FINAL REPORT

METHOW VALLEY IRRIGATION DISTRICT ALTERNATIVES EVALUATION REPORT

Prepared for

U.S. Bureau of Reclamation
1150 North Curtis Road
Boise, Idaho 83706-1234

Contract No. R08PC10679
Task No. R13PD10014

Prepared by

Anchor QEA, LLC
720 Olive Way, Suite 1900
Seattle, Washington 98101

August 2013

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LIST OF ACRONYMS AND ABBREVIATIONS

AER	Alternatives Evaluation Report
bgs	below ground surface
cfs	cubic feet per second
Ecology	Washington State Department of Ecology
DAHP	Washington State Department of Archaeology and Historic Preservation
ESA	Endangered Species Act
fps	feet per second
gpm	gallons per minute
HDPE	high density polyethylene
MVID	Methow Valley Irrigation District
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
O&M	operations and maintenance
OHWM	ordinary high water mark
PUD	Public Utility District
PVC	polyvinyl chloride
Reclamation	U.S. Bureau of Reclamation
RM	River Mile
SEPA	State Environmental Policy Act
TDH	total dynamic head
TU	Trout Unlimited
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFD	variable frequency drive
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The Methow Valley Irrigation District (MVID) Alternatives Evaluation Report (AER) was prepared to evaluate alternatives for improving the MVID delivery system near Twisp, Washington. MVID operates canal systems on the east and west sides of the Methow Valley near Twisp. The MVID East Canal system diverts water for irrigation from the Methow River, approximately 4 miles upstream of the Town of Twisp. The MVID West Canal system diverts water for irrigation from the Twisp River, approximately 3.5 miles upstream of the Town of Twisp. Both rivers provide critical spawning, rearing, and migration habitat for fish species listed under the Endangered Species Act (ESA). The MVID West Canal diversion on the Twisp River reduces instream flow and impacts off channel habitat, channel form, and instream complexity. The diversion also has the potential to cause injury and mortality by stranding juvenile Chinook salmon and dewatering redds.

The MVID delivery system, local water supplies, and the impact of irrigation diversions on the Twisp and Methow Rivers have been studied extensively over the past 25 years. The findings of these studies led the Washington State Department of Ecology (Ecology) to issue Administrative Orders in 2002 and 2003 requiring that MVID reduce diversions from the Twisp and Methow Rivers. Further study and litigation led to an agreement between Ecology and MVID in March 2011 (Ecology 2011). As part of the agreement, MVID has agreed to reduce diversions from the Twisp River to 11 cubic feet per second (cfs) by 2016. MVID has also agreed to reduce diversions from the Methow River to 20 cfs less inflow from the Barkley Ditch.

This AER was completed under the direction of the U.S. Bureau of Reclamation (Reclamation) and in coordination with MVID and other stakeholders to evaluate alternatives that would improve the MVID delivery system and allow MVID to reduce diversions and meet the requirements set forth in the agreement with Ecology. The AER is intended to provide sufficient detail to inform selection and implementation of a preferred improvement project that will improve instream flow in the Twisp River, improve access to spawning and rearing habitat for ESA-listed fish species, reduce injury and mortality to juvenile fish species, and improve the reliability of irrigation supply for MVID water users.

Alternatives

Initially, four alternatives were identified by MVID and the project stakeholder group that focused primarily on improvements to the West Canal system designed to reduce diversions from the Twisp River. Based on feedback from MVID members, the first three alternatives were expanded to include replacement of the East Canal with a gravity-fed pipe system. A fifth alternative was also added that included the West Canal improvements from Alternative 4 with the East Canal improvements from the first three alternatives. The following is a short description of the alternatives evaluated in the AER:

- **Alternative 1** would result in result in replacement of the MVID West Canal system with a pressurized pipe system supplied through a pump station on the Methow River. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.
- **Alternative 2** would result in replacement of the MVID West Canal system with a pressurized pipe system supplied from groundwater wells. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.
- **Alternative 3** would result in replacement of the MVID West Canal system with two pressurized pipe systems, each supplied from groundwater wells. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.

For each of these first three alternatives, a few users not served through one of the pipe systems or the Town of Twisp system would be converted to individual wells.

- **Alternative 4** would include conversion of the majority of MVID users to individual groundwater wells. West Canal users in and near the Town of Twisp would be served through a smaller pressurized pipe system supplied from a groundwater well. Lateral

E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well.

- **Alternative 5** would include conversion of the majority of West Canal users and users at the downstream end of the East Canal to individual groundwater wells. West Canal users in and near the Town of Twisp would be served through a smaller pressurized pipe system supplied from a groundwater well. Most of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.

Groundwater Supply Feasibility

The alternatives evaluated as part of this study would convert a portion of the existing irrigation supply from a surface water diversion to groundwater wells. Previous studies by the United States Geologic Survey (USGS) and Ecology, well logs from the Ecology database, a groundwater investigation completed for a Grant County Public Utility District (PUD) well near MVID properties, and Reports of Examination for previous water right changes in the valley were reviewed to evaluate the feasibility of supplying a portion of the irrigation water needs through groundwater wells. This information indicates that unconsolidated sedimentary deposits along the bottom and lower slopes of the Methow Valley and tributary valleys are most likely to have highly productive aquifers that would support groundwater wells for irrigation supply.

The review of groundwater well supply feasibility also included drilling and testing wells on properties identified as potential production well locations for Alternatives 2 and 3. The first well, drilled on property owned by MVID near the middle of the West Canal, encountered bedrock at 79 feet below ground surface (bgs). The test well was not far from the sloped west side of the valley and bedrock outcroppings. Although the shallow material in the well appeared to be highly transmissive, it was concluded that the well would likely not be suitable for pumping large quantities of water that would be required to supply the MVID West Canal systems included in Alternatives 2 and 3. A second well was developed near the lower end of the system on property owned by Alyssa Jumars. The well was not tested due

to the weather and dewatering constraints, but the well was drilled to 178 feet bgs and appeared to have potential for providing a portion of the supply that would be needed for Alternatives 2 and 3. A third well was drilled and tested near the middle of the system just east of the first test well on property owned by Janet Eileen. The well was drilled to 160 feet bgs and appeared to be the most suitable of the three wells drilled for delivering the large quantities that would be needed to supply Alternatives 2 and 3.

Based on the groundwater well feasibility evaluation, three wells, each with a capacity of 1,800 to 2,000 gallons per minute (gpm) are recommended to serve the 4,950 gpm (11 cfs) supply required for Alternative 2. It is anticipated that the well would be located near the third test well drilled on property owned by Janet Eileen. For Alternative 3, two wells, each with a capacity of 1,200 gpm are recommended to serve the 2,295 gpm (5.1 cfs) supply required the middle and upper portions of the proposed system. Three additional wells, each with a capacity of 2,700 gpm to 3,000 gpm (6 to 6.7 cfs), are recommended to serve the 2,655 gpm (5.9 cfs) required for the lower portion of the proposed system. Alternatives 1, 2, and 3 would include conversion of only 16 total parcels to individual well systems. For parcels in the Twisp River Valley, which is much narrower than the Methow Valley, it is recommended that individual wells be drilled as close as possible to the Twisp River, where unconsolidated sediments may be deeper than towards the margins of the valley.

Alternatives 4 and 5 would result in a greater number of parcels being converted to individual well systems. It is recommended that individual wells be drilled as close as possible to the Methow and Twisp Rivers, where unconsolidated sediments are likely to be deeper and more productive. It is anticipated that a single production well drilled in unconsolidated sediments should have capacity to serve the 1,260 gpm (2.8 cfs) required for a reduced delivery system at the upper end of the West Canal included in Alternatives 4 and 5. A potential well location was identified on property owned by Dave Shulz. No test well has been drilled at that location yet to confirm the well capacity.

Alternatives Evaluation

As part of the AER, design and cost analyses were also completed to evaluate and compare the proposed alternatives. Hydraulic analyses were completed to determine preliminary

sizing for recommended facilities for each alternative. Feasibility level drawings were also developed to show the general location and major materials that would be included for each alternative (Appendix A). Opinions of probable implementation costs, long-term operating costs, and replacement fund costs were also developed for each alternative. The alternatives evaluation revealed the following:

- The project implementation costs would be highest and of a similar order of magnitude for Alternatives 1, 2, and 3. Implementation costs for Alternatives 4 and 5 would be lower. Overall project implementation costs were estimated to be within the following ranges:
  - Alternative 1: $10.6 million to $12.8 million
  - Alternative 2: $10.7 million to $12.8 million
  - Alternative 3: $10.3 million to $12.4 million
  - Alternative 4: $6.9 million to $8.3 million
  - Alternative 5: $7.3 million to $8.8 million
- Long-term operations and maintenance (O&M) and pumping power costs incurred by MVID would be highest for Alternatives 1, 2 and 3. However, the long-term costs per assessed acre served would be highest for Alternative 4, because the operating costs would be spread over a smaller service area. Alternative 5 would offer the lowest long-term costs per assessed acre served. The long-term O&M and pumping costs are estimated to be approximately $127,300 ($91 per assessed acre) for Alternative 1, $132,200 ($95 per assessed acre) for Alternative 2, $133,400 ($96 per assessed acre) for Alternative 3, $53,500 ($159 per assessed acre) for Alternative 4, and $85,200 ($88 per assessed acre) for Alternative 5 during the first year of operation.
- Alternatives 2 through 5 would shift the majority of the irrigation supply to the West Canal from the surface water diversion on the Twisp River to groundwater wells in connectivity with the Methow River. Alternative 4 would also convert most of the supply for East Canal users from the surface water diversion on the Methow River to individual groundwater wells.
- All of the alternatives evaluated would reduce the impact of existing irrigation operations on surface water resources by eliminating the diversion on the Twisp River. The alternatives would also reduce the overall water supply required by making the delivery system more efficient.

- Alternatives 1, 2, and 3 would result in the most significant impacts to private property because the facilities included in these alternatives would be more extensive Alternatives 4 and 5 would have less impact on private property, but would impact more private property owners who are currently served by MVID by requiring those properties to convert to individual well systems.
- All of the alternatives would require permits, but permitting requirements have not been identified as a "fatal flaw" to implementation of any of the alternatives.
- Constructability concerns have been identified for all of the alternatives. The most significant challenge will likely be construction phasing and scheduling to allow for continued irrigation operation and construction of facilities outside the winter months when the ground is thawed and not covered with snow.
- Alternatives 4 and 5 would likely also be easier and less expensive to operate and maintain because the systems would be smaller and have fewer components. Alternatives 1, 2, and 3 would include larger pumps, more pumps, more storage tanks, and longer pipelines to operate and maintain.

Preferred Alternative

Based on the review of the results of the alternatives evaluation, public meetings, and consultation with MVID members, input from funding and permitting agencies, and review by other project stakeholders, the MVID Board of Directors selected Alternative 5 as the preferred alternative and is working toward implementation. The following would be included as part of Alternative 5:

- Elimination of the West Canal diversion on the Twisp River
- Replacement of the existing West Canal system from Alder Creek Road to the existing Lateral W-4 with a pressurized pipe system supplied from a groundwater well
- Conversion of approximately 87 MVID West Canal parcels upstream and downstream of the proposed pipe system to individual well systems
- Replacement of the East Canal system from upstream of the Mill Spill to Beaver Creek with a pipe system served through an inlet structure on the existing East Canal
- Service to MVID members within the Town of Twisp on the east side of the Methow River through the town's potable water distribution system or through a replacement of the existing Lateral E-1

- Conversion of approximately eight MVID East Canal parcels downstream of the Beaver Creek Spill to individual well systems.

The opinion of probable construction costs developed for Alternative 5 is $4.8 million to $5.8 million. The opinion of the overall project implementation cost, with a 20 percent allowance for engineering, permitting, and administration and an allowance for land acquisition, is $7.3 million to $8.8 million, including $1.5 million to $1.8 million for conversion of 95 parcels to individual well systems.

Annual operations, maintenance, administrative, and pumping costs are projected to be approximately $85,200 during the first year of the project, or $88 per assessed acre. The annual cost of a replacement fund that would pay for 25 percent of pipe and infrastructure during a 50-year life cycle, 100 percent of pumps and electrical components during a 25-year life cycle, and 25 percent of storage facilities over a 50-year life cycle is projected to be approximately $31,824 during the first year of the project, or $33 per assessed acre.

Recommended Steps Forward

It is recommended that MVID, Reclamation, and other project partners move forward with detailed design and implementation of Alternative 5. As an initial step, groundwater supply availability for the delivery system in the upper end of the West Canal should be verified by drilling and testing a well at the Shulz property. It is also recommended that MVID and Reclamation focus on the following:

- Refine proposed facility locations and coordinate with private property owners to ensure successful acquisition of easements and property
- Complete a detailed permitting evaluation to define permitting requirements
- Complete additional geotechnical investigations and topographic survey
- Refine the design analysis to verify sizing and facility locations
- Refine the cost analysis to verify that adequate funding is available
- Review construction phasing to ensure that the project can be constructed in time to meet the requirements of the agreement between MVID and Ecology
- Continue consultation with Ecology regarding water right changes

1 INTRODUCTION

This Alternatives Evaluation Report (AER) provides an evaluation of the improvement alternatives currently proposed for the Methow Valley Irrigation District (MVID) delivery system near the Town of Twisp (Twisp), Washington. MVID owns and operates two canal systems that serve irrigators on the east and west sides of the Methow River between the towns of Twisp and Carlton in the Methow Valley. The East Canal system is supplied through a diversion on the Methow River at River Mile (RM) 44.8. The West Canal system is supplied through a diversion on the Twisp River at RM 4.3. This AER evaluates five alternatives identified by project stakeholders that would improve portions of each canal system or convert users to individual well systems.

Initially, four alternatives were evaluated that focused primarily on improvements to the West Canal system designed to reduce diversions from the Twisp River. Feedback generated through review of the initial evaluation of alternatives with the MVID Board of Directors and members overwhelmingly indicated that the project needed to evaluate improvements to both the East and West Canal systems. The first three alternatives were expanded to include replacement of the East Canal with a gravity-fed pipe system. A fifth alternative was added that included the West Canal improvements from Alternative 4 with the East Canal improvements from the first three alternatives. The resulting alternatives are as follows:

- Alternative 1 would result in result in replacement of the MVID West Canal system with a pressurized pipe system supplied through a pump station on the Methow River. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.
- Alternative 2 would result in replacement of the MVID West Canal system with a pressurized pipe system supplied from groundwater wells. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.

- Alternative 3 would result in replacement of the MVID West Canal system with two pressurized pipe systems, each supplied from groundwater wells. A portion of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.

For each of these first three alternatives, a few users not served through one of the pipe systems or the Town of Twisp system would be converted to individual wells.

- Alternative 4 would include conversion of the majority of MVID users to individual groundwater wells. West Canal users in and near the Town of Twisp would be served through a smaller pressurized pipe system supplied from a groundwater well. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well.
- Alternative 5 would include conversion of users at the downstream end of each canal system to individual groundwater wells. West Canal users in and near the Town of Twisp would be served through a smaller pressurized pipe system supplied from a groundwater well. Most of the MVID East Canal system would be replaced with a gravity-fed pipe system. Lateral E1 users would be served irrigation water through the Town of Twisp potable water distribution system or through a new lateral system supplied by a groundwater well or connection to the East Canal pipeline.

This AER has been completed by Anchor QEA, LLC, under the direction of the U.S. Bureau of Reclamation (Reclamation). Reclamation is working with the MVID and other project stakeholders in an effort to meet tributary habitat commitments outlined in the *2008 Federal Columbia River Power System Biological Opinion* (NMFS 2008). The AER was completed under the direction of the Pacific Northwest Regional office of Reclamation as part of the MVID Instream Flow Improvement Project. Other key project stakeholders include:

- MVID – As owner of the irrigation system and proposed improvements, MVID will be responsible for selecting a preferred improvement alternative.
- Washington Water Project of Trout Unlimited (TU) – TU is the project sponsor and is responsible for implementation of this project.

- Washington State Department of Ecology (Ecology) – Ecology is the funding entity for this project and will provide input on the preferred alternative and designs.
- MVID Landowners – The project sponsor will communicate and coordinate with impacted landowners.

The AER is intended to evaluate the proposed alternatives in enough detail so that the MVID Board of Directors can select a preferred improvement project alternative that will allow for a more efficient and reliable supply to the MVID East and West Canal systems. The AER will then be used as a basis for developing detailed designs and implementing the project.

1.1 Background

The Twisp River is one of the largest tributaries to the Methow River and provides critical spawning, rearing, and migration habitat for fish species listed under the Endangered Species Act (ESA). ESA-listed species include Upper Columbia River Chinook salmon, Upper Columbia River steelhead, Columbia River bull trout, and coho salmon. Other species of concern include West Slope Cutthroat trout. Limiting factors that impact the abundance and quality of spawning and habitat in the Lower Twisp River include low late summer instream flow and lack of side-channel, bedform, and instream complexity. The MVID West Canal diversion on the Twisp River reduces instream flows and impacts off channel habitat, channel form, and instream complexity. The diversion also has the potential to cause injury and mortality by stranding juvenile Chinook salmon and dewatering redds.

The alternatives evaluated in this report would each result in elimination of the diversion on the Twisp River. The change in diversion would improve instream flows in the Twisp River during the irrigation season, allow for improved habitat complexity in the river, and reduce impacts to juvenile Chinook salmon and other ESA-listed species. The improvements would also reduce diversions from the Methow River, improve the efficiency and reliability of water supply to MVID water users, and help lessen the habitat effects of reduced and warmer late summer flows predicted with future climate change.

1.2 Previous Work

This study is intended to build on previous work done to evaluate improvements to the MVID system. The MVID system and local water supplies have been studied by several consultants and agencies over the past 25 years in an effort to reduce the impact of irrigation diversions on the Twisp and Methow Rivers. Table 1-1 provides a list, in chronological order, and brief description of previous studies and work that have been done. It is not the purpose of this study to recap MVID's history. A more complete description of the MVID system and previous work done can be found by reading the sources listed in Table 1-1.

Table 1-1
Previous Studies and Work Related to the MVID

Year	Study	Description
1990	Water Management Plan for Methow Valley Irrigation District (Klohn Leonoff 1990)	• Initial evaluation of the MVID system • Inventory of system facilities • Recommendations for improvements and reorganization of the MVID service area
1994	Draft Methow River Basin Plan (Methow Valley Water Pilot Planning Committee 1994)	• Initial effort by the Ecology to provide a basin-wide approach to managing water resources • Initial findings of the pilot planning committee
1996	Methow Valley Irrigation District Water Supply Facility Plan (MWG 1996)	• Improvement plan report, preliminary drawings, and opinions of cost prepared by Montgomery Water Group (now Anchor QEA) for Ecology
1997	Methow Valley Irrigation District Project, Final Environmental Assessment and Finding of No Significant Impact (BPA 1997)	• Environmental Assessment (EA) prepared by Bonneville Power Administration (BPA) based on the MVID Water Supply Facility Plan • Finding of No Significant Impact
2000	Aquifer Testing and Hydrogeologic Evaluation, Methow Valley Irrigation District (MWG/HWA GeoSciences 2000)	• Hydrogeologic investigation of the alluvial aquifer near Twisp • Three test wells drilled and tested
2002	Engineering Analysis of On-farm and Canal Efficiency for MVID Based on 1995 Aerials and Previous Engineering Studies (Ecology 2002)	• Prepared by Ecology to evaluate the efficiency of water use in the MVID based on estimates of irrigated acreage from 1995 aerial photographs
2003, 2005	Seepage Loss in Methow Valley Irrigation District (Reclamation 2003 and 2005)	• Reclamation documentation of flow measurements and estimated seepage losses in the MVID canals in 2003 and 2005
2003	2003 MVID Engineering Evaluation (Ecology 2003)	• Engineering report prepared by Ecology to document evaluation of MVID system
2005	Water Resources Investigations Report 03-4244, Hydrogeology of Unconsolidated Sediments, Water Quality, and Ground-Water/Surface-Water Exchanges in the Methow River Basin, Okanogan County, Washington (USGS 2005)	• Detailed investigation by the U.S. Geological Survey (USGS) of the hydrogeology of unconsolidated sedimentary deposits, water quality, and exchanges between groundwater and surface water
2007	MVID Canal Management Plan (Anchor Environmental/IRZ Consulting 2007)	• Prepared by Anchor Environmental (now Anchor QEA) and IRZ Consulting for MVID and Ecology • Detailed delivery system modeling and recommendations for further improvements

1.3 Alternatives Evaluation Report Description

1.3.1 Scope of Work

The scope of work identified for development of the AER included the following tasks:

1. Project Coordination and Meetings, including:
   - Coordination with project stakeholders
   - Presentation of findings to the MVID Board of Directors and members
   - Meetings with the project team
2. Hydrogeologic Feasibility Analysis, including:
   - Preparation of a groundwater well testing plan and specifications
   - Observation of groundwater test well drilling
   - Analysis of the option of converting MVID users to individual well systems
   - Preparation of a groundwater feasibility memorandum that is incorporated into this AER as Section 4
3. Preparation of the AER, including:
   - Collection and review of background information
   - Hydraulic analysis of the alternatives
   - Preparation of feasibility level drawings for each alternative
   - Development of an opinion of probable construction costs for each alternative
   - Preparation of a life-cycle cost analysis for each alternative to identify long-term power costs, operations and maintenance costs, and replacement fund costs, and impacts to member assessments
   - Preparation of a summary table (Table 7-1 in this report) comparing the alternatives based on selection criteria identified by project stakeholders
   - Completion of this report

1.3.2 Project Goals

The goals of the MVID Instream Flow Improvement Project are to:

- Improve instream flow in the Twisp River during the irrigation season
- Improve access to spawning and rearing habitat in the Twisp River for ESA-listed Chinook salmon, steelhead, and bull trout
- Improve habitat quantity and quality for ESA-listed fish species
- Reduce injury and mortality to juvenile Chinook salmon and other fish species

- Develop an improved, reliable irrigation supply and delivery system for MVID

The goals of the AER are to analyze the five conceptual alternatives proposed by the stakeholder group in sufficient detail to inform MVID's selection of a preferred alternative and provide a basis for the design and implementation of the project.

1.3.3 Report Organization

This report includes the following sections:

- **Background** – This section describes existing conditions and water supply needs.
- **Description of Improvement Alternatives** – This section provides a brief description of the four proposed improvement alternatives.
- **Groundwater Well Supply Feasibility** – This section summarizes the hydrogeologic feasibility analysis task and includes a description of existing groundwater conditions, test well drilling results and findings, and a summary of the feasibility of using groundwater to supply MVID water users.
- **Design Evaluation of Alternatives** – This section provides a summary of the technical analysis of each alternative.
- **Cost Analysis** – This section provides a summary of the opinion of probable construction costs and life cycle cost analysis for each alternative. The life cycle cost analysis includes an evaluation of operations and maintenance costs, pumping costs, replacement costs, and potential impacts to member assessments.
- **Alternatives Evaluation** – This section summarizes the selection criteria identified by the project stakeholders for evaluating and selecting a preferred alternative and provides a comparison of alternatives based on the selection criteria.
- **Summary of Preferred Alternative** – This section provides a more detailed description of the preferred alternative selected for detailed design analysis and implementation by the MVID Board of Directors.
- **Conclusions and Recommendations** – This section provides an overall summary of the AER and recommendations for detailed design and implementation.

Tables and figures are included throughout the report. Appendices follow the main body of the report.

2 BACKGROUND

2.1 Existing MVID System

As was noted in Section 1, the MVID operates two canal systems: the East Canal and the West Canal. A location map, showing the two canals and the MVID service area is included as Figure 2-1. The following provides a brief description of the MVID canal systems.

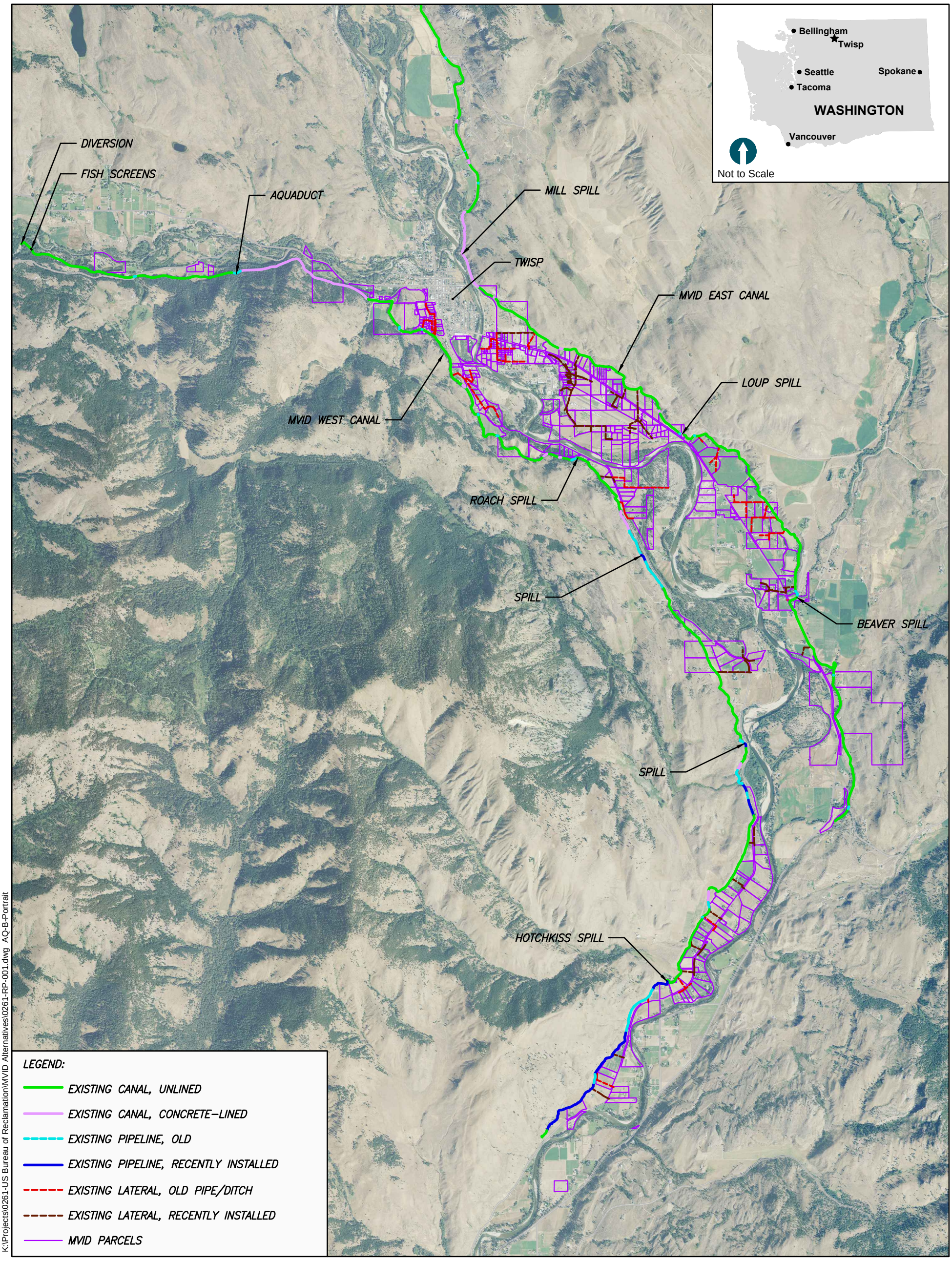
2.1.1 MVID East Canal

The MVID East Canal is more than 10 miles long and is supplied through a diversion on the Methow River at RM 44.8, approximately 4 miles upstream (north) of Twisp. The diversion has undergone extensive renovation during the last 10 years, including removal of most of the old timber crib dam that was a barrier to fish passage during late summer low flow conditions, improvements to maintain flow to the intake canal, and upgrades to the intake structure, fish screen, and flow measurement.

The existing MVID East Canal consists of unlined canal, concrete-lined canal, and pipe. The length of pipe shown includes several culverts. The MVID East Canal system also serves water to users through a series of laterals that extend from the canal south and west, toward the Methow River. The laterals consist of pressure-rated pipe and unlined ditch. Table 2-1 provides a short summary of the composition of the existing MVID East Canal.

Table 2-1
Existing MVID East Canal Facilities

Description	Length (feet)
Open canal, unlined	51,480
Open canal, lined with concrete	4,525
Pipe	995
Laterals	34,200



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Mar 06, 2013 10:07am drice

AERIAL SOURCE: 2011 NAIP Aerial Photograph

HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.

VERTICAL DATUM: NAVD 88

0 6,000
Scale in Feet

ANCHOR QEA

Figure 2-1
Location Map
Methow Valley Irrigation District
Alternatives Evaluation Report

The MVID East Canal operates by gravity. Operational spills occur at three locations: the Mill Spill near Twisp, the Loup Spill near the intersection of State Highway 20 and State Highway 153, and the Beaver Spill at Beaver Creek near the bottom end of the canal. Water is also spilled back to the Methow River at the tail end of the canal.

2.1.2 MVID West Canal

The MVID West Canal is more than 12 miles long and is supplied through a diversion on the Twisp River at RM 4.3, approximately 3.5 miles upstream (west) of Twisp. The diversion consists of a boulder weir dam that has to be pushed up during the late summer and an excavated diversion channel. An intake structure with fish screens is located downstream of the diversion channel. The fish screen and flow measurement at the intake structure were upgraded in 2005 to bring them into compliance with current standards.

The existing MVID West Canal consists of unlined canal, concrete-lined canal, older segments of pipe, and several newer segments of pipe installed within the last 20 years. The older pipe includes several segments of flume constructed with half sections of corrugated metal pipe (CMP). The newer segments of pipe include primarily gravity pipe; however, the newest segment of pipe at the downstream end of the canal includes approximately 3,100 feet of polyvinyl chloride (PVC) irrigation pipe at the downstream end of the canal with a pressure rating of 80 pounds per square inch (psi). The MVID West Canal system also serves water to users through a series of laterals that extend from the West Canal to the east, toward the Methow River. The laterals consist of pressure-rated pipe and unlined ditch. Table 2-2 provides a short summary of the composition of the existing MVID West Canal.

Table 2-2
Existing MVID West Canal Facilities

Description	Length (feet)
Open canal, unlined	42,740
Open canal, lined with concrete	8,310
Newer pipe	8,380
Older pipe	7,950
Laterals	21,600

MVID has identified a 6,500-foot segment of the existing canal, consisting of an elevated flume and a concrete-lined canal upstream of Alder Road, as being at high risk of failure. This segment of the canal is perched on the side of a steep hillside. The majority of the users are served from the system downstream of this segment of the canal.

The MVID West Canal operates by gravity. Operational spills occur at four locations: the Roach Spill near Twisp, the Hotchkiss Spill near the inlet to piping at the downstream end of the canal, and at two intermediate locations between the Roach Spill and Hotchkiss Spill. Water is also spilled back to the Methow River at the tail end of the canal.

2.2 Water Supply Needs

MVID has water rights for surface water diversions from the Twisp River, for the MVID West Canal, and the Methow River, for the MVID East Canal. Prior to conservation efforts that began in the mid 1990s, MVID diverted approximately 40 cubic feet per second (cfs) from the Methow River and 32 cfs from the Twisp River during the peak irrigation season. Diversions have since been reduced as a result of conservation efforts and reduction in MVID's service area in the late 1990s. For example, in 2007, the peak diversion from the Methow River was approximately 18 cfs and the peak diversion from the Twisp River was approximately 26 cfs.

A delivery model was developed as part of the 2007 *MVID Canal Management Plan* (Anchor Environmental/IRZ Consulting 2007) to estimate water deliveries, seepage, and the total diversion required for each canal. The model was based on a detailed analysis of irrigated acreage, irrigation requirements, seepage measurements made by Reclamation in 2003 and 2005, and field observations. For the West Canal, the model results indicated that prior to piping improvements made in 2006, a diversion of 23.6 cfs would have been required to irrigate 345 acres in the MVID West Canal service area. The model estimated that total deliveries at irrigator turnouts of only 6.9 cfs would have been required to irrigate 345 acres and that 16.7 cfs would have been lost through seepage. The model estimated that piping improvements made in 2006 would have reduced seepage to 12.8 cfs and reduced the diversion required to serve the same number of acres to 19.7 cfs.

A similar model was developed for the East Canal. The model estimated that a total diversion of 19.6 cfs was required to serve the 426 acres irrigated within the MVID East Canal service area and the 267 acres irrigated within the Barkley Ditch service area from the East Canal system. The model estimated that total deliveries at irrigator turnouts of 13.9 cfs were required to irrigate those acres, and that a total of 5.0 cfs were lost through seepage.

Ecology completed an engineering evaluation in 2002 to estimate the amount of water needed to supply the total acreage within the MVID service area and other acreage served through the MVID system (Ecology 2002a). That report became the basis for an administrative order that was issued by Ecology in April 2002 (Administrative Order No. DE 02WRCR-3950 [Ecology, 2002b]). The Administrative Order limited MVID diversions as follows:

- 29 cfs maximum and 7,367 acre-feet total from the Twisp River (to the West Canal)
- 24 cfs maximum and 5,829 acre-feet total from the Methow River (to the East Canal)
- 53 cfs maximum and 13,196 acre-feet total diversion to MVID

The Administrative Order was appealed by both MVID and the Okanogan Wilderness League to the Pollution Control Hearings Board (PCHB). In response to the directive delivered by the PCHB, Ecology completed an additional engineering evaluation (Ecology 2003a) and issued a second Administrative Order in December 2003 (Administrative Order No. DE 03WRCR-5904 [Ecology 2003b]). The new Administrative Order limited MVID diversions as follows:

- 21 cfs maximum and 5,161 acre-feet total from the Twisp River (to the West Canal)
- 20 cfs maximum and 4,909 acre-feet total from the Methow River (to the East Canal)
- 41 cfs maximum and 10,070 acre-feet total diversion to MVID

The new order further reduced the limit on future diversions (effective after September 2006) from the Methow River to 11 cfs maximum and 2,176 acre-feet total. The total diversion limit for MVID was set at 31 cfs maximum and 7,625 acre-feet annually.

These orders and subsequent litigation resulted in an agreement between MVID and Ecology, signed in March 2011 (Ecology 2011). The agreement set a schedule for limiting

diversions from the Twisp River to comply with the intent of Administrative Order No. DE 03WRCR-5904. Table 2-3 summarizes those limits. The agreement also limits diversion to the East Canal to 20 cfs and 4,909 acre-feet less inflow from the Barkley Ditch.

Table 2-3
Water Right Settlement Agreement Diversion Limits – West Canal

Year	Apr15 to Jun 15 (cfs)	Jun 15 to Aug 31 (cfs)	Sep 1 to Oct 15 (cfs)	Annual Limit, Qa (Acre-feet)
2010	17	17	17	5,161
2011	16	17	15	4,500
2012	16	17	15	4,500
2013	16	17	14	4,000
2014	14	15	13	3,500
2015	12	13	11	3,000
2016	11	11	11	2,716

Notes:
cfs = cubic feet per second
Qa = total annual diversion volume

The improvement alternatives outlined in this AER are needed to improve the efficiency of the West Canal system so that diversions can be reduced to 11 cfs to meet the requirements set forth in the agreement with Ecology. A total design flow rate of 11 cfs was used to size proposed facilities for each alternative. The improvements would also change the point of diversion for the West Canal to the Methow River or to groundwater wells, to provide greater benefit to instream flows and habitat conditions in the Twisp River. The improvements proposed for the East Canal would also reduce seepage and enable MVID to more easily meet the limit set on diversions from the Methow River.

3 DESCRIPTION OF IMPROVEMENT ALTERNATIVES

3.1 Alternative 1

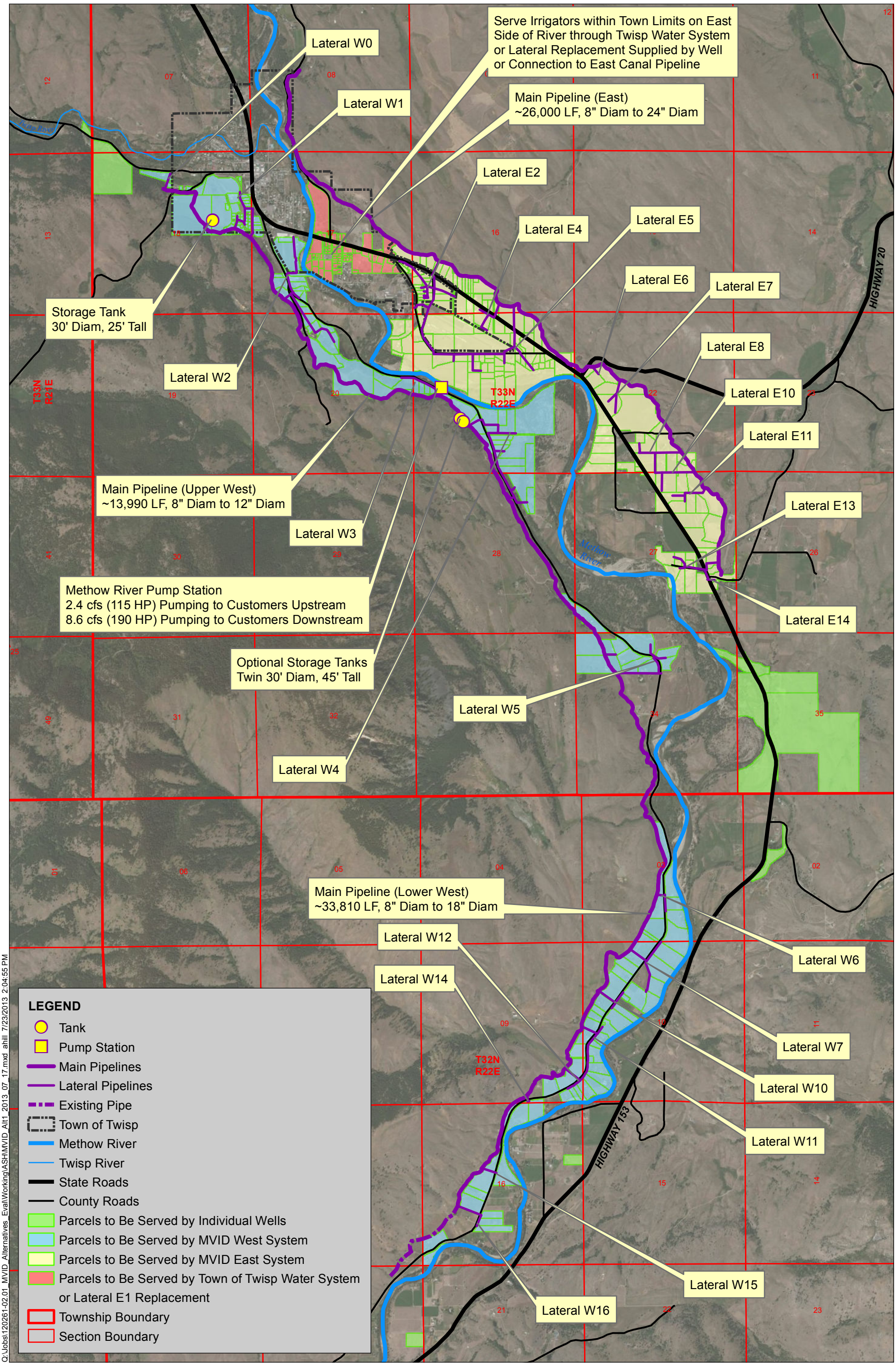
Alternative 1 would replace most of the existing MVID West Canal with a pressurized pipe system supplied through a pump station on the Methow River. The East Canal would also be replaced with a pipeline from upstream of the Mill Spill to Beaver Creek. Lateral E1 users would be served through the Town of Twisp water distribution system under an agreement with MVID or through a replacement lateral system supplied by a new groundwater well or a connection to the East Canal pipeline. Figure 3-1 provides a general overview of the major improvements that would be included as part of Alternative 1. More detailed feasibility level drawings for Alternative 1 are included as Drawings 1-1 through 1-6 in Appendix A. Table 3-1 provides a summary of the major components of Alternative 1 and the areas that would be served by each. A description of the major components of Alternative 1 follows.

