

AUG 27 2021



Department of Water Resources
Northern Region

Rocky Mountain
ENVIRONMENTAL™
ASSOCIATES, INC.

Supporting Data and Analysis of Transfer No. 84788

**Water Right Nos. 22-131C, 22-238B, and 22-
2029E, Teton, Teton County, Idaho**

RMEA Project Number: 20-0055

August 27, 2021

Prepared on behalf of
Grouse Creek Reserve LLC
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1. Introduction

Grouse Creek Reserve LLC is the owner of water rights 22-131C, 22-238B, and 22-2029E from North Leigh Creek. The place of use (Subject Property) is located within the SESE of Section 22 and the SWSW and SESW of Section 23, T6N, R45E. These rights can be diverted through either the North Leigh Canal or the Hubbard Ditch.

On March 11, 2021, Grouse Creek Reserve LLC (Applicant) filed Transfer Application #84788 to add a point of injection and redirection on Grouse Creek, allowing a portion of the water right to be injected into and conveyed through the natural channel of Grouse Creek and redirected downstream to the place of use. Five protests were filed by the following parties: Gary L Hansen, Rodney Barnes, Dennis D Craig, Ronald D Hansen, and Kyle Hansen.

Prior to the prehearing conference held on June 21, 2021, Rocky Mountain Environmental Associates, Inc. (RMEA) provided a letter to all parties with the intention of addressing the seven potential issues as given in Idaho Code §42-222. As not all issues are applicable, this report focuses on providing further detail in regards to conservation of water resources, injury to existing water rights, management practices, and local public interest.

Data and information was collected from the following sources:

1. IDWR's geospatial and water right database,
2. NAIP imagery,
3. NRCS Web Soil Survey,
4. Fremont Madison Irrigation District,
5. Water District 01, and
6. Field work performed by RMEA.

Bryce Contor, Hydrologist, of RMEA, performed field reconnaissance of the Hubbard Ditch on July 22, 2021 to collect additional data, which is summarized in Attachment #1, and is referenced herein. This summary describes the state of the ditches as observed, estimated flows where possible, measurements, and verification of measuring devices installed.

This report will summarize the data collected and reviewed that supports and justifies the proposed Transfer 84788 to convey the applicant's water rights through Grouse Creek and redirect to the subject property. In so doing, a portion of at least 0.37 cfs should be left in the original conveyance system to ensure no perceived injury to remaining users of the system. It is also the opinion of RMEA that not all reduction in water availability should be attributed to the applicant's transfer of water rights as proposed. The poor state of the Hubbard Ditch and lack of water master contribute to the ineffectiveness of water delivery. Maintenance of the Hubbard Ditch would improve the water delivery to all users, allowing each user to receive a greater portion of their water rights, even upon approval of Transfer 84788.

2. Conservation of Water Resources

The current delivery system begins on North Leigh Creek, either at the North Leigh Canal or the Hubbard ditch diversion. The North Leigh Canal joins the Hubbard Ditch near the center of the NWNE of Section 25, T6N, R45E. Figure 1 illustrates the existing and proposed conveyance systems from North Leigh Creek to the subject property.

The existing system is in a poor state of maintenance, with multiple obstructions (see Attachment #1, Lines 151-154) affecting flow and preventing adequate water from reaching the subject property during periods of low flow. Even if the Hubbard is only evaluated downstream of the confluence of the North Leigh Canal and the Hubbard, there appears to be sufficient debris to significantly reduce flows. At each of these obstructions, the water in the Hubbard Ditch must maneuver under and through the debris in order to reach the other side and continue downstream. Based on the descriptions in Attachment #1, it appears that there is about 1 mile of the Hubbard Ditch downstream of the confluence that is described as alternating flowing sections and debris clogged areas.

The proposed conveyance system is in a better state of repair, as evidenced by the description and photos provided in Attachment #1. The applicant has invested resources and worked with Intermountain Aquatics to improve the quality of this system, both along the Grouse Creek Ditch and Grouse Creek, thereby improving the rate of flow in the channels.

The images below demonstrate the differences between the state of the Hubbard Ditch and the Grouse Creek Ditch. Although these are taken at a single location, they are representative of the general state of each ditch.



Photo 2752. Looking upstream at Grouse Creek Ditch. Photo 2803. Debris in channel of Hubbard Ditch.

The existing and proposed conveyance systems are similar in length, being 3.7 miles and 4.1 miles, respectively. The proposed system is 8% longer by comparison. However, the state of repair of the proposed system outweighs the increase in distance

rendering it a more efficient way to transport the water to the subject property. In addition, creek channels will develop a natural lining of silt and clay over time as the sediment fills pores and open spaces of the creek bed. Grouse Creek will naturally lose less water than a man-made conveyance such as the Hubbard Ditch.

If the ditch is to remain in its poor state of repair, removing the applicant's flow will make the obstructions in the Hubbard Ditch less of a problem for the remaining flow.

Delivering the water rights through the proposed Grouse Creek system will also aid in delivery of the existing water rights that use the same system. Table 1 below shows the North Leigh Creek water rights that are injected into Grouse Creek through the Grouse Creek Ditch. There's a total of 2.91 cfs that are already authorized to be delivered through this same system, which appears to have the available capacity to carry the additional flow proposed to be moved under this transfer, as explained on Lines 63-65 of Attachment #1.

Table 1. Existing water rights injected into Grouse Creek through the Grouse Creek Ditch.

<u>Water Right</u>	<u>Priority Date</u>	<u>Owner</u>	<u>WaterUse</u>	<u>Diversion Rate (cfs)</u>
22-238A	6/1/1890	JEFFERY O BEARD	IRRIGATION	1.55
22-459A	6/1/1898	MARY F KLINGLER	IRRIGATION	1.14
22-459B	6/1/1898	TRACY WRIGHT	IRRIGATION	0.22
Total Diversion				2.91

More water will be conserved by redirecting the water rights through the Grouse Creek Ditch and through Grouse Creek, allowing more water to be delivered to the subject property for its intended use. This advantage will be most noticeable during low flows when water is difficult to deliver through the entire length of the Hubbard Ditch to the subject property.

3. Injury Analysis

3.1 Existing Water Rights

In order to determine potential injury, all water rights authorized to be delivered through the North Leigh Canal and/or the Hubbard Ditch were identified using the IDWR geospatial database. A list of each group of water users are included in Attachment #2. It is important to note that there are water rights that are not authorized to be diverted through both diversions.

Of the five protestants, only two were identified as being current water right holders, according to the IDWR database. Ronald Hansen owns several water rights from North Leigh Creek, also in the name of Franklin B Hansen, which is shown on Attachment #2 lists. Ron Hansen is one of the senior water right owners in the Hubbard Ditch and North Leigh Canal with a priority date of 6/1/1889.

The other senior water right holder is Gary Hansen, another protestant. Gary Hansen owns water right 22-339B, which can be delivered through the Hubbard Ditch or North Leigh Canal. In addition, water right 22-13887, with a priority of 9/1/1898, is partially owned by Gary Hansen and it is authorized to be delivered through the Hubbard Ditch only.

Rodney Barnes indicated that he has an interest in water right 22-2019, which is currently listed as being owned by Stephen Hansen and Linda Hansen. Mr. Barnes' name is not listed as an owner of the water right; however, his name does appear as a current owner of a portion of the original place of use, as discovered through Teton County public records. Water right 22-2019 is only deliverable through the Hubbard Ditch and is not authorized to be diverted through North Leigh Canal.

Mr. Dennis Craig and Mr. Kyle Hansen do not appear to have any water rights in their own names nor do any water rights appear to overlap any of Mr. Craig's property. Mr. K. Hansen does not appear to be a property owner along the Hubbard Ditch.

Figure 2 illustrates the locations of the other water users of the Hubbard Ditch and the North Leigh Canal, as well as the locations of the property represented by the protestants listed above.

In the prehearing conference on June 21, 2021, it was indicated that the primary concern of the protestants is the period of time when junior, or high water, rights are curtailed and only the senior users are remaining in the ditch. This report narrows that time period to when the priority call only authorizes rights equal to or more senior than June 1, 1890, which is the priority date of the most senior water right owned by the applicant. A list of these senior water rights are included in Tables 2 and 3, which include the protestants Ronald Hansen and Gary Hansen. Protestant's water rights are highlighted in blue. The applicant's water right is highlighted in yellow.

Several of the water rights in Tables 2 and 3 include up to 6 possible diversion locations. This report does not consider the use of any other diversions beyond North Leigh Canal and the Hubbard Ditch. Also, right 22-400B is only deliverable to the Hubbard and not North Leigh Canal.

Table 2. Senior water users in the Hubbard Ditch with priorities equal to or more senior than June 1, 1890.

Water Right	Priority Date	Owner	Diversion Rate (cfs)	Authorized Ditches
22-339A	6/1/1889	FRANKLIN B HANSEN	2.25	Hubbard, North Leigh Canal
22-339B	6/1/1889	GARY HANSEN	0.75	Hubbard, North Leigh Canal
22-400A	6/10/1889	BRUCE J WATKINS	0.96	North Leigh Canal, Center Canal, Hansen 1, Hansen 2, Hubbard and Hansen Struebel Ditch
22-400B	6/10/1889	FRANKLIN B HANSEN	1.6	Hubbard Ditch, Hansen 1, Hansen 2, Hansen 3, Hansen Struebal, and/or McPherson
22-14159	6/10/1889	CJH LIVING TRUST	0.64	North Leigh Canal, Center Canal, Hansen 1, Hansen 2, Hubbard and Hansen Struebel Ditch
22-238A	6/1/1890	JEFFERY O BEARD	1.55	Hubbard, North Leigh Canal
22-238B	6/1/1890	DENNY THOMAS	1.55	Hubbard, North Leigh Canal
		Total Diversion Rate	9.3	

Table 3. Senior water users in the North Leigh Canal with priorities equal to or more senior than June 1, 1890.

Water Right	Priority Date	Owner	Diversion Rate (cfs)	Ditches for Diversion
22-339A	6/1/1889	FRANKLIN B HANSEN	2.25	Hubbard, North Leigh Canal
22-339B	6/1/1889	GARY HANSEN	0.75	Hubbard, North Leigh Canal
22-400A	6/10/1889	BRUCE J WATKINS	0.96	North Leigh Canal, Center Canal, Hansen 1, Hansen 2, Hubbard and Hansen Struebel Ditch
22-14159	6/10/1889	CJH LIVING TRUST	0.64	North Leigh Canal, Center Canal, Hansen 1, Hansen 2, Hubbard and Hansen Struebel Ditch
22-238A	6/1/1890	JEFFERY O BEARD	1.55	Hubbard, North Leigh Canal
22-238B	6/1/1890	DENNY THOMAS	1.55	Hubbard, North Leigh Canal
		Total Diversion Rate	7.7	

3.2 Conveyance Losses

Conveyance losses have been estimated using the Worstall method¹. This method is further described in the Hubble² report, which describes conveyance loss calculation methods that were adopted by IDWR for use in the Snake River Basin Adjudication. The procedures include using information such as soil type to determine seepage rates, ditch length, and top width of water surface.

