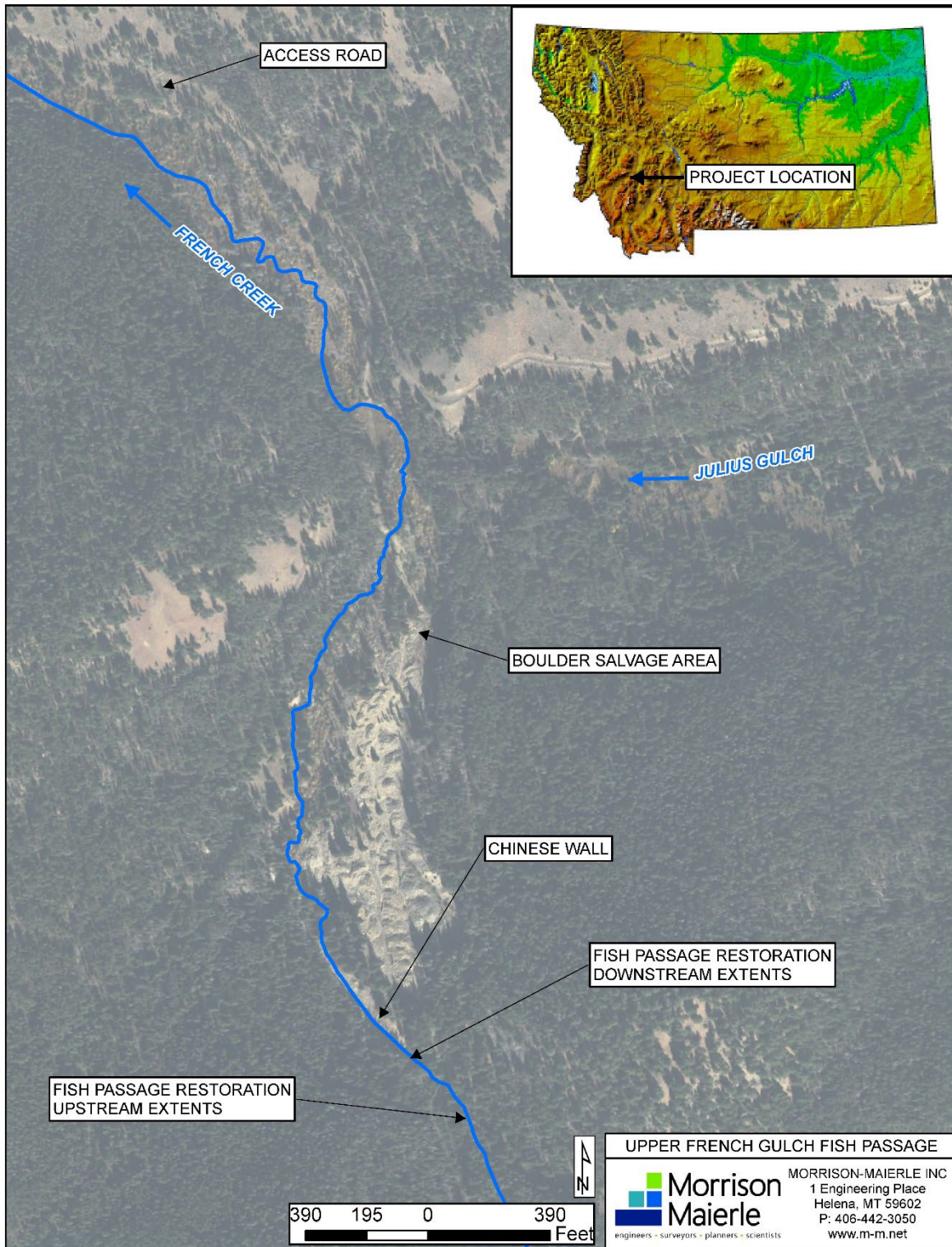


Figure 1 – Upper French Gulch Site Map

## 2. Hydrology

The USGS online application of StreamStats was used to estimate the 2-year and 100-year flowrates at the site. The regression equations for this site are based on the calculated basin characteristics of drainage area (2.9 square miles), annual precipitation (28.16 inches), and forested area (86.5 percent). The discharge estimate results from Streamstats are shown in Table 1.

**Table 1 – Peak Discharge Estimates**

Recurrence Interval	Flowrate (cfs)
2-year	10.4
100-year	82.2

## 3. Design Basis

Fish passage is currently impeded by a cascade directly upstream from the “Chinese Wall”. See photo 1. To improve fish passage to the upstream reach of French Creek, Morrison-Maierle provided four design alternatives.

