CONCEPTUAL DESIGN REPORT

FOR THE

COLLIER DITCH FISH AND WATER PASSAGE PROJECT

WWC ENGINEERING

CONCEPTUAL DESIGN REPORT
COLLIER DITCH FISH AND WATER PASSAGE PROJECT

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1. Introduction

Collier ditch is located on the Little Cimarron River approximately 3.25 miles upstream of the confluence with the Cimarron River. The ditch is the second priority water right on the river with a diversion right of 12 cfs. The first right on the river is the McKinley ditch located about five miles upstream of the Collier ditch. Much of the stream flows through a heavily vegetated confined valley. The Little Cimarron River is a relatively steep cobble bed stream containing small riffle and pool complexes connected by short runs. The stream in the reach containing the Collier diversion dam has an average slope of 0.025. The diversion dam is a concrete weir with an uneven crest sloping from elevation of ~7435.3 on the left abutment to elevation 7434.5 on the right abutment. The crest contains two low sections that allow for sluicing sediment. During low stream flows check boards are placed in front of the low sections to raise the upstream pool elevation for diversion of irrigation flows. The concrete weir has hydraulic height of about 2.5 to 3.0 feet. Below the weir, large rock has been placed in the stream to control scour occurring along the toe of the weir. The rock causes a second similar height drop about 30 feet downstream of the weir crest. High velocity flow passing over the weir has impacted the channel for about 140 feet downstream.

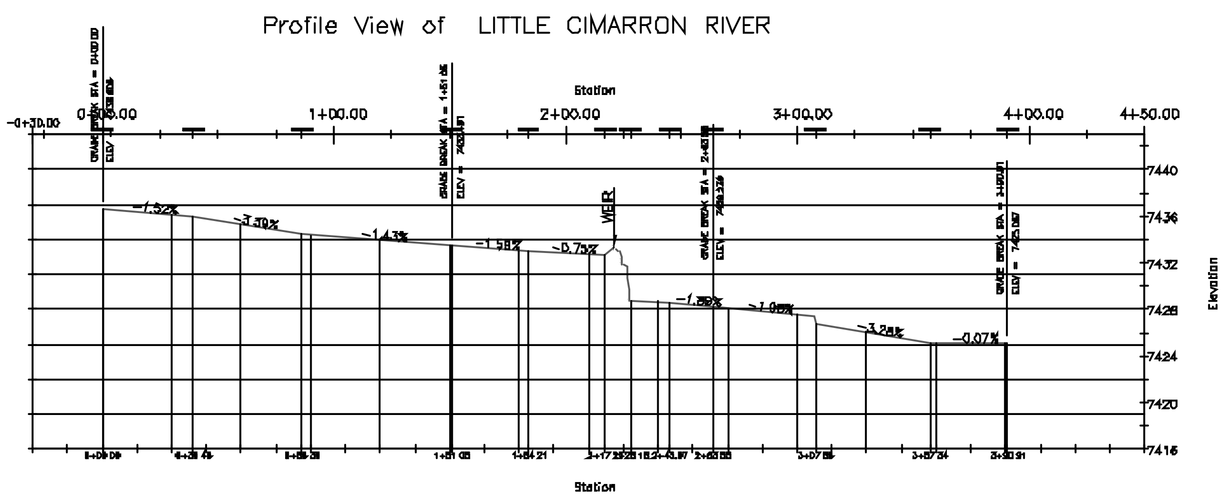


Figure 1 – Profile View of the Little Cimarron River

The Collier Ditch is a significant barrier to upstream passage of resident fish of the Little Cimarron River. Studies have shown drops of 3 feet can block upstream movement of nearly all brook trout, the dominant fish in the river, and likely all non-salmonid fish species. In summer and fall flows in the river are significantly depleted due to irrigation diversions. To date, the Collier ditch can divert the entire river when flows fall below 12 cfs above the diversion. Recently, the Colorado Water Trust (CWT) purchased a portion of the McKinley ditch and obtained an in-stream water right allowing them to pass a portion of McKinley ditch water downstream past the Collier Ditch when river flows are low. The purpose of the in-stream right is to prevent the Little Cimarron from being totally dewatered below the Collier ditch and promote fish passage for resident fish species. Brook trout migrate upstream in the late fall to spawn. Depletion of river flows below Collier ditch combined with the velocity barrier provided by the weir has in most years blocked upstream migration of fish in the lower river during this period.

Figure 3 – Collier Diversion Dam

Figure 2 –Typical operation with check boards installed.

The CWT contracted with the design team of WWC Engineering (WWC) and Wild Fish Engineering (WFE) to develop alternatives with the following objectives:

- Split river flows between the Collier ditch and in-stream flows.
- Where possible, CWT would like to assist the irrigation district with improving the condition and operation of the diversion dam.
- Provide improved fish passage at the Collier diversion dam.

This report provides the results of the study concept development phase including site survey, hydraulic modeling using HEC-RAS, fish passage options and structures for implementing the necessary flow split at the diversion.

The design team met on site with Tony LaGreca from CWT and irrigators from the Collier Ditch on August 12, 2020 to discuss the project and get feedback from irrigators. During the site visit, WWC conducted a survey of the diversion dam, river channel above and below the dam and the ditch. A summary of the site survey is shown in Attachment A.

2. Condition of the Existing Diversion Structure

The diversion weir has experienced scour along the downstream toe. The irrigators said they placed several truckloads of concrete in the scour hole below the weir several years ago to prevent further scour of the toe. Large rocks were also placed across the channel about 20 feet downstream of the weir toe at the same time to form a larger plunge pool below the weir. These actions appear to have prevented further scour at the weir toe. The concrete weir shows signs of freeze thaw cracking and concrete spalling, particularly near the abutments. There are no drawings available that indicate concrete specifications or if the weir contains adequate reinforcing steel. Two issues on the right abutment were noted by the design team that raises concern. A steel plate was observed near the weir crest extending from the concrete into the bank. Based on the site visit, it is unclear the extent of structural tie between the weir and right bank. The diversion headgate structure also shows significant freeze thaw damage to the concrete. In several locations steel plates have been added to prevent excessive leakage upstream of the control gate.

During the site visit and survey two large pits were found excavated in the right bank about 20 feet to the right of the dam. These were dug by the landowner (not a ditch member) as a potential location for an infiltration gallery for domestic water supply. The depth of the pits could not be determined during the survey but are more than 4 feet. The pits clearly extend down to the toe elevation of the concrete weir or below. Prior to completing this report, the design team was notified that the landowner had finished constructing the infiltration gallery, Figure 4. Photos of the completed infiltration galley show substantial changes to the river channel adjacent to the infiltration galley may have resulted from construction of the gallery. No further information is currently available.

3. Hydraulic Modeling

Hydraulic modeling was completed to understand the performance of the ditch in its existing condition and look for opportunities for improvement. During the site survey, specific data was collected in order to model the hydraulics of Collier Ditch. This included topographic data on the dam crest, intake structure, and flume along with cross sections and water surface elevation profile of the ditch for approximately 1000 feet downstream. This data was used to develop a hydraulic model of the ditch in HEC-RAS.
Collier Ditch has a water surface slope upstream of the flume of approximately 1.1%, Figure 5. This is a relatively steep for an irrigation ditch. The model shows that the diversion provides adequate headwater elevation to deliver 12 cfs down Collier Ditch. Looking at the section of Collier ditch below the flume, the water surface slope is approximately 0.5%. Based on the

hydraulic modeling, the ditch would pass 12 cfs if the slope upstream of the flume were reduced to the downstream slope of 0.5%. This modification would allow for the diversion elevation to be lowered based on the hydraulic model. At this time, lowering the diversion crest elevation has not been considered but could be further evaluated with the irrigators.