3.2.1 Variables

A large portion of the Hubbard Ditch was walked with a GPS, allowing a more accurate mapping of the distances of the existing conveyance (see Attachment #1, Lines 12-18).

¹ Worstall, Robert V., "Estimating Seepage Losses from Canal Systems," *Journal of the Irrigation and Drainage Division*, ASCE, Vol. 102, No. IR1, Proc. Paper 11960, March, 1976, pp. 137-147.

² Hubble Engineering, Inc. and Associated Earth Sciences, Inc., "Guidelines for the Evaluation of Irrigation Diversion Rates," pp. 33-41.

Width of the peak water surface (where visible) and existing water surface was measured at various locations, providing data for full flows and low flows. This is especially important for calculating conveyance losses during low flows since the width of the water surface is less than when the ditch is at full capacity. Widths vary from 2.5 feet to an average of 6 feet for a reach. The Hubbard Ditch is approximately 20 feet wide at the heading. Figure 3 illustrates the reaches of the conveyance system and their distances.

The NRCS Web Soil Survey, see Attachment #3, identifies the soil along the Hubbard Ditch as Units 13425 and 13430. At a depth of 2 feet these units are described as “Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam,” or “Extremely gravelly sandy loam, extremely cobbly loamy sand.” According to Hubble, soils of this description could have seepage rates in the range of 2.2 – 6.0 ft/day (Hubble, pg. 35). Both seepage rates have been considered and used in the calculations to demonstrate a lower bracket and upper bracket estimate.

3.2.2 Results

Attachment #1, Line 77 indicates that in late July 2021, there was no flow in North Leigh Creek at the Hubbard ditch. Assuming there may be periods of time in the later season when North Leigh Creek is flowing at the Hubbard diversion, conveyance losses have been calculated for the Hubbard Ditch as well.

Table 4 below provides a summary of the conveyance loss calculations for the Hubbard Ditch and North Leigh Canal, assuming only priorities of June 1, 1890 and senior are deliverable. Estimates of the proportionate share of the applicant’s losses may range from 0.37 - 1.0 cfs in North Leigh Canal and 0.22 – 0.61 cfs in the Hubbard Ditch. More extensive calculations are provided in Attachment #4.

Table 4. Summary of calculated conveyance losses using a range of seepage loss values.

Path	Total Authorized at Headgate			Lower Bracket Conveyance Losses			Upper Bracket Conveyance Losses		
	All Water Rights (cfs)	Applicants Rights Only (cfs)	Applicant's Proportion	Rate of Seepage Loss (ft/day)	Total Conveyance Losses (cfs)	Proportionate Conveyance Losses for Applicant (cfs)	Rate of Seepage Loss (ft/day)	Total Conveyance Losses (cfs)	Proportionate Conveyance Losses for Applicant (cfs)
1 North Leigh Canal	7.7	1.55	20%	2.2	1.83	0.37	6.0	4.99	1.00
2 Hubbard Ditch	9.3	1.55	17%	2.2	1.34	0.22	6.0	3.66	0.61

Just as a natural channel such as Grouse Creek can develop a natural lining, a canal or ditch may also benefit from natural sediments and biological matter. According to Hubble, “in almost every instance, seepage is reduced by a skin of sediment and biological slime that develops over time. However, this skin is destroyed by drying and by freezing and thawing cycles. Other biological factors, such as plant roots and worms, are known to increase seepage, but their effects vary greatly and are difficult to measure or estimate” (Hubble, pg. 33). Typically, when a canal or ditch is filled with water at the beginning of the season, the seepage losses are high, as the soil profile is absorbing moisture and has not yet developed the annual biological matter that may

help seal the channel. When the system is fully charged with water and the biological matter has developed, the seepage losses will be reduced. Drying cycles can affect this seal.

Since the primary period of concern is later in the season after the system has been charged, it is likely that the conveyance losses will be on the lower end of the range calculated. Leaving at least 0.37 cfs of 22-238B in North Leigh Canal and/or the Hubbard Ditch would provide the same carriage water that the other users have enjoyed during low flows.

4. Management and Distribution

From information obtained at the prehearing conference, the Hubbard Ditch is operated on a process of direct distribution, meaning that each water user takes their water from the ditch when it is in priority. It does not appear that there is an official water master or manager of the shared ditch, which typically would enable water to be delivered properly to each water user according to the priorities that are being served. Without a manager or water master, the best alternative is measuring devices for self-regulation. The field reconnaissance revealed that there are multiple structures in place to allow delivery of the water to the various users on the ditch. However, it does not appear that any of the structures allow accurate measurement of the flow of water on the Hubbard Ditch.

A third alternative is system design such as is suggested in Lines 208-211 of Attachment #1. Without proper management and regulation, the users at the end of the ditch typically receive less water than is due. Such is the case for the applicant's water rights under Transfer No. 84788.

The applicant owns 20% of the water rights deliverable through North Leigh Canal when the priority call is limited to June 1, 1890 and senior. On July 22, 2021, the creek was likely administered under futile call, since it did not connect with the Teton River. There was no water observed reaching the subject property (see Lines 259 and 260, Attachment #1). As a senior water right holder, the subject property should have been receiving a proportionate share of the 1890 flow since the ditch is managed as a direct delivery system. High contributing factors to the non-delivery of water rights appear to be a poorly managed and maintained system. Any perceived injury beyond what is calculated in this report, cannot be attributed solely to the applicant's proposed transfer. A change in practices and state of the system would highly improve water deliverability to all users.

As in all ditch systems, seepage losses are expected and each water user will sustain losses. Using the same parameters as described in the previous section, conveyance losses were estimated for the other North Leigh Canal water rights to give a representative deliverable value for each senior water right, as shown in Table 5. Each user is estimated to lose about 24% of their flow. This estimate disregards distance to

individual headgates and represents losses along the entire length of the ditch, at the seepage rate of 2.2 ft/day.

Table 5. Summary conveyance losses for all North Leigh Canal senior users..

WR	Senior User	Div. Rate (cfs)	Proportionate Share of Conveyance Losses (cfs)	Remaining Diversion Rate Deliverable (cfs)
22-339A	Ron Hansen	2.25	0.53	1.72
22-339B	Gary Hansen	0.75	0.18	0.57
22-400A	Bruce Watkins	0.96	0.23	0.73
22-14159	CJH Living Trust	0.64	0.15	0.49
22-238A	Jeffrey O Beard	1.55	0.37	1.18
22-238B	Grouse Creek Reserve	1.55	0.37	1.18
		7.7	1.83	5.87

It was uncertain at the time of this report which diversions pertained to the protestants water rights; therefore, they are not discussed in this report in regards to the estimated flows at their headgates at the time of field reconnaissance. However, if this information is disclosed by the protestants, further conclusions may be possible.

5. Local Public Interest

Two benefits may result for the local public interest. First, other users of the proposed conveyance system will benefit through the additional carriage water in their system.

In addition, there will be some incidental benefits to the flows of Grouse Creek downstream of the point where the water is injected, resulting in improved fish and wildlife habitat.

There are no anticipated detriments to the local public interest.

6. Summary

It is the opinion of RMEA that a transfer of the applicant's water rights as proposed in Transfer 84788 would not result in injury to the remaining users of the Hubbard Ditch, provided a portion of at least 0.37 cfs of the senior water right 22-238B during curtailment of all junior rights. Indeed, the application proposes to leave behind 0.62 cfs of this senior right to be delivered through the Hubbard Ditch/North Leigh Canal to the subject property, which appears to be adequate. It is also the opinion of RMEA that not all perceived or calculated injury to existing water users should be attributed to the applicant's transfer of water rights as proposed. The poor state of the Hubbard Ditch and lack of water master contribute to the ineffectiveness of water delivery. Maintenance of the Hubbard Ditch would improve the water delivery to all users,

allowing each user to receive a greater portion of their water rights, even upon approval of Transfer 84788.



Kristin Moore
Senior Water Rights Analyst



Bryce A. Contor
Senior Hydrologist

FIGURES

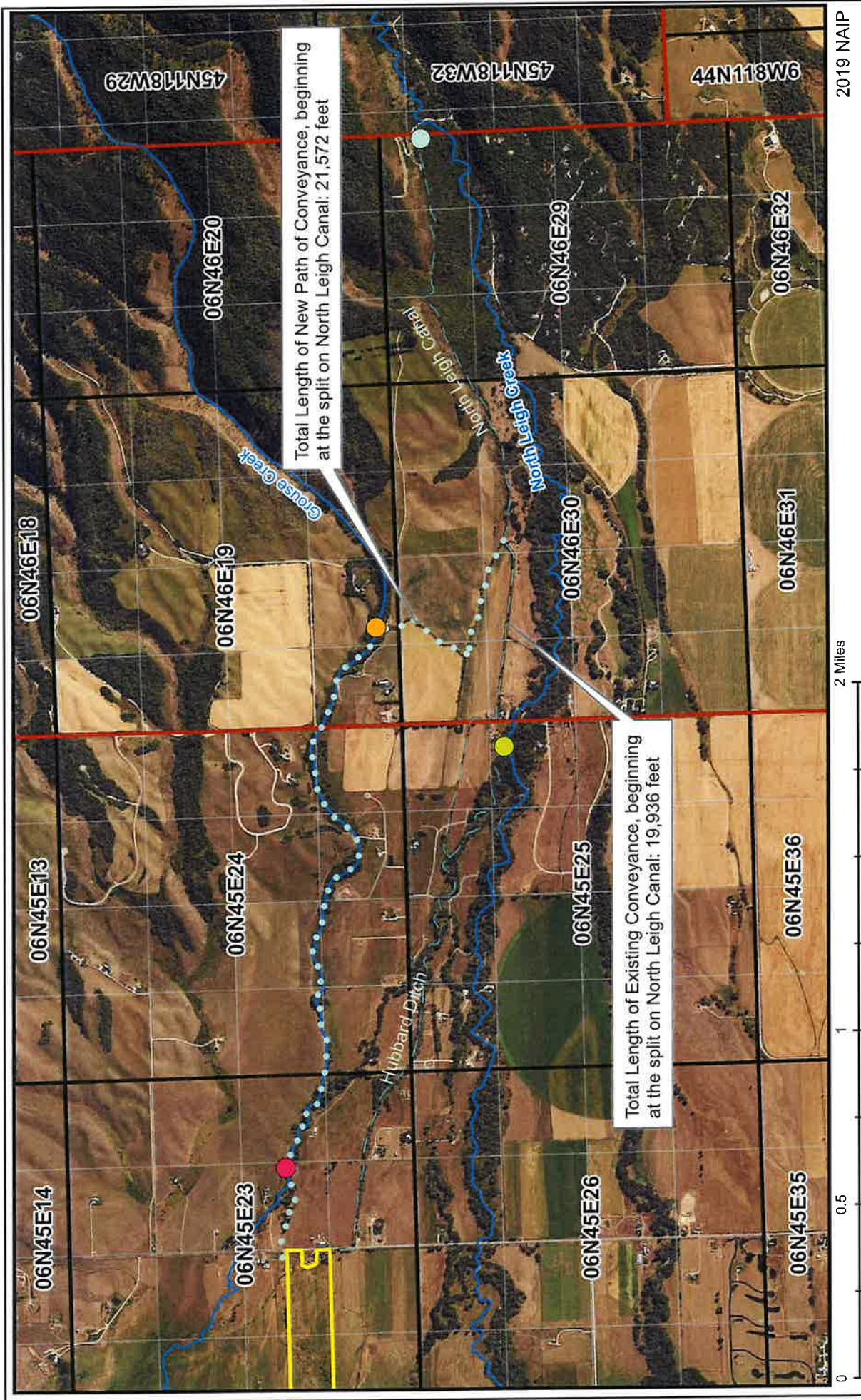


Figure 1. Existing and Proposed Conveyance System

Grouse Creek Reserve LLC

Legend

- Point of Injection
- Grouse Creek Rediversion
- Existing Diversion - North Leigh Canal
- Existing Diversion - Hubbard Ditch
- Proposed Addition to Path of Conv.
- Existing Path of Conveyance
- Place of Use
- Township and Range
- Section
- QQ

Figure 1. Existing and Proposed Conveyance System

Grouse Creek Reserve LLC

RMEA # 20-0055

by: KM

Date: 8/27/2021

Rocky Mountain ENVIRONMENTAL
ASSOCIATES, INC.