- Alternative 1 – No Action.
- Alternative 2 – Relocate French Creek channel to the North through the large boulder piles.
- Alternative 3 – Reconnect upstream passage on the existing alignment with step pools.
- Alternative 4 – Reconnect upstream passage using a sinuous alignment with step pools.

Morrison-Maierle worked with BHWC and FWP to select the most stable and feasible approach. A step pool design approach was selected and upon further discussion it was determined a straight stream with step pools was the most feasible for the site constraints and long-term stability (Alternative 3).

Morrison-Maierle relied on FWP expertise for fish passage capabilities. FWP provide recommendations on pool step height, pool widths and depths, pool sequence, and max velocities. See Table 2 below.

**Table 2 – Step Pool Guidance**

	Step Height Range (ft)	Pool Width Range (ft)	Pool Depth Range (ft)	Max Velocity (ft/s)
<b>Normal Pool</b>	1 – 1.5	8 – 12	1.5 – 2.5	5
<b>Resting Pool</b>	1 – 1.5	10 – 14	2.5 – 3.5	5

Fish passage recommendations were incorporated into the hydraulic model to ensure velocities would allow for fish passage of Westslope Cuthroat Trout and Arctic Grayling. Literature suggests the species of concern are able to migrate upstream at velocities up to 5 feet per second. Longer and wider resting pools were incorporated into the step pool design to provide areas with lower velocities so the fish can rest. See sheet D-1, detail 1 on the attached final design drawings. These resting pools were incorporated due to the length of the of the reach being restored. The



## Upper French Gulch – Hydrology and Hydraulics

new channel length is approximately 285 feet. See sheet C-2 on the attached final design drawings.

Final design drawings were reviewed by Jim Olsen, Montana Fish, Wildlife and Parks fisheries biologist and Erin Ryan United States Forest Service hydrologist and fish passage specialist. Their review comments were incorporated into the final design. The final design was determined to be the most cost effective and had the most likelihood of success for providing fish passage to the upstream reaches of French Gulch.

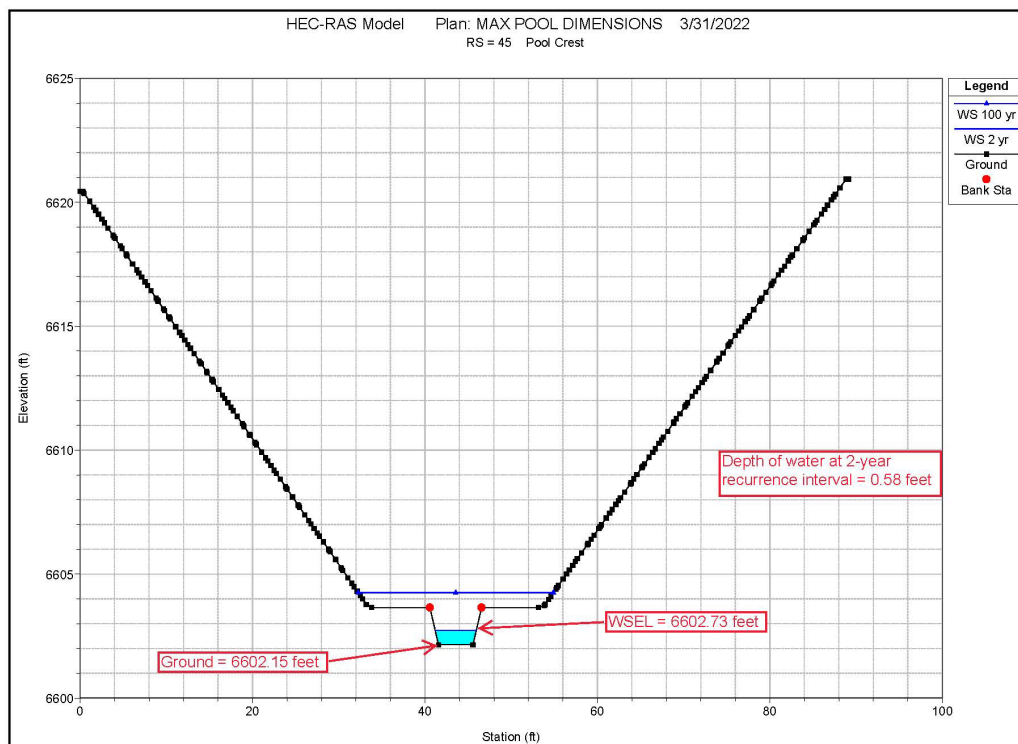
Upper French Gulch – Hydrology and Hydraulics