Figure 4 - View of completed Infiltration gallery

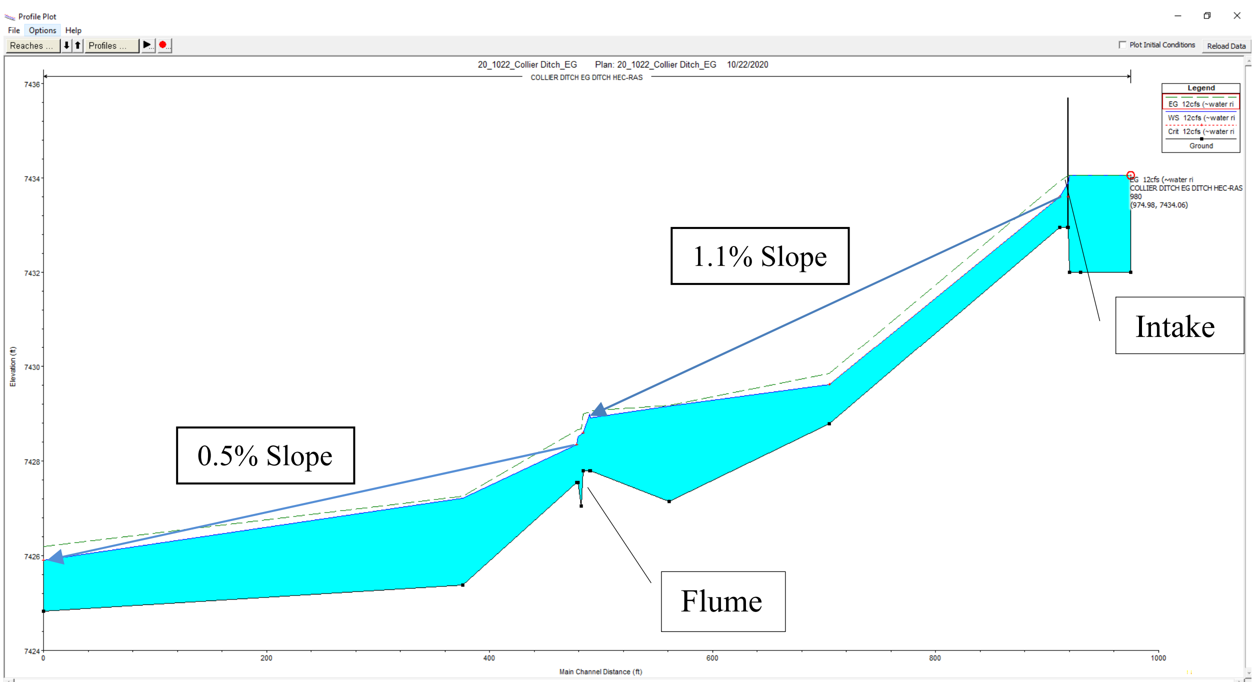


Figure 5- HEC-RAS Profile View of Collier Ditch

4. Fish Passage Alternatives

Fish passage for the dam can be accomplished in several ways. We considered a technical fish ladder constructed on the left abutment of the diversion, a nature-like fishway channel constructed adjacent to the stream along the left bank, a rock ramp constructed in-river and an in-river step pool fishway using a series of low height cross vanes. A nature-like fishway was dropped from consideration due to the large footprint required along the stream on private land. An in-river step pool fishway using cross vanes was eliminated due to the required distance between cross vanes combined with the steep stream slope. Therefore concept designs for technical fishway and rock ramp options were developed for the project. Approximately 1 ft high stop boards are currently installed across the sluiceway slots in the dam crest during low stream flows. For purposes of discussion, modifying the dam crest to elevation of 7434.2 with a single slot near the left abutment is also presented. This would maintain a channel thalweg closer to the left bank and eliminate the need for placing stopboards near the right bank. The following is a list of the fishway options presented.

- Technical fishway on left bank with modified dam crest.
- Technical fishway on left bank with existing dam crest.
- Grouted rock ramp with boulder weirs, crest elevation 7434.2 with modified dam crest.
- Grouted rock ramp with boulder weirs, crest elevation 7433.3 with existing dam crest.

All fishway alternatives were developed using a maximum passage velocity in the 4.5± ft/s range. This range was chosen based on swim studies using wild brook and brown trout reported by Castro-Santos et. al., 2013. The study found burst swim speeds of >20 body lengths per second (bl/s) in test fish. Based on the Castro-Santos study, the fish passage design velocity for the alternatives presented herein will allow 3" and larger brook trout and brown trout to pass upstream. Other similar studies (Katopodis, C, and R Gervais. 2016, Peake, 2008) also report similar swim speeds can be expected for cutthroat and rainbow trout. Native Bluehead Suckers that may be present in the lower Little Cimarron or Cimarron River will likely display maximum swim speeds ~ 4 ±1 bl/s, Aedo, J. et al. 2009, Katopodis, C, and R Gervais. 2016. The fishways presented herein would be expected to provide passage for adult suckers. When stop boards are installed on the dam crest fish will need to jump to pass over the boards. The jumping ability of brook trout was based on a study by Kondratieff and Myrick, 2006. The jumping ability of Bluehead suckers is assumed to be poor.

4.1 Technical Fish Ladder Alternatives

A technical fish ladder is a long flume containing baffles that slow the flow velocity to levels fish can swim through. The most common type is a step pool fishway. Baffles within the fishway create low drops in the water surface followed by a pool of slower moving flow. Step pool fishways simply reduce a large drop with high velocity flow into a series of small drops with lower velocity flow linked by resting pools for fish. Technical fishways can also be designed without resting pools in which case fish must swim or "burst" the length of the ladder without resting. The most common burst style ladder is called a Denil fishway. Denil ladders can be used to past adult salmonids at slopes up to 15 percent. However, they have been shown to function poorly in systems with high debris loads and/or significant changes in head water levels. We considered a Denil ladder as a poor choice for the Collier Diversion and have not included one in the concept alternatives.

Figure 6 - Dual slot pile fishway designed for passing native fish species near Sheridan Wyoming.

4.1.1 Technical Fishway Design

A technical fishway can be designed to provide passage velocities for small bodied or weak swimming fish by reducing the drop height produced by each baffle. However, the smaller the drop height the greater the number of baffles and pools needed resulting in significant increases in fishway length and project costs. For this project, a number of technical fishway designs of varying passage velocities, flows and structure size were considered. Minimizing the footprint of a technical fishway was deemed important given the potential impact to private property surrounding the diversion dam not associated with the irrigation project.

The design team proposes a 4-foot wide single slot step pool fishway using half cylinder pile baffles. Baffles would be spaced 6 feet apart and each provide about 0.35 – 4 feet of drop in the water surface. For the existing dam the fishway exit would be set at elevation 7433.3. The entrance to the fishway would be set at about 7428.3 with a difference in the water surface across the weir of about 5.0 ft. The fishway would have 12 baffle-pool segments yielding a fishway length of about 80 ft., Attachment A. The minimum flow required for passage through the fishway would be approximately 1.5 cfs. Using 3-foot high baffles the fishway could maintain passage velocities for river flows up to ~100 cfs.

