North Fork of the Gunnison River Irrigation Management Plan

Prepared for:

North Fork Water Conservancy District

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1.0 EXECUTIVE SUMMARY

The North Fork of the Gunnison River (North Fork) is a major tributary to the Gunnison River in Western Colorado. It is a river of roughly 35.5 miles in length, beginning at the confluence of Muddy Creek and Anthracite Creek, both of whose origins begin in the West Elk Mountains of Colorado. The North Fork ends roughly 8 miles southwest of Hotchkiss, CO at its confluence with the Gunnison River. The surrounding terrain is highly variable with a combination of river corridor lowlands and fertile mesas. The North Fork traverses the valley such that irrigation and crop cultivation occur on both sides of the river. The terrain and river location within the valley require multiple diversions to serve all of the irrigable lands. As such, there are approximately 12 agricultural river diversions along the North Fork, each of varying scale and varying impact to the overall river system.

The North Fork Valley (the Valley or Valley) contains fertile soils, and experiences a climate conducive to widely varying agricultural production. Agriculture would not be practical in the Valley without irrigation. Farming and ranching provide a major economic driver to the region, and are important to the local and regional culture and economy. As the primary beneficial consumptive users of water from the North Fork, it is important that agricultural irrigators continue their work to improve the river system as a whole while protecting their historic water rights through beneficial consumptive use. Agriculture will remain an important part of the Valley for generations to come.

The purpose of this irrigation management plan is twofold. The primary objective is to identify the near river infrastructure needs of agricultural users who divert water directly from the North Fork and provide recommendations for moving forward with improvements within the river corridor that have multiple benefits. Secondarily, this plan seeks to educate the agricultural water users of their strong position on the river, and to bring them into the process of stream management planning and emphasize the following ideas:

- Non-consumptive beneficial uses may also be realized without damage to existing agricultural water rights
- Beneficial and meaningful infrastructure improvements may be achieved by working with non-consumptive water use interests on the river.
- Infrastructure improvements are a means of protecting agricultural water rights.

Irrigator needs were identified in two ways: through interviews with ditch board members and water users and through a brief river infrastructure assessment focused primarily on the diversion infrastructure. Interviews have provided a wealth of local knowledge and experience to help promote or reject potential improvement opportunities. The interview process also allowed for one on one conversations regarding river infrastructure improvements and the "big picture" issues associated with the North Fork and its place in the larger Colorado River basin. The river infrastructure assessment contributed ideas for improvements regarding infrastructure, beginning in-stream and ending near the measuring device utilized by the Colorado Division of Water Resources (CDWR) division 4 staff for diversion measurement.

Preliminary cost estimates were provided for potential improvements to provide a sense of scale and to help identify which projects may be fundable. Once practical potential improvements were identified, they were ranked with a relative priority scale.

This report presents some of the findings (water rights, river system interaction, etc.). However, this report does not seek to report on actual river administration. Administration of water rights along the North Fork is the responsibility of the CDWR Division 4. This report is intended to assist decision makers in moving forward with agricultural water resources projects in the Valley.

2.0 EXISTING CONDITIONS ASSESSMENT

This existing conditions assessment was developed through a combination of agricultural user interviews and a river infrastructure assessment, both conducted by J-U-B Engineers, Inc. The intent of the assessment was to analyze the infrastructure and needs of the agricultural diversions between the confluence of Muddy Creek and Anthracite Creek to the confluence with the Gunnison River.

To assist in long-term planning and to assist with further projects associated with stream management planning we have established a series of reaches along the river. These reaches are based on locations of larger diversions. These may be used when examining infrastructure needs, looking at environmental concerns on the river, discussions of river health, etc. Table 2.0.1 summarizes the locations of the established reaches. Note that stationing was established with 0+00 at the confluence of Muddy Creek and Anthracite Creek. Appendix A contains a mapbook showing diversion locations, reach divisions, and river stationing.

Table 2.0.1. Summary of Established Reaches

Reach	Description	Starting Sta.	Ending Sta.	Length (mi.)	Diversions within Reach
1	Upper North Fork	0+00	376+35	7.13	N/A
2	Fire Mountain to Stewart	376+35	608+87	4.40	Fire Mountain Canal, Carrol Ditch, Lennox Ditch Pump
3	Stewart to N.F. Farmer's	608+87	719+59	2.10	Stewart Ditch
4	N.F. Farmer's to Paonia	719+59	813+33	1.78	North Fork Farmer's Ditch, Feldman Ditch
5	Paonia to Short	813+33	1060+76	4.69	Paonia Ditch, Monitor Ditch, Shepherd and Wilmott Ditch
6	Short to Vandeford	1060+76	1296+73	4.47	Short Ditch
7	Vandeford to Smith and McKnight	1296+73	1385+65	1.68	Vandeford
8	Lower North Fork	1385+65	1873+55	9.24	Smith and McKnight

The Fire Mountain Canal in Reach 2 is the largest diversion (by total volume diverted) in the North Fork, with an average annual diversion of over 45,000 ac-ft. This diversion, however, is largely supplemented by Paonia Reservoir. The other North Fork diversions do not have access to reservoir water. However, they benefit significantly from increased natural flow made available for diversion in the North Fork because of Paonia Reservoir. Figure 2.0.1 summarizes the agricultural diversion volumes within each reach along the North Fork. This figure displays the average annual diversion from the years 2007 to 2016 according to the

Colorado Department of Natural Resources (DNR). Note that data for the Carrol Ditch was only available for 2015 to 2016.

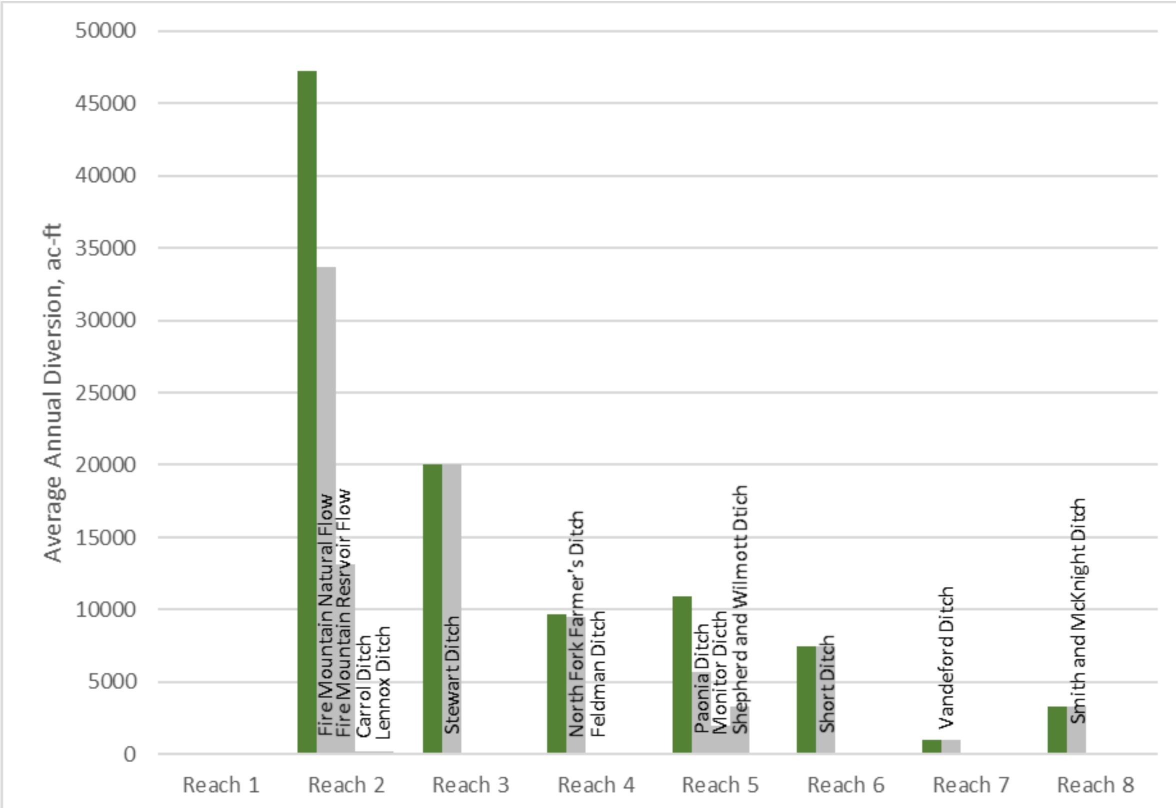


Figure 2.0.1. 2007 to 2016 Average Annual Diversion Volumes by reach Along the North Fork

The efficiency of an irrigation diversion (system efficiency) is the measure of diverted water consumptively used for crops as a percentage of the total water diverted for irrigation. Ideally, efficiency would be 100%, but a variety of factors prevents this from happening even in the most efficient systems. System efficiency is a product of both conveyance efficiency and application efficiency, however, with the data available it is difficult to distinguish where the inefficiencies lie within the total system.

Data for crop consumptive use for the irrigated lands was borrowed from the "Jessie Ditch Irrigation Demand Study" completed by Olsson Associates in May 2016. Using the ASCE Standardized Penman-Monteith Method, the study found the historical consumptive use for Alfalfa to be 34.7 in/ac while the consumptive use for grass pasture is 33.1 in/ac. The spatial proximity and climactic similarity of the Jessie Ditch service area makes this data suitable for use within this report. Consumptive use by other crops was not explored in the Jessie Ditch Irrigation Demand Study, so the grass pasture consumptive use requirement was assumed for all irrigable acreage on each diversion. This should serve as a conservative estimate as corn, small grains, and orchards often require less water than grass pasture.

By utilizing data on irrigated acreage and annual diversion amounts acquired from the Colorado Division Support System (CDSS) with the crop consumptive use data, system efficiencies were determined for each diversion. An overview of system efficiency is provided with each ditch overview in the ensuing sections. It is important to emphasize that low system efficiency is not inherently an indicator of negative management. The diversions along the North Fork have been managed in conjunction with each other for decades in a manner that decreases conflict amongst users and provides sufficient water throughout the irrigation season. Aged infrastructure often requires higher diversion in order to deliver sufficient water to each field.

2.1 Reach 1 Overview

Reach 1, known as the Upper North Fork begins at the confluence of Muddy Creek and Anthracite Creek and travels 7.13 miles to immediately before the Fire Mountain Canal Diversion. While there are no diversions in this reach, flows are largely impacted by the releases from Paonia Reservoir to the Fire Mt. Canal diversion. For this reason, relatively higher flows are often maintained in Reach 1 late into the irrigation season.

2.2 Reach 2 Overview

Reach 2 begins with the Fire Mountain Canal Diversion and ends immediately prior to the Stewart Ditch Diversion. Within this 4.4 mile stretch there are two other small diverters (the Carrol Ditch and the Lennox Ditch Pump). The Fire Mountain Canal is the largest diverter on the North Fork, and thus Reach 2 has substantially less flow than Reach 1 during the irrigation season. Figure 2.2.1 summarizes the average annual diversions from 2007 to 2016 for all reaches, with a focus on the diversions from Reach 2.

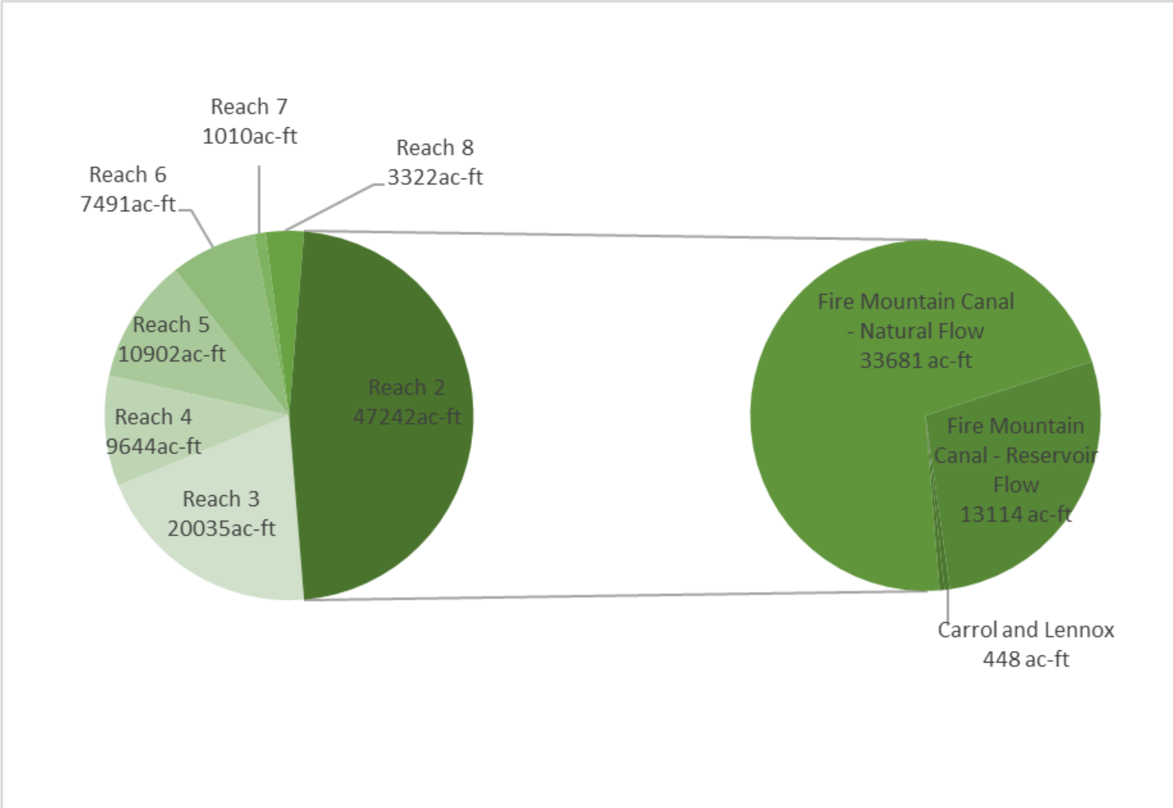


Figure 2.2.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 2

2.2.1 Fire Mountain Canal

Canal Overview –

The Fire Mountain Canal Diversion is located in Reach 2 at 376+35, just below the Town of Somerset, CO. The ditch traverses the Northern edge of the Valley irrigating multiple areas along the way. The bulk of the Fire Mountain Canal's water is used to supply irrigators on Rogers Mesa. On its way to Rogers Mesa, the Fire Mountain Canal receives inflows from multiple water sources including Terror Creek and Leroux Creek. Figure 2.2.1.1 provides the 2007 to 2016 average diversion statistics for the Fire Mountain Canal. A large portion of this water, particularly in mid-to-late irrigation season, is reservoir water from Paonia Reservoir.

It is important to note that the 10-year average diversions for the Fire Mt. canal during the months of May, June and July are relatively uniform. The month of August shows a slightly decreased average diversion, however the decrease of average diversion in August can be almost entirely accounted for by August of 2012 in which only 1,045 ac-ft was diverted. The relatively constant diversion throughout the season represents a constant demand across the irrigation season and does not represent a demand curve that is a function of crop demand.

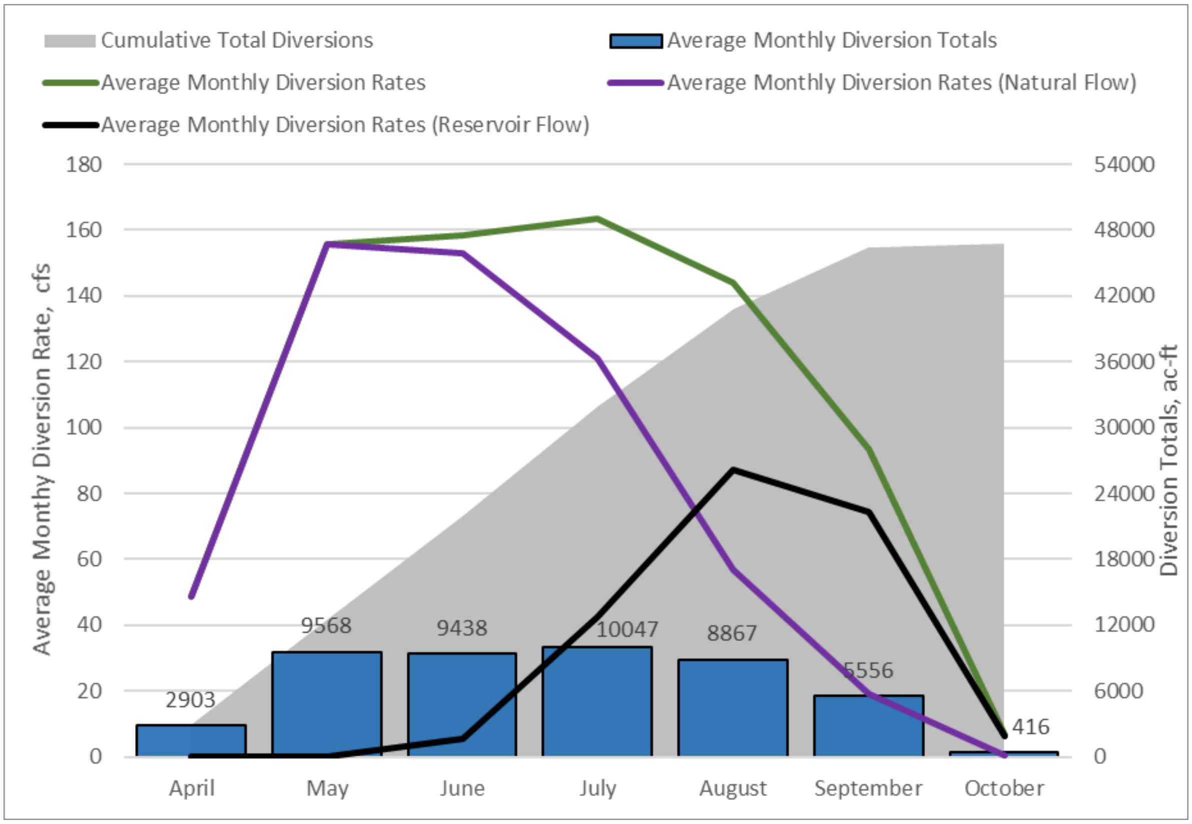


Figure 2.2.1.1. 2007 to 2016 Average Diversion Statistics for Fire Mountain Canal from the North Fork

CDSS reports that the Fire Mountain Canal provides irrigation water to 5,632 acres. Approximately 72% of the irrigated land is used to cultivate grass pasture, with substantial acreage used for alfalfa, and fruit orchards. Small grains and corn are also cultivated within the service area. Using the methods described in Section 2.0, the efficiency was calculated as 24%. Note that this figure does not account for water diverted from other water sources (such as Terror and Leroux Creek). Accounting for these additional sources would decrease overall efficiency. Figure 2.2.1.2 provides a visual breakdown for the calculated efficiency of the Fire Mountain Canal.

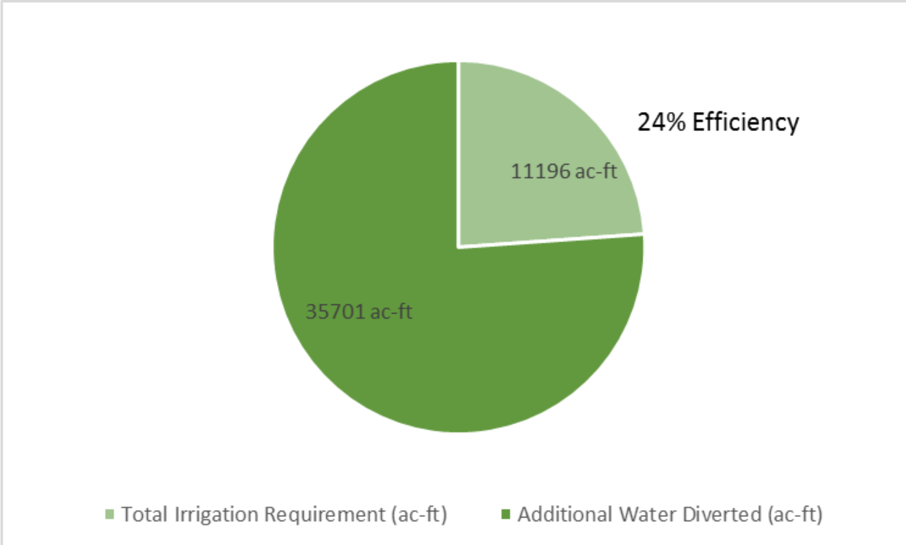


Figure 2.2.1.2. Calculated System Efficiency for the Fire Mountain Canal, excluding Terror and Leroux Creek Inflows

Brief Diversion Description –

The Fire Mountain Canal Diversion consists of a concrete wall that spans the entire width of the North Fork. The downstream side of the wall is backfilled with large boulders that gradually slope to the natural river bottom. Figure 2.2.1.3 shows a portion of the concrete wall with the boulder back-fill.

Figure 2.2.1.3. Portion of Concrete Wall with Boulder Backfill

There is a large concrete intake structure on the North side of the river. Flow into the canal is managed by a large radial gate. Once through the radial gate, water enters a stilling pool and then is immediately siphoned under the highway into the Fire Mountain Canal. The front of the intake structure consists of a concrete headwall and large trash rack of vertical steel bars. Recently, a skimming boom was placed upstream of the headwall to redirect large debris away from the structure and prevent it from clogging the trash rack. Figure 2.2.1.4 shows the front of the intake structure, including the trash rack and skimming boom. Figure 2.2.1.5 shows the radial gate along with a steel plate which can be used to prevent water entry into the canal.

Figure 2.2.1.4. Fire Mountain Canal Intake Structure

Figure 2.2.1.5. Radial Gate and Steel Stop Plate within Fire Mountain Canal Intake Structure

Structural Integrity and Diversion Functionality –

The Fire Mountain Canal diversion appears to be both structurally sound and functional. The concrete diversion wall is in good repair and is well supported by the boulder backfill. The river channel in the immediate vicinity of the diversion is well established and unlikely to meander. There appears to be minimal risk of flanking around the diversion wall, allowing the continual supply of water to the intake structure. The intake structure appears to be in good repair. The recent addition of the skimming boom will likely decrease maintenance requirements at the diversion during the irrigation season.

Ability to Divert Appropriate Range of Flows –

The diversion is able to divert a wide range of flows, as evidenced by both diversion records and physical inspection. The concrete diversion wall maintains a sufficient water surface elevation in the river such that water may always be supplied to the intake structure. The intake itself is adequately sized to take the full water right.

Diversion Issues that Affect River Function –

The diversion segregates the waters upstream of the concrete wall with those downstream of the wall. This likely makes fish passage more difficult; however, the boulder backfill may act as somewhat of a fish ladder. The boulder backfill helps dissipate the energy of the river to help maintain channel integrity. River energy is kept parallel to the banks by the diversion, assisting in maintaining channel integrity.

Diversion Issues that Affect Recreational Users –

At low flows the diversion blocks river passage for recreational users, as seen in Figure 2.2.1.3. At high flows, the diversion likely creates rapids while allowing boat passage. The skimming boom has likely provided safety to recreationalists, as it assists in keeping watercraft within the river channel. The banks in the vicinity of the diversion are steep and likely make it difficult to remove water craft from the river. Boat passage through or around the diversion may make recreation in the area easier.

Recommendations –

1. Boat Passage: With augmented flows during the latter portion of the irrigation season, the river upstream of the Fire Mountain Canal diversion is likely heavily used for watercraft. Adding boat passage through the diversion or a semi-maintained overland passage around the diversion may improve safety for recreationalists.

Preliminary Cost Estimates –

1. Boat Passage - $25,000 to $50,000

2.2.2 Carrol Ditch

Ditch Overview –

The Carrol Ditch Diversion is located in Reach 2 at 429+38, roughly one mile downstream of the Fire Mountain Canal Diversion. The ditch irrigates the river bottom in the immediate vicinity where a single landowner cultivates hay. The infrastructure is minimally disruptive to the river due to the small diversion rate and water right. Figure 2.2.2.1 provides the 2015 to 2016 average diversion statistics for the Carrol Ditch.

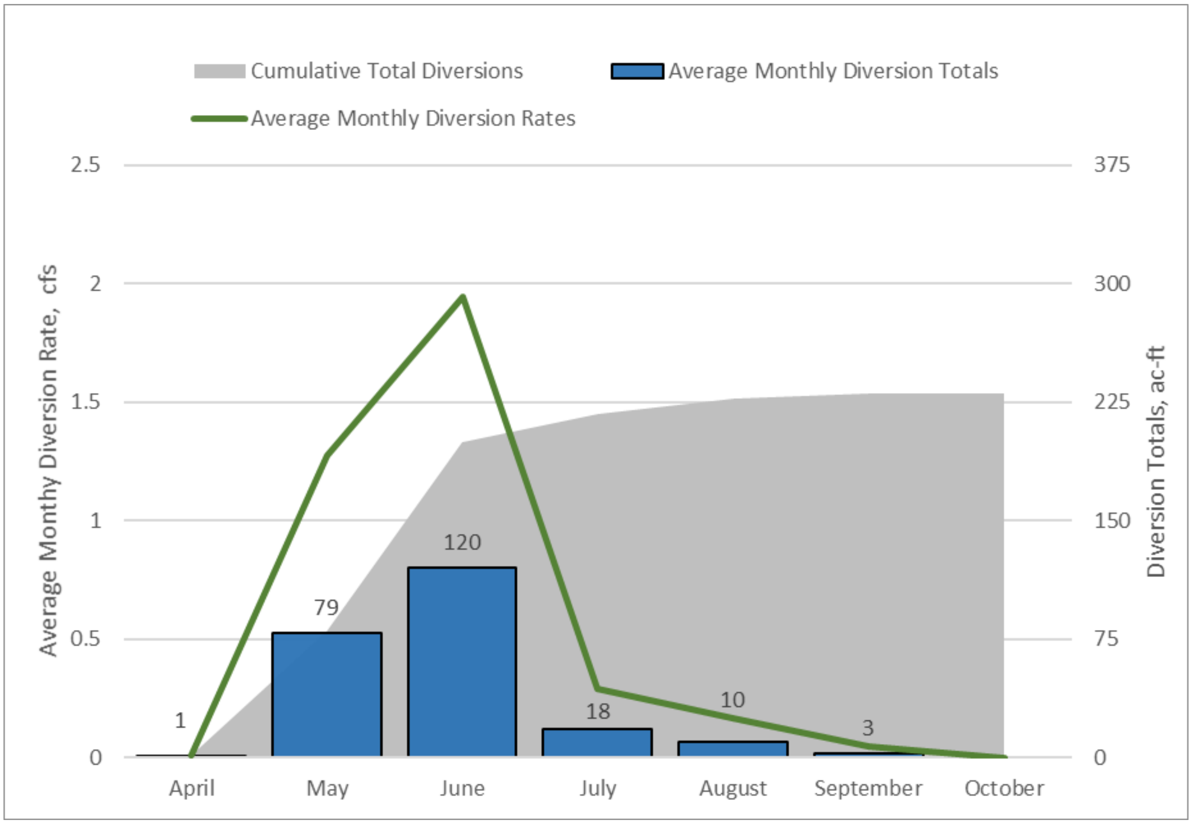


Figure 2.2.2.1. 2015 to 2016 Average Diversion Statistics for the Carrol Ditch

CDSS did not provide an estimate for irrigated lands served by the Carrol Ditch, so an efficiency was not calculated. The amount of water diverted by the Carrol Ditch is small relative to most diversions on the North Fork, so any efficiency improvements will likely represent a small impact on the overall river system.

Brief Diversion Description –

The Carrol Ditch Diversion consists of a small diversion channel adjacent to the principal river channel of the North Fork. Approximately 180 feet from the start of the diversion channel is a small headgate utilized to administer water into the Carrol Ditch. The diversion channel reconnects with the principal river approximately 200 feet downstream of the original diversion.

The Carrol Ditch diversion is entirely dependent on river level for its diversion as no artificial structure is in place to raise the level of the river. This is reflected in the data as well. Figure 2.2.2.2 displays the entrance to the diversion channel from the principal river channel. Figure 2.2.2.3 shows the ditch headgate from the entrance of the diversion channel.

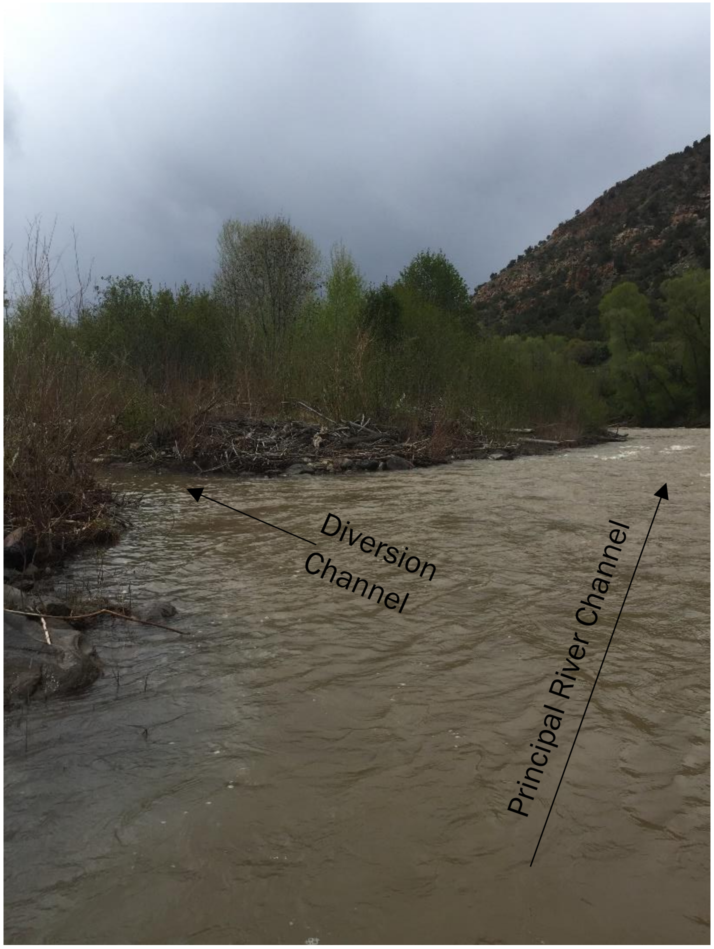


Figure 2.2.2.2. Entrance to Diversion Channel from Principal River Channel

Figure 2.2.2.3. Ditch Headgate from Entrance of Diversion Channel

Structural Integrity and Diversion Functionality –

From a structural standpoint, there is minimal concern with the Carrol Ditch inlet. As a simple headgate, regular maintenance and occasional replacement may be required.

Diversion functionality is likely a seasonal issue. With no structure in the river to raise water levels, there are likely times when the river cannot access the diversion channel, meaning no water can be supplied to the Carrol Ditch. Additionally, the low-velocity flow through the channel makes it ideal for sediment deposition. Semi-regular dredging of the diversion channel is necessary to maintain use of the water right.

Ability to Divert Appropriate Range of Flows –

The simple design of the Carrol Ditch inlet structure easily provides the ditch its water right (0.625 cfs). This is, however predicated on the ability of the diversion channel to take water from the North Fork. The Carrol Ditch currently has no ability to maintain water surface elevation in the river at the point of diversion, so the ability to divert water year-round is limited during low flows.

Diversion Issues that Affect River Function –

The current configuration of the Carrol Ditch diversion has a minimal impact on river function. The diversion amount is small relative to the other irrigators, and excess diversions are re-introduced to the river soon after the initial water diversion.

Diversion Issues that Affect Recreational Users –

The current Carrol Ditch layout creates no river impedance for recreational users and should cause minimal or no issues. In fact most recreational users would likely pass by without noticing that the Carrol Ditch existed.