Table 3-1
Alternative 1 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe system	Pressurized pipeline and lateral system supplied by river pump station	West Canal users from Station 161+00 to downstream end of canal	166	561	11.0
Individual wells	MVID Users Converted to Individual Well Systems	West Canal Users Upstream of Station 161+00	8	25	0.5
East Canal Improvements					
East pipe system	Pipeline and lateral system supplied by existing East Canal	East Canal users from Station 193+00 (upstream of Mill Spill) to Beaver Creek	180	617	10.0
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID users within Town of Twisp limits on east side of Methow River	71	135	2.7
Individual wells	MVID users converted to individual well systems	East Canal users downstream of Lateral E14	8	30	0.6

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and east pipe system provided by Reclamation.

cfs = cubic feet per second



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Feet
0 1,500 3,000 4,500 6,000

Figure 3-1
Alternative 1
Methow Valley Irrigation District
Alternatives Evaluation Report

3.1.1 West Canal Improvements

A pressurized irrigation main line would be installed to replace the MVID West Canal from Station 161+00, just upstream of Alder Creek Road, to Station 639+03. The system would be supplied through a surface water pump station on the Methow River near the existing Roach Spill. Although some existing lateral pipe may be relatively new, this evaluation assumes that existing laterals would be replaced to ensure that they can accommodate new system pressures. Approximately eight water users that are currently served from the MVID West Canal upstream of Station 161+00 would be converted to individual well systems.

3.1.1.1 Water Supply

Alternative 1 would change the point of diversion for the MVID West Canal water supply from the Twisp River to a surface water pump station on the Methow River. The pump station would be designed as follows (see Drawing 1-5 in Appendix A):

- **Location** – The pump station would be constructed on the right (west) bank of the Methow River at RM 37.9, adjacent to the existing Roach Spill. A relatively deep scour pool behind a bedrock outcropping at that location would provide favorable conditions for a surface water diversion.
- **Intake Configuration** – The pump station would include an inclined screen intake, designed to meet the requirements of the National Marine Fisheries Service (NMFS) Anadromous Salmonid Passage Facility Design Guidelines (NMFS 2008) developed by the NMFS Northwest Region. The intake would be designed to fit into the river bank and divert flows over a range of river flow conditions.
- **Wet Well/Intake Structure** – The intake would divert surface water into a reinforced concrete wet well structure for pumping. The pumps would be mounted on a reinforced concrete slab above the wet well and intake.
- **Pump Type** – The pumps would be vertical turbine type pumps with electric motors, each designed to pull water from the wet well through a submerged impeller and vertical shaft to a discharge mounted on the slab above the wet well.
- **Pump Configuration** – The pump station would include two sets of pumps. One set would be designed to deliver water to users upstream of the pump station at a higher pressure head, or hydraulic gradient (HGL). The other set would be designed to deliver water to the users downstream of the pump station at a lower HGL.

- **Pump Flow Rates**
  - Upper pumps – 2.4 cfs (1,080 [gallons per minute] gpm)
  - Lower pumps – 8.6 cfs (3,860 gpm)
- **Number of Pumps**
  - Upper pumps – one duty, one standby
  - Lower pumps – two duty, one standby
- **Pump House –** A concrete masonry or fabricated metal building would be constructed to house the pumps and electrical equipment.
- **Electrical and Controls –** At least one pump in each set of pumps would be equipped with a variable frequency drive (VFD) to optimize performance, provide flexibility in delivering a range of flow rates, and allow for soft pump starts and stops. The pump station would require extension of 3-phase power service. An emergency generator would also need to be available to provide power for pumping during outages.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

3.1.1.2 Water Delivery

Water would be delivered to users through a pressurized pipe system, consisting primarily of pressure-rated PVC irrigation pipe, gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances. The system would be divided into two pressure zones to maximize pumping efficiency. Each pressure zone would be supplied through a set of pumps at the river pump station.

The Upper Pressure Zone would serve water users upstream of the proposed pump station at a maximum static HGL of 1,804 feet North American Vertical Datum (NAVD) 88. The pressurized irrigation main would extend approximately 13,990 feet up the existing MVID West Canal from the pump station discharge line to the existing concrete-lined section of the canal upstream of Alder Creek Road. The pumps and piping would be sized to deliver water at pressures in the range of 10 to 20 psi at the highest turnout on the main line. Lateral W0, a new lateral serving users near Alder Creek Road at the upstream end of the proposed system, and laterals W1 and W2 would be served from the Upper Pressure Zone.

The Lower Pressure Zone would serve water users downstream of the proposed pump station at a maximum static HGL of 1,667 feet NAVD 88. The new pressurized irrigation main would extend approximately 33,810 feet from the pump station discharge line to newly installed pressure pipe at the downstream end of the existing MVID West Canal. A new lateral, Lateral W3, would serve users on the Twisp-Carlton Road near the Roach Spill from the lower pressure zone. Laterals W4 through W16 would also be served by the Lower Pressure Zone. Some existing laterals would be combined, looped, or relocated to provide for more efficient delivery and address landowner concerns.

3.1.1.3 Water Storage

The concept shown on Figure 3-1 and illustrated in Drawings 1-1 through 1-4 (Appendix A) includes the option of providing water storage tanks in both pressure zones. Water storage would improve pump operation and allow for more consistent control of operating pressures within the delivery system. Water storage can also be used to provide some reserve to meet demand when a pump is not operating. Providing enough storage to supply demand during a long-term pumping outage would require a very large volume of storage and is not practical for this project. The proposed storage would be sized with capacity roughly equal to 2 hours of the peak summer design flow. The following storage is recommended:

- **Upper Pressure Zone –** One 132,100-gallon reinforced concrete tank with an overflow elevation of 1,804 feet NAVD 88.
- **Lower Pressure Zone –** Two 237,900-gallon reinforced concrete tanks with overflow elevations of 1,667 feet NAVD 88.

The storage facilities would need to be sited on a hillside at an elevation that will allow for the overflow to be set at the elevations indicated above. Storage facilities would include inlet/outlet piping, overflow piping, valves, fittings, and other appurtenances needed to access and maintain the tanks.

Table 3-2 provides a summary of pressure zones and materials that would be included to serve West Canal users as part of Alternative 1.

Table 3-2
Alternative 1 West System Summary

Pressure Zone	Maximum Static HGL (feet)	Pump Design Flow Rate (cfs)	Number of Pumps	Target Pressure at Highest Turnout (psi)	Main Pipeline Length (feet)	Storage Overflow Elevation (feet)	Storage Volume (gallons)
Upper	1,804	2.4	1 duty 1 standby	10 to 20	13,990	1,804	132,100
Lower	1,667	8.6	2 duty 1 standby	20 to 30	33,810	1,667	475,800

Notes:
cfs = cubic feet per second
psi = pounds per square inch

3.1.2 East Canal Improvements

Alternative 1 would also include installation of a pipeline to replace the MVID East Canal from Station 193+00, approximately 2,400 feet upstream of the Mill Spill, to the Beaver Creek Spill at Station 453+00. The system would be supplied by gravity through an inlet structure constructed in the existing East Canal. The pipeline would operate full under pressure by closing a valve at the downstream end and maintaining submergence at the inlet. The pipeline would be designed with the potential for extending it in the future upstream to the headgate and diversion structure at the Methow River. Although some lateral pipe may be relatively new, this evaluation assumes that existing laterals would be replaced to ensure that they can accommodate future system pressures. Approximately eight water users that are currently served from the MVID East Canal downstream of Lateral E14 would be converted to individual well systems.

3.1.2.1 Water Supply

The pipeline would be supplied directly from the East Canal with water diverted from the Methow River. An inlet structure would be installed to control flow to the pipeline. The inlet structure would be designed as follows (see Drawing 1-6 in Appendix A):

- **Location** – The inlet structure would be constructed in the MVID East Canal at Station 193+00, upstream of the Mill Spill.

- **Configuration** – The inlet structure would be designed to transition flow from the open East Canal to the pipeline. The structure would include a self-cleaning or travelling intake screen to keep debris out of the pipeline.
- **Spill** – The structure would be designed to allow excess water to spill to a pipe that would be installed under Twisp-Winthrop Road. Water would discharge through the pipe to a ditch or other conveyance designed to convey water to the Methow River.
- **Control** – Gates would be provided at the inlet to the main pipeline and at the inlet to the spill pipe to control flows. During the irrigation season, the gates would normally be open. Stop logs would be placed between the main pipeline inlet and the spill pipe inlet to control the water surface elevation at the main pipeline inlet.

3.1.2.2 Water Delivery

Water would be delivered to users through a pipe system, consisting primarily of pressure-rated polyvinyl chloride (PVC) irrigation pipe, gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances. The pipeline would be designed to operate full under pressure by closing a valve at the downstream end and maintaining submergence at the pipe inlet. The pipe would have a pressure rating sufficient to accommodate pressures that would result from a potential future extension of the pipeline up to the main head gate. Laterals E2 through E14 would be replaced and connected to the main pipeline. Some existing laterals would be combined, looped, or relocated to provide for more efficient delivery and address landowner concerns. The existing trestle at Beaver Creek and the canal downstream of Beaver Creek would be abandoned.

3.1.2.3 Lateral E1

If an agreement is reached between the Town of Twisp and MVID, MVID users on the east side of the Methow River within the Town of Twisp would be served irrigation water directly through the Town of Twisp water distribution system. Most of these users are currently served by MVID Lateral E1. The Town's water system would need to be upgraded to accommodate the additional demand. Upgrades would include use of the Town's existing Well No. 4, which is currently only used for emergencies; installation of a new well source; and replacement of existing pipe with larger pipe to provide additional capacity. If an agreement is not reached with the Town of Twisp, MVID Lateral E1 users would be served through a renovated Lateral E1 system connected to the proposed East Canal pipeline or supplied by a new well.

3.2 Alternative 2

Alternative 2 would replace the existing MVID West Canal with a pressurized pipe system supplied through groundwater wells. The East Canal would also be replaced with a gravity-fed pipeline from upstream of the Town of Twisp to Beaver Creek. Lateral E1 users would be served through the Town of Twisp water distribution system under an agreement with MVID or through a replacement lateral system supplied by a new groundwater well or a connection to the East Canal pipeline. Figure 3-2 provides a general overview of the major improvements that would be included as part of Alternative 2. More detailed feasibility level drawings for Alternative 1 are included as Drawings 2-1 through 2-5 in Appendix A. Table 3-3 provides a summary of the major components of Alternative 2 and the areas that would be served by each. A description of the major components of Alternative 2 follows.

Table 3-3
Alternative 2 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe system	Pressurized pipeline and lateral system supplied by groundwater wells	West Canal users from Station 161+00 to downstream end of canal	166	561	11.0
Individual wells	MVID users converted to individual well systems	West Canal users upstream of Station 161+00	8	25	0.5
East Canal Improvements					
East pipe system	Pipeline and lateral system supplied by existing East Canal	East Canal users from Station 193+00 (upstream of Mill Spill) to Beaver Creek	180	617	10.0
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID users within Town of Twisp limits on east side of Methow River	71	135	2.7
Individual wells	MVID users converted to individual well systems	East Canal users downstream of Lateral E14	8	30	0.6

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and east pipe system provided by Reclamation.

cfs = cubic feet per second

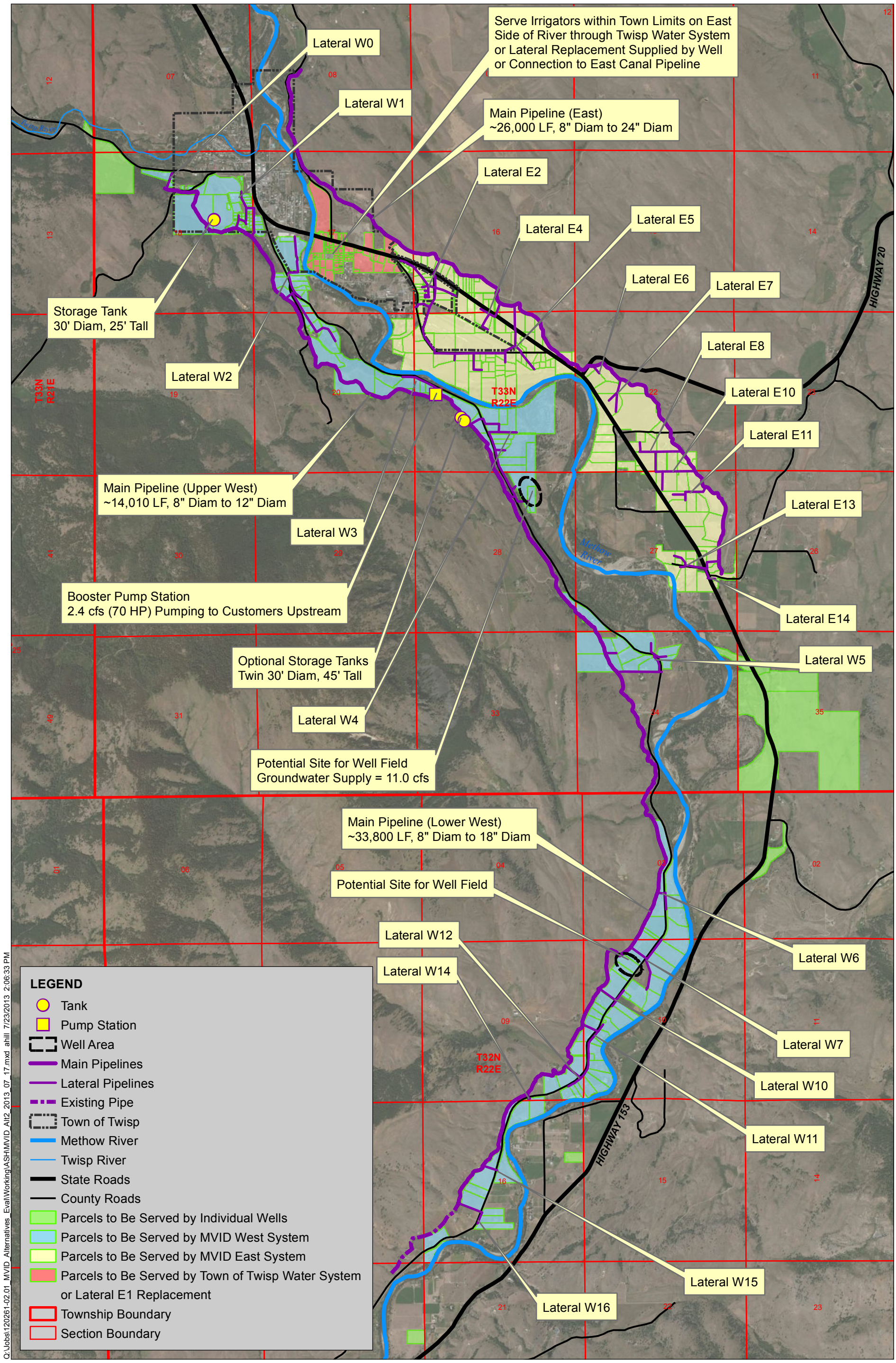

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Figure 3-2
Alternative 2
Methow Valley Irrigation District
Alternatives Evaluation Report

3.2.1 West Canal Improvements

Like Alternative 1, Alternative 2 would include a pressurized main line installed in the MVID West Canal from Station 161+00 to Station 639+03. The system would be served through groundwater wells in hydraulic connectivity with the Methow River. Although some existing lateral pipe may be relatively new, this evaluation assumes that existing laterals would be replaced to ensure that they can accommodate new system pressures. Approximately eight water users that are currently served from the MVID West Canal upstream of Station 161+00 would be converted to individual well systems.

3.2.1.1 Water Supply

Alternative 2 would change the point of diversion for the existing MVID West Canal water supply from the Twisp River to groundwater wells near the Methow River. The groundwater wells would be designed as follows (see Drawing 2-5 in Appendix A):

- **Location –** The groundwater wells would either be located in the vicinity of the Test Well 2 or Test Well 3, as documented in Section 4. Test Well 2 was drilled near Lateral W7 on property owned by Alyssa Jumars. Test Well 3 was drilled near Lateral W4 east on property owned by Janet Eileen.
- **Pump Type –** The well pumps would likely be submersible well pumps with electrical motors, designed for submergence and operation in groundwater. If groundwater levels are shallow, vertical turbine pumps could also be used.
- **Pump Flow Rates –** The combination of groundwater wells would need to deliver the total peak design flow rate required by the system, 11 cfs (4,940 gpm).
- **Number of Wells –** It is estimated that at least three wells would need to be constructed, each with a capacity of at least 3.7 cfs (1,645 gpm). Section 4.3.1 recommends that the wells each be sized to deliver approximately 4.4 to 4.5 cfs (1,800 gpm to 2,000 gpm) to provide a margin of safety if maintenance is required on one of the wells.
- **Well House –** A small, pre-fabricated, insulated shed or enclosure would be installed to house the wellhead and electrical equipment at each well.
- **Electrical and Controls –** At least one well pump would be equipped with a variable frequency drive (VFD) to optimize performance, provide flexibility in delivering a range of flow rates, and allow for soft pump starts and stops. Each well location

would require extension of 3-phase power. An emergency generator would need to be available to provide emergency power during outages.

- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

3.2.1.2 Water Delivery

Water would be delivered to water users through a pressurized pipe system, consisting primarily of pressure-rated PVC irrigation pipe, gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances. The system would be divided into two pressure zones by installing a booster pump station near the Roach Spill. The booster pump station would deliver water supplied by wells in the Lower Pressure Zone to the Upper Pressure Zone. The booster pump station would reduce the pumping head required for the well pumps and improve overall pumping efficiency. The pump station would be designed as follows (see Drawing 2-5 in Appendix A):

- **Location –** The pump station would be located on MVID property at the bottom of the drop near the top of the existing Roach Spill.
- **Pump Type –** The pumps would be end-suction centrifugal type pumps, designed to pump water from the Lower Pressure Zone (HGL approximately 1,667 feet) to the Upper Pressure Zone (HGL approximately 1,804 feet).
- **Pump Station Configuration –** The pump station would include parallel pumps mounted above a reinforced concrete slab with suction and discharge pipe, fittings, valves, and other appurtenances.
- **Pump Flow Rates –** 2.4 cfs (1,080 gpm)
- **Number of Pumps** – one duty, one standby
- **Pump House –** A small concrete masonry or fabricated metal building would be constructed to house the pumps and electrical equipment.
- **Electrical and Controls –** At least one pump would be equipped with a VFD to optimize performance, provide flexibility in delivering a range of flow rates, and allow for soft pump starts and stops. The pump station would require extension of 3-phase power service. An emergency generator would also need to be available to provide power for pumping during outages.

- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

The Upper Pressure Zone would serve water users upstream of the proposed pump station at a maximum static HGL of 1,804 feet NAVD 88. The pressurized irrigation main would extend approximately 14,010 feet up the existing MVID West Canal from the booster pump station to the existing concrete-lined section of the canal upstream of Alder Creek Road. The pumps and piping would be sized to deliver water at pressures of 10 to 20 psi at the highest turnout on the main line. Lateral W0, a new lateral serving users near Alder Creek Road at the upstream end of the proposed system, and laterals W1 and W2 would be served from the Upper Pressure Zone.

The Lower Pressure Zone would serve water users downstream of the proposed pump station at a maximum static HGL of 1,667 feet NAVD 88. The pressurized irrigation main would extend approximately 33,800 feet down the MVID West Canal from the booster pump station. The production wells would supply water directly to the lower pressure zone. A new lateral, Lateral W3, would serve users on the Twisp-Carlton Road near the Roach Spill from the Lower Pressure Zone. Laterals W4 through W16 would also be served by the lower pressure zone. Some existing laterals would be combined and looped to provide for more efficient delivery and address landowner concerns regarding the lateral location.

3.2.1.3 Water Storage

The concept shown on Figure 3-2 and illustrated in Drawings 2-1 through 2-4 (Appendix A) includes the option of providing water storage tanks in both pressure zones. Water storage would improve pump operation and allow for more consistent control of operating pressures within the delivery system. Water storage can also be used to provide some reserve to meet demand when a pump is not operating. Providing enough storage to supply demand during a long-term pumping outage would require a very large volume of storage and is not practical for this project. The proposed storage would be sized with capacity roughly equal to 2 hours of the peak summer design flow. The following storage is recommended:

- **Upper Pressure Zone –** One 132,100-gallon reinforced concrete tank with an overflow elevation of 1,804 feet NAVD 88

- **Lower Pressure Zone –** Two 237,900-gallon reinforced concrete tanks with overflow elevations of 1,667 feet NAVD 88

The storage facilities would need to be sited on a hillside at an elevation that will allow for the overflow to be set at the elevations indicated above. Storage facilities would include inlet/outlet piping, overflow piping, valves, fittings, and other appurtenances needed to access and maintain the tanks.

Table 3-2 provides a summary of pressure zones and materials that would be included as part of Alternative 2.

Table 3-4
Alternative 2 West System Summary

Pressure Zone	Maximum Static HGL (feet)	Pump/Well Design Flow Rate (cfs)	Number of Pumps/ Wells	Target Pressure at Highest Turnout (psi)	Main Pipeline Length (feet)	Storage Overflow Elevation (feet)	Storage Volume (gallons)
Upper	1,804	2.4	1 duty 1 standby	10 to 20	14,010	1,804	132,100
Lower	1,667	11.0	3 wells	20 to 30	33,800	1,667	475,800

Notes:
cfs = cubic feet per second
psi = pounds per square inch

3.2.2 East Canal Improvements

Alternative 2 would also include installation of a pipeline to replace the MVID East Canal from Station 193+00, approximately 2,400 feet upstream of the Mill Spill, to the Beaver Creek Spill at Station 453+00. The pipeline and lateral system would be identical to what was described for Alternative 1 in Section 3.1.2. Like Alternative 1, Alternative 2 would also serve irrigation water to MVID users on the east side of the Methow River within the Town of Twisp either through the Town of Twisp water distribution system or through a lateral replacement system supplied by a well or connection to the East Canal pipeline. The likely requirements and conditions that would apply for service to these users would be the same as those described for Alternative 1 in Section 3.1.2.3.

3.3 Alternative 3

Alternative 3 would replace the existing MVID West Canal System with two separate pressurized pipe systems supplied through groundwater wells. The East Canal would also be replaced with a pipeline from upstream of the Town of Twisp to Beaver Creek. Lateral E1 users would be served through the Town of Twisp water distribution system under an agreement with MVID or through a replacement lateral system supplied by a new groundwater well or a connection to the East Canal pipeline. Figure 3-3 provides a general overview of the major improvements that would be included as part of Alternative 3. More detailed feasibility level drawings for Alternative 1 are included as Drawings 3-1 through 3-5 in Appendix A. Table 3-5 provides a summary of the major components of Alternative 3 and the areas that would be served by each. A description of the major components of Alternative 3 follows.

Table 3-5
Alternative 3 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe systems	Two pressurized pipeline and lateral systems supplied by groundwater wells	West Canal users from Station 161+00 to downstream end of canal	166	561	11.0
Individual wells	MVID users converted to individual well systems	West Canal users upstream of Station 161+00	8	25	0.5
East Canal Improvements					
East pipe system	Pipeline and lateral system supplied by existing East Canal	East Canal users from Station 193+00 (upstream of Mill Spill) to Beaver Creek	180	617	10.0
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID users within Town of Twisp limits on east side of Methow River	71	135	2.7
Individual wells	MVID users converted to individual well systems	East Canal users downstream of Lateral E14	8	30	0.6

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and east pipe system provided by Reclamation.

cfs = cubic feet per second

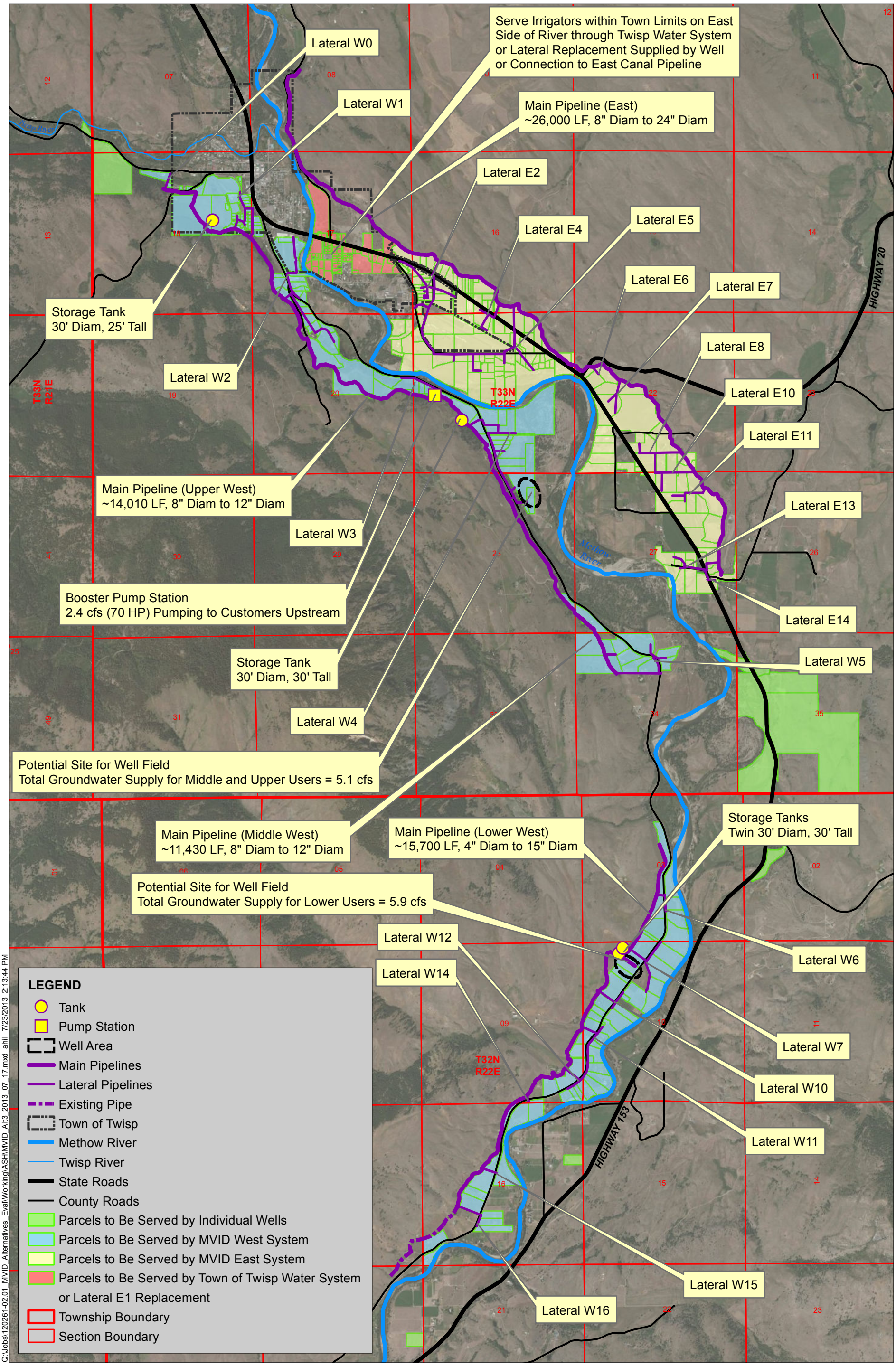

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Figure 3-3
Alternative 3
Methow Valley Irrigation District
Alternatives Evaluation Report

3.3.1 West Canal Improvements

Alternative 3 would include two pressurized systems. The upper system would include a pressurized main line installed in the MVID West Canal from Station 161+00 to Station 415+40 and would be served by wells near the middle of the canal. The lower system would include a pressurized main line installed in the MVID West Canal from Station 482+06 to Station 639+03 and would be served by wells near the lower end of the canal. Having two separate systems would reduce the overall length, size, and cost of the main pipeline. Although some lateral pipe may be relatively new, this evaluation assumes that existing lateral pipe would also be replaced to ensure that the laterals can accommodate new system pressures. Approximately eight water users that are currently served from the MVID West Canal upstream of Station 161+00 would be converted to individual well systems.

3.3.1.1 Water Supply

Alternative 3 would change the point of diversion for the existing MVID West Canal water supply from the Twisp River to groundwater wells. The groundwater wells would be designed as follows (see Drawing 3-5 in Appendix A):

- **Location**
  - Upper System – The groundwater wells for the upper system would be located in the vicinity of Test Well 3, as documented in Section 4. Test Well 3 was drilled near Lateral W4 east on property owned by Janet Eileen.
  - Lower System – The groundwater wells for the lower system would be located in the vicinity of Test Well 2. Test Well 2 was drilled near Lateral W9 on property owned by Alyssa Jumars.
- **Pump Type** – The well pumps would be submersible well pumps with electrical motors, designed for submergence and operation in groundwater. If groundwater levels are shallow, vertical turbine pumps could also be used.
- **Pump Flow Rates**
  - Upper System – The groundwater wells serving the upper system would need to deliver the total peak design flow rate of 5.1 cfs (2,290 gpm).
  - Lower System – The groundwater wells serving the lower system would need to deliver the total peak design flow rate of 5.9 cfs (2,650 gpm).

- **Number of Wells**
  - Upper System – It is estimated that at least two wells would need to be constructed to serve the upper system, each with a capacity of at least 2.6 cfs (1,170 gpm). Section 4.3.1 recommends that the wells each be sized to deliver up to 2.7 cfs (1,200 gpm) to provide a margin of safety if maintenance is required on one of the wells.
  - Lower System – It is estimated that at least three wells would need to be constructed to serve the lower system, each with a capacity of at least 2.0 cfs (900 gpm). Section 4.3.1 recommends that the wells each be sized to deliver up to 2.2 cfs (1,000 gpm) to provide a margin of safety if maintenance is required on one of the wells.
- **Well House –** A small, pre-fabricated, insulated shed or enclosure would be installed to house the wellhead and electrical equipment at each well.
- **Electrical and Controls –** At least one well pump for each system would be equipped with a VFD to optimize performance, provide flexibility in delivering a range of flow rates, and allow for soft pump starts and stops. Each well location would require extension of 3-phase power. An emergency generator would need to be available to provide emergency power during outages.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

3.3.1.2 Water Delivery

Water would be delivered to water users through two pressurized pipe systems, consisting primarily of pressure-rated PVC irrigation pipe, gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances. The upper system would be divided into Upper and Middle Pressure Zones by installing a booster pump station near the Roach Spill. The lower system would be a single pressure zone. The booster pump station would deliver water supplied by wells in the Middle Pressure Zone of the upper system to the Upper Pressure Zone. The booster pump station would reduce the pumping head required for the well pumps and improve overall pumping efficiency. The pump station would be designed as follows (see Drawing 3-4 in Appendix A):

- **Location –** The pump station would be located on MVID property at the bottom of the drop near the top of the existing Roach Spill.
- **Pump Type –** The pumps would be end-suction centrifugal type pumps, designed to pump water from the Middle Pressure Zone of the upper system (HGL approximately 1,667 feet) to the Upper Pressure Zone (HGL approximately 1,804 feet).
- **Pump Station Configuration –** The pump station would include parallel pumps mounted above a reinforced concrete slab with suction and discharge pipe, fittings, valves, and other appurtenances.
- **Pump Flow Rates –** 2.4 cfs (1,080 gpm)
- **Number of Pumps –** one duty, one standby
- **Pump House –** A small concrete masonry or fabricated metal building would be constructed to house the pumps and electrical equipment.
- **Electrical and Controls –** At least one pump would be equipped with a VFD to optimize performance, provide flexibility in delivering a range of flow rates, and allow for soft pump starts and stops. The pump station would require extension of 3-phase power service. An emergency generator would also need to be available to provide power for pumping during outages.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

The Upper Pressure Zone would serve water users upstream of the proposed pump station at a maximum static HGL of 1,804 feet NAVD 88. The pressurized irrigation main would extend approximately 14,010 feet up the existing MVID West Canal from the booster pump station to the existing concrete-lined section of the canal upstream of Alder Creek Road. The pumps and piping would be sized to deliver water at pressures of 10 to 20 psi at the highest turnout on the main line. Lateral W0, a new lateral serving users near Alder Creek Road at the upstream end of the proposed system, and laterals W1 and W2 would be served from the Upper Pressure Zone.

The Middle Pressure Zone would serve water users downstream of the proposed pump station from the upper system at a maximum static HGL of 1,667 feet NAVD 88. The pressurized irrigation main would extend approximately 11,430 feet down the MVID West Canal from the booster pump station. The production wells would supply water directly to

the Middle Pressure Zone. A new lateral, Lateral W3, would serve users on the Twisp-Carlton Road near the Roach Spill from the Middle Pressure Zone. Laterals W4 and W5 would also be served by the Middle Pressure Zone. Some existing laterals would be combined and looped to provide for more efficient delivery and address landowner concerns regarding the lateral location.

The Lower Pressure Zone would comprise the entire lower system and would serve users at a maximum static HGL of 1,620 feet NAVD 88. The pressurized irrigation main would extend approximately 15,300 feet along the existing West Canal. The production wells would supply water directly to the Lower Pressure Zone near the upper third of the main line. Laterals W6 through W16 would be served by the Lower Pressure Zone. Some existing laterals would be combined and looped to provide for more efficient delivery and address landowner concerns regarding the lateral location.

3.3.1.3 Water Storage

The concept shown on Figure 3-3 and illustrated in Drawings 3-1 through 3-4 (Appendix A) includes the option of providing water storage tanks in all three pressure zones. Water storage would improve pump operation and allow for more consistent control of operating pressures within the delivery system. Water storage can also be used to provide some reserve to meet demand when a pump is not operating. Providing enough storage to supply demand during a long-term pumping outage would require a very large volume of storage and is not practical for this project. The proposed storage would be sized with capacity roughly equal to two hours of the peak summer design flow. The following storage is recommended:

- **Upper Pressure Zone –** One 132,100-gallon reinforced concrete tank with an overflow elevation of 1,804 feet NAVD 88
- **Middle Pressure Zone –** One 158,600-gallon reinforced concrete tank with an overflow elevation of 1,667 feet NAVD 88
- **Lower Pressure Zone –** Two 158,600-gallon reinforced concrete tanks with overflow elevations of 1,620 feet NAVD 88

The storage facilities would need to be sited on a hillside at an elevation that will allow for the overflow to be set at the elevations indicated above. Storage facilities would include

inlet/outlet piping, overflow piping, valves, fittings, and other appurtenances needed to access and maintain the tanks.

Table 3-6 provides a summary of pressure zones and materials that would be included as part of Alternative 3.

Table 3-6
Alternative 3 West System Summary

Pressure Zone	Maximum Static HGL (feet)	Pump/Well Design Flow Rate (cfs)	Number of Pumps/ Wells	Target Pressure at Highest Turnout (psi)	Main Pipeline Length (feet)	Storage Overflow Elevation (feet)	Storage Volume (gallons)
Upper	1,804	2.4	1 duty 1 standby	10 to 20	14,010	1,804	132,100
Middle	1,667	5.1	2 wells	20 to 30	11,430	1,667	158,600
Lower	1,620	5.9	3 wells	20 to 30	15,300	1,620	317,200

Notes:
cfs = cubic feet per second
psi = pounds per square inch

3.3.2 East Canal Improvements

Alternative 3 would also include installation of a pipeline to replace the MVID East Canal from Station 193+00, approximately 2,400 feet upstream of the Mill Spill, to the Beaver Creek Spill at Station 453+00. The pipeline and lateral system would be identical to what was described for Alternative 1 in Section 3.1.2. Like Alternatives 1 and 2, Alternative 3 would also serve irrigation water to MVID users on the east side of the Methow River within the Town of Twisp either through the Town of Twisp water distribution system or through a lateral replacement system supplied by a well or connection to the East Canal pipeline. The likely requirements and conditions that would apply for service to these users would be the same as those described for Alternative 1 in Section 3.1.2.3.

3.4 Alternative 4

Alternative 4 would focus on converting as many existing MVID users as possible to individual well systems. Two areas of the existing MVID system have been identified where conversion to individual wells is likely not feasible:

- **Upper West Side –** The users at the higher elevations served by the West Canal upstream of the drop near the Roach Spill are located on the hillside above and outside the extent of the alluvium in the valley and would likely not be able to drill productive wells that would meet individual irrigation needs
- **Lateral E1 –** Existing MVID users within the Town limits near Lateral E1 are unlikely to have the opportunity to drill individual wells due to restrictions on individual wells within the Town limits and the size and proximity of the parcels served

Two options were considered for service to these users:

- Replacement of existing MVID facilities with a smaller system designed to serve users that cannot be served through individual wells.
- Service to users within the Town of Twisp directly through the Town of Twisp water distribution system. An arrangement with the Town of Twisp would likely require transfer of a portion of MVID's existing water rights to the Town of Twisp so that the system would have sufficient water rights to supply the irrigation demand.

The users at the higher elevations served from the upstream end of the West Canal include a few larger parcels. The irrigation demand for these larger parcels would likely be too much for the Town of Twisp water system to supply without extensive upgrades. In addition, some of the parcels are outside the Town of Twisp limits and are not adjacent to existing Town of Twisp system. Consequently, a smaller system with a well and pressurized pipe would be needed to serve these users.

Existing MVID users within the Town limits near Lateral E1 generally include smaller parcels that are adjacent to existing Town of Twisp water system facilities. Although upgrades would be needed to accommodate the additional demand, it is anticipated that these users could be served directly through the Town's water system if an agreement can be reached between MVID and the Town of Twisp. If an agreement is not reached with the

Town of Twisp, MVID Lateral E1 users could be served through a renovated Lateral E1 system supplied by a new groundwater well.