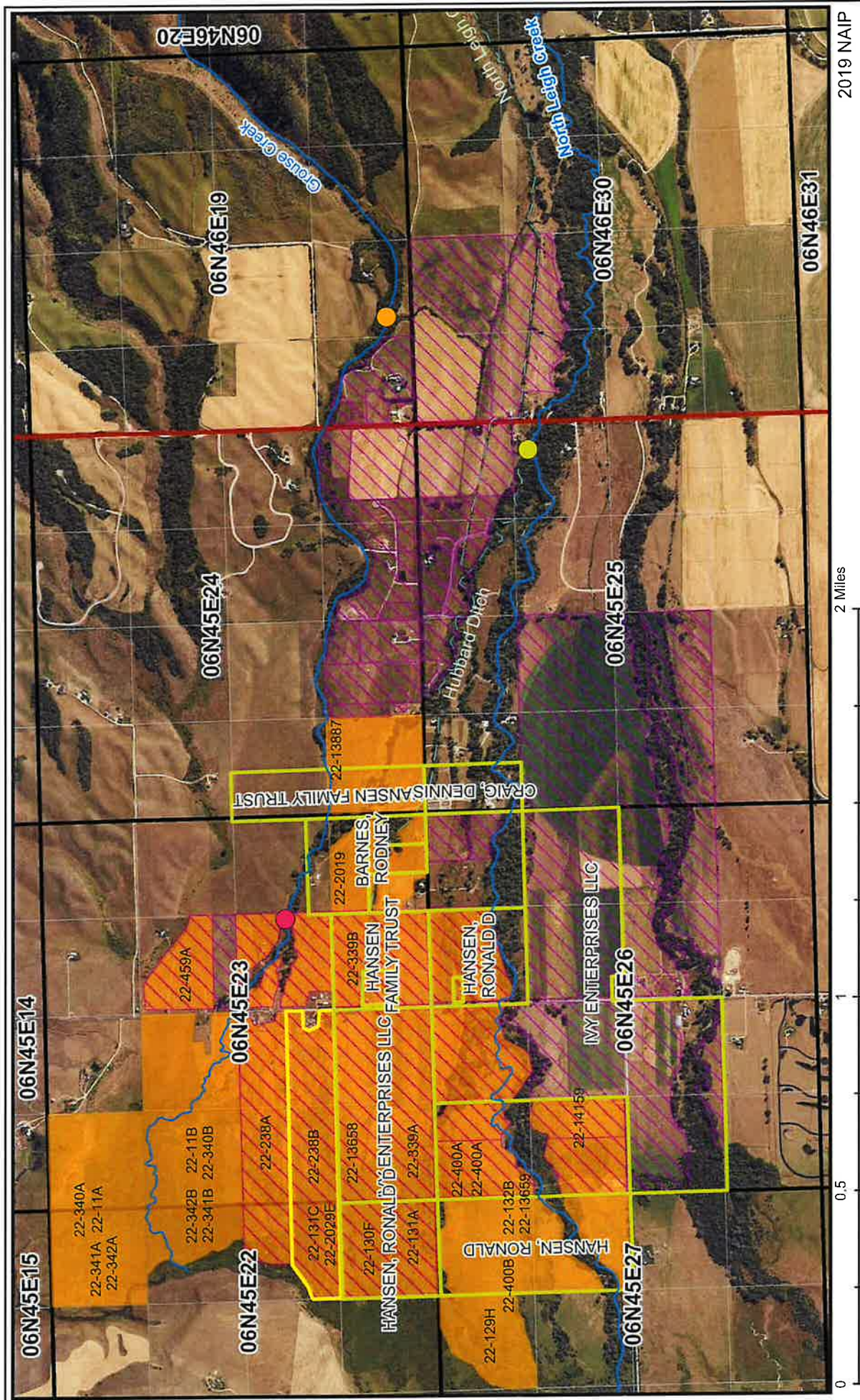


Figure 2. Protestor's Property and Water Right Locations

Grouse Creek Reserve LLC

RMEA # 20-0055

by: KM

Date: 8/27/2021

Legend

- Point of Injection
- Grouse Creek Rediversion
- Existing Diversion - Hubbard Ditch
- Existing Path of Conveyance
- Protestor Parcels
- Place of Use
- North Leigh Canal Users
- Hubbard Ditch Users
- Township and Range
- Section
- QQ

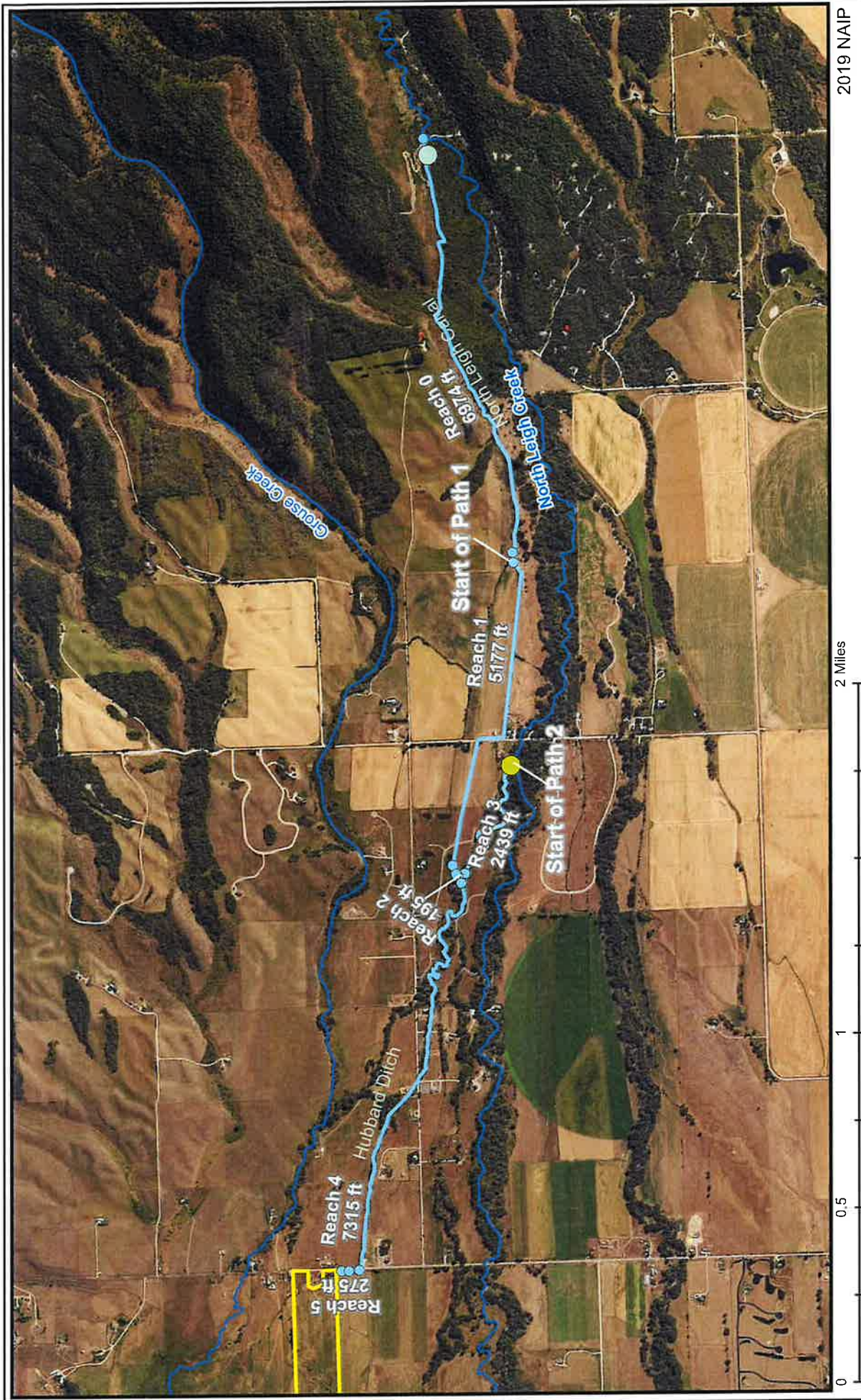


Figure 3. Reaches of the Existing Ditches

Grouse Creek Reserve LLC

RMEA # 20-0055

by: KM

Date: 8/27/2021



Legend

- Existing Diversion - North Leigh Canal
- Existing Diversion - Hubbard Ditch
- Existing Conveyance Reaches
- Place of Use

ATTACHMENTS

MEMO

To: 20-0055 Grouse Creek Files
Fr: B. Contor
Date: 24 August 2021
Re: Ditch reconnaissance 22 July 2021

On July 22, 2021, I walked parts of the ditch system that are involved in a proposed water-rights transfer for RMEA project 20-0055.

Figure 1 (all figures are attached at the end of the memo) shows an overview of the path walked, GPS waypoints, and reference letters.

The "Ditches" shapefile was obtained from the National Hydrography Data Set, and in some places it does not closely track the current location of channels. When the GPS track data depart from the shapefile, it generally is due to the channel being in a different location. At some places, I walked around brush or fences and in those cases the GPS track does depart from the channel location. "Ditches - Edited" is my mapping of the ditches I walked, based on my GPS tracks, recollections, and referral to detailed aerial images.