Recommendations –

1. Grouted Boulder U-Weir: An in-stream grouted boulder U-weir would ensure that there is adequate water surface elevation for the Carrol Ditch to be able to divert flows throughout the season. This type of infrastructure would likely also need to create significant recreation, environmental or other benefit to justify the costs of creating an in-stream structure for such a small water right. It should be noted that the single user of the Carrol Ditch at this time finds the infrastructure adequate for the needs of the irrigation taking place. However, if significant non-consumptive benefit could be realized by in-stream work at this location, incorporating the diversion would be necessary and may aid in permitting.

Preliminary Cost Estimates –

1. Grouted Boulder U-Weir – N/A, costs far exceed benefits at this time.

2.2.3 Lennox Ditch Pump

Ditch Overview –

The Lennox Diversion is located in Reach 2 at 495+12. This is approximately 1.25 miles downstream of the Fire Mountain Canal. Historically there was a physical ditch; however, the diversion now supplies water to a pool immediately adjacent to the river channel where a pump is utilized to divert water. The Lennox supplies a single landowner who grows Alfalfa for a ranching operation. Figure 2.2.3.1 provides the 2007 to 2016 average diversion statistics for the Lennox Ditch.

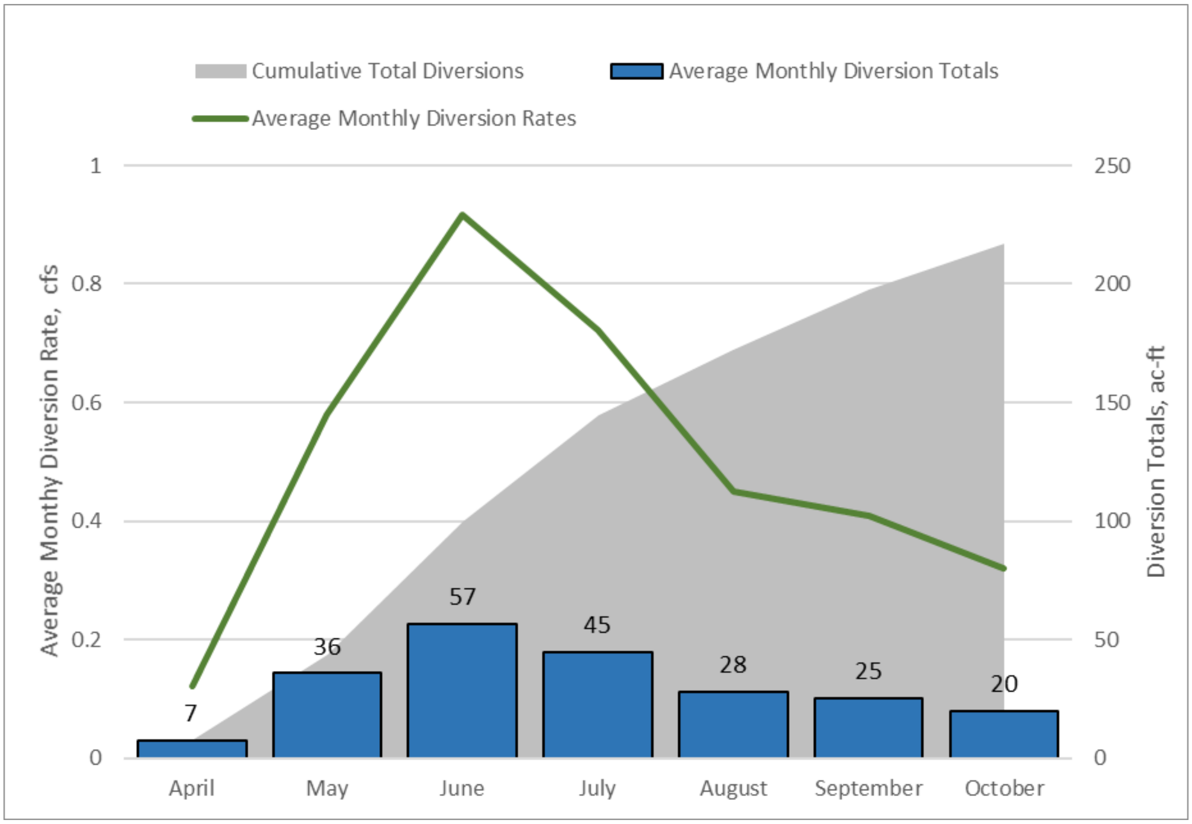


Figure 2.2.3.1. 2007 to 2016 Average Diversion Statistics for the Lennox Ditch

As would be expected with sprinkler irrigation and no conveyance losses, the system efficiency of the Lennox diversion is substantially higher than all other diversions on the North Fork. CDSS reports that a total acreage of 49.13 acres is served by the Lennox, and reports the acreage as grass pasture. With this in mind, system efficiency for the Lennox is calculated as 62%. Figure 2.2.3.2 illustrates the system efficiency of the Lennox Ditch.

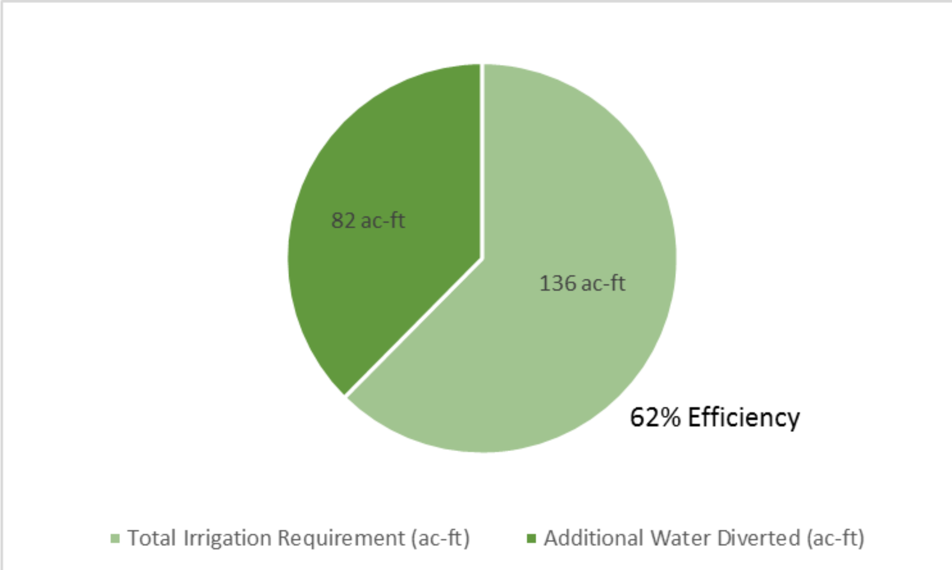


Figure 2.2.3.2. Calculated System Efficiency for the Lennox Ditch

Brief Diversion Description –

The Lennox “Ditch” provides irrigation water to a single landowner with multiple parcels both near the river and on the neighboring mesa via pressurized sprinkler irrigation. The diversion consists of a submerged boulder weir to maintain water surface elevation in a small pool adjacent to the river channel. The pump system suction hose is placed in the pool to extract water from the river. Figure 2.2.3.3 shows the river diversion with the manmade pool. Figure 2.2.3.4 displays the pump system that is used to convey the irrigation water.

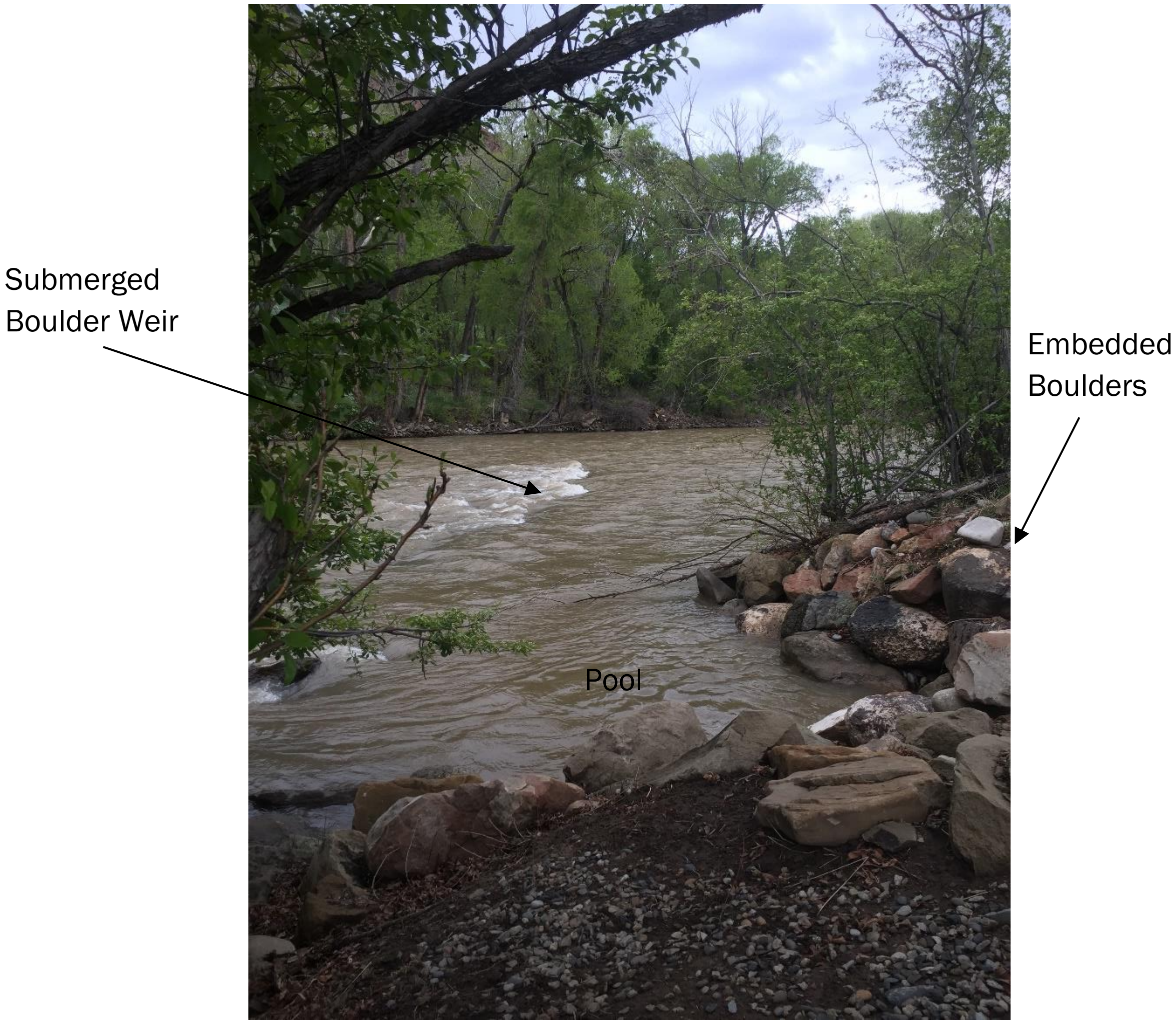


Figure 2.2.3.3. Lennox River Diversion with Pool

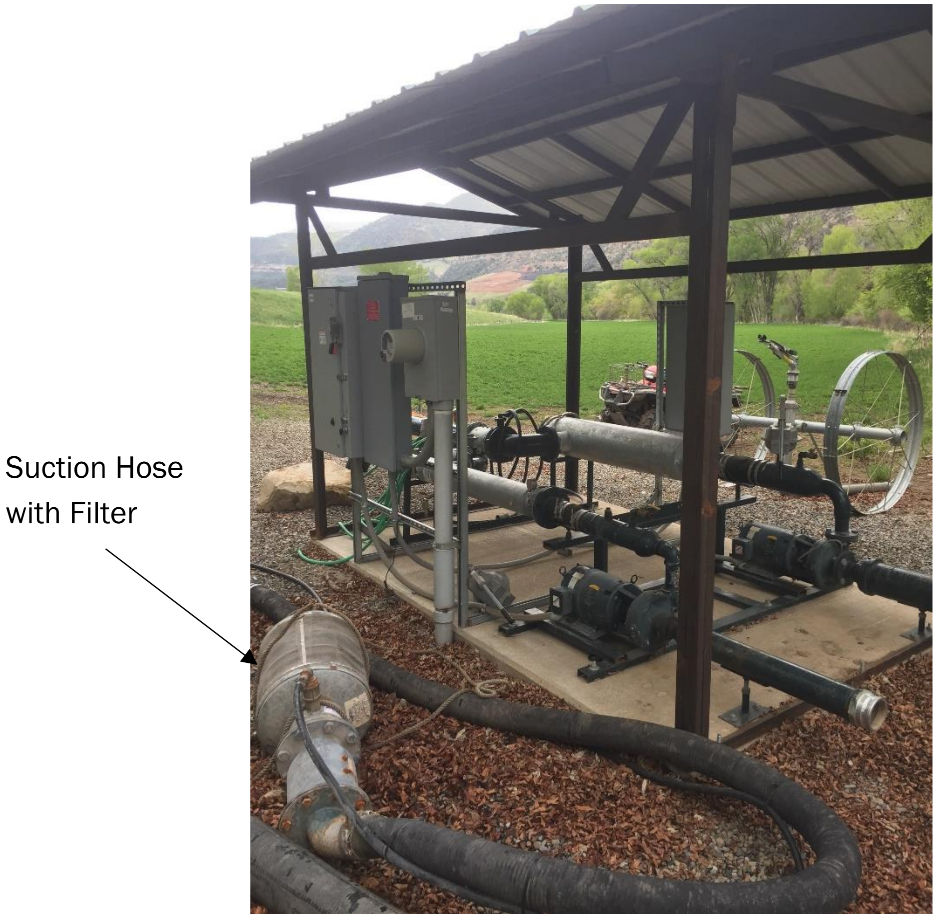


Figure 2.2.3.4 Lennox Ditch Pump System to Convey Irrigation Water

Structural Integrity and Diversion Functionality –

The pool structure is maintained by boulders embedded into the river bank, and is out of alignment with the primary flow path. The submerged boulder weir appears to be successfully directing the energy of the flow back toward the center of the river channel, making erosion of the pool unlikely during normal river conditions.

The diversion remains functional as long as there is adequate depth in the pool to fully submerge the pump suction hose and filter. Agricultural interviews revealed that there is an annual history of sediment build up that must be manually cleared.

Ability to Divert Appropriate Range of Flows –

The submerged boulder weir appears to keep to the water an appropriate level so that the pool remains full year round. This allows for the pumps to take the appropriate quantity of water at any time.

Diversion Issues that Affect River Function –

All in-stream diversions slightly effect the water surface profile of the river; however, the size of this diversion provides a minimal and highly localized effect. The weir does not span the entirety of the river channel, which helps maintain river function.

Diversion Issues that Affect Recreational Users –

Riffles are created by the submerged boulder weir; however, since it does not span the width of the entire river, passage through this segment of river is likely unimpaired for recreational users.

Recommendations –

There appear to be no major issues with this diversion or the river in the immediate vicinity. Time will tell if the submerged weir is structurally sound and will continue to perform its function. No recommendations are made at this time.

Preliminary Cost Estimate –

N/A

2.3 Reach 3 Overview

Reach 3 begins with the Stewart Ditch Diversion and ends just before the North Fork Farmer's Ditch. Reach 3 totals 2.1 miles in length and is located downstream of Bowie, CO but before Paonia, CO. The Stewart Ditch, which is the second largest diverter on the North Fork, is the sole diverter in Reach 3. Figure 2.3.1 below shows the average annual diversions for each reach on the North Fork, with focus given to Reach 3.

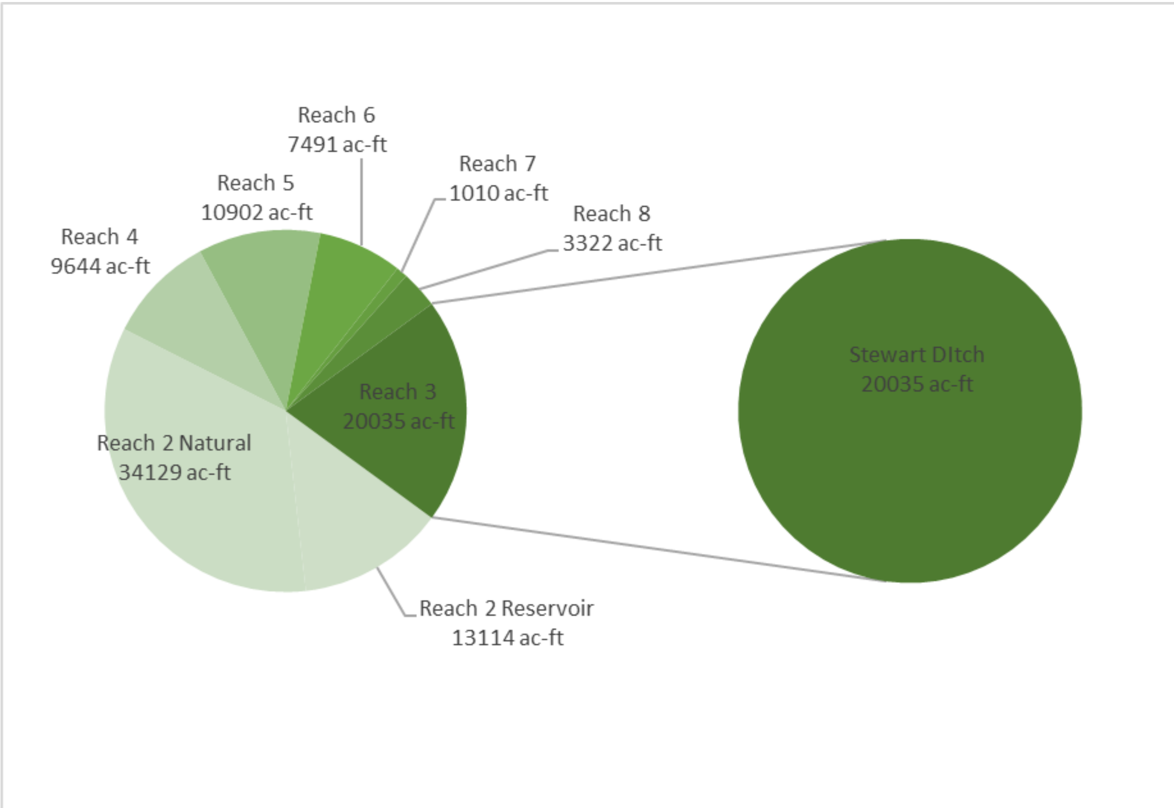


Figure 2.3.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 3

2.3.1 Stewart Ditch

Ditch Overview –

The Stewart Ditch Diversion is located in Reach 3 at 608+87, just downstream of Bowie, CO. The ditch supplies water to the south of the river to river-bottom fields upstream of Paonia, CO and elevated mesas between Hochkiss, CO and Paonia, CO. Figure 2.3.1.1 illustrates the average diversion statistics from 2007 to 2016 for the Stewart Ditch.

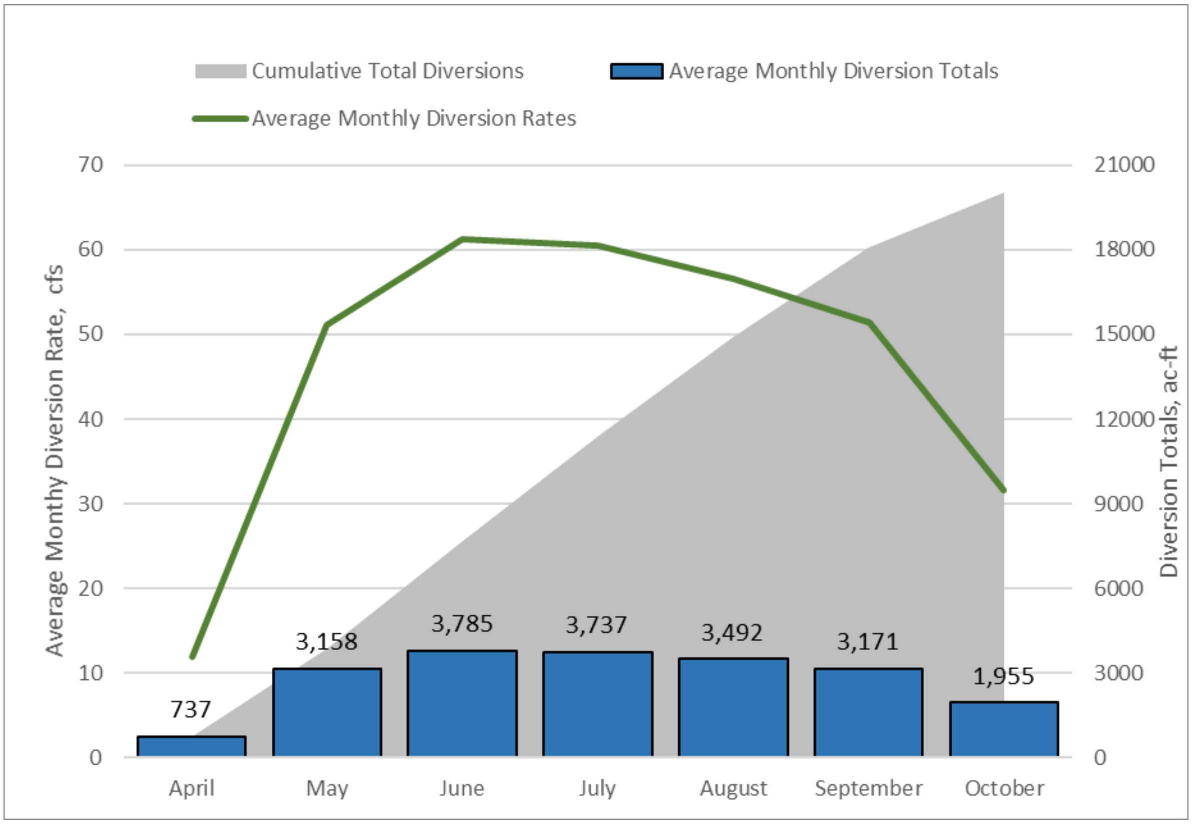


Figure 2.3.1.1. 2007 to 2016 Average Diversion Statistics for the Stewart Ditch

State records show that the Stewart Ditch provides irrigation water to 2743.8 acres. The records indicate that nearly 95% of the acreage is used to cultivate grass pasture, with the remaining acreage growing alfalfa and fruit orchards. The annual water requirement for consumptive use for the Stewart Ditch was calculated to be 7172.2 ac-ft, placing the system efficiency at 36%. Figure 2.3.1.2 provides the calculated system efficiency for the Stewart Ditch.

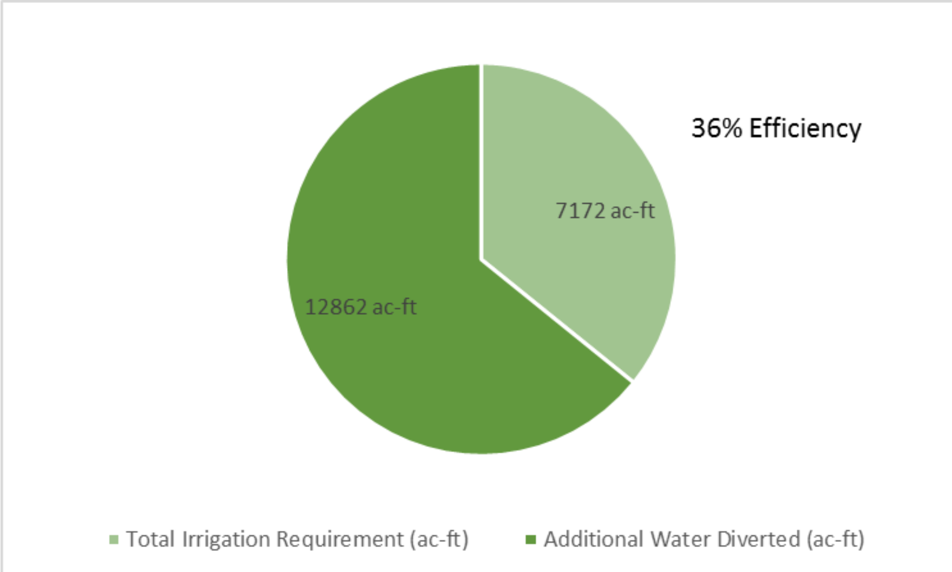


Figure 2.3.1.2. Calculated System Efficiency for the Stewart Ditch

Brief Diversion Description –

The Stewart Ditch diversion utilizes a small island in the North Fork to segregate a diversion channel from the principal river channel. There does not appear to be any structure in place at the upstream end of the island to control flow separation between the diversion channel and the river, but the diversion channel appears to be of similar scale to the adjacent river, and most likely is the dominant flow channel during the latter parts of irrigation season. Once in the diversion channel, water travels approximately 0.2 miles to the Stewart Ditch headgate. Adjacent to the headgate a large boulder weir supports the diversion channel bed above the natural riverbed. Figure 2.3.1.3 shows the headgate with the diversion channel in the foreground and river channel in the background. The function of the boulder weir is to maintain water surface elevation at the headgate. Any excess water in the diversion channel flows over the boulder weir and back into the river channel, as shown in Figure 2.3.1.4. The headgate consists of a radial gate on a small concrete headwall. The headwall is not of sufficient height to keep water from overtopping into the ditch at high flows, and thus sandbags are often used to aid in headwall function. Figure 2.3.1.5 shows the radial headgate with sandbags used to prevent overtopping.

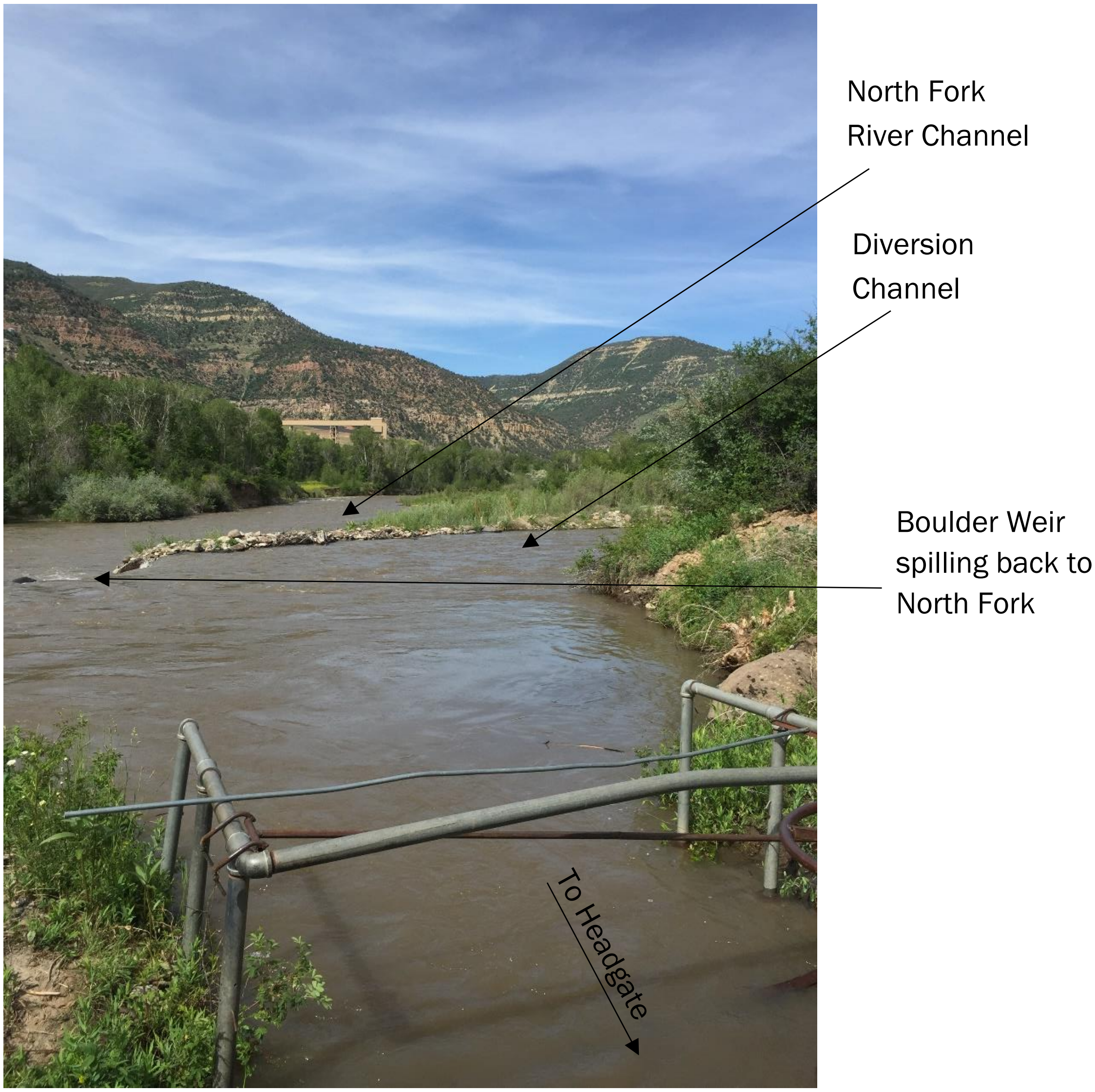


Figure 2.3.1.3. View of Stewart Ditch Diversion Channel from Headgate

Figure 2.3.1.4. Spill over Boulder Weir

Figure 2.3.1.5. Stewart Ditch Headgate

Structural Integrity and Diversion Functionality –

The boulder weir at the end of the diversion channel provides adequate, year-round water surface elevation to supply water to the Stewart Ditch. However, the ability of the boulder weir to withstand flood conditions is unknown, and likely will become an issue eventually. Also, the area where the two channels diverge upstream of the headgate is likely to be adversely affected by high flow events.

The top elevation of the headwall at the headgate is too low and results in uncontrolled over diversion at times during high flows. The over diversion is not a problem from a water rights standpoint and does not appear to threaten the integrity of the ditch. However, it appears to be a nuisance at high flows. Inability to control intake into the diversion channel may inhibit functionality at some future date. Natural river channel migration may require that the Stewart Ditch enter the river with heavy equipment to re-form the top end of the diversion channel. This could become an annual maintenance operation at some future date.

The river island separating the diversion channel from the river channel is an important feature for the Stewart ditch diversion. If the island loses the ability to fully segregate the channels during a flood event, the Stewart Ditch could potentially need to complete extensive river work to replace it.

Ability to Divert Appropriate Range of Flows –

The boulder weir and headgate allow for the regulation of flows into the ditch. The inability to control flow into the diversion channel could make diversion of decreed volumes difficult under certain river conditions. Examination of historical diversion records do not indicate that this is a problem. However, a single high flow event could do significant damage to the Stewart Ditch's ability to divert their water right.

Diversion Issues that Affect River Function –

There is currently no mechanism to control flow into the diversion channel other than building a "push up" dam in the river channel. For this reason, the diversion channel often acts as the main river channel. This potentially creates a fish passage issue during certain, relatively short times of the year.

Diversion Issues that Affect Recreational Users –

Since the diversion channel is of similar size to the main river channel, recreationalists have inadvertently traveled down the diversion channel rather than the river channel. The boulder weir is an impassable obstruction for boaters, which results in frustration for recreational users that inadvertently travel down the diversion channel.

Recommendations –

1. River Signs: Signs on the river visible to recreationalists on the approach to the division between the diversion channel and the principal river channel to provide warning and avoid confusion.
2. Island Stabilization: Stabilization of island that segregates river channel and diversion channel – embedded boulders on upstream end with geostabilization along entire island banks.
3. Upstream Headwall: Headwall with sluice at upstream end of diversion channel to regulate flow into diversion channel.
4. Diversion Relocation/Complete Rebuild: Relocation of diversion upstream, construction of new diversion structure and 1,200 feet of large diameter conveyance pipeline.