**Photo 1 – Downstream Extents of Cascade**

#### 4. Hydraulics

The hydraulic modeling software HEC-RAS 5.0.7 was used to model the Q2 and Q100 water surface profiles for the proposed final design. The design water surface elevation at the pool crest are references to the North American Vertical Datum of 1988 (NAVD88). These elevations will be used to ensure the depth of water at the pool crest is a minimum depth of 0.3' at the 2-year recurrence interval, see Figure 2 for a typical crest. The velocity and shear stress values from modeling the 100-year recurrence interval will be used to size the footer and surface boulders.



**Figure 2 – Typical Pool Crest Cross Section**

#### 5. Boulder Sizing

The hydraulics analysis results were used to size footer and surface boulders, as well as estimate local scour in the pools. Guidance for Local Scour at Grade-Control Structures (Lenzi, et al, 2003) was used to determine scour below the step pools. The results of the analysis estimated a scour depth of 2.4 feet by 5.9 feet long. Placing four-to-six-foot boulders as footers and stacking similar sized surface boulders on top with well-graded gravel/cobble alluvium, should stabilize the step pool sequence. Boulders were sized using U.S. Department of the Interior, Bureau of Reclamation, Rock Ramp Design Guidelines, 2007. To ensure the boulders were sized appropriately, the most conservative boulder sizing results were used from Section 4.3. A range

Upper French Gulch – Hydrology and Hydraulics

of boulder sizes (four-to-six-feet) was provided due to the variation of on-site material available and to make construction more feasible.

## **6. Attachments**

Final Design Drawings

**Attachment C: MMI Upper French Gulch Final Construction  
Completion Report**

**TO:** Ben LaPorte, BHWC  
**FROM:** Andrea Price, EI  
**DATE:** November 23, 2022  
**JOB NO.:** 5406.00501  
**RE:** Upper French Gulch Final Construction Completion Report  
**CC:** Christine Percy, MMI; Pedro Marques, BHWC

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Urgent       For Review       Please Comment       Please Reply       For Your Use

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## Introduction

This memo summarizes Morrison-Maierle's involvement during the design and construction of the Upper French Gulch Fish Passage and Restoration Project. Project partners included the Big Hole Watershed Committee (BHWC), Montana Fish, Wildlife & Parks (FWP), and Watershed Consulting. The goal of this project was to improve fish habitat, connectivity, and water quality in Upper French Gulch near Anaconda, MT.

These goals were achieved by reconnecting 1.7 miles of Westslope Cutthroat trout and Arctic grayling habitat above the former Frenchtown mining site. This part of French Gulch was heavily mined in the late 1800s and early 1900s, which resulted in an approximately 40-foot tall headcut and perched concrete culvert upstream that were impassible to native fish. The restoration project replaced these passage barriers with a series of step-pools, thereby facilitating the reestablishment of historically present populations of Arctic grayling and Westslope Cutthroat trout. The project also sought to improve water quality in French Gulch by reducing sediment loads from two eroding banks downstream of the Chinese Wall using streambank bioengineering techniques.

Project partners describe this project as the last major restoration effort required to achieve suitable native fish habitat in the French Gulch Drainage. Morrison-Maierle was hired by BHWC to conduct site investigation, survey, alternative documentation, design, and permitting, bidding, and construction support.

## Design

In September 2019, Morrison-Maierle collected topographic and stream channel data necessary to develop restoration designs. Imagery and photogrammetry topographic data of floodplain and overbank areas was collected using unmanned aerial vehicle (UAV) drone equipment, and bathymetric cross sections were collected in-stream throughout the project area. Montana DNRC's LiDAR Inventory was determined to provide sufficiently accurate data for final design and estimation of earthwork quantities. Together, these datasets comprised a complete digital terrain model to be used for design development. A field investigation of aquatic features in the project vicinity was also conducted in September 2019. Additional information is available in the May 2020 *Upper French Gulch Aquatic Features Review*.

## Upper French Gulch Final Construction Completion Report

Several restoration design alternatives were analyzed and presented to BHWC and partners for consideration. Stream relocation, stream reconnection on various channel alignments, and a no action alternative were considered. Ultimately, reconnecting the stream by constructing step-pools on the existing channel alignment was chosen as the most favorable alternative based on the project goals and geographic constraints. Additionally, a reference reach upstream of the project site was identified and measured. Parameters from this reach were used to inform the project design.