Upstream (East) End

The east end of Figure 1 shows the split of the Grouse Creek Ditch from the North Leigh Canal at Location A. Photo 2763 is looking upstream on the Grouse Creek Ditch toward the structure at Point A. Photo 2765 shows the structure, with water entering from the top of the photo. North Leigh Canal water exits to the right of the photo and the Grouse Creek Ditch water exits toward the camera.



27
28 Photo 2763. Looking upstream on the Grouse Creek Ditch toward the structure at Point
29 A on the Figures.
30



31
32 Photo 2765. Structure at Point A.
33

34 Photo 2762 shows the Grouse Creek Ditch looking upstream from Waypoint 2762.
35 Photo DJI 0022 is a drone view of the same location, with the top of the photo aligned
36 approximately east. Photo DJI 0019 shows the ditch between Waypoint 2759 and
37 Waypoint 2760, also with the top of the photo aligned approximately east.
38



39
40 Photo 2752. Looking upstream at Grouse Creek Ditch.
41



Photo DJI 0022. Drone view of the area near Waypoint 2762.

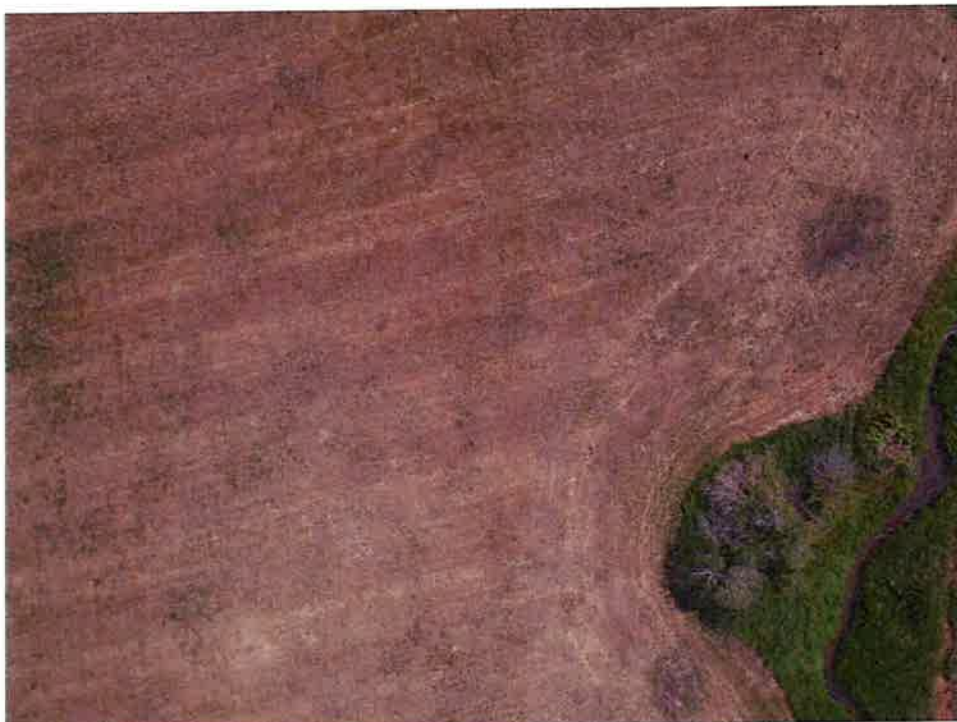


Photo DJU 0019. Drone view of the area between Waypoint 2759 and Waypoint 2760.

48 The structure at location B is shown in photo 2752. The Grouse Creek Ditch proceeding
49 north exits at the right of the photo and the lateral proceeding west goes toward the
50 top of the photo. Photo DJI 0015 is a drone view of the ditch at Waypoint 2746.
51



52
53 Photo 2752. Structure at Location B.
54



55
56 Photo DJI 0015. The culvert crossing in the photo is at Waypoint 2746. The top of the
57 photo is oriented approximately to the southeast.

58
59 Near Waypoint 2746, I made a reconnaissance-level flow measurement and found 3.1
60 cfs +/- approximately 0.6 cfs in the ditch. Water marks indicate that typical flows are
61 considerably greater.

62
63 From my observation, the Grouse Creek Ditch is well maintained, clear of obstructions
64 and debris, and has considerable capacity beyond the typical water levels indicated by
65 marks I observed on the banks.

66
67 I saw no measurement devices at Location A or Location B. Photo 2738 shows a staff
68 gauge at the inlet of a culvert at the location mapped as "Staff Gauge" in Figure 2,
69 which would be a good measuring device for the Grouse Creek Ditch if calibrated.



Photo 2738. Staff gauge at waypoint "Staff Gauge" (Figure 3)

Hubbard Ditch Diversion

Label "C" in Figure 1 shows where I observed the Hubbard Ditch diversion from North Leigh Creek. There was no flow at this location. Photo 2779 is looking downstream at North Leigh Creek, with the diversion structure on the right. Photo 2785 shows the structure with a staff gauge attached to the wing wall visible on the left of the photo. IDWR site tag A0013865 is attached to the concrete structure, and a red/pink printed notice was on top of the concrete under a weight, reading in part "This headgate has been regulated by the Watermaster of this District." Hubbard Ditch immediately downstream of the diversion is shown Photo 2786.



Photo 2779. North Leigh Creek at Hubbard Diversion.



Photo 2785. Looking upstream at the diversion structure from the head of Hubbard Ditch.



92
93 Photo 2786. Looking downstream in the Hubbard Ditch immediately downstream of the
94 diversion.

95
96 Below the diversion, the Hubbard Ditch channel is steep, very wide (visual estimate 20 -
97 25 feet) relative to its depth (approximately one foot), and the channel appears to be
98 unstable. In my opinion the staff gauge seen in photo 2785 would be difficult to rate
99 and the rating would not be stable. Even if stable and properly rated, precision would
100 be low; a large change in flow would be reflected by a small change in stage and
101 turbulence would make stage difficult to read. I measured the structure at this location
102 but did not measure the Hubbard Ditch channel.

103
104 Photo DJI 0052 shows a drone image of the Hubbard Ditch (without water) a little east
105 of Point C. The top of the photo is oriented approximately to the east.



Photo DJI 0052. The white line through the trees is bed of the Hubbard Ditch, dry in this photo.

Ditch Confluence

Figure 3 shows the detail near point "D," where the North Leigh Canal joins the Hubbard Ditch. North Leigh Canal the northern-most and Hubbard Ditch is the southern-most of the two ditches coming into the figure from the east. Photo DSCN2801 is looking upstream (east) at the Hubbard Ditch channel just above the confluence. The silver part of the staff in the photo is a 4-foot aluminum ruler.



- 118
119 Photo 2801. Hubbard Ditch upstream of the confluence. There is no water; the dark
120 areas on the right are shadows.
121
122 Photos DSCN2794 through DSCN2797 show the channel between the confluence and
123 Waypoint 2802. These are presented in upstream to downstream order, which is
124 opposite the photo-numbering order.
125



126
127 Photo 2797. Looking upstream at the Hubbard Ditch between Point D and Waypoint
128 2802.
129



130
131 Photo 2796. Looking upstream at the Hubbard Ditch between Point D and Waypoint
132 2802.

133



134

135

136

137

Photo 2795. Looking upstream at the Hubbard Ditch between Point D and Waypoint 2802.



138

139

Photo 2794. Looking upstream at the Hubbard Ditch just above Waypoint 2802.

I did not measure dimensions of the Hubbard Ditch channel above the confluence but subjectively it is both smaller and less steep than Hubbard Ditch at the diversion, suggesting its capacity is substantially less. This indicates high losses between the diversion and the confluence.

Between the Bridge and the Splitter Structure

Photos DSCN2802 through DSCN2805 illustrate the character of the channel between the bridge at Waypoint 2802 in Figure 3 and the four-way splitter structure that is located near location "E" in Figure 4. The staff shown in some of the photos is approximately four and one-half feet long with a four-foot aluminum ruler attached. The general characterization of this reach of the ditch is free-flowing sections interrupted by fallen logs that have accumulated debris, with heavy brush crowding the banks in many locations.



Photo 2802. Hubbard Ditch channel immediately below the bridge labeled in Figure 3.



158
159
160

Photo 2803. Debris in channel of Hubbard Ditch.



161
162

Photo 2804. Hubbard Ditch downstream of the bridge labeled in Figure 3.



Photo 2805. Staff with water-marks on tree showing typical flows in the Hubbard Ditch.

Photo DSCN2805 shows that on July 22, flow depth was about half the recent depth as indicated by the marks on the bank and the tree trunk. Due to the effect on hydraulic radius and therefore flow velocity, doubling the depth will more than double the flow.

Four-Way Splitter

Near Location E on the maps, a recently-built splitter structure is located at Waypoint "Ditch Split" in Figure 4, with Figure 5 showing a not-to-scale schematic. Drone photo DJI 0063 shows the structure in the upper right corner, with the top of the photo oriented to the Flows to the west continue down the Hubbard Ditch, with the other three outlets serving laterals. The following photos illustrate the structure and the channels leaving it.



176
177
178

Photo DJI 0063. Drone photo of splitter structure.



179
180
181

Photo 2807. Four-way splitter structure looking northwest.



182
183 Photo 2812. Looking downstream from the south outlet of the splitter structure. This
184 outlet supplies a lateral that turns and heads due west.
185



186
187 Photo 2815. Looking downstream on the west (Hubbard Ditch) outlet of the splitter
188 structure.

189



190

191

192

193

Photo 2822. Looking downstream at the ditch proceeding from the northwest outlet of the splitter structure.



194

195 Photo 2819. Looking downstream at the channel that proceeds north from the splitter
196 structure.

197
198 I measured the structure and the water marks in it. The Hubbard-Ditch branch is 7.75
199 feet wide and water marks indicate a depth downstream of the check boards of about
200 11 inches. The south exit is 6.75 feet wide with water marks at 13 inches. The north
201 branch is 6.75 feet wide and its water marks are at about four inches. The small
202 channel to the northwest does not appear to have been used recently. From these
203 data, I calculate that the typical split is approximately eight percent to the north, 44
204 percent down the Hubbard Ditch and 48 percent down the south ditch.

205
206 I did not measure flows as they appeared to be much less than typical.

207
208 I did not see staff gauges or flow-measurement devices. However, if the split of
209 authorized delivery at this point were known, the structure would lend itself to a
210 modification that would automatically divide the flows proportionally over a wide range
211 of flows.

212 213 **West (Downstream) Reconnaissance**

214
215 The following photos in downstream order (not numerical order) show the typical
216 configuration of the Hubbard Ditch west of the structure and south of the east-west
217 road. For approximately 100 to 150 feet the channel is partially blocked with fallen
218 trees and accumulated debris, similar to the reach upstream of the structure. Beyond
219 to the crossing of the east-west road, the channel is cleaner and straighter, though
220 trees and brush are immediately adjacent to the channel in places.