Preliminary Cost Estimates –

1. River Signs – $1,000
2. Island Stabilization - $20,000 to $50,000
3. Upstream Headwall - $100,000 to $300,000
4. Diversion Relocation/Complete Rebuild - $1M - $3M

2.4 Reach 4 Overview

Reach 4 spans the area between the North Fork Farmer's Ditch and the Paonia Ditch. The smaller Feldman Ditch is just upstream of the Paonia Ditch and thus falls within the Reach. Reach 4 is 1.78 miles in length and ends just upstream of the Town of Paonia, CO. Figure 2.4.1 illustrates the average annual diversion rates from Reach 4 from 2007 to 2016 in comparison to the other reaches of the North Fork. The large majority of the diversion rate from Reach 4 comes from the North Fork Farmer's Ditch.

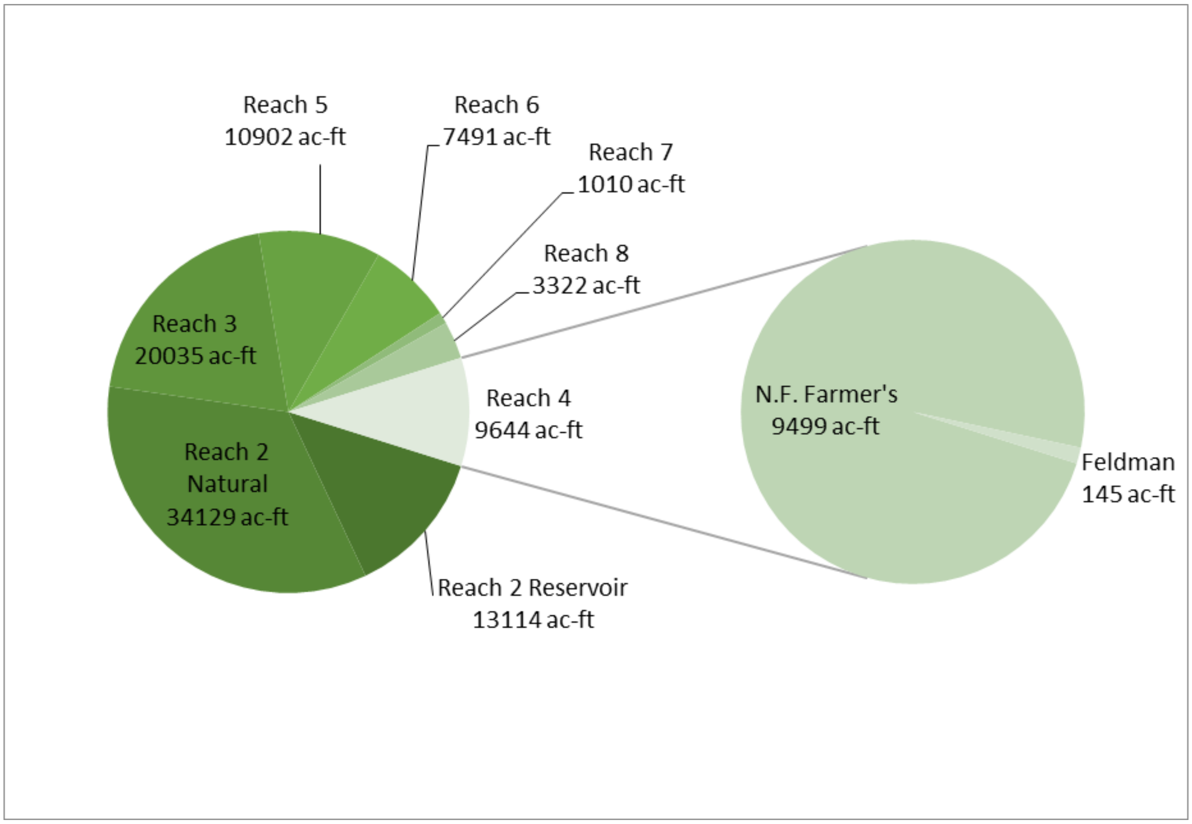


Figure 2.4.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 4

2.4.1 North Fork Farmer's Ditch

Ditch Overview –

The North Fork Farmer's Ditch Diversion is located in Reach 4 at 719+59, approximately 2.1 miles downstream of the Stewart Ditch Diversion. The ditch supplies irrigation water to river lowlands on the north side of the North Fork and to the Hansen Mesa area just Northeast of Hotchkiss, CO. The upper end (in the river lowlands) is governed by a separate board than the lower end (Hansen Mesa area). The governing body for the lower end is known as the North Fork Farmer's Ditch Extension. Grass pasture, corn, and small grains are common along the entire ditch while some vineyards and fruit are grown on the Extension. Figure 2.4.1.1 illustrates the average diversion statistics from 2007 to 2016 for the North Fork Farmer's Ditch.

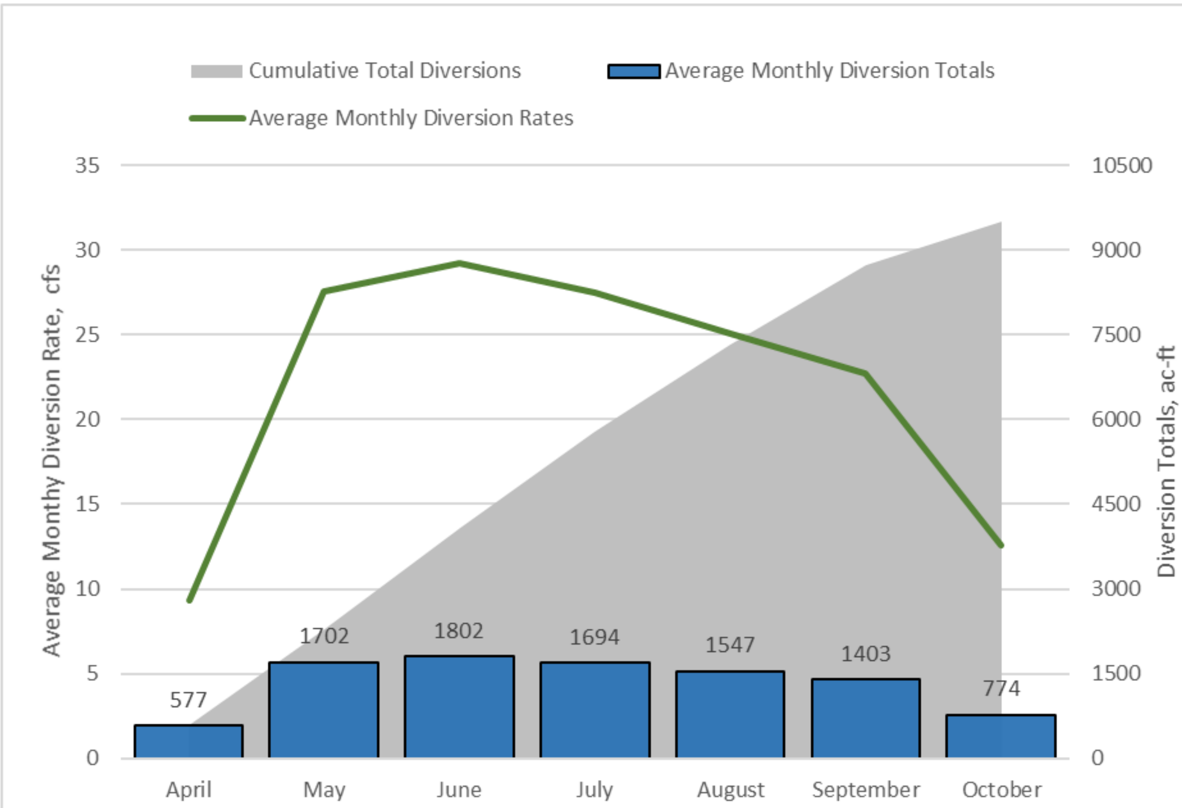


Figure 2.4.1.1. 2007 to 2016 Average Diversion Statistics for the North Fork Farmer's Ditch

According to CDSS 965.87 acres are irrigated using water from the North Fork Farmer's Ditch, with a reported 87% of the irrigated acres cultivating either grass pasture or alfalfa. A 28% system efficiency was calculated for the North Fork Farmer's Ditch. Figure 2.4.1.2 provides a breakdown of water provided to fulfill the total irrigation requirement versus the total water diverted.

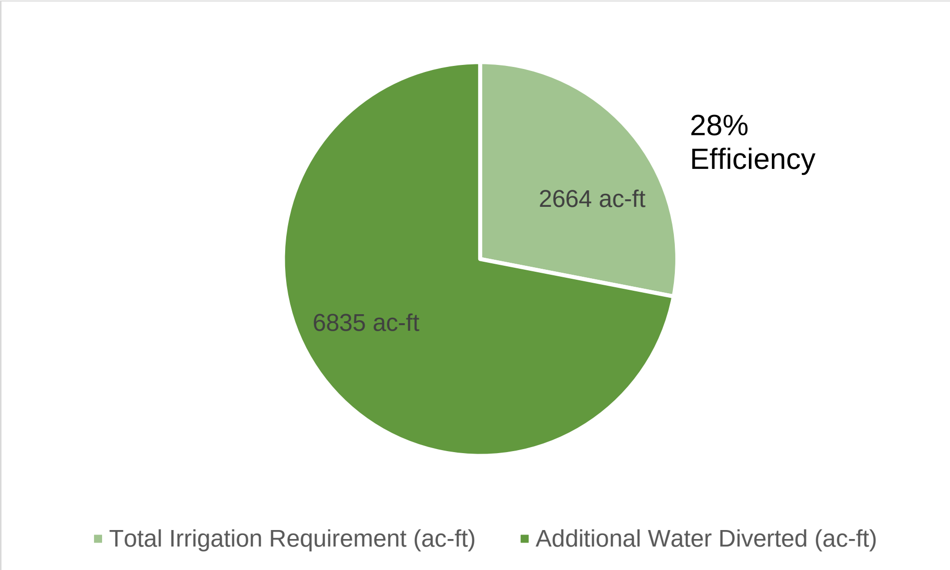


Figure 2.4.1.2. Calculated System Efficiency for the North Fork Farmer's Ditch

Brief Diversion Description –

The North Fork Farmer's Ditch diversion consists of a concrete and timber structure that spans the entire width of the North Fork River. There is a small concrete intake structure on the northwest bank of the river with a custom sluice gate to allow flow into the North Fork Farmer's Ditch. The downstream side of the diversion is supported by boulders, which gradually grade the diversion back to the natural river bottom. The upstream side of the diversion appears to be supported by a metal cribbing structure, which protrudes above the timbers, likely to allow for more timbers to be added to the diversion. The ditch headgate and turnback to the river are approximately 0.3 miles downstream of the diversion. Figure 2.4.1.3 shows the North Fork Farmer's Ditch diversion and intake structure. Figure 2.4.1.4 shows the southeast side of the diversion.

Figure 2.4.1.3. North Fork Farmer's Ditch Diversion and Intake Structure

Figure 2.4.1.4. North Fork Farmer's Ditch Diversion

Structural Integrity and Diversion Functionality –

As one of the older active diversions in the North Fork, the North Farmer's Ditch diversion is stable in its current condition. The downstream boulders and upstream metal cribbing have kept the timbers in place. The river channel in the vicinity appears stable and unlikely to meander away from the diversion. Because the diversion is perpendicular to the flow of the river, the energy is kept within the corridor, thereby minimizing bank erosion. From an irrigation standpoint, the diversion serves its function.

Ability to Divert Appropriate Range of Flows –

The North Fork Farmer's Ditch diversion is able to divert its full diversion as evidenced by the State's diversion records. At low flows, the diversion is able to "sweep the river", as seen in the above figures.

Diversion Issues that Affect River Function –

During low flows, the North Fork Farmer's Ditch diversion is detrimental to overall river function. Since the structure is able to, and often does, sweep the river, it creates a major impasse for the passage of aquatic species. During low flows, it adversely affects the river for approximately 0.3 miles until the headgate and spillback reintroduce water back to the river. Figure 2.4.1.5 shows the North Fork Farmer's Ditch and North Fork River side-by-side immediately after the diversion. Note: the picture used for Figure 2.4.1.5 was taken in early September, 2017.

Figure 2.4.1.5. North Fork Farmer's Ditch and North Fork River Immediately Downstream of Diversion

Diversion Issues that Affect Recreational Users –

The North Fork Farmer's Ditch negatively impacts recreation along the North Fork River corridor. During low flows, the river is dry for 0.3 miles, inhibiting recreation in that stretch. The metal cribbing on the front of the diversion also represents a hazard to recreationalists. There is a history of a contentious relationship between the irrigators on the North Fork Farmer's Ditch and recreationalists.

Recommendations –

1. Improved Diversion: Provide modification to the diversion structure that would allow minimum flows, those typically returned 0.3 miles downstream, to remain in this reach of the river. This could be simply accomplished with a sectioned portion of the weir that accommodates removable check boards. Additionally, removal of exposed cribbing iron that poses a risk to recreationalists should be prioritized. A boat passage could also be incorporated on the south bank of the river.

Preliminary Cost Estimates –

1. Improved Diversion – $75,000 to $100,000

2.4.2 Feldman Ditch

Ditch Overview –

The Feldman Ditch diversion is located immediately upstream of the Paonia Ditch Diversion at stationing 803+63. An irrigator or board member could not be located or contacted for the Feldman Ditch so an interview and infrastructure assessment were not conducted. Division of Natural Resources data shows minor, but active, diversion at the Feldman Ditch. Figure 2.4.2.1 provides some average diversion data for the Feldman Ditch from 2007 to 2016.

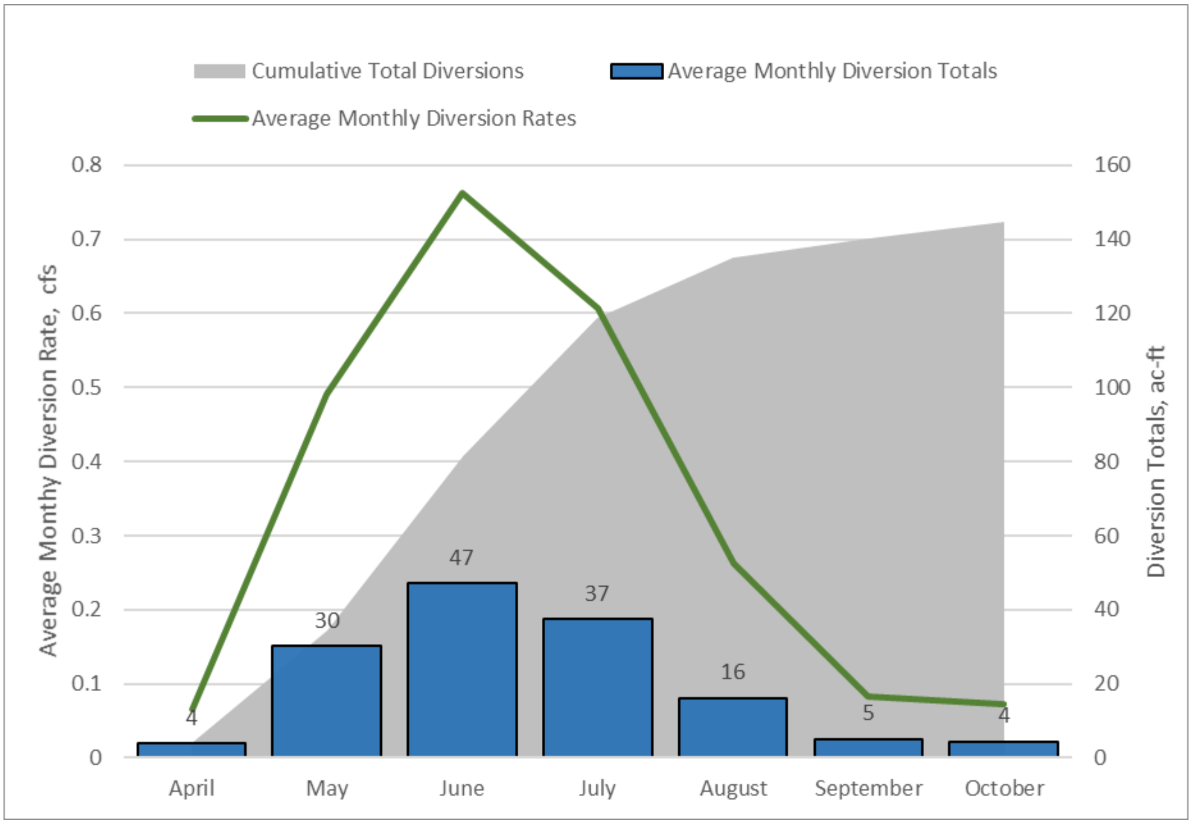


Figure 2.4.2.1. 2007 to 2016 Average Diversion Statistics for the Feldman Ditch

CDSS does not have any record of irrigated lands for the Feldman Ditch. Without acreage or crop data, system efficiency was not calculated.

2.5 Reach 5 Overview

Reach 5 begins with the Paonia Ditch and ends immediately prior to the Short Ditch. The 4.69 mile reach begins immediately prior to the Town of Paonia and ends well downstream of the town. The Monitor Ditch and Shepherd and Wilmott Ditch divert within Reach 5. The Paonia Ditch diverts the most water within the reach; however, diversion amounts are well distributed between the three ditches. Figure 2.5.1 compares the average annual diversion amounts from 2007 to 2016 for the reaches on the North Fork with special emphasis given to Reach 5.

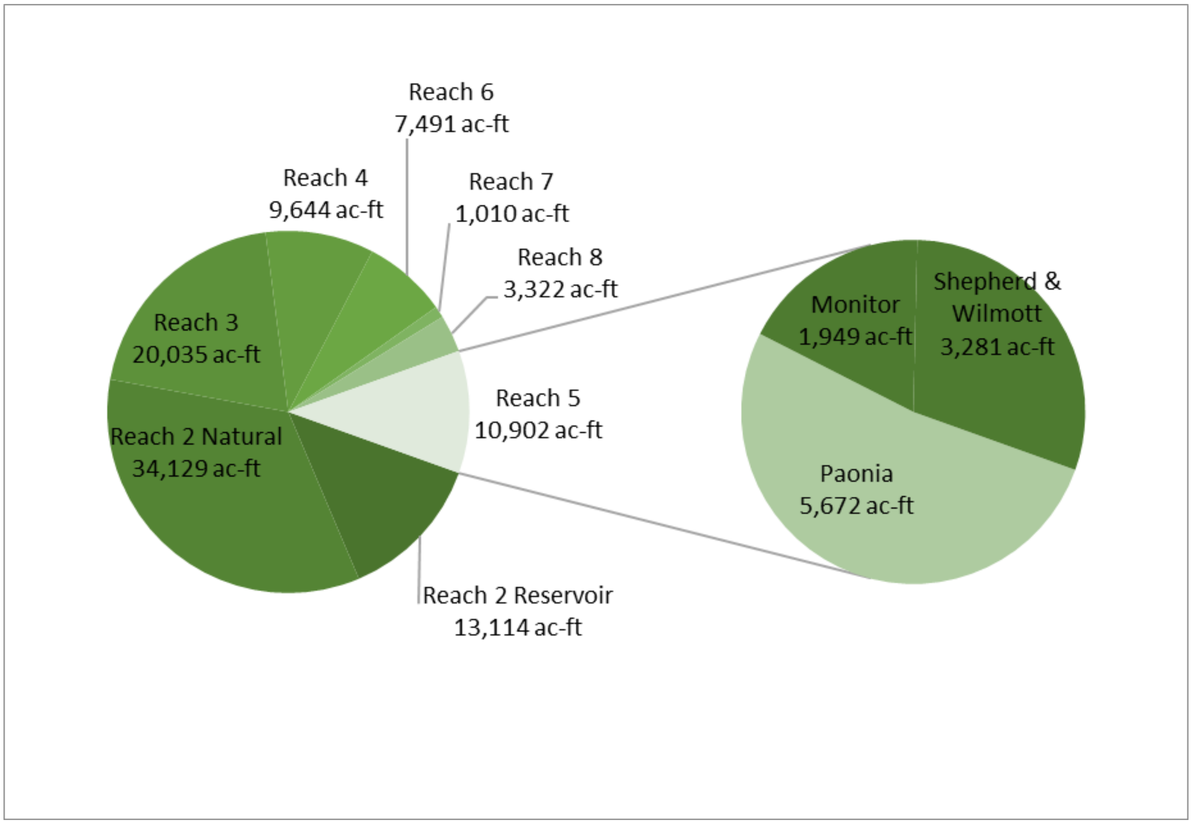


Figure 2.5.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 5

2.5.1 Paonia Ditch Diversion

Ditch Overview –

The Paonia Ditch Diversion is located in Reach 5 at 813+33, just upstream of the Town of Paonia. The Paonia Ditch Diversion supplies irrigation water to both the Paonia Ditch and the Wade and Hightower Ditch. Wade and Hightower water shares the first 0.75 miles of the Paonia Ditch (after the headgate), where it is then divided via proportional split sent into the Wade and Hightower Ditch.

The Paonia Ditch supplies irrigation water to lands primarily to the Southeast of Paonia where a variety of crops are grown including: fruit, alfalfa, small grains, and pasture. Irrigators in this area seem to be trending to more fruits, hops, and farm-to-table crops. Figure 2.5.1.1 illustrates some average diversion statistics from 2007 to 2016 for the Paonia Ditch.

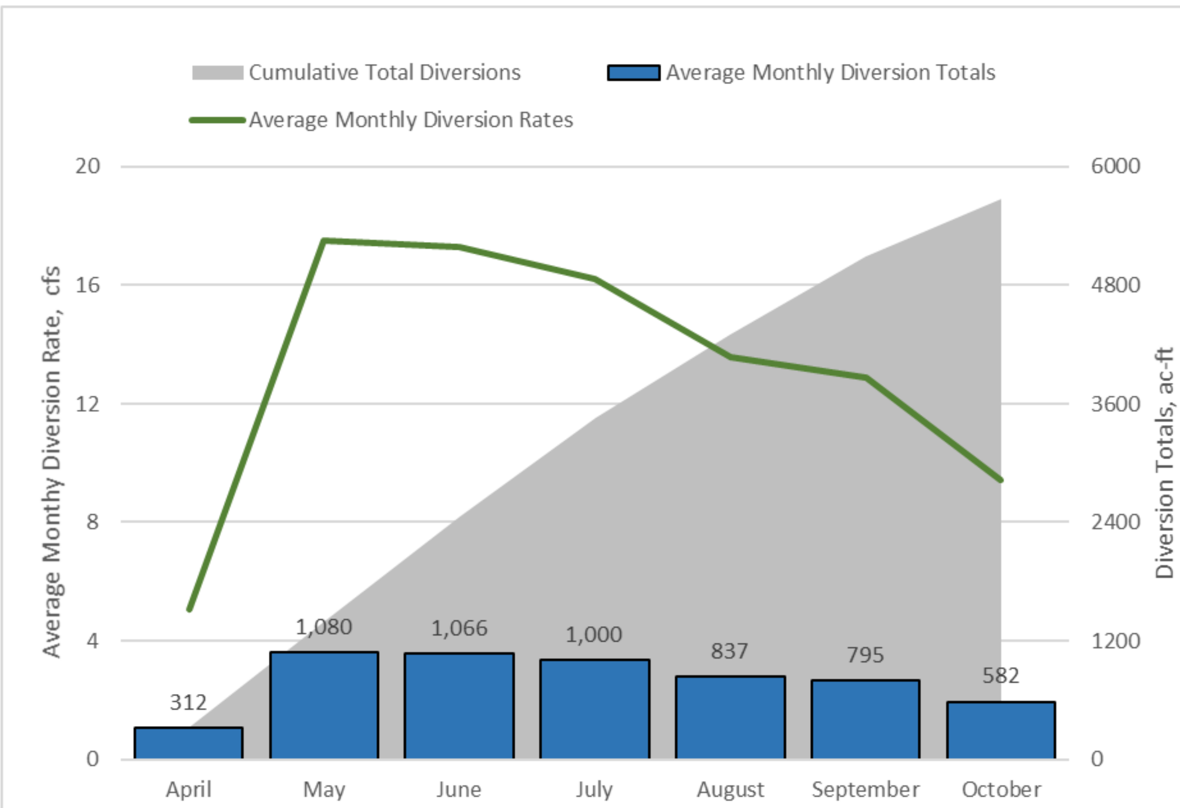


Figure 2.5.1.1. 2007 to 2016 Average Diversion Statistics for the Paonia Ditch

According to CDSS, the Paonia Ditch serves 304.86 acres. Approximately 157 acres are used to cultivate grass and alfalfa, while roughly 148 acres have fruit orchards. This total does not include the irrigated lands of the Wade and Hightower Ditch, which is likely decreasing the calculated efficiency of the system. Based on the CDSS data, the Paonia Ditch has a 15% system efficiency, though it is likely more efficient given the supply to Wade and Hightower. Figure 2.5.1.2 shows the calculated efficiency of the Paonia Ditch.

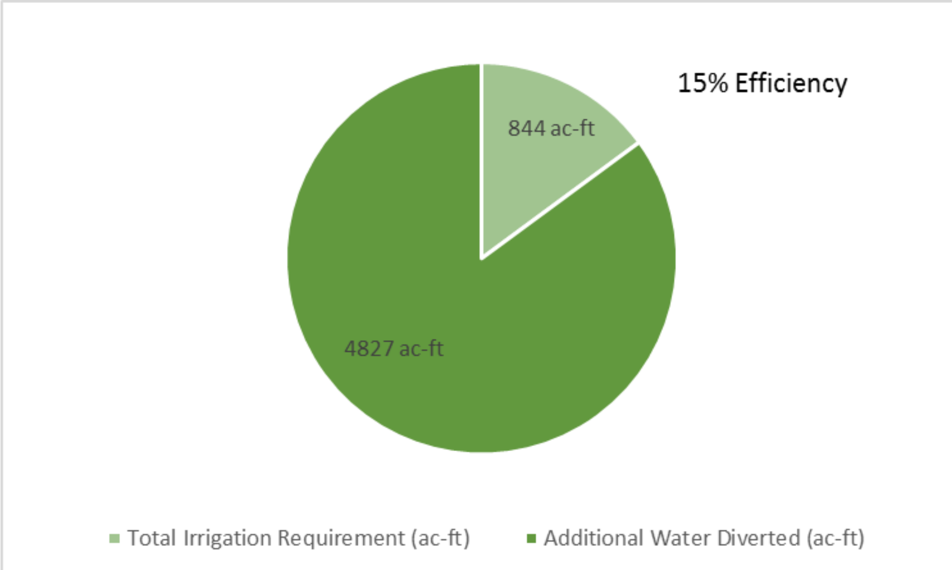


Figure 2.5.1.2. Calculated System Efficiency of the Paonia Ditch

Brief Diversion Description –

The Paonia Ditch diversion consists of a boulder weir with a core of interlocking concrete blocks that crosses diagonally across the river. There is a concrete headwall with an intake at the downstream end of the diversion structure with a canal gate to potentially isolate the ditch from the river (a canal gate is needed here because of the shared channel with Minnesota Creek). Figures 2.5.1.3 and 2.5.1.4 show the river diversion and concrete intake structure for the Paonia Ditch. Approximately 0.25 miles downstream of the intake structure, the diverted water combines with Minnesota Creek. The two water sources share a channel for roughly 0.17 miles until the Paonia Ditch headgate, pictured in Figure 2.5.1.5. Minnesota Creek branches away toward the North Fork of the Gunnison River and serves as a spillway in case of over diversion from the North Fork. Measurement occurs via a 4 foot Parshall flume downstream of the headgate.

The Town of Paonia has expanded around the Paonia Ditch, with the alignment of the ditch crossing through residential and commercial areas. To lower the risk of flooding the town during storm events, the Paonia Ditch utilizes its original headgate location as a secondary spill location. The secondary spill location is pictured in Figure 2.5.1.6.

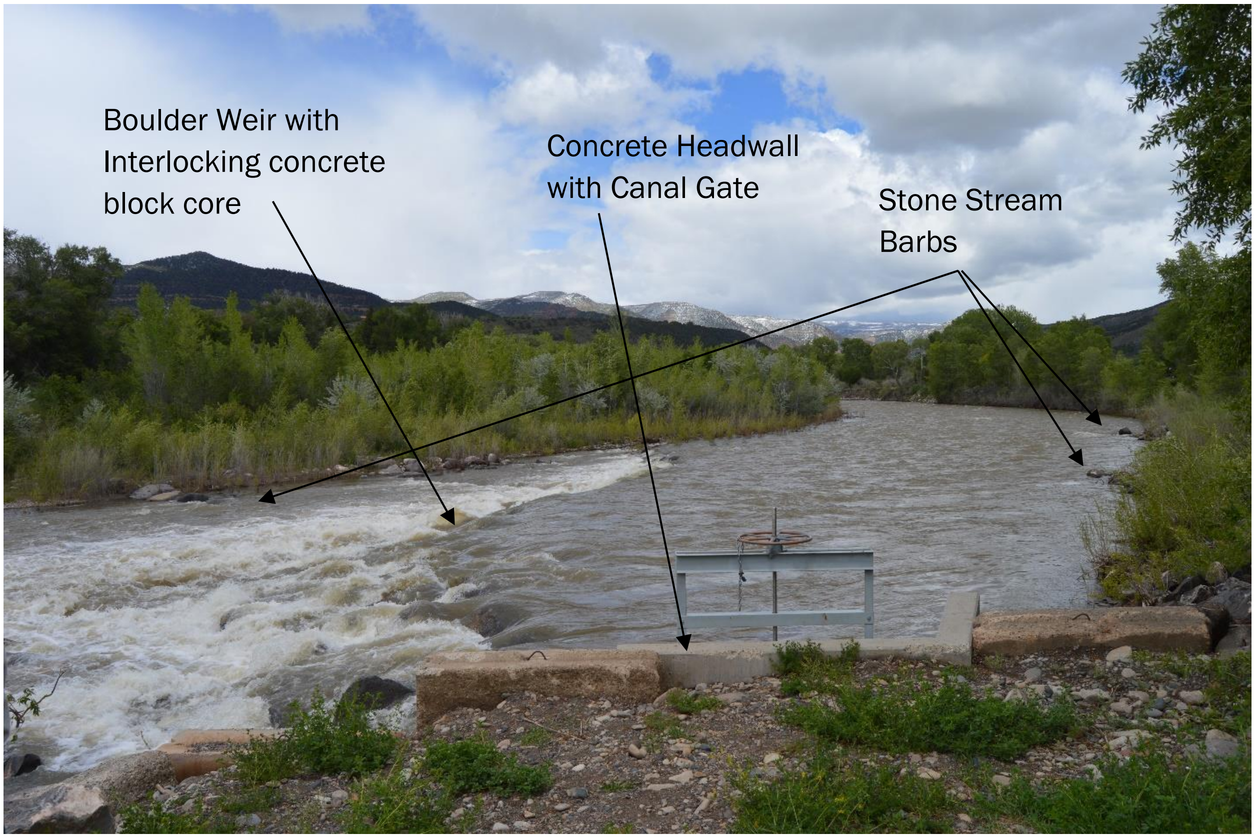


Figure 2.5.1.3. Boulder Weir and Concrete Intake Structure for Paonia Ditch

Figure 2.5.2.4. Concrete Headwall with High Flow Channel at Paonia Ditch Intake Structure

Figure 2.5.1.5. Paonia Ditch Headgate with Spill (Minnesota Creek) to River

Figure 2.5.1.6. Paonia Ditch Secondary Spill and Headgate

Structural Integrity and Diversion Functionality –

In the recent past, the Paonia Ditch Diversion has been reconstructed twice. Using NFRIA funding a U-weir of grouted bounders was constructed, along with the current headwall intake structure. After approximately 3 months, the diversion failed and a reconstruction effort followed. This resulted in the current diversion, which at its core, is comprised of large interlocking concrete barrier blocks tied together by steel cable. The blocks are surrounded by large boulders. The diversion has not sustained any major damage since its reconstruction and appears to be stable.