4.1.2 Technical Fishway Location

A technical fishway would be constructed on the left stream bank to provide ease of access. The river for approximately 100 ft upstream of the dam would be realigned to move the thalweg against the left bank combined with modifying the dam crest elevation right of the existing left sluice to approximately elevation 7434.2, Figure 5. Raising the slot would reduce scouring along the right bank and dam abutment. The diversion headgate location would need to be moved about 10 ft upstream of its current location to reduce the likelihood of fish entrainment with diversion flows. The fishway exit would be located several feet upstream of the dam crest to reduce the likelihood of fish being passed back over the dam after passing through the fishway. If a technical fishway option is selected, the design team proposes a technical fishway that provides passage over the concrete weir combined with selective grading downstream of the weir to ensure passage to the fishway entrance. Grouted rock would be placed between the fishway entrance and the dam to increase scour protection below the dam and direct flows for fishway attraction.

4.2 Roughened Rock Ramp Fishway

A roughen rock ramp fishway is similar to rock and cobble riffles found in the Little Cimarron River, only typically steeper and designed to meet fish passage criteria. Rock ramps are generally constructed in-channel, preferably across the full channel width. Ramps can be constructed at slopes up to about 2.5 to 3 percent without using concrete grout if rock of adequate size, shape and durability is available. For steeper sloped ramps, concrete grout is typically pumped into the interstitial voids between the rocks to form a hardened surface that can resist the power of the flowing water.

The survey of the river channel near Collier ditch shows the channel contains several steep riffles with average slopes in the 0.04 to 0.06 range Figure 8. These steep riffles are characteristic of snow melt driven upper-watershed mountain streams that flow down narrow valleys. The natural riffles likely change slope, length and possibly location during large flows. The natural riffles provide a snapshot of the challenges resident fish confront while migrating upstream.

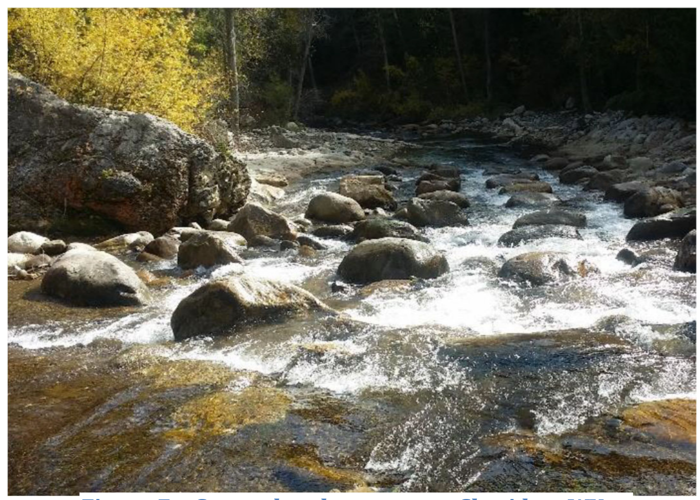


Figure 7 – Grouted rock ramp near Sheridan, WY

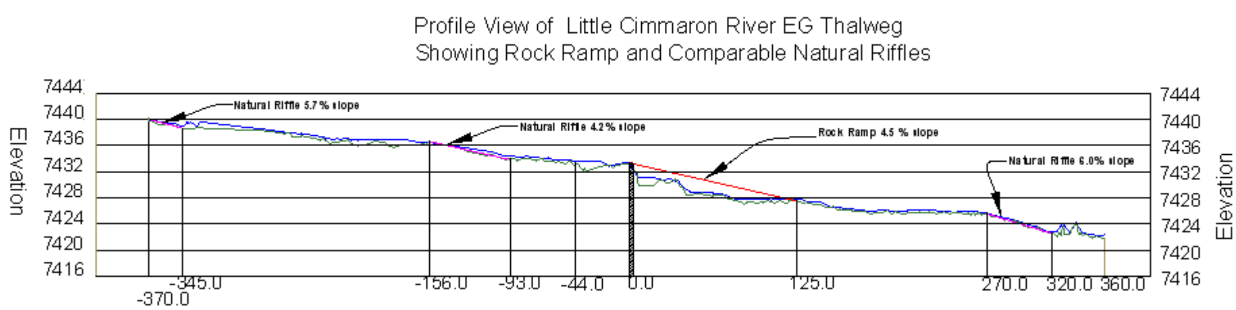


Figure 8 – Little Cimarron River Thalweg Profile

4.2.1 Roughened Rock Ramp Fishway Design

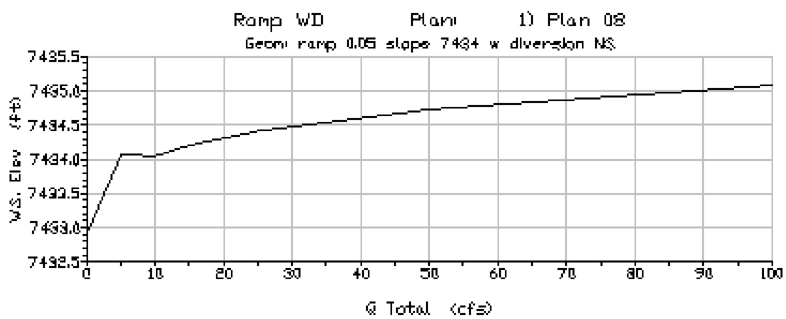
A rock ramp concept of comparable slope to the natural riffles shown in Figure 8 was designed to provide fish passage for Collier diversion dam, Attachment C. The ramp would be approximately 150 feet long and span the full river width at bank full. To provide passage over a wide range of flows and facilitate the required flow split at the dam, we recommend modifying the existing crest to a uniform elevation of 7434.2 right of the left side sluice, see Attachment C. The existing left bank slot would be modified by adding a sluiceway box extending from the dam face downstream about 5 feet. The invert of the sluice would be the same as the existing slot. The sluiceway box would include a slot for inserting a measuring weir or stop boards during in-stream flow releases. The weir/stop board would provide a better water seal than currently possible with the existing boards/tarp system. Crest elevation 7434. 2 would allow > 12 cfs diversion prior to flow passing down the rock ramp. Passages of adult brook trout would be possible with the weir installed assuming a 1 ft deep pool is present below the weir. A rock ramp option could also be constructed for the as-built dam (no crest modifications) with an upstream ramp elevation of 7433.3. The district would continue current practice of placing boards across the right side sluicing slot.

A ramp alternative would approximately follow the existing river thalweg from the weir to station 150 at a slope of about 5%. In cross section the ramp would consist of a 34-foot wide bankfull channel with 10:1 side slopes down to a 14-foot wide low flow channel with an 8-foot bottom width. The channel will grade to existing ground at 3:1 side slopes on either side of the bankfull channel. The cross-sectional shape of the proposed ramp is similar to the existing channel in many locations and provides concentration of low flows. A grouted rock cutoff wall is proposed at the end of the ramp to protect against scour from flows leaving the ramp. A double drop cross vane is also proposed approximately 25 feet downstream of the end of the rock ramp. A cross vane would protect against a headcut migrating upstream as well as providing a smooth transition back to the existing channel and centralization of flows.

Figure 9 gives an example rating curve based on a HEC-RAS model of the river, Collier ditch, and a rock ramp with a 7434.0 crest elevation. The rating curve shows water surface elevation in the river at the ditch headgate. Diversion flows were either limited by available flow in the river or controlled by the diversion headgate to pass the ditch water right ±15 percent. Note, numerical modeling of the river, ditch and ramp required some flow be passed downstream of the Collier ditch. The simulated rating curve given in Figure 9 assumes no McKinley flow is being passed downstream as in-stream flow. During the release of in-stream flow the Collier ditch headgate would have to be adjusted to ensure McKinley water minus any conveyance losses assigned would be passed downstream.

Boulder weirs are shown in Attachment C on the ramp. Boulder weirs offer several improvements to a plain rock ramp.

- The boulders provide greater resting areas along the length of the ramp.
- The chevron shape of the boulder weirs redirects flow toward the center of the ramp downstream of each weir increasing the variability of flow depth and velocity on the ramp.
- The addition of boulder weirs may allow the length of the ramp to be reduced. This was not studied for the concept design.