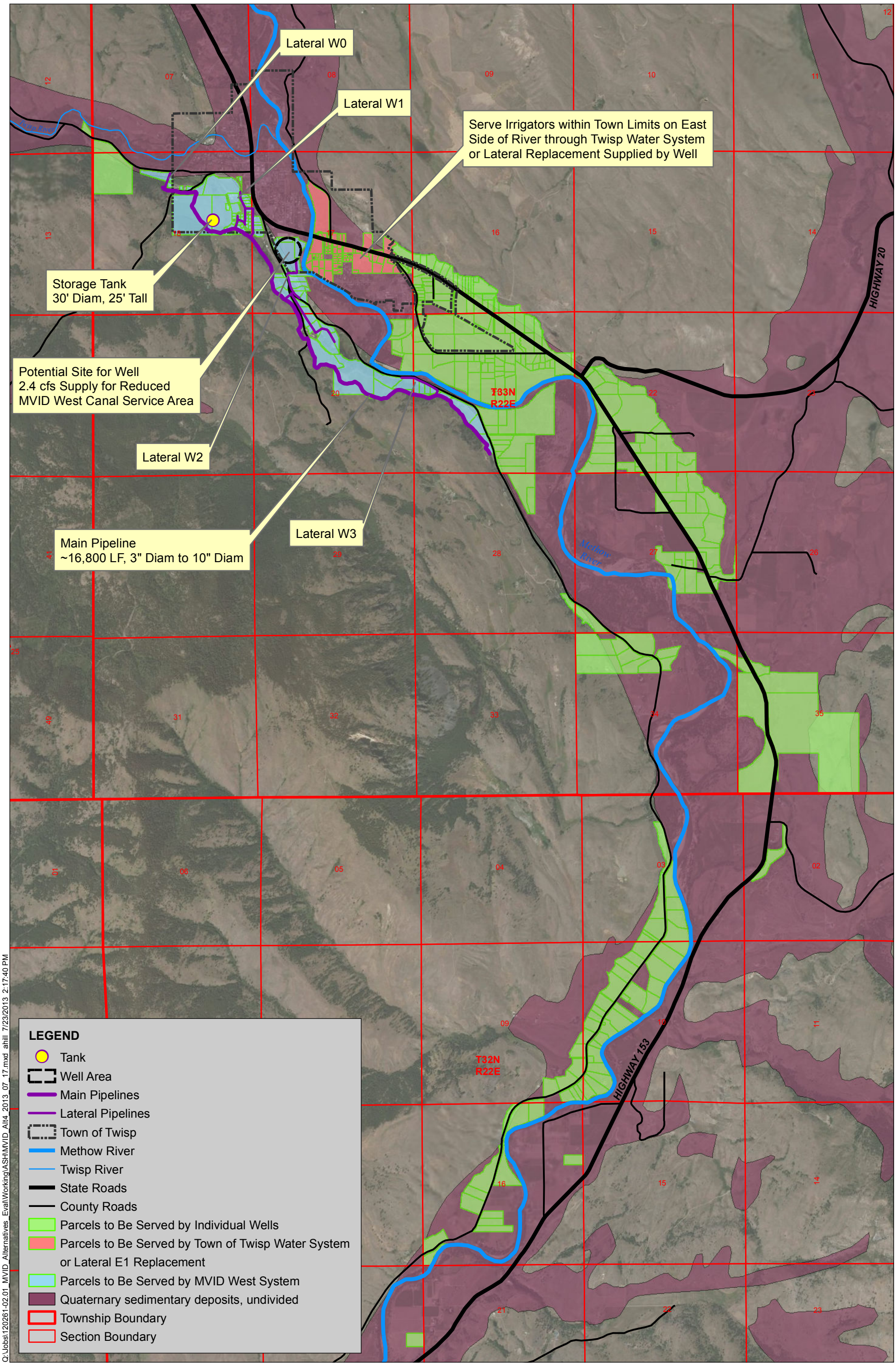
Figure 3-4 provides a general overview of the major improvements that would be included as part of Alternative 4. More detailed feasibility level drawings for Alternative 4 are included as Drawings 4-1 through 4-5 in Appendix A. Table 3-7 provides a summary of the major components of Alternative 4 and the areas that would be served by each. A description of the major components of Alternative 4 follows.

Table 3-7
Alternative 4 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe system	Smaller pressurized pipeline and lateral systems supplied by groundwater well	West Canal users from Station 161+00 to Station 329+05	87	141	2.8
Individual wells	MVID users converted to individual well systems	West Canal users upstream of Station 161+00 and downstream of 329+05	87	445	8.9
East Canal Improvements					
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID users within Town of Twisp limits on east side of Methow River	71	135	2.7
Individual wells	MVID users converted to individual well systems	East Canal users outside Town of Twisp limits on east side of Methow River	188	647	13.0

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and Lateral E1 scaled from design flow rate for larger west pipe system and east pipe system included in Alternatives 1, 2, and 3. Design flow rates for individual well conversions based on maximum withdrawal rate of 9 gallons per minute per acre.

cfs = cubic feet per second



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Feet
0 1,500 3,000 4,500 6,000

Figure 3-4
Alternative 4
Methow Valley Irrigation District
Alternatives Evaluation Report

3.4.1 West Canal Improvements

Alternative 4 would include a pressurized system supplied by a groundwater production well to serve users at higher elevations at the upstream end of the West Canal who would not likely have success supplying their irrigation needs through individual wells. The Upper West System would include a pressurized main line installed in the MVID West Canal from Station 161+00 to Station 329+05. The system would be operated as a reduced MVID system. Existing West Canal users upstream of Station 161+00 and downstream of 329+05 would be converted to individual well systems.

3.4.1.1 Water Supply

Alternative 4 would change the point of diversion for the existing MVID West Canal water supply from the Twisp River to groundwater wells, including groundwater wells designed to serve individual parcels. The Upper West system would be supplied through a groundwater production well near the Methow River. The wells would be designed as follows (see Drawing 4-5 in Appendix A):

- **Location**
  - The groundwater well for the Upper West system would likely be located near the Methow River in the vicinity of the orchard owned by Dave Shulz. No test well has been drilled at this location, so that capacity of a production well would need to be verified. If sufficient capacity is not available from a well on the Shulz property, another well location in the vicinity of Test Well 3 should be considered. Test Well 3 was drilled near Lateral W4 on property owned by Janet Eileen, as documented in Section 4.
  - Individual Wells – Individual wells would be located on individual parcels and developed in alluvium at the bottom of the valley.
- **Pump Type –** The well pumps would be submersible well pumps with electrical motors, designed for submergence and operation in groundwater. If groundwater levels are shallow, vertical turbine pumps could also be used.
- **Pump Flow Rates**
  - Upper West System – The groundwater wells serving the upper system would need to deliver the total peak design flow rate of 2.8 cfs (1,260 gpm).

  - Individual Wells – Individual wells would be designed to serve up to 9 gpm per acre irrigated.

- **Number of Wells**
  - Upper West System – One well would be drilled to serve the 2.8 cfs (1,260 gpm) needed for the Upper West system. A spare pump could be purchased for redundancy.
  - Individual Wells – Approximately 87 parcels currently served by the West Canal would be converted to individual well systems.

- **Well House –** A small, pre-fabricated, insulated shed or enclosure would be installed over the production well serving the Upper West System.
- **Electrical and Controls –** The production well would require extension of 3-phase power. An emergency generator would need to be available to provide emergency power during outages.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

3.4.1.2 Water Delivery

The Upper West system would be a pressurized pipe system, consisting primarily of pressure-rated PVC irrigation pipe, gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances. The system would consist of a single pressure zone with a maximum static HGL of 1,804 feet NAVD 88. The system would include approximately 16,800 feet of new pressurized main line installed in the existing MVID West Canal. The well pump and piping would be sized to deliver water at pressures of 10 to 20 pounds psi at the highest turnout on the main line. Laterals W0, W1, W2, and W3 would be served by the Upper West system.

3.4.1.3 Water Storage

The concept shown on Figure 3-4 and illustrated in Drawings 4-1 through 4-4 (Appendix A) includes the option of providing a water storage tank for the Upper West system. Water storage would improve pump operation and allow for more consistent control of operating pressures within the delivery system. Water storage can also be used to provide some reserve

to meet demand when a pump is not operating. Providing enough storage to supply demand during a long-term pumping outage would require a very large volume of storage and is not practical for this project. The proposed storage would be sized with capacity roughly equal to two hours of the peak summer design flow. One 132,100-gallon reinforced concrete tank with an overflow elevation of 1,804 feet NAVD 88 is recommended.

Table 3-8 provides a summary of the Upper West system that would replace the upstream end of the West Canal as part of Alternative 4.

Table 3-8
Alternative 4 West System Summary

System	Maximum Static HGL (feet)	Pump/Well Design Flow Rate (cfs)	Number of Pumps/ Wells	Target Pressure at Highest Turnout (psi)	Storage Overflow Elevation (feet)	Storage Volume (gallons)
Upper West	1,804	2.8	1 well	10 to 20	1,804	132,100

Notes:
cfs = cubic feet per second
psi = pounds per square inch

3.4.2 East Canal Improvements

Alternative 4 would convert the majority of users on the existing MVID East Canal to individual well systems. The existing MVID East Canal would be abandoned downstream of Station 193+00. The canal upstream of Station 193+00 would be maintained to convey water to Barkley Ditch Company users who are currently served through the MVID East Canal. Approximately 188 water users that are currently served from the MVID East Canal downstream of Lateral E1 would be converted to individual well systems. Approximately 71 users within the Town of Twisp near Lateral E1 would be served directly through the Town of Twisp water distribution system, or through a system designed to replace Lateral E1.

3.4.2.1 Water Supply

Alternative 4 would change the point of diversion for the majority of the existing MVID East Canal water supply from the Methow River to groundwater wells. The water right for

parcels within the Town of Twisp would be leased or transferred to the Town of Twisp under an agreement with MVID to serve irrigation water to users in the Town of Twisp.

3.4.2.2 Lateral E1

If an agreement is reached between the Town of Twisp and MVID, MVID users on the east side of the Methow River within the Town of Twisp would be served irrigation water directly through the Town of Twisp water distribution system. Most of these users are currently served by MVID Lateral E1. The Town's water system could need to be upgraded to accommodate the additional demand. Upgrades would include use of the Town's existing Well No. 4, which is currently only used for emergencies; installation of a new well source; and replacement of existing pipe with larger pipe to provide additional capacity. If an agreement is not reached with the Town of Twisp, MVID Lateral E1 users could be served through a renovated Lateral E1 system supplied by a new production well near the Methow River with a capacity of at least 2.7 cfs.

3.5 Alternative 5

Alternative 5 was developed by project stakeholders as a combination of items from the first four Alternatives. Alternative 5 would include the following improvements:

- **West Canal Improvements** – Improvements to the existing West Canal and conversion of existing users to individual wells on the west side of the Methow River would be the same for Alternative 5 as what was described for Alternative 4, in Section 3.4.1. Users at the upstream end of the West Canal (from Station 161+00 to Station 329+05) would be served through a pressurized pipe system supplied by a groundwater production well. The system would be operated as a reduced MVID system. Existing West Canal users upstream of Station 161+00 and downstream of 329+05 would be converted to individual well systems.
- **East Canal Improvements** – Improvements to the existing East Canal and conversion of existing users to individual wells on the east side of the Methow River would be the same for Alternative 5 as what was described for Alternatives 1 through 3, in Section 3.1.2. A pipeline would be installed to replace the MVID East Canal from Station 193+00 to the Beaver Creek Spill. Existing MVID users within the Town of Twisp would either be served through the Town's water distribution system under an

agreement with the Town of Twisp or through a lateral replacement system supplied by a groundwater well or connection to the East Canal pipeline. Approximately eight water users that are currently served from the MVID East Canal downstream of Lateral E14 would be converted to individual well systems.

Figure 3-5 includes a map providing a general overview of the major improvements that would be included as part of Alternative 5. More detailed feasibility level drawings for Alternative 5 are included as Drawings 5-1 through 5-5 in Appendix A. Table 3-9 provides a summary of the major components of Alternative 5 and the areas that would be served by each. A description of the major components of Alternative 5 follows.

Table 3-9
Alternative 5 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe system	Smaller Pressurized Pipeline and Lateral Systems Supplied by Groundwater Well	West Canal Users from Station 161+00 to Station 329+05	87	141	2.8
Individual Wells	MVID Users Converted to Individual Well Systems	West Canal Users Upstream of Station 161+00 and Downstream of 329+05	87	445	8.9
East Canal Improvements					
East pipe system	Pipeline and Lateral System Supplied by Existing East Canal	East Canal Users from Station 193+00 (Upstream of Mill Spill) to Beaver Creek	180	617	10.0
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID Users Within Town of Twisp Limits on East Side of Methow River	71	135	2.7
Individual Wells	MVID Users Converted to Individual Well Systems	East Canal Users Downstream of Lateral E14	8	30	0.6

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and Lateral E1 scaled from design flow rate for larger west pipe system and east pipe system included in Alternatives 1, 2, and 3. Design flow rates for individual well conversions based on maximum withdrawal rate of 9 gallons per minute per acre.

cfs = cubic feet per second

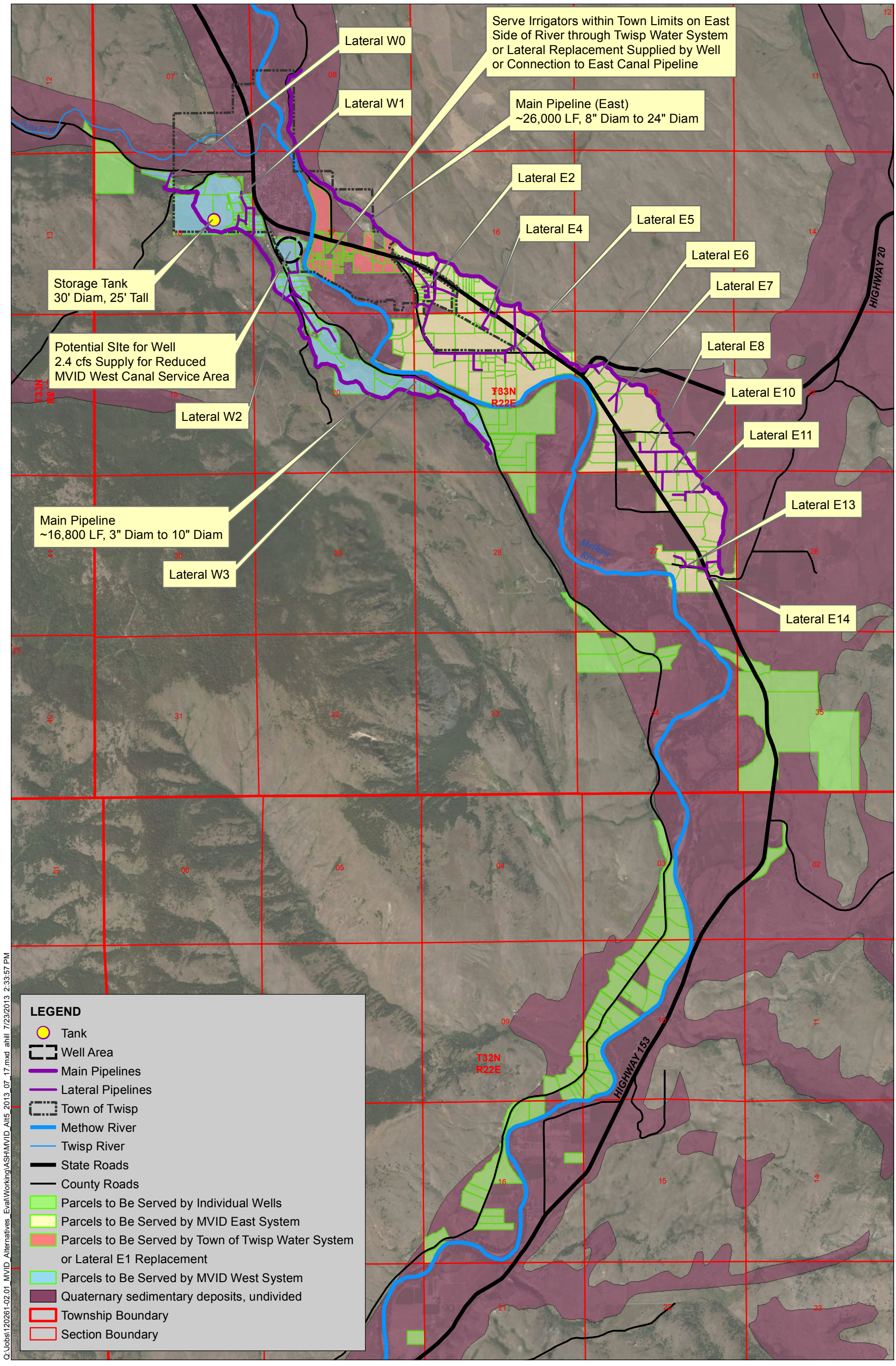

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Figure 3-5
Alternative 5
Methow Valley Irrigation District
Alternatives Evaluation Report

4 GROUNDWATER WELL SUPPLY FEASIBILITY

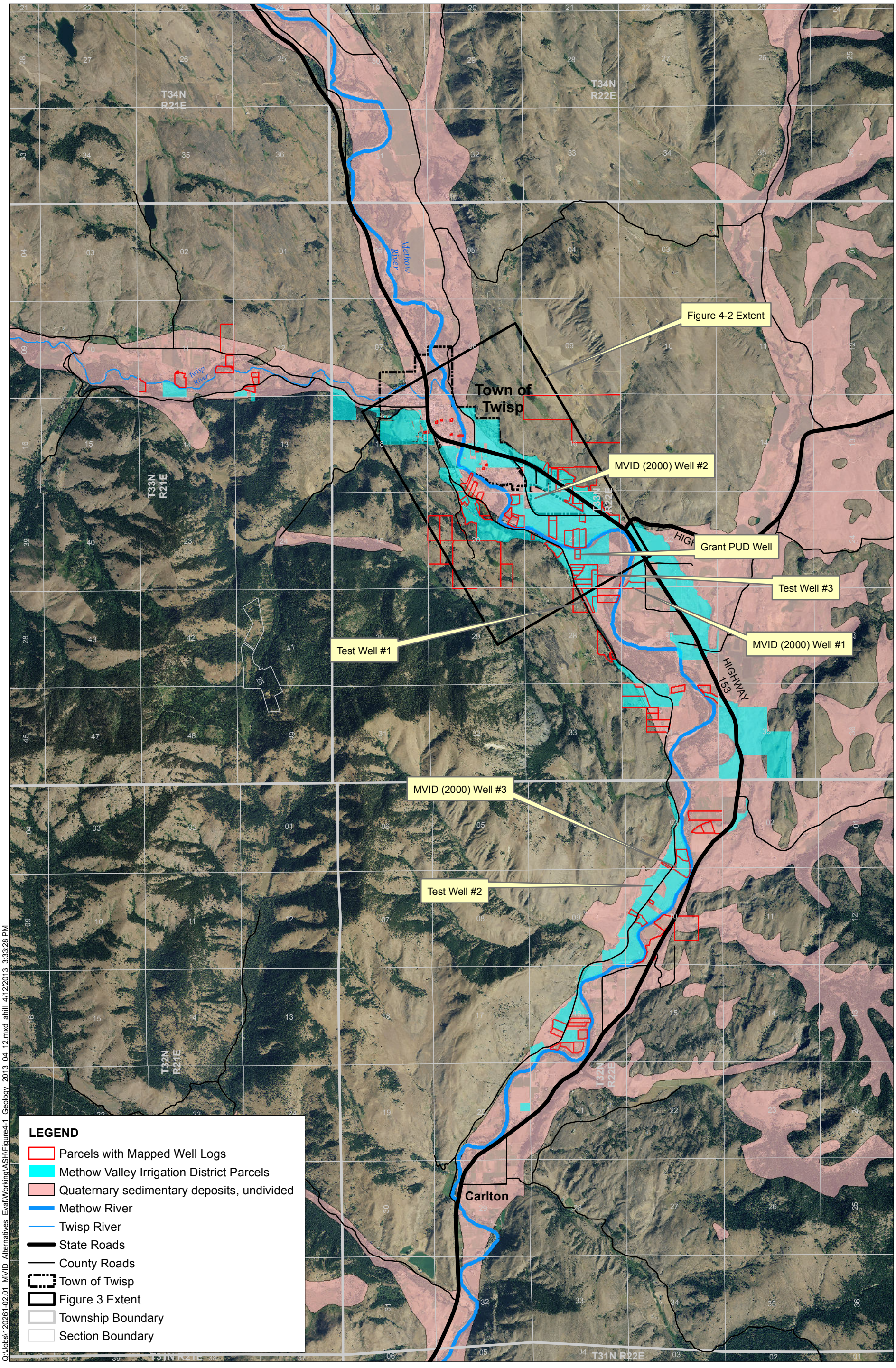
4.1 Groundwater Information Used in Report

The information relied upon for this groundwater feasibility section was obtained from a USGS study; previous groundwater investigations performed for Ecology; a groundwater investigation performed for Public Utility District No. 2 of Grant County (Grant PUD); well logs obtained from Ecology; Reports of Examination (ROEs) for water right changes within the previous boundaries of the MVID and test wells drilled in 2013 for this report.

4.1.1 USGS Study

The USGS investigated the hydrogeology of unconsolidated sedimentary deposits, the surface water and groundwater quality, and exchange between surface water and groundwater in the Methow Valley (USGS 2005). According to the USGS study, the unconsolidated sediments along the bottoms and lower slopes of valleys are the most significant portion of the groundwater reservoir in the Methow River Basin in terms of volume, proximity to rivers, and proximity to human population. The unconsolidated sediments are composed of sand and gravel, and range from a few feet to more than a thousand feet in thickness. The sediments beneath the main Methow River valley are dominated by coarse-grained material, which are highly transmissive and are the most productive aquifers in the basin where saturated. From Twisp to Benson Creek, the thickness of the unconsolidated sediments near the center of the valley is over 250 feet, while on the margins bedrock is found at shallow depths. Layers of silt, clay, or glacial till are present within the sands and gravels and act locally as confining beds. The existing data indicate that the confining units are of limited lateral extent. The Methow and Twisp Rivers are major sources of recharge for the unconsolidated aquifer, particularly during high-flow periods in May and June.

Figure 4-1 presents the areas of sedimentary deposits in the project vicinity. Based on the USGS study, these areas are expected to have highly productive aquifers and would likely be feasible for groundwater well supply.



ANCHOR QEA

Feet
0 2,500 5,000 7,500 10,000

Figure 4-1
Geology and Well Locations
Methow Valley Irrigation District
Alternatives Evaluation Report

4.1.2 Previous Test Wells

4.1.2.1 2000 MVID Wells

Wells were constructed in 1999 and 2000 as part of an aquifer testing and hydrogeologic evaluation within the MVID to study alternative water supply sources (MWG/HWA 2000). Ecology was the lead agency and funded the evaluation. Wells were constructed in three locations, which are shown on Figure 4-1.

Each location had a test well with a corresponding observation well drilled 50 feet away. Wells were developed in the unconsolidated sedimentary formations. Table 4-1 presents a summary of the physical properties of the wells, including the boring depth (depth to which the well was drilled), the completed well depth, the depth at which a well screen was installed, and the observed static water level in each well.

Table 4-1
2000 MVID Well Physical Properties

Well and Location	Diameter (in)	Boring Depth (ft bgs)	Well Depth (ft bgs)	Screened Depth Range (ft bgs)	Static Water Level (ft bgs)
Test Well 1	12	200	161	86-156	10
Test Well 2	12	200	195	155-190	51
Test Well 3	12	140	140	100-135	33
Observation Well 1	6	200	156	136-156	10
Observation Well 2	6	200	190	170-190	51
Observation Well 3	6	140	135	115-135	33

Source: MWG/HWA 2000
Notes:
ft bgs = feet below ground surface
in = inches

The wells were tested during spring 2000 by performing a step pumping test and a constant rate pumping test on each test well. These tests were used to analyze aquifer properties. A summary of results of the pumping tests are shown in Table 4-2.

Table 4-2
2000 MVID Well Pump Test Results

Location	Well 1	Well 2	Well 3
Step Test Date	5/9/2000	4/18/2000	4/4/2000
Maximum Step Test Rate (gpm)	1,200	925	1,022
Maximum Step Test Duration (min)	130	80	90
Maximum Step Test Drawdown (ft)	18.5	16.5	4.6
Constant Rate Test Date	5/10/2000	4/19/2000	4/5/2000
Constant Rate (gpm)	1,100	825	1,025
Constant Rate Test Duration (min)	7,220	8,890	7,220
Maximum Drawdown – Test Well (ft)	17.3	14.4	5.2
Maximum Drawdown – Observation Well (ft)	6	2.2	2.6
Transmissivity Estimate (ft^2/day)	62,000	35,000	96,000
Hydraulic Conductivity (ft/day)	411	243	897

Source: MWG/HWA 2000
Notes:
ft = feet
ft^2 = square feet
gpm = gallons per minute

The pump tests had minor effects on observation wells and using the wells at the pumping rates tested (800 to 1,100 gpm, or 1.8 to 2.4 cfs) would not be expected to affect any nearby domestic wells. The pump tests were also found to not affect Methow River water levels at the rates tested.

Additional details can be found in the MWG/HWA report that originally presented the pump test results for the MVID wells (MWG/HWA 2000).

4.1.2.2 2011 Grant PUD Well

A well was constructed in 2011 for Grant PUD to assess groundwater availability at a site within the geographical boundary of the MVID. The location of the well is shown in Figure 4-1 and is known as the Carlton Pond site.

A 12-inch diameter well was constructed during October and November 2011 to a depth of 170 feet below ground surface (ft bgs) in sand and gravel. A screen was set between 110 ft bgs and 160 ft bgs. The static water level was 10 ft bgs. The well was tested in November and December 2011 by performing a step pump test and two constant rate pump tests. Table 4-3 summarizes the pumping test results. No observation well was available.

Table 4-3
2011 Grant PUD Well Pump Test Results

Test	Results
Step Test Date – 11/30/2011	
Maximum Step Test Rate (gpm)	2,035
Maximum Step Test Duration (min)	60
Maximum Step Test Drawdown (ft)	25.6
Constant Rate Test #1 Date – 12/1/2011	
Constant Rate – Test #1 (gpm)	2,014
Constant Rate Duration – Test #1 (min)	1,300
Maximum Drawdown – Test #1 (ft)	26.4
Constant Rate Test #2 Date – 12/3/2011	
Constant Rate – Test #2 (gpm)	1,990
Constant Rate Duration – Test #2 (min)	3,340
Maximum Drawdown – Test #2 (ft)	27.5
Transmissivity Estimate (ft^2/day)	57,950
Hydraulic Conductivity (ft/day)	725

Source: Anchor QEA 2012
Notes:
ft = feet
ft^2 = square feet
gpm = gallons per minute
min = minute

Additional details on the pump test can be found in the report titled "Carlton Pond Well Drilling and Testing Results" (Anchor QEA 2012).

4.1.3 MVID 2013 Test Wells

Three test wells were constructed in 2013 for this report. The locations of the wells are shown on Figure 4-1. The locations were selected to investigate the potential for use of groundwater that would supply a pipeline replacing the West Canal. The first well was constructed on MVID-owned property near the West Canal at a site called the Beaver Ponds. The second well was constructed on the Jumars property also along the West Canal in the lower part of the MVID. The third well was constructed on the Eileen property east of the first well as the first well was found to encounter bedrock at a relatively shallow depth. Table 4-4 shows the physical properties for the wells. Well logs for the three test wells are provided in Appendix B.

Table 4-4
2013 MVID Well Physical Properties

Well and Location	Diameter (in)	Boring Depth (ft bgs)	Well Depth (ft bgs)	Screened Depth (ft bgs)	Static Water Level (ft bgs)
Test Well 1	8	90	79	N/A	10
Test Well 2	8	178	168	144 to 164	66.5
Test Well 3	8	160	160	134 to 154	10

Notes:
ft bgs = feet below ground surface
in = inches
N/A = not applicable

Test Well 1 encountered bedrock at 79 ft bgs. Although the formation between the ground surface and bedrock is gravel and probably highly transmissive, it was determined that the well would not be suitable for pumping the large quantities of water required for the MVID (see Section 4.3 for required water supply) because of its shallow depth and adjacent bedrock valley wall. A screen was not installed and the well was not further developed. The well may have value as a backup well to others drilled nearby and should not be abandoned.

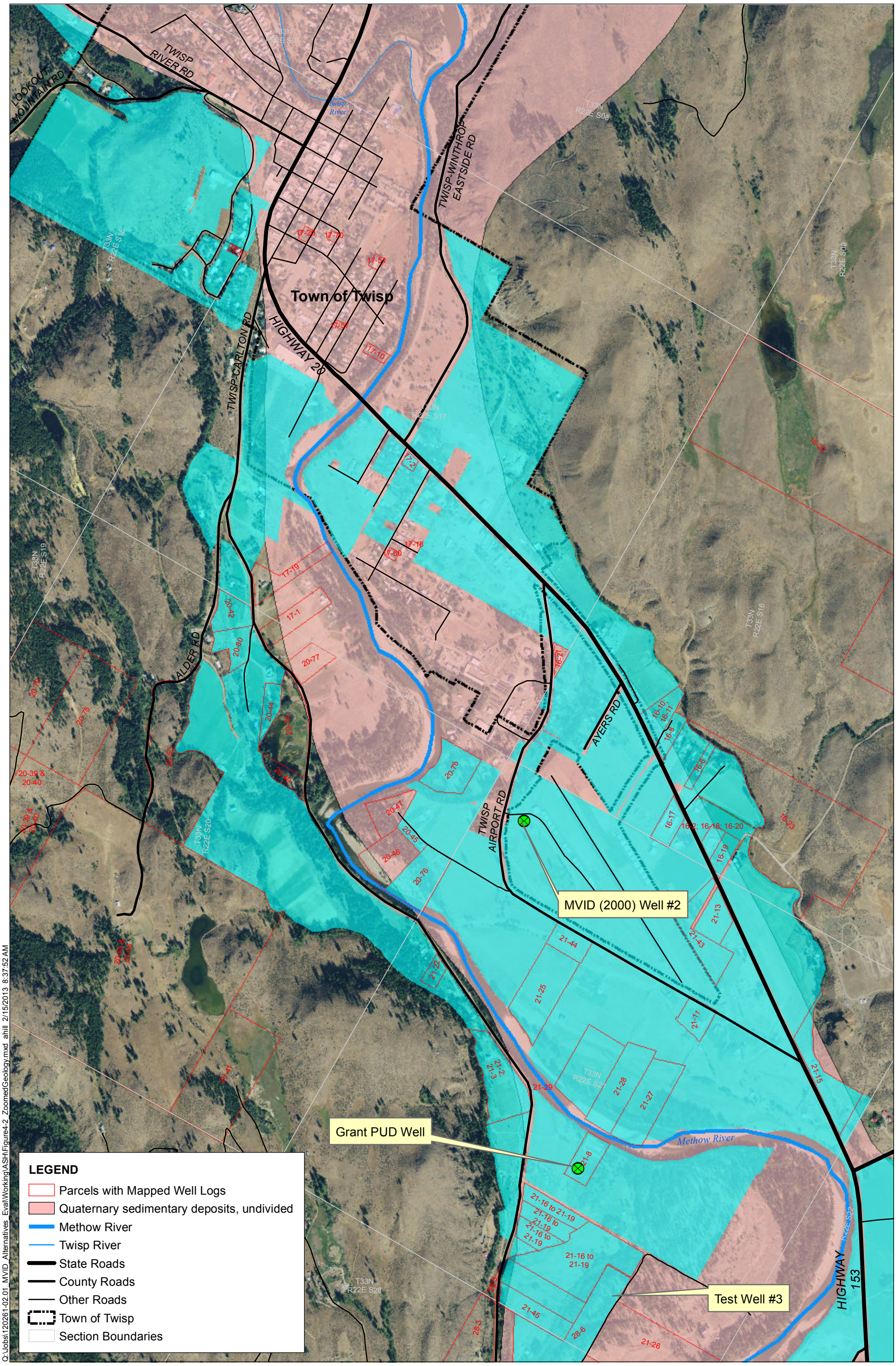
Test Well 2 is located west of the Twisp-Carlton Highway in the lower west side of the MVID on the Jumars property. Although the well site is mapped as being within the valley sedimentary deposits, there was concern bedrock would be encountered at a shallow depth and the aquifer formation may not be as suitable as a well located closer to the Methow

River. The well was drilled to a depth of 178 ft bgs. A sand-and-gravel layer was found between 133 ft bgs and 169 ft bgs. Below that, finer-grained material was encountered and the drilling stopped at 178 ft bgs. A 20-foot-long screen was set from 144 ft bgs to 164 ft bgs. The screen was a composite of 30-slot to 40-slot screen selected by the driller. The selection was based upon a visual examination of aquifer material found and screen sizes which were readily available to install which reduced downtime in the field. No attempt was made to optimize the screen size as the long-term use of this well will be either as a monitoring well or used solely by the property owner for an individual irrigation well. In either case, the pumping demand will be zero or much smaller than the capacity of the well and screen. A pump test was not performed after the well was developed, because of frozen ground and no way to dispose of testing water without the risk of freezing and potentially causing damage to property, drainage ditches, or the West Canal. If this well site is required for the preferred alternative, a pump test may be planned after the completion of this report.

Test Well 3 is located east of Test Well 1 on the Eileen property. This well is located closer to the center of the valley where much deeper alluvial sediments are expected. The well was drilled to 160 ft bgs and a 20-foot screen set between 134 ft bgs and 154 ft bgs. The screen was a composite of 30-slot to 40-slot screen selected by the driller. The selection was based upon a visual examination of aquifer material found and screen sizes which were readily available to reduce downtime in the field. The static water level is 10 ft bgs. The materials found were a mix of sand, gravel, and cobbles with few fines. The most suitable aquifer material was found from 134 to 160 ft bgs.

4.1.4 Well Logs

Well logs in the MVID area were obtained from the Ecology web site http://apps.ecy.wa.gov/welllog/. Well log owner, address, and/or parcel number records were matched against Okanogan County Geographic Information System (GIS) parcel data to develop a database of well logs matched to parcels. Figures 4-1 and 4-2 present the locations of parcels with mapped well logs. A total of 103 well logs were matched against parcels in the project area. These well logs are provided in Appendix C and are arranged by Section, Township Range in the appendix.



Q:\Jobs\120261-02.01_MVID_Alternatives_Eval\Working\ASH\Figure4-2_ZoomedGeology.mxd ahill 2/15/2013 8:37:52 AM

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Feet
0 500 1,000 1,500 2,000

Figure 4-2
Geology and Well Locations - Upper area
Methow Valley Irrigation District
Alternatives Evaluation Report

4.1.5 Hydrogeology Information in Water Right Change Applications

In 2000, numerous water right change applications were processed by Ecology that added points of diversion to existing MVID surface water rights in the southern end of the MVID (the MVID boundaries prior to 2000) on parcels that used to be served by the East and West Canals. The additional points of diversion are groundwater wells on parcels that are no longer within the MVID. The groundwater wells were found to be in continuity with the Methow River. The ROE for those water right change applications can be found using the Water Resources Explorer on Ecology's website at: http://www.ecy.wa.gov/programs/wr/info/webmap.html.

A couple representative ROEs were reviewed to check if the hydrogeologic characterization of the Methow Valley in the project area is consistent with the other information described in this section. The hydrogeologic setting described in the ROEs states "the unconfined aquifer is commonly composed of glacial, fluvial and alluvial cobbles, gravels, sands, some silts and discontinuous clays . . . a high degree of hydraulic connection between the Methow River and the valley fill aquifer is recognized . . . In this lower reach, between Twisp and Carlton, sediments are less coarse and reflect downstream fining processes, yet hydrogeologically are expected to behave in a similar manner." (Ecology 2000)

Hydraulic conductivities were estimated based upon sediments described in nearby well logs. The hydraulic conductivity estimated for a well near the south end of the West Canal is 120 to 147 feet per day (ft/day). A conclusion regarding interference with nearby wells was also provided that stated "at approximately 10 feet from the applicant's well, aquifer drawdown due to the requested change will be about 0.50 feet or less. As a result, composite drawdown/well interference which may occur is not expected to be significant" (Ecology 2000). The requested pumping rate was 43.5 gpm (0.097 cfs).

4.2 Summary of Aquifer Extent and Properties

4.2.1 Methow River Valley

According to the USGS study, the unconsolidated sediments along the bottoms and lower slopes of valleys are the most significant portion of the groundwater reservoir in the Methow River Basin in terms of volume, proximity to rivers, and proximity to human population.

The mapped areas of unconsolidated sediments (see Figures 4-1 and 4-2) are the most likely areas where groundwater supply can be obtained to serve the MVID.

Well logs for parcels within the MVID were obtained from Ecology and reviewed. A review of the well logs within the unconsolidated sediments confirms that a sand-and-gravel aquifer is present that is likely connected to the Methow River. Interbedded layers of silty material and cemented gravel were also found which may confine or partially confine an aquifer in locations. Water levels in the well logs are close to the river water level indicating connection to the Methow River. Most wells reviewed were constructed to depths less than 100 feet as the static groundwater level was shallow and water demands did not warrant a deeper well. A number of well logs also indicate that high water flow rates were encountered during drilling. The materials described in the well logs and availability of water is consistent with the other studies performed in the unconsolidated sediments.

The test wells completed for MVID in 2000 and 2013, and the Grant PUD well completed in 2011, provide additional information on the depth and extent of the aquifer in the unconsolidated sediments. The 2000 MVID Test Wells 1 and 2 were drilled to a depth of 200 ft bgs. The 2000 MVID Test Well 3 was drilled to 140 ft bgs. The Grant PUD well was drilled to 170 ft bgs. Test Well 2 completed in 2013 was drilled to 178 ft bgs and Test Well 3 to 160 ft bgs. The formations encountered in those wells were primarily sands and gravels with silt present in some layers.

Information on aquifer properties can be inferred from the well logs using the description of aquifer material found during drilling and the estimated thickness of the aquifer layer. However, better information was obtained from the construction and pump testing of the deeper wells. In addition, USGS compiled data from pump tests, which included the 2000 MVID test wells.

According to the USGS report, hydraulic conductivities calculated from specific-capacity tests from 10 wells completed in the confined aquifer in the Methow River Basin ranged from 50 to 2,600 ft/day with a median of 460 ft/day, assuming storativity was 0.01. When storativity was changed to 0.0001, the hydraulic conductivity of the unit ranged from 70 to 3,500 ft/day with a median of 620 ft/day (USGS 2005). Hydraulic conductivities calculated

from specific-capacity tests from 26 wells completed in the unconfined aquifer in the Methow River Basin ranged from 20 to 3,500 ft/day with a median of 430 ft/day (USGS 2005).