Ability to Divert Appropriate Range of Flows –

The current diversion intake is able to divert its full range of flows, as long as the water within the river is at a suitable elevation. During times of low flow in the river, check boards are used to raise water at the intake. However, often times this is not sufficient, so sand bags and other temporary obstructions are utilized to raise the water surface elevation.

Diversion Issues that Affect River Function –

The addition of sandbags and other obstructions later in the irrigation season potentially negatively impacts the river ecosystem. Unlike a U-weir diversion, the current shape of the diversion does not direct the energy of the river away from the banks. While this normally raises the potential for bank erosion, improvements made by the Paonia Ditch in the form of rock stream barbs that extend both upstream and downstream of the diversion help maintain channel integrity. There is additional boulder stabilization upstream of the diversion, on the intake side of the river to prevent flanking.

Diversion Issues that Affect Recreational Users –

The Paonia Ditch Board states that upon putting in the latest diversion, there have been no issues with recreational users.

Recommendations –

1. Improved Headgate Structure: In sharing a channel with Minnesota Creek, silt and trash build-up are more common at the Paonia Ditch headgate. An improved headgate that removes debris and excess silt would benefit users of the ditch, particularly those with high efficiency systems requiring filtration.
2. Bank Stabilization: Stabilization of the bank downstream of the diversion could benefit the longevity of the diversion as erosion is of concern with the current diversion configuration. Imbedded boulders could provide erosion control.
3. Secondary Spill Channel Improvements: The secondary spill channel is overgrown and prevents proper use of the spill channel. This channel provides an extra layer of safety just as the ditch enters the Town of Paonia.

Preliminary Cost Estimates –

1. Improved Headgate Structure – $30,000 to $50,000
2. Bank Stabilization - $10,000 to $20,000
3. Secondary Spill Channel Improvements– $5,000

2.5.2 Monitor Ditch

Ditch Overview –

The Monitor Ditch Diversion is located in Reach 5 at 938+45, approximately 2.4 miles downstream from the Paonia Ditch Diversion and 2.0 miles upstream of the Shepherd and Wilmott Diversion. The Monitor Ditch supplies irrigation water to a section of river lowlands to the North side of the North Fork where hay pasture is the predominant crop. The diversion is new and has recently been replaced through NFRIA funding. Figure 2.5.2.1 presents some average diversion statistics from 2007 to 2016 for the Monitor Ditch.

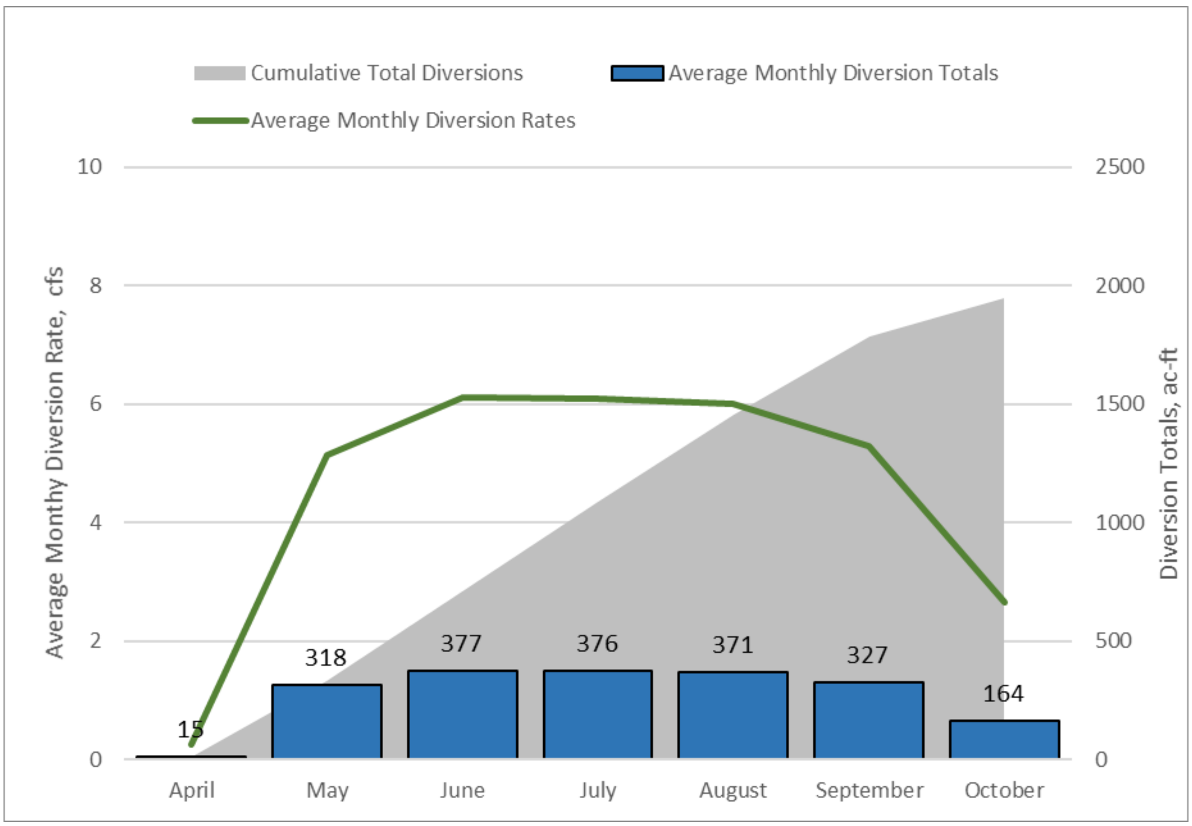


Figure 2.5.2.1. 2007 to 2016 Average Diversion Statistics for the Monitor Ditch

CDSS reports that the Monitor Ditch provides irrigation water to 204.14 acres of primarily grass pasture. The total irrigation requirement for the Monitor Ditch was found to be approximately 564 acre-ft. With a reported annual average diversion, this puts the system efficiency at 29%. Figure 2.5.2.2 provides the system efficiency breakdown for the Monitor Ditch.

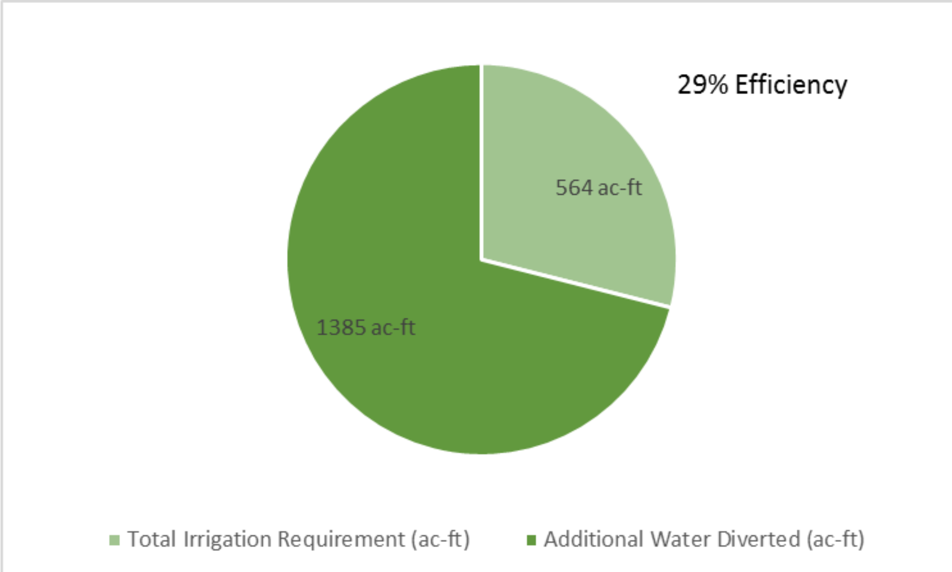


Figure 2.5.2.2. Calculated System Efficiency of the Monitor Ditch

Brief Diversion Description –

The Monitor Ditch Diversion consists of an asymmetric U-weir of grouted and loose boulders within the river. The boulders are grouted on the ditch side of the river, and loose on the far side. Figure 2.5.2.3 shows the rapids created by the boulder weir, along with the resultant high water created by the diversion. On the ditch side bank, a large concrete headwall separates the river from the diversion channel. The headwall contains an opening to allow water to enter the diversion channel, as shown in Figure 2.5.2.4. Within the diversion channel is a steel head gate, used to regulate flow into the Monitor Ditch. There is a 24-inch steel Parshall flume downstream of the headgate to measure flow into the ditch. Water from the diversion channel that is not taken into the Monitor Ditch is returned to the river. Figure 2.5.2.5 illustrates the movement of water at the headgate, and Figure 2.5.2.6 shows the headgate for the Monitor Ditch.

The river banks immediately upstream and downstream of the diversion appear stable, as does the river island that segregates the diversion channel from the main river channel.

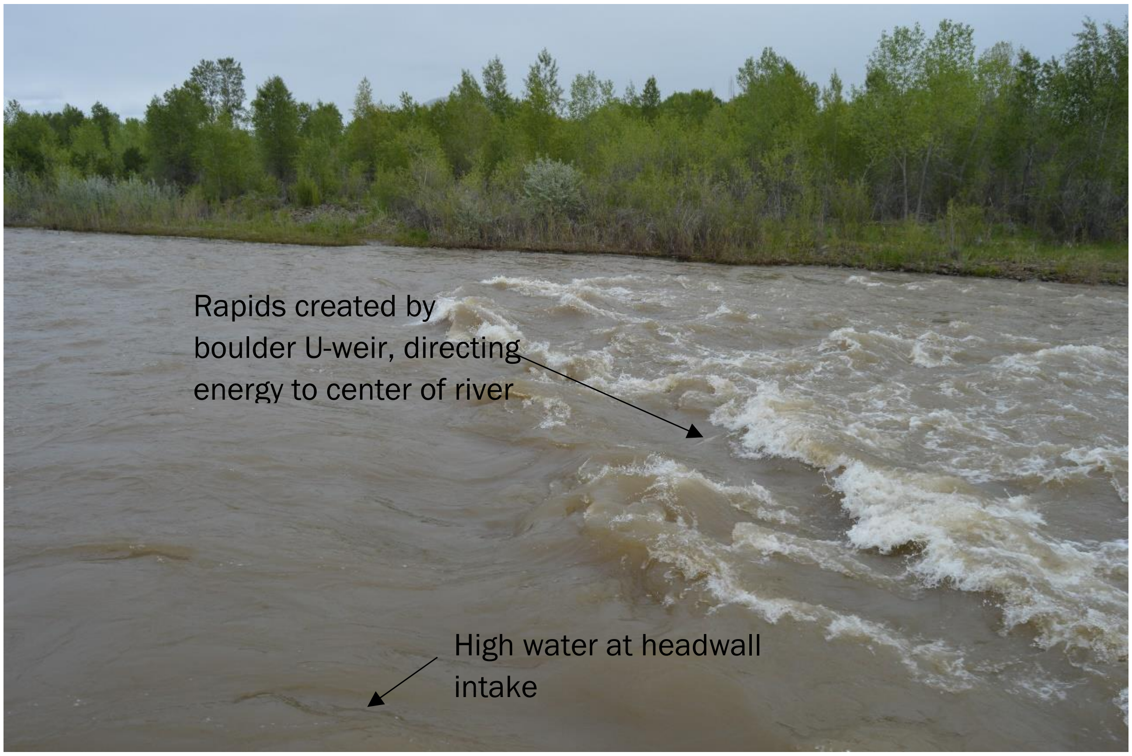


Figure 2.5.2.3. Resultant Water Profile from Monitor Ditch Diversion

Figure 2.5.2.4. Concrete Headwall for Monitor Ditch at River Diversion

Figure 2.5.2.5. Flow of Water in Diversion Channel for Monitor Ditch

Figure 2.5.2.6. Monitor Ditch Headgate

Structural Integrity and Diversion Functionality –

The diversion does an acceptable job of raising water levels at the headwall intake into the diversion channel, while directing the energy of the flow toward the center of the river. The water at the headwall intake can become still in certain flow regimes resulting in the collection of branches and trash at the intake, causing occasional clogging.

The river banks immediately upstream and downstream of the diversion appear stable, as does the river island that segregates the diversion channel from the main river channel. All concrete structures involved in the diversion appear to be in good condition.

Ability to Divert Appropriate Range of Flows –

With the exception of occasional intake clogging, the headwall intake maintains an acceptable water surface elevation in the diversion channel during most river flow regimes. The headgate is able to effectively regulate flow into the ditch from the diversion channel. With the occasional curtailment of the Monitor's junior-most water rights, effective regulation is critical. During exceptionally high flows, however, water will sometimes overtop the headgate, as seen in Figure 2.5.2.5.

Diversion Issues that Affect River Function –

The diversion does not appear to negatively affect river function, as the shape of the weir directs energy away from the banks and prevents erosion.

Diversion Issues that Affect Recreational Users –

Since the installation of the in-stream U-weir, the Monitor Ditch has not had notable issues with the river recreation community.

Recommendations –

1. <u>Increase Headwall Height</u>: To prevent overtopping, it is recommended to add approximately 24" of concrete to the top of the headgate headwall. This will require replacement of the sluice gate.
2. <u>Trash Rack</u>: A trash rack would prevent clogging of the headgate and would act as a safety barrier for river users.

Preliminary Cost Estimates –

1. <u>Increase Headwall Height</u> – $1,000
2. <u>Trash Rack</u> – $10,000

2.5.3 Shepherd and Wilmott Ditch

Ditch Overview –

The Shepherd and Wilmott Ditch Diversion is located at 1045+22 in Reach 5 of the North Fork, roughly 1500 feet upstream of the Short Ditch Diversion. It provides irrigation and stock water to river lowlands immediately downstream of the diversion. Typical crops are pasture, alfalfa, corn, and small grains with no trends to other crop types. The diversion was recently replaced via NFRIA funding. Figure 2.5.3.1 shows average diversion statistics for 2007 to 2016 for the Shepherd and Wilmott Ditch.

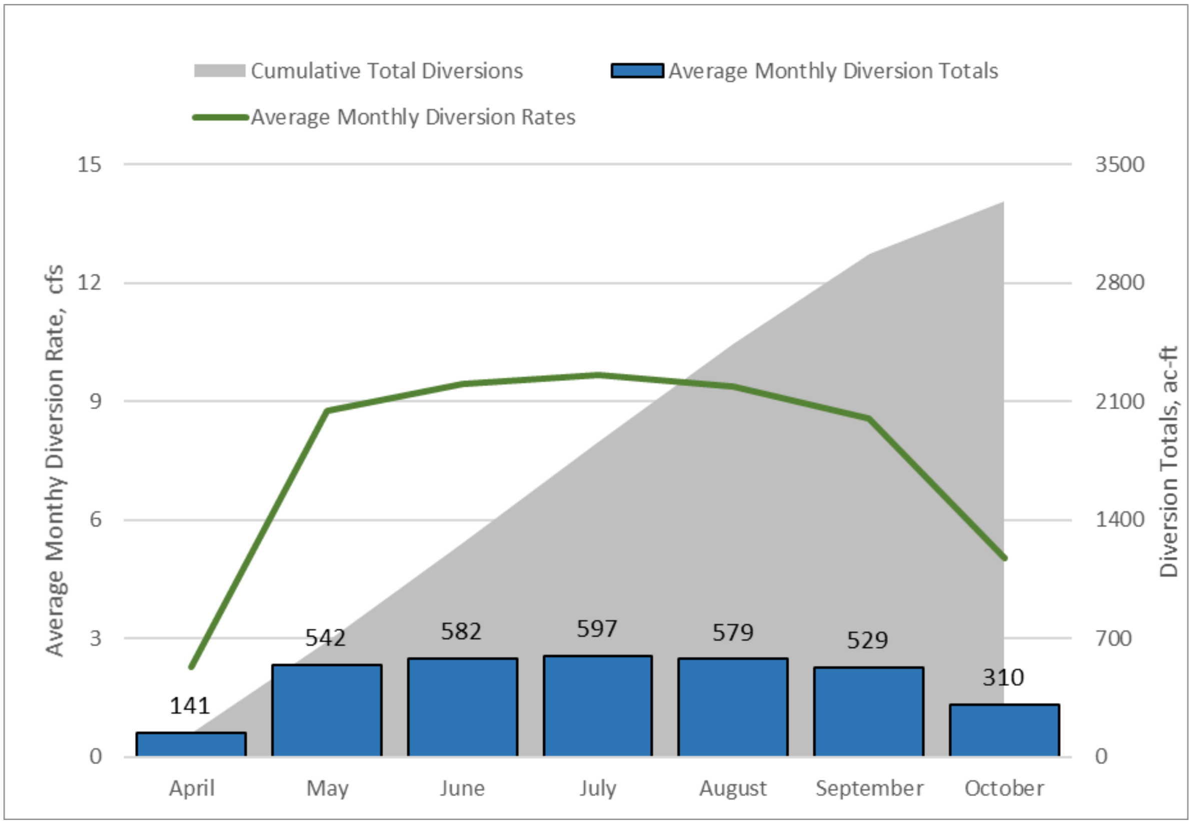


Figure 2.5.3.1. 2007 to 2016 Average Diversion Statistics for the Shepherd and Wilmott Ditch

The Shepherd and Wilmott Ditch reportedly serves 284.26 acres with irrigation water. Roughly 256 of these acres are used for grass pasture cultivation with the remaining acreage used for corn. The total irrigation requirement calculated for the Shepherd and Wilmott is 707 ac-ft annually. With a total reported annual average diversion of 3281.1 ac-ft, the calculated system efficiency of the Shepherd and Wilmott Ditch is 22%.

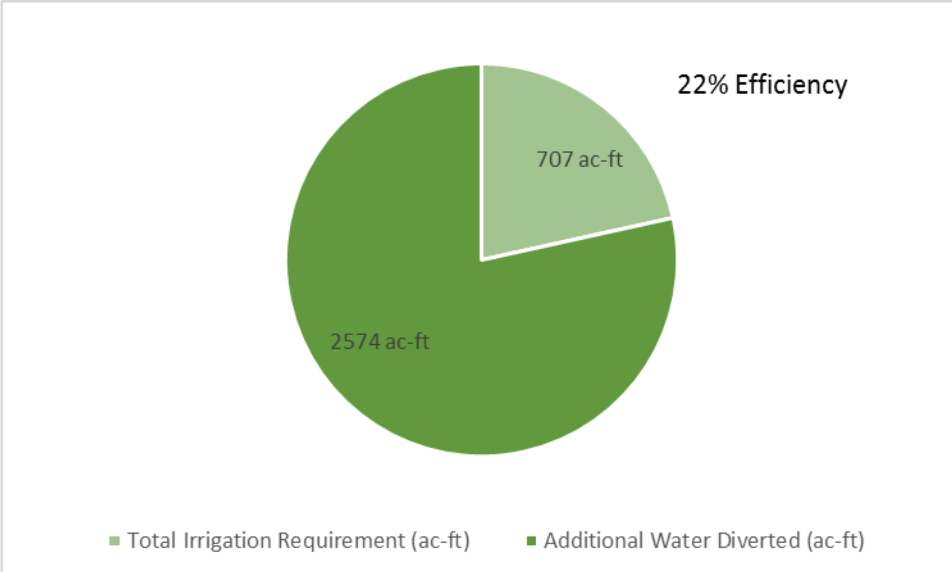


Figure 2.5.3.2. Calculated System Efficiency of the Shepherd and Wilmott Ditch

Brief Diversion Description –

The Shepherd and Wilmott Ditch Diversion consists of an asymmetric U-weir of grouted boulders in the river. The weir creates a still, high water condition on the ditch side bank of the river. There is a concrete headwall separating a diversion channel from the main river channel. Figure 2.5.3.3 shows the concrete headwall and the still high-water created from the diversion. The channel has an intake that directs water from the river into the diversion channel. During many times of the year, there is a substantial drop in water surface elevation from the river into the diversion channel. Figure 2.5.3.4 illustrates the difference in head created by the concrete headwall and intake structure.

To maintain water elevation in the diversion channel there are two concrete spillways that spill back into the river directly in front of the Shepherd and Wilmott headgate. Figure 2.5.3.5 shows the spillway just upstream of the headgate, while Figure 2.5.3.6 shows the entire headgate/spillway infrastructure on the diversion channel. Downstream of the headgate is a 24-inch steel flume to measure flow into the ditch.

The river has had a history of meandering near the Shepherd and Wilmott Diversion. Historically, the diversion intake has had to be relocated to account for the changing river alignment. The stretch near this diversion is a wide and flat floodplain, which can experience erosion and channelizing with annual high-water.

Figure 2.5.3.3. Concrete Headwall and Intake Structure for the Shepherd and Wilmott Diversion

Figure 2.5.3.4. Concrete Headwall and Intake Structure from Diversion Channel

Figure 2.5.3.5. Diversion Channel and Spillway to River from Shepherd and Wilmott Headgate

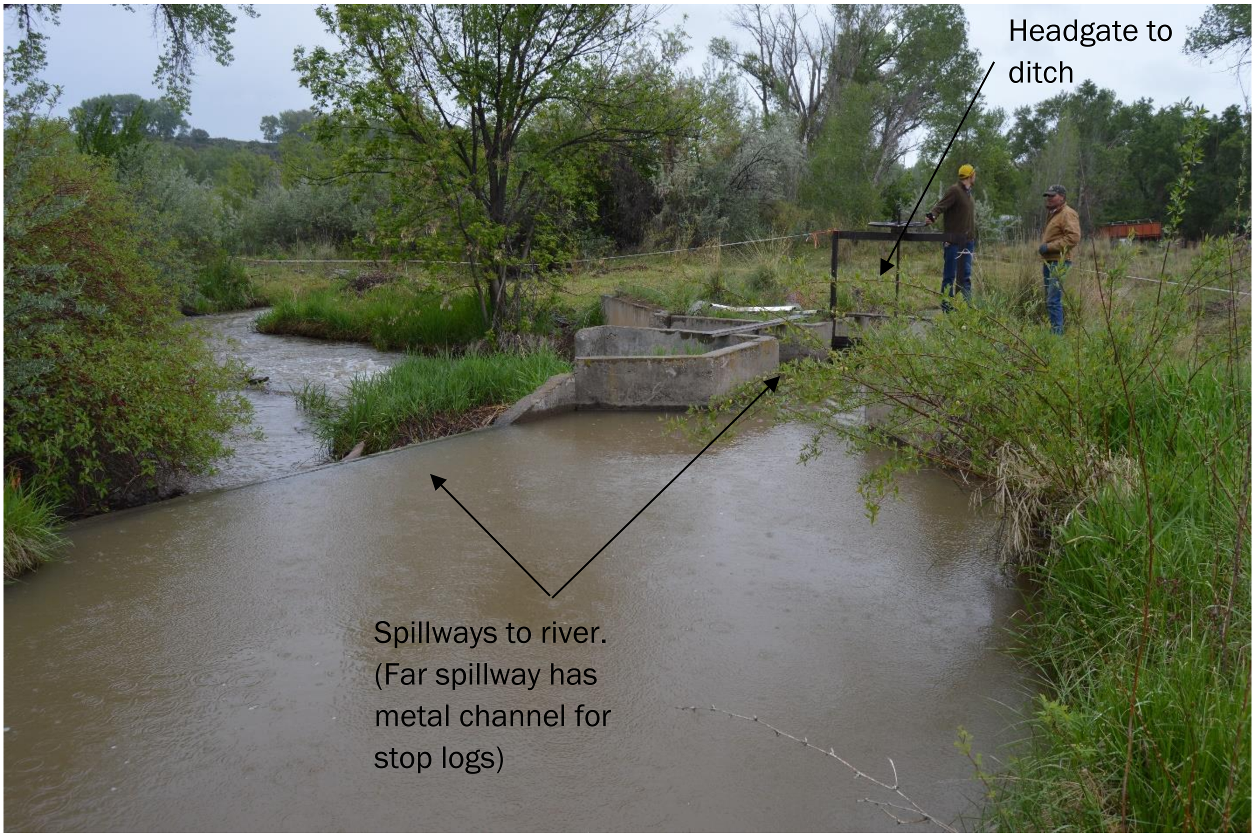


Figure 2.5.3.6. Shepherd and Wilmott Headgate and Spillways from Diversion Channel

Structural Integrity and Diversion Functionality –

The boulder weir for the Shepherd and Wilmott diversion is grouted and has maintained its structural integrity since it was replaced with NFRIA funding. At certain times of the year, the concrete headwall and intake structure creates substantial suction from the river into the diversion channel. Small 2x4 boards are used to prevent suction of debris. All excess water taken by the intake structure is returned to the river just prior to the headgate to the Shepherd and Wilmott. Functionally, the diversion meets the needs to the Shepherd and Wilmott Ditch.

Ability to Divert Appropriate Range of Flows –

The concrete intake structure allows sufficient water to enter the diversion channel at all flow rates within the river. Flow into the ditch is regulated by the headgate. As such, the diversion can handle all necessary flow rates for the ditch. There are plans to install a custom sluice gate on the intake structure to allow further water regulation.

Diversion Issues that Affect River Function –

The boulder weir appears to be a minor obstruction that does not impede river function during most of the year. The still water created by the diversion results in the build-up of debris, however, this is more of a hassle for the ditch company than an issue affecting river function.

Diversion Issues that Affect Recreational Users –

The boulder weir may result in a minor obstruction to recreational boaters and rafters, however, there does not appear to have been disputes between the ditch company and recreational users since the new NFRIA funded diversion. The suction created by the headwall and intake structure may pose a safety hazard to people.

Recommendations –

1. Trash Rack: Because of the high suction potential at the headgate, a trash rack would help keep debris from entering the diversion channel. Secondarily, the trash rack would protect recreational users from potential suction hazards.
2. Bank Stabilization: Stabilization of the bank downstream of the diversion could benefit the longevity of the diversion as the stream has a tendency to meander in this section of the reach. Geostabilization would likely be an appropriate option.

Preliminary Cost Estimates –

1. Trash Rack – $10,000 to $50,000
2. Bank Stabilization - $20,000 to $50,000

2.6 Reach 6 Overview

Reach 6 begins with and includes the Short Ditch, and ends just before the Vandeford Ditch. It is a total of 4.5 miles in length and does not pass through any towns. The Short Ditch is the last of the major diverters on the North Fork. Figure 2.6.1 compares the average annual diversion totals from 2007 to 2016 for all diverters on the North Fork, focusing on Reach 6.

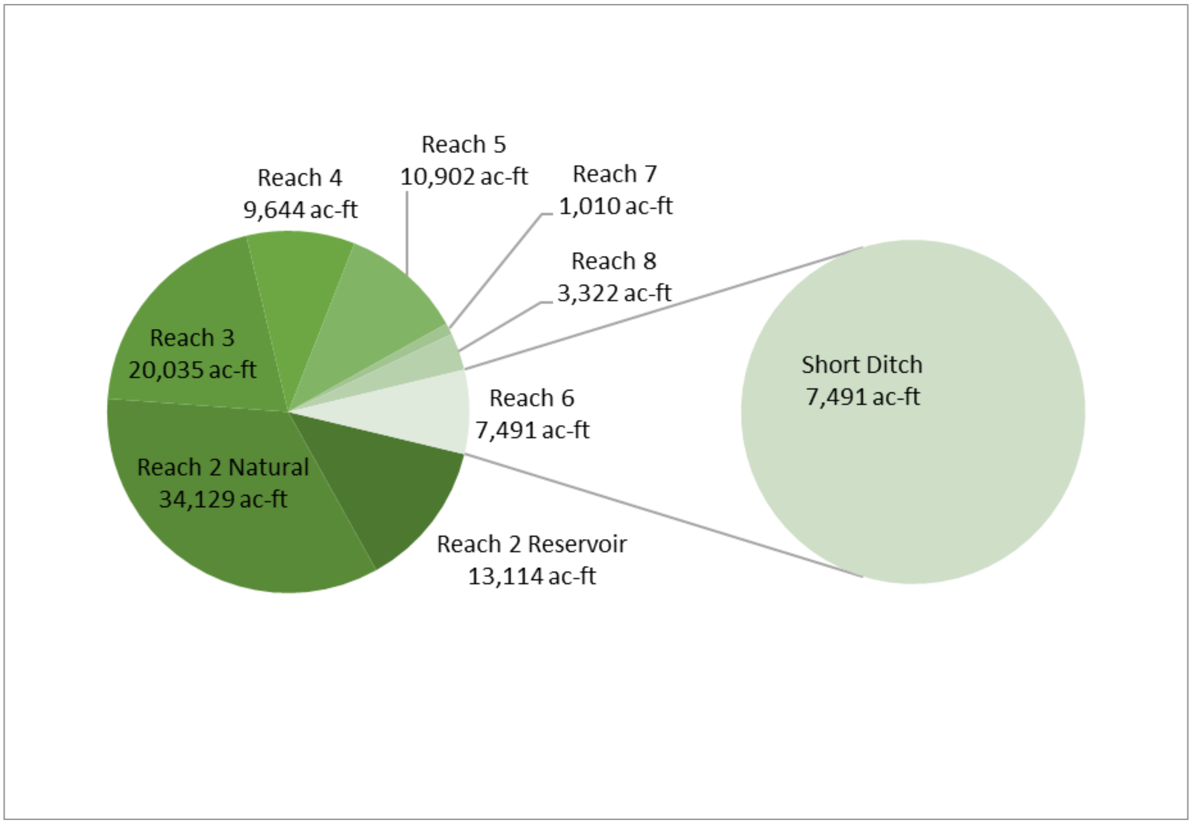


Figure 2.6.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 6

2.6.1 Short Ditch

Ditch Overview –

The Short Ditch is located in Reach 6 of the North Fork at 1060+76, approximately 1500 feet downstream of the Shepherd and Wilmott Diversion. The ditch travels along the South side of the North Fork where irrigation and stockwater are supplied to many of the areas directly to the East of Hotchkiss, CO. Typical crops are pasture, hay, and row crops. The diversion was recently replaced through NFRIA funding. Figure 2.6.1.1 provides average diversion statistics for the Short Ditch for the period from 2007 to 2016.

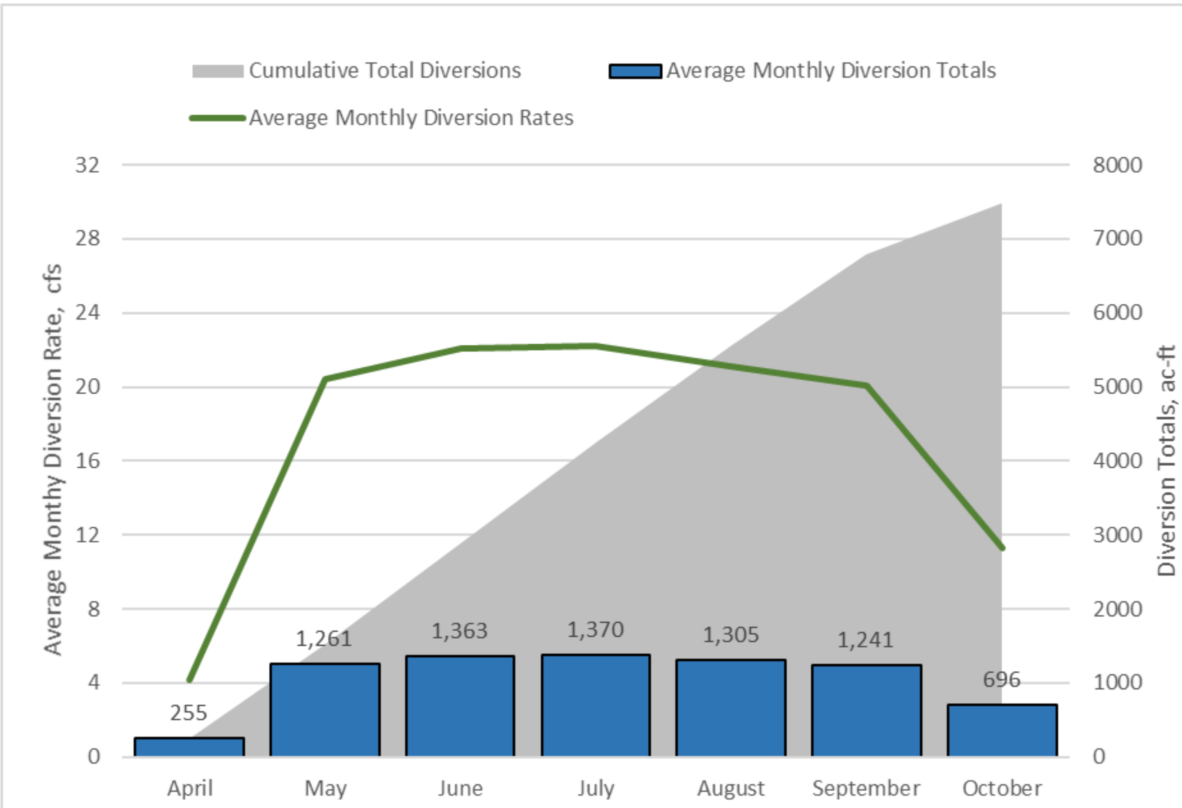


Figure 2.6.1.1. 2007 to 2016 Average Diversion Statistics for the Short Ditch

A total irrigation requirement of 1477 ac-ft/yr was calculated for the Short Ditch. This figure is based on the 535.5 acres receiving irrigation water as reported by CDSS. According to CDSS 100% of the irrigated lands are grass pasture. With this in mind, the overall system efficiency of the Short Ditch is 20%. Figure 2.6.1.2, below, shows the total annual irrigation requirement in relation to the average annual diversion for the Short Ditch.