Q River Above Diversion (cfs)	Q Collier Ditch (cfs)
5	4.91
10	9.74
15	11.99
25	13.76
50	13.31
100	14.2

Figure 9 - Rating curve based on HEC-RAS model showing river stage in front of the Collier Ditch for the diversion flows given in the table.

Table 1 - Comparing Fish Passage Advantages and Disadvantages

Feature	Technical Fishway	Rock Ramp or Step-pool Ramp
Footprint	Small, on abutment	Large, in river
Impacts to diversion structure	Requires moving headgate and ditch upstream 10+ feet	None, best if used with single elevation crest
Construction Difficulty	Straight forward concrete forming	Requires near constant grade over length of structure. Placing large rock to constant grade can be difficult. Dewatering of channel may be required if grout is placed between the rocks.
Durability	>50 years	30-50 years
Passage Efficiency	Good for trout >4 inch and suckers >10 inch	Good for trout >2 inch and suckers >6 inch
Maintenance	Cleaning trashrack on fishway exit will be required periodically during high flows	Little maintenance is anticipated
Estimated Project Cost	$347,000	$428,000

*Detailed engineer's cost estimates are included in Attachment D.

5. Flow Split and Water Measurement

In-stream flow released at the McKinley ditch could be assessed a conveyance loss. This loss would be determined by the local water commissioner if during low flows the river loses water to groundwater between the McKinley ditch and the Collier ditch. If a conveyance loss is found to occur, in-stream flow at the Collier ditch will be adjusted by subtracting the conveyance loss from the McKinley in-stream flow release.

Two methods for splitting and measuring flow at the diversion dam were considered. The first method was proposed by the Collier ditch irrigators during the site visit. They proposed constructing a weir, in the river, upstream of the Collier Ditch to measure total river flow. They would then set their headgate to divert the difference between the measured river flow less the adjusted in-stream flow. The remaining in-stream flow would pass over the dam crest or if a technical fishway is selected, pass through the fishway. The Collier ditch irrigators felt this method would allow for determining conveyance loss by comparing stream measurements below McKinley ditch and a river measurement at Collier. An example of a broad crested weir that could be placed in-river for measuring small flows is shown in Figure 10. This method would provide fish passage during in-stream flows at the diversion of greater than approximately 2 cfs. The second measurement option is to provide a flow measurement device for directly measuring in-stream flows. No measurement would be performed for other than in-stream flows. Water measurement would be done differently depending on the type of structure chosen for fish passage. For a technical fishway an in-stream water measurement device could be separate from the fishway or integral to it. A measurement device separate from the fishway is shown in Figure 11. In this case, fish passage would likely be poor or blocked during in-stream flows. To achieve fish passage during in-stream flows a weir could be placed within the fishway exit. The weir would be removable and only used during in-stream flows. The weir crest would be set at elevation ~7434.0. This would allow the district to divert their full water right prior to flows passing over the weir. To set in-stream releases the district would adjust their headgate until a set depth/in-stream flow was achieved over the weir. This option is shown on Attachment B. A similar approach could also be adopted for a rock ramp fishway. In this case a measurement box containing a removable weir could be constructed off the downstream face of the dam below the existing left side sluice slot in the dam crest. This option is shown on Attachment C.

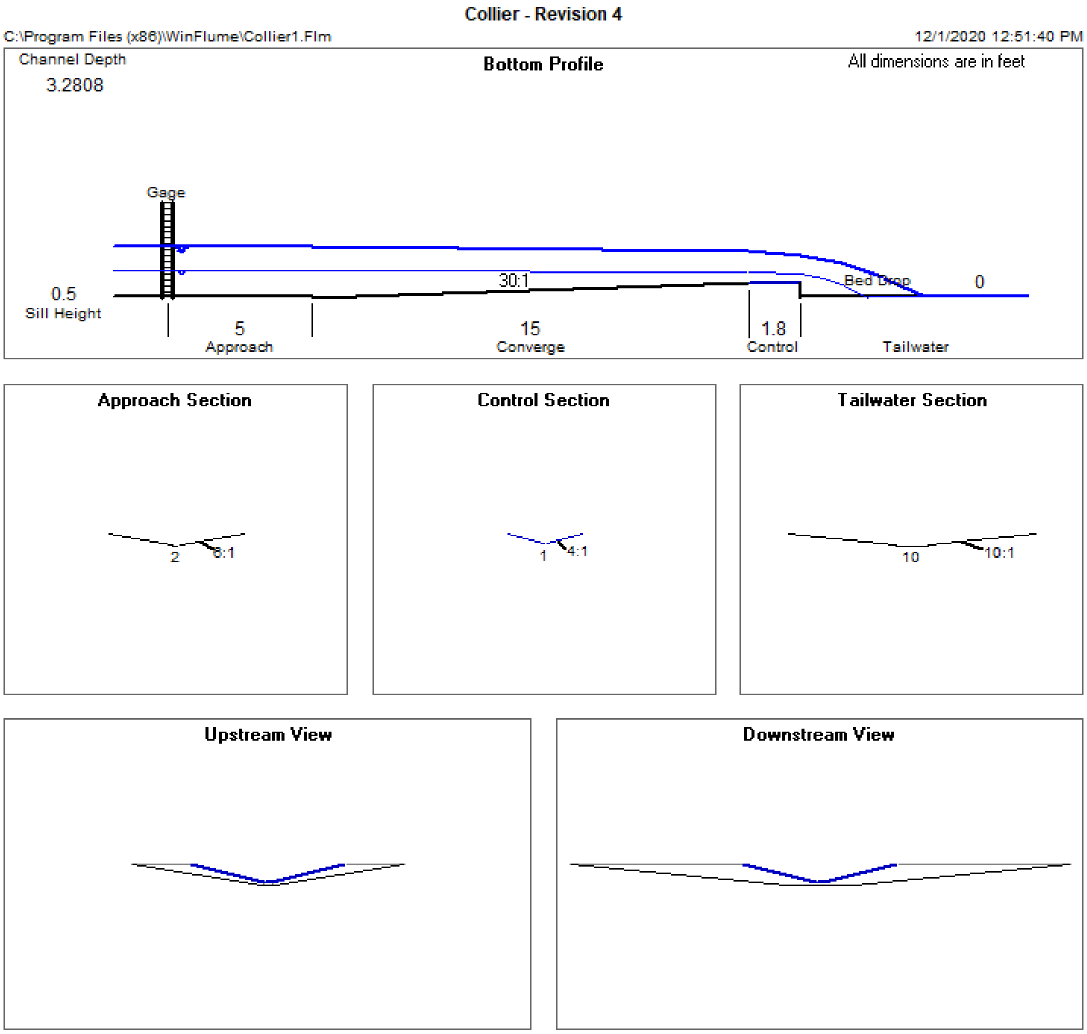
Table 2 - Comparison table for flow split and measurement options

Flow Measurement Method	Flow Split	Flow Measurement	Maintenance	Fish Passage	Automation
In-stream weir above Collier diversion	The Collier ditch headgate and Parshall flume would be	A broad crested weir constructed about 50 feet upstream of the	Minimal maintenance is anticipated. Rocks or large woody debris	Good	Requires instrumentation on both Collier ditch flume and river weir.