The hydraulic conductivity of the aquifers at the three MVID wells drilled in 2000 was estimated to range from 243 ft/day to 897 ft/day. The aquifers at Test Wells 1 and 2 were thought to be semi-confined at the depth of the well screen from analysis of pump test data while the aquifer at Test Well 3 was thought to be unconfined, because of the coarser aquifer material found, its shallower depth, and the results of the pump test. Those hydraulic conductivity values compare well to those reported in the USGS study. The hydraulic conductivity of the aquifer at the Grant PUD well was estimated to be 725 ft/day, also comparative to the USGS and MVID wells tested in 2000. The aquifer at the Grant PUD well was also thought to be semi-confined from analysis of aquifer material and pump test data.

The hydraulic conductivities described in ROEs for water right change applications described in Section 1.1.5 was 94 to 147 ft/day, less than found in the pump tests. However, they were inferred from the aquifer material described in well logs and are less accurate than the estimates from the pump tests.

4.2.2 Twisp River Valley

Each of the alternatives would convert individual parcels at the upstream end of the MVID West Canal to individual well systems in connectivity with the Twisp River. Figure 4-1 shows the extent of alluvium deposits in the Twisp River Valley. However, the valley is narrow with steep sides. Wells located near MVID parcels in the Twisp River Valley are generally shallow, less than 50 feet deep, with depth to water less than 10 ft bgs. The formations encountered included sand, gravel, and cobbles intermixed with silts and clays. The formations appear to be finer grained than found in the Methow River Valley and therefore, likely to produce less groundwater. It is recommended that individual wells be drilled as close as possible to the Twisp River where unconsolidated sediments may be deeper than towards the margin of the valley. The wells should be drilled deep enough and with screens to ensure the wells are developed into the best formations possible at the site.

4.3 Feasibility of Obtaining Groundwater for Water Supply

The feasibility of obtaining groundwater to supply the MVID was analyzed from the information presented in the previous sections. Two scenarios were analyzed: the first scenario analyzed the feasibility of supplying water using the test well sites or a well field near the location of the test wells, and the second scenario analyzed the feasibility of supplying water using individual wells. The feasibility of supplying groundwater is described for each of the water supply alternatives described in Section 3.

Alternatives 2 through 5 will require groundwater supply for improvements to the West Canal. Alternative 2 assumes the entire West Canal demand can be supplied by groundwater and it is desired to have a single well field supply the 11 cfs demand. The desired location of the well field is in the middle section of the West Canal service area near the location of Test Well 3. Alternative 3 assumes two well fields will be constructed: one near Test Well 3 and one near Test Well 2. Alternatives 4 and 5 assume that a majority of the parcels on the MVID West Canal will be converted to individual wells except the areas along the hillside above the alluvium deposits at the upstream end of the system. As outlined in Section 3, a well and pipeline would need to be constructed to supply water to serve these parcels, which extend along the hillside from just upstream of Alder Creek Road down to Lateral W4.

All of the alternatives will require additional groundwater supply for the Town of Twisp. One new well would be needed, along with the full use of existing Town of Twisp Wells 2, 3 and 4, to supply irrigation demands for MVID parcels within the Town of Twisp on the east side of the Methow River. All of the alternatives assume that a few parcels at the upstream end of the West Canal system would be converted to individual wells. Alternatives 1, 2, 3, and 5 assume that a few parcels at the downstream end of the East Canal system would be converted to individual wells. Alternative 4 assumes that all of the parcels served by the MVID East Canal outside of the Town of Twisp would be converted to individual wells.

The required groundwater supply to serve parcels that would remain part of the MVID is summarized for Alternatives 2 through 5 in Tables 4-5 through 4-8.

Table 4-5
Required Groundwater Supply for MVID – Alternative 2

Location	Peak Flow Rate (cfs)	Peak Flow Rate (gpm)
West Canal Upper Zone (upstream of Roach Spill)	2.4	1,080
West Canal Lower Zone (downstream of Roach Spill)	8.6	3,870
Total (West Canal)	11.0	4,950
East Canal - Lateral E1 (additional supply for service through Town of Twisp system)	2.7	1,215

Notes:
cfs = cubic feet per second
gpm = gallons per minute

Table 4-6
Required Groundwater Supply for MVID – Alternative 3

Location	Flow Rate (cfs)	Flow Rate (gpm)
West Canal Upper Zone (upstream of Roach Spill)	2.4	1,080
West Canal Middle Zone (downstream of Roach Spill, upstream of Lateral W5)	2.7	1,215
Total Demand in Upper Zone	5.1	2,295
West Canal Lower Zone (downstream of Lateral W5)	5.9	2,655
Total (West Canal)	11.0	4,950
East Canal - Lateral E1 (additional supply for service through Town of Twisp system)	2.7	1,215

Notes:
cfs = cubic feet per second
gpm = gallons per minute

Table 4-7
Required Groundwater Supply for MVID – Alternative 4

Location	Flow Rate (cfs)	Flow Rate (gpm)
West Canal Upper Zone (upstream of Lateral W4)	2.8	1,260
East Canal - Lateral E1 (additional supply for service through Town of Twisp system)	2.7	1,215

Notes:
cfs = cubic feet per second
gpm = gallons per minute

Table 4-8
Required Groundwater Supply for MVID – Alternative 5

Location	Flow Rate (cfs)	Flow Rate (gpm)
West Canal Upper Zone (upstream of Lateral W4)	2.8	1,260
East Canal - Lateral E1 (additional supply for service through Town of Twisp System)	2.7	1,215

Notes:
cfs = cubic feet per second
gpm = gallons per minute

The water supply that will be allocated to individual water users in the MVID will be 9 gpm/acre, based upon previous ROEs for Water Right Change Applications processed by Ecology within the MVID (Ecology 2000). A review of the number of parcels, their size, and potential individual demands was made to review the potential water supply requirements for individual wells outside of the West Canal and East Canal upper zones under each alternative. Table 4-9 provides a summary of that calculation.

The demands on an individual parcel basis range from less than 9 gpm to approximately 340 gpm. No parcels larger than 10 acres would be served by individual wells as part of Alternatives 1, 2, and 3. The largest parcel on the East Canal that would be served by an

individual well as part of Alternative 4 is 38.2 acres and would have a demand of 343 gpm (0.77 cfs). The largest parcel on the West Canal that would be served by an individual well as part of Alternatives 4 and 5 is 23.1 acres and would have a demand of 208 gpm (0.46 cfs).

Table 4-9
Estimated Peak Irrigation Demands for Individual Wells

Parcel Size Range (acre)	Number of Parcels - Alternative 1	Number of Parcels - Alternative 2	Number of Parcels - Alternative 3	Number of Parcels - Alternative 4	Number of Parcels - Alternative 5	Estimated Peak Irrigation Demand (gpm)
East Canal						
<1	1	1	1	32	1	<9
1-5	6	6	6	117	6	9-45
5.01-10	1	1	1	33	1	45-90
>10	0	0	0	6	0	>90
Largest Parcel > 10 Acres				38.2 Acres		343
West Canal						
<1	2	2	2	7	7	<9
1-5	5	5	5	46	46	9-45
5.01-10	1	1	1	29	29	45-90
>10	0	0	0	5	5	>90
Largest Parcel > 10 Acres				23.1 Acres	23.1 Acres	208

Notes:
gpm = gallons per minute

The following sections evaluate potential groundwater supplies for Alternatives 1 through 5 using the demand numbers listed in Tables 4-5 through 4-8.

4.3.1 Feasibility of Alternative 1

The groundwater supply requirement for Alternative 1 would be limited to individual well systems for 16 parcels that would not be served by the proposed pipelines on the West and East canals. The West Canal parcels are located upstream of the proposed upstream end (Station 161+00) of the West Canal pipeline in the Twisp River valley. The East Canal parcels are located south of Beaver Creek along the current Lateral E14.

Well logs for both areas were reviewed. Wells located near the MVID parcels in the Twisp River indicate that the material is finer grained than found in the Methow Valley and therefore likely to produce less groundwater. The parcel sizes in the Twisp River valley range from 0.5 acre to 10 acres, with the 10-acre parcel owned by Patterson located the furthest west (upstream). Although that parcel is adjacent to the Twisp River, a well producing 90 gpm may be difficult to develop because of the finer-grained formations. Two wells may be needed. Further east (downstream) the parcels are smaller and a single well drilled in the unconsolidated sediments should be sufficient to provide the required amount of water. It is recommended that wells drilled for these parcels be placed as close as possible to the Twisp River, where unconsolidated sediments may be deeper than towards the margin of the valley. The wells should be drilled deep enough and with screens to ensure the wells are developed into the best formations possible at the site.

The East Canal parcels not served by the proposed pipeline are located within the unconsolidated sediments of the Methow River valley. An adequate supply of water appears to be feasible for those parcels.

4.3.2 Feasibility of Alternative 2

The groundwater supply requirement for the West Canal system for Alternative 2 is 11 cfs (4,950 gpm). A review of hydrogeologic conditions at and near Test Well 3 was made to determine the feasibility of this alternative.

Based upon experience with the aquifer formation found at Test Well 3, it is recommended that three wells be constructed to meet the 4,950 gpm (11 cfs) demand. Each well can be designed to have a capacity of 1,800 to 2,000 gpm so the total pumping capacity will be 5,400 to 6,000 gpm (12 to 13.3 cfs). This would provide some margin of safety in case the wells decline in pumping capacity with age or maintenance is required on one of the wells.

Calculations of the required well spacing were made using the aquifer properties described in Section 4.2. The hydraulic conductivity found for the 2000 MVID Test Well 1 (411 ft/day) was used as that is the closest well with pump test data. The saturated thickness of the aquifer, derived from examining the well log for Test Well 3, is 150 feet. The material found

during drilling of Test Well 3 is sands, gravels, and cobbles. However, the drilling method (air rotary) and the large volume of water encountered during drilling made sampling and classifying material difficult. Finer grained material may exist in the sand and gravel layers. The aquifers for both the 2000 MVID Test Well 1 and the Grant PUD Carlton Pond well were found to be partially confined, indicating silt or clay may be present in layers. A storativity value of 0.0005 was used, which was based upon the 2000 MVID Test Well 1 pump test results.

The pumping rates and aquifer properties described above were used to estimate drawdown at a pumping well and at distances away from the pumping well. The drawdown estimated at distances away from the pumping well was used to estimate interference and potential drawdown that may affect other non-MVID wells. A spreadsheet calculation using the Theis equation for confined aquifers was used (USGS 2002). The aquifer properties were adjusted during the calculations to better fit the results of pump tests performed at the Grant PUD Carlton Pond well and the 2000 MVID Test Well 1. For the calculations an aquifer thickness of 70 feet was used, which results in a Transmissivity of about 29,000 square feet per day (ft^2/day).

Table 4-9 summarizes the drawdown calculations at a pumping rate of 1,800 gpm.

Table 4-9
Summary of Well Drawdown Calculations – Alternative 2 West Canal

Pumping Duration, days	Estimated Drawdown at Distance Away from Pumping Well (feet)			
	At Well	100 feet away	200 feet away	1000 feet away
1	16	6	5	5
3	20	10	9	6
30	22	12	11	8
60	23	13	12	9
90	24	13	12	9
150	24	14	13	10

A pumping duration of 150 days was used in the calculation. Although the MVID canal may operate for a longer duration than 150 days, the wells will not be pumped at the maximum rate for the whole season as the allowable volume for MVID's water rights would be exceeded. The estimated drawdown at the well is 24 feet and drawdown away from the well will range from

10 to 14 feet. As more than one well will be operating, the interference between wells can be estimated by adding the drawdown at the location of the other well. For example, with two wells operating spaced 1,000 feet apart, the drawdown at each well will be 24 feet plus 10 feet or 34 feet. With three wells spaced 1,000 feet apart from each other, the drawdown can be estimated by adding together the drawdown caused by each well. The drawdown is estimated to be 24 feet plus 10 feet plus 10 feet, or 44 feet total. In addition the bedrock hillside may act as a boundary, creating additional drawdown similar to that of another pumping well. A number of assumptions are made in these calculations and they should be viewed as preliminary until further aquifer drilling and testing at the site of the well field is performed.

The available drawdown in each well will depend on the size of the well, the aquifer formations encountered at each well site and the pumping rate desired for the well. At a rate of 1,800 gpm and using a screen with 30 slot openings, a screen length of between 41 and 66 feet will be required. If the bottom of the screen is placed at 160 ft bgs and the static water level is 10 ft bgs, the available drawdown (water level drop in the well until the screen is exposed) will be 84 to 109 feet. That is much greater than the 44 foot total drawdown estimated in Table 4-9.

A review of available well logs in the vicinity of Test Well 3 was completed. The six well logs reviewed that are located within a couple thousand feet of the well were found to all be shallow, less than 45 feet deep. The static water level for the wells was about 10 ft bgs, which leaves up to 30 feet of submergence (depth below the static water level to bottom of well). We assume all nearby wells will need to be inspected and some may need deepening and pumps replaced to ensure they can pump when the MVID well field is in operation. The need for replacement will depend on the final configuration of the MVID well field, the proximity of the existing well and the drawdown that would occur when the well field is in operation. An allowance for that work was placed in the cost estimate for Alternative 2 to ensure it is not overlooked.

Alternative 2 would also include conversion of 16 parcels to individual well systems that would not be served by the proposed pipelines on the West and East canals. Groundwater supply feasibility for these parcels is described in Section 4.3.1.

4.3.3 Feasibility of Alternative 3

The water supply requirement for the West Canal for Alternative 3 is 5.1 cfs (2,295 gpm) for the upper and middle zones and 5.9 cfs in the lower zone. The calculations described in Section 4.3.1 were repeated for two wells at the site where the 2013 MVID Test Well 3 was constructed, each with capacities of 1,200 gpm (total 5.3 cfs). A single well could be used; however, two wells are recommended to provide a margin of safety and reduce the risk of being without water if maintenance is required on one of the wells.

Table 4-10 summarizes the drawdown calculations at a pumping rate of 1,200 gpm.

Table 4-10
Summary of Well Drawdown Calculations – Alternative 3, Upper and Middle West Canal

Pumping Duration, days	Estimated Drawdown at Distance Away from Pumping Well (feet)			
	At Well	100 feet away	200 feet away	1000 feet away
1	13	6	5	3
3	14	7	6	4
30	15	8	7	5
60	15	9	8	6
90	16	9	8	6
150	16	9	8	6

The estimated drawdown at each well is 16 feet and drawdown away from the well will range from 6 to 9 feet. The interference between wells can be estimated by adding the drawdown at the location of the other well. For this case, with two wells operating spaced 1,000 feet apart, the drawdown at each well will be 16 feet plus 6 feet or 22 feet. The available drawdown will depend on screen size and aquifer formations found but will be similar to that for Alternative 2 (84 to 109 feet). The available drawdown at each well will be much greater than the estimated drawdown for this alternative.

The conclusion regarding potential impacts to nearby wells holds for Alternative 3 at the West Canal upper and middle zones well field. We assume all nearby wells will need to be inspected and some may need deepening and pumps replaced to ensure they can pump adequate volumes of water when the MVID well field is in operation. The need for replacement will depend on

the final configuration of the MVID well field, the proximity of the existing well and the drawdown that would occur when the well field is in operation. An allowance for that work was placed in the cost estimate for Alternative 3 to ensure it is not overlooked.

In the West Canal lower zone, a peak water supply of 5.9 cfs (2,655 gpm) is required. Based upon the formations found at Test Well 2 and the screen length required, it is recommended that three wells be constructed to meet the demand. Each well can be designed to have a capacity of 900 to 1,000 gpm so the total pumping capacity will be 2,700 to 3,000 gpm (6 to 6.7 cfs). This would provide some margin of safety in case the wells decline in pumping capacity with age or maintenance is required on one of the wells.

Calculations of the required well spacing were made using the aquifer properties described in Section 4.2. No pump test was performed at Test Well 2 and the aquifer properties have to be inferred from other pump tests and the aquifer material and thickness noted when drilling the well. The 2000 MVID Test Well 3 is the closest well where a pump test was performed to determine aquifer properties. However that well appears to have been drilled into river bed material with high continuity with the Methow River. It is not likely that Test Well 2 properties are similar to the 2000 MVID Test Well 3 properties as it is set further back from the river and layers of silty sand and gravel were found. The hydraulic conductivity found for the 2000 MVID Test Well 1 (411 ft/day) was used in the calculations as it appears to be representative of the unconsolidated sediments found in the Methow Valley. The saturated thickness of the aquifer, derived from examining the well log for Test Well 2, is 102 feet. The material found during drilling of Test Well 2 is generally sands, gravels and cobbles with layers of silty gravel and cemented gravel. The layers of silty gravel and cemented gravel may indicate the aquifer is confined or partially confined, similar to that found for the 2000 MVID Test Wells 1 and 2 and the Grant PUD Carlton Pond well. A storativity value of 0.0005 was used, which was based upon the 2000 MVID Test Well 1 pump test results.

The pumping rates and aquifer properties described above were used to estimate drawdown at a pumping well and at distances away from the pumping well. The drawdown estimated at distances away from the pumping well was used to estimate interference and potential drawdown that may affect other wells. A spreadsheet calculation using the Theis equation for confined aquifers was used (USGS 2002). The aquifer properties were adjusted during the

calculations to better fit the results of pump tests described in Section 4.1. For the calculations reported below an aquifer thickness of 36 feet was used, which represents the gravel and sand layer from 133 and 169 ft bgs. The transmissivity is then estimated to be 15,000 ft^2/day (36 feet times 411ft/day).

Table 4-11 summarizes the drawdown calculations at a pumping rate of 900 gpm.

Table 4-11
Summary of Well Drawdown Calculations – Alternative 3, Lower West Canal

Pumping Duration, days	Estimated Drawdown at Distance Away from Pumping Well (feet)			
	At Well	100 feet away	200 feet away	1000 feet away
1	18	8	7	4
3	19	9	8	5
30	21	11	10	7
60	22	12	11	8
90	22	12	11	8
150	23	13	12	9

The estimated drawdown at the well is 23 feet and drawdown away from the well will range from 9 to 13 feet. As more than one well will be operating, the interference between wells can be estimated by adding the drawdown at the location of the other well. For example, with two wells operating spaced 1,000 feet apart, the drawdown at each well will be 23 feet plus 9 feet or 32 feet. With three wells spaced 1,000 feet apart from each other, the drawdown can be estimated by adding together the drawdown caused by each well. The drawdown is estimated to be 23 feet plus 9 feet plus 9 feet, or 41 feet total. A number of assumptions are made in these calculations and they should be viewed as preliminary until further aquifer drilling and testing at the site of the well field is performed.

The available drawdown in the well will depend on the size of the screen, the aquifer formations encountered at each well site and the pumping rate desired for the well. At a rate of 900 gpm and using a 12-inch screen with 30 slot openings, a screen length of 36 feet will be required. If the bottom of the screen is placed at 169 ft bgs and the static water level is 67

ft bgs, the available drawdown (water level drop in the well until the screen is exposed) will be 66 feet. That is more than the 41 feet drawdown estimated in the previous paragraph.

A review of available well logs in the vicinity of Test Well 2 was completed. The four well logs reviewed that are located within a couple thousand feet of the well were found to range in depth from 68 feet to 100 feet. The bottom of the wells had 21 feet to 42 feet of submergence (depth below the static water level to bottom of well). A well field designed to withdraw 2,700 gpm may reduce water levels in these wells enough to affect their operations. All nearby wells will need to be inspected and some may need deepening and pumps replaced to ensure they can pump when the MVID well field is in operation. The need for replacement will depend on the final configuration of the MVID well field, the proximity of the existing well and the drawdown that would occur when the well field is in operation. An allowance for that work was placed in the cost estimate for Alternative 3 to ensure it is not overlooked.

Alternative 3 would also include conversion of 16 parcels to individual well systems that would not be served by the proposed pipelines on the West and East canals. Groundwater supply feasibility for these parcels is described in Section 4.3.1.

4.3.4 Feasibility of Alternative 4

Mapped well logs located within the unconsolidated sediments shown in Figures 4-1 and 4-2 were reviewed to compare against studies described in previous sections. These well logs show relatively shallow wells that were developed in sands and gravels and did not encounter bedrock. These wells had relatively high water flow rates and shallow depths to static groundwater levels. The materials described in the well logs and availability of water is consistent with the materials encountered in various test wells constructed for the MVID and for Grant PUD. Within the mapped areas of unconsolidated sediments, it is expected that groundwater supply for individual wells is feasible. The demands for individual parcels will vary as shown in Table 4-8. The largest demands could be 343 gpm. For larger demands and for parcels located near the valley margins, it is recommended that wells be placed as close to the center of the valley as possible and constructed deep enough and with screens to ensure an adequate supply is provided.

The MVID West Canal serves parcels located on the hillside above Twisp (see Figure 4-2). Well logs were examined in that area to determine if suitable geologic formations exist to allow groundwater wells to be constructed. The well logs examined showed bedrock at shallow depths. An adequate water supply for irrigation of individual parcels could not be obtained in that area and an alternate water supply should be provided. The water supply could be pumped from the Methow River as planned in Alternative 1 or supplied from a groundwater well sited in unconsolidated sediments in the vicinity of the upper West Canal. A potential site has been identified, which is located southwest of where Highway 20 crosses the Methow River, on property owned by Dave Shulz. The water supply required for the alternate water supply is 2.8 cfs (1,260 gpm). A single well developed into the unconsolidated sediments should be capable of supplying that demand.

Another area where concern has been expressed of obtaining groundwater is along the upper East Canal, from Twisp to the intersection of Highway 20 and Highway 153 south of Twisp. Parcels located east of Highway 20 adjoin a hillside with bedrock exposed in some areas. Seven well logs for that area were reviewed and are summarized in Table 4-12. The parcels associated with the well logs are shown in Figure 4-2.

The well log for the parcel closest to the intersection of Highway 20 and Highway 153 shows bedrock at 84 ft bgs, however the rock was overlain with sand, gravel, and some silt. A short pump test was performed for that well that indicates 20 gpm could be obtained with a small drawdown. Only one of the well logs for parcels located further north indicate an issue with obtaining a sufficient groundwater source. The exact location of that well is not known. In general, it appears there is sufficient groundwater available for the size of parcels located in this area.

We recommend that any new wells drilled in the area east of Highway 20 be located as far west as possible (towards the center of the valley). There is a possibility that some small areas are not suitable for wells and may require a well off of their property. Further investigation may be needed for specific parcels to ensure a groundwater supply can be obtained.

Table 4-12
Summary of Well Logs, Upper East Canal Service Area

Well Log Number from Figure 4-2	Well Depth, ft	Static Water Level, ft bgs	Formations Encountered Below Static Water Level	Depth to Bedrock, ft	Well Test Data from Well Log
16-6	82	53	Sand, some gravel	-	30 gpm
16-8	82	50	Coarse sand, fine gravel	-	30 gpm
16-10	137	60	Sand and gravel	-	20 gpm
16-11	90	60	Sand and gravel	-	20 gpm
16-19	123	61	Coarse sand with interbed layer of clay	-	5 gpm, 10 feet drawdown after 1 hour
21-13	104	65	Sand and gravel	-	20 gpm
21-15	84	47	Sand, gravel and silt	84	20 gpm, 9 inches drawdown after 2 hours

Notes:
ft = feet
bgs = below ground surface
gpm = gallons per minute

4.3.5 Feasibility of Alternative 5

Alternative 5 would include the same improvements to the West Canal system as outlined for Alternative 4. These include replacement of the upstream end of the West Canal system with a pressurized pipe system served through a well near the Shulz property and conversion of approximately 87 parcels that would not be served by the Upper West Canal system to individual well systems. The feasibility of groundwater supply for Alternative 5 for the West Canal would be as described in Section 4.3.4.

Alternative 5 would include the same improvements to the East Canal system as outlined for Alternative 1 through 3. These improvements include conversion of 8 parcels to individual well systems that would not be served by the proposed pipelines on the East Canal. Groundwater supply feasibility for these parcels is described in Section 4.3.1.

4.4 Water Rights Permitting

To obtain groundwater for water supply, water right permits would have to be changed from the existing MVID water right (Surface Water Right Claim No. 003935 on the Twisp River and Surface Water Right Certificate No. 945 on the Methow River) to individual or consolidated groundwater rights. Both alternatives would require a similar process of applying for the water right change to Ecology. Ecology would review the change applications in accordance with Revised Code of Washington (RCW) 90.03.

In 2000, similar water right application changes occurred when landowners within the MVID service area applied for water right changes to convert their portions of the MVID water right from the MVID surface water point of diversion to individual groundwater wells. Ecology reviewed the water right change applications and made recommendations based on its findings. A process similar to the one completed in 2000 would take place to obtain groundwater for water supply for this project.

5 DESIGN EVALUATION OF ALTERNATIVES

5.1 Alternative 1

A detailed description of Alternative 1 is included in Section 3.1. Alternative 1 would include the following major improvement projects:

- Replacement of the MVID West Canal system from Station 161+00 to the downstream end with a pressurized pipe system supplied through a pump station on the Methow River
- Replacement of the MVID East Canal system from Station 193+00 to Beaver Creek with a gravity-fed pipe system
- Improvements that would enable Lateral E1 users to be served irrigation water through the Town of Twisp potable water distribution system under an agreement with the Town of Twisp or replacement of Lateral E1 with a new system supplied through a groundwater well or connection to the East Canal pipeline

The following provides a summary of the design evaluation of Alternative 1.

5.1.1 West Canal Improvements

5.1.1.1 Water Supply

The source of supply for the West Canal system for Alternative 1 would be a surface water pump station on the right (west) bank of the Methow River approximately 8,500 feet downstream of the Highway 20 bridge in Twisp. The pump station intake structure would need to be designed to divert water from the Methow River under the full range of flow conditions that could be expected during the irrigation season. The USGS maintains a gage on the Methow River at Twisp (USGS Gage No. 12449500). Daily mean flow statistics reported by the USGS for the Methow River at Twisp are summarized in Table 5-1.

The pump station site was surveyed from the MVID West Canal down to the river's edge on September 25, 2012. The survey measurements indicate that the water surface elevation was approximately 1534.7 feet NAVD 88 at the time of the survey. The mean daily flow rate was 266 cfs on September 25, 2012, as reported by the USGS for the Methow River at Twisp. This indicates that the river water surface at the time of the survey was typical of what could be

expected during late summer low flow conditions for average to below average water year. A more detailed hydrologic analysis would need to be completed during detailed design to ensure that the pump station intake was designed for the appropriate range of conditions if a river pump station is part of the preferred alternative.

Table 5-1
Daily Mean Flow Statistics – Methow River at Twisp

Day	90% Exceedance Flow (cfs)	Mean Flow (cfs)	10% Exceedance Flow (cfs)
May 1	699	2,690	4,950
June 1	2,510	6,080	9,430
July 1	1,200	3,160	6,270
August 1	317	781	1,350
September 1	180	343	590
October 1	198	335	587

Notes:
cfs = cubic feet per second

5.1.1.2 Hydraulic Analysis

As noted in Section 3.1, the Alternative 1 West Canal system would consist of two separate pressure zones, each supplied by a set of pumps at the proposed pump station on the Methow River. The Upper Pressure Zone would require a smaller flow rate, but the pumping head would need to be higher to reach the upstream end of the system. The Lower Pressure Zone would require a larger flow rate, but the pumping head would be lower.

A preliminary hydraulic analysis was completed to estimate the size of pumps and pipe included as part of the West Canal system for Alternative 1. The results of the analyses are included in Appendix D. A spreadsheet analysis was used to estimate losses through the system, from the pump to each lateral and delivery location. A system curve was developed for each alternative that shows the estimated total dynamic head (TDH), or pumping head, required for pumping at different flow rates. The Hazen-William formula was used to estimate friction losses through the system. The hydraulic analysis assumed that pump station manifold piping would be steel pipe with a Hazen-Williams coefficient of 110 and that the delivery system piping would be PVC with a Hazen-Williams coefficient of 140. An

allowance was also included for minor losses to account for losses through bends, valves, pipe entrances, pipe exits, and other fittings. Table 5-2 summarizes the results of the hydraulic analysis for Alternative 1.

Table 5-2
Summary of Hydraulic Analysis Results – Alternative 1 West Canal System

Design Parameter	Lower Pressure Zone	Upper Pressure Zone
Water Surface Elevation at River, Minimum[1] (feet)	1,534.7	1,534.7
Maximum Static System HGL[1] (feet)	1,667	1,804
Pump Station Design Flow (cfs)	8.6	2.4
Pumping Head, or TDH (feet)	138	298
Total Pumping Horsepower Required	190	115
Main Line Pressures[2] (psi)	13 to 67	10 to 102
Lateral Pressures[3] (psi)	13 to 83	20 to 93

Notes:
1. Elevations and hydraulic gradients based on the NAVD 88 datum.
2. Represents expected range of pressures in main line from tee with pump discharge line to end of line.
3. Represents expected range of pressures in replaced laterals.

cfs = cubic feet per second
HGL = hydraulic gradient
psi = pounds per square inch
TDH = total dynamic head

The pump station facility would include a fish screen consistent with NMFS and Washington State Department of Fish and Wildlife (WDFW) guidelines. Different types of screens are available for diversions and pumping that meet NMFS and WDFW guidelines, including fixed-plate screens, cylindrical end-of-pipe screens, rotating drum screens, vertical traveling screens, horizontal screens, and infiltration galleries. An inclined fixed-plate screen was identified as the most likely screening option for a pump station diverting water from the bank of the Methow River. Table 5-3 provides a summary of the design parameters and sizes required for a fixed plate screen for the range of design flows that were evaluated as part of this analysis. Fish screen calculations are included in Appendix D.

In order to minimize maintenance, ensure proper performance, and secure approval by WDFW, the screen would need to be self-cleaning. Typical self-cleaning options for an inclined, fixed plate screen would include a mechanical air-burst system or mechanical brush. Another similar self-cleaning screen option would include an inclined traveling

water screen that would rotate on a conveyor. Debris would be lifted out of the water and removed with internal water jets, a brush, or other self-cleaning mechanism.

Table 5-3
Fish Screen Sizing – Inclined Flat-plate Screen

Maximum Screen Flow (cfs)	Maximum Approach Velocity (fps)	Effective Screen Area (ft^2)	Screen Area with FOS (ft^2)	Proposed Screen Height (feet)	Minimum Required Screen Length (feet)
11	0.4	27.5	34.9	3	12

Notes:
cfs = cubic feet per second
FOS = Factor of Safety
fps = feet per second
ft^2 = square feet

5.1.2 East Canal Improvements

5.1.2.1 Water Supply

The source of supply for the East Canal system for Alternative 1 would continue to be surface water diverted from the Methow River to the upstream end of the existing East Canal. An inlet structure would be designed to transition flow from the open canal to the proposed pipeline. A design flow rate of 10 cfs at the upstream end of the pipeline was assumed for evaluation of the proposed pipeline, as directed by Reclamation and MVID. The flow was reduced moving downstream through the pipeline based on the distribution of assessed acres.

The inlet structure would be designed to maintain at least 2 feet of submergence over the proposed 24-inch diameter pipe inlet. An air vent would be needed to evacuate air just downstream of the pipe inlet. The inlet structure would also be designed to spill excess flow through a pipe under the Twisp-Winthrop Road to the Methow River. The spill would be controlled by placing stop logs in the structure upstream of the inlet to the spill pipe. A width of at least four feet is proposed for the stop log control. A 24-inch diameter pipe is recommended under the Twisp-Winthrop Road to provide capacity for spilling flows up to the design flow rate for the East Canal pipeline.

5.1.2.2 Hydraulic Analysis

As noted in Section 3.1, the East Canal pipe system would be gravity-fed, meaning that no pumping would be required. However, the system would be designed to operate full under pressure by closing a valve at the downstream end of the main pipeline and maintaining submergence over the pipe at the proposed inlet structure. Pressures would increase with the difference in elevation between the pipe inlet and downstream points along the mainline and laterals. Pipe would be rated to accommodate pressures that would result from future extension of the pipeline up to the main head gate at the Methow River.

A preliminary hydraulic analysis was completed to estimate the size of pipe for the East Canal system. The results of the analyses are included in Appendix D. A spreadsheet analysis was used to estimate losses through the system, from the inlet structure to each lateral and delivery location. The Hazen-William formula was used to estimate friction losses through the system. The hydraulic analysis assumed that the delivery system piping would be PVC with a Hazen-Williams coefficient of 140. An allowance was also included for minor losses to account for losses through bends, valves, pipe entrances, pipe exits, and other fittings. Table 5-4 summarizes the results of the hydraulic analysis.

Table 5-4
Summary of Hydraulic Analysis Results – Alternative 1 West Canal System

Design Parameter	Lower Pressure Zone
Water Surface Elevation at Pipeline Inlet, Minimum[1] (feet)	1657.0
Design Flow (cfs)	10.0
Main Line Pressures[2] (psi)	2 to 53
Lateral Pressures[3] (psi)	16 to 65

Notes:
1. Elevations and hydraulic gradients based on the NAVD 88 datum.
2. Represents expected range of pressures in main line from tee with pump discharge line to end of line.
3. Represents expected range of pressures in replaced laterals.

cfs = cubic feet per second
HGL = hydraulic gradient
psi = pounds per square inch
TDH = total dynamic head

5.1.2.3 Lateral E1 Analysis

As outlined in Section 3.1, if an agreement can be reached between MVID and the Town of Twisp, Alternative 1 would serve irrigation water to MVID users within the Town of Twisp on the east side of the Methow River through the town's water distribution system. If an agreement cannot be reached, Lateral E1 would be replaced and supplied by a groundwater well or through a connection to the East Canal pipeline.

The *Town of Twisp Water System Plan Update* (Gray and Osborne 2008) provides an evaluation of the town's water distribution system and recommends upgrades needed to meet Washington State Department of Health (DOH) requirements. The Water System Plan was reviewed to identify upgrades that would be needed to provide capacity for irrigation deliveries to MVID users from the town's water distribution system.

Water system planning uses the following water system demand terms:

- Average Daily Demand (ADD) - The average water system demand for a given year
- Maximum Daily Demand (MDD) – The average water system demand on the peak day of use during a given year
- Peak Hourly Demand (PHD) – The demand during the hour of peak use during a given year

Table 5-5 summarizes the projected water system demand, as reported in Table 2-7 of the Water System Plan, and estimates the impact that irrigation service to MVID would have on the projected demand. Service to the proposed MVID users could increase demand by as much as 2.83 acre-feet per acre annually and 9 gpm per acre during peak irrigation use. The peak use for irrigation service to MVID users would likely correspond with the peak day of use for the existing water system. The projected annual water system demand would increase from 450 acre-feet to 832 acre-feet in 2013 and from 720 acre-feet to 1,102 acre-feet in 2027 if the maximum annual withdrawal allowed by existing water rights was added to the projected water system production. The projected MDD would increase from a 670 gpm to 1,885 gpm in 2013 and from a projected 1,070 gpm to 2,285 gpm if the maximum irrigation rate allowed by existing water rights was added to the projected water system demand. The total acreage of MVID parcels within the Town of Twisp that could be

irrigated under MVID's water right would likely never be irrigated all at once. In addition, the maximum rate of irrigation allowed by the water right would likely never be sustained throughout the day of peak use. Consequently, these estimates of the impact to the annual demand and MDD are conservative.

Table 5-5
Impact to Projected Twisp Water System Demands

Projection	2013	2027
Existing Twisp Water System Demand:		
Service Area Population	1,251	1,998
ADD (gpd)	400,000	639,000
Well Production (acre-feet)	450	720
MDD (gpd)	960,000	1,534,000
MDD (gpm)	670	1,070
PHD (gpm)	1,010	1,610
Maximum Projected Irrigation Demand for MVID Users:		
Well Production (acre-feet)	382	382
Maximum Irrigation Rate (gpd)	1,749,600	1,749,600
Maximum Irrigation Rate (gpm)	1,215	1,215
Maximum Projected Water System Demand with MVID Irrigation Demand:		
Well Production (acre-feet)	832	1,102
MDD (gpd)	2,709,600	3,283,600
MDD (gpm)	1,885	2,285
PHD (gpm)	2,225	2,825

Notes:
gpd = gallons per day
gpm = gallons per minute
ADD = average daily demand
MDD = maximum daily demand
PHD = peak hourly demand

The existing water system includes four wells. Well No. 1 is currently inactive and disconnected from the system. Well No. 4 historically operated at a capacity of 600 gpm, but is currently used only for emergencies. The Water System Plan indicates that air entrainment issues have limited use of the well. Recent testing indicates that the well may be able to operate adequately at a capacity of 400 gpm. Well No. 2 and Well No. 3, each with a capacity of approximately 600 gpm, are active and operate to meet existing water demands.

If irrigation service to MVID users is provided, additional source capacity will be required. The projected 2027 MDD with service to MVID users is estimated to be 2,285. Activation of Well No. 4 (400 gpm) and installation of a new well source would be required to serve existing water system demand and irrigation demand to MVID users. An additional well with a source capacity of at least 700 gpm is recommended to increase the overall source capacity to at least 2,300 gpm.

The Town of Twisp currently has three storage reservoirs with a total storage capacity of 675,000 gallons. The Water System Plan projected a surplus storage capacity of 208,000 gallons in 2013 and a deficiency of 69,000 gallons in 2027. The estimated storage requirement for 2027 includes 90,000 gallons of operating storage, 60,000 gallons of equalizing storage, 414,000 gallons of standby storage, and 180,000 gallons of fire suppression storage. The projections assume that standby storage and fire suppression storage are nested, meaning only the larger volume is included in the total storage requirement. The addition of the irrigation demand will increase the system demands that are used as a basis for calculating storage requirements. However, the increase in demand will be balanced by an increase in well capacity. It is recommended that enough well capacity be provided to minimize equalizing and standby storage requirements so that the total storage required does not exceed the total capacity of the existing storage reservoirs.

Because the water system demand is low relative to the fire flows required, sizing of the system and system upgrades is typically driven by the need to meet fire flow requirements. The Water System Plan recommended upgrades to distribution pipe in the vicinity of Lateral E1 to correct fire flow deficiencies. Additional hydraulic analysis using the City's water system model would be needed to verify the impact of the additional irrigation demand on the distribution system's ability to meet fire flow requirements. An initial review of the City's water distribution system map, existing pipe sizes, and fire flow requirements indicates that additional upgrades would be required to convey irrigation flows to MVID users while preserving capacity for fire flow and domestic flows to existing water system users. Upgrades would likely require replacement of 8-inch and 6-inch pipe in the vicinity of Lateral E1 with 12-inch pipe and completion of a loop with 12-inch pipe.