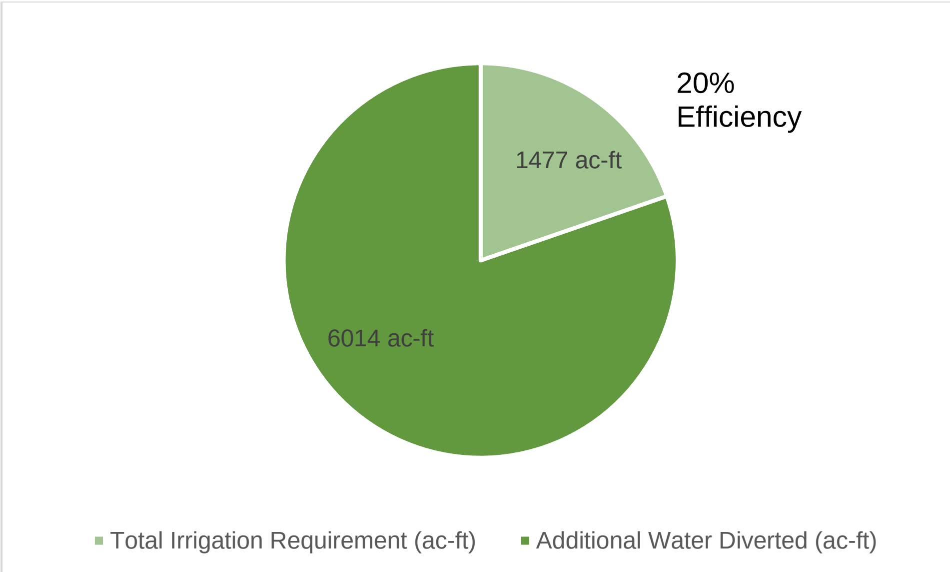


Figure 2.6.1.2. Calculated System Efficiency of the Short Ditch

Brief Diversion Description –

The Short Ditch Diversion consists of an in-stream boulder weir, a concrete headwall with an intake gate, an approximately 0.65 mile long diversion channel with a ditch headgate and a spillback to the river. Water in the diversion channel is regulated by a large canal gate on the concrete headwall. The headwall has a small water surface control channel adjacent to the intake gate that assists in water level management during high flows and allows for more effective capture of water during low flows with the utilization of check boards. Figure 2.6.1.3 shows the boulder weir during a low flow condition in the North Fork. Figure 2.6.1.4 shows the concrete headwall and intake gate.

Figure 2.6.1.3. Short Ditch Boulder Weir Diversion

Figure 2.6.1.4. Short Ditch Diversion Headwall and Intake

Structural Integrity and Diversion Functionality –

The headwall and intake for the Short Ditch are on the southern bank of the North Fork at a point where the river channel is split by a small river island. The boulder weir diversion is positioned between the headwall and the river island; the channel on the far side of the island is significantly smaller than the principal channel on the near side. The weir experiences continual erosion resulting in the dispersion of rocks and boulders down the river channel, as shown in Figure 2.6.1.3. This requires regular maintenance from the Ditch Company through the frequent rebuilding of the weir so the diversion will continue to function.

The continual dispersion of rocks and boulders from the weir threatens to create a river condition where the small channel to the North of the river island is hydraulically favored, causing the stream to predominantly flow to the far side of the island. This could potentially strand the point of diversion during low flows, resulting in the need for a secondary or new diversion.

The headwall/intake is structurally sound. There is concern, however, that the river may flank the sides of the intake structure and wash out the upstream bank, or overtop the headwall during high-flow conditions. Bank stabilization and in-stream energy dissipation may help maintain the integrity of the upstream bank. Expanding the water surface control channel in front of the gate may help to prevent overtopping of the headwall.

Ability to Divert Appropriate Range of Flows –

Prior to erosion and dispersion, the rock and boulder weir is able to divert the appropriate range of flows for the Short Ditch. The concrete channel in front of the headgate allows for sufficient head to be built up during low-flow conditions through the use of checkboards. During high-flow conditions, the checkboards can be removed to decrease the stress on the boulder weir to help prevent erosion.

Unfortunately, over the course of a typical irrigation season, the weir is eroded and dispersed in the river. In order to continue to divert their allotted flow rates, the Ditch Company must often use heavy equipment to rebuild the weir mid-season.

Diversion Issues that Affect River Function –

Continual dispersion of rocks and boulders from the weir appears to have an adverse impact on stream connectivity near the diversion during times of low flow. This is likely most noticeable during the late irrigation season (August through October). Discontinuity in the stream may inhibit fish passage through the reach.

Diversion Issues that Affect Recreational Users –

As with river function, stream discontinuity negatively impacts recreational users. River passage is likely difficult near the Short Ditch diversion. With limited nearby infrastructure, takeout of recreational watercraft is more difficult near the Short Ditch.

Recommendations –

1. <u>Diversion Improvement</u>: Create a more stable and permanent diversion in the river to prevent the erosion/rebuild cycle of the current boulder weir. A grouted boulder weir with a poured concrete core may provide necessary stability.
2. <u>Expand Water Control Channel</u>: Expand the water control channel on the headgate to help displace more water during flood and high-flow conditions.
3. <u>Bank Stabilization</u>: Stabilize the river bank upstream of the headwall to prevent a wash-out and bypass of the headwall. Difficulty of access with heavy equipment will be likely increase cost.

Preliminary Cost Estimates –

1. <u>Diversion Improvement</u> – $100,000+ (possibly very high costs for complete re-build)
2. <u>Expand Water Control Channel</u> - $10,000 to $25,000
3. <u>Bank Stabilization</u> - $50,000 to $100,000

2.7 Reach 7 Overview

Reach 7 begins with the Vandeford ditch and ends just before the Smith and McKnight Diversion. This segment is 1.7 miles in length and travels around the outskirts of Hotchkiss, CO. Figure 2.7.1 puts the diversion totals from this reach in comparison with those from other reaches, calculated as averages from 2007 to 2016.

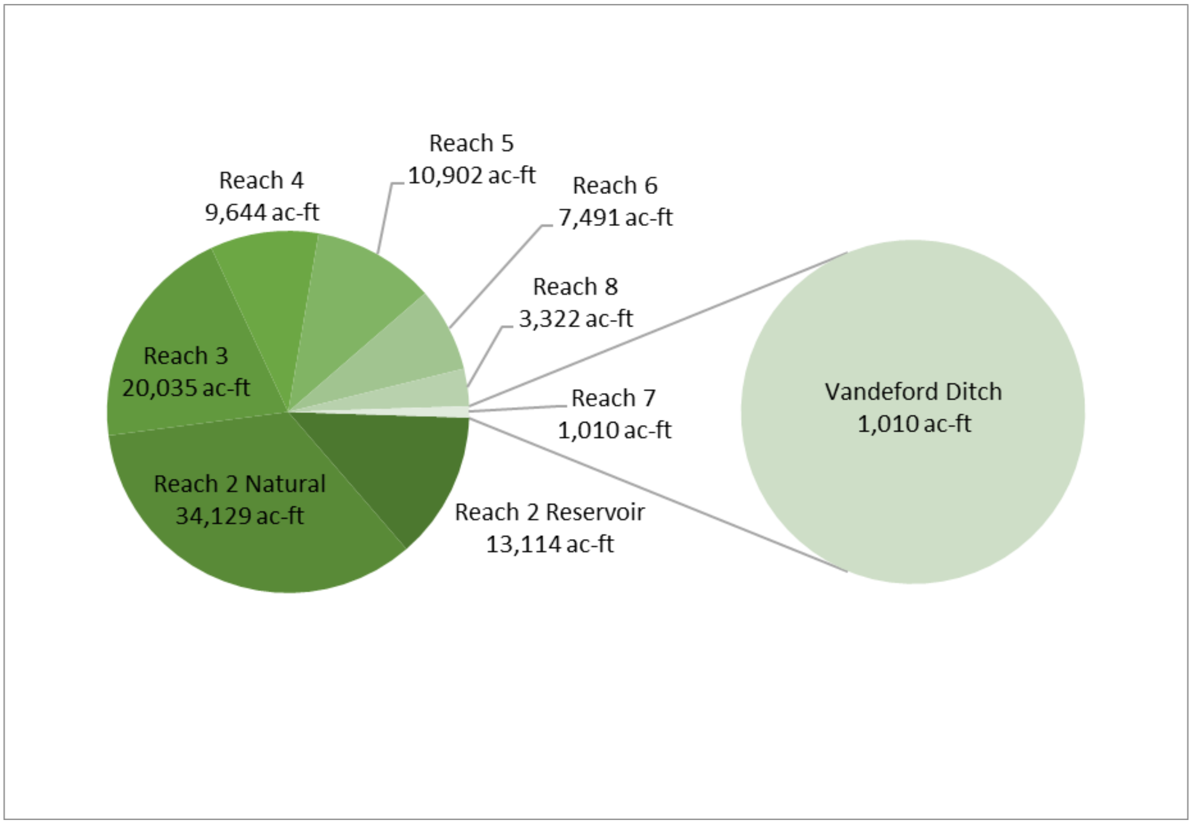


Figure 2.7.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 7

2.7.1 Vandeford Ditch

Ditch Overview –

The Vandeford ditch marks the start of Reach 7 and is located at 1296+73, nearly 4.5 miles downstream of the Short Ditch diversion, and just upstream of Hotchkiss. It supplies irrigation and stock water to a section of lowlands south of Hanson Mesa and North of the river. Common crops are triticale, alfalfa, oats, grass, and corn, with no trends to new crops. No engineering has been completed on the Vandeford Ditch; however, there are some issues that could benefit from engineering assistance. Figure 2.7.1.1 provides average diversion statistics from the period 2007 to 2016 for the Vandeford Ditch.

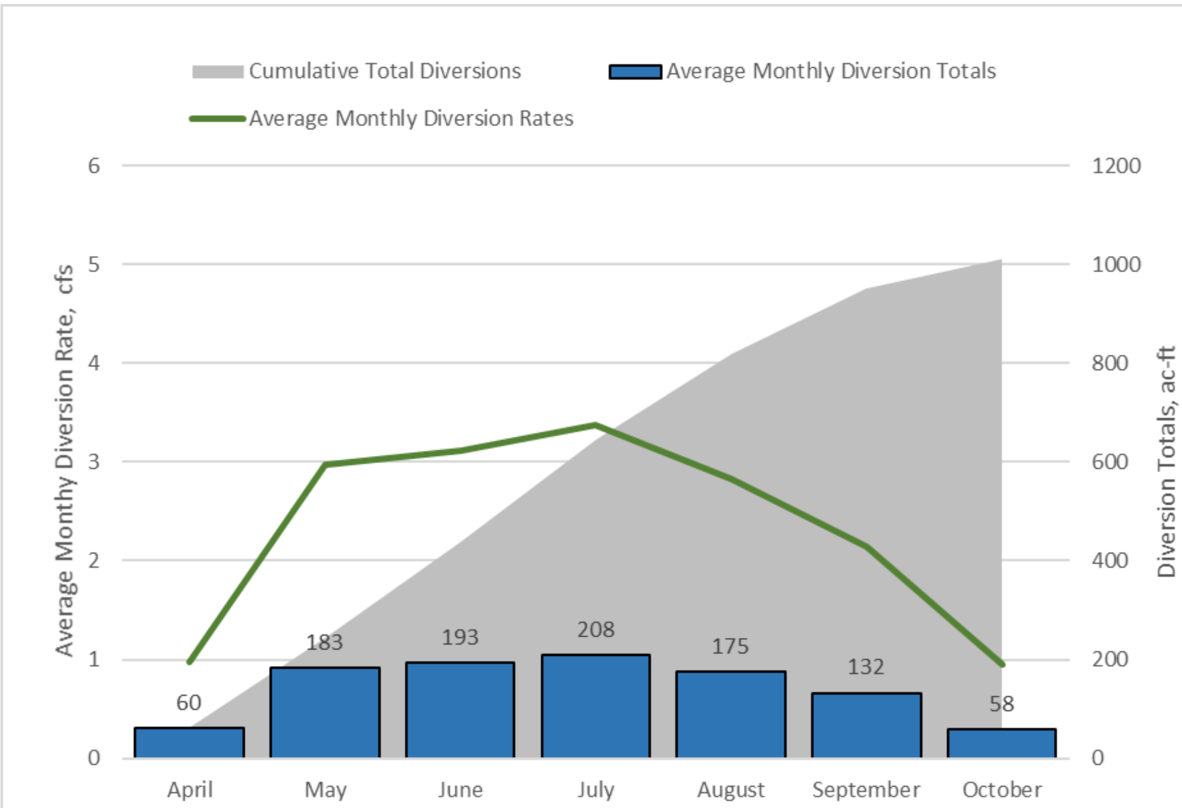


Figure 2.7.1.1. 2007 to 2016 Average Diversion Statistics for the Vandeford Ditch

CDSS reports that 89.2 acres are irrigated by water from the Vandeford Ditch. Cultivation of this acreage is well distributed amongst grass pasture, alfalfa, and corn. Based on the reported acreage and crop distribution, the total irrigation requirement for the Vandeford Ditch is 250 ac-ft or approximately 25% system efficiency. Figure 2.7.1.2 provides the calculated system efficiency of the Vandeford Ditch.

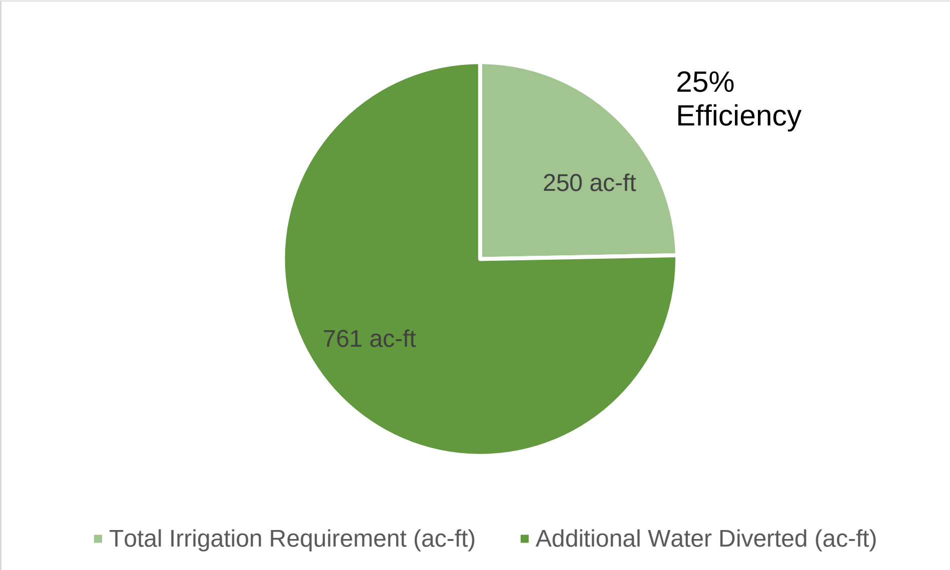


Figure 2.7.1.2. Calculated System Efficiency of the Vandeford Ditch

Brief Diversion Description –

The Vandeford Ditch diversion consists of an in-stream boulder weir that spans approximately one-half of the North Fork. This allows for passage around the diversion, while allowing sufficient flow diversion for the Vandeford's water rights. Just upstream of the diversion on the Northwest bank of the river there is a headgate mounted on the front of a small concrete headwall. Figure 2.7.1.3 shows the headgate and boulder weir of the Vandeford diversion. After water passes through the headgate, it travels through river-bottom wetlands for approximately 0.25 miles to another small headgate, shown in Figure 2.7.1.4. There is a turn-back spill immediately in front of the headgate, sending excess flow back to the river. The Parshall flume used to measure flows on the ditch is another 0.25 miles downstream of the second headgate. In the first half-mile span of the ditch (river diversion to flume), there are significant inflows from irrigation occurring on the surrounding higher ground. Figure 2.7.1.5 provides an example of inflows coming from irrigation on nearby high ground. This directly influences the amount of water the Vandeford must divert from the North Fork, and allows for substantially reduced diversions from the North Fork under certain conditions.

Figure 2.7.1.3. Vandeford Ditch Diversion

Figure 2.7.1.4. Spill Back to River

Figure 2.7.1.5. Example Inflows into Vandeford Ditch

Structural Integrity and Diversion Functionality –

The boulder weir appears to be structurally sound and is able to provide high water at the headgate. The weir often raises the water level above the headwall; however, this does not create any long-term structural or functional issues. The turn-back spill is earthen, so structural integrity is a concern. There have been historical issues with sediment in the Vandeford Ditch.

Ability to Divert Appropriate Range of Flows –

The current configuration of the diversion and headgate is able to divert the appropriate range of flows. The headgate on the ditch, near the turn-back spill, allows for rate adjustments.

Diversion Issues that Affect River Function –

Since the boulder weir does not span the entire river cross-section, there is adequate passage around the diversion for fish and recreational users. The current configuration of the boulder weir tends to create rapids very near the bank of the river. This could cause erosion over time.

Diversion Issues that Affect Recreational Users –

The diversion itself has not caused issues for recreational users. Rafters and kayakers are able to float the river and simply go around the diversion. The rapids created by the boulder weir are attractive to fly fishermen which has caused some conflict with the Vandeford Ditch.

Recommendations –

1. <u>Engineered Spill</u>: The current turn-back spill is earthen and subject to erosion over time. A concrete spill structure with a sluice gate in front of the ditch headgate would be a more permanent structure and would allow for sluicing out material and sediment, which have caused issues for the ditch.

Preliminary Cost Estimates –

1. <u>Engineered Spill</u> – $30,000 to $50,000

2.8 Reach 8 Overview

The Smith and McKnight Ditch Diversion marks the starting point of Reach 8, which concludes at the confluence with the Gunnison River. This reach has a total length of 9.24 miles. It begins in the Town of Hotchkiss and forms the southern boundary of the area known as Roger's Mesa. Figure 2.8.1 compares the diversions from Reach 8 with the other reaches on the river, with special emphasis on Reach 8.

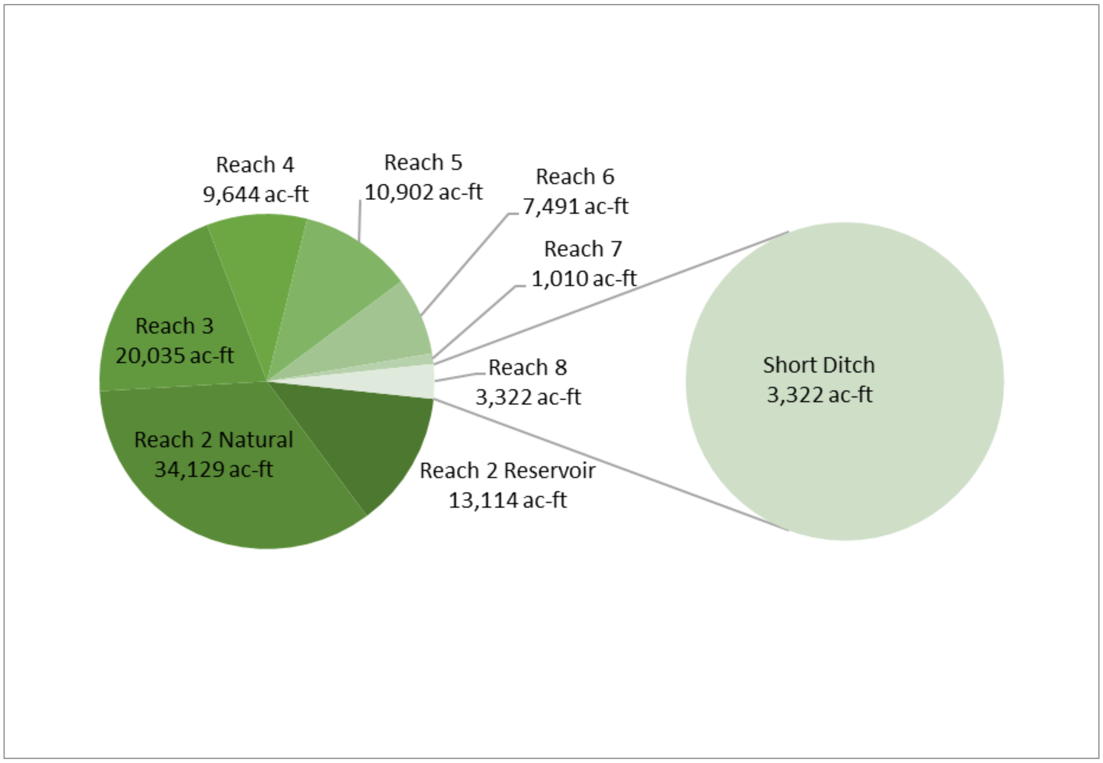


Figure 2.8.1. 2007 to 2016 Average Annual Diversion Rates for Reaches with Focus on Reach 8

2.8.1 Smith and McKnight Ditch

Ditch Overview –

The Smith and McKnight is the final irrigation diversion on the North Fork of the Gunnison and is located at 1385+65, immediately to the Southeast of downtown Hotchkiss, CO. It provides irrigation water to lands to the Southwest of Hotchkiss, in an area bounded by the North Fork to the North and West and arid bluffs to the South and East. Irrigators on the ditch typically cultivate corn, alfalfa, and dry beans. Figure 2.8.1.1 gives some average statistics for diversion amounts for a period from 2007 to 2016 for the Smith and McKnight Ditch.

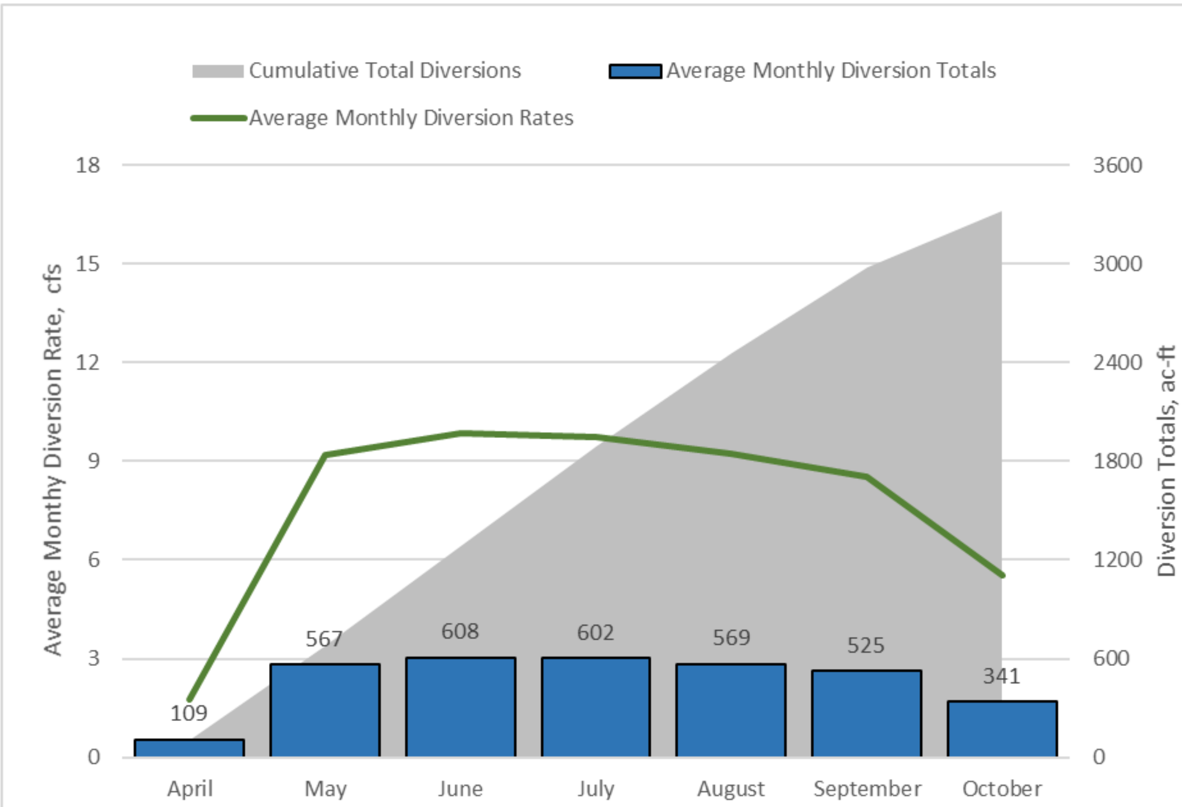


Figure 2.8.1.1. 2007 to 2016 Average Diversion Statistics for the Smith and McKnight Ditch

The Smith and McKnight reportedly diverts an average of 3322 ac-ft per year for 375.66 acres of irrigable land. Crop selection is dominated by grass and alfalfa, though dry beans are also reported on CDSS. Based on this data, 1048 ac-ft is required to properly irrigate the crops. The total system efficiency is 32%, which is depicted in Figure 2.8.1.2.

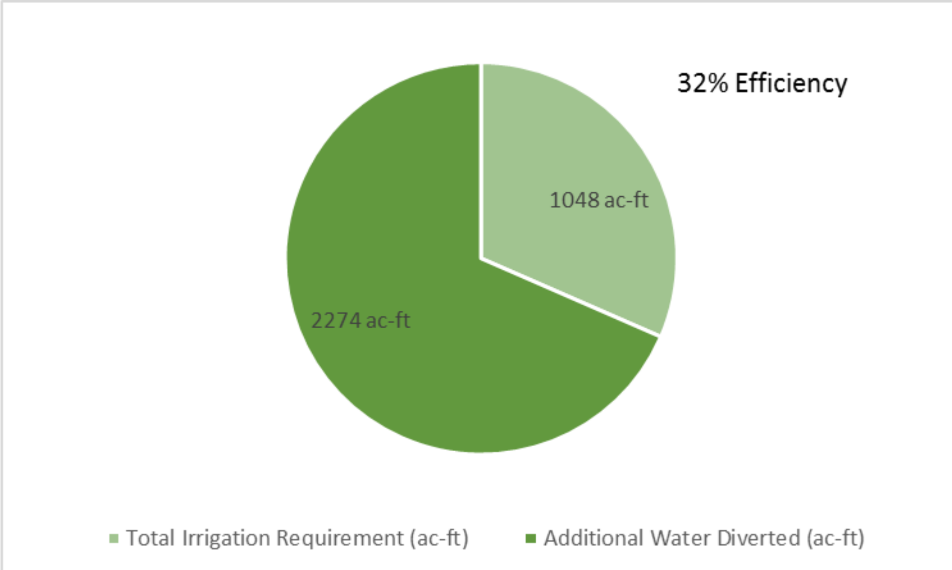


Figure 2.8.1.2. Calculated System Efficiency of the Smith and McKnight Ditch

Brief Diversion Description –

The Smith and McKnight Ditch Diversion occurs on the upstream side of the CO-92 highway bridge over the North Fork. It consists of an in-stream partially submerged boulder weir and a canal gate mounted to a concrete headwall, as shown in Figure 2.8.1.3. Behind the canal gate there is a pipe that brings water under the highway and into the Smith and McKnight Ditch. The concrete headwall is designed to prevent erosion of the bank, and also provides a point on which a safety fence is mounted on the front of the canal gate, which is shown in detail in Figure 2.8.1.4.

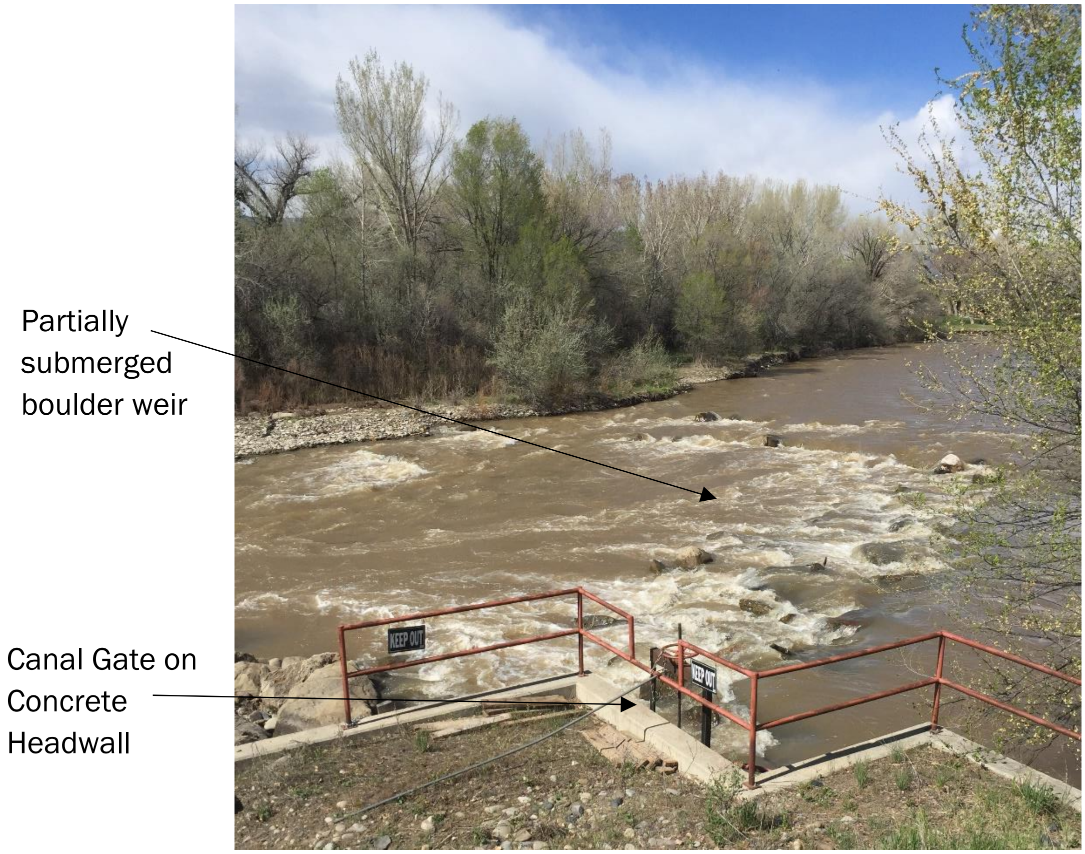


Figure 2.8.1.3. Smith and McKnight Diversion

Figure 2.8.1.4. Canal Headgate with Safety Fence

Structural Integrity and Diversion Functionality –

The ditch inlet structure (concrete headwall, gate, and safety fence) appears to be in good repair and is functional and appropriate for the ditch. The partially submerged boulder weir does not appear to have an engineered form, and seems to be an accumulation of stacked boulders over the course of many years. While the boulders are effective in diverting the river, during low flows they create a major river obstruction.