222
223 Photo 2837. Hubbard Ditch about 40 feet downstream of splitter.
224



225
226 Photo 2828. Hubbard Ditch downstream of splitter.
227



Photo 2831. Hubbard Ditch west of splitter.

From the crossing of the paved east-west road, the Hubbard Ditch proceeds to the northwest, and I did not walk this section. I did observe the lateral that proceeds west at Waypoint "Lateral West." The lateral is controlled by a slide gate shown in Photo 2832. There is no structure in the Hubbard Ditch, which proceeds northwest under the log shown in Photo 2833. I did not follow the Hubbard Ditch northwest from this point. See Figure 6.



238
239
240

Photo 2832. Slide gate for a lateral ditch proceeding west at Waypoint West Lateral.



241
242
243

Photo 2833. Looking northwest down the Hubbard Ditch from Waypoint West Lateral.

I measured flow down the west lateral at 0.6 cfs +/- 0.1 cfs, and the flow down the Hubbard Ditch at 0.4 cfs +/- 0.08 cfs. Water marks indicate typical flows are substantially more than this. I did not see any provision for flow measurement at this location.

A wooden structure is located near mapped point "G," shown in Photo 2848. There was a small amount of flow at this point, mostly bypassing or running beneath the structure.



Photo 2848. Wooden structure near Point G on the maps. Hubbard ditch comes in from the left side of the photo and continues to the right. Coming toward the camera is a channel that heads towards Grouse Creek. I saw no provision for flow measurement at this location.

From Point G I walked the Hubbard Ditch to its final bifurcation near Point H. Photos 2845 and 2844 show this channel in downstream order. The small amount of flow seen in Photo 2845 sinks before reaching Point H; I did not see any withdrawal or use from the ditch. The ditch is clean and in reasonably good condition in this reach.



263
264
265

Photo 2845. Hubbard Ditch west of Point G.



266
267
268

Photo 2844. Hubbard Ditch west of Point G.

269 At location H where the ditch crosses the north-south road, the ditch is dry as shown in
270 photo 2834 (looking upstream from the east edge of the road) and photo 2836 (looking
271 northeast toward the west edge of the road).
272



273
274 Photo 2834. Looking upstream (east) along the Hubbard Ditch at Point H from the road
275 shoulder.
276



277
278 Photo 2836. Looking northeast at the final bifurcation of the Hubbard Ditch on the west
279 side of the road at Point H.
280
281 In photo 2836, flow would come toward the camera from the culvert at upper right. At
282 the pile of cobble rocks near the center of the photo, flow would go north (toward the
283 upper left) along the branch that serves the Thomas Ranch, or would continue west
284 (toward the lower left of the photo).



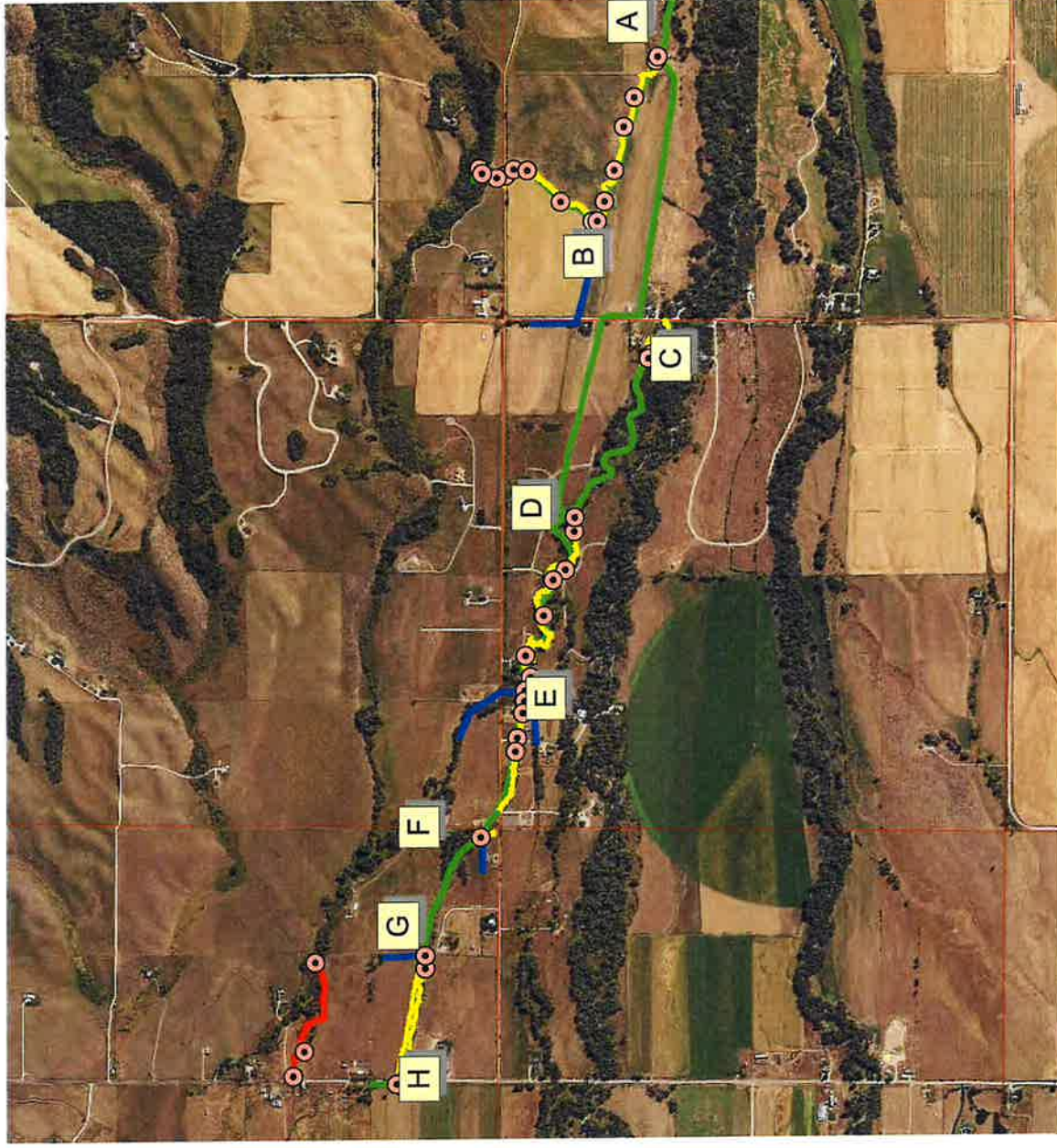
Photo 2835. Staff gauge at the final bifurcation.

The location on the right side of the ditch where cobble rocks are visible in DSCN2836 is the final bifurcation of the Hubbard Ditch, with a staff gauge present as shown in DSCN2835. There is no wooden, metal or concrete structure here; it appears flow is controlled by placing rocks and perhaps at times canvas dams. It is unclear how the staff gauge would be used to measure flow. Photo DSCN2837 is looking down and west at the same bifurcation. The branch that currently would carry the applicant's water goes to the right of this photo and the other branch goes straight away from the viewer.

Waypoint "Mannings" did not plot correctly and I manually moved it to the approximate location where I measured the cross-section of the ditch. Using this cross section and a slope scaled off the topographic map, I calculated a typical flow rate of 1.8 to 3.2 cfs, with a bank-full capacity of approximately six cfs. It does not appear that bank-full flow has occurred recently.

Prepared by Bryce A Contor, Hydrologist

Bryce A. Contor



- GPS Waypoints
- Manual Track
- GPS Track
- Ditches (Partial)
- Ditches
- Section LinesPLSS