	similar to existing. In-stream flows would pass through a technical fishway or a sluicebox for the rock ramp option.	Collier diversion. The weir would be designed to measure stream flows between 1- 20 cfs. No direct measurement of in-stream flows passing the diversion would be available. Could take 10+ minutes after adjusting headgate to reach flow equilibrium for ditch measurement due to upstream pool volume and distance between headgate and Collier Parshall flume.	would need to be keep off the broad crested weir.		
Separate headgates with measurement devices	Construct new diversion headworks with headgates for the Collier Ditch and a separate headgate for in-stream flow diversions to the river. (Figure 11 example)	The Collier ditch headgate and Parshall flume would be operated similar to existing. The Parshall flume could be moved closer to the headgate to reduce the lag time for flow changes to show at the measuring flume. A separate measuring device for in-stream flow would allow for adjustment and direct	Normal maintenance of headgate structure. If the dam crest was modified to constant elevation the in-stream headgate could be designed to also act as a sluiceway for passing sands and gravels during all flows.	Poor to no passage during in-stream flows	Requires instrumentation of in-stream measuring device. Allows for future automated or remotely adjustable headgate.

		measurement of in-stream flow. During in-stream flows, only the in-stream flow headgate would need to be adjusted. The Collier ditch headgate could be left fully opened. The in-stream headgate would be adjusted to pass the in-stream water right based on a measuring device located downstream of the headgate structure. All remaining river flow would flow to the Collier ditch.			
Water Measurement Weir within Fishway	In-stream flows would pass through a technical fishway or for a rock ramp option pass through a left side sluicebox.	Removable rectangular weir for measuring in-stream flows. Removed at the end of the irrigation season.	Minimal, inserting weir plate during in-stream flows. A technical fishway would have a course trashrack across the exit that would require cleaning.	Good during high flows and good to poor during in-stream flows.	Requires instrumentation of in-stream flow measuring device.

Figure 10 – Schematic of broad crested weir located upstream of Collier Diversion. Used to measurement of low river flows during in-stream releases.



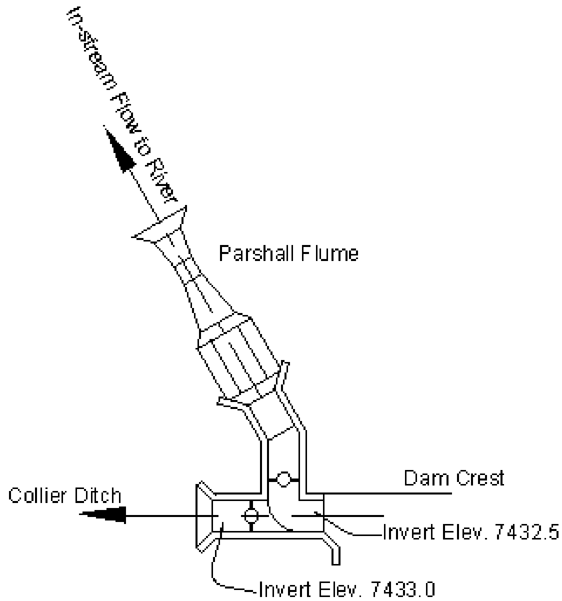


Figure 11 - T-box headworks for flow split with two headgates.

6. Conclusions

This report summarizes options to provide the irrigators with a project that improves the functionality and efficiency of their existing diversion, while providing by-pass flows and improved fish passage when flows allow. The two proposed alternative projects presented herein provide for measurement of bypass flows and fish passage, as well as a new intake structure, a rehabilitated diversion structure, instream flow measurements and improved operations of the diversion. Both alternatives propose placing grouted rock downstream of the existing crest. This grouted rock will provide protection from future scour during the design flood flow events. In addition, grouted rock will be placed downstream of the right abutment to help reduce leaking and potential failure mechanisms at this abutment. Proposed modifications to the crest for sluicing purposes would still provide adequate headwater elevation to divert the water right. Multiple viable options were identified for measurement of in-stream flows for each proposed alternative. The final design will be selected with irrigator input. The proposed headgate for both alternatives consists of a new slide gate and concrete structure which will improve ditch operations and reduce leakage.

7. References

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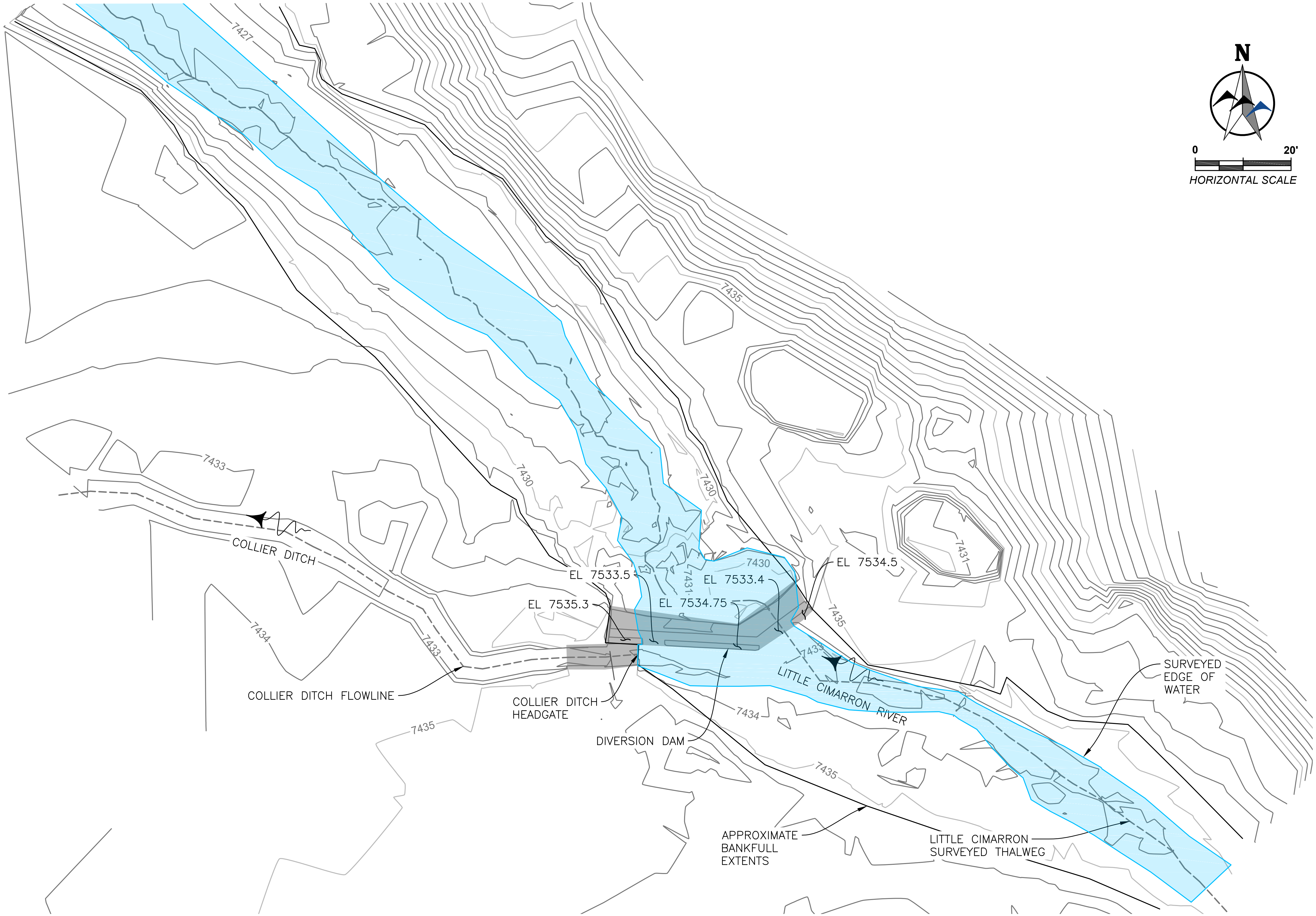
ATTACHMENT A