Ability to Divert Appropriate Range of Flows –

The canal gate allows for adjustments of flow rates to the Smith and McKnight Ditch. The size of the boulder weir allows for the water right to be diverted even in times of low flow.

Diversion Issues that Affect River Function –

It has been noted that often times during the late summer the Smith and McKnight Diversion tends to drawdown the river to levels that make recreational use of the river difficult immediately below the diversion.

Diversion Issues that Affect Recreational Users –

During times of low river flow, the Smith and McKnight Diversion creates a major obstruction in the North Fork of the Gunnison. The safety fence has been effective in helping recreational users safely navigate the section of the river.

Recommendations –

1. Diversion Improvement: Creating a more efficient and low profile weir with an engineered low-flow bypass may help alleviate issues of river function. The canal gate could potentially be lowered further into the stream with the inlet pipe extended further down the Smith and McKnight alignment to make the low profile weir functional during low flow conditions.
2. Boat Passage: Boat passage through the diversion or an overland passage around the diversion may assist with recreational issues at diversion.

Preliminary Cost Estimate –

1. Diversion Improvement - $50,000 to $100,000
2. Boat Passage - $25,000 to $50,000

3.0 IMPROVEMENT PRIORITIZATION

Potential river infrastructure improvements have been broadly categorized into three major categories, “Low”, “Medium”, and “High”. Category definitions are defined below:

Low – The “Low” category is for improvement projects that provide minor improvements to diversion efficiency or river function or are unlikely to receive grant funding.

Medium – The “Medium” category is for improvement projects that correct minor to medium safety deficits in river infrastructure and for improvements that can provide medium to high diversion efficiency or river function.

High – Improvements fall into the “High” category when there is a safety deficit in current river infrastructure that an improvement can immediately remedy. Other improvements in the “High” category are those which can greatly improve diversion efficiency or river function in a cost-effective and fundable manner.

Table 3.0.1, below, lists potential river corridor improvements with their associated priority category.

Table 3.0.1. Potential North Fork River Corridor Infrastructure Improvements

Reach	Applicable Ditch Company	Project Description	Desc. Of Benefits	Estimated Cost*	Relative Priority
2	Fire Mountain Canal	Boat Passage	Improved safety for recreationalists	$25,000 to $50,000	Medium
2	Carrol Ditch	Grouted Boulder U-Weir	Would allow for a longer irrigation season	N/A	Low
3	Stewart Ditch	River Signs	Improved safety for recreationalists	$1,000	Medium
3	Stewart Ditch	Island Stabilization	Improved long term river and diversion function	$20,000 to $50,000	High
3	Stewart Ditch	Upstream Headwall	Improved river function, improved safety for recreationalists	$100,000 to $300,000	Medium
3	Stewart Ditch	Diversion Relocation / Complete Rebuild	Improved long-term river function, improved diversion for ditch, improved recreational use	$1M to $3M	Low - Unlikely to be funded
4	North Fork Farmer's Ditch	Improved Diversion	Improved long term river function, improved safety for recreationalists	$75,000 to $100,000	High
5	Paonia Ditch	Secondary Spill Channel Improvements	Improved safety	$5,000	High
5	Paonia Ditch	Improved Headgate Structure	Reduction in silt for users on Paonia Ditch	$30,000 to $50,000	Medium
5	Paonia Ditch	Bank Stabilization	Improved long-term diversion function	$10,000 to $20,000	Medium
5	Monitor Ditch	Increase Headwall Height	Improved diversion functionality	$1,000	High
5	Monitor Ditch	Trash Rack	Improved safety for recreationalists, improved diversion functionality	$10,000	Medium
5	Shepherd and Wilmott Ditch	Trash Rack	Improved safety for river users, improved diversion functionality	$10,000 to $50,000	High
5	Shepherd and Wilmott Ditch	Bank Stabilization	Improved long-term river and diversion function	$20,000 to $50,000	High
6	Short Ditch	Diversion Improvement	Improved long-term diversion functionality, improved river function, improved recreational use	$100,000+	High
6	Short Ditch	Expand Water Control Channel	Improved diversion functionality	$10,000 to $25,000	High
6	Short Ditch	Bank Stabilization	Improved diversion functionality	$50,000 to $100,000	High
7	Vandeford Ditch	Engineered Spill	Improved diversion functionality	$30,000 to $50,000	Low
8	Smith and McKnight Ditch	Diversion Improvement	Improved diversion functionality, improved river function, improved reacreational use	$50,000 to $100,000	High
8	Smith and McKnight Ditch	Boat Passage	Improved recreational safety and use	$25,000 to $50,000	High

*Cost Estimates indicate potential conceptual project scale. Specific projects will require further feasibility and cost exploration

The proposed projects in Table 3.0.1 involve ditch infrastructure improvements that predominantly provide benefits that can be realized by both irrigators and non-consumptive users. The proposed projects do not, however, address many of the inherent irrigation inefficiencies within the Valley. Upgraded conveyance infrastructure (piping or lining) on many ditches could assist in improving conveyance efficiency while providing environmental benefit. For certain ditches, such as the Short Ditch and Smith and McKnight Ditch, combination projects to increase efficiency and reduce river infrastructure warrant exploration. Consideration for such projects must include verification that ditch combination will not upset current river administration, as described in Section 4.

4.0 AGRICULTURE'S POSITION ON THE NORTH FORK

4.1 Big Picture Issues for Agriculture

Agriculture has historical, cultural and economic significance in the North Fork Valley. The water rights and the irrigable land use reflect this. The users on the North Fork have historically done a great job protecting their rights by continuing to use their decreed water for beneficial uses. It is in the best interest of irrigators and the larger community to ensure that any infrastructure improvements do not endanger these water rights.

The biggest factor in determining beneficial use in irrigation is irrigated acreage. Irrigating agricultural land proves that water is used beneficially, which will preserve existing water rights. Permanent reduction of agricultural land use in the North Fork Valley could endanger the water rights. The extent of irrigated acreage in the North Fork is shown in Appendix B, which contains maps that show the irrigated lands for each diversion. This data was collected from the HydroBase Data Viewer from the Colorado Department of Natural Resources. These maps are intended to be used as a visual guide to show general areas served by each ditch and may not reflect the most current data. While beneficial use does account for system inefficiencies (conveyance and application), efficiency improvements will not endanger absolute water rights but should instead serve to benefit irrigators and secure the volume of the water right.

Avoiding a loss of decreed water is a top priority of both the agricultural community and those that enjoy the wooded and riparian areas created within the North Fork Valley. Better utilizing the water of the North Fork for multiple purposes should not, and will not, endanger the water rights of the irrigators.

4.2 Water Rights and Administration Concerns

Administration of water rights on the North Fork is complex. Water rights range in administration numbers from 14413.11840 (the Senior Most Right of the Stewart Ditch, appropriated in 1882) to flood decrees with very junior administration numbers and appropriation dates of as recent as 2015. Many ditches have multiple water rights with ranging seniorities. This results in the frequent total or partial discontinuance of junior rights throughout the valley and thus complex administration during mid to late irrigation season on many of the ditches. Table 4.1.1 provides a ranking of water rights by administration numbers. According to the agricultural interviews (compiled in Appendix C), it is historically rare that any ditch on the North Fork has been completely curtailed to satisfy a more senior diverter due to the portfolio of water rights possessed by many of the ditches.

Table 4.1.1. North Fork Water Rights by Administration Number

Adminstration Number	Diverter	Appropriation Date	Rate Amount (cfs)
14413.11840	STEWART DITCH	1882-06-01	1.3
14413.12054	VANDEFORD DITCH	1883-01-01	2.7
14413.12054	VANDEFORD DITCH	1883-01-01	0.6
14413.12100	MONITOR DITCH	1883-02-16	6.5
14413.12114	PAONIA DITCH	1883-03-02	9.5
14413.12483	SHEPHERD & WILMOTT DITCH	1884-03-05	8.2
14413.13185	VANDEFORD DITCH	1886-02-05	10.0
14413.14062	VANDEFORD DITCH	1888-07-01	1.8
14427.00000	PAONIA DITCH	1889-07-01	2.3
14567.00000	SHORT DITCH	1889-11-18	10.5
14766.00000	NORTH FORK FARMERS DITCH	1890-06-05	22.8
15702.00000	STEWART DITCH	1892-12-27	4.7
15873.00000	PAONIA DITCH	1893-06-16	0.6
16528.00000	PAONIA DITCH	1895-04-02	1.3
16882.00000	NORTH FORK FARMERS DITCH	1896-03-21	2.0
16954.00000	SMITH AND MCKNIGHT DITCH	1896-06-01	4.1
19415.12996	MONITOR DITCH	1885-07-31	1.8
19415.13938	CARROL DITCH	1888-02-28	0.6
19415.14567	SHORT DITCH	1889-11-18	2.2
19415.16770	STEWART DITCH	1895-11-30	50.8
19415.16954	SMITH AND MCKNIGHT DITCH	1896-06-01	0.9
19415.16998	SHEPHERD & WILMOTT DITCH	1896-07-15	0.4
19415.17059	FIRE MOUNTAIN CANAL	1896-09-14	50.0
19415.18353	SHEPHERD & WILMOTT DITCH	1900-04-01	2.9
19415.18718	STEWART DITCH	1901-04-01	1.1
19415.18718	SHEPHERD & WILMOTT DITCH	1901-04-01	0.2
19415.18718	SHORT DITCH	1901-04-01	6.5
19415.18718	SMITH AND MCKNIGHT DITCH	1901-04-01	0.6
19415.19083	SHEPHERD & WILMOTT DITCH	1902-04-01	0.5
19415.19083	SHORT DITCH	1902-04-01	4.5
19415.19083	SMITH AND MCKNIGHT DITCH	1902-04-01	0.3
19448.00000	SHEPHERD & WILMOTT DITCH	1903-04-01	0.4
19448.00000	SHORT DITCH	1903-04-01	2.5
19448.00000	SMITH AND MCKNIGHT DITCH	1903-04-01	1.8
21263.18353	FELDMAN DITCH	1900-04-01	1.9
21701.00000	FIRE MOUNTAIN CANAL	1909-06-01	44.5
25807.17623	NORTH FORK FARMERS DITCH	1898-04-01	7.3
25807.19783	SHORT DITCH	1904-03-01	17.3
25807.22261	STEWART DITCH	1910-12-13	19.3
25807.23550	FIRE MOUNTAIN CANAL	1914-06-24	7.5
29260.18730	PAONIA DITCH	1901-04-13	21.4
30771.00000	SMITH AND MCKNIGHT DITCH	1934-04-01	2.7
31924.12100	MONITOR DITCH	1883-02-16	2.0
31924.12483	SHEPHERD & WILMOTT DITCH	1884-03-05	3.5
31924.17059	FIRE MOUNTAIN CANAL	1896-09-14	30.0
31924.31197	FIRE MOUNTAIN CANAL	1935-06-01	90.0
31924.31197	FIRE MOUNTAIN CANAL	1935-06-01	16.0
46020.18353	FELDMAN DITCH	1900-04-01	1.9
52595.25932	STEWART DITCH	1920-12-31	5.0
60306.00000	FIRE MOUNTAIN CANAL	2015-02-10	100.0
60630.13118	STEWART DITCH	1885-11-30	5.0
Total:			591.8

Like many other river systems in western Colorado, but perhaps to a greater extent, administration of rights on the North Fork is a function of both priority and location. Beginning at the Fire Mountain Canal diversion and ending at the Smith and McKnight diversion, there are twelve diversions within an approximately 19.1 mile long reach. Within this same 19.1 miles, there are countless arroyos and washes, and numerous tributaries including Terror Creek, Minnesota Creek, Jay Creek, and Roatcap Creek. Nearly all of the ditches begin and end within this 19.1 mile segment, meaning that there are return flows from certain ditches before other ditches have diverted flow. Appendix D contains the North Fork of the Gunnison River Straight-Line Diagram from "North Fork Study", prepared by Clear Water Solutions in July 2014. This diagram illustrates the approximate locations of many of the large inflows and outflows along the river. It does not, however, illustrate ditch tailwater returns and subsurface flow from up-gradient irrigation, which have significant contribution to total streamflow at the down-river diversions.

Downstream of the Paonia Ditch, river flows are increased by incoming tributary flows from Minnesota Creek, Stevens Gulch, and Roatcap Creek all before the next irrigation diversion (Monitor Ditch). The incoming flow is often sufficient to satisfy many rights downstream of the Paonia Ditch, while allowing the Paonia Ditch to divert the entire available natural stream flow. In many ways, this allows water rights on the North Fork to be administered as if there are two separate, unconnected rivers divided by the Paonia Ditch. This often allows for upstream Juniors to continue diverting later in the season.

While there are countless scenarios for how water is administered on the North Fork, acknowledgement that both priority and location are critical components of administration is vital. Changes in efficiency could have a direct impact on individual irrigators. Significant projects to increase efficiency may provide recreational and/or environmental benefit. However, water administration impact studies may be a prudent exercise before any major projects are undertaken.

4.3 Cooperation with Other Water Users

There are several non-agricultural communities that have an interest in agricultural use of water on the river. These communities include both recreationalists and environmentalists, and their interests can benefit from many of the infrastructure improvements provided in this report. Many of the proposed river corridor improvement projects increase safety and river function, while providing a functional benefit to the irrigators by ensuring operable infrastructure. Multiple beneficiaries to single projects can allow ditch companies and irrigators to leverage the benefits for partial or total funding of projects.

5.0 CONCLUSION & RECOMMENDATIONS

The North Fork of the Gunnison River is a complex system with many beneficial uses competing for a renewable, but at times scarce resource. The agricultural uses of water benefit from their position as senior appropriators of the natural flow of water, and have a stake in protecting their right to beneficial use of the water. The diversions for irrigation purposes support significant riparian habitat along the river corridor as well as maintain the North Fork Valley as an important agricultural region within Colorado.

Increased value is being recognized within the surrounding community of the benefits of non-consumptive uses of the water. Recreationalists are increasingly placing value in the river as an important place for boating and fishing. River health continues to be emphasized by interested groups, some with a significant local presence. Late season flows are often viewed as a proxy for river health. Historically late season river flows were likely less than seen today. Return flows from irrigation coupled with stored water released from Paonia Reservoir and other smaller storage facilities on the Grand Mesa that are tributary to the North Fork likely increase late season river flows on the North Fork.

Historically the river has been managed primarily as a means of supplying irrigation water to the surrounding community. This report does not intend to suggest any change to this use of the river corridor. However, there is significant opportunity to manage the river in a way that maintains the historic use of the river as a means for irrigation delivery while recognizing non-consumptive uses and at times utilizing the infrastructure and seniority of the agricultural rights to increase the beneficial use of the resource in the Valley.

Our recommendations for action within the river corridor are as follows:

1. **Create a small-scale water control structure grant program**.

   There is a significant amount of aging infrastructure associated with irrigation diversions and conveyance infrastructure. A grant program could be set up, potentially with seed money from a local non-consumptive use group, and potentially augmented with state funds. The program would likely be best administered by the Delta Conservation District or the North Fork Water Conservancy District. A very simple application could be generated. Irrigators could apply for funds for small-scale repair of water control structures within the valley.

   A grant program like this was successfully executed in the Plateau Valley (on the North side of the Grand Mesa) for a number of years. Simple ranking criteria, such as that used in our project prioritization, could be developed in order to guide the projects towards solutions that create multiple benefits. Emphasis should be placed on structures that decrease the use of proportional splits and provide opportunity to increase on-farm efficiency.

2. **Develop a conservation program allowing for irrigators to monetize "foregone diversion".**

   This is likely a complex idea and would require significant administration to develop. However, a conservation program of this type may be feasible for at least a portion of the

North Fork. There are also potentially interested non-consumptive use groups who may “lease” foregone diversion from irrigators for environmental purposes. State law allows conservation practices of this nature with no risk to future water rights transactions if the program is sponsored by and approved by a water conservation district such as the NFWCD of the CRWCD. A water conservation program of this type may also serve as the basis for future “demand management” associated with drought resiliency and already identified in the Colorado River Basin Drought Contingency Plan.

3. **Begin (and continue in some cases) to educate irrigators and community members that the basis for any value associated with the beneficial use of irrigation water is dominated, not by the diversion, but by the irrigated acreage.**

   It appears in the data that many diversions from the North Fork are far above crop demand during the spring and early summer. A significant portion of the increased diversion is likely a product of insufficient and/or inefficient infrastructure, and therefore necessary and beneficial. However, some of the excessive diversion can likely be attributed to a misunderstanding of the “use it or lose it” nature of Colorado water law. Leaving this water in the river has no effect on the value of a water right.

4. **Emphasize and support a funding plan for improvements to the following large diversions:**
   a. A feasibility study on combining the diversion and conveyance infrastructure of the Short and Smith-McKnight Ditches, or reconstruction of existing Smith-McKnight diversion to allow for bypass flows when appropriate and boat passage and possibly incorporated boater access.
   b. Stewart Ditch, construction of a new diversion or rehabilitation of the existing facilities with incorporated riparian bioengineering and geo-stabilization on the “island” created between the diversion channel and the North Fork.
   c. Fire Mt Canal, rehabilitation of existing facilities, including continued support for reservoir rehabilitation and efficiency projects. Specific emphasis should be placed on eliminating proportional splits of irrigation water within the lateral system on Roger’s Mesa.
   d. North Fork Farmer’s Ditch, rehabilitation of existing diversion structure. Specifically removing exposed iron (see Figure 2.4.1.3).
   e. Shepherd and Wilmott Ditch, placement of rock rip-rap and in stream low profile rock weir to stabilize river movement.

5. **Emphasize and support projects that remove proportional splits from conveyance infrastructure.**
   It remains very common in the North Fork Valley for shares of water to be split amongst users utilizing proportional splits of available water. This is the single biggest limitation to flexible water management in the Valley. Under current conditions, each ditch must remain as full as possible in order to deliver the maximum demand to any single user. The ability of an irrigation system to deliver large quantities of water to each user is an

important function, and in an on-demand system, is an important part of an efficient irrigation system. The largest impact may be felt by converting the shareholders in the Fire Mountain from proportional splits to an on-demand system. This could, if managed properly, free up natural flow for the other users that in turn frees up natural flow for the river system itself.

6. **Support the rehabilitation of Paonia Reservoir and encourage increased management**.

   Paonia Reservoir currently has a huge positive effect on the river system and has the potential through increased management of the water resource to have an even greater effect on the overall health of the river for all users.

7. **Continue to support Colorado River Salinity Reduction projects with local and state funds.**

   Conveyance efficiency improvements will benefit not only the irrigators but also the environmental and recreational community. The United States Bureau of Reclamation (USBR) provides funding to projects that reduce salinity inflows into the Colorado River and its tributaries. The North Fork community should continue to utilize these federal funds to pipe open irrigation canals. State grant and loan funds are available to increase the cost effectiveness of the projects and local and state decision makers should continue to emphasize the opportunities available to the irrigators.

APPENDIX A – MAPBOOK

North Fork of the Gunnison
Reach Mapbook

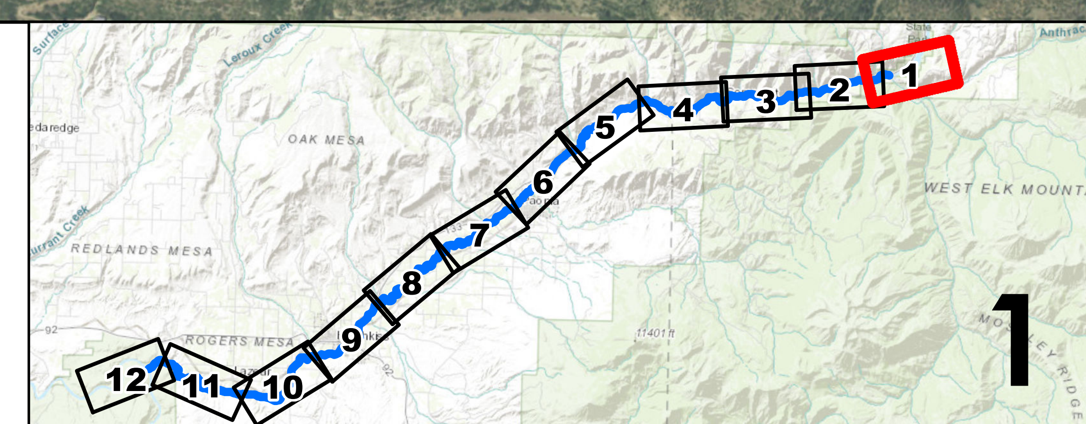
J-U-B ENGINEERS, INC.
THE LANGDON GROUP a J-U-B Company
GATEWAY MAPPING INC. a J-U-B Company
OTHER J-U-B COMPANIES

0 1,000 2,000 Feet

11/21/2017

Legend

- Diversion Locations
- Reach Start/End Locations
- Stationing
- North Fork of the Gunnison



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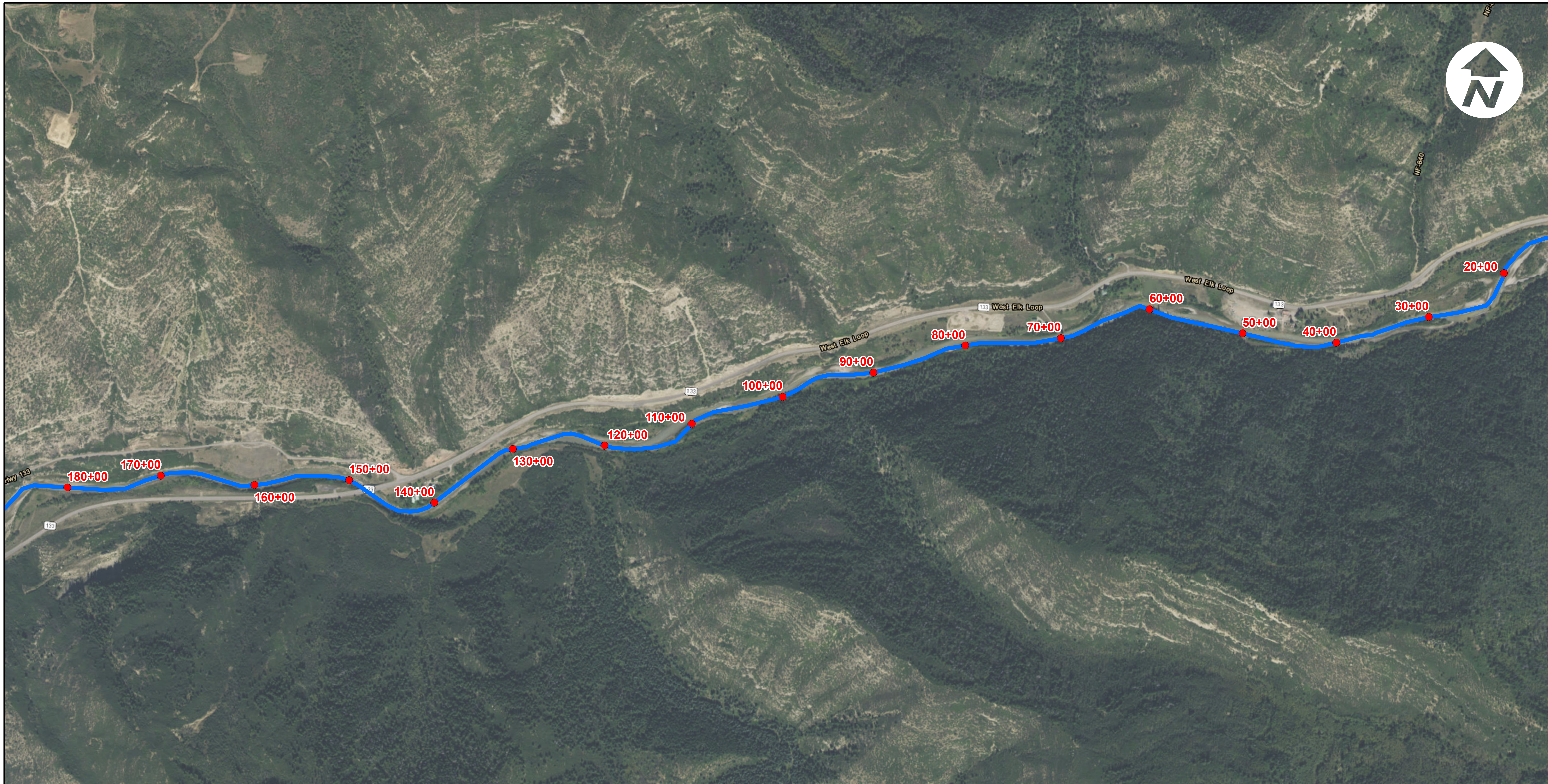

North Fork of the Gunnison

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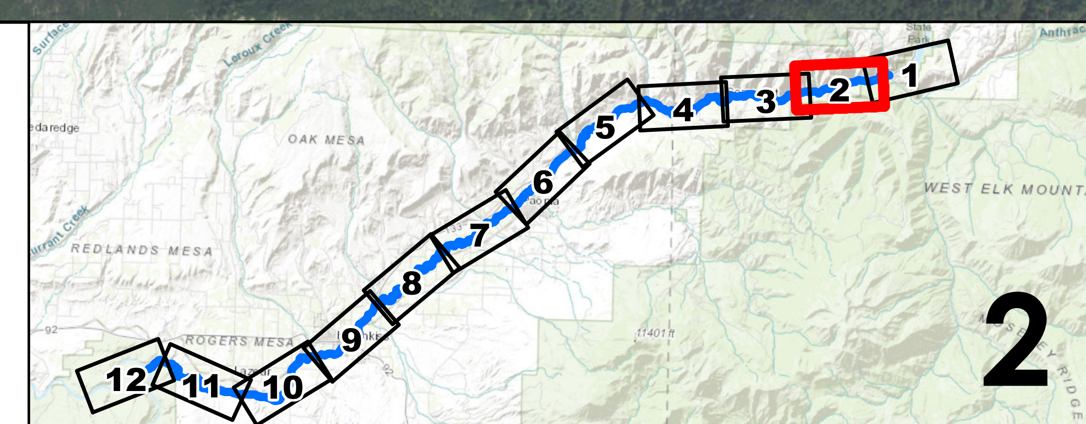

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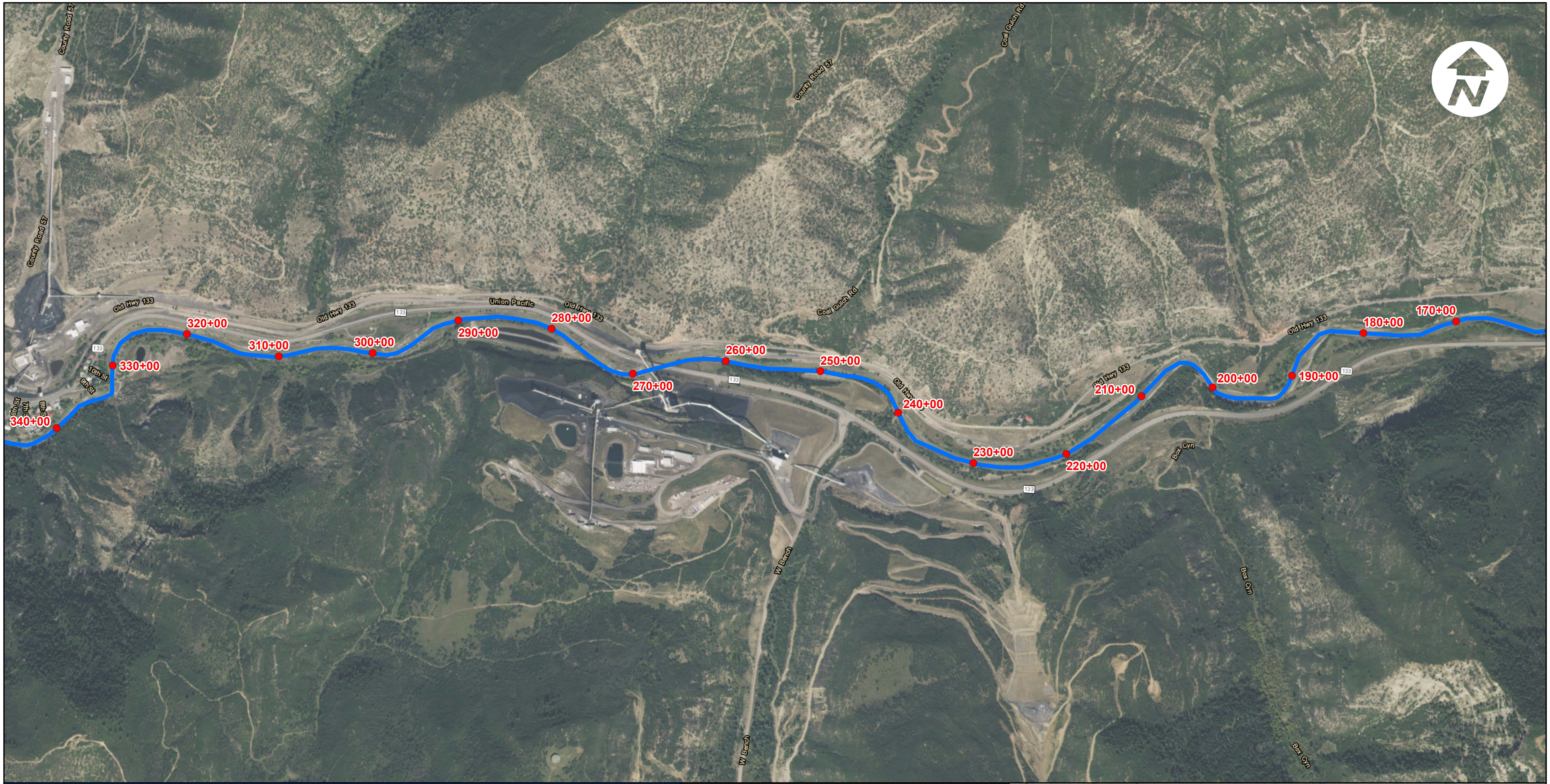

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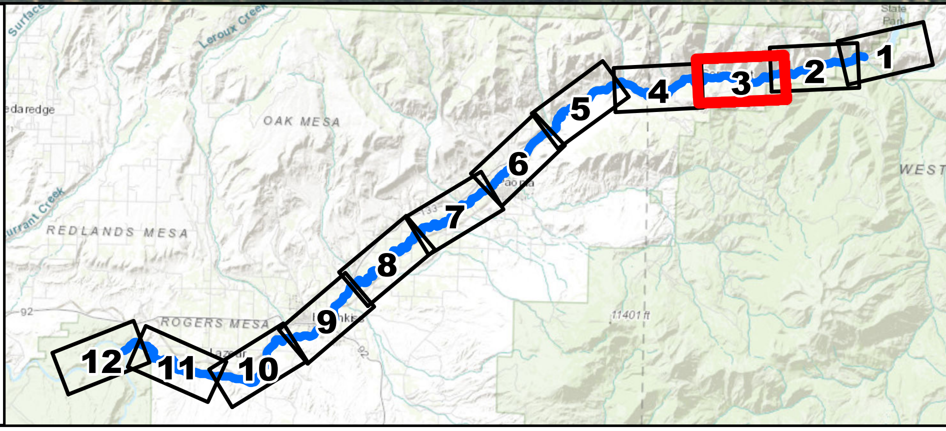