Figure 1: Reconnaissance Overview

Background: 2019 NAIP Image from USDA

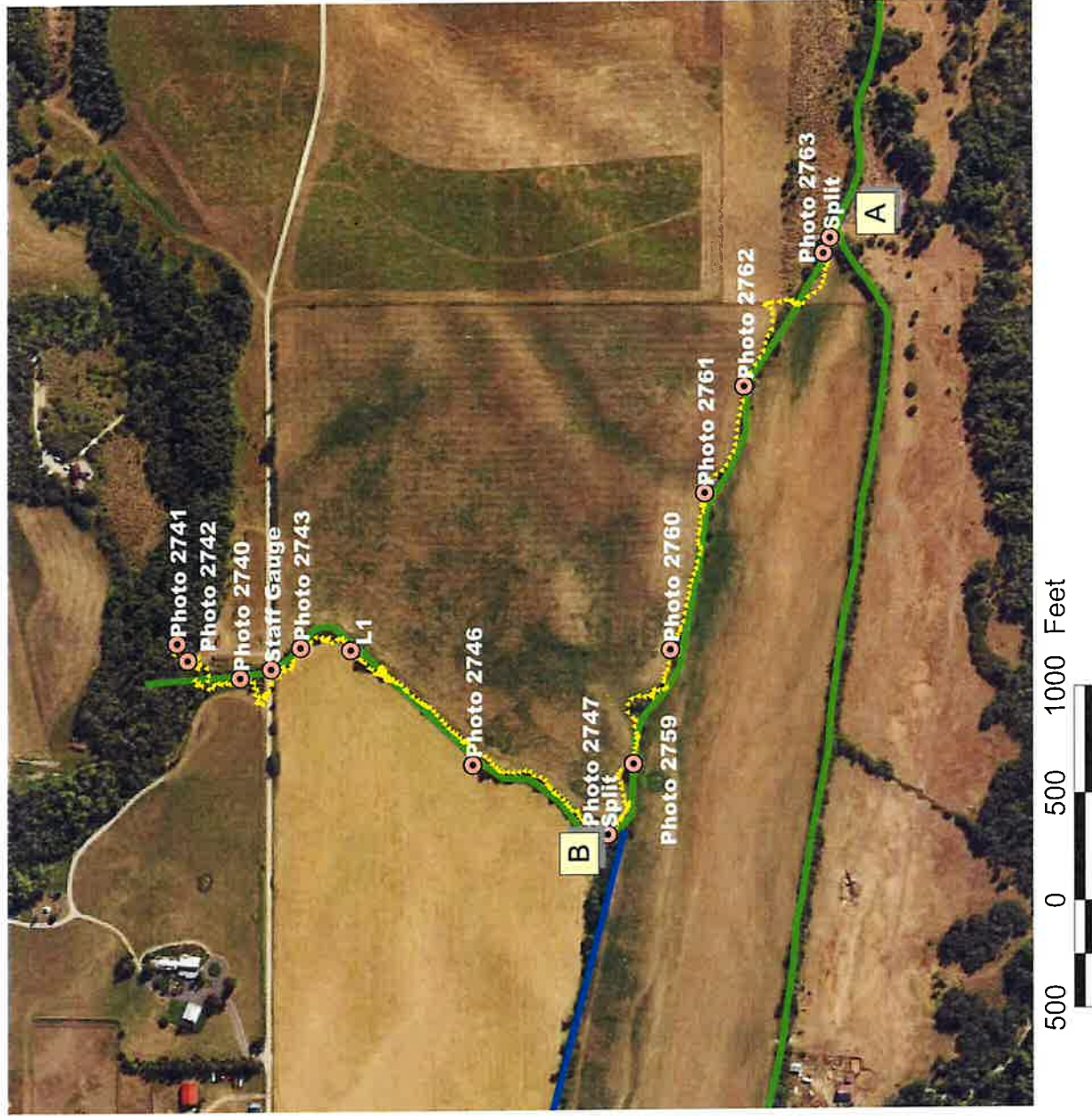


Figure 2: Reconnaissance Upstream

Background: 2019 NAIP Image from USDA



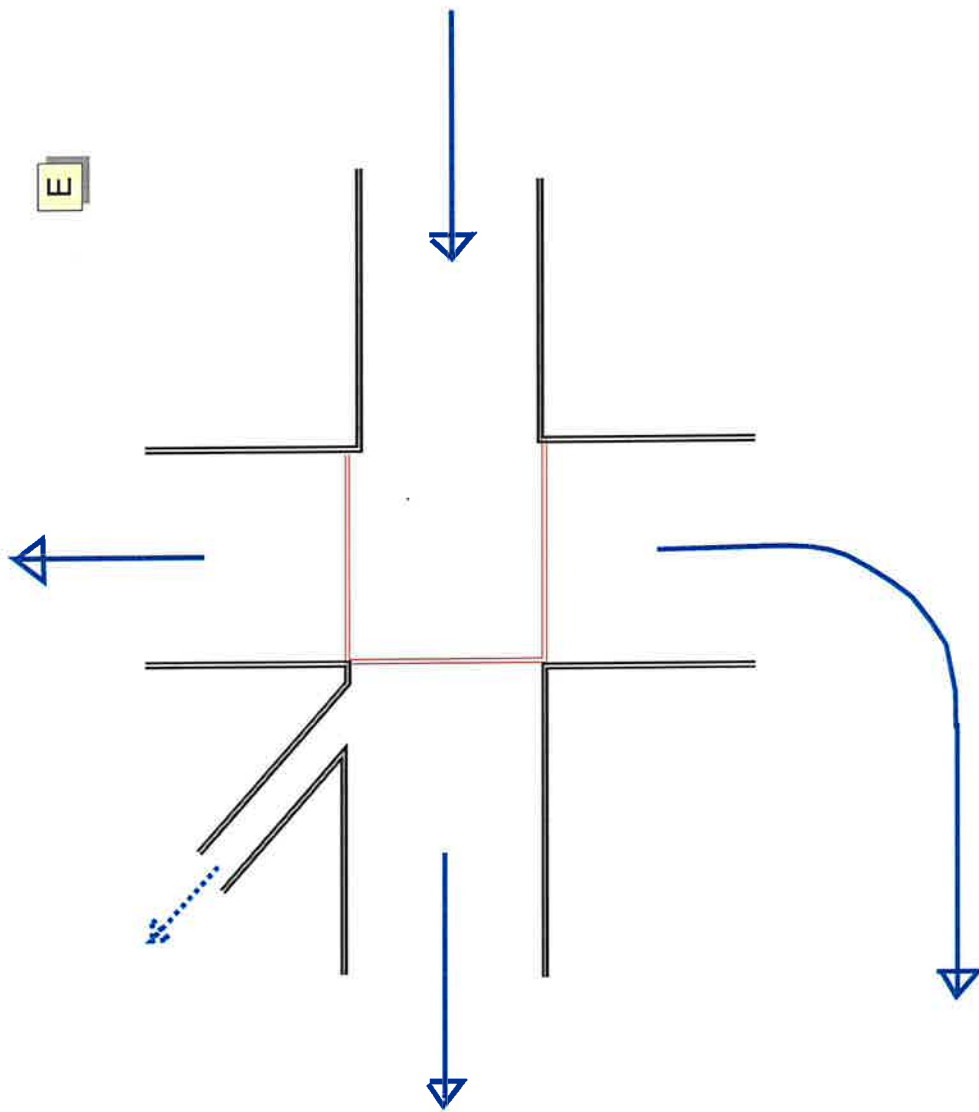
Figure 3: Ditch Confluence

Background: 2019 NAIP Image from USDA



Figure 4: New Structure

Background: 2019 NAIP Image from USDA



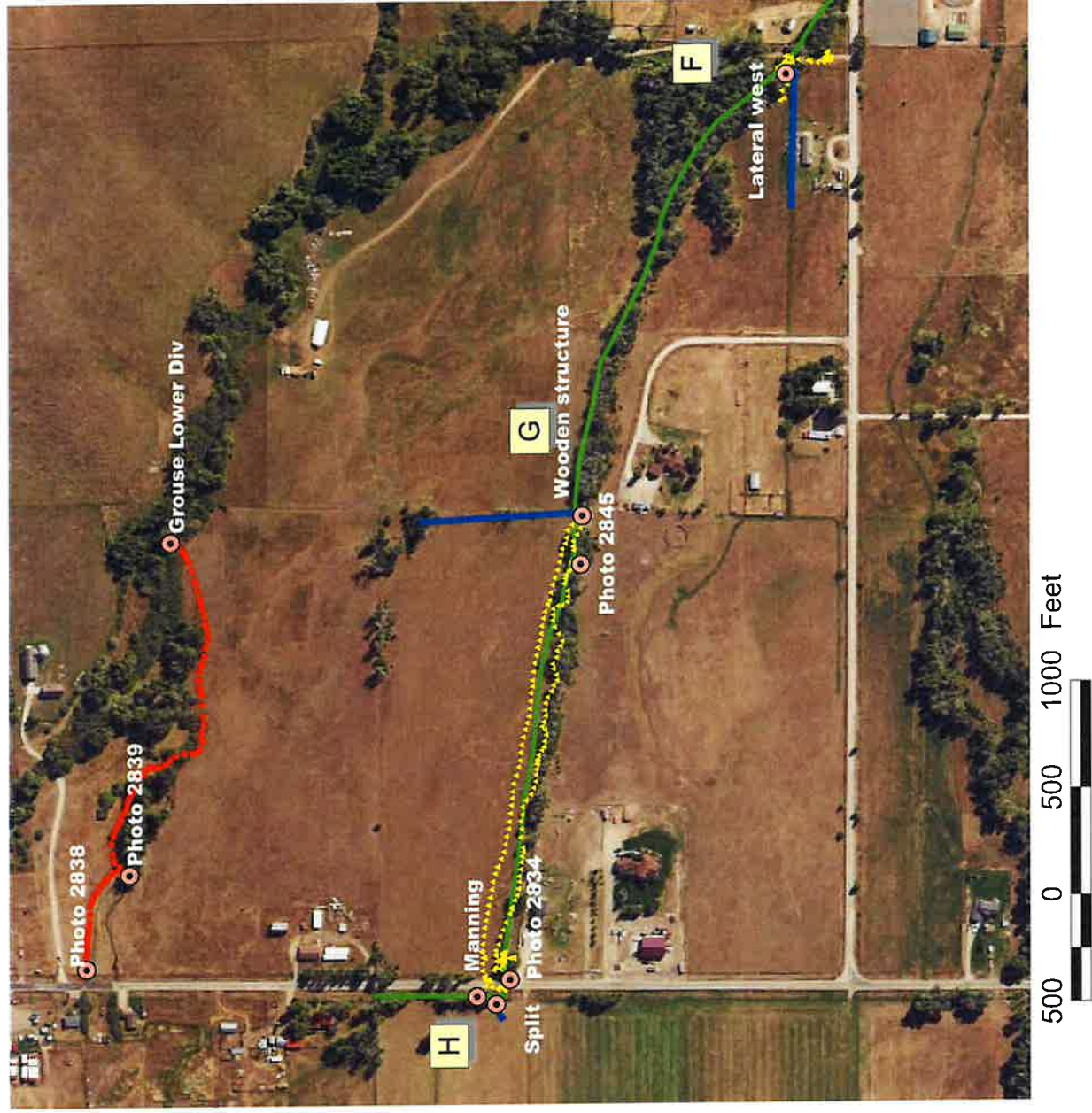
Structure Sketch
(No Flow)
Check Board
Concrete Wall
Flow Dir.



Rocky Mountain
ENVIRONMENTALSM

Figure 5: New Structure Conceptual Detail

Not to Scale



GPS Waypoints
Manual Track
GPS Track
Ditches (Partial)
Ditches



Figure 6: Downstream Detail

Background: 2019 NAIP Image from USDA

HUBBARD DITCH USERS

In order of Priority

Protestor
Subject Property
Also Owned by Applicant

Total Diversion Equal to or Senior to 6/1/1890	9.3
Total Diversion Equal to or Senior to 1/20/1908	19.26
Total Diversion Equal to or Senior to 1/22/1916	29.76

<u>Water Right</u>	<u>Priority Date</u>	<u>Owner</u>	<u>WaterUse</u>	<u>Diversion Rate</u>
22-339A	6/1/1889	FRANKLIN B HANSEN	IRRIGATION	2.25
22-339B	6/1/1889	GARY HANSEN	IRRIGATION	0.75
22-400A	6/10/1889	BRUCE J WATKINS	IRRIGATION	0.96
22-400B	6/10/1889	FRANKLIN B HANSEN	IRRIGATION	1.6
22-14159	6/10/1889	CJH LIVING TRUST	IRRIGATION	0.64
22-238A	6/1/1890	JEFFERY O BEARD	IRRIGATION	1.55
22-238B	6/1/1890	DENNY THOMAS	IRRIGATION	1.55
22-340A	6/1/1891	ROYCE REILEY	IRRIGATION	0.37
22-340B	6/1/1891	JUDY LOPEZ	IRRIGATION	1.13
22-459A	6/1/1898	MARY F KLINGLER	IRRIGATION	1.14
22-13887	9/1/1898	JACK & BONNIE CAUZZA REVOCABLE TRUST	IRRIGATION	0.8
22-341A	6/1/1900	ROYCE REILEY	IRRIGATION	0.15
22-341B	6/1/1900	JUDY LOPEZ	IRRIGATION	0.45
22-342A	6/1/1902	ROYCE REILEY	IRRIGATION	0.15
22-342B	6/1/1902	JUDY LOPEZ	IRRIGATION	0.45
22-2019	9/24/1906	LINDA HANSEN	IRRIGATION	0.8
22-2029E	1/20/1908	DENNY THOMAS	IRRIGATION	0.8
22-13658	1/20/1908	FRANKLIN B HANSEN	IRRIGATION	2.61
22-13659	1/20/1908	FRANKLIN B HANSEN	IRRIGATION	1.11
22-11A	1/22/1916	ROYCE REILEY	IRRIGATION	0.8
22-11B	1/22/1916	JUDY LOPEZ	IRRIGATION	2.4
22-129H	1/22/1916	ESTATE OF PAUL J HANSEN	IRRIGATION	0.6
22-130F	1/22/1916	FRANKLIN B HANSEN	IRRIGATION	1.52
22-131A	1/22/1916	FRANKLIN B HANSEN	IRRIGATION	2.38