SITE SURVEY



NO.	REVISIONS	DATE

WWC ENGINEERING

LITTLE CIMARRON RIVER SITE SURVEY

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
CHECKED BY: JAT
DATE: 3/2021

DRAWING

ATTACHMENT B

TECHNICAL FISHWAY ALTERNATIVE CONCEPTUAL DESIGN

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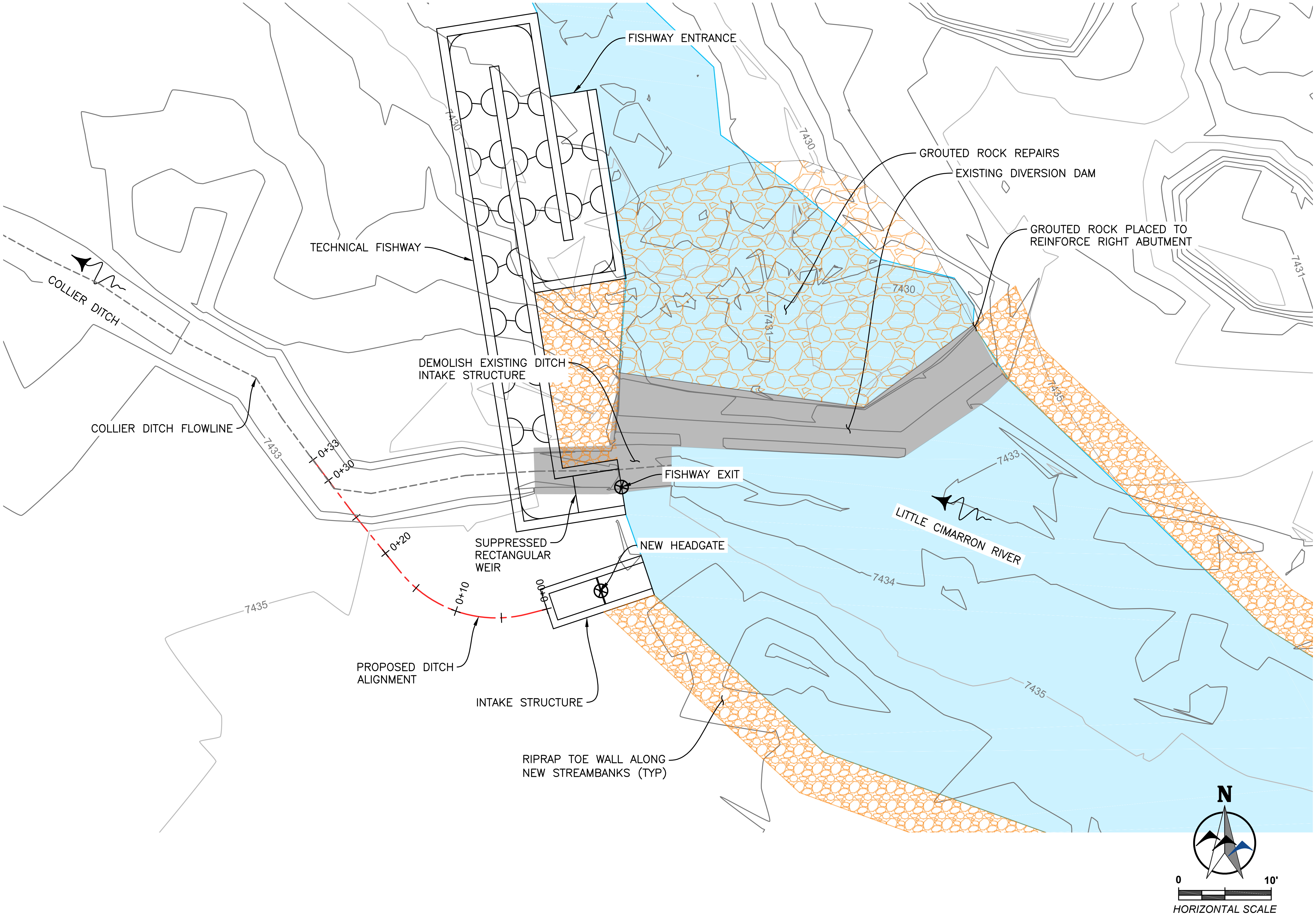


NO.	REVISIONS	DATE

WWC ENGINEERING

TECHNICAL FISHWAY ALTERNATIVE

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
CHECKED BY: JAT
DATE: 3/2021

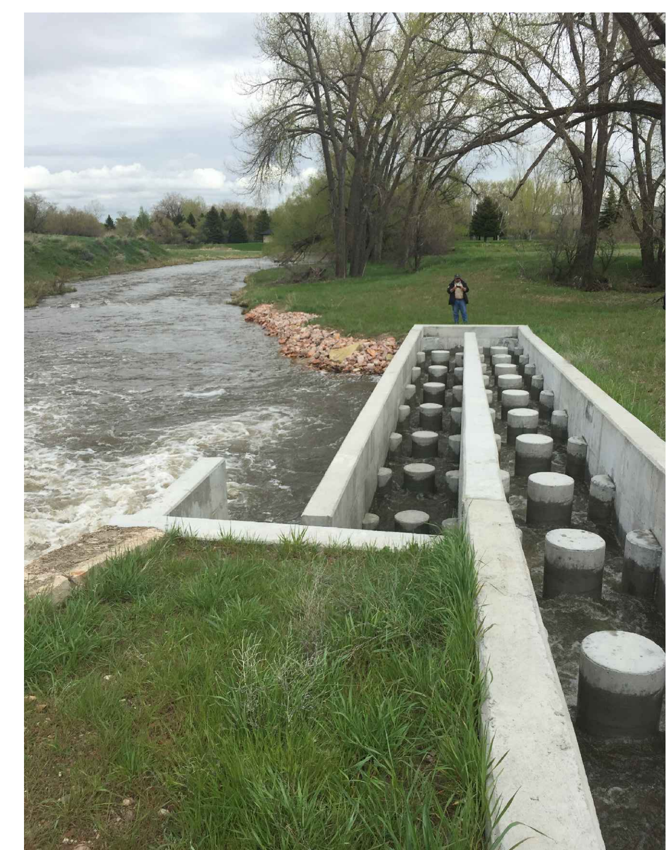
DRAWING

THE FOLLOWING PHOTOS ARE FROM THE PRATT AND FERRIS DIVERSION FISH PASSAGE PROJECT COMPLETED IN 2015 ON PINEY CREEK NEAR BUFFALO, WYOMING.

FORMING USED TO CAST THE CYLINDRICAL FISHWAY BAFFLES.

VIEW OF THE COMPLETED FISHWAY LOOKING AT THE TRASH RACK AND WATER ENTRANCE.

VIEW OF THE COMPLETED FISHWAY LOOKING UPSTREAM AT THE DIVERSION.



VIEW OF THE COMPLETED FISHWAY LOOKING DOWNSTREAM AT THE FISHWAY WATER EXIT.