Overall, it is anticipated that the following upgrades would be required to enable the Town of Twisp to serve MVID users on the east side of the Methow River within the town limits:

- Activate Well No. 4 (Assumed capacity of at least 400 gpm).
- Add a new well with a source capacity of at least 700 gpm.
- Replace existing 8-inch pipe along Highway 20 frontage with 12-inch pipe
- Replace 8-inch pipe in Marble Street with 12-inch pipe
- Replace 6-inch pipe in Burton Street with 12-inch pipe
- Replace 8-inch pipe in Riverside Avenue with 12-inch pipe
- Complete loop from Marble Street to Riverside Avenue with 12-inch pipe

The costs and figures presented in this report assume that Lateral E1 users would be served irrigation water through an agreement with the Town of Twisp and that the improvements summarized above would be needed. As of the date of this report, an agreement has not been reached. If an agreement cannot be established with the Town of Twisp, then MVID parcels within the Town of Twisp would need to continue to be served by MVID. The lateral pipe would need to be replaced and the lateral system would need to be supplied by a groundwater well or through a connection to the East Canal pipeline. It is estimated that a supply of at least 2.7 cfs would be needed to serve Lateral E1 users. If a well is used, it is estimated that the well would require a 60-horsepower well pump. If Lateral E1 is supplied through a connection to the East Canal pipeline, the size of the pipeline upstream of the connection may need to be larger and should be re-evaluated.

5.1.3 Other Considerations

Additional items that should be given consideration as part of the evaluation and design of this alternative include:

- **Land Acquisition –** The following property or easements would need to be acquired to implement Alternative 1:
  - Pipelines – The main line would likely be located within the existing ditch easement. Relocated laterals would require new easements.
  - Water Supply Facilities – The proposed pump station and associated discharge pipeline on the Methow River would be located on existing MVID property.

- Storage – New storage facilities would likely be located outside the existing ditch easement to ensure that the tanks are located at the appropriate elevation. Property would need to be acquired for these facilities.

- **Geology –** Subsurface geotechnical exploration would be needed to complete the design of the facilities. Preliminary observations indicate that the bedrock and boulders are likely to be encountered in excavations for the proposed pump station and pipelines. Some allowance for excavation of rock has been assumed as part of the cost analysis outlined in Section 6. Additional evaluation would be needed to better understand the impact on the construction cost for this alternative.
- **Drainage –** The existing canals currently capture and convey stormwater runoff from the hillsides above the canals. Additional evaluation is needed to determine the impact of piping or abandoning existing canals and laterals on stormwater runoff.
- **Vegetation –** Trees and vegetation lining the existing canals currently rely on the water supply in the canal. When the canals are piped or abandoned, trees and vegetation will be impacted. Additional consideration should be given to tree mortality and potential hazards that could result from falling trees.
- **Permitting –** A detailed analysis of permitting requirements has not been completed as part of this alternatives analysis. However, it is anticipated that construction of the facilities included as part of Alternative 1 would require the following:
  - U.S. Army Corps of Engineers (USACE) Section 404 approval
  - ESA review and approvals
  - State Environmental Policy Act (SEPA) review and approvals
  - National Historic Preservation Act (NHPA) and Washington State Department of Archaeology and Historic Preservation (DAHP) cultural resources review and approvals, including compliance with Governor's Executive Order 05-05
  - Ecology Section 401 water quality approval
  - Ecology National Pollution Discharge Elimination System (NPDES) Construction General Permit Approval
  - Local environmental, critical areas, and building permit approvals

- **Water Right Transfer Requirements –** This alternative would require transfer of a surface water right from the existing point of diversion on the Twisp River to the proposed point of diversion on the Methow River. This alternative would also

require transfer of a surface water right from the existing points of diversion on the Twisp River and the Methow River to the groundwater aquifer for individual wells. Because Ecology is funding and participating in review of this project, it is anticipated that the transfer of water rights would not be an issue that would prevent the implementation of Alternative 1.

5.2 Alternative 2

A detailed description of Alternative 2 is included in Section 3.2. Alternative 2 would include the following major improvement projects:

- Replacement of the MVID West Canal system from Station 161+00 to the downstream end with a pressurized pipe system supplied through groundwater production wells near the Methow River.
- Replacement of the MVID East Canal system from Station 193+00 to Beaver Creek with a gravity-fed pipe system.
- Improvements that would enable Lateral E1 users to be served irrigation water through the Town of Twisp potable water distribution system under an agreement with the Town of Twisp.

The following provides a summary of the design evaluation of Alternative 2.

5.2.1 West Canal Improvements

5.2.1.1 Water Supply

The source of supply for the West Canal system for Alternative 2 would be groundwater wells located near Test Well 3 that was drilled on property owned by Janet Eileen (Parcel 4270000100), as outlined in Section 4.3.1. The wells would need to serve the entire 11 cfs (4,950 gpm) design demand. Based on the aquifer formation found at Test Well 3, three production wells are recommended to serve a total of 11 cfs. Section 4.3.1 recommends that each well be designed to have a capacity of 1,800 to 2,000 gpm so the total pumping capacity would be 5,400 to 6,000 gpm (12 to 13.3 cfs). This would provide some margin of safety in case the wells decline in pumping capacity with age or maintenance is required on one of the wells. Additional analysis of groundwater conditions and recommendations for water supply for

Alternative 2 are included in Section 4. Based on the results of the test well drilling, it is anticipated that three wells drilled with adequate spacing should be able to supply 11 cfs.

5.2.1.2 Hydraulic Analysis

As noted in Section 3.2, the Alternative 2 West Canal system would consist of two separate pressure zones. The production wells would deliver water directly to the Lower Pressure Zone. A booster pump station would be constructed near the existing Roach Spill to deliver water to the Upper Pressure Zone.

A preliminary hydraulic analysis was completed to estimate the preliminary size of well pumps, booster pumps, and pipe included as part of the West Canal system for Alternative 2. The results of the analyses are included in Appendix D. A spreadsheet analysis was used to estimate losses through the system, from the pump to each lateral and delivery location. A system curve was developed for each alternative that shows the estimated TDH, or pumping head, required for pumping at different flow rates. The Hazen-William formula was used to estimate friction losses through the system. The hydraulic analysis assumed that pump station manifold piping would be steel pipe with a Hazen-Williams coefficient of 110 and that the delivery system piping would be PVC with a Hazen-Williams coefficient of 140. An allowance was also included for minor losses to account for losses through bends, valves, pipe entrances, pipe exits, and other fittings. Table 5-6 summarizes the results of the hydraulic analysis for Alternative 2.

Table 5-6
Summary of Hydraulic Analysis Results – Alternative 2 West Canal System

Design Parameter	Lower Pressure Zone	Upper Pressure Zone
Groundwater elevation, minimum[1] (feet)	1,455	N/A
Booster pump suction HGL, Minimum[1] (feet)	N/A	1,645
Maximum static system HGL[1] (feet)	1,667	1,804
Well design flow (cfs)	11	N/A
Booster pump station design flow (cfs)	N/A	2.4
Pumping head, or TDH (feet)	175	173
Total pumping horsepower required	330	70
Main line pressures[2] (psi)	20 to 67	10 to 99
Lateral pressures[3] (psi)	20 to 83	20 to 93

Notes:
1. Elevations and hydraulic gradients based on the NAVD 88 datum.
2. Represents expected range of pressures in main line from tee with pump discharge line to end of line.
3. Represents expected range of pressures in replaced laterals.

cfs = cubic feet per second
HGL = hydraulic gradient
N/A = not applicable
psi = pounds per square inch
TDH = total dynamic head

5.2.2 East Canal Improvements

The East Canal improvements for Alternative 2 would be identical to those evaluated for Alternative 1 in Section 5.1.2. A pipeline would replace the East Canal from Station 193+00 to Beaver Creek. The water supply analysis and hydraulic analysis outlined in Section 5.1.2 also apply to the East Canal facilities for Alternative 2. If an agreement can be reached with the Town of Twisp, MVID users within the Town limits on the east side of the Methow River would be served through the Town's water distribution system. If an agreement cannot be reached, MVID would need to replace the lateral with a new pipe system supplied through a groundwater well or through a connection to the East Canal pipeline. An evaluation and requirements for service to these users are as outlined in Section 5.1.2.3.

5.2.3 Other Considerations

Additional items that should be given consideration as part of the evaluation and design of this alternative include:

- **Land Acquisition –** The following property or easements would need to be acquired to implement Alternative 2:
  - Pipelines – The main line would likely be located within the existing ditch easement. Relocated laterals would require new easements.
  - Water Supply Facilities – The new production wells would require new property and easements for discharge pipelines.
  - Storage – New storage facilities would likely be located outside the existing ditch easement to ensure that the tanks are located at the appropriate elevation. Property would need to be acquired for these facilities.
- **Geology –** Subsurface geotechnical exploration would be needed to complete the design of the facilities. Preliminary observations indicate that the bedrock and boulders are likely to be encountered in excavations for the proposed pipelines and drilling for proposed wells. Some allowance for excavation of rock has been assumed as part of the cost analysis outlined in Section 6. Additional evaluation would be needed to better understand the impact on the construction cost for this alternative.
- **Drainage –** The existing canals currently capture and convey stormwater runoff from the hillsides above the canals. Additional evaluation is needed to determine the impact of piping or abandoning existing canals and laterals on stormwater runoff.
- **Vegetation –** Trees and vegetation lining the existing canals currently rely on the water supply in the canal. When the canals are piped or abandoned, trees and vegetation will be impacted. Additional consideration should be given to tree mortality and potential hazards that could result from falling trees.
- **Permitting –** A detailed analysis of permitting requirements has not been completed as part of this alternatives analysis. However, it is anticipated that the work completed under this alternative would require fewer permit approvals than Alternative 1, because the facilities would not require work in the Methow River Channel. Construction of the facilities included as part of Alternative 2 would require the following:
  - ESA review and approvals
  - SEPA review and approvals
  - NHPA and DAHP cultural resources review and approvals, including compliance with Governor's Executive Order 05-05

- Ecology NPDES Construction General Permit Approval
- Local environmental, critical areas, and building permit approvals

- **Water Right Transfer Requirements –** This alternative would require transfer of a surface water right from the existing point of diversion on the Twisp River to the groundwater aquifer. This alternative would also require transfer of a surface water right from the existing points of diversion on the Twisp River and the Methow River to the groundwater aquifer for individual wells. Because Ecology is funding and participating in review of this project, it is anticipated that the transfer of water rights would not be an issue that would prevent the implementation of Alternative 2, provided that nearby wells are either not affected or are improved to ensure that their water supply is not affected.

5.3 Alternative 3

A detailed description of Alternative 3 is included in Section 3.3. Alternative 3 would include the following major improvement projects:

- Replacement of the MVID West Canal system from Station 161+00 to the downstream end with two separate pressurized pipe systems supplied through groundwater production wells near the Methow River.
- Replacement of the MVID East Canal system from Station 193+00 to Beaver Creek with a gravity-fed pipe system.
- Improvements that would enable Lateral E1 users to be served irrigation water through the Town of Twisp potable water distribution system under an agreement with the Town of Twisp.

The following provides a summary of the design evaluation of Alternative 3.

5.3.1 West Canal Improvements

5.3.1.1 Water Supply

The source of supply for the West Canal system for Alternative 3 would be groundwater wells located near both Test Well 2, that was drilled on property owned by Alyssa Jumars (Parcel 5130360001) near the lower end of the canal, and Test Well 3, that was drilled on

property owned by Janet Eileen (Parcel 4270000100) near the middle of the canal, as outlined in Section 4.3.2. The wells near the Eileen property would need to serve the 5.1 cfs (2,295 gpm) design demand for the Upper System (Middle and Upper Pressure Zones). The wells near the Jumars property would need to serve the 5.9 cfs (2,650 gpm) design demand for the Lower System. Based on the aquifer formation found at Test Well 3, two production wells are recommended to serve a total 5.1 cfs demand for the Upper System. Section 4.3.2 recommends that each well be designed to have a capacity of up to 2.7 cfs (1,200 gpm) so the total pumping capacity would be approximately 2,400 gpm (5.3 cfs). This would provide some margin of safety in case the wells decline in pumping capacity with age or maintenance is required on one of the wells.

Based on the aquifer formation found at Test Well 2, three production wells are recommended to serve a total 5.9 cfs demand for the Lower System. Two of the wells would be located near Test Well 2, and an additional well would need to be located on the east side of the Twisp-Carlton Road near the lower end of the system. Section 4.3.2 recommends that each well be designed to have a capacity of up to approximately 2.0 to 2.2 cfs (900 to 1,000 gpm) so the total pumping capacity would be between 2,700 and 3,000 gpm (6.0 to 6.7 cfs). This would provide some margin of safety in case the wells decline in pumping capacity with age or maintenance is required on one of the wells.

Additional analysis of groundwater conditions and recommendations for water supply for Alternative 3 are included in Section 4. Based on the results of the test well drilling, it is anticipated that two adequately spaced wells should be able to supply the Upper System and three adequately spaced wells should be able to supply the Lower System.

5.3.1.2 Hydraulic Analysis

As noted in Section 3.3, the Alternative 3 West Canal improvements would create two separate systems, an Upper System and a Lower System. The Upper System would consist of two pressure zones, an Upper Pressure Zone and Middle Pressure Zone. The Lower System would be a single Lower Pressure Zone. The production wells near Test Well 3 would deliver water directly to the Middle Pressure Zone. A booster pump station would be

constructed near the existing Roach Spill to deliver water to the Upper Pressure Zone. The production wells near Test Well 2 would deliver water directly to the Lower Pressure Zone.

A hydraulic analysis was completed to determine the preliminary size of well pumps, booster pumps, and pipe included as part of the West Canal System for Alternative 3. The results of the analyses are included in Appendix D. A spreadsheet analysis was used to estimate losses through the system, from the pump to each lateral and delivery location. A system curve was developed for each alternative that shows the estimated total dynamic head (TDH), or pumping head, required for pumping at different flow rates. The Hazen-William formula was used to estimate friction losses through the system. The hydraulic analysis assumed that pump station manifold piping would be steel pipe with a Hazen-Williams coefficient of 110 and that the delivery system piping would be PVC with a Hazen-Williams coefficient of 140. An allowance was also included for minor losses to account for losses through bends, valves, pipe entrances, pipe exits, and other fittings. Table 5-7 summarizes the results of the hydraulic analysis for Alternative 3.

Table 5-7
Summary of Hydraulic Analysis Results – Alternative 3 West Canal System

Design Parameter	Lower Pressure Zone	Middle Pressure Zone	Upper Pressure Zone
Groundwater elevation, minimum[1] (feet)	1,383	1,455	N/A
Booster pump suction HGL, minimum[1] (feet)	N/A	N/A	1,645
Maximum Static System HGL[1] (feet)	1,620	1,667	1,804
Well Design Flow (cfs)	5.9	5.1	N/A
Booster Pump Station Design Flow (cfs)	N/A	N/A	2.4
Pumping Head, or TDH (feet)	192	175	173
Total Pumping Horsepower Required	195	150	70
Main Line Pressures[2] (psi)	20 to 46	20 to 46	10 to 100
Lateral Pressures[3] (psi)	24 to 63	20 to 73	20 to 93

Notes:
1. Elevations and hydraulic gradients based on the NAVD 88 datum.
2. Represents expected range of pressures in main line from tee with pump discharge line to end of line.
3. Represents expected range of pressures in replaced laterals.

cfs = cubic feet per second
HGL = hydraulic gradient
N/A = not applicable
psi = pounds per square inch
TDH = total dynamic head

5.3.2 East Canal Improvements

The East Canal Improvements for Alternative 3 would be identical to those evaluated for Alternative 1 in Section 5.1.2. A pipeline would replace the East Canal from Station 193+00 to Beaver Creek. The water supply analysis and hydraulic analysis outlined in Section 5.1.2 also apply to the East Canal facilities for Alternative 2. If an agreement can be reached with the Town of Twisp, MVID users within the Town limits on the east side of the Methow River would be served through the Town's water distribution system. If an agreement cannot be reached, MVID would need to replace the lateral with a new pipe system supplied through a groundwater well or through a connection to the East Canal pipeline. An evaluation and requirements for service to these users are as outlined in Section 5.1.2.3.

5.3.3 Other Considerations

Additional items that should be given consideration as part of the evaluation and design of this alternative include:

- **Land Acquisition –** The following property or easements would need to be acquired to implement Alternative 3:
  - Pipelines – The main line would likely be located within the existing ditch easement. Relocated laterals would require new easements.
  - Water Supply Facilities – The new production wells would require new property and easements for discharge pipelines. This alternative would include more water supply wells than Alternative 2 and would require more property and easements.
  - Storage – New storage facilities would likely be located outside the existing ditch easement to ensure that the tanks are located at the appropriate elevation. This alternative would include more storage locations than Alternatives 1 and 2 and would require more property.
- **Geology –** Subsurface geotechnical exploration would be needed to complete the design of the facilities. Preliminary observations indicate that the bedrock and boulders are likely to be encountered in excavations for the proposed pipelines and drilling for proposed wells. Some allowance for excavation of rock has been assumed as part of the cost analysis outlined in Section 6. Additional evaluation would be needed to better understand the impact on the construction cost for this alternative.

- **Drainage –** The existing canals currently capture and convey stormwater runoff from the hillsides above the canals. Additional evaluation is needed to determine the impact of piping or abandoning existing canals and laterals on stormwater runoff.
- **Vegetation –** Trees and vegetation lining the existing canals currently rely on the water supply in the canal. When the canals are piped or abandoned, trees and vegetation will be impacted. Additional consideration should be given to tree mortality and potential hazards that could result from falling trees.
- **Permitting –** A detailed analysis of permitting requirements has not been completed as part of this alternatives analysis. However, it is anticipated that the work completed under this alternative would require fewer permit approvals than Alternative 1 because the facilities would not require work in the Methow River Channel. Construction of the facilities included as part of Alternative 3 would require the following:
  - ESA review and approvals
  - SEPA review and approvals
  - NHPA and DAHP cultural resources review and approvals, including compliance with Governor's Executive Order 05-05
  - Ecology NPDES Construction General Permit Approval
  - Local environmental, critical areas, and building permit approvals
- **Water Right Transfer Requirements –** This alternative would require transfer of a surface water right from the existing point of diversion on the Twisp River to the groundwater aquifer. This alternative would also require transfer of a surface water right from the existing points of diversion on the Twisp River and the Methow River to the groundwater aquifer for individual wells. Because Ecology is funding and participating in review of this project, it is anticipated that the transfer of water rights would not be an issue that would prevent the implementation of Alternative 3, provided that nearby wells are either not affected or are improved to ensure that their water supply is not affected.

5.4 Alternative 4

A detailed description of Alternative 4 is included in Section 3.4. Alternative 4 would focus on converting as many existing MVID users as possible to individual well systems. For those users that cannot be served by individual well systems, Alternative 4 includes:

- Replacement of the MVID West Canal system from Station 161+00 to Station 329+05 with a smaller pressurized pipe system supplied through a groundwater production well near the Methow River.
- Improvements that would enable Lateral E1 users to be served irrigation water through the Town of Twisp potable water distribution system under an agreement with the Town of Twisp.

The following provides a summary of the design evaluation of Alternative 4.

5.4.1 West Canal Improvements

5.4.1.1 Water Supply

Alternative 4 would convert approximately half of the parcels currently served by the MVID West Canal to individual well systems. The water supply for individual well systems was evaluated in Section 4. It is anticipated that parcels within the mapped area of unconsolidated sediments in the Methow Valley would be able to drill individual wells with adequate supply to meet irrigation needs.

A reduced system is recommended to serve users at the upstream end of the MVID West Canal that would not be able to drill individual wells with sufficient supply to meet irrigation needs. A production well is recommended to supply these users located near the Methow River in the vicinity of property owned by Dave Shulz (Parcel 3322170384). The well would need to have a minimum capacity of 2.8 cfs (1,260 gpm). Field testing has not been completed to verify the capacity of a well at that location. Additional analysis of groundwater conditions and recommendations for water supply for Alternative 4 are included in Section 4. Based on the research of existing well logs and the evaluation of hydrogeology summarized in Section 4, it is anticipated that a well located near the Methow River would have capacity to supply the proposed system.

If a well on the Shulz property cannot supply the required design flow, consideration should be given to supply the proposed system through a well near the location of Test Well No. 3, as described in Section 4, which was drilled on property owned by Janet Eileen. Other higher capacity wells have been drilled in the vicinity of that test well and there would be high probability of supplying the required 2.8 cfs from a well at that location.

5.4.1.2 Hydraulic Analysis

A hydraulic analysis was completed to determine the preliminary size of well pumps and pipe included as part of the reduced system needed to serve MVID users along the upper end of the West Canal as part of Alternative 4. The results of the analyses are included in Appendix D. A spreadsheet analysis was used to estimate losses through the system, from the pump to each lateral and delivery location. A system curve was developed for each alternative that shows the estimated total dynamic head (TDH), or pumping head, required for pumping at different flow rates. The Hazen-William formula was used to estimate friction losses through the system. The hydraulic analysis assumed that pump station manifold piping would be steel pipe with a Hazen-Williams coefficient of 110 and that the delivery system piping would be PVC with a Hazen-Williams coefficient of 140. An allowance was also included for minor losses to account for losses through bends, valves, pipe entrances, pipe exits, and other fittings. Table 5-8 summarizes the results of the hydraulic analysis for Alternative 4.

Table 5-8
Summary of Hydraulic Analysis Results – Alternative 4 West Canal System

Design Parameter	Upper West System
Groundwater elevation, minimum[1] (feet)	1,556
Maximum static system HGL[1] (feet)	1,804
Well design flow (cfs)	2.8
Pumping Head, or TDH (feet)	249
Total pumping horsepower required	115
Main line pressures[2] (psi)	10 to 96
Lateral pressures[3] (psi)	10 to 89

Notes:
1. Elevations and hydraulic gradients based on the NAVD 88 datum.
2. Represents expected range of pressures in main line from tee with pump discharge line to end of line.
3. Represents expected range of pressures in replaced laterals.

cfs = cubic feet per second
HGL = hydraulic gradient
psi = pounds per square inch
TDH = total dynamic head

If a well at the Shulz property is not feasible or does not supply the capacity needed and an alternate well location is selected in the vicinity of Test Well No. 3, additional analysis would need to be completed to identify changes in pipe sizes and system configuration needed to

deliver water to irrigators. If the alternate well location is selected, a larger pipeline would be required between the well and Lateral W2 and the size of the Lateral 2 pipe between the Shulz property and the main pipeline could be reduced. In addition, if the alternate well site is selected, it may make sense to shift the location of the tank closer to the well and include a booster pump to deliver to the upstream end of the system.

5.4.2 East Canal Improvements

Alternative 4 would convert the majority of the parcels currently served by the MVID East Canal to individual well systems. The water supply for individual well systems was evaluated in Section 4. It is anticipated that parcels within the alluvium at the bottom of the Methow Valley would be able to drill individual wells with adequate supply to meet irrigation needs.

If an agreement can be reached with the Town of Twisp, MVID users within the Town limits on the east side of the Methow River would be served through the Town's water distribution system. If an agreement cannot be reached, MVID would need to replace the lateral with a new pipe system supplied through a groundwater well. An evaluation and requirements for service to these users are as outlined in Section 5.1.2.3.

5.4.3 Other Considerations

Additional items that should be given consideration as part of the evaluation and design of this alternative include:

- **Land Acquisition –** The following property or easements would need to be acquired to implement Alternative 4:
  - Pipelines – The main line would likely be located within the existing ditch easements. Relocated laterals would require new easements.
  - Water Supply Facilities – The new production wells would require new property and easements for discharge pipelines.
  - Storage – A new storage tank recommended for the Upper West system would likely be located outside the existing ditch easement to ensure that the tank is at the appropriate elevation. Property would be required for this facility.

- **Geology –** Subsurface geotechnical exploration would be needed to complete the design of the facilities. Preliminary observations indicate that the bedrock and boulders are likely to be encountered in excavations for the proposed pipelines and drilling for proposed wells. Some allowance for excavation of rock has been assumed as part of the cost analysis outlined in Section 6. Additional evaluation would be needed to better understand the impact on the construction cost for this alternative.
- **Drainage –** The existing canals currently capture and convey stormwater runoff from the hillsides above the canals. Additional evaluation is needed to determine the impact of piping or abandoning existing canals and laterals on stormwater runoff.
- **Vegetation –** Trees and vegetation lining the existing canals currently rely on the water supply in the canal. When the canals are piped or abandoned, trees and vegetation will be impacted. Additional consideration should be given to tree mortality and potential hazards that could result from falling trees.
- **Permitting –** A detailed analysis of permitting requirements has not been completed as part of this alternatives analysis. However, it is anticipated that the work completed under this alternative would require fewer permit approvals than the other alternatives. The most challenging permit requirement would likely be water right transfers. Construction of the facilities included as part of Alternative 4 would require the following:
  - ESA review and approvals
  - SEPA review and approvals
  - NHPA and DAHP cultural resources review and approvals, including compliance with Governor's Executive Order 05-05
  - Ecology NPDES Construction General Permit Approval
  - Local environmental, critical areas, and building permit approvals
- **Water Right Transfer Requirements –** This alternative would require transfer of a surface water right from the existing point of diversion on the Twisp River to the groundwater aquifer, for both production wells and individual wells. This transfer process is described in Section 4.4. Because Ecology is funding and participating in review of this project, it is anticipated that the transfer of water rights would not be an issue that would prevent the implementation of Alternative 4, provided that

nearby wells are either not affected or are improved to ensure that their water supply is not affected.

5.5 Alternative 5

A detailed description of Alternative 5 is included in Section 3.5. Alternative 5 would combine the West Canal Improvements included in Alternative 4 with the East Canal improvements included in Alternatives 1, 2, and 3. Alternative 5 includes:

- Replacement of the MVID West Canal system from Station 161+00 to Station 329+05 with a smaller pressurized pipe system supplied through a groundwater production well near the Methow River.
- Replacement of the MVID East Canal system from Station 193+00 to Beaver Creek with a gravity-fed pipe system.
- Improvements that would enable Lateral E1 users to be served irrigation water through the Town of Twisp potable water distribution system under an agreement with the Town of Twisp.

5.5.1 West Canal Improvements

The West Canal improvements for Alternative 5 would be identical to those evaluated for Alternative 4 in Section 5.4.1. The water supply analysis and hydraulic analysis outlined in Section 5.1.2 also apply to the West Canal facilities for Alternative 5.

5.5.2 East Canal Improvements

The East Canal improvements for Alternative 5 would be identical to those evaluated for Alternative 1 in Section 5.1.2. A pipeline would replace the East Canal from Station 193+00 to Beaver Creek. The water supply analysis and hydraulic analysis outlined in Section 5.1.2 also apply to the East Canal facilities for Alternative 5. If an agreement can be reached with the Town of Twisp, MVID users within the Town limits on the east side of the Methow River would be served through the Town's water distribution system. If an agreement cannot be reached, MVID would need to replace the lateral with a new pipe system supplied through a groundwater well or through a connection to the East Canal pipeline. An evaluation and requirements for service to these users are as outlined in Section 5.1.2.3.

5.5.3 Other Considerations

Additional items that should be given consideration as part of the evaluation and design of this alternative include:

- **Land Acquisition –** The following property or easements would need to be acquired to implement Alternative 5:
  - Pipelines – The main pipelines would likely be located within the existing ditch easement. Relocated laterals would require new easements.
  - Water Supply Facilities – The new production well would require new property and easements for discharge pipelines.
  - Storage – New storage facilities would likely be located outside the existing ditch easement to ensure that the tanks are located at the appropriate elevation. Property would need to be acquired for these facilities.
- **Geology –** Subsurface geotechnical exploration would be needed to complete the design of the facilities. Preliminary observations indicate that the bedrock and boulders are likely to be encountered in excavations for the proposed pipelines and drilling for proposed wells. Some allowance for excavation of rock has been assumed as part of the cost analysis outlined in Section 6. Additional evaluation would be needed to better understand the impact on the construction cost for this alternative.
- **Drainage –** The existing canals currently capture and convey stormwater runoff from the hillsides above the canals. Additional evaluation is needed to determine the impact of piping or abandoning existing canals and laterals on stormwater runoff.
- **Vegetation –** Trees and vegetation lining the existing canals currently rely on the water supply in the canal. When the canals are piped or abandoned, trees and vegetation will be impacted. Additional consideration should be given to tree mortality and potential hazards that could result from falling trees.
- **Permitting –** A detailed analysis of permitting requirements has not been completed as part of this alternatives analysis. However, it is anticipated that the work completed under this alternative would require fewer permit approvals than Alternative 1, because the facilities would not require work in the Methow River Channel. Construction of the facilities included as part of Alternative 5 would require the following:

- ESA review and approvals
- SEPA review and approvals
- NHPA and DAHP cultural resources review and approvals, including compliance with Governor's Executive Order 05-05
- Ecology NPDES Construction General Permit Approval
- Local environmental, critical areas, and building permit approvals

- **Water Right Transfer Requirements –** This alternative would require transfer of a surface water right from the existing point of diversion on the Twisp River to the groundwater aquifer. This alternative would also require transfer of a surface water right from the existing points of diversion on the Twisp River and the Methow River to the groundwater aquifer for individual wells. Because Ecology is funding and participating in review of this project, it is anticipated that the transfer of water rights would not be an issue that would prevent the implementation of Alternative 5, provided that nearby wells are either not affected or are improved to ensure that their water supply is not affected.

6 COST ANALYSIS

6.1 Construction Cost

Opinions of probable construction costs were developed for each of the alternatives. Table 6-1 provides a comparison of the opinion of probable construction costs for each alternative. The costs are summarized by the three major components of each alternative: pipelines and laterals, water supply and pumping facilities, and water storage facilities. Individual wells are listed separately and costs are totaled with and without the cost of individual wells. More detailed cost information, including a list of major items, estimated quantities, and unit costs used to develop the opinions of cost is included in Appendix E.

Table 6-1
Summary of Opinion of Probable Project Costs[1]

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Pipelines and laterals	$6,561,000 to $7,874,000	$6,593,000 to $7,912,000	$5,774,000 to $6,929,000	$1,560,000 to $1,872,000	$4,119,000 to $4,943,000
Water supply and pumping facilities	$1,150,000 to $1,380,000	$1,096,000 to $1,315,000	$1,522,000 to $1,826,000	$460,000 to $552,000	$460,000 to $552,000
Water storage facilities	$948,000 to $1,138,000	$948,000 to $1,138,000	$1,003,000 to $1,204,000	$225,000 to $270,000	$225,000 to $270,000
Total field costs – without individual wells	**$8,659,000 to $10,392,000**	**$8,637,000 to $10,365,000**	**$8,299,000 to $9,959,000**	**$2,245,000 to $2,694,000**	**$4,804,000 to $5,765,000**
Engineering, permitting, administration (20%)	$1,732,000 to $2,079,000	$1,728,000 to $2,073,000	$1,660,000 to $1,992,000	$449,000 to $539,000	$961,000 to $1,153,000
Land acquisition – pipelines	$15,000	$15,000	$15,000	$10,000	$15,000
Land acquisition – water supply facilities	$0	$56,000	$103,500	$28,000	$28,000
Land acquisition – water storage facilities	$20,000	$20,000	$20,000	$20,000	$20,000
Total project costs – without individual wells	**$10,426,000 to $12,506,000**	**$10,456,000 to $12,529,000**	**$10,098,000 to $12,090,000**	**$2,752,000 to $3,291,000**	**$5,828,000 to $6,981,000**
Individual well conversion	$217,000 to $261,000	$217,000 to $261,000	$217,000 to $261,000	$4,165,000 to $4,998,000	$1,512,000 to $1,815,000
Total project costs – with individual wells	**$10,643,000 to $12,767,000**	**$10,673,000 to $12,790,000**	**$10,315,000 to $12,351,000**	**$6,917,000 to $8,289,000**	**$7,340,000 to $8,796,000**

Notes:
1. Costs shown are in 2013 dollars. Actual costs will vary based on materials and labor costs at the time of construction.

The opinions of probable construction costs incorporate the following:

- A 7.5 percent allowance for mobilization/demobilization
- A 10 percent allowance for unlisted items
- A 7.7 percent sales tax rate

The high end of the range of total field costs, or construction costs, included in the summary tables includes a 20 percent contingency. Other costs that would be included in the total project cost include:

- A 20 percent allowance for engineering, permitting, and administration
- An allowance for land acquisition

A summary of the cost for converting typical parcels currently served by MVID to individual well systems is included in Table 6-2. Two local well drillers were contacted for guidance on costs for drilling an individual well that would serve less than 5 acres. The estimates provided by these well drillers are included in Appendix F. The individual well costs include the cost to drill a 6-inch diameter, 100-foot deep well, install a well pump and accessories, and connect to nearby on-farm plumbing. The well costs also include allowances for mobilization/demobilization, unlisted items, sales tax, and contingencies, as noted above.

Table 6-2
Opinion of Individual Well Conversion Costs[1]

Parcel Size (Acres)	Maximum Irrigation Flow Rate (gpm per acre)	(gpm)	Total Field Costs
<1	9	<9	$11,900 to $14,300
1 to 5	9	9 to 45	$13,400 to $16,100
5 to 10	9	45 to 90	$16,800 to $20,200
>10	9	>90	$43,400 to $52,100

Notes:
1. Costs shown are in 2013 dollars. Actual costs will vary based on materials and labor costs at the time of construction.

gpm = gallons per minute

The costs for individual wells were multiplied by the total number of parcels to be converted to individual wells for each range of irrigated acreages for each alternative to determine the total cost of individual wells for each alternative. These totals are summarized in Table 6-1. The largest impact of the cost of individual wells is to Alternative 4. Individual well systems represent more than 60 percent of the total project cost. Individual well systems represent more than 20 percent of the total project cost for Alternative 5. Alternatives 1, 2, and 3 would include only eight parcels on each side of the Methow River that would convert to individual wells at the upstream end of the West Canal.

6.2 Long-term Operating Costs

Opinions of probable operations and maintenance costs for operating a continued MVID system with the improvements described as part of each alternative were developed based on input from MVID. A summary of projected operations and maintenance (O&M) costs (in 2013 dollars) for each alternative are summarized in Tables 6-3 through 6-7. The O&M costs shown do not include power costs, which are summarized in Table 6-8.

Table 6-3
Opinion of Operations and Maintenance Costs[1] Summary – Alternative 1

Item	MVID West Canal	MVID East Canal	Total
Staff salaries	$15,000	$10,000	**$25,000**
Benefits	$3,200	$2,020	**$5,220**
Transportation costs	$2,700	$2,300	**$5,000**
Utilities, phones, communications	$1,230	$730	**$1,960**
Maintenance, small repairs, supplies, other	$4,870	$1,400	**$6,270**
Contracted labor costs	$3,000	$3,450	**$6,450**
Subtotal	**$30,000**	**$19,900**	**$49,900**
Administration	$26,500	$11,800	**$38,300**
Total	**$56,500**	**$31,700**	**$88,200**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that O&M costs will increase with inflation.

Table 6-4

Opinion of Operations and Maintenance Costs[1] Summary – Alternative 2

Item	MVID West Canal	MVID East Canal	Total
Staff Salaries	$15,000	$10,000	**$25,000**
Benefits	$3,200	$2,020	**$5,220**
Transportation costs	$2,700	$2,300	**$5,000**
Utilities, phones, communications	$1,230	$730	**$1,960**
Maintenance, small repairs, supplies, other	$5,370	$1,400	**$6,770**
Contracted labor costs	$3,500	$3,450	**$6,950**
Subtotal	**$31,000**	**$19,900**	**$50,900**
Administration	$26,500	$11,800	**$38,300**
Total	**$57,500**	**$31,700**	**$89,200**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that O&M costs will increase with inflation.

Table 6-5

Opinion of Operations and Maintenance Costs[1] Summary – Alternative 3

Item	MVID West Canal	MVID East Canal	Total
Staff Salaries	$15,000	$10,000	**$25,000**
Benefits	$3,200	$2,020	**$5,220**
Transportation costs	$2,700	$2,300	**$5,000**
Utilities, phones, communications	$1,230	$730	**$1,960**
Maintenance, small repairs, supplies, other	$5,670	$1,400	**$7,070**
Contracted labor costs	$3,700	$3,450	**$7,150**
Subtotal	**$31,500**	**$19,900**	**$51,400**
Administration	$26,500	$11,800	**$38,300**
Total	**$58,000**	**$31,700**	**$89,700**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that O&M costs will increase with inflation.

Table 6-6
Opinion of Operations and Maintenance Costs[1] Summary – Alternative 4

Item	MVID West Canal	MVID East Canal	Total
Staff salaries	$9,000	$0	**$9,000**
Benefits	$1,820	$0	**$1,820**
Transportation costs	$1,500	$0	**$1,500**
Utilities, phones, communications	$530	$0	**$530**
Maintenance, small repairs, supplies, other	$1,100	$0	**$1,100**
Contracted labor costs	$4,250	$0	**$4,250**
Subtotal	**$18,200**	**$0**	**$18,200**
Administration	$9,800	$0	**$9,800**
Total	**$28,000**	**$0**	**$28,000**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that O&M costs will increase with inflation.

Table 6-7
Opinion of Operations and Maintenance Costs[1] Summary – Alternative 5

Item	MVID West Canal	MVID East Canal	Total
Staff salaries	$9,000	$10,000	**$19,000**
Benefits	$1,820	$2,020	**$3,840**
Transportation costs	$1,500	$2,300	**$3,800**
Utilities, phones, communications	$530	$730	**$1,260**
Maintenance, small repairs, supplies, other	$1,100	$1,400	**$2,500**
Contracted labor costs	$4,250	$3,450	**$7,700**
Subtotal	**$18,200**	**$19,900**	**$38,100**
Administration	$9,800	$11,800	**$21,600**
Total	**$28,000**	**$31,700**	**$59,700**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that O&M costs will increase with inflation.

The operations and maintenance costs listed in Tables 6-3 through 6-7 do not include the annual cost of a service agreement with the Town of Twisp that MVID would incur for service to MVID members within the Town of Twisp limits near Lateral E1. That cost is yet to be negotiated, but

would likely need to cover a portion of the Town of Twisp's operating costs. Although this cost has not been negotiated, $12,000 was included to account for MVID's contribution to the Town of Twisp's operations and maintenance costs. An additional $7,000 was included to cover administrative costs that MVID would incur for service to MVID members within the Town of Twisp limits near Lateral E1. These costs would apply to each alternative.

Another long-term cost that will be incurred through implementation of any of the proposed alternatives is pumping power costs. Opinions of annual pumping power costs were developed using Okanogan Public Utility District (PUD) Rate Schedule No. 6 for Irrigation Service. Pumping costs assumed that the total volume of water pumped would not exceed 2.83 acre-feet per acre. A summary of the total pumping power requirements, opinion of the probable annual power costs (in 2013 dollars), and total long-term operating costs (pumping plus operations and maintenance) is included in Table 6-8. The costs in Table 6-8 do not include long-term savings for facility replacement. Replacement costs are outlined in Section 6.3.