<u>Water Right</u>	<u>Priority Date</u>	<u>Owner</u>	<u>WaterUse</u>	<u>Diversion Rate</u>
22-131C	1/22/1916	DENNY THOMAS	IRRIGATION	1.2
22-132B	1/22/1916	FRANKLIN B HANSEN	IRRIGATION	1.6

NORTH LEIGH CANAL USERS

In order of priority

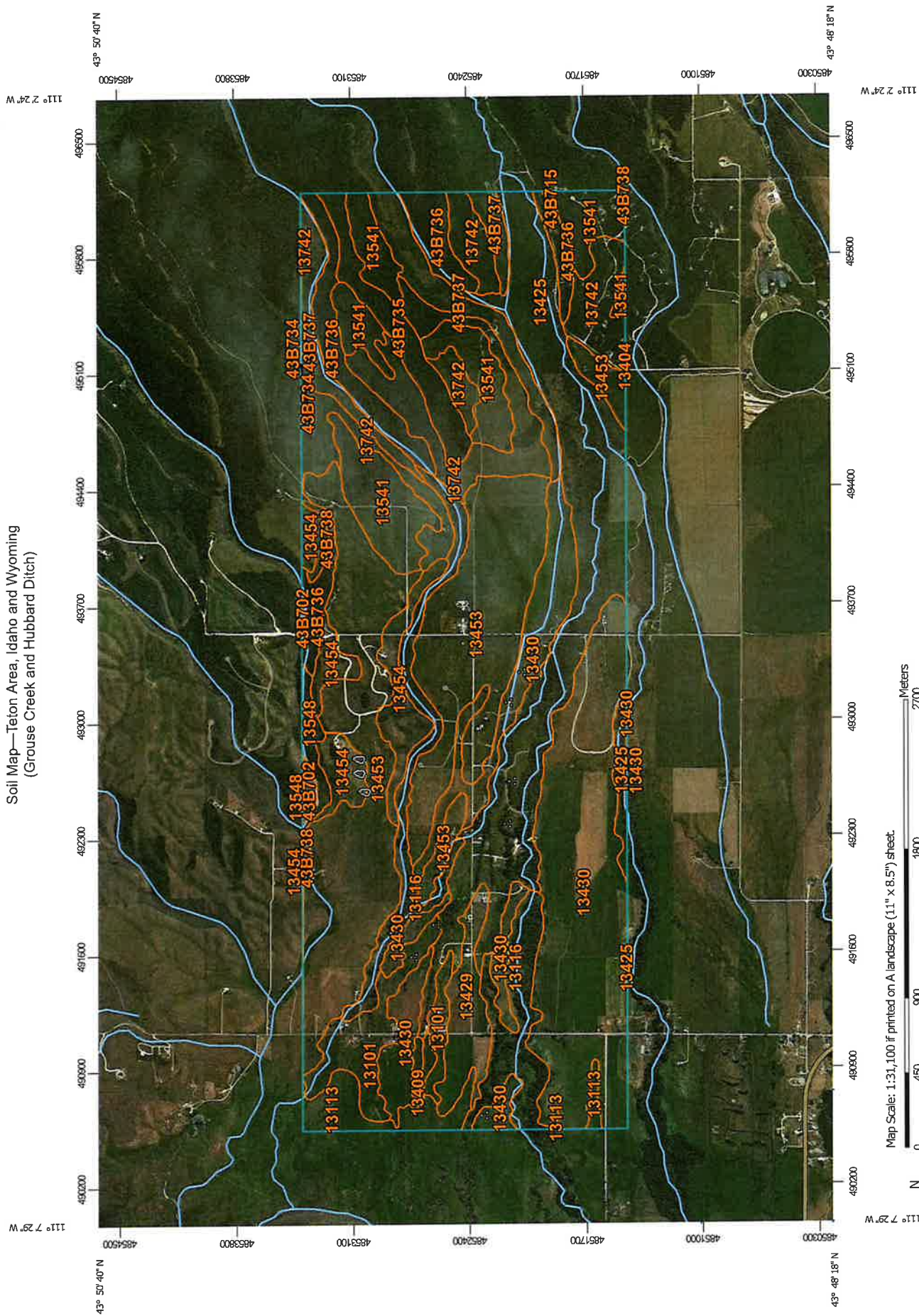
Protestor
Subject Property
Also Owned by Applicant

Total Diversion Equal to or Senior to 6/1/1890	7.7
Total Diversion Equal to or Senior to 1/20/1908	23.47
Total Diversion Equal to or Senior to 1/22/1916	33.27

<u>Water Right</u>	<u>Priority Date</u>	<u>Owner</u>	<u>WaterUse</u>	<u>Diversion Rate</u>
22-339A	6/1/1889	FRANKLIN B HANSEN	IRRIGATION	2.25
22-339B	6/1/1889	GARY HANSEN	IRRIGATION	0.75
22-400A	6/10/1889	BRUCE J WATKINS	IRRIGATION	0.96
22-14159	6/10/1889	CJH LIVING TRUST	IRRIGATION	0.64
22-238A	6/1/1890	JEFFERY O BEARD	IRRIGATION	1.55
22-238B	6/1/1890	DENNY THOMAS	IRRIGATION	1.55
22-12176	6/20/1897	DOUBLE DIAMOND ASSOC LLC	IRRIGATION	0.41
22-13530	6/20/1897	LEIGH CREEK LLC	IRRIGATION	0.82
22-13791	6/20/1897	LYLE F KNIGHT FAMILY TRUST	IRRIGATION	0.84
22-13792	6/20/1897	EDWIN G KNIGHT FAMILY INTER VIVOS REV	IRRIGATION	0.14
22-14023	6/20/1897	SIERRA CHARLIE ASSOC LLC	IRRIGATION	0.39
22-289B	6/1/1898	LOIS A JOHNSON	IRRIGATION	0.1
22-289C	6/1/1898	DOUGLAS A JOHNSON	IRRIGATION	0.04
22-289D	6/1/1898	CAROLYN K MAX	IRRIGATION	0.1
22-338	6/1/1898	JOHN E LOFTHOUSE	IRRIGATION	1
22-459A	6/1/1898	MARY F KLINGLER	IRRIGATION	1.14
22-459B	6/1/1898	TRACY WRIGHT	IRRIGATION	0.22
22-14291	6/1/1898	JARED HILL	IRRIGATION	0.6
22-14293	6/1/1898	TIMOTHY MORLEY	IRRIGATION	0.06
22-290B	9/1/1898	LOIS A JOHNSON	IRRIGATION	0.26
22-290C	9/1/1898	DOUGLAS A JOHNSON	IRRIGATION	0.1
22-290D	9/1/1898	CAROLYN K MAX	IRRIGATION	0.22
22-13013	9/1/1898	JOHN F GARVEY	IRRIGATION	0.11
22-14294	9/1/1898	TIMOTHY MORLEY	IRRIGATION	0.19
22-2029B	1/20/1908	GROUSE CREEK RESERVE LLC	IRRIGATION	0.05
22-2029E	1/20/1908	DENNY THOMAS	IRRIGATION	0.8
22-12175	1/20/1908	DOUBLE DIAMOND ASSOC LLC	IRRIGATION	0.41

<u>Water Right</u>	<u>Priority Date</u>	<u>Owner</u>	<u>WaterUse</u>	<u>Diversion Rate</u>
22-13555	1/20/1908	LEIGH CREEK LLC	IRRIGATION	0.8
22-13657	1/20/1908	FRANKLIN B HANSEN	IRRIGATION	3.52
22-13658	1/20/1908	FRANKLIN B HANSEN	IRRIGATION	2.61
22-14022	1/20/1908	SIERRA CHARLIE ASSOC LLC	IRRIGATION	0.39
22-14122	1/20/1908	GROUSE CREEK RESERVE LLC	IRRIGATION	0.37
22-14123	1/20/1908	GARY BEARD	IRRIGATION	0.08
22-129B	1/22/1916	LOIS A JOHNSON	IRRIGATION	0.32
22-129C	1/22/1916	DOUGLAS A JOHNSON	IRRIGATION	0.11
22-129E	1/22/1916	GROUSE CREEK RESERVE LLC	IRRIGATION	0.08
22-129G	1/22/1916	JOHN E LOFTHOUSE	IRRIGATION	1
22-129J	1/22/1916	LEIGH CREEK LLC	IRRIGATION	1
22-130F	1/22/1916	FRANKLIN B HANSEN	IRRIGATION	1.52
22-131A	1/22/1916	FRANKLIN B HANSEN	IRRIGATION	2.38
22-131C	1/22/1916	DENNY THOMAS	IRRIGATION	1.2
22-12177	1/22/1916	DOUBLE DIAMOND ASSOC LLC	IRRIGATION	0.34
22-14024	1/22/1916	SIERRA CHARLIE ASSOC LLC	IRRIGATION	0.32
22-14120	1/22/1916	GROUSE CREEK RESERVE LLC	IRRIGATION	0.59
22-14121	1/22/1916	GARY BEARD	IRRIGATION	0.13
22-14290	1/22/1916	JARED HILL	IRRIGATION	0.6
22-14303	1/22/1916	TIMOTHY MORLEY	IRRIGATION	0.21

Soil Map—Teton Area, Idaho and Wyoming
(Grouse Creek and Hubbard Ditch)



Soil Map—Teton Area, Idaho and Wyoming
(Grouse Creek and Hubbard Ditch)

MAP LEGEND

- Area of Interest (AOI)

Area of Interest (AOI)
- Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points
- Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot
- Water Features

Streams and Canals
- Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads
- Background

Aerial Photography
- Special Line Features

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Teton Area, Idaho and Wyoming
Survey Area Data: Version 9, Jun 4, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 24, 2011—Nov 2, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
43B702	Beehunt-Conner complex, 20 to 60 percent slopes	6.3	0.2%
43B715	Coldfeet gravelly loam, 20 to 60 percent slopes	1.1	0.0%
43B734	Grouse silt, 2 to 12 percent slopes	0.1	0.0%
43B735	Grouse silt, 12 to 30 percent slopes	62.6	2.3%
43B736	Grouse-Ezbin-Rock outcrop complex, 20 to 50 percent slopes	127.5	4.7%
43B737	Dra-Pinotchle-Rock outcrop complex, 25 to 55 percent slopes	123.8	4.5%
43B738	Dra-Pinotchle-Rock outcrop complex, 4 to 25 percent slopes	8.8	0.3%
13101	Redfish-Foxcreek complex, 0 to 2 percent slopes	82.6	3.0%
13113	Foxcreek mucky peat, 0 to 2 percent slopes	53.8	2.0%
13116	Redfish mucky peat, 0 to 2 percent slopes	158.5	5.8%
13404	Alpine silt loam, 2 to 4 percent slopes	0.1	0.0%
13409	Snyderville gravelly loam, 0 to 4 percent slopes	4.9	0.2%
13425	Badgerton-Alpine complex, 2 to 8 percent slopes	384.0	14.0%
13429	Alpine gravelly loam, 0 to 2 percent slopes	58.4	2.1%
13430	Alpine-St. Anthony complex, 0 to 2 percent slopes	527.9	19.3%
13453	Bustle silt loam, 1 to 6 percent slopes	562.9	20.6%
13454	Ririe-Bustle complex, 4 to 20 percent slopes	100.4	3.7%
13541	Jedediah-Liza complex, 1 to 10 percent slopes	205.5	7.5%
13548	Greys silt loam, lee side hillslope, 8 to 30 percent slopes	18.9	0.7%
13742	Jedediah-Liza complex, 10 to 20 percent slopes	247.5	9.0%
Totals for Area of Interest		2,736.3	100.0%