NO.	REVISIONS	DATE

WWC ENGINEERING

TECHNICAL FISHWAY EXAMPLE PHOTOS

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
CHECKED BY: JAT
DATE: 3/2021

DRAWING

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ATTACHMENT C

Grouted Rock Ramp Alternative Conceptual Design

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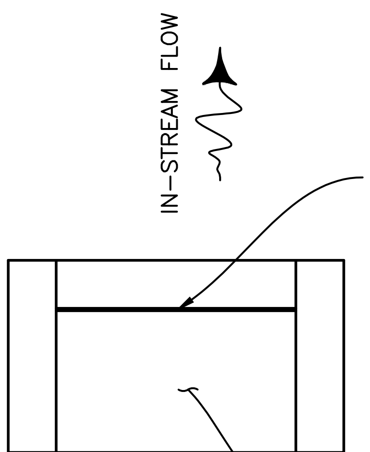
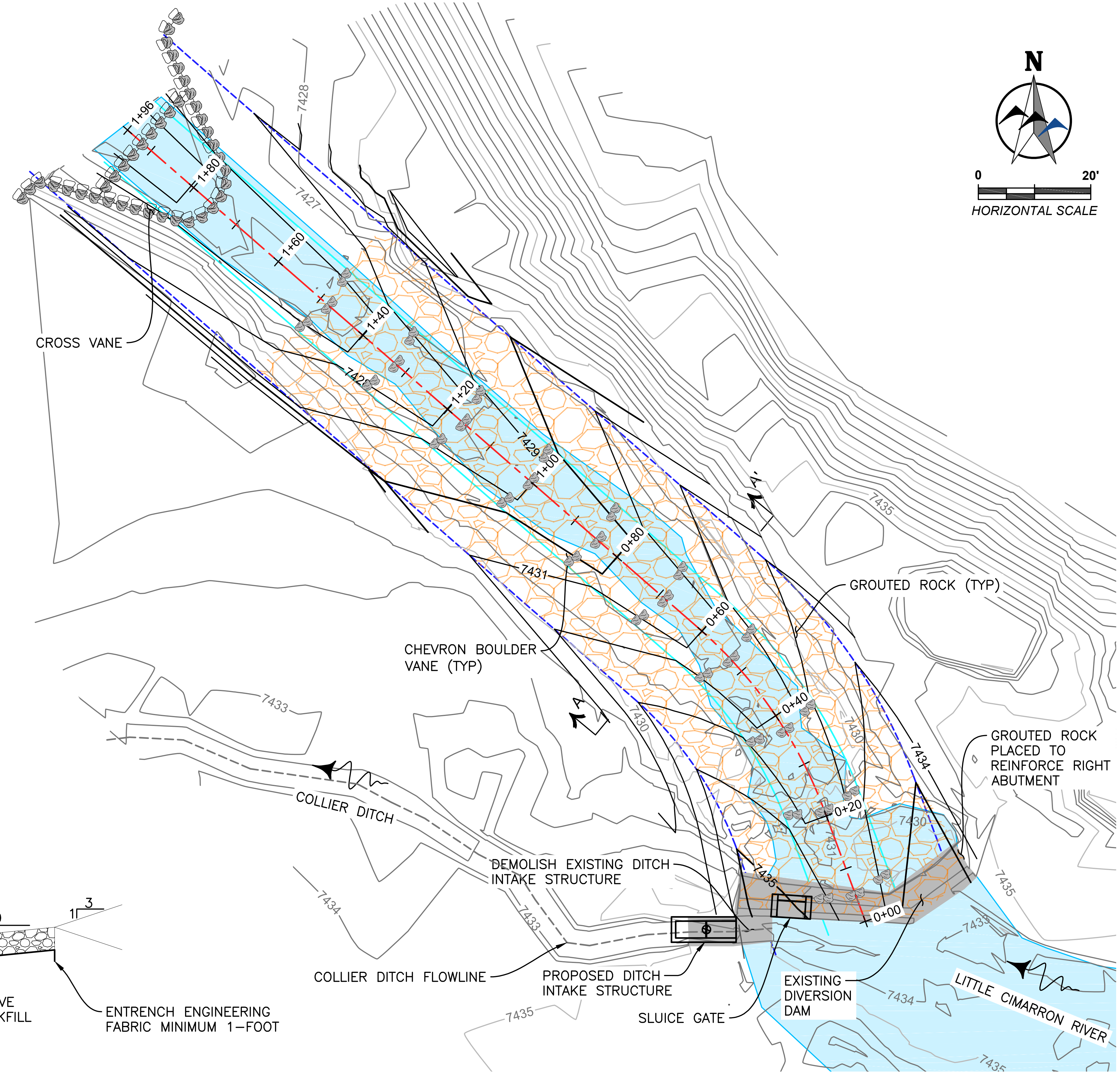
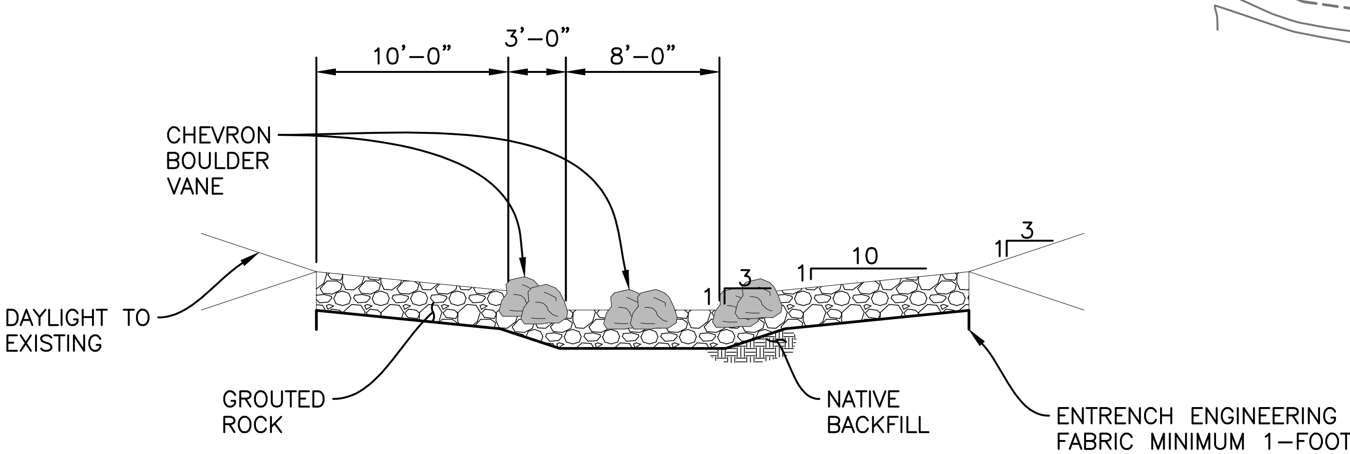


SLUICE GATE PLAN VIEW

0 10'
HORIZONTAL SCALE





TYPICAL SECTION A-A'