Analysis of the hydrology and hydraulics of Upper French Gulch were conducted to facilitate the restoration design. StreamStats was used to estimate the 2-year and 100-year flows expected in the project area. These results were combined with step-pool guidance provided by FWP in the hydraulic modeling software HEC-RAS to determine appropriate pool design. The resulting scour depths and shear stresses were used to determine the appropriate size range for footer and surface boulders. Further detail is available in the April 2022 *Upper French Gulch Hydrology and Hydraulics* memo and plan set.

Morrison-Maierle also provided support on permitting. This included providing quantities, data, figures, and review of a Joint Application for SPA 124, Section 404, and 318 permits. Given the presence of historical features (namely, the “Chinese Wall”) near the project, a Cultural Inventory was carried out by the Montana State Historic Preservation Office (SHPO) with input from BHWC.

Morrison-Maierle also assisted in developing a bid package, conducting a pre-bid meeting, and reviewing bids. Watershed Consulting was the sole bidder on the project and thus, they were selected to perform the work. Morrison-Maierle provided the Notice of Award to Watershed Consulting on May 18, 2022. The Upper French Gulch Fish Passage Project manual contract documents were assembled and provided to all parties during the pre-construction meeting.

## **Construction**

On June 14, 2022, a pre-construction meeting was conducted between BHWC, Morrison-Maierle, and Watershed Consulting to prepare a strategy for mobilization, site preparation, stream diversion, material sorting, step-pool construction, and site restoration. Project implementation began on July 28, 2022 and concluded on October 6, 2022. Morrison-Maierle personnel visited the site to conduct construction observation on six days during this period; BHWC provided additional oversight. Additionally, a weekly conference call was conducted between Morrison-Maierle, BHWC, Watershed, and FWP. Morrison-Maierle also received payment applications and submittals from the contractor and reviewed them for compliance with specifications.

Access improvements were required to mobilize equipment to the site, including the installation of temporary culverts at two stream crossings in addition to clearing and widening access roads. Prior to in-stream work, the reach was dewatered, and flows were diverted into a plastic-lined temporary diversion channel constructed on the south side of the stream. A sandbag diversion dam was installed above the top of the project reach and flows were returned to the stream through a short section of corrugated plastic pipe. A pump was used to maintain dewatering and remove groundwater return flows in the project reach. Overbank and upland areas surrounding the project were cleared and grubbed.

Upper French Gulch Final Construction Completion Report

Morrison-Maierle, FWP, and BHWC determined that 1:1 overbank slopes would be acceptable (rather than the 2:1 slopes originally specified) in order to reduce earthmoving and minimize the footprint of disturbance. Most of the boulders needed for step-pool construction were sourced while excavating the project reach to subgrade; the remainder were sourced from the material salvage area. The existing RCP culvert was removed from the stream channel and disposed of with all excess excavated material at the dump site. Construction was primarily completed with the use of two excavators and a dump truck. Watershed Consulting used a laser level throughout to check overall channel grade and the elevation of each step-pool. All construction activities avoided impacts to the “Chinese Wall” historical area.

During construction, FWP provided input that that step heights of up to two feet were acceptable (rather than the maximum step height of 1.5 feet originally specified); this specification was adopted throughout the project. In total, 31 step-pools were constructed. Watershed Consulting also reported excavating and removing more earth than expected. This may be in part due to the six additional pools constructed to meet grade and tie into the stream. The quantity of boulders present within the excavated material also indicate the possibility of a high expansion factor which could lead to a higher volume of transported material.

Bedrock was encountered beneath the existing stream channel at station 1+80. Watershed Consulting reported that the bedrock layer was impossible to penetrate using the excavator bucket and obtained a hydraulic jackhammer attachment to break through the bedrock layer. These unexpected subsurface conditions lead to an approximately two-week delay in construction progress.

On September 28, 2022, all in-stream work had been completed and flows were introduced to the newly constructed stream channel. The temporary diversion ditch and temporary stream crossings were decommissioned. Slash was placed on the disturbed overbank and upland areas and all disturbed areas were seeded with a native seed mix. All equipment was demobilized by October 6, 2022.