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007 (<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Engineering Properties—Teton Area, Idaho and Wyoming														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity Index
					Unified	AASHTO	>10 Inches	3-10 Inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	
13425—Badgerton-Alpine complex, 2 to 8 percent slopes														
Badgerton, rarely flooded	55 B		0-9	Loam	ML, CL-ML	A-4	0-0-0	0-0-0	85-85-100	80-80-95	65-70-90	50-55-75	25-35-40	5-10-10
			9-17	Gravelly loam, very gravelly loam	GM, GC-GM, CL	A-4, A-2, A-1, A-6	0-0-0	0-10-10	45-55-95	40-50-90	35-40-80	25-30-65	25-35-40	5-10-15
			17-31	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	GM, GP-GM	A-1, A-2	0-0-25	0-0-15	25-30-40	20-25-40	10-20-35	5-10-25	20-20-35	NP-0-10
			31-43	Extremely stony sandy loam, very gravelly sandy loam, extremely gravelly loamy coarse sand	GW-GM, GP, GC	A-1, A-2	0-0-40	0-0-45	15-45-50	10-25-45	5-15-30	0-5-15	15-15-25	NP-0-10

Engineering Properties--Teton Area, Idaho and Wyoming														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity Index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
13430—Alpine-St. Anthony complex, 0 to 2 percent slopes														
Alpine	50 B		0-2	Gravelly loam	SM, SC-SM	A-4, A-2	0-0-0	0-0-10	70-75-85	65-70-85	50-60-65	35-45-50	25-25-35	5-5-10
			2-11	Very gravelly loam, gravelly loam	GC, GC-GM, GM	A-4, A-2, A-1	0-0-0	0-0-0	30-30-75	25-25-70	20-25-65	15-20-45	25-30-35	5-10-10
			11-17	Extremely gravelly loam, extremely gravelly silt loam, very cobbly loam	GM, GP-GC	A-1, A-2	0-0-0	0-0-30	15-20-30	10-15-25	5-10-20	5-10-20	25-30-35	5-10-10
			17-25	Extremely gravelly sandy loam, extremely cobbly loamy sand	GW, GC, GP-GC	A-1, A-2	0-10-20	0-10-45	10-15-35	5-10-30	0-5-20	0-5-15	15-20-30	NP-5-10
			25-31	Extremely gravelly loamy sand, extremely gravelly loamy coarse sand	GW, GP	A-1	0-10-10	0-10-15	10-20-20	5-15-15	0-10-10	0-0-0	0-20-20	NP-0-5
			31-35	Extremely cobbly loamy sand, extremely gravelly sandy loam, extremely gravelly coarse sand	GW, GP-GC	A-1, A-2	0-10-25	0-10-50	5-15-30	0-10-25	0-10-15	0-5-10	0-20-30	NP-5-10
			35-44	Extremely gravelly loamy sand, extremely gravelly loamy coarse sand	GP, GW	A-1	0-10-10	0-10-15	10-20-20	5-15-15	0-5-10	0-0-0	0-20-20	NP-0-5

Engineering Properties--Teton Area, Idaho and Wyoming														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
			44-51	Extremely cobbly loamy sand, extremely gravelly sandy loam, extremely gravelly coarse sand	GP-GC, GW	A-1, A-2	0-10- 25	0-10- 50	5-15- 30	0-10- 25	0-10- 15	0- 5- 10	0-20 -32	NP-5 -10
			51-60	Extremely cobbly loamy sand, extremely gravelly coarse sand, gravel	GP, GW	A-1	0-10- 20	0-15- 55	10-10- 35	5- 5- 30	0- 5- 20	0- 0- 0	0-15 -20	NP-0 -5
St. anthony	35	B	0-7	Gravelly loam	GC-GM, CL	A-4, A-2, A-6	0- 0- 0	0- 0- 0	50-75- 75	45-70- 70	35-60- 65	30-50- 55	25-25 -30	5-10-15
			7-12	Loam, gravelly loam	CL, GC	A-6, A-2	0- 0- 0	0- 0- 0	50-75- 95	45-70- 90	35-60- 85	30-50- 70	25-30 -30	10-15-1 5
			12-23	Gravelly loam, very gravelly sandy loam, extremely gravelly sandy loam	GC, GP- GC	A-2, A-6	0- 0- 0	0- 0- 15	30-50- 75	25-45- 70	15-35- 65	10-20- 50	25-25 -30	10-10-1 5
			23-47	Extremely gravelly coarse sandy loam, extremely gravelly loamy coarse sand	GP-GC, GP, GW-GC	A-1	0- 0- 0	5-15- 30	15-25- 40	10-20- 35	5-10- 20	0- 5- 10	0-20 -20	NP-5 -5
			47-60	Extremely gravelly loamy sand	GW, GP- GC	A-1	0- 0- 0	15-30- 45	20-20- 30	10-15- 25	5-10- 20	0- 5- 10	0-20 -20	NP-5 -5

Data Source Information

Soil Survey Area: Teton Area, Idaho and Wyoming
Survey Area Data: Version 9, Jun 4, 2020



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

**Conveyance Loss Calculation for 22-238B - Priorities 6/1/1890 and Earlier Using Lower Bracket Seepage Rate
Worstell Method**

$$S=0.0667IW$$

S seepage loss (cfs/mile)

i seepage rate (ft/day)

W Top width of water surface (ft)

0.0667 conversion factor to convert units and a factor to estimate the wetted perimeter as a function of W

Path	Ditch/Canal	Reach	Soil Symbol*	Soil Texture @ 2 ft	Loss per day (ft/day)**	Reach Length (ft)***	Reach Length (mi)***	Reach Ave Width (ft)***	S (cfs/mile)	Conveyance Losses (cfs)
1	North Leigh Canal	1	13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	2.2	5177	0.98	6	0.88	0.86
	North Leigh Canal	2	13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	2.2	195	0.04	6	0.88	0.03
	Hubbard	4	13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	2.2	7313	1.39	4.5	0.66	0.91
	Hubbard	5	13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	2.2	275	0.05	2.5	0.37	0.02
	Totals for Path 1					12960	2.45			1.83
2	Hubbard	3	13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	2.2	2439	0.46	6	0.88	0.41
	Hubbard	4	13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	2.2	7313	1.39	4.5	0.66	0.91
	Hubbard	5	13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	2.2	275	0.05	2.5	0.37	0.02
	Totals for Path 2					10027	1.90			1.34

Path 1		Path 2
North Leigh Canal that flows into Hubbard		Hubbard Ditch Only
Canal or Ditch		
Total Seepage Losses in Canal (cfs)		1.83 cfs
Total Users (cfs)****		7.7 cfs
Grouse Creek Senior Right Only 22-238B		1.55 cfs
Grouse Creek Portion of Conveyance Losses (%)		20%
Grouse Creek Portion of Conveyance Losses (cfs)		0.37 cfs
Portion Proposed to Leave in Original Ditch (cfs)		18 inches
Grouse Creek Portion Transferable (cfs)		0.62 cfs
Portion Proposed to Transfer (cfs)		1.18 cfs
		0.93 cfs

References

*Soil Symbol and Soil Texture obtained from NRCS Soil Report

**Worstell Method and Losses per day based on soil type from Hubble Report Pgs 35-38. Reported to be in the range of 2.2-6 ft/day

***Reach length and width were measured using aerial imagery and verified through field measurements of select locations.

****Based on information obtained through WR database and then limited to only those users who can divert from the North Leigh Canal or Hubbard Ditch or Both

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*****Based on information obtained through WR database and then limited to only those users who can divert from the North Leigh Canal or Hubbard Ditch or Both

Conveyance Loss Calculation for 22-238B - Priorities 6/1/1890 and Earlier Using Upper Bracket Seepage Rate
Worstell Method

S=0.0667W

S seepage loss (cfs/mile)

i seepage rate (ft/day)

W Top width of water surface (ft)

0.0667 conversion factor to convert units and a factor to estimate the wetted perimeter as a function of W

Path	Ditch/Canal	Soil Symbol*	Soil Texture @ 2 ft	Loss per day (ft/day)**	Reach Length (ft)***	Reach Length (mi)***	Reach Ave Width (ft)***	S (cfs/mile)	Conveyance Losses (cfs)
1	North Leigh Canal	1 13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	6	5177	0.98	6	2.40	2.35
	North Leigh Canal	2 13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	6	195	0.04	6	2.40	0.09
	Hubbard	4 13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	6	7313	1.39	4.5	1.80	2.49
	Hubbard	5 13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	6	275	0.05	2.5	1.00	0.05
	Totals for Path 1				12960	2.45			4.99
2	Hubbard	3 13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	6	2439	0.46	6	2.40	1.11
	Hubbard	4 13425	Extremely gravelly loam, extremely gravelly loamy sand, very gravelly loam	6	7313	1.39	4.5	1.80	2.49
	Hubbard	5 13430	Extremely gravelly sandy loam, extremely cobbly loamy sand	6	275	0.05	2.5	1.00	0.05
	Totals for Path 2				10027	1.90			3.66

Path 1

North Leigh Canal that flows into Hubbard

Canal or Ditch

Total Seepage Losses in Canal (cfs)

Total Users (cfs)****

Grouse Creek Senior Right Only 22-238B

Grouse Creek Portion of Conveyance Losses (%)

Grouse Creek Portion of Conveyance Losses (cfs)

Portion Proposed to Leave in Original Ditch (cfs)

Grouse Creek Portion Transferable (cfs)

Portion Proposed to Transfer (cfs)

Path 2

Hubbard Ditch Only

3.66 cfs

9.3 cfs

1.55 cfs

17%

0.61 cfs

30 inches

0.62 cfs

0.94 cfs

0.93 cfs

References

*Soil Symbol and Soil Texture obtained from NRCS Soil Report

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: <http://websoilsurvey.sc.egov.usda.gov/>. Accessed [month/day/year]

**Worstell Method and Losses per day based on soil type from Hubble Report Pgs 35-38. Reported to be in the range of 2.2-6 ft/day

***Reach length and width were measured using aerial imagery and verified through field measurements of select locations.

****Based on information obtained through WR database and then limited to only those users who can divert from the North Leigh Canal or Hubbard Ditch or Both