0 10'
HORIZONTAL SCALE

NO.	REVISIONS	DATE

WWC ENGINEERING

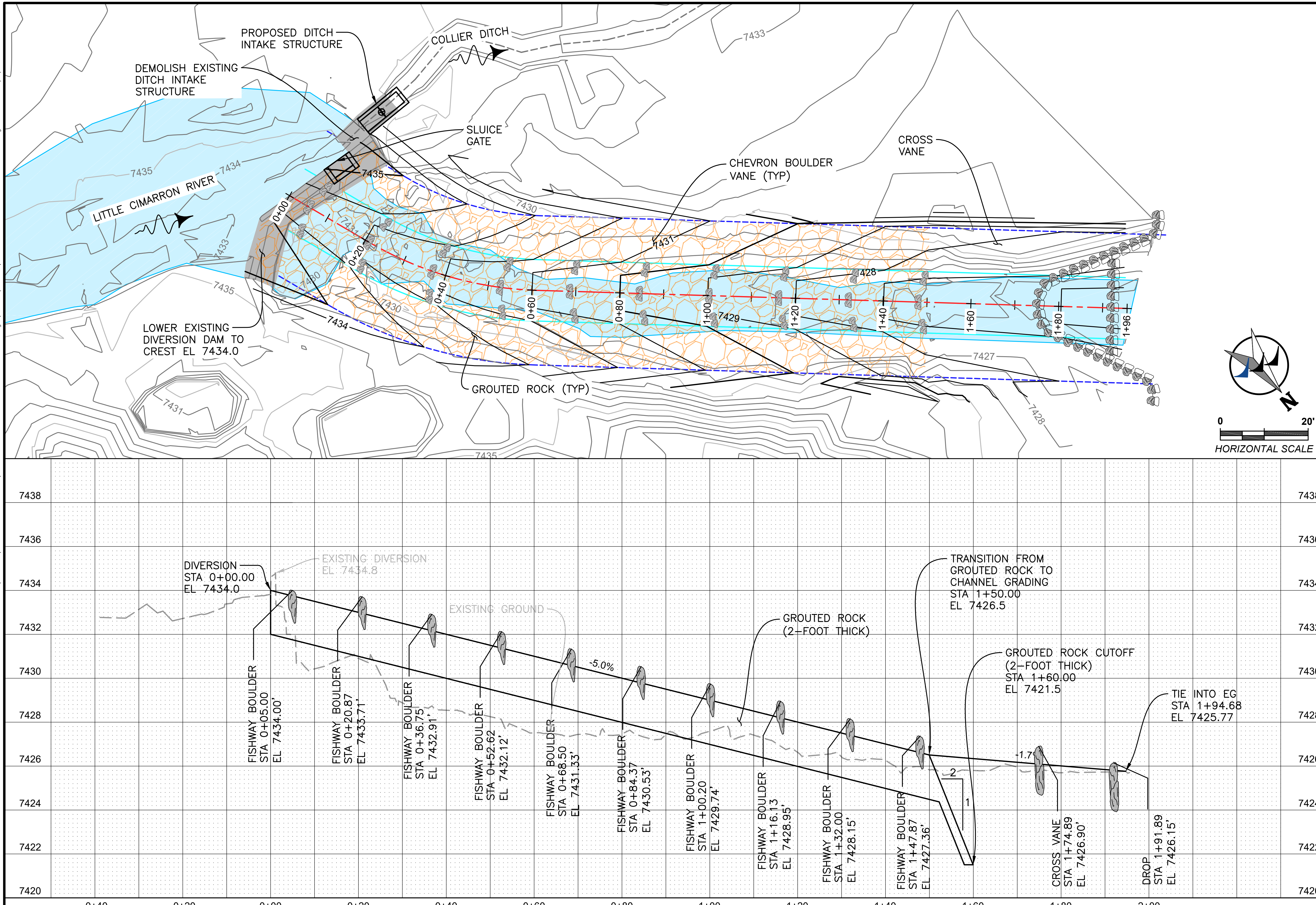
GROUTED ROCK RAMP ALTERNATIVE

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
CHECKED BY: JAT
DATE: 3/2021

DRAWING

K:\Laramie\Colorado Water Trust\2020159 Collier Ditch Fish & Water Passage\05CAD\Sheets\2020159_COLLIER DITCH_PLAN SET.dwg Alt2 PP 3/2/2021 11:14:05 AM



NO.	REVISIONS	DATE

WWC ENGINEERING

GROUTED ROCK RAMP
PLAN AND PROFILE

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
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DATE: 3/2021

DRAWING

THE FOLLOWING PHOTOS ARE FROM THE BIG CREEK FISH PASSAGE PROJECT COMPLETED IN 2017 ON BIG CREEK NEAR RIVERSIDE, WYOMING.

PREPARATION OF THE SUBGRADE MATERIAL AFTER EXCAVATION.

PLACEMENT OF ENGINEERING FABRIC AND RIPRAP WITH CHEVRON BOULDER VANES.

LEAN CONCRETE GROUT BEING PLACED ON ROCK RAMP.

COMPLETED GROUTED ROCK RAMP SHOWING FLOW THROUGH THE LOW FLOW CHANNEL.

COMPLETED GROUTED ROCK RAMP SHOWING FLOW THROUGH THE LOW FLOW CHANNEL.

NO.	REVISIONS	DATE

WWC ENGINEERING

GROUTED ROCK RAMP EXAMPLE PHOTOS

COLLIER DITCH FISH AND WATER PASSAGE PROJECT
COLORADO WATER TRUST
GUNNISON COUNTY, CO

DESIGNED BY: WWC
DRAWN BY: BEL
CHECKED BY: JAT
DATE: 3/2021

DRAWING

ATTACHMENT D

ENGINEER'S COST ESTIMATES

Collier Ditch Fish and Water Passage Project - Gunnison County, CO

Alternative 1 - Technical Fishway

Conceptual Design Engineer's Estimate

Item	Description	Unit	Unit Price	Quantity	Cost
1	Mobilization and Bonds (8% of all bid items)	LS	8%	1	$26,016
2	Site Work (Clearing and Grubbing, Access Roads, Etc.)	LS	$5,000	1	$5,000
3	Temporary Water Control	LS	$5,000	1	$5,000
4	Demolition	LS	$5,000	1	$5,000
5	Excavation (Grading Cut)	CY	$10	750	$7,500
6	Embankment (Grading Fill)	CY	$10	500	$5,000
7	Spoil Material	CY	$10	250	$2,500
8	Grouted Class 1 Riprap (2-feet)	SY	$500	100	$50,000
9	Riprap Toe Wall (2-feet)	SY	$50	200	$10,000
10	Grading W Base (8-inches)	SY	$30	40	$1,200
11	Cast-In-Place Concrete (Fishway)	CY	$1,200	135	$162,000
12	Cast-In-Place Concrete (Intake)	CY	$1,200	10	$12,000
13	Slide Gate	EA	$5,000	2	$10,000
14	Metal Work	LS	$15,000	1	$15,000
15	Landscaping	LS	$10,000	1	$10,000
16	Cast-In-Place Broad Crested (Permanent) Weir	LS	$25,000	1	$25,000
A	Construction Cost Subtotal				$351,216
B	Contingency (15% of A)		15%		$52,682
	Estimated Project Cost				**$403,898**
	Rounded Project Cost				**$404,000**

Bid Alternate 1

1	Steel V-Notch Sharp Crested (Temporary) Weir	LS	$10,000	1	**$10,000**

WWC ENGINEERING

Collier Ditch Fish and Water Passage Project - Gunnison County, CO

Alternative 2 - Grouted Rock Ramp

Conceptual Design Engineer's Estimate

Item	Description	Unit	Unit Price	Quantity	Cost
1	Mobilization and Bonds (8% of all bid items)	LS	8%	1	$24,240
2	Site Work (Clearing and Grubbing, Access Roads, Etc.)	LS	$5,000	1	$5,000
3	Temporary Water Control	LS	$5,000	1	$5,000
4	Demolition	LS	$5,000	1	$5,000
5	Excavation (Grading Cut)	CY	$10	100	$1,000
6	Embankment (Grading Fill)	CY	$10	650	$6,500
7	Imported Borrow Material	CY	$10	250	$2,500
8	Grouted Class 1 Riprap (2-feet)	SY	$400	550	$220,000
9	Boulder Cross Vane (125 tons/structure, 1 total)	EA	$17,000	1	$17,000
10	Cast-In-Place Concrete (Intake)	CY	$1,200	10	$12,000
11	Cast-In-Place Concrete (Sluice Gate)	CY	$1,200	5	$6,000
12	Slide Gate	EA	$4,000	2	$8,000
13	Metal Work	LS	$10,000	1	$10,000
14	Landscaping	LS	$5,000	1	$5,000
A	Construction Cost Subtotal				$327,240
B	Contingency (15% of A)		15%		$49,086
	Estimated Project Cost				**$376,326**
	Rounded Project Cost				**$376,000**

WWC ENGINEERING