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North Fork of the Gunnison

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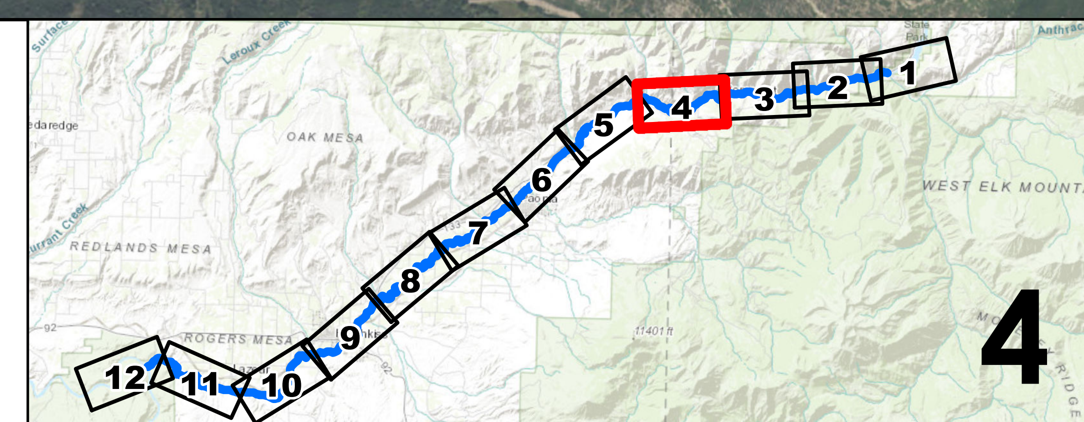

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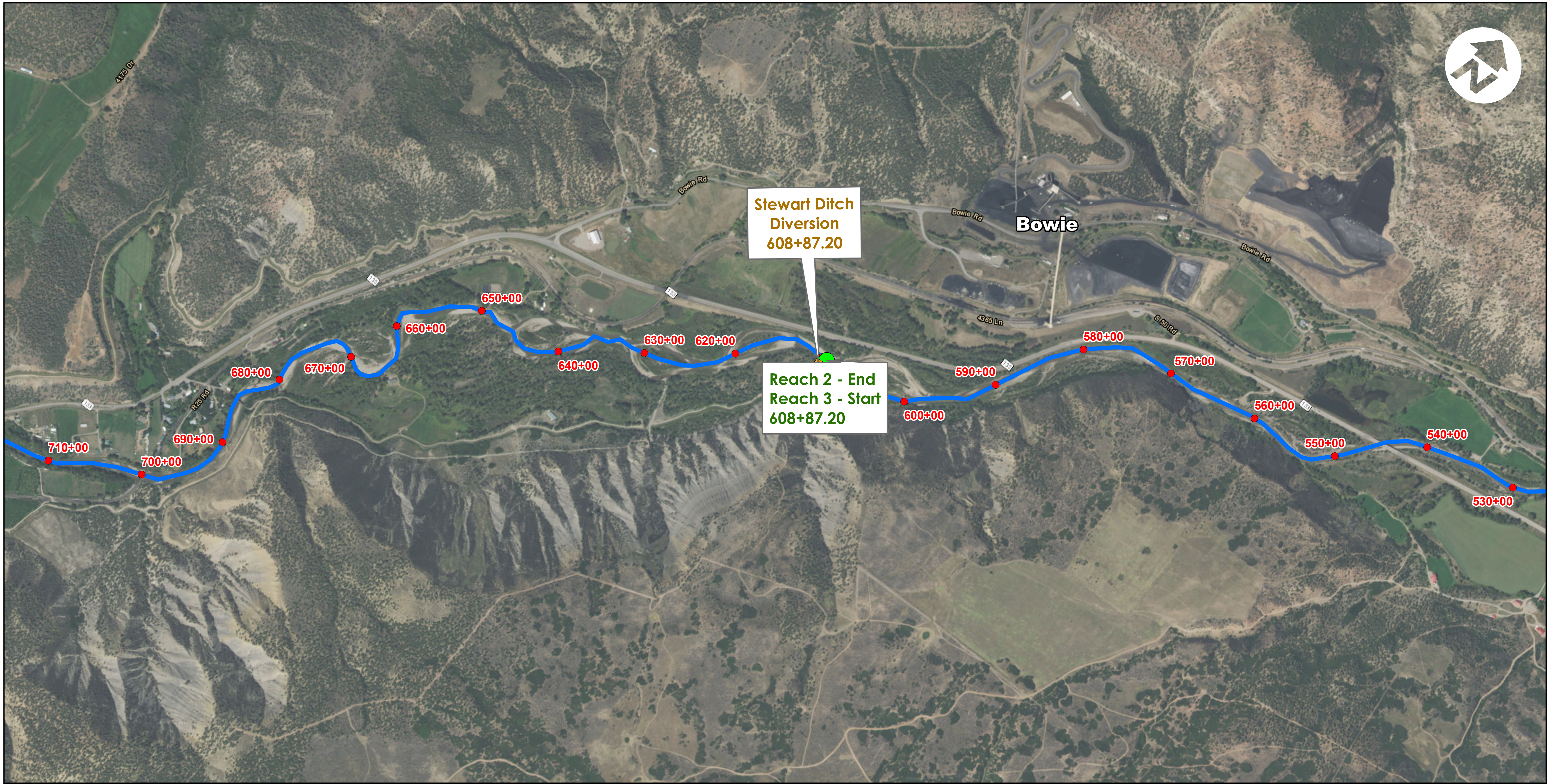

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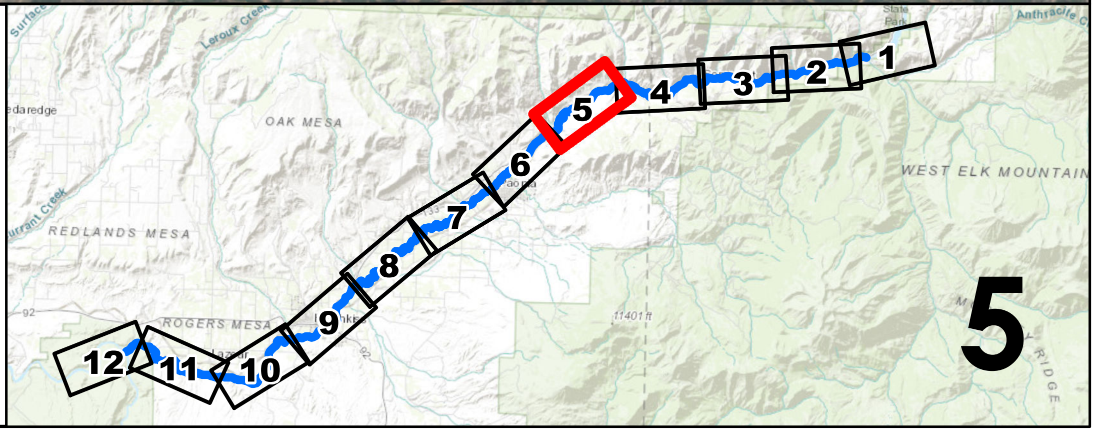

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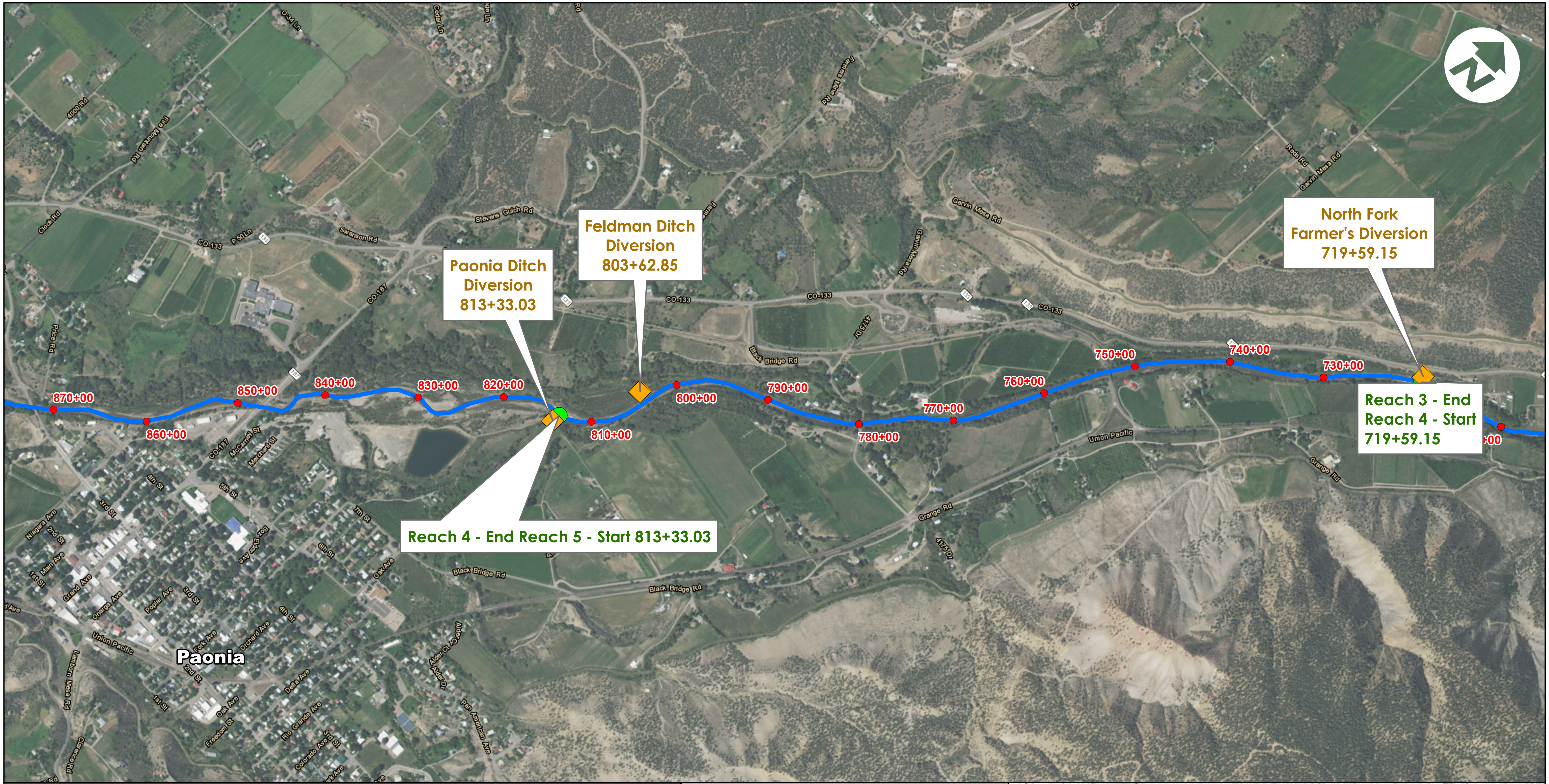

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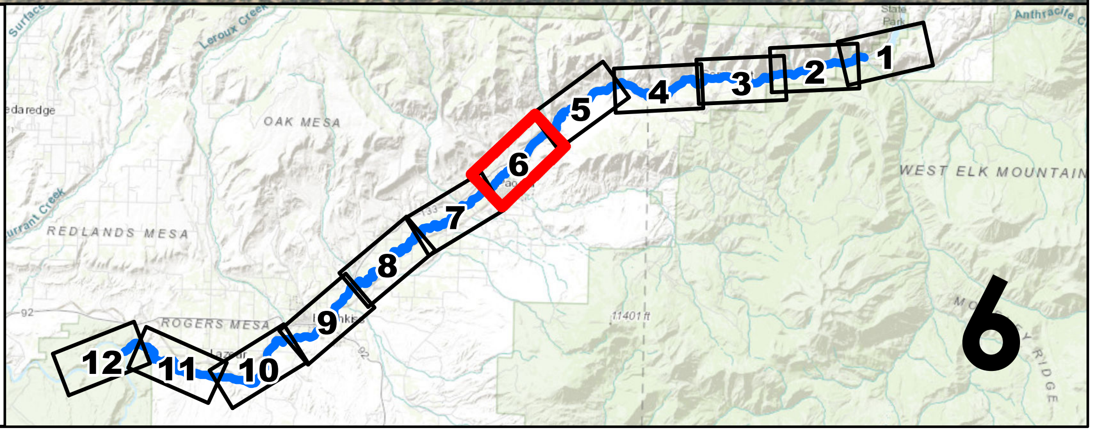

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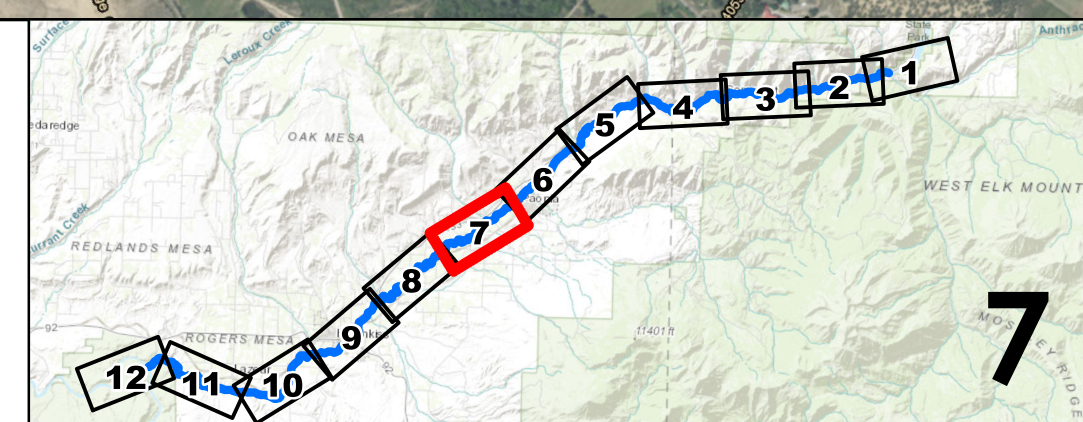

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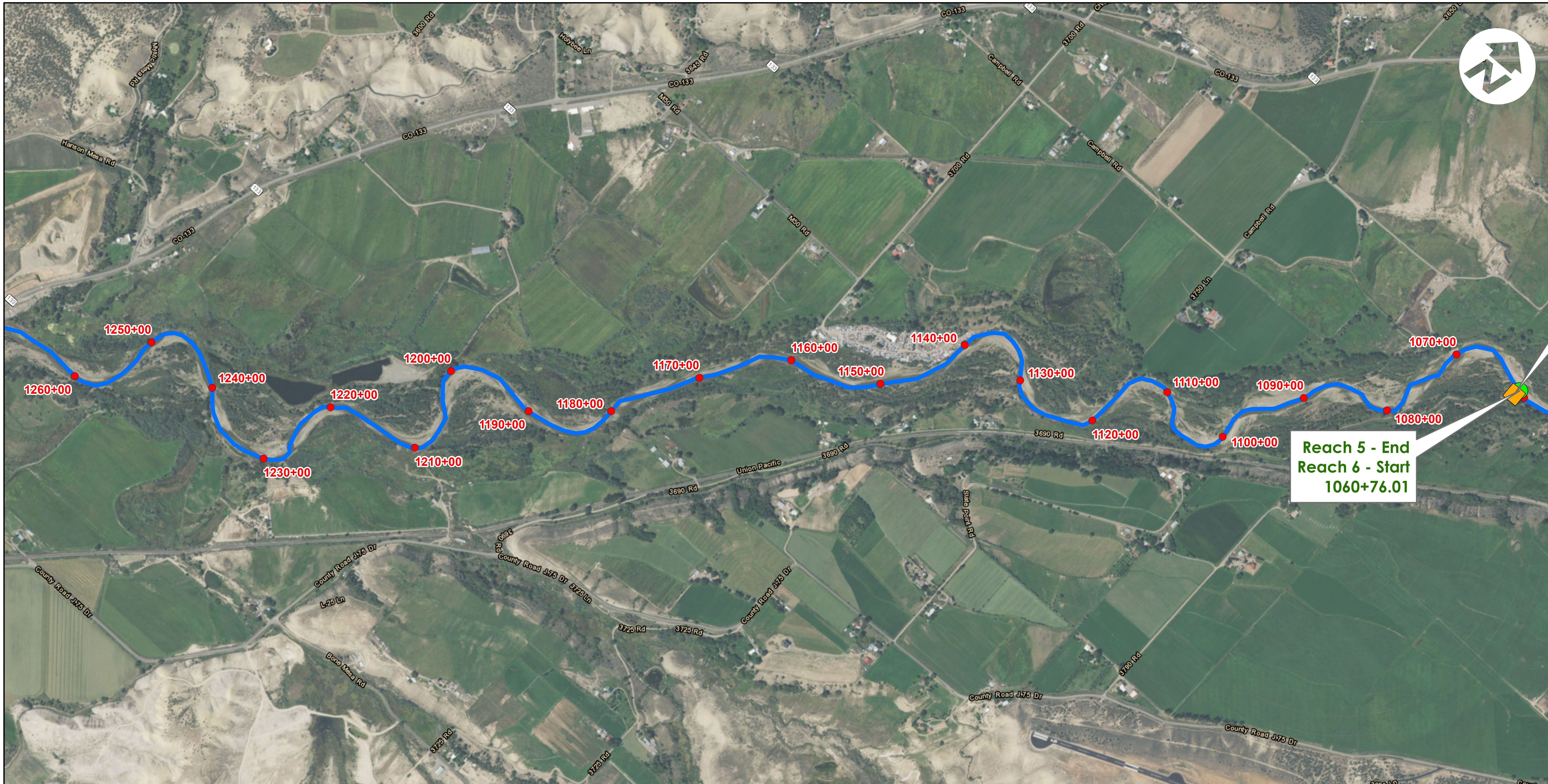

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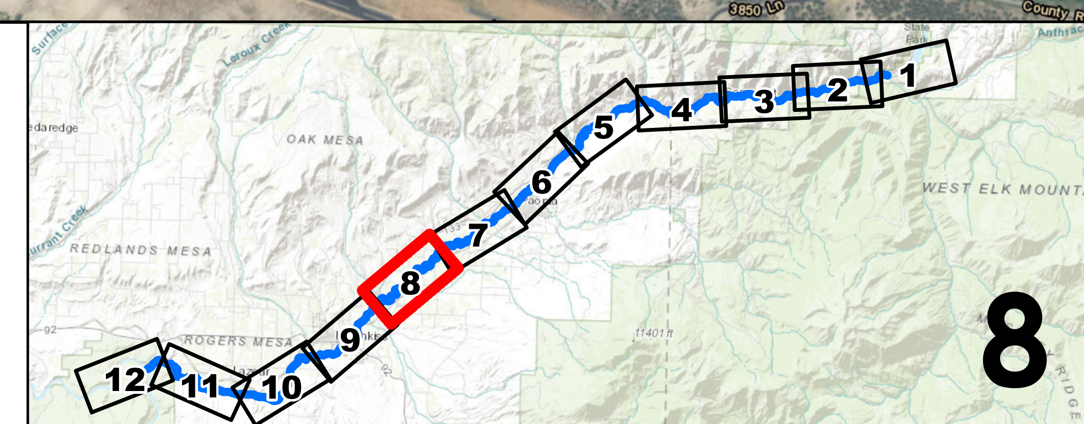

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North Fork of the Gunnison

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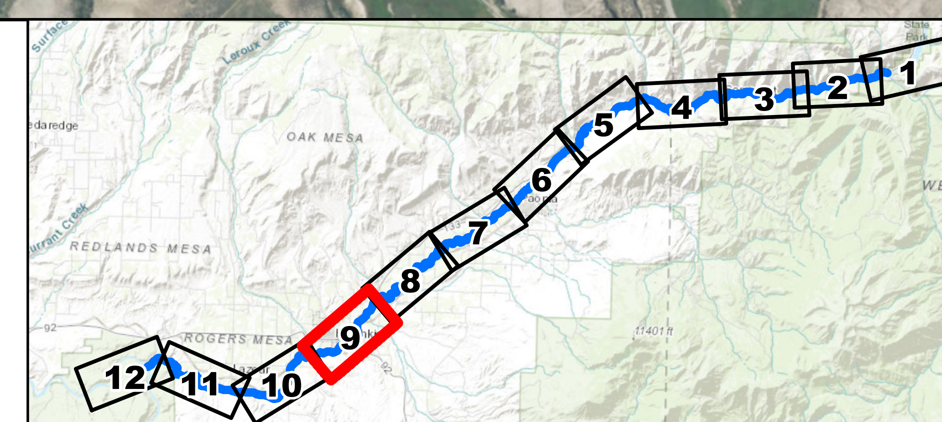

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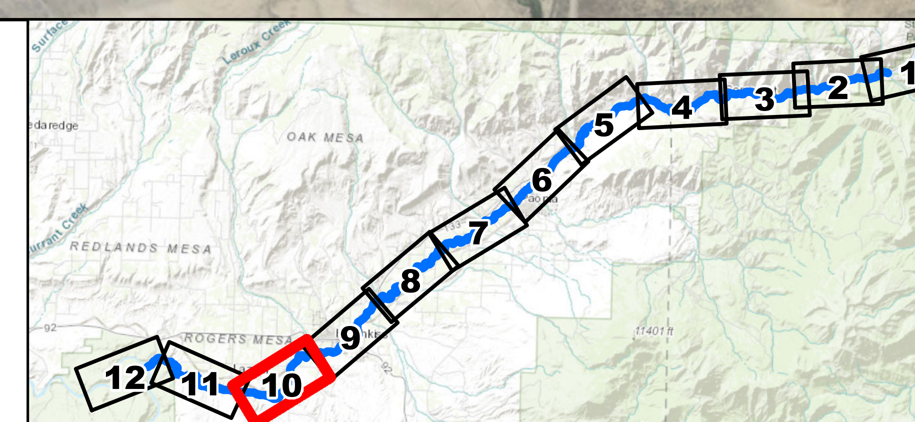

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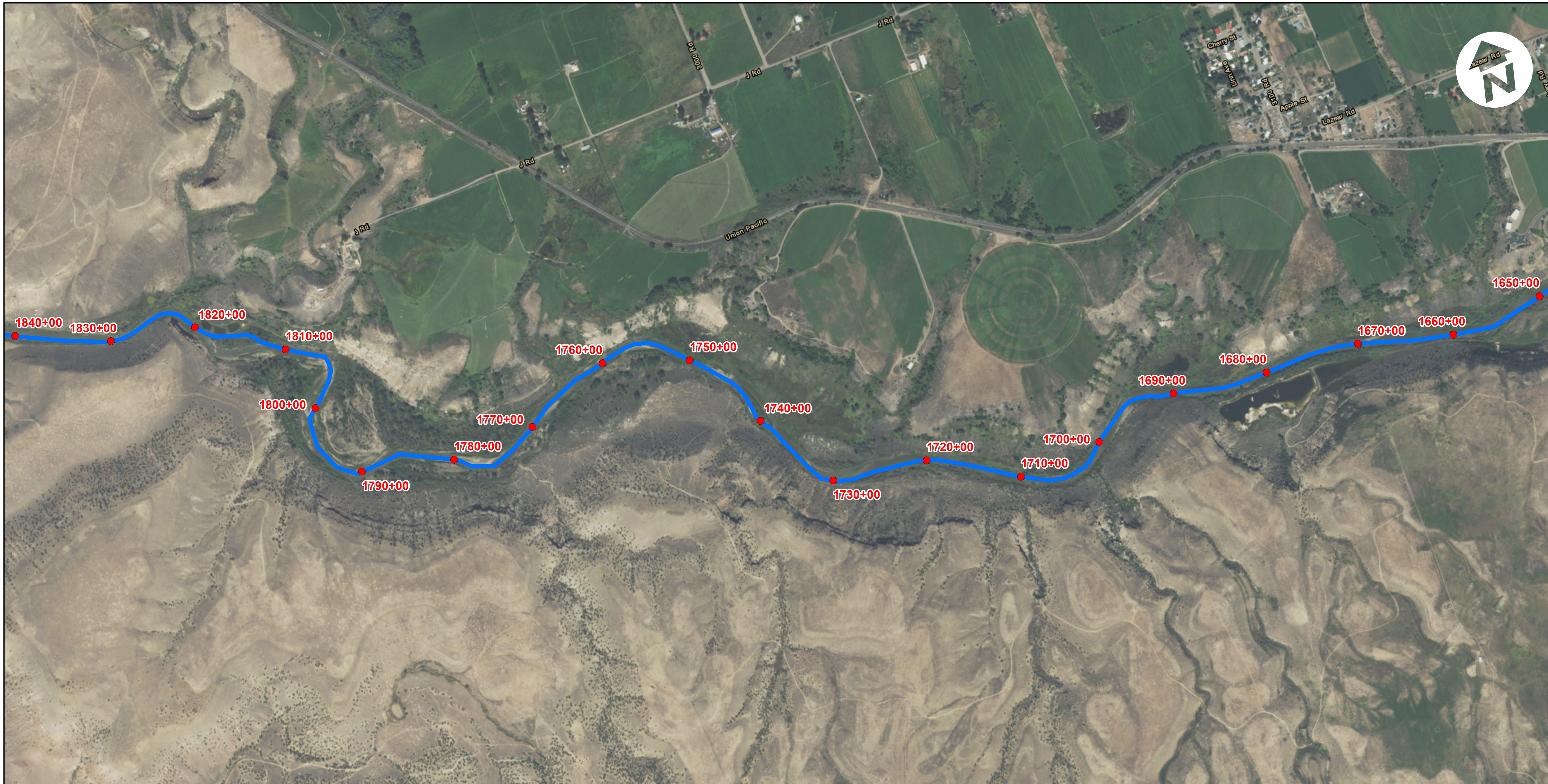

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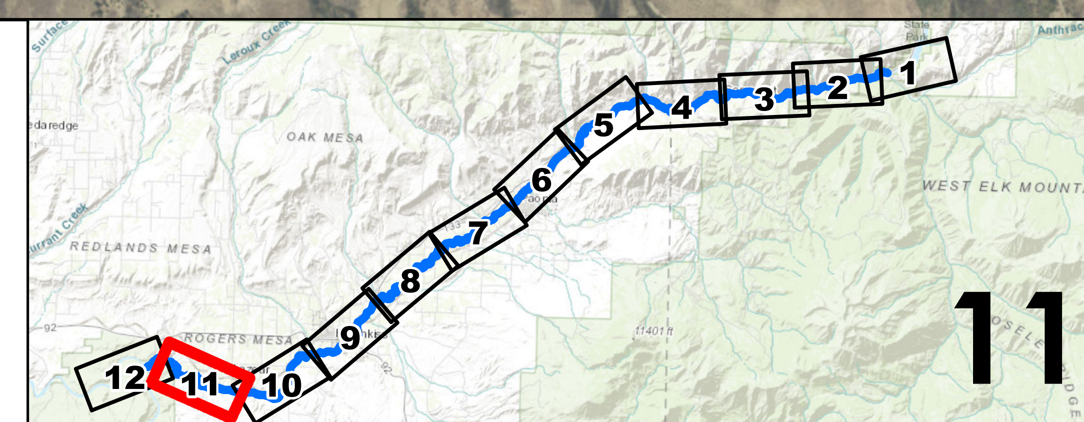

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North Fork of the Gunnison

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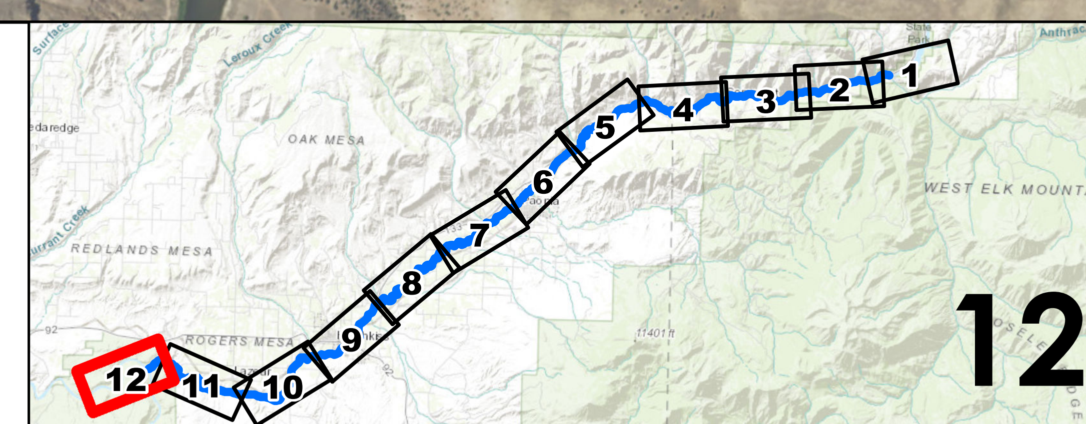

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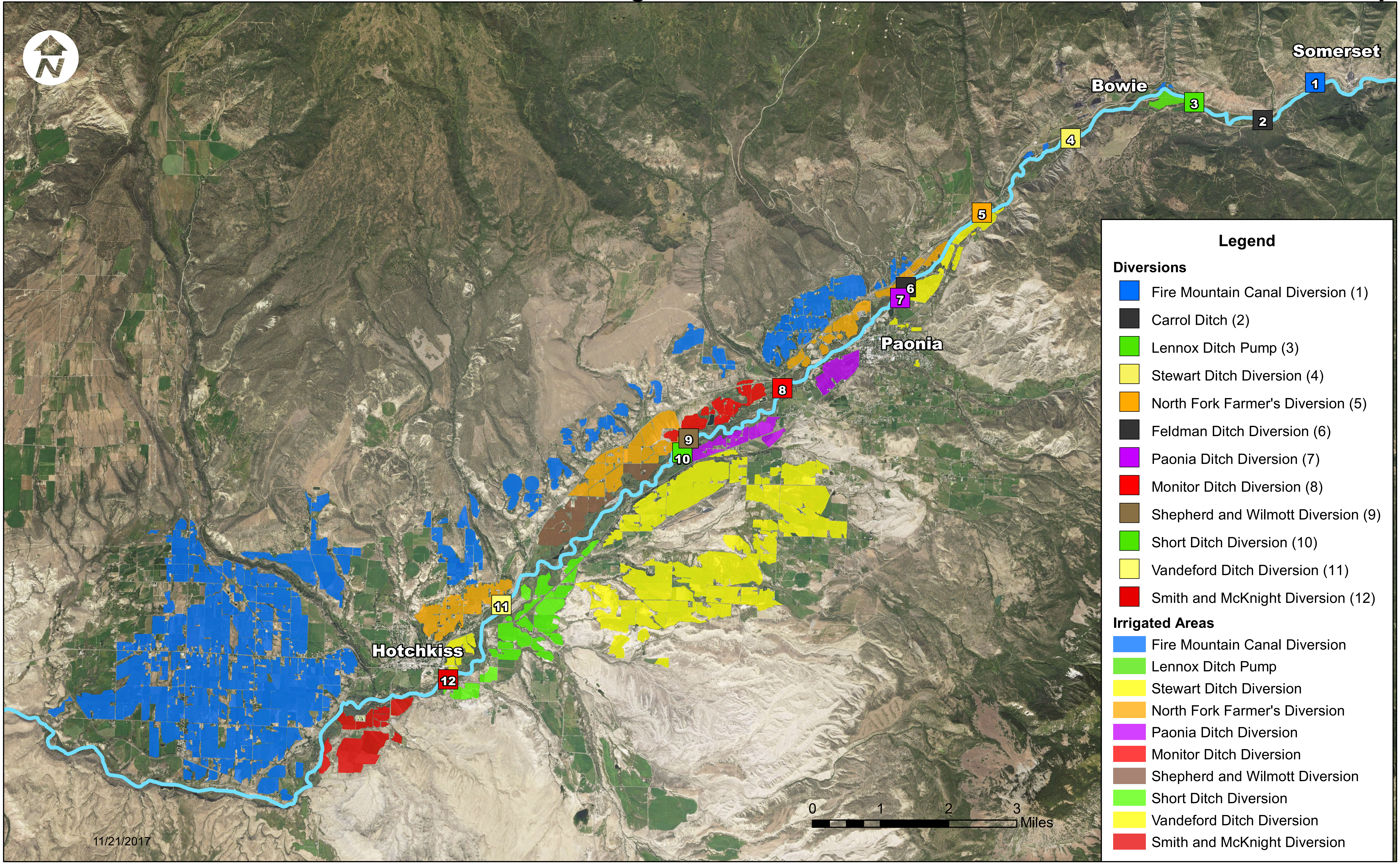
APPENDIX B – MAPS OF IRRIGATED LANDS