Table 6-8
Opinion of Probable Annual Operating Costs

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Annual O&M/Administration	**$88,200**	**$89,200**	**$89,700**	**$28,000**	**$59,700**
Lateral E1 – Town of Twisp O&M	$12,000	$12,000	$12,000	$12,000	$12,000
Lateral E1 – Admin.	$7,000	$7,000	$7,000	$7,000	$7,000
Lateral E1 – O&M/Administration	**$19,000**	**$19,000**	**$19,000**	**$19,000**	**$19,000**
Pumping Power Requirements					
Minimum HP Required	305	400	415	115	115
Recommended Duty HP	305	430	430	115	115
Recommended Standby HP	210	70	70	0	0
Recommended Total HP	515	500	500	115	115
Annual Pumping Power Cost	**$20,100**	**$24,000**	**$24,700**	**$6,500**	**$6,500**
Annual O&M/Admin. + Power Cost	**$127,300**	**$132,200**	**$133,400**	**$53,500**	**$85,200**
Annual O&M/Admin. + Power Cost per Assessed Acre	**$91**	**$95**	**$96**	**$159**	**$88**

Notes:
1. Costs shown are in 2013 dollars. Long-term cost analysis assumes that costs will increase with inflation.
HP = Horsepower

The total long-term operating costs, which include power costs and O&M costs, were divided by the number of assessed acres for each alternative to determine an operating cost per assessed acre. The cost represents the potential assessment that would result from each alternative without funding replacement of the facilities. The costs assume a minimum charge for lots under 1 acre equal to the per acre cost shown.

The costs listed in Table 6-8 only include those that would be incurred by MVID and do not include costs for individual wells. Table 6-9 includes a summary of the opinion of probable annual pumping costs for individual wells. The costs include a range of likely pumping power costs for well pumps sized to meet the demands of parcels with irrigated acreage in the ranges shown. Opinions of annual pumping power costs were developed using Okanogan Public Utility District (PUD) Rate Schedule No. 6 for Irrigation Service.

Table 6-9
Opinion Annual Pumping Power Costs – Individual Wells

Parcel Size (Acres)	Maximum Flow Rate (gpm)	Estimated Pumping Power (Horsepower per gpm)	Estimated Pumping Power (Horsepower)	Annual Pumping Cost
<1	<9	0.056	0 to 0.50	$0 to $100
1 to 5	9 to 45	0.056	0.50 to 2.50	$100 to $210
5 to 10	45 to 90	0.056	2.50 to 5.00	$210 to $348
>10	>90	0.056	>5.00	$348 to $1,177

6.3 Replacement Cost

Replacement costs were evaluated to determine the annual deposit that would need to be made to an account to fund replacement of the facilities at the end of the assumed life cycle for the project. For this analysis, the following design life cycles were assumed for system components:

- Pipe and infrastructure – 50 years
- Pumps and electrical equipment – 25 years
- Storage facilities – 50 years

It is unlikely that the all of the facilities would need to be completely replaced at the end of their assumed life cycle. For this reason, the analysis was performed for three levels of replacement: 25, 50, and 100 percent. The life cycle replacement cost analysis is included in Appendix G. The analysis assumed an annual interest on the replacement fund of 3 percent and an annual inflation rate of 3 percent.

Two methods of annual deposit to a replacement fund were evaluated. The first would be a constant annual deposit through the life of the project. The second would be an increasing annual deposit, escalated at the assumed annual inflation rate. The analysis of both methods is included in Appendix G.

Table 6-10 summarizes annual replacement fund costs assuming the following:

- Escalation of the annual replacement fund deposit at an annual rate of 3 percent
- 25 percent of pipe and infrastructure would need to be replaced within the 50-year design life cycle for those components
- 100 percent of pumps and electrical equipment would need to be replaced within the 25-year design life cycle for those components
- 25 percent of storage facilities would need to be replaced within the 50-year design life cycle for those components

Table 6-10 also includes a summary of the annual replacement fund costs on a per assessed acre basis. The cost represents the additional assessment that would be needed to fund replacement at the levels noted above. The per-acre costs were estimated assuming a minimum charge for lots under 1 acre equal to the per acre assessment.

Table 6-10
Annual Replacement Fund Costs

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Replacement Fund Costs					
At Year 1	$64,390	$65,347	$67,643	$15,993	$31,824
At Year 25	$130,892	$132,838	$137,504	$32,510	$64,692
At Year 50	$274,059	$278,133	$287,902	$68,069	$135,450
Replacement Fund Costs/Assessed Acre					
At Year 1	$46	$47	$49	$48	$33
At Year 25	$94	$95	$99	$97	$67
At Year 50	$197	$200	$207	$203	$139

7 ALTERNATIVES EVALUATION

7.1 Selection Criteria

The following criteria were identified by MVID and other stakeholders for evaluating the alternatives and selecting a preferred alternative:

- Cost
  - Capital cost
  - Annual operations and maintenance costs
  - Replacement cost
  - Impact to annual member assessments
- Water Supply
  - Impacts to adjacent groundwater wells
  - Impacts to surface water
  - Continuity with Methow River
- Property Impacts
- Ease of permitting
  - Water rights permitting
  - Environmental permitting
- Construction, Operation, and Maintenance
  - Constructability
  - Ease of operation

These criteria are not listed in any particular order of priority. The intent of the AER is not to assign ratings or positive and negative values to each criteria based on the evaluation. Rather, the AER presents the information for each alternative to allow the MVID Board of Director's and members to compare the alternatives side by side and assign value based on MVID's priorities and goals for the future.

7.2 Summary and Comparison of Alternatives

Table 7-1 provides a summary of each alternative, with key information related to each of the selection criteria listed in Section 7.1. The following summarizes the alternatives evaluation based on the selection criteria.

7.2.1 Cost

The capital costs for each project alternative listed in Table 7-1 include the cost of constructing the proposed facilities (the field cost); engineering, permitting, and administration costs that will be incurred through the design and construction of the project; and the cost of acquiring land and easements for the proposed facilities. Total project costs were developed for each alternative with and without the additional cost of converting existing MVID users to individual well systems.

The cost analysis indicates that the overall capital cost of the project, including the cost to convert existing MVID users to individual well systems, would be highest for Alternative 2. The total project costs for Alternatives 1 through 3 would of a similar order of magnitude, with the least expensive being Alternative 3 and the most expensive being Alternative 2. Alternative 4 would be the least expensive option and would result to the greatest change to the MVID service area. More than 60 percent of the cost of Alternative 4 would be for converting existing MVID users to individual wells. Alternative 5 is only slightly higher cost than Alternative 4, but would result in more improvements to the MVID system, and a larger number of parcels would still be served by MVID.

Because the capital costs will likely be funded by others, MVID is primarily concerned with the annual operating costs of the system after the project is completed and the impact those operating costs will have on member assessments. The long-term cost analysis indicates that annual O&M costs for the first three alternatives would be similar, ranging from $88,200 for Alternative 1 to $89,700 for Alternative 3. Power costs for the first three alternatives would range from $20,100 for Alternative 1 to $24,700 for Alternative 3. The operating costs shown for Alternative 4 would be a fraction of those shown for Alternatives 1 through 3, but do not include the operations and maintenance of individual well systems. Individual well owner costs would be separate. The operating costs incurred by MVID for Alternative 4

would also be spread over fewer parcels and assessed acreage. The operating costs for Alternative 5 would be less than Alternatives 1 through 3, but would be higher than Alternative 4. The operating costs incurred by MVID for Alternative 5 would be spread over fewer parcels and assessed acreage than Alternatives 1 through 3 and over more parcels and assessed acreage than Alternative 4.

The overall assessment that would be required to pay for O&M and power costs would range from approximately $88 per acre, for Alternative 5, to $159 per acre, for Alternative 4. If deposits were made to an account to fund replacement of facilities to the level described in Section 6.3, the additional assessment required for the replacement funding would range from $33 per acre for Alternative 5 to $49 per acre for Alternative 3. These numbers are presented in 2013 dollars and should be considered as order of magnitude projections. Actual assessments and costs may vary based on how and when the improvements are constructed and how MVID operates and manages the resulting delivery system.

7.2.2 Water Supply

The water supply for each alternative is characterized in Table 7-1 according to likely impacts on adjacent groundwater wells, impacts to surface water, and continuity with the Methow River. Alternative 1 would have the least impact to groundwater, as it would draw water directly from the Methow River for both the East and West Canal systems. Because the supply of water in the Methow River is well documented, the probability of successfully meeting irrigation needs with the facilities described in this evaluation is higher for Alternative 1 than for the other alternatives, which would rely on groundwater supply. Groundwater supply can vary depending on the depth, location, and size of well drilled.

Alternative 2 would rely on water supply from groundwater wells drilled in the vicinity of the Eileen property near the middle of the existing West Canal system. The evaluation of groundwater supply at that location indicates that there is potential for relatively high-yield wells with low drawdown potential and limited impact to adjacent groundwater wells.

Alternative 3 would result in two separate systems to serve West Canal users. The upper system would rely on wells drilled near the Eileen property, where the evaluation of

groundwater supply indicates that there is potential for relatively high-yield wells with low drawdown potential and limited impact to adjacent groundwater wells. The lower system would rely on wells drilled in the vicinity of the Jumars property, where the success of drilling high-yield wells is less certain. Therefore, smaller capacity wells are recommended for the Jumars site and an additional well would likely be required somewhere closer to the river to supply the lower system. Wells in the vicinity of the Jumars property are likely to have some impact on existing groundwater wells, which can be mitigated by deepening affected wells and replacing pumps as needed. An allowance for that work is included in the costs presented in Section 6 and Appendix E.

Alternative 4 would rely on a combination of individual wells, a smaller production well, and well supply from the Town of Twisp to meet irrigation needs. Because the wells would be smaller, the impacts on other groundwater wells would likely be limited and the probability of successfully supplying water to meet irrigation needs would be higher.

Alternative 5 would also rely on a combination of individual wells, a smaller production well, and well supply from the Town of Twisp wells to meet irrigation needs. Because the wells would be smaller, the impacts on other groundwater wells would likely be limited and the probability of successfully supplying water to meet irrigation needs would be higher.

7.2.3 Property Impacts

All of the alternatives would impact private property and would require easements and property for implementation. Easements and property would be needed for pumping and supply facilities, storage facilities, and lateral relocations. Alternative 1 would have less impact on private property because the river pump station and discharge pipeline would be located on existing MVID property. Alternative 3 would have the most impact on private property because it would require the largest number of wells and storage facilities and all of these facilities would probably require property acquisition.

7.2.4 Ease of Permitting

Table 7-1 summarizes the ease of completing the water rights and environmental permitting processes needed to implement each alternative. No permitting barriers have been identified that would prevent any alternative from being implemented.

Alternative 1 would offer the most straightforward process for water right permitting. The point of diversion would be changed from the Twisp River to the Methow River. Alternatives 2 and 3 would require conversion of a surface water right on the Twisp River to a groundwater right at multiple well locations. Additional groundwater testing and analysis would likely be required to prove that groundwater is available and that existing wells would not be impaired. This process would take longer than Alternative 1.

Alternative 4 would require the most detailed water right permitting process. A significant effort would be required on the part of Ecology to process change applications for the large number of individual well conversions and the creation of a smaller system supplied by groundwater. Alternative 5 would also require a number of change applications for individual well conversions and the creation of a smaller system supplied by groundwater.

Because the proposed pump station facilities would require construction in the Methow River channel, Alternative 1 would likely require more permit approvals for construction than the other alternatives. Securing permit approvals is not considered a "fatal flaw" to the success of this alternative, but the permit process would need to be managed more carefully to complete the project on the required timeline. Because Alternatives 2 through 5 do not require work in the river channel, securing permit approvals for construction would likely be more straightforward and would require less time.

7.2.5 Construction, Operation, and Maintenance

Key factors that would impact constructability and ease of operation for each alternative are also outlined in Table 7-1. The key construction challenge will be phasing construction to allow for uninterrupted irrigation service. The main pipeline and some laterals will likely need to be constructed between irrigation seasons. Because the weather in the Methow Valley limits construction activities through most of the winter, successful construction of

these facilities may require multiple contracts or construction during multiple seasons. Construction of pump stations, source wells, storage tanks, and other facilities that would not impact existing irrigation operations could be completed during the irrigation season.

Another challenge likely to be encountered during construction of any of the alternatives is excavation of rocky soils. The river pump station that would be constructed as part of Alternative 1 would likely require excavation in rock or soil with large cobbles and boulders. Trenching for pipelines may also require excavation in rocky soils.

Alternatives 1, 2, and 3 would replace the existing MVID West Canal system and a majority of the MVID East Canal system with new pipelines. The new pipelines may require less maintenance than is currently required to keep the ditch system running. However, additional effort would be required to operate and maintain well pumps and a booster pump station or a surface water pump station. Because MVID does not have experience operating, maintaining, and repairing pumps and electrical systems, additional contract labor will likely be required to keep these facilities running smoothly.

Alternative 3 would have the largest number of pumps and storage facilities to operate and maintain. As a result, operation and maintenance of Alternative 3 would likely require more effort than Alternatives 1 and 2. Alternatives 4 and 5 would have only one well pump to operate and would take less effort to operate and maintain. All of the alternatives would require an agreement with the Town of Twisp that would cover some of the operations and maintenance costs related to serving MVID users within the Town of Twisp limits near Lateral E1 through the Town's water distribution system. If no agreement can be reached, a small system would need to be installed to replace Lateral E1 with supply from a groundwater well or a connection to the East Canal pipeline. These options would result in additional operations and maintenance.

Table 7-1
Summary and Comparison of Alternatives

Selection Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
COST					
Capital Cost[1]					
Pipelines - main line, laterals	$6,561,000 to $7,874,000	$6,593,000 to $7,912,000	$5,774,000 to $6,929,000	$1,560,000 to $1,872,000	$4,119,000 to $4,943,000
Water supply/pumping facilities	$1,150,000 to $1,380,000	$1,096,000 to $1,315,000	$1,522,000 to $1,826,000	$460,000 to $552,000	$460,000 to $552,000
Water storage facilities	$948,000 to $1,138,000	$948,000 to $1,138,000	$1,003,000 to $1,204,000	$225,000 to $270,000	$225,000 to $270,000
Total Field Cost – Without Individual Wells	**$8,659,000 to $10,392,000**	**$8,637,000 to $10,365,000**	**$8,299,000 to $9,959,000**	**$2,245,000 to $2,694,000**	**$4,804,000 to $5,765,000**
Engineering, permitting, administration	$1,732,000 to $2,079,000	$1,728,000 to $2,073,000	$1,660,000 to $1,992,000	$449,000 to $539,000	$961,000 to $1,153,000
Land acquisition – pipelines	$15,000	$15,000	$15,000	$10,000	$15,000
Land acquisition – water supply facilities	$0	$56,000	$103,500	$28,000	$28,000
Land acquisition – water storage facilities	$20,000	$20,000	$20,000	$20,000	$20,000
Total Project Costs – Without Individual Wells	**$10,426,000 to $12,506,000**	**$10,456,000 to $12,529,000**	**$10,098,000 to $12,090,000**	**$2,752,000 to $3,291,000**	**$5,828,000 to $6,981,000**
Number of parcels to be converted to individual wells	16	16	16	275	95
Individual well conversion cost	$217,000 to $261,000	$217,000 to $261,000	$217,000 to $261,000	$4,165,000 to $4,998,000	$1,512,000 to $1,815,000
Total Project Costs – With Individual Wells	**$10,643,000 to $12,767,000**	**$10,673,000 to $12,790,000**	**$10,315,000 to $12,351,000**	**$6,917,000 to $8,289,000**	**$7,340,000 to $8,796,000**
Annual Operating Costs					
Annual O&M costs[2]	$88,200	$89,200	$89,700	$28,000	$59,700
Lateral E1 – O&M[2]	$12,000	$12,000	$12,000	$12,000	$12,000
Lateral E1 – Administration[2]	$7,000	$7,000	$7,000	$7,000	$7,000
Annual pumping costs[2]	$20,100	$24,000	$24,700	$6,500	$6,500
Annual O&M + Lateral E1 + pumping costs[2,3]	$127,300 ($91/Assessed Acre)	$132,200 ($95/Assessed Acre)	$133,400 ($96/Assessed Acre)	$53,500 ($159/Assessed Acre)	$85,200 ($88/Assessed Acre)
Life Cycle Replacement Cost[2,3]	$64,390 ($46/Assessed Acre)	$65,347 ($47/Assessed Acre)	$67,643 ($49/Assessed Acre)	$15,993 ($48/Assessed Acre)	$31,824 ($33/Assessed Acre)

Selection Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
WATER SUPPLY					
Impacts to Adjacent groundwater wells	• No impact for West Canal. Diversion is from Methow River. • If Lateral E1 is served through Town of Twisp, additional groundwater supply would be required for Town of Twisp.	• Groundwater impact will be localized and adjacent to well field. Well field location currently identified in middle of West Canal service area appears to have potential for high-yield wells with low drawdown impacts to adjacent wells are possible. A review of wells that could be impacted should be performed and mitigation (deepening, larger pump) determined as part of detailed design. • If Lateral E1 is served through Town of Twisp, additional groundwater supply would be required for Town of Twisp.	• Two well fields are planned. The well field located in the middle of the West Canal service area appears to have potential for high-yield wells with low drawdown. The well field located in the lower West Canal service area will likely experience greater drawdown and may reduce localized (within 1,000 feet of the well field) groundwater levels by 5-10 feet. However that drawdown is only 5-10% of the available aquifer drawdown so the primary issue is whether adjacent wells are deep enough to prevent impacts from drawdown. A review of wells that could be impacted should be performed and mitigation (deepening, larger pump) determined as part of detailed design. • If Lateral E1 is served through Town of Twisp, additional groundwater supply would be required for Town of Twisp.	• A production well would be required to meet the demand of MVID members located on the upper West Canal. The well would have a small, localized impact on groundwater levels but not likely enough to impact other wells. • If Lateral E1 is served through Town of Twisp, additional groundwater supply would be required for Town of Twisp. • Construction of individual wells or use of existing wells would be required for irrigation of several parcels on both sides of the Methow River. The groundwater supply and aquifer formations in the Methow Valley within the MVID are very conducive to groundwater wells. The small volumes of water pumped from each well would have very small impacts to adjacent wells.	• A production well would be required to meet the demand of MVID members located on the upper West Canal. The well would have a small, localized impact on groundwater levels but not likely enough to impact other wells. • If Lateral E1 is served through Town of Twisp, additional groundwater supply would be required for Town of Twisp. • Construction of individual wells or use of existing wells would be required for irrigation of several parcels on the West side and just a few parcels on the East side of the Methow River. The groundwater supply and aquifer formations in the Methow Valley within the MVID are very conducive to groundwater wells. The small volumes of water pumped from each well would have very small impacts to adjacent wells.
Surface Water	• Increased instream flow in the lower Twisp River of approximately 11 cfs during the late summer • Up to 11 cfs to be diverted from the Methow River during the irrigation season • Increased instream flow in the Methow River downstream of Twisp due to reduced seepage and losses in the MVID system	• Increased instream flow in the lower Twisp River of approximately 11 cfs during the late summer • Increased instream flow in the Methow River downstream of Twisp due to reduced seepage and loss in the MVID system	• Increased instream flow in the lower Twisp River of approximately 11 cfs during the late summer • Increased instream flow in the Methow River downstream of Twisp due to reduced seepage and loss in the MVID system	• Increased instream flow in the lower Twisp River of approximately 11 cfs during the late summer • Increased instream flow in the Methow River downstream of Twisp due to reduced seepage and loss in the MVID system	• Increased instream flow in the lower Twisp River of approximately 11 cfs during the late summer • Increased instream flow in the Methow River downstream of Twisp due to reduced seepage and loss in the MVID system

Selection Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Continuity with Methow River	• Surface water for West Canal system supplied directly from the Methow River	• Wells near middle of West Canal system would be approximately 1,000 feet from the Methow River and 150 to 200 feet deep • Wells near lower end of West Canal system would be approximately 1,500 feet from the Methow River and 150 to 200 feet deep • Wells would draw from Methow Valley alluvial aquifer	• Wells near middle of system would be approximately 1,000 feet from the Methow River and 150 to 200 feet deep • Wells near lower end of system would be approximately 1,500 feet from the Methow River and 150 to 200 feet deep • Wells would draw from Methow Valley alluvial aquifer	• Well supply for Upper West system would be within 1,000 feet of the Methow River and 150 to 200 feet deep • Individual wells would draw from the Methow Valley alluvial aquifer	• Well supply for Upper West system would be within 1,000 feet of the Methow River and 150 to 200 feet deep • Individual wells would draw from the Methow Valley alluvial aquifer
PROPERTY IMPACTS	• River pump station and discharge for West Canal system to be constructed within existing MVID property • New easements needed for new and realigned laterals on both sides • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Upper Pressure Zone on the West Canal system • Property/easement (approximately 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Lower Pressure Zone on the West Canal system • Property/easement needed for new spill at inlet to East Canal pipeline	• Property/easement required for wells on/near Eileen property • Property/easement required for wells on/near Jumars property (if need; it is anticipated that wells near Eileen property will supply most or all of the 11 cfs design demand for this alternative) • New easements needed for new and realigned laterals on both sides • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Upper Pressure Zone on the West Canal system • Property/easement (approximately 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Lower Pressure Zone on the West Canal system • Property/easement needed for new spill at inlet to East Canal pipeline	• Property/easement required for wells on/near Eileen property • Property/easement required for wells on/near Jumars property • New easements needed for new and realigned laterals on both sides • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Upper Pressure Zone, Upper/Middle System on the West Canal system • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Middle Pressure Zone, Upper/Middle System on the West Canal system • Property/easement (approximately 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in Lower Pressure Zone on the West Canal system • Property/easement needed for new spill at inlet to East Canal pipeline	• Property/easement required for well for Upper West system on/near Shulz property • New easements needed for new and realigned laterals on both sides • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in the Upper West system	• Property/easement required for well for Upper West system on/near Shulz property • New easements needed for new and realigned laterals on both sides • Property/easement (approximately 1/3 to 1/2 acre) needed for storage tank, inlet/outlet pipe and access for storage in the Upper West system • Property/easement needed for new spill at inlet to East Canal pipeline

Selection Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
EASE OF PERMITTING					
Water rights permitting	• Water right change application required to change point of diversion for West Canal from Twisp River to Methow River. • Only a few transfers to parcels with individual well systems would be required. • Process may take up to 6 months but no barriers to obtaining the change have been identified.	• Water right change application required to change point of diversion from Twisp River to groundwater production wells in continuity with Methow River. Additional groundwater testing and analysis will be needed to prove water is available and no impacts to adjacent wells will occur. • Only a few transfers to parcels with individual well systems would be required. • This process will take longer than Alternative 1 but no barriers to obtaining the change have been identified.	• Water right change application required to change point of diversion from Twisp River to groundwater wells in continuity with Methow River. Additional groundwater testing and analysis will be needed to prove water is available and no impacts to adjacent wells will occur. • Only a few transfers to parcels with individual well systems would be required. • This process will take longer than Alternative 1 but no barriers to obtaining the change have been identified.	• Water right change applications required to change point of diversion from Twisp River to a groundwater well in continuity with Methow River for Upper West system. Additional groundwater testing and analysis will be needed to prove water is available and no impacts to adjacent wells will occur. • Water right change applications will be required for remainder of MVID members, which includes approximately 275 parcels that would be converted to individual well systems. • This process will take longer but will be similar to that completed 12 years ago for other MVID members who received individual wells. No barriers to obtaining the changes have been identified however a significant effort from Ecology will be needed to process the change applications in the required time frame.	• Water right change applications required to change point of diversion from Twisp River to a groundwater well in continuity with Methow River for Upper West system. Additional groundwater testing and analysis will be needed to prove water is available and no impacts to adjacent wells will occur. • Water right change applications will be required for remainder of MVID members, which includes approximately 95 parcels that would be converted to individual well systems. • This process will take longer but will be similar to that completed 12 years ago for other MVID members who received individual wells. No barriers to obtaining the changes have been identified however a significant effort from Ecology will be needed to process the change applications in the required time frame.
Environmental Permitting	• No barriers to obtaining permits have been identified	• No barriers to obtaining permits have been identified	• No barriers to obtaining permits have been identified	• No barriers to obtaining permits have been identified	• No barriers to obtaining permits have been identified

Selection Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
CONSTRUCTION, OPERATION, AND MAINTENANCE					
Constructability	• Dewatering would be required for construction of river pump station on right bank of Methow River. • Excavation in rock or soil with large boulders likely required for construction of river pump station. • Excavation for main pipeline and laterals would likely encounter rock. • In-river work would be limited to the fish window established by permit approvals. • Construction phasing would be a challenge. The main pipeline and some laterals would need to be constructed between irrigation seasons to allow for uninterrupted irrigation service. The river pump station, storage tanks, and some lateral replacements could be completed during the irrigation season.	• Well drilling may encounter boulders. • Excavation for main pipeline and laterals would likely encounter rock. • Construction phasing would be a challenge. The main pipeline and some laterals would need to be constructed between irrigation seasons to allow for uninterrupted irrigation service. The production wells, storage tanks, and some lateral replacements could be completed during the irrigation season.	• Well drilling may encounter boulders. • Excavation for main pipeline and laterals would likely encounter rock. • Construction phasing would be a challenge. The main pipeline and some laterals would need to be constructed between irrigation seasons to allow for uninterrupted irrigation service. The production wells, storage tanks, and some lateral replacements could be completed during the irrigation season.	• Well drilling may encounter boulders. • Excavation for pipelines and laterals would likely encounter rock. • Construction phasing would be a challenge, but will be less of a challenge for this alternative. Replacement pipelines and laterals would need to be constructed between irrigation seasons to allow for uninterrupted irrigation service. The production well, storage tank, and some lateral replacements could be completed during the irrigation season. Individual wells could be constructed at property owner's convenience.	• Well drilling may encounter boulders. • Excavation for pipelines and laterals would likely encounter rock. • Construction phasing would be a challenge, but would be less of a challenge than Alternatives 1 through 3 because the work in and around existing irrigation facilities would not be as extensive. Replacement pipelines and laterals would need to be constructed between irrigation seasons to allow for uninterrupted irrigation service. The production well, storage tank, and some lateral replacements could be completed during the irrigation season. Individual wells could be constructed at property owner's convenience.
Ease of operation	• Pumping at one single location, easier to access and maintain • Self-cleaning screen system, additional maintenance • Longer pipe system, more maintenance than Alternatives 3 and 4 • Fewer storage tanks to maintain than Alternative 3 • Would require an agreement with the Town of Twisp or new lateral system to serve MVID users near Lateral E1.	• Wells at multiple locations, more difficult to access and maintain • Booster pump station, additional maintenance • Longer pipe system, more maintenance than Alternatives 3 and 4 • Fewer storage tanks to maintain than Alternative 3 • Would require an agreement with the Town of Twisp or new lateral system to serve MVID users near Lateral E1.	• Wells at multiple locations, more difficult to access and maintain • Booster pump station, additional maintenance • Shorter pipe system, less maintenance than Alternatives 1 and 2 • More storage tanks, more maintenance than Alternatives 1 and 2 • Would require an agreement with the Town of Twisp or new lateral system to serve MVID users near Lateral E1.	• A smaller West Canal system would be easier to operate and maintain. • Would require an agreement with the Town of Twisp or new lateral system to serve MVID users near Lateral E1.	• A smaller West Canal system would be easier to operate and maintain. • Would require an agreement with the Town of Twisp or new lateral system to serve MVID users near Lateral E1.

Notes:
1. Capital costs are from Opinion of Probable costs in 2013 dollars, rounded to nearest $10,000.
2. Pumping, O&M, and Life Cycle Replacement costs represent the first year of annual long-term costs in 2013 dollars, rounded to nearest $100. Analysis assumes costs would increase per an assumed inflation rate of 3 percent through project life cycle.
3. Annual costs per assessed acre assume a minimum cost for all parcels assessed at less than 1 acre equal to the amount per acre shown.
4. Represents one-time grant funding to be made available to offset pumping and maintenance costs incurred by proposed project.

8 SUMMARY OF PREFERRED ALTERNATIVE

This alternatives evaluation initially only included Alternatives 1 through 4. Alternatives 1 through 3 were initially focused on improvements to the West Canal system designed to reduce diversions from the Twisp River. Alternative 4 was focused on maximizing the number of parcels converted to individual well systems. Feedback generated through review of the initial alternatives evaluation with the MVID Board of Directors and members overwhelmingly indicated that the project needed to evaluate improvements to both the East and West Canal systems. The first three alternatives were expanded to include replacement of the East Canal with a gravity-fed pipe system. A fifth alternative was then added that combined the East Canal improvements from Alternatives 1, 2, and 3 with the West Canal improvements from Alternative 4. Alternative 5 was selected by the MVID Board of Directors as the preferred alternative. Alternative 5 features:

- Elimination of the West Canal diversion on the Twisp River
- Replacement of the existing West Canal system from Alder Creek Road to the existing Lateral W-4 with a pressurized pipe system supplied from a groundwater well
- Conversion of approximately 87 MVID West Canal parcels upstream and downstream of the proposed pipe system to individual well systems
- Replacement of the East Canal system from upstream of the Mill Spill to Beaver Creek with a pipe system served through an inlet structure on the existing East Canal
- Service to MVID members within the Town of Twisp on the east side of the Methow River through the town's potable water distribution system or through a replacement of the existing Lateral E-1
- Conversion of approximately 8 MVID East Canal parcels downstream of the Beaver Creek Spill to individual well systems

A preliminary description of these improvements was provided in Section 3.5. Detailed feasibility level drawings for Alternative 5 are included as Drawings 5-1 through 5-5 in Appendix A. Table 8-1 provides a summary of the major components of Alternative 5 and the areas that would be served by each. The section provides a more detailed summary of the water supply, conveyance, and delivery improvements that would be included as part of Alternative 5.

Table 8-1
Alternative 5 Summary

System	Description	Description of Areas Served	Parcels Served[1]	Assessed Area[1] (Acres)	Design Flow[2] (cfs)
West Canal Improvements					
West pipe system	Smaller Pressurized Pipeline and Lateral Systems Supplied by Groundwater Well	West Canal Users from Station 161+00 to Station 329+05	87	141	2.8
Individual Wells	MVID Users Converted to Individual Well Systems	West Canal Users Upstream of Station 161+00 and Downstream of 329+05	87	445	8.9
East Canal Improvements					
East pipe system	Pipeline and Lateral System Supplied by Existing East Canal	East Canal Users from Station 193+00 (Upstream of Mill Spill) to Beaver Creek	180	617	10.0
Lateral E1	Service through Town of Twisp water system or through replacement system	MVID Users Within Town of Twisp Limits on East Side of Methow River	71	135	2.7
Individual Wells	MVID Users Converted to Individual Well Systems	East Canal Users Downstream of Lateral E14	8	30	0.6

Notes:
1. Approximate number of parcels and assessed areas served estimated based on MVID assessment roles.
2. Design flow rates for west pipe system and Lateral E1 scaled from design flow rate for larger west pipe system and east pipe system included in Alternatives 1, 2, and 3. Design flow rates for individual well conversions based on maximum withdrawal rate of 9 gallons per minute per acre.

cfs = cubic feet per second

8.1 West Canal Improvements

Alternative 5 would include a pressurized system supplied by a groundwater production well to serve users at higher elevations at the upstream end of the West Canal who would not likely have success supplying their irrigation needs through individual wells. The Upper West System would include a pressurized main line installed in the MVID West Canal from Station 161+00 to Station 329+05. The system would be operated as a reduced MVID system. Existing West Canal users upstream of Station 161+00 and downstream of 329+05 would be converted to individual well systems.

8.1.1.1 Water Supply

The Upper West system would be supplied through a groundwater production well near the Methow River. The well would be designed as follows (see Drawing 5-5 in Appendix A):

- **Location –** The groundwater well for the Upper West system would likely be located near the Methow River in the vicinity of the orchard owned by Dave Shulz (Parcel 3322170384). A backup location, on property owned by Janet Eileen (Parcel 4270000100), would be considered if well testing on the Shulz property indicates that a well there would not provide sufficient capacity.
- **Pump Flow Rates –** The groundwater well would need to deliver the total peak design flow rate of 2.8 cfs (1,260 gpm).
- **Pumping Head –** The estimated pumping head required for a well designed to deliver 2.8 cfs while maintaining a minimum pressure of 10 psi at the high end of the system would be approximately 249 feet.
- **Pumping Power –** A 115-horsepower pump would be required to deliver 2.8 cfs at 249 feet of total dynamic head, assuming a pump efficiency of 70 percent.
- **Pump Type –** The well pumps would be submersible well pumps with electrical motors, designed for submergence and operation in groundwater. If groundwater levels are shallow, vertical turbine pumps could also be used.
- **Number of Wells –** It is anticipated that a single well could be drilled to serve the 2.8 cfs (1,260 gpm) needed for the Upper West system. However, this needs to be confirmed by drilling a testing well on the Shulz property. A spare pump could be purchased for redundancy.
- **Well House –** A small, pre-fabricated, insulated shed or enclosure would be installed over the production well.
- **Electrical and Controls –** The production well would require extension of 3-phase power. An emergency generator would need to be available to provide emergency power during outages.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

Approximately 87 parcels would be converted to individual well systems. The individual well systems would be designed as follows:

- **Location –** Individual wells would be located on individual parcels and developed in alluvium at the bottom of the valley.
- **Pump Flow Rates –** Individual wells would be designed to serve up to 9 gpm per acre irrigated.
- **Pumping Head –** The estimated pumping head for individual wells would vary from well to well. Preliminary pumping power calculations assumed a typical static groundwater level of 50 feet bgs and a discharge pressure of 40 psi.
- **Pumping Power –** The estimated pumping power for individual wells would vary based on flow and pumping head requirements. For a parcel irrigating 1 acre, it was estimated that a 0.5-horsepower pump would be sufficient. For a parcel irrigating 10 acres, it was estimated that a 5-horsepower pump would be needed.
- **Pump Type –** The well pumps would be submersible well pumps with electrical motors, designed for submergence and operation in groundwater. If groundwater levels are shallow, vertical turbine pumps could also be used.
- **Number of Wells** – Approximately 87 parcels currently served by the West Canal would be converted to individual well systems.
- **Electrical and Controls –** Each well would require power to the well house. It is anticipated that only the largest individual well pumps would require 3-phase power.
- **Other Equipment –** Associated equipment would include discharge piping, valves, fittings, pressure transmitters and switches, flow meters, and other appurtenances.

8.1.1.2 Water Delivery

The Upper West system would be a pressurized pipe system. The delivery system characteristics would be as follows:

- **Pipe Material** – Pressure-rated PVC irrigation pipe
- **Pipe Length**:
  - Main Line – Approximately 16,800 feet
  - Laterals – Approximately 8,700 feet
- **Pipe Size**:
  - Main Line – 3 inches to 12 inches in nominal diameter
  - Laterals – 3 inches to 12 inches in nominal diameter

- **System Configuration** – Delivery system would comprise a single pressure zone with a maximum static HGL of 1,804 feet NAVD 88.
- **System Pressures** – 10 to 20 psi operating pressure at highest turnout.
- **Appurtenances** – Gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances.

8.1.1.3 Water Storage

Water storage would improve pump operation and allow for more consistent control of operating pressures within the delivery system. The proposed storage would be sized with capacity roughly equal to two hours of the peak summer design flow. One 132,100-gallon reinforced concrete tank with an overflow elevation of 1,804 feet NAVD 88 is recommended.

Table 8-2 provides a summary of the Upper West system that would replace the upstream end of the West Canal as part of Alternative 5.

Table 8-2
Alternative 5 West System Summary

System	Maximum Static HGL (feet)	Pump/Well Design Flow Rate (cfs)	Number of Pumps/ Wells	Target Pressure at Highest Turnout (psi)	Storage Overflow Elevation (feet)	Storage Volume (gallons)
Upper West	1,804	2.8	1 well	10 to 20	1,804	132,100

Notes:
cfs = cubic feet per second
psi = pounds per square inch

8.2 East Canal Improvements

Alternative 5 would also include installation of a pipeline to replace the MVID East Canal from Station 193+00, approximately 2,400 feet upstream of the Mill Spill, to the Beaver Creek Spill at Station 453+00. The system would be supplied by gravity through an inlet structure constructed in the existing East Canal. The pipeline would operate full under pressure by closing a valve at the downstream end and maintaining submergence at the inlet. Approximately eight water

users that are currently served from the MVID East Canal downstream of Lateral E14 would be converted to individual well systems.

8.2.1.1 Water Supply

The pipeline would be supplied by gravity directly from the East Canal with water diverted from the Methow River. An inlet structure would be installed to control flow to the pipeline. The inlet structure would be designed as follows (see Drawing 5-6 in Appendix A):

- **Location** – The inlet structure would be constructed in the MVID East Canal at Station 193+00, upstream of the Mill Spill.
- **Flow Rate** – The inlet structure would be designed to convey up to 10 cfs to the pipe system from the existing East Canal.
- **Configuration** – The inlet structure would be designed to transition flow from the open East Canal to the pipeline. The structure would include a self-cleaning or travelling intake screen to keep debris out of the pipeline.
- **Spill** – The structure would be designed to allow excess water to spill to a pipe that would be installed under Twisp-Winthrop Road. Water would discharge through the pipe to a ditch or other conveyance designed to convey water to the Methow River.
- **Control** – Gates would be provided at the inlet to the main pipeline and at the inlet to the spill pipe to control flows. During the irrigation season, the gates would normally be open. Stop logs would be placed between the main pipeline inlet and the spill pipe inlet to control the water surface elevation at the main pipeline inlet.

8.2.1.2 Water Delivery

Water would be delivered to users through a closed pipe delivery system. The delivery system characteristics would be as follows:

- **Pipe Material** – Pressure-rated PVC irrigation pipe
- **Pipe Length**:
  - Main Line – Approximately 26,000 feet
  - Laterals – Approximately 25,000 feet
- **Pipe Size**:
  - Main Line – 8 inches to 24 inches in nominal diameter

  - Laterals – 3 inches to 12 inches in nominal diameter

- **System Pressures** – 10 to 20 psi operating pressure at highest turnout.
- **Appurtenances** – Gate valves, air release and vacuum valves, flush valves, turnout connections, and other appurtenances.
- **Other** – The existing trestle at Beaver Creek and the canal downstream of Beaver Creek would be abandoned or removed.

8.2.1.3 Lateral E1

If an agreement is reached between the Town of Twisp and MVID, MVID users on the east side of the Methow River within the Town of Twisp would be served irrigation water directly through the Town of Twisp water distribution system. Most of these users are currently served by MVID Lateral E1. The Town's water system would need to be upgraded to accommodate the additional demand. Upgrades would include:

- Use of the Town's existing Well No. 4, which is currently only used for emergencies
- Installation of a new well source with a capacity of at least 700 gpm
- Replacement of existing pipe with larger pipe to provide additional capacity

If an agreement is not reached with the Town of Twisp, MVID Lateral E1 users would be served through a renovated Lateral E1 system connected to the proposed East Canal pipeline or supplied by a new groundwater well. The capacity of a new well or connection to the East Canal pipeline would need to be approximately 2.7 cfs. If a renovated system is supplied through a connection to the East Canal pipeline, the sizing of the inlet structure and East Canal pipeline upstream of Lateral E1 would need to be re-evaluated.