### **Post Completion Inspection and Discussion**

Morrison-Maierle and BHWC personnel carried out a post-completion inspection on October 17, 2022. The data set is presented in Appendix A. Measurements of each step-pool, including length, width, step height, and approximate depth were collected. Depth is likely to change significantly during high water and as sediment loads to the project area stabilize. Pool lengths and widths are also highly variable depending on the stream discharge at the time measurement. Of note were several pools near the upstream end of the project that were built with high steps that exceed the specification for step height by up to one foot. There were also several pools in which the footer boulders protruded into the pool in such a way that there is a shallow “splash pad” beneath the step. In contrast, a deep plunge pool beneath the step is generally a more favorable configuration for fish passage. Some shifts in channel form are to be expected during the months following construction as sediment, cobbles, and woody debris move through the system. It is therefore recommended that BHWC reassess the site after high water, paying particular attention to pools with large steps and/or protruding footer boulders. Any maintenance tasks needed to maximize the ease of fish passage through these areas can likely be conducted with hand tools.





## APPENDIX A: Upper French Gulch Post Completion Inspection Data

Date: 30-Nov-2022  
 Project #: 5406.00501  
 Project Name: Upper French Gulch Fish Passage and Restoration Project  
 Engineer: Andrea Price, EI

1055 Mount Avenue  
 Missoula, Montana 59801  
 Ph: (406) 542-8880  
 Fax: (406)-542-4801

Pool	Height of step below pool (ft)	Pool depth with relation to lower pool crest (ft)	Pool Length (ft)	Pool Width (ft)	Pool size qualifier	Notes
0	0	N/A	N/A	N/A	N/A	Measurement taken in run beneath step 1
1	0.22	-1.73	14.5	9.0	resting	
2	1.24	-1.73	13.0	10.0	resting	
3	0.96	-0.78	12.6	8.2	resting	
4	1.54	-1.19	14.7	7.5	resting	
5	1.12	-0.30	11.6	6.4	normal	No plunge pool due to protruding footer boulder beneath step.
6	1.71	-0.74	11.2	8.0	normal	No plunge pool due to protruding footer boulder beneath step. One may develop over time.
7	1.33	-0.65	11.5	9.1	resting	
8	1.62	-0.30	9.8	7.3	normal	Step is a large slap with broad crest. Hardened material below step/in plunge pool.
9	1.46	-0.36	14.6	8.7	resting	
10	1.61	-0.40	13.0	8.0	resting	
11	0.95	-0.63	12.0	10.1	resting	
12	1.74	-0.59	10.7	9.8	resting	
13	1.43	-0.98	10.4	9.0	normal	
14	0.67	-1.25	11.2	4.8	small	
15	1.54	-1.81	10.8	9.5	resting	
16	1.57	-0.63	11.0	6.1	normal	
17	1.75	-0.25	8.0	4.5	small	Step is made of two boulders with a large gap in between; may shift in spring 2023 runoff. Pool is shallow throughout with hard rock bottom.
18	1.90	-0.17	11.3	8.0	normal	No plunge pool due to protruding footer boulder beneath step. Large splash pad underneath pourover.
19	1.78	-0.19	9.0	6.2	small	Shallow pool
20	1.49	-5.59	11.5	7.1	normal	
21	2.06	-0.83	12.5	9.7	resting	Deep plunge pool. Pourover "spout" is narrow.
22	1.86	-0.76	11.4	7.2	normal	
23	1.49	-0.82	9.6	8.2	normal	
24	1.34	-0.23	10.2	7.3	normal	No plunge pool due to protruding footer boulder beneath step.
25	1.38	-0.08	11.0	6.6	normal	Shallow pool with large magnitude step upstream; challenging combination.
26	2.77	-0.86	12.2	8.0	normal	
27	1.58	-1.36	16.1	12.7	large	
28	2.90	-2.04	15.0	11.8	resting	Large step magnitude with exposed footer boulders beneath.
29	2.03	-0.50	12.3	10.0	resting	
30	2.24	0.16	14.0	5.2	normal	No plunge pool due to protruding footer boulder beneath step. One may develop over time.
31	2.55					Transition into plane-bed stream

METHODOLOGY: Data collected 17 Oct 2022 by Andrea Price (MMI) and Ben LaPorte (BHCW). Step elevations were taken at the lowest point on each crest boulder. Pool depth elevations were measured at a single location in the middle of each pool; maximum depths were not captured as the pool bottoms were silty. Pool widths and lengths were measured as the maximum length/width of water surface on 17 Oct 2022. Lengths and widths were measured using a tape measure to 0.1' accuracy. Depths and step heights were measured using a laser level to .01' accuracy.

KEY	Within original spec
	Within modified spec
	Outside spec