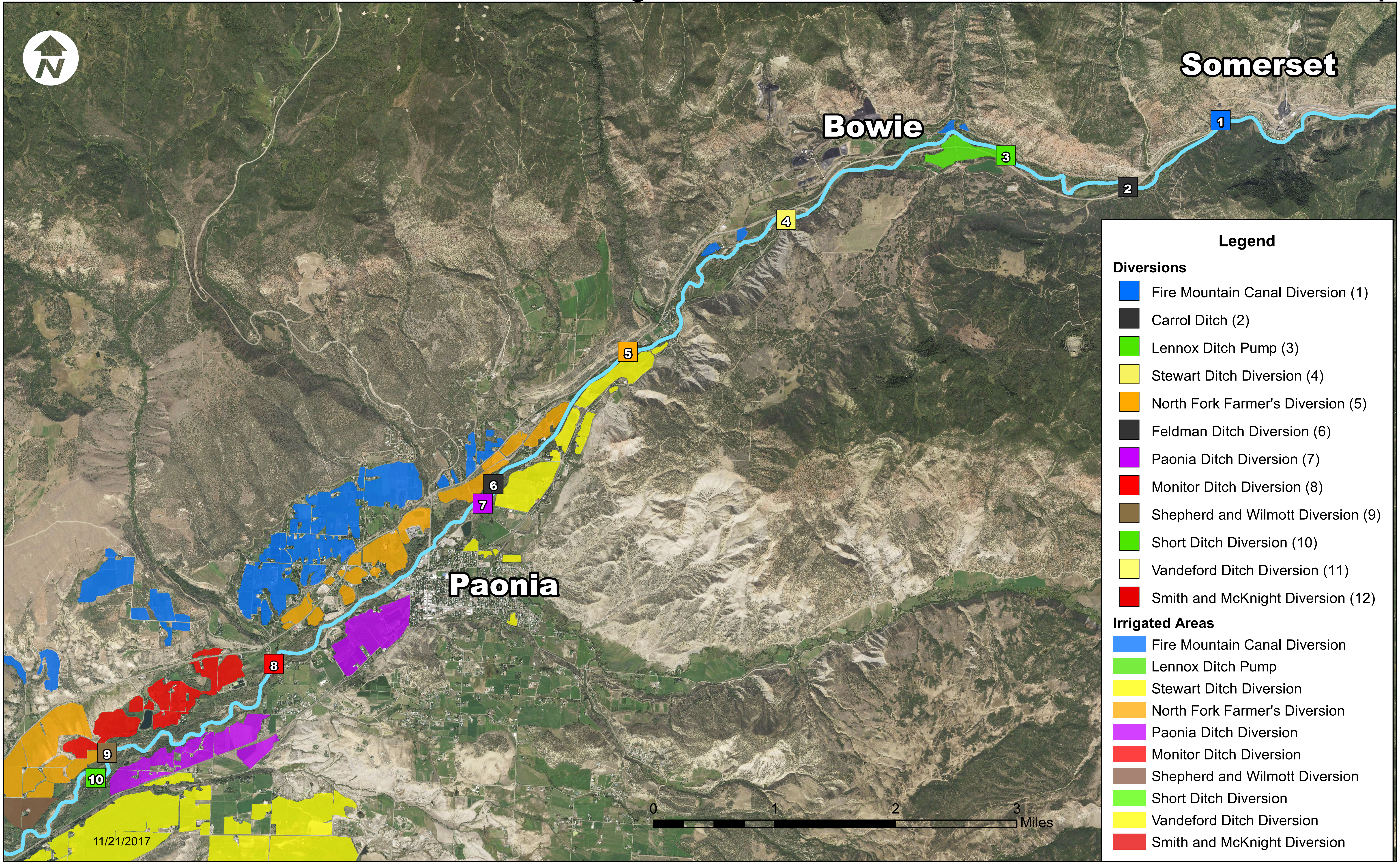
North Fork of the Gunnison: Diversions and Irrigated Lands

Overview Map



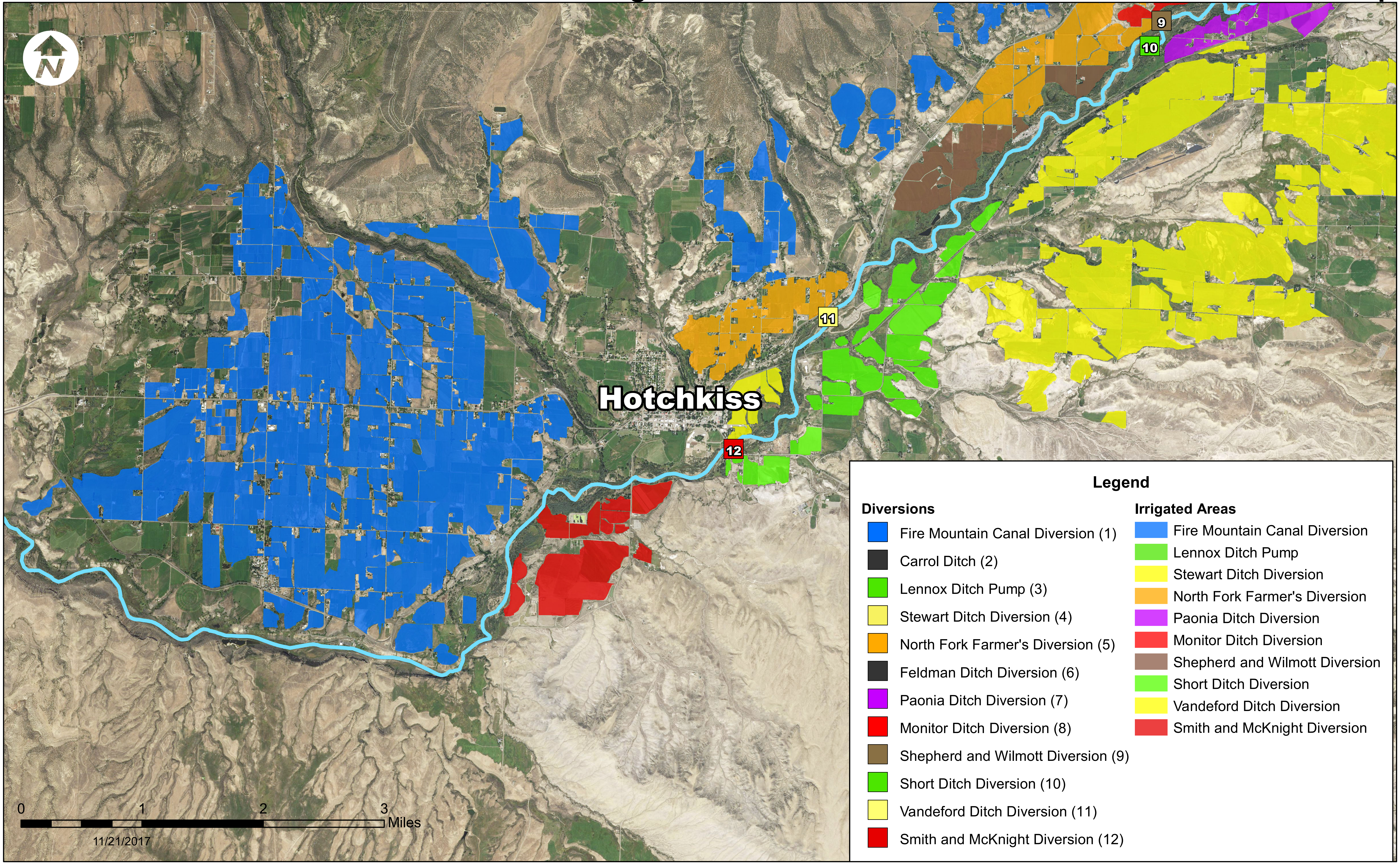
North Fork of the Gunnison: Diversions and Irrigated Lands

Overview Map



North Fork of the Gunnison: Diversions and Irrigated Lands

Overview Map



APPENDIX C – RESPONSES TO AGRICULTURAL INTERVIEWS

Fire Mountain Canal

Interviewee: Steve Fletcher

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Multiple decrees, exchange agreements, very complicated. Div 4 (Steve Tuck) knows best how it is administered and when and why. Clearwater report should contain water rights data.**
a. How often do you get called out?	**Often, but there is Paonia res water for the project**
• Who is calling you out?	**"Assumed" call by Paonia ditch, other DS mainstem diversions**
b. Is there any stored water released to your diversion?	**Yes**
• How much?	**15,300 ac-ft**
• When?	**Throughout season, fruit growers would like later water**
2. Is there any record of the acres served by the diversion?	**Yes. Not sure where, shares are tied to acres, but can be sold**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**Yes**
b. Have you been successful in securing funding?	**Yes, salinity funding, other Reclamation grants**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**A few boaters use the river near diversion, fishermen use it too**

5. What about your diversion would you change if funds were available?	**Automate emergency canal gates (see Mcloughlin report), change orientation of intakes, need better sluice channel, big gravel bar gives them trouble in front of diversion.**
6. How are orders for water placed within the system?	**No orders placed, 130% of shares early, 100% shares until res is exhausted**
7. What are typical turn in/turn out dates?	**Turn in – Mid-April** **Turn out – September**
8. Is there any stockwater decreed and/or used on the system?	**Some water enters FM Canal at Leroux Creek and is utilized for stock – unsure of water right of exchange**
9. What type of crops are grown?	**Forage/fruit/some row crops/some vineyards**
a. Are there any trends towards other crops?	**Did not ask**
10. Have USDA-NRCS programs had an impact on the overall system?	**Yes**
11. Who are your current Board members?	**FM Canal board and NFWCD board (I did not get this information at the time of interview)**

a. Do you have any staff? Please describe.	**4 people**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Yes, Steve's email**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Yes**
13. Are there any infrastructure improvements within the conveyance system that are needed?	
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	

Additional notes:

This conversation took place on Aug. 4, 2016; Steve Fletcher is current manager. Steve has a lot of experience, but was still quite new to his position as manager of the FM Canal. Therefore, he did not have as much information as he would like, but he will quickly be coming up to speed. Steve is a very knowledgeable manager, and has been through the process of infrastructure improvements with other water users and canals. Steve definitely expressed that he sees the opportunity to extend the usefulness of the storage in Paonia Reservoir.

Interview done with Steve Fletcher and Bill

Carrol Ditch

Interviewee: Roy Graham

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Take as much as possible until call comes on**
a. How often do you get called out?	**Has never been called out**
• Who is calling you out?	**N/A**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**No, used to be entire river bottom previously. Lots of it is currently overgrown.**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☐ N☒**
a. Can I get a copy of what exists?	**N/A**
b. Have you been successful in securing funding?	**N/A**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A**
5. What about your diversion would you change if funds were available?	**Nothing currently. Would see what (if anything) was offered and evaluate any suggestions.**

6. How are orders for water placed within the system?	**None. Only one irrigator**
7. What are typical turn in/turn out dates?	**Turn in – April 1st** **Turn out – End of October**
8. Is there any stockwater decreed and/or used on the system?	**Yes**
9. What type of crops are grown?	**Hay**
a. Are there any trends towards other crops?	**No**
10. Have USDA-NRCS programs had an impact on the overall system?	**No**
11. Who are your current Board members?	**Roy Graham (owner)**
a. Do you have any staff? Please describe.	**No**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Roygraham91@yahoo.com**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**No, he prefers flood irrigation**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**No, everything is in good shape now**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**No**

Additional notes:

Lennox Ditch

Interviewee: Lisa Escher

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Multiple Decrees totaling 348 gpm, and high water decrees.**
a. How often do you get called out?	**Usually annually. It was August in 2016**
• Who is calling you out?	**Fire Mountain Canal**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**Unsure, but there are approximately 60 acres**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**N/A, all work is completed**
b. Have you been successful in securing funding?	**Work was privately funded with NRCS Engineering Help**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A**
5. What about your diversion would you change if funds were available?	**Nothing**

6. How are orders for water placed within the system?	**N/A, only one user on "ditch"**
7. What are typical turn in/turn out dates?	**Turn in – late May or June** **Turn out - October**
8. Is there any stockwater decreed and/or used on the system?	**No**
9. What type of crops are grown?	**All Alfalfa**
a. Are there any trends towards other crops?	**No**
10. Have USDA-NRCS programs had an impact on the overall system?	**Yes, they designed the sprinkler system**
11. Who are your current Board members?	**None**
a. Do you have any staff? Please describe.	**None**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	Lisaescher@hotmail.com **Office #: 970.929.5934**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**No, entire system is already pressurized, in pipe, and in sprinklers**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**No, it is all piped.**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**No, pivots and sprinklers work great.**

Additional notes:

The Lennox Ditch serves one water user. Water is taken from the stream via an NRCS designed pump system.

Stewart Ditch

Interviewee: Karl Burns

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**59 cfs, 19 cfs out of Minnesota (separate from our plan)**
a. How often do you get called out?	**It happens almost yearly – none in 2016**
• Who is calling you out?	**Probably the Short Ditch**
b. Is there any stored water released to your diversion?	**Lost Lakes slough water**
• How much?	**Not much**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**Yes, they have some record – around 2500 acres**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**Salinity FOA 2017 and 2012/2013**
b. Have you been successful in securing funding?	**Yes – first; yes, for 2017 (except salinity)**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A**
5. What about your diversion would you change if funds were available?	**Diversion changes necessary. During high water a sluice for first section; headgate repair.**

Interview Questions and Responses

6. How are orders for water placed within the system?	**Traditionally proportional split with new flexibility or current changes adjusting to pipeline**
7. What are typical turn in/turn out dates?	**Turn in – April 15th** **Turn out – October 15th**
8. Is there any stockwater decreed and/or used on the system?	**Yes – year-round**
9. What type of crops are grown?	**Some small grains, corn, hay, orchard, pasture**
a. Are there any trends towards other crops?	**Hops, hemp**
10. Have USDA-NRCS programs had an impact on the overall system?	**Yes**
11. Who are your current Board members?	**Karl Burns, Rick Dean, Susan Miller, Dave Miller, Bill Peachrich**
a. Do you have any staff? Please describe.	**Yes – DR hired**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**stewartditchandreservoir@gmail.com**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**They could have an impact**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Yes - piping**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Some individuals are interested in on-farm efficiency improvements**

Additional notes:

North Fork Farmer’s Ditch

Interviewee: Jess Campbell

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NORTH FORK OF THE GUNNISON AGRICULTURAL DIVERSION

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**32 cfs at flood, 26 cfs on decree**
a. How often do you get called out?	**No call. Sometimes work with Paonia and Short Ditch to find solutions**
• Who is calling you out?	**N/A**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**Jess believes that the NRCS did a study, however, he does not believe this is in a decree.**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**Lee Bradley (secretary/treasurer – 970.270.7716) has the info. Harward did FOA application, Applegate did survey)**
b. Have you been successful in securing funding?	**No, salinity numbers were too low**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☒ N☐**
a. If yes, can you elaborate?	**A few complaints, nothing major**
5. What about your diversion would you change if funds were available?	**Probably not much. The diversion works great. Might consider improvements to help with recreational issues.**

6. How are orders for water placed within the system?	**No orders. Proportional split used to measure. It is satisfactory though some control would help**
7. What are typical turn in/turn out dates?	**Turn in – April 5th Turn out – October 15th**
8. Is there any stockwater decreed and/or used on the system?	**No decree, there is stockwater in summer**
9. What type of crops are grown?	**Pasture, corn, small grains (extension has some vineyards and fruit)**
a. Are there any trends towards other crops?	**Consistent, but vineyards becoming a little more common**
10. Have USDA-NRCS programs had an impact on the overall system?	**No,**
11. Who are your current Board members?	**Mark Shaffer Jess Campbell Lee Bradley Ron Wist**
a. Do you have any staff? Please describe.	**No official staff**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**No, phone calls to individuals is typical form of contact**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Efficiency improvements could be help**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Spillway above Bowie loadout could help.**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Yes, a few people have expressed desire**

Additional notes:

North Fork Farmer's has an extension company which manages irrigators on upper end. There are 215.7 shares total, and buying/selling shares is allowed. Some eroding hillsides along canal length.

Paonia Ditch

Interviewees: Olen Lund, Wayne Frasier, Patrick McPherson

J·U·B ENGINEERS, INC.

NORTH FORK OF THE GUNNISON AGRICULTURAL DIVERSION

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Roughly 35 cfs split over 4 decrees (also carry water for Wade and Hightower Ditch)**
a. How often do you get called out?	**Flood decree gets called out annually, usually in mid-June. Lowest they ever get called to is about 12 cfs**
• Who is calling you out?	**Short Ditch**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**770 Acres**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**NFRIA planned diversion structure, which lasted 3 months. Nothing for conveyance infrastructure**
b. Have you been successful in securing funding?	**Yes**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**Originally, but with latest diversion there is no issue**
5. What about your diversion would you change if funds were available?	**Something to take out sediment (most of the sediment is coming from Minnesota Creek rather than North Fork).**

6. How are orders for water placed within the system?	**N/A, proportional split**
7. What are typical turn in/turn out dates?	**Turn in – April 15th Turn out – October 15th**
8. Is there any stockwater decreed and/or used on the system?	**No**
9. What type of crops are grown?	**Fruit, alfalfa, small grains, pasture**
a. Are there any trends towards other crops?	**Renewed interest in fruit, hops, farm-to-table**
10. Have USDA-NRCS programs had an impact on the overall system?	**No (however, proportional split to Wade and Hightower was designed by NRCS)**
11. Who are your current Board members?	**Patrick McPherson – President Olen Lund – Treasurer/Ditch Rider Wayne Frasier - Secretary**
a. Do you have any staff? Please describe.	**Olen Lund – Ditch Rider (part time)**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Mailing list (paper)**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Yes – potential longer season, but they are pinched in by river to ever expand acreage**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Sediment Control for users using pressurized irrigation, diversion boxes could increase efficiency.**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Some users are utilizing NRCS funding for on-farm efficiency improvements. But responsibility of ditch company ends at shareholder's point of diversion**

Additional notes:

Currently, there is substantial sections of open ditch through the town of Paonia. For both safety and efficiency concerns, piping could be beneficial.

Monitor Ditch

Interviewee: Calvin Campbell

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**10.25 cfs**
a. How often do you get called out?	**Once per year, sometimes twice. Often in mid-July, but it is not a major issue.**
• Who is calling you out?	**Would need to talk to water commissioner, probably Short Ditch.**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**Yes, CDSS. Overview Map provided by JUB looks consistent with reality.**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**NFRIA planned diversion structure (this is extent of what is available, and all the engineering that has happened)**
b. Have you been successful in securing funding?	**Yes, through NFRIA**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A**
5. What about your diversion would you change if funds were available?	**Could grout the entirety of the rock weir in river. Would like to add height to headgate. Would like a self-cleaning trash-rack.**

6. How are orders for water placed within the system?	**No orders are placed. Shares are restricted and tied to land.**
7. What are typical turn in/turn out dates?	**Turn in – April 10th (avg)** **Turn out – late October**
8. Is there any stockwater decreed and/or used on the system?	**Yes, and it is used all winter**
9. What type of crops are grown?	**Mainly hay pasture**
a. Are there any trends towards other crops?	**No, everything is consistent**
10. Have USDA-NRCS programs had an impact on the overall system?	**No**
11. Who are your current Board members?	**Evelyn Roseberry**
a. Do you have any staff? Please describe.	**Not officially, Jess and Calvin Campbell act as ditch riders.**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Through the secretary (Evelyn Roseberry)**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**No**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Nothing serious, though ditch could be higher to more effectively irrigate some acreage that borders the ditch.**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**No**

Additional notes:

Shepherd and Wilmott Ditch

Interviewee: Jess Campbell

J-U-B ENGINEERS, INC.

NORTH FORK OF THE GUNNISON AGRICULTURAL DIVERSION

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Jess Campbell has paperwork, unsure at time of interview**
a. How often do you get called out?	**Never**
• Who is calling you out?	**N/A**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**Property Deeds contain records (shares are tied to land in deed)**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☐ N☒**
a. Can I get a copy of what exists?	**N/A**
b. Have you been successful in securing funding?	**N/A**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A (NFRI helped with new diversion)**
5. What about your diversion would you change if funds were available?	**Nothing**

Interview Questions and Responses

6. How are orders for water placed within the system?	**No orders. Proportional split boards currently in use to manage water**
7. What are typical turn in/turn out dates?	**Turn in – April 5th** **Turn out – October 15th**
8. Is there any stockwater decreed and/or used on the system?	**Yes (and it is utilized)**
9. What type of crops are grown?	**Pasture, alfalfa, corn, small grains**
a. Are there any trends towards other crops?	**No, crop types are consistent year to year**
10. Have USDA-NRCS programs had an impact on the overall system?	**No, but they have helped with a few divide boxes**
11. Who are your current Board members?	**Calvin Campbell** **Helen Quain** **Dave Mitchell** **Pat Stroud**
a. Do you have any staff? Please describe.	**No official, Jess Campbell functions as ditch rider**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**No, phone calls to individuals is typical form of contact**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**No**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**No, Jess does not believe there is adequate elevation to pressurize the system**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Not really**

Additional notes:

Jess has a list of shareholders that he can provide. Shares cannot be exchanged between parcels, water is entirely tied to land.

Short Ditch

Interviewee: Bill Carpenter

J·U·B ENGINEERS, INC.

NORTH FORK OF THE GUNNISON AGRICULTURAL DIVERSION

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**24 cfs and flood decree**
a. How often do you get called out?	**Not too often, Short down to 13 on highest priority**
• Who is calling you out?	**Just to river**
b. Is there any stored water released to your diversion?	**No**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**CDSS numbers appear to reflect actual acreage fairly well**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☒ N☐**
a. Can I get a copy of what exists?	**FOA by JUB**
b. Have you been successful in securing funding?	**No; exception of NFRIA on diversion. Diversion works well now, but might be left in river if there is another big year**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☐ N☒**
a. If yes, can you elaborate?	**N/A**
5. What about your diversion would you change if funds were available?	**Move it back to bank to avoid disaster at high water, or from the river moving away**

Interview Questions and Responses

6. How are orders for water placed within the system?	**None, proportional splits**
7. What are typical turn in/turn out dates?	**Turn in – April 15th** **Turn out – middle of November or freeze**
8. Is there any stockwater decreed and/or used on the system?	**No stockwater is decreed, but tail water is used during winter in some places**
9. What type of crops are grown?	**Hay, + TK's row crops, pasture**
a. Are there any trends towards other crops?	**No**
10. Have USDA-NRCS programs had an impact on the overall system?	**TK pivots, Pitt put in sprinklers**
11. Who are your current Board members?	**Jim Carpenter, Ed Odle, Gary Boden, Bill Carpenter, Tom Curry**
a. Do you have any staff? Please describe.	**Yes – Bill Carpenter on upper end is DR and Superintendent, Carl Carpenter on lower end**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**No**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Possibly, but only if pumps were implemented**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Yes – leaks through bank are marked on map near Jay Bob Davis residence**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Yes**

Additional notes:

Vandeford Ditch

Interviewee: Bill Carston

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**14 cfs, up to 16 cfs in come cases**
a. How often do you get called out?	**Only Zack's BBQ (within the ditch), no call from Steve (CDWR)**
• Who is calling you out?	**N/A**
b. Is there any stored water released to your diversion?	**N/A**
• How much?	**N/A**
• When?	**N/A**
2. Is there any record of the acres served by the diversion?	**128 acres (Bill), 6 (or more) acres, 22 acres of riverbottom lands**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☐ N☒**
a. Can I get a copy of what exists?	**N/A**
b. Have you been successful in securing funding?	**N/A**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☒ N☐**
a. If yes, can you elaborate?	**People want to fish on diversion**
5. What about your diversion would you change if funds were available?	**The whole thing. Sediment in ditch is a big problem, new headgate in river is shoddy. River elevation dropped when gravel was harvested from river, Vandeford owners put big rock in river, which helps.**

Interview Questions and Responses

6. How are orders for water placed within the system?	**Self**
7. What are typical turn in/turn out dates?	**Turn in – April 15th** **Turn out – October 15th**
8. Is there any stockwater decreed and/or used on the system?	**Yes – both decreed and used**
9. What type of crops are grown?	**Triticale, alfalfa, oats, grass, corn**
a. Are there any trends towards other crops?	**No – users rotate above crops**
10. Have USDA-NRCS programs had an impact on the overall system?	**Yes, a long time ago – users went from flood irrigation to gated pipe**
11. Who are your current Board members?	**Bill, other Board members currently being selected**
a. Do you have any staff? Please describe.	**No. Ditch rider is Bill**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Cell phone**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Yes, pivot would help, sprinklers due to high water table, river bottom could be developed a further 45 acres**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Piped to the first headgate would be beneficial – 1.5 miles, or all the way to the canals**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Pivots, sprinklers, benefits to using pipe on fields**

Additional notes:

Smith and McKnight Ditch

Interviewee: Tom Kay

J-U-B ENGINEERS, INC.

NORTH FORK OF THE GUNNISON AGRICULTURAL DIVERSION

Interview Questions and Responses

1. What is the diversion right(s) (cfs) associated with your diversion?	**Senior, 10.303 cfs**
a. How often do you get called out?	**Never**
• Who is calling you out?	**N/A (do not get called out)**
b. Is there any stored water released to your diversion?	**No**
• How much?	**Unsure**
• When?	**Unsure**
2. Is there any record of the acres served by the diversion?	**Not that Tom Kay is aware of**
3. Has any engineering and/or planning taken place for the areas served by this diversion?	**Y☐ N☒**
a. Can I get a copy of what exists?	**Very Preliminary Engineering Done by Tracy Allen at J-U-B**
b. Have you been successful in securing funding?	**No**
4. Have you had any conflicts with recreational river users at your diversion?	**Y☒ N☐**
a. If yes, can you elaborate?	**They try to mess with the headgate (attempt to close it).**
5. What about your diversion would you change if funds were available?	**Would like to change the headgate**

6. How are orders for water placed within the system?	**N/A**
7. What are typical turn in/turn out dates?	**Turn in – April 1** **Turn out – November 1**
8. Is there any stockwater decreed and/or used on the system?	**Yes**
9. What type of crops are grown?	**Corn, alfalfa, dry beans**
a. Are there any trends towards other crops?	**Possibly, but unsure**
10. Have USDA-NRCS programs had an impact on the overall system?	**Not that Tom Kay is aware of**
11. Who are your current Board members?	**Bobby Orlando, President** **Mike Owens, Vice President** **Tom Kay, Secretary and Treasurer**
a. Do you have any staff? Please describe.	**No**
b. Is there a centralized way to contact your group (email, accountant, attorney)?	**Yes, members have email accounts.**
12. Would system (efficiency) improvements within your delivery and on-farm system increase the ability for beneficial irrigation use (expansion of acreage, longer season) under your ditch?	**Yes**

13. Are there any infrastructure improvements within the conveyance system that are needed?	**Yes**
14. Are there on-farm efficiency improvements amongst the water users on the ditch that are necessary or desired?	**Yes**

Additional notes:

Tom Kay at the Smith and McKnight Ditch is interested in pursuing USBR Salinity funding to help fund a piped system. Plans on getting some more engineering work done.

APPENDIX D – STRAIGHT LINE DIAGRAM OF NORTH FORK (CLEAR WATER SOLUTIONS, 2014)

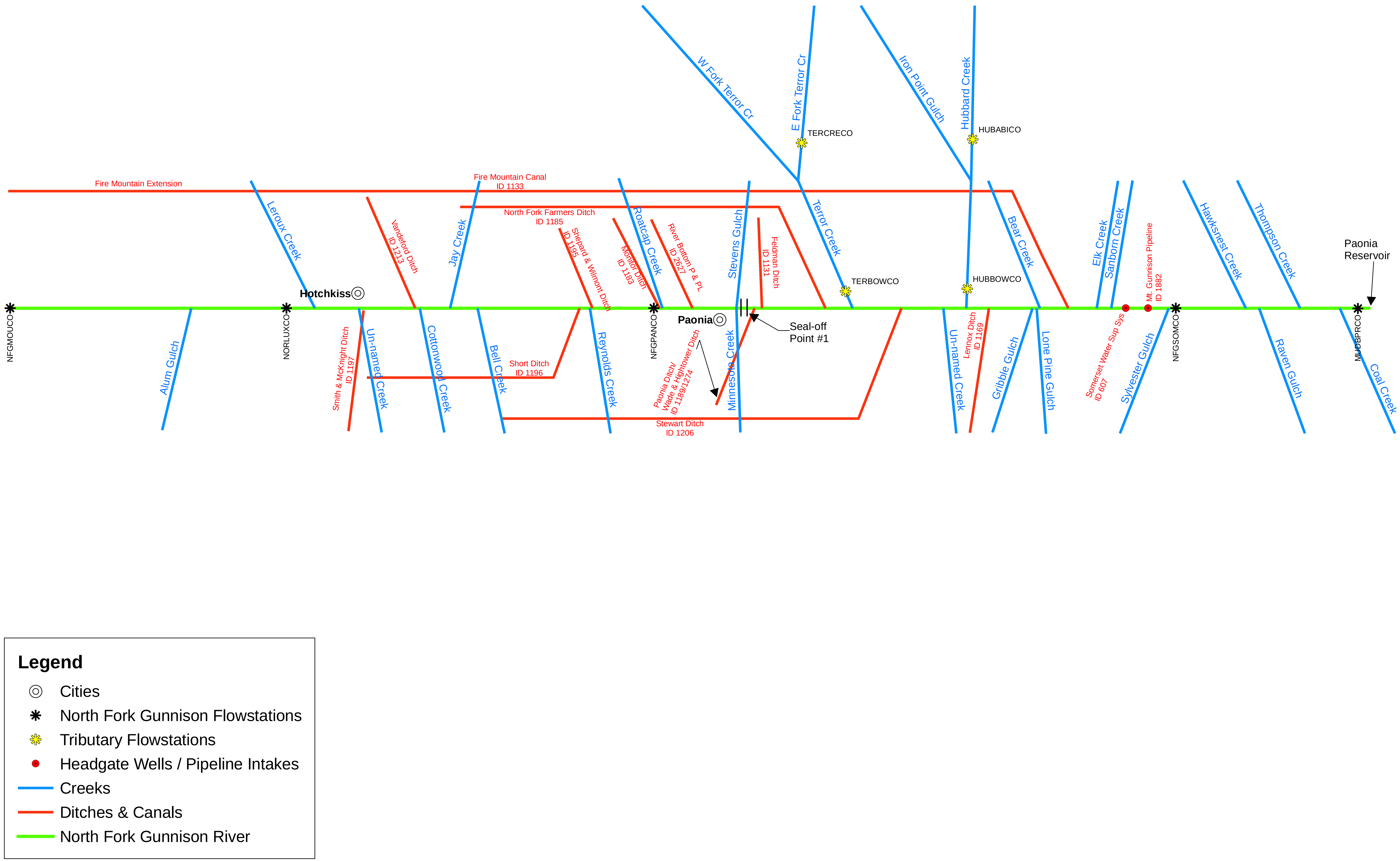

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Figure 1

North Fork of the Gunnison River
Straight-Line Diagram

North Fork Study

Date: 5-15-2013

Drawn By: RVP

Scale: 1 in = 2 miles

Job No: 13-120