8.3 Project Costs

Opinions of the probable project costs for each alternative were outlined in Section 6. Table 8-3 provides a summary of the opinion of probable project implementation costs for the preferred alternative (Alternative 5). Overall implementation costs for the preferred alternative are estimated to be between $7,340,000 and $8,796,000.

Table 8-4 includes a summary of the opinion of probable long-term costs for the preferred alternative. The long-term operations and maintenance costs were developed primarily

based on input from MVID. Power costs were based on current Okanogan PUD Rate Schedule 6, for irrigation service. Long-term costs were evaluated to estimate the impact on MVID member assessments. Operations, maintenance, and power costs are estimated to be approximately $85,200 annually (in 2013 dollars), which is equal to $88 per assessed acre, with a minimum charge for lots smaller than 1 acre. The cost of funding replacement of the facilities is estimated to be $31,824 during the first year of the project life, which is equal to $33 per assessed acre, with a minimum charge for lots smaller than 1 acre.

Table 8-3
Summary of Probable Project Costs – Preferred Alternative[1]

Item	West Canal[2]	East Canal[3]	Lateral E1[4]	Total
Pipelines and laterals	$982,000 to $1,178,000	$2,559,000 to $3,071,000	$578,000 to $694,000	$4,119,000 to $4,943,000
Water supply and pumping facilities	$319,000 to $383,000	$0	$141,000 to $169,000	$460,000 to $552,000
Water storage facilities	$225,000 to $270,000	$0	$0	$225,000 to $270,000
Total field costs – without individual wells	**$1,526,000 to $1,831,000**	**$2,559,000 to $3,071,000**	**$719,000 to $863,000**	**$4,804,000 to $5,765,000**
Engineering, permitting, administration (20%)	$305,000 to $366,000	$512,000 to $614,000	$144,000 to $173,000	$961,000 to $1,153,000
Land acquisition	$53,000	$5,000	$5,000	$63,000
Total project costs – without individual wells	**$1,884,000 to $2,250,000**	**$3,076,000 to $3,690,000**	**$868,000 to $1,041,000**	**$5,828,000 to $6,981,000**
Individual well conversion	$1,403,000 to $1,684,000	$109,000 to $131,000	$0	$1,512,000 to $1,815,000
Total project costs – with individual wells	**$3,287,000 to $3,934,000**	**$3,185,000 to $3,821,000**	**$868,000 to $1,041,000**	**$7,340,000 to $8,796,000**

Notes:

1. Costs shown are in 2013 dollars. Actual costs will vary based on materials and labor costs at the time of construction.
2. West Canal Improvements include a pressurized pipe system supplied by a well to serve parcels on the hillside above the Twisp-Carlton Road from Alder Creek Road down to existing Lateral W-4.
3. East Canal Improvements include a gravity-fed pipe system from an inlet structure upstream of the Mill Spill down to Beaver Creek.
4. Later E1 Improvements include improvements to the Town of Twisp water distribution system that would be needed to provide capacity for serving irrigation water to MVID users within the town limits on the east side of the Methow River under an agreement between MVID and the Town of Twisp. If not agreement can be reached, a replacement system for Lateral E1 would need to be constructed to serve these users.

Table 8-4
Summary of Probable Long-term Operating Costs – Preferred Alternative[1]

Item	West Canal[2]	East Canal[3]	Lateral E1[4,5]	Total
Annual O&M/Admin. Cost	$28,000	$31,700	$19,000	$78,700
Annual Pumping Power Cost	$6,500	$0	$0	$6,500
Total – Annual O&M/Admin. + Power Cost				**$85,200**
Total – Annual O&M/Admin. + Power Cost per Assessed Acre				**$88**
Total Replacement Fund Costs[6]	**$15,993**	**$15,831**	**$0**	**$31,824**
Total Replacement Fund Costs per Assessed Acre				**$33**

Notes:

1. Costs shown are in 2013 dollars. Actual costs will vary based on materials and labor costs at the time of construction.
2. West Canal Improvements include a pressurized pipe system supplied by a well to serve parcels on the hillside above the Twisp-Carlton Road from Alder Creek Road down to existing Lateral W-4.
3. East Canal Improvements include a gravity-fed pipe system from an inlet structure upstream of the Mill Spill down to Beaver Creek.
4. Later E1 Improvements include improvements to the Town of Twisp water distribution system that would be needed to provide capacity for serving irrigation water to MVID users within the town limits on the east side of the Methow River under an agreement between MVID and the Town of Twisp. If not agreement can be reached, a replacement system for Lateral E1 would need to be constructed to serve these users.
5. Later E1 operating costs include an assumed agreement with the Town of Twisp for service to MVID users with the town limits on the east side of the Methow River through the Tow of Twisp water distribution system. The costs assume that approximately $12,000 would be paid to the Town of Twisp by MVID to cover operations and maintenance costs, including pumping costs, incurred by the town's system. Approximately $7,000 would be assessed by MVID to cover administrative costs.
6. Replacement funding represents the deposit that would be required at year 1 of the design life to save enough funds to replace 25 percent of pipe and infrastructure components every 50 years, 100 percent of pumps and electrical equipment every 25 years, and 25 percent of storage facility components every 50 years. The analysis is based on the cost of the proposed components in 2013 dollars and assumes the replacement deposit would increase annually at an assumed inflation rate of 3 percent.

9 SUMMARY AND RECOMMENDATIONS

The MVID AER was prepared to analyze alternatives for improving the MVID delivery system in sufficient detail to inform MVID's selection of a preferred alternative and provide a basis for the design and implementation of the project. Five alternatives were identified by the stakeholder group and evaluated as part of this effort. The evaluation included analysis of the feasibility of supplying MVID with groundwater, hydraulic analysis, preparation of feasibility level drawings, development of an opinion of probable construction costs, and preparation of a life-cycle cost analysis to understand long term costs. The following are conclusions from the evaluation and comparison of alternatives:

- The project implementation costs would be highest and of a similar order of magnitude for Alternatives 1, 2, and 3. Implementation costs for Alternatives 4 and 5 would be lower.
- Long-term costs incurred by MVID would also be highest for Alternatives 1, 2 and 3, because more pumping would be required and the systems would be more extensive, resulting in higher operations and maintenance costs. However, the long-term costs per assessed acre served would be highest for Alternative 4, because the operating costs would be spread over a smaller service area. Alternative 5 would offer the lowest long-term costs per assessed acre served.
- Alternatives 2 through 5 would shift the majority of the irrigation supply to the West Canal from the surface water diversion on the Twisp River to groundwater wells in connectivity with the Methow River. Alternative 4 would also convert most of the supply for East Canal users from the surface water diversion on the Methow River to individual groundwater wells.
- All of the alternatives evaluated would reduce the impact of existing irrigation operations on surface water resources by eliminating the diversion on the Twisp River. The alternatives would also reduce the overall water supply required by making the delivery system more efficient.
- Alternatives 1, 2, and 3 would result in the most significant impacts to private property because the facilities included in these alternatives would be more extensive Alternatives 4 and 5 would have less impact on private property, but would impact more private property owners who are currently served by MVID by requiring those properties to convert to individual well systems.

- All of the alternatives would require permits, but permitting requirements have not been identified as a "fatal flaw" to implementation of any of the alternatives.
- Constructability concerns have been identified for all of the alternatives. The most significant challenge will likely be construction phasing and scheduling to allow for continued irrigation operation and construction of facilities outside the winter months when the ground is thawed and not covered with snow.
- Alternatives 4 and 5 would likely also be easier and less expensive to operate and maintain because the systems would be smaller and have fewer components. Alternatives 1, 2, and 3 would include larger pumps, more pumps, more storage tanks, and longer pipelines to operate and maintain.

Based on the review of these findings, consultation with their members, and review with other stakeholders, the MVID Board of Directors selected Alternative 5 as the preferred alternative and is working toward implementation. The following would be included as part of Alternative 5:

- Elimination of the West Canal diversion on the Twisp River
- Replacement of the existing West Canal system from Alder Creek Road to the existing Lateral W-4 with a pressurized pipe system supplied from a groundwater well.
- Conversion of approximately 87 MVID West Canal parcels upstream and downstream of the proposed pipe system to individual well systems.
- Replacement of the East Canal system from upstream of the Mill Spill to Beaver Creek with a pipe system served through an inlet structure on the existing East Canal.
- Service to MVID members within the Town of Twisp on the east side of the Methow River through the town's potable water distribution system or through a replacement of the existing Lateral E-1.
- Conversion of approximately 8 MVID East Canal parcels downstream of the Beaver Creek Spill to individual well systems.

The opinion of probable construction costs developed for Alternative 5 is $4.8 million to $5.8 million. The opinion of the overall project cost, with a 20 percent allowance for engineering, permitting, and administration and an allowance for land acquisition, is $7.3 million to $8.8 million, including $1.5 million to $1.8 million for conversion of 95 parcels to individual well systems.

Annual operations, maintenance, administrative, and pumping costs are projected to be approximately $85,200 during the first year of the project, or $88 per assessed acre. The annual cost of a replacement fund that would pay for 25 percent of pipe and infrastructure during a 50-year life cycle, 100 percent of pumps and electrical components during a 25-year life cycle, and 25 percent of storage facilities over a 50-year life cycle is projected to be approximately $31,824 during the first year of the project, or $33 per assessed acre.

It is recommended that MVID, Reclamation, and other project partners move forward with detailed design and implementation of Alternative 5, with a focus on the following:

- Groundwater Supply – It is recommended that MVID and Reclamation verify the availability of groundwater supply on the Shulz property to serve the system that would replace the upstream end of the MVID West Canal by drilling and testing a well on the Shulz property.
- Easements and Land Acquisition – It is recommended that MVID and Reclamation further refine proposed pipeline alignments and facility locations so that ongoing coordination with private property owners results in successfully securing the easements and property needed to implement Alternative 5.
- Permitting Evaluation – It is recommended that a more detailed permitting evaluation be completed to identify permitting requirements. This effort should include early consultation and engagement with regulatory agencies to avoid delays during implementation.
- Detailed Site Investigations – Additional site investigations will likely be required to complete design of the facilities proposed as part of Alternative 5. In addition to drilling a test well at the Shulz property, additional geotechnical investigation and supplemental topographic survey may be required to complete the design work.
- Detailed Design Analysis – The information and recommendations provided in this report are considered preliminary. Design flow rates, pipe sizing, pump sizing, alignments, profiles, and other design parameters will need to be evaluated in more detail as part of the detailed design effort.
- Refined Cost Analysis and Funding – The opinions of cost presented in this report are also considered preliminary and are based on incomplete design information. The

opinions of probable construction and long-term operating costs should be refined as more detailed design information is developed.

- Constructability Review and Phasing – Several potential constructability concerns were identified in this report. The most significant of these may likely be construction scheduling and phasing to minimize impact on existing irrigation operations. It is recommended that these issues be evaluated in more detail.
- Water Rights Coordination – Early consultation with Ecology is already moving forward. It is recommended that MVID, Reclamation, and other project partners continue regular consultation with Ecology to ensure that water right change applications can be processed efficiently so that the project isn't delayed.

10 REFERENCES

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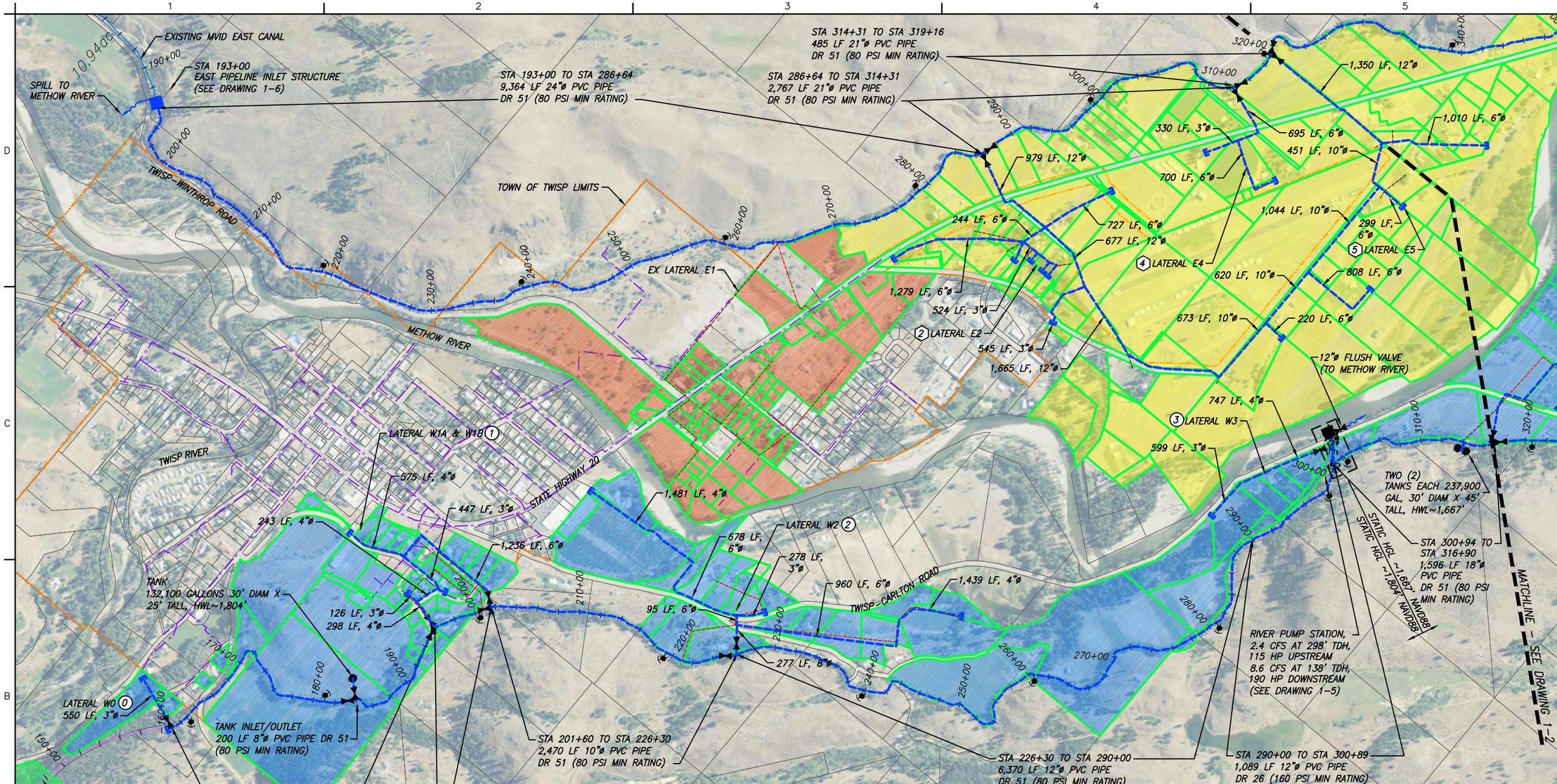
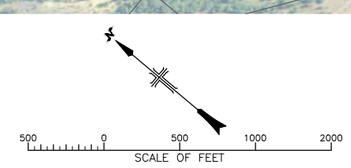
APPENDIX A
FEASIBILITY LEVEL DRAWINGS





PIPE MATERIALS FOR LATERALS:

- (0) LATERAL W0: DR 41 (100 PSI MIN RATING) PVC
- (1) LATERALS W1A AND W1B: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL W2: DR 26 (160 PSI MIN RATING) PVC
- (3) LATERAL W3: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL E2: DR 51 (80 PSI MIN RATING) PVC
- (4) LATERAL E4: DR 51 (80 PSI MIN RATING) PVC
- (5) LATERAL E5: DR 51 (80 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
- MVID PARCELS
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- SECTION LINE
- CITY WATER SUPPLY
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- PROPOSED AIR & VACUUM VALVE
- PROPOSED TURNOUT
- PROPOSED TANK
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- PROPOSED MJ CAP
- PROPOSED SPILL
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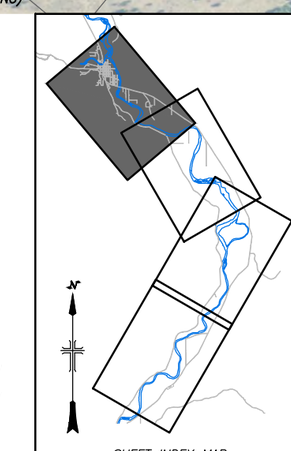
- PARCELS TO BE SERVED BY MVID EAST SYSTEM
- PARCELS TO BE SERVED THROUGH TOWN OF TWISP SYSTEM OR LATERAL E1 REPLACEMENT SYSTEM
- PARCELS TO BE SERVED BY INDIVIDUAL WELLS

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88.



SHEET INDEX MAP

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METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 1

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 1
CONCEPT PLAN

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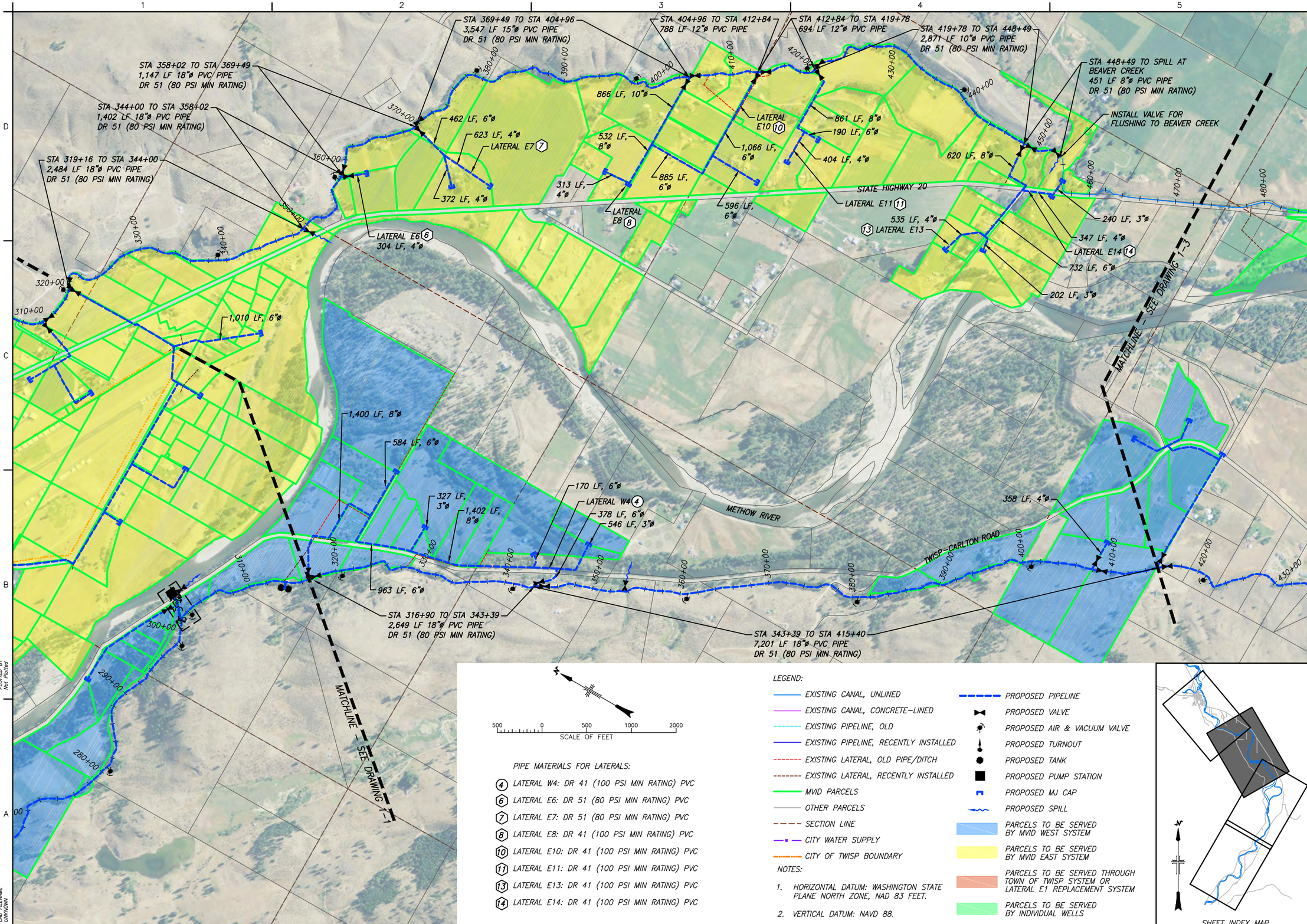

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MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 1

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME - TITLE
APPROVED ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 1
CONCEPT PLAN

DRAWING 1-2

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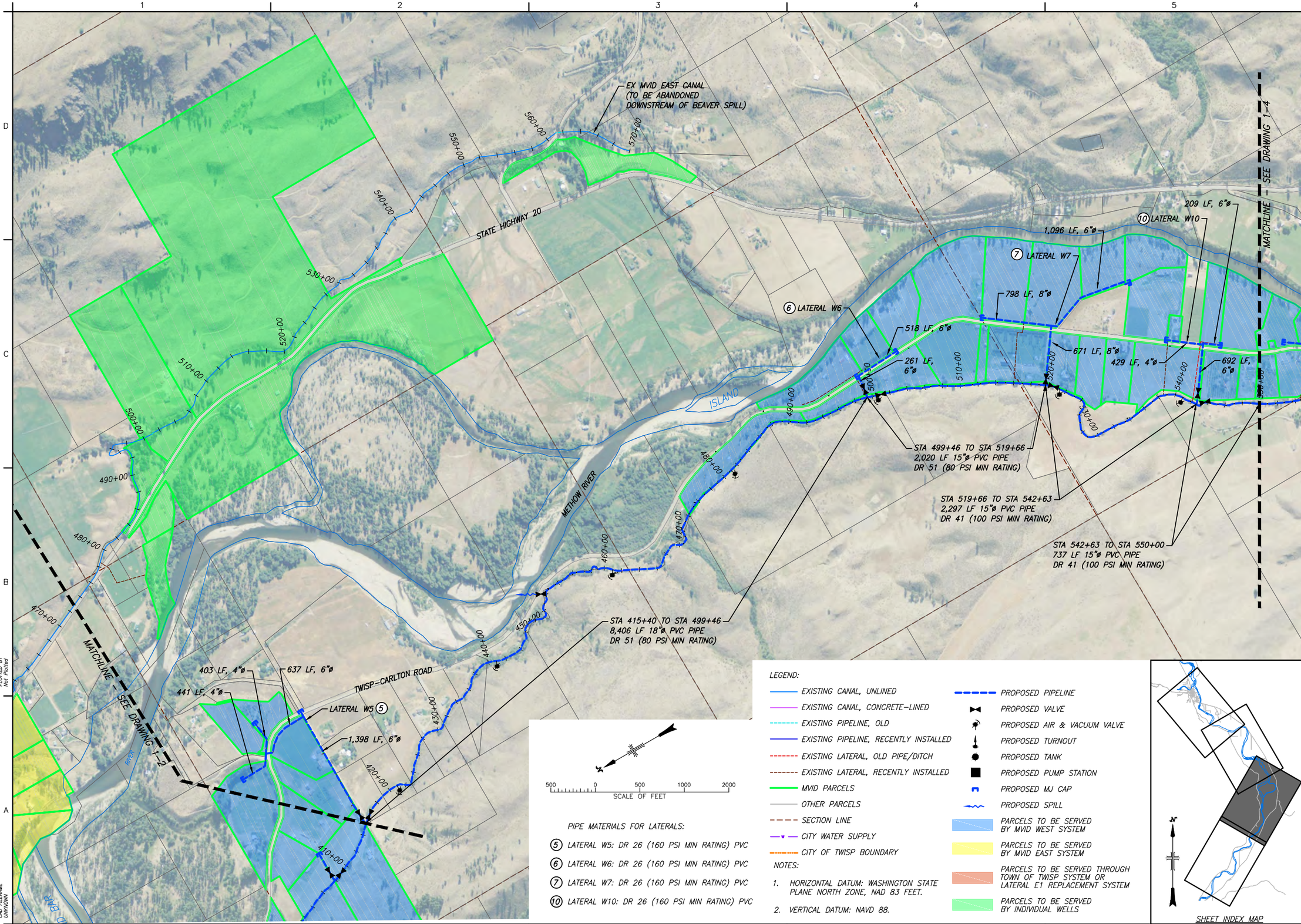

PIPE MATERIALS FOR LATERALS:

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LEGEND:

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NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88.

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MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 1

REV NO

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TWISP, WA

ALTERNATIVE 1
CONCEPT PLAN

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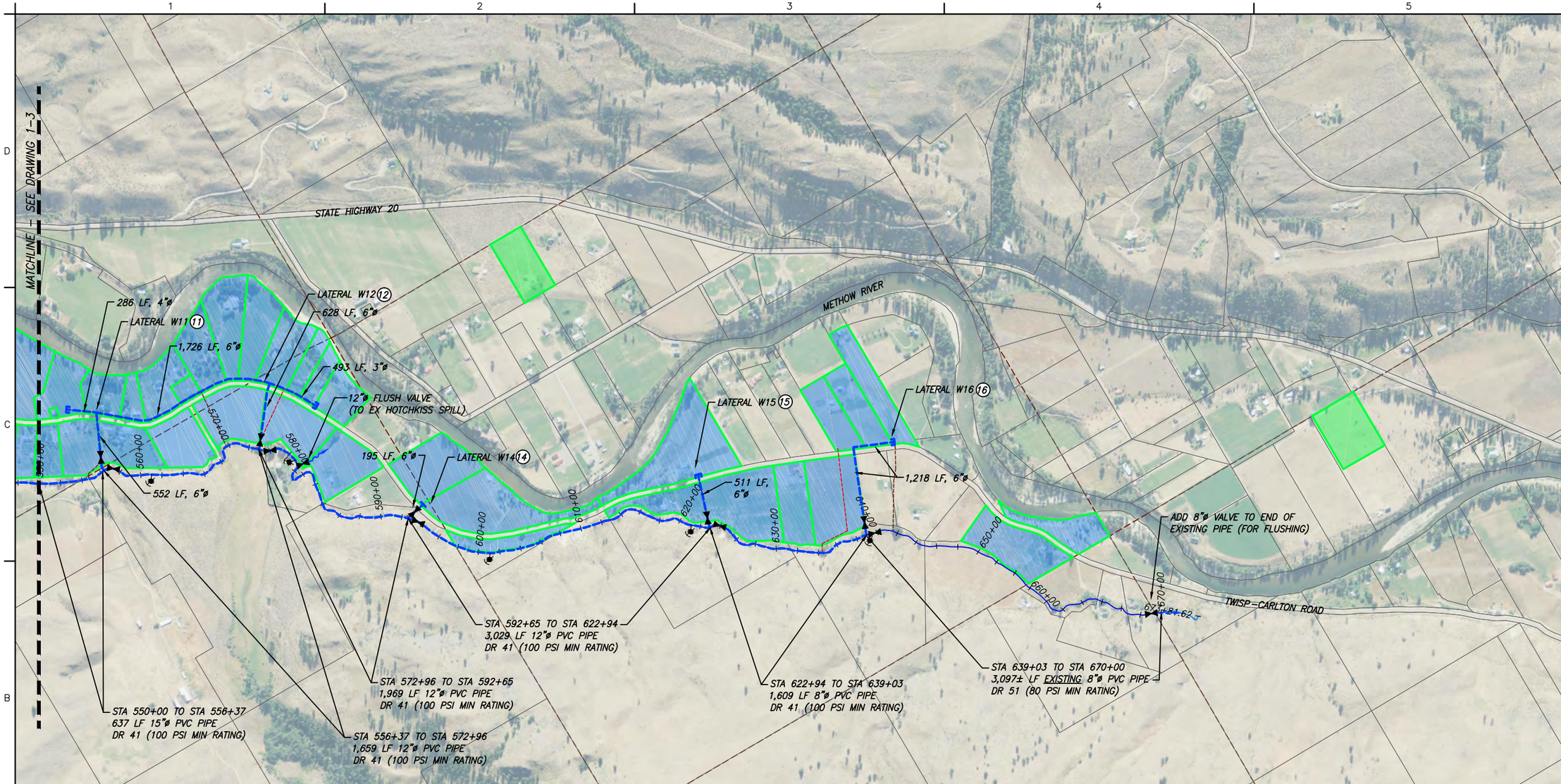

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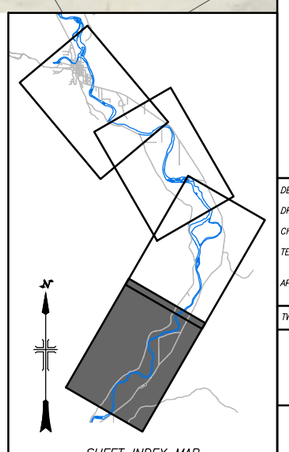

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METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 1

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TWISP, WA

ALTERNATIVE 1
CONCEPT PLAN

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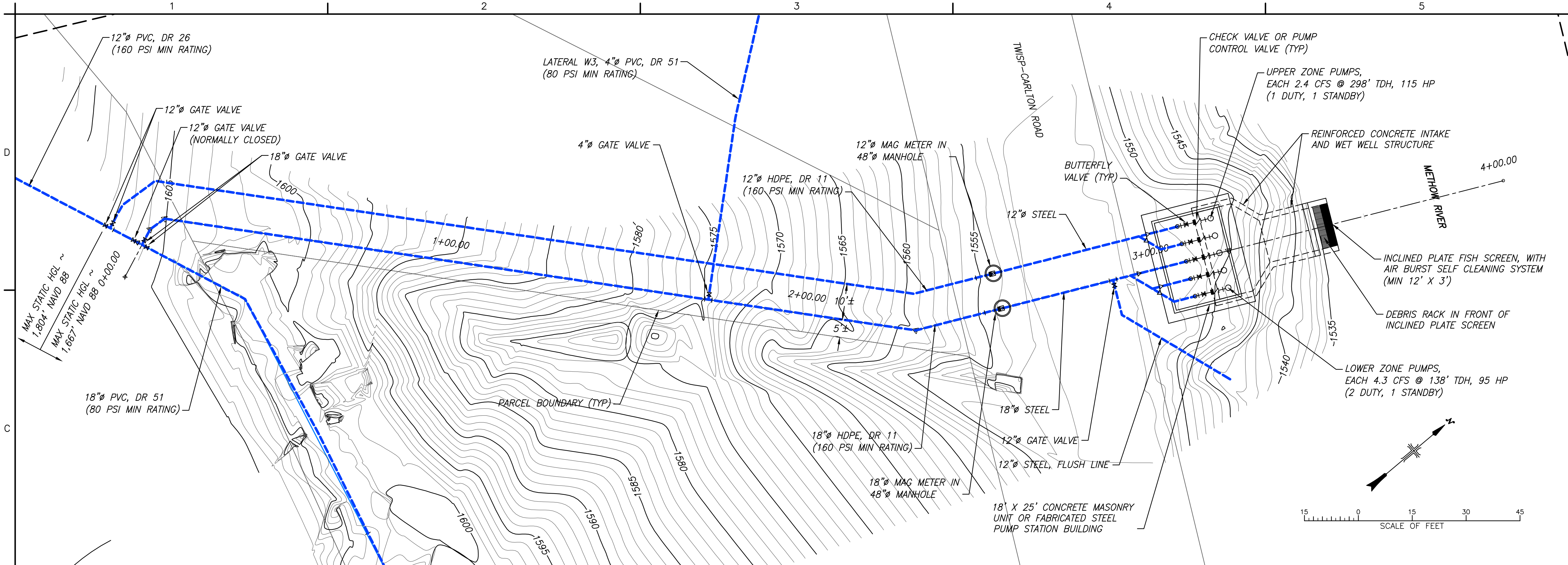
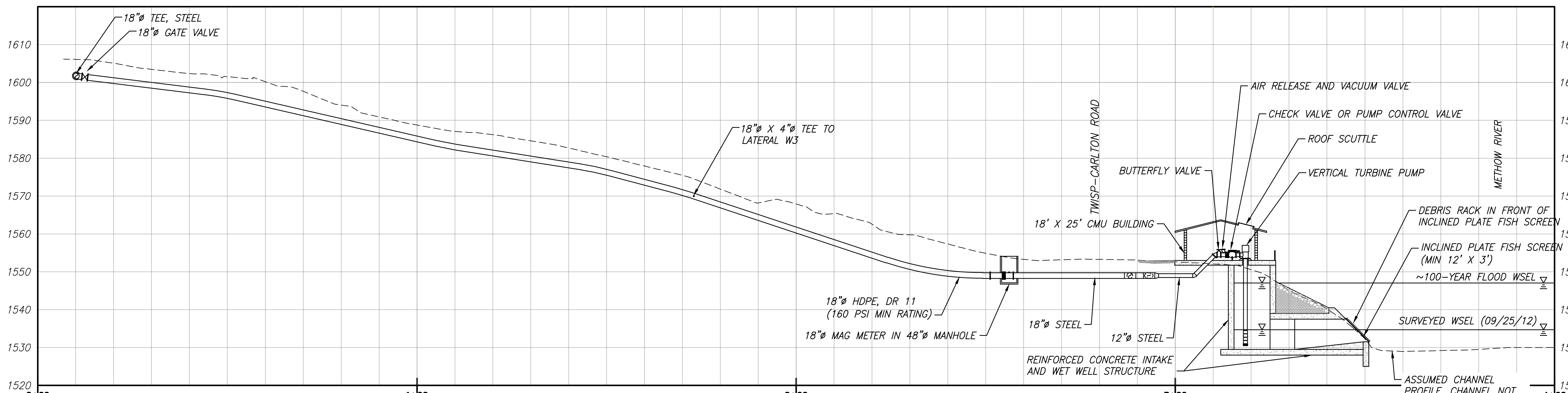


RIVER PUMP STATION CONCEPT PLAN



RIVER PUMP STATION CONCEPT PROFILE

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ALTERNATIVE 1 CONCEPT PLAN & PROFILE

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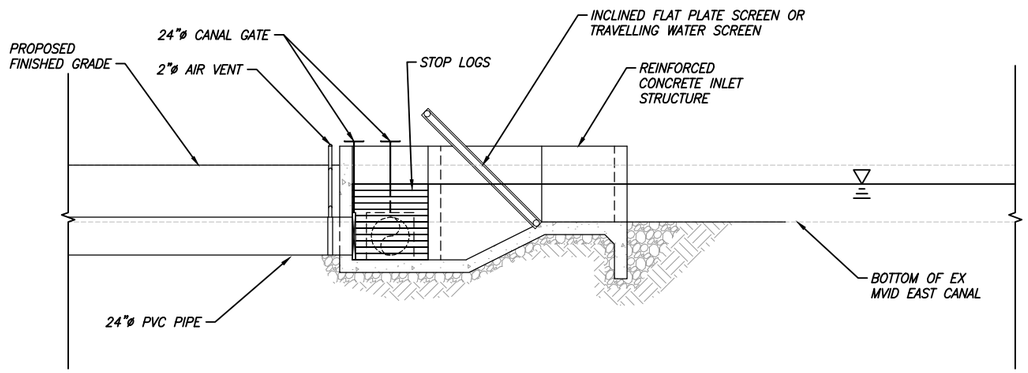

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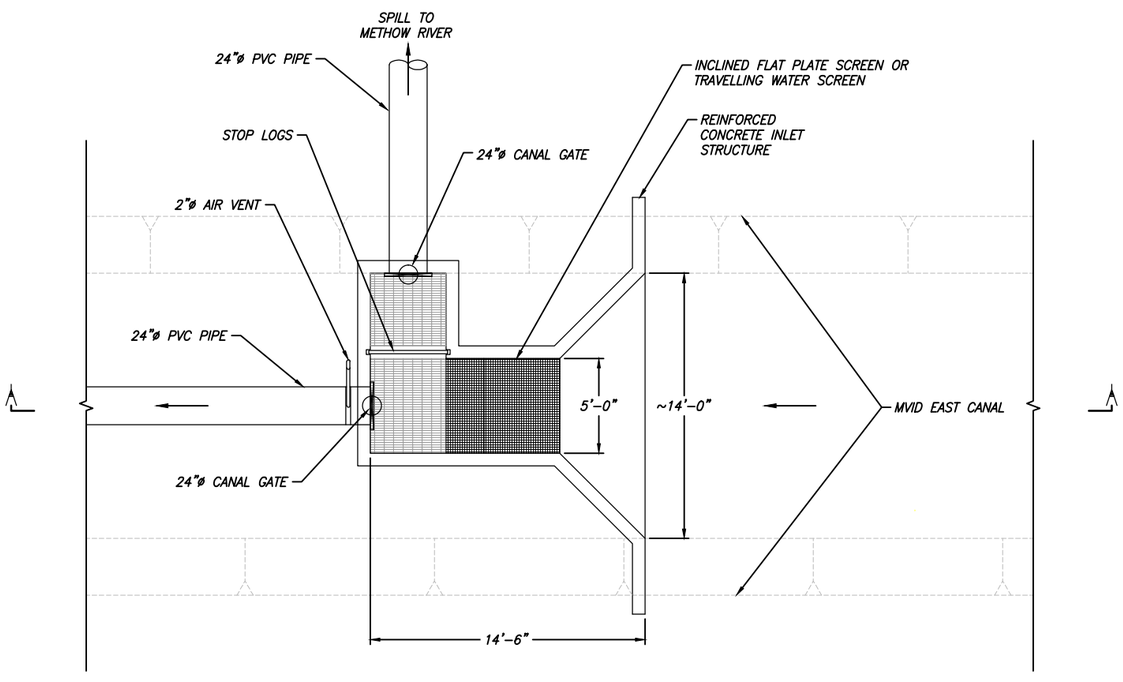

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ALTERNATIVE 1

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APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 1
CONCEPT PLAN &
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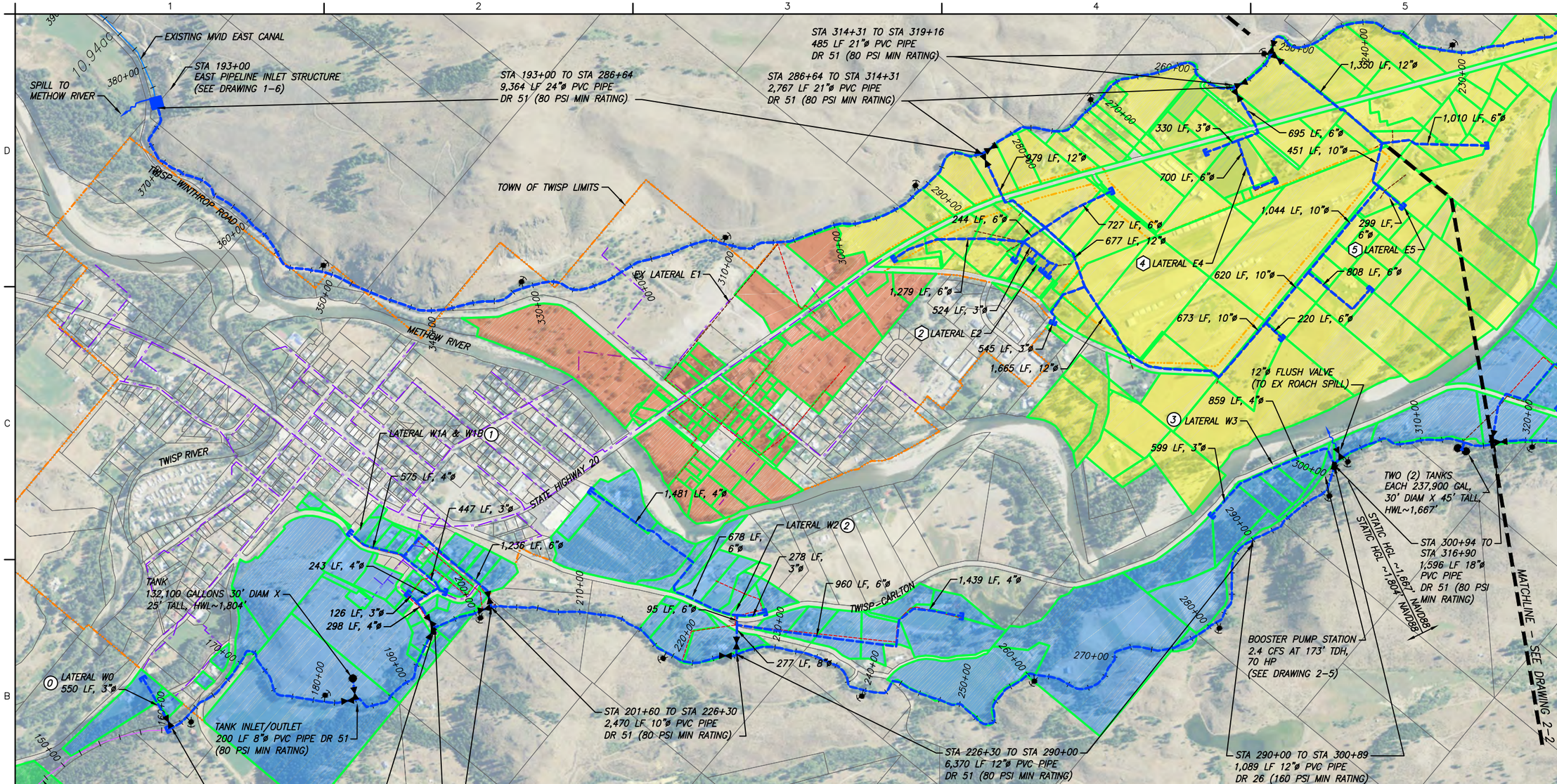

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PIPE MATERIALS FOR LATERALS:

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- (1) LATERALS W1A AND W1B: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL W2: DR 26 (160 PSI MIN RATING) PVC
- (3) LATERAL W3: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL E2: DR 51 (80 PSI MIN RATING) PVC
- (4) LATERAL E4: DR 51 (80 PSI MIN RATING) PVC
- (5) LATERAL E5: DR 51 (80 PSI MIN RATING) PVC

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NOTES:

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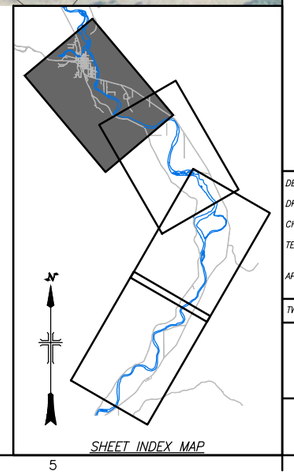

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METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 2

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 2
CONCEPT PLAN

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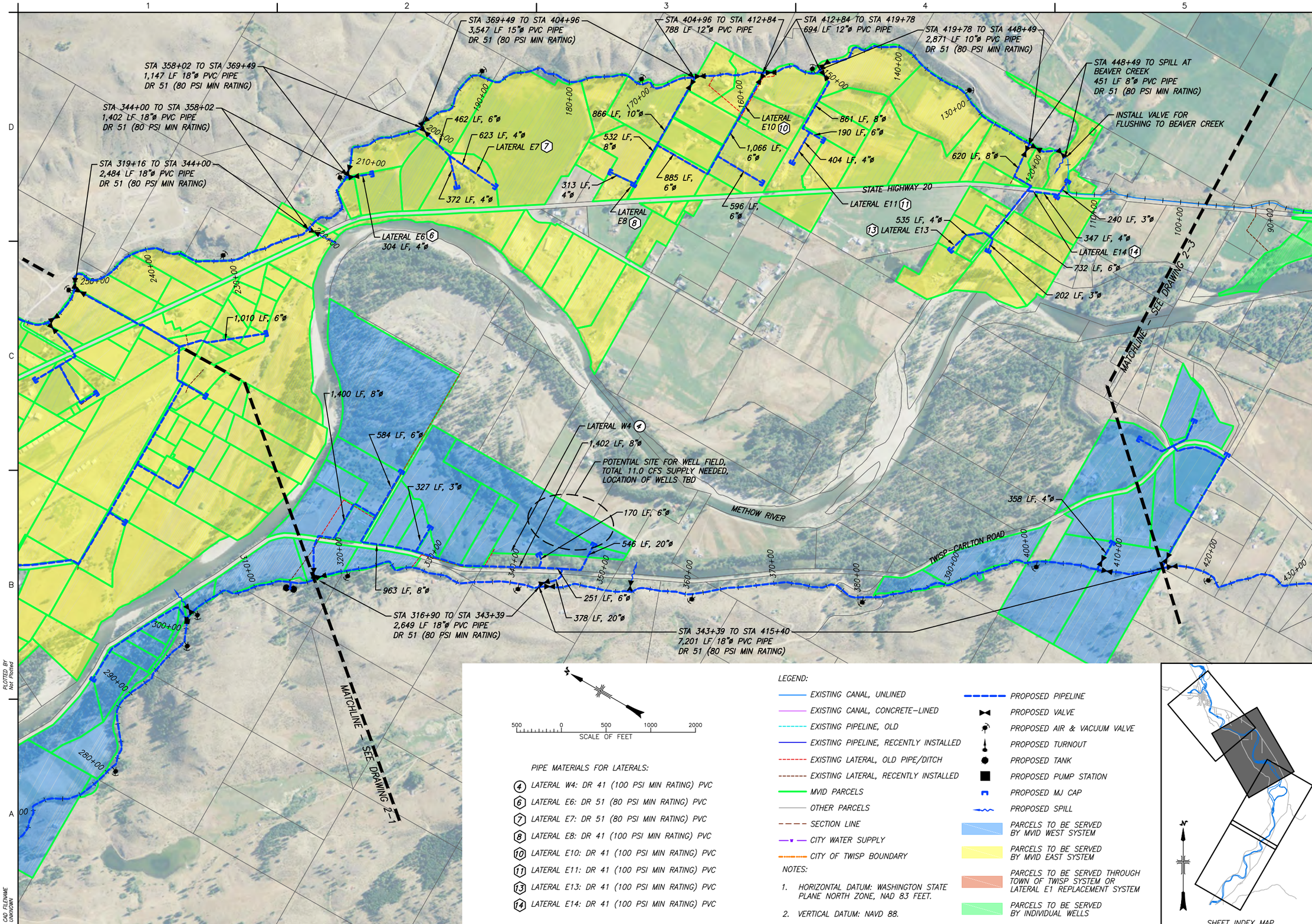

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PIPE MATERIALS FOR LATERALS:

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LEGEND:

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- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
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METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 2

REV. NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 2
CONCEPT PLAN

DRAWING 2-2

SHEET 2 OF 5

Jul 17, 2013 12:00pm drice
CAD SYSTEM
CAD FILE
CAD FILENAME
UNKNOWN

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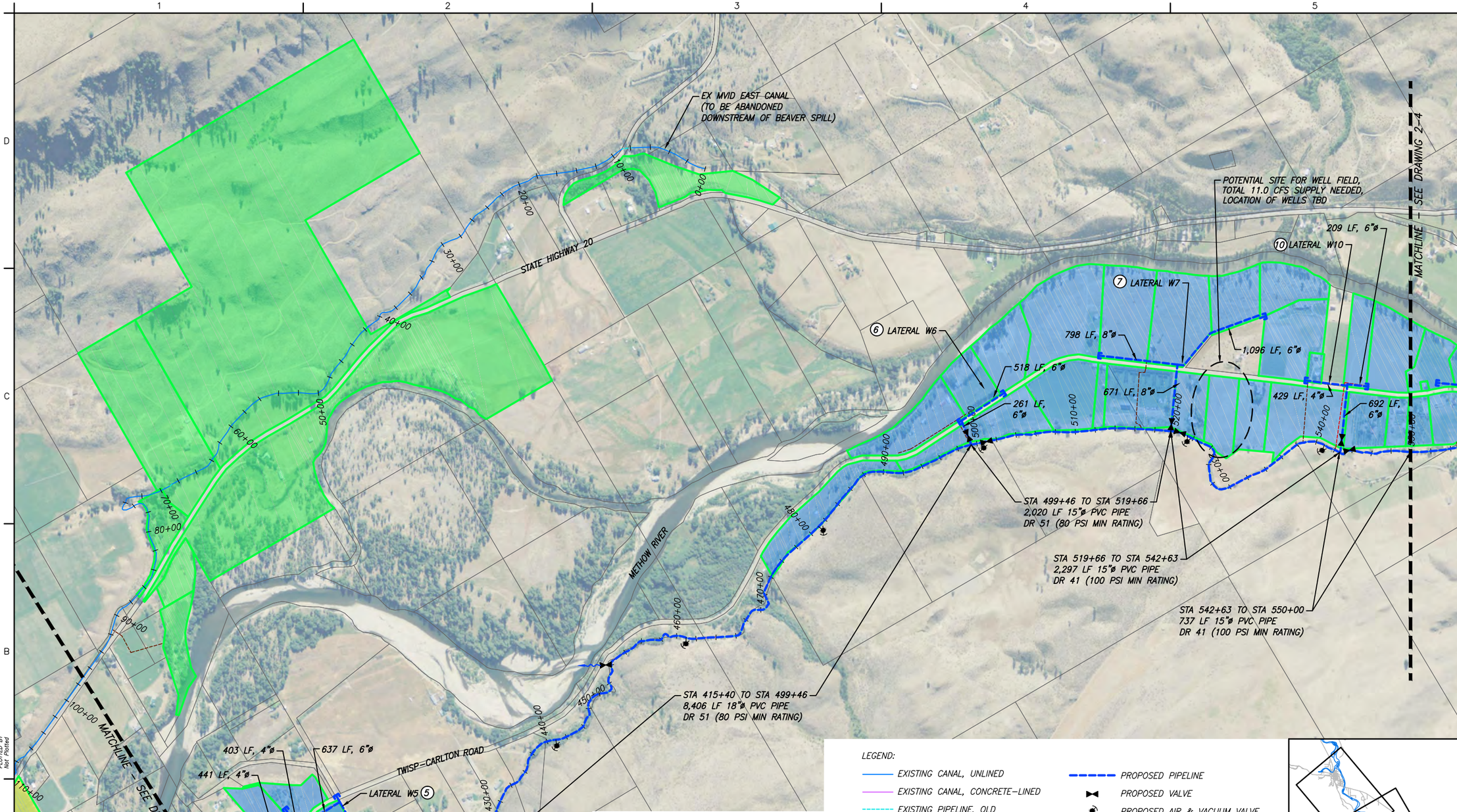
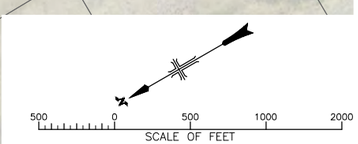
DATE AND TIME PLOTTED
Wednesday
PLOTTED BY
Not Plotted

DRAWING 2-2





PIPE MATERIALS FOR LATERALS:

5 LATERAL W5: DR 26 (160 PSI MIN RATING) PVC

6 LATERAL W6: DR 26 (160 PSI MIN RATING) PVC

7 LATERAL W7: DR 26 (160 PSI MIN RATING) PVC

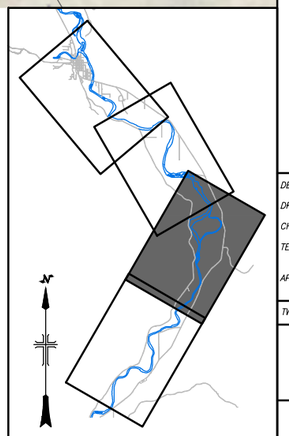
10 LATERAL W10: DR 26 (160 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
- MVID PARCELS
- OTHER PARCELS
- SECTION LINE
- CITY WATER SUPPLY
- CITY OF TWISP BOUNDARY
- PROPOSED PIPELINE
- PROPOSED VALVE
- PROPOSED AIR & VACUUM VALVE
- PROPOSED TURNOUT
- PROPOSED TANK
- PROPOSED PUMP STATION
- PROPOSED MJ CAP
- PROPOSED SPILL
- PARCELS TO BE SERVED BY MVID WEST SYSTEM
- PARCELS TO BE SERVED BY MVID EAST SYSTEM
- PARCELS TO BE SERVED THROUGH TOWN OF TWISP SYSTEM OR LATERAL E1 REPLACEMENT SYSTEM
- PARCELS TO BE SERVED BY INDIVIDUAL WELLS

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88.



SHEET INDEX MAP

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

COLUMBIA

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 2

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 2
CONCEPT PLAN

DRAWING 2-3

SHEET 3 OF 5

Jul 17, 2013 12:00pm dtice
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Civil 3D
CAD FILENAME
UNKNOWN

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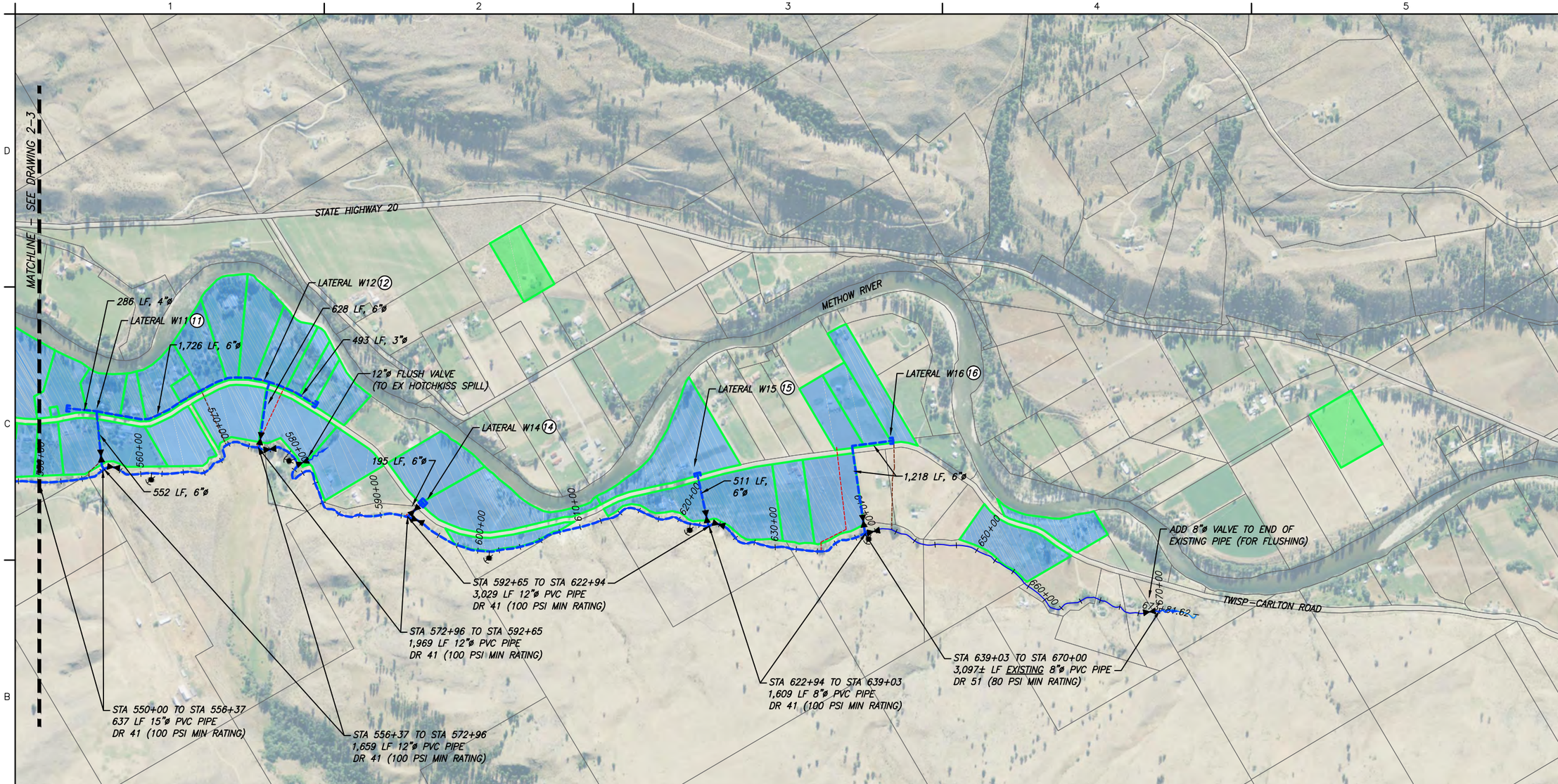
DATE AND
Not Plotted TIME PLOTTED
PLOTTED BY
Not Plotted



PIPE MATERIALS FOR LATERALS:

(11) LATERAL W11: DR 26 (160 PSI MIN RATING) PVC

(12) LATERAL W12: DR 26 (160 PSI MIN RATING) PVC

(14) LATERAL W14: DR 26 (160 PSI MIN RATING) PVC

(15) LATERAL W15: DR 26 (160 PSI MIN RATING) PVC

(16) LATERAL W16: DR 26 (160 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE–LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
- MVID PARCELS
- OTHER PARCELS
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- PROPOSED VALVE
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NOTES:

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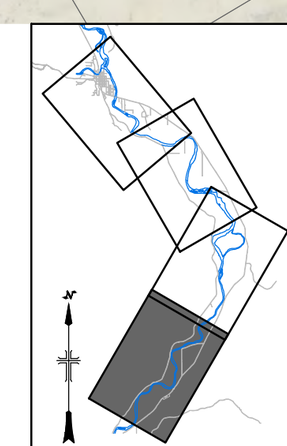

SHEET INDEX MAP

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 2

REV. NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 2
CONCEPT PLAN

DRAWING 2–4

SHEET 4 OF 5

DRAWING 2-4
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PLOTTED BY
Not Plotted
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CAD SYSTEM
Civil 3D
CAD FILENAME
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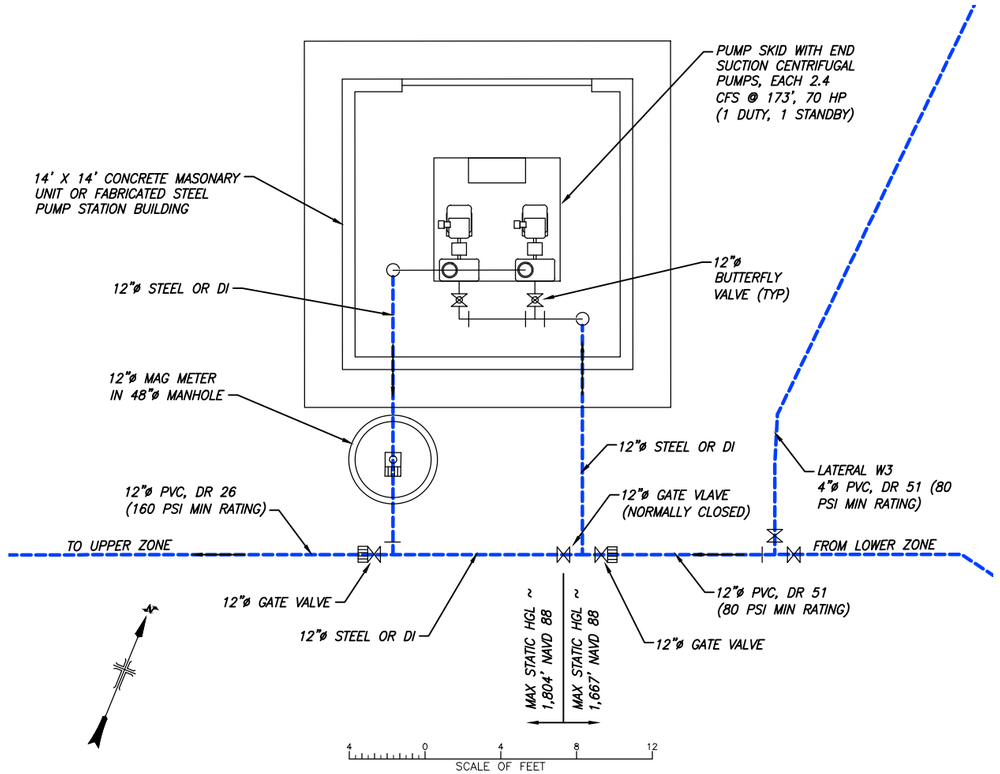
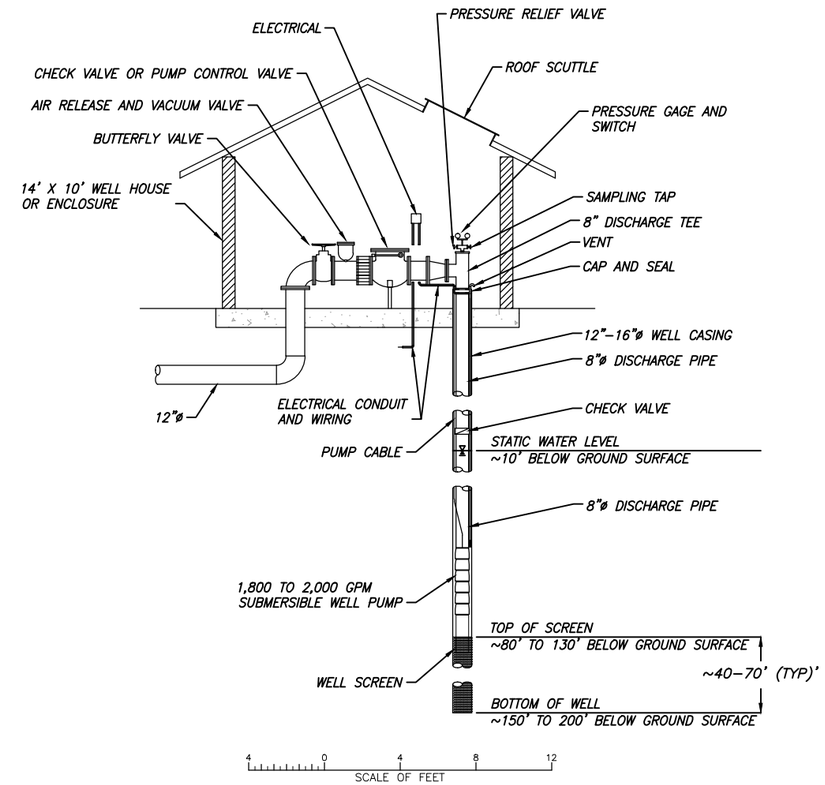
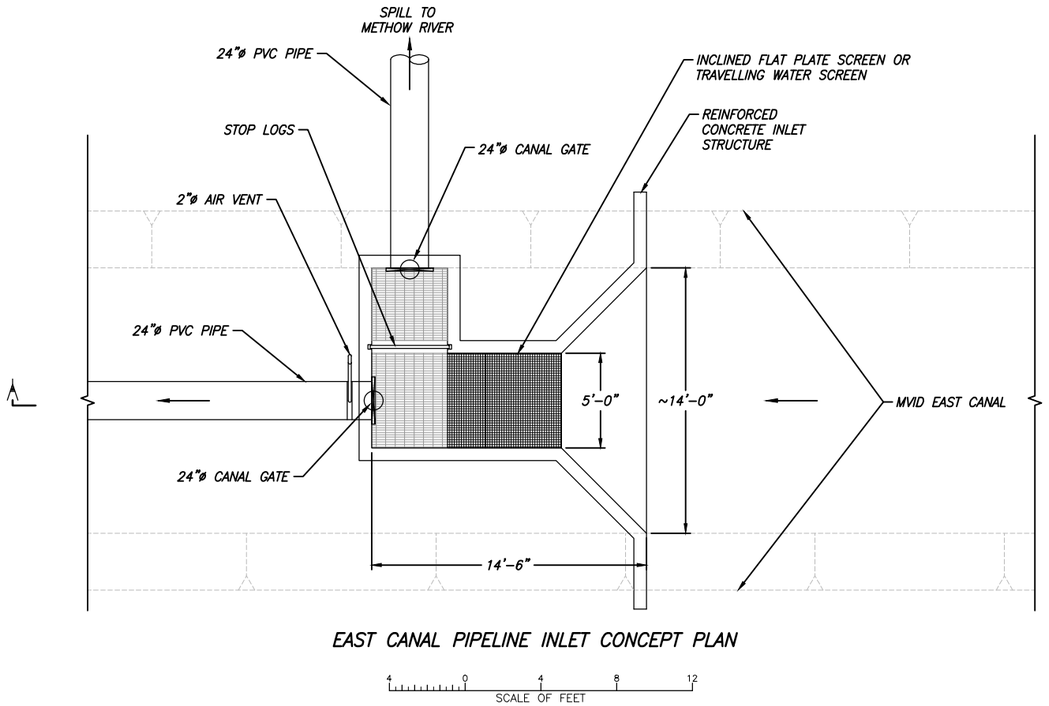


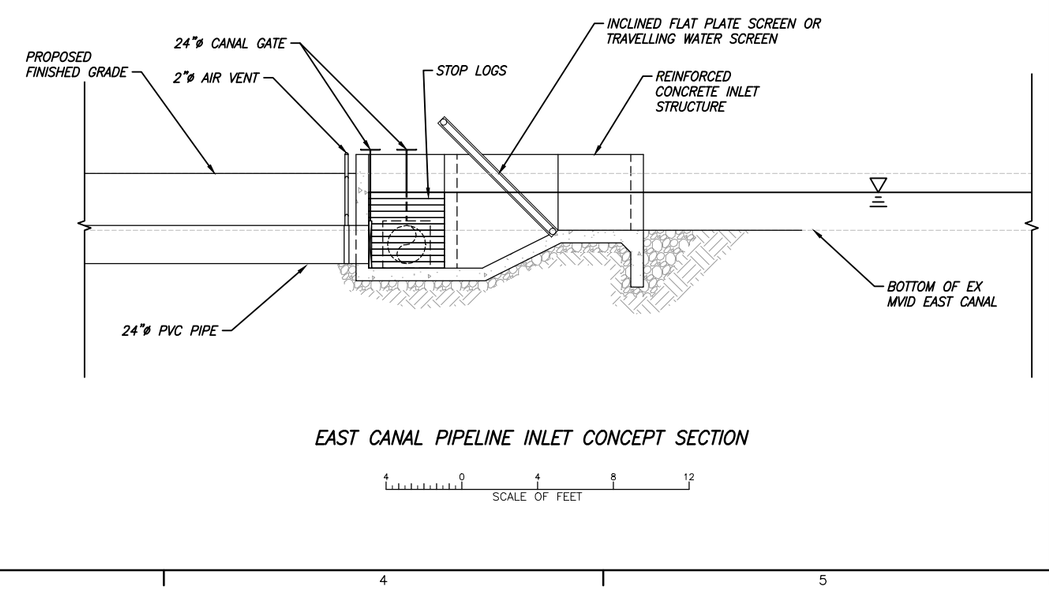
BOOSTER PUMP STATION CONCEPT PLAN



TYPICAL PRODUCTION WELL CONCEPT



EAST CANAL PIPELINE INLET CONCEPT PLAN



EAST CANAL PIPELINE INLET CONCEPT SECTION

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Managing Water in the West

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BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 2

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 2
CONCEPT PLAN

DRAWING 2–5

SHEET 5 OF 5

DRAWING 2-5
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PLOTTED BY Not Plotted
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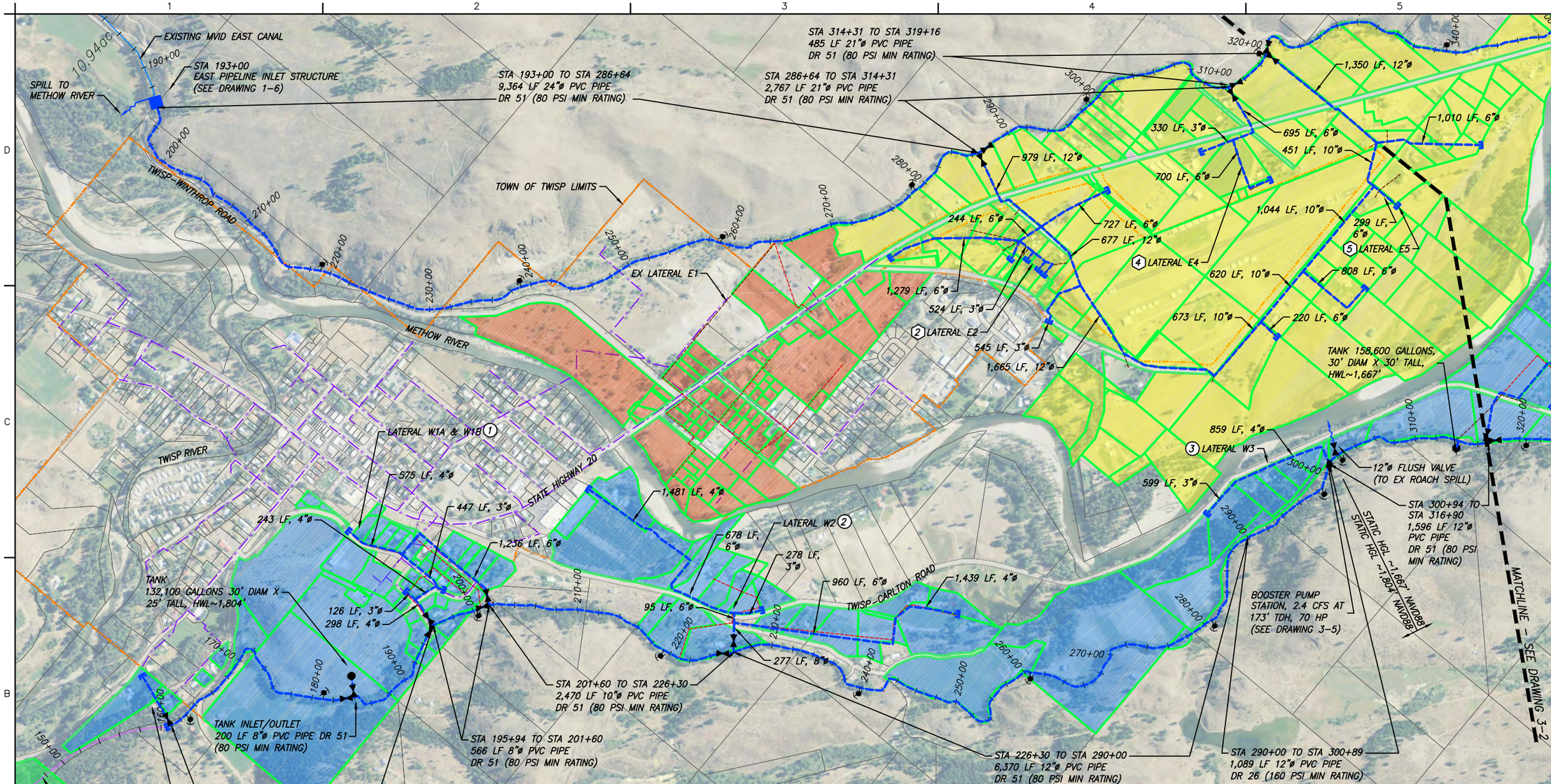

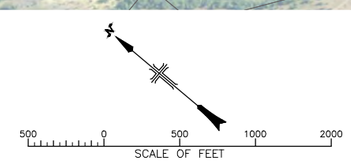

PIPE MATERIALS FOR LATERALS:

- (0) LATERAL W0: DR 41 (100 PSI MIN RATING) PVC
- (1) LATERALS W1A AND W1B: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL W2: DR 26 (160 PSI MIN RATING) PVC
- (3) LATERAL W3: DR 51 (80 PSI MIN RATING) PVC
- (2) LATERAL E2: DR 51 (80 PSI MIN RATING) PVC
- (4) LATERAL E4: DR 51 (80 PSI MIN RATING) PVC
- (5) LATERAL E5: DR 51 (80 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
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- PROPOSED VALVE
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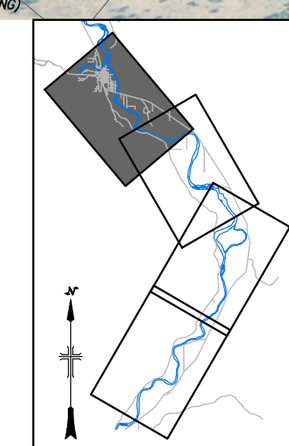
- PARCELS TO BE SERVED BY INDIVIDUAL WELLS

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88.



SHEET INDEX MAP

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 3

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME - TITLE
APPROVED ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 3 CONCEPT PLAN

DRAWING 3-1

SHEET 1 OF 5

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CAD FILENAME
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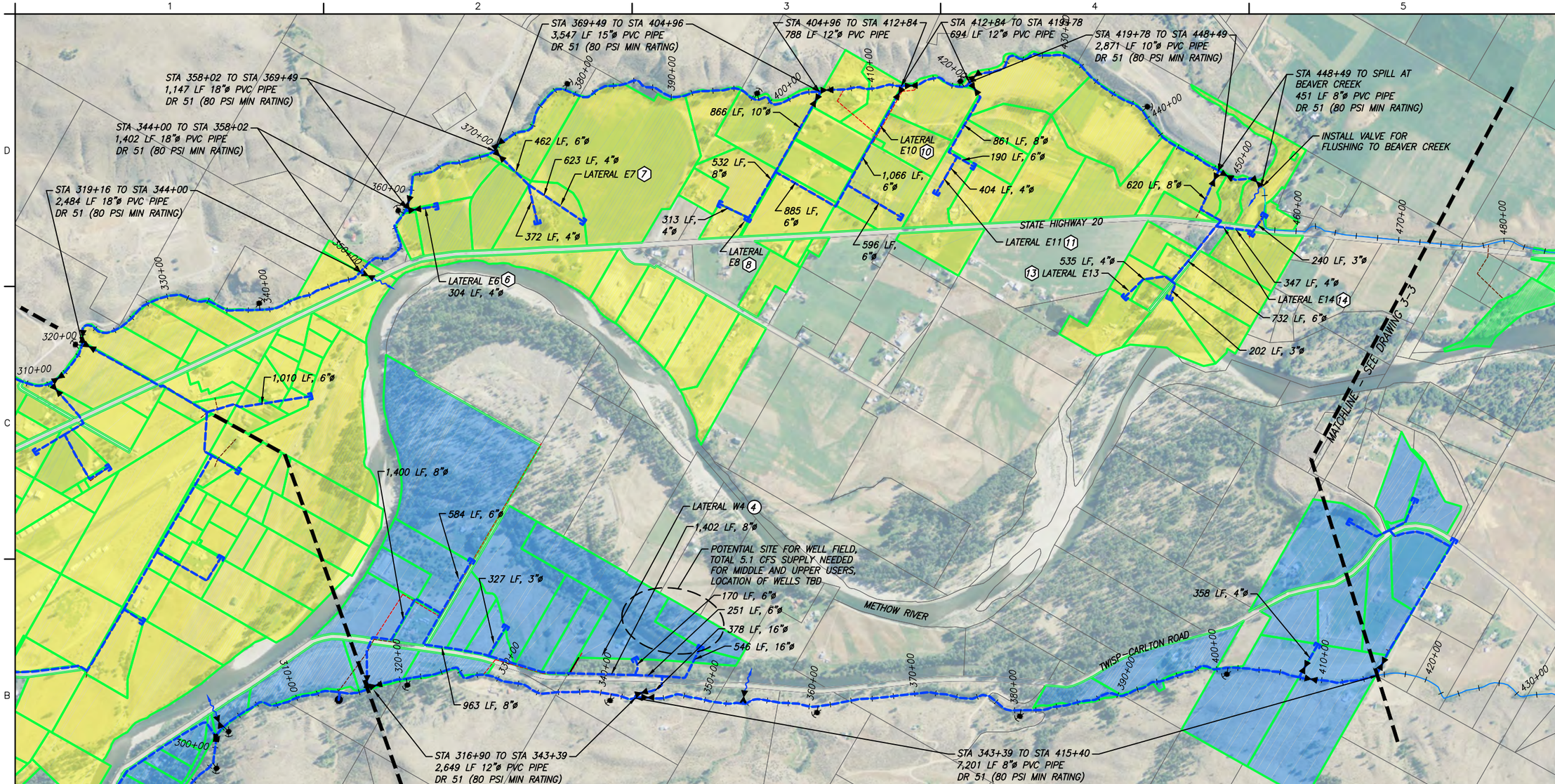
Not Plotted



SCALE OF FEET: 500 0 500 1000 2000

PIPE MATERIALS FOR LATERALS:

- (4) LATERAL W4: DR 41 (100 PSI MIN RATING) PVC
- (6) LATERAL E6: DR 51 (80 PSI MIN RATING) PVC
- (7) LATERAL E7: DR 51 (80 PSI MIN RATING) PVC
- (8) LATERAL E8: DR 41 (100 PSI MIN RATING) PVC
- (10) LATERAL E10: DR 41 (100 PSI MIN RATING) PVC
- (11) LATERAL E11: DR 41 (100 PSI MIN RATING) PVC
- (13) LATERAL E13: DR 41 (100 PSI MIN RATING) PVC
- (14) LATERAL E14: DR 41 (100 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
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NOTES:

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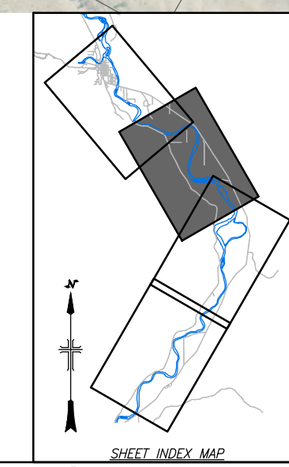
2. VERTICAL DATUM: NAVD 88.



RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 3

REV. NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 3
CONCEPT PLAN

DRAWING 3-2

SHEET 2 OF 5

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Wed, February 6, 2013
PLOTTED BY
Not Plotted

Jul 17, 2013 12:03pm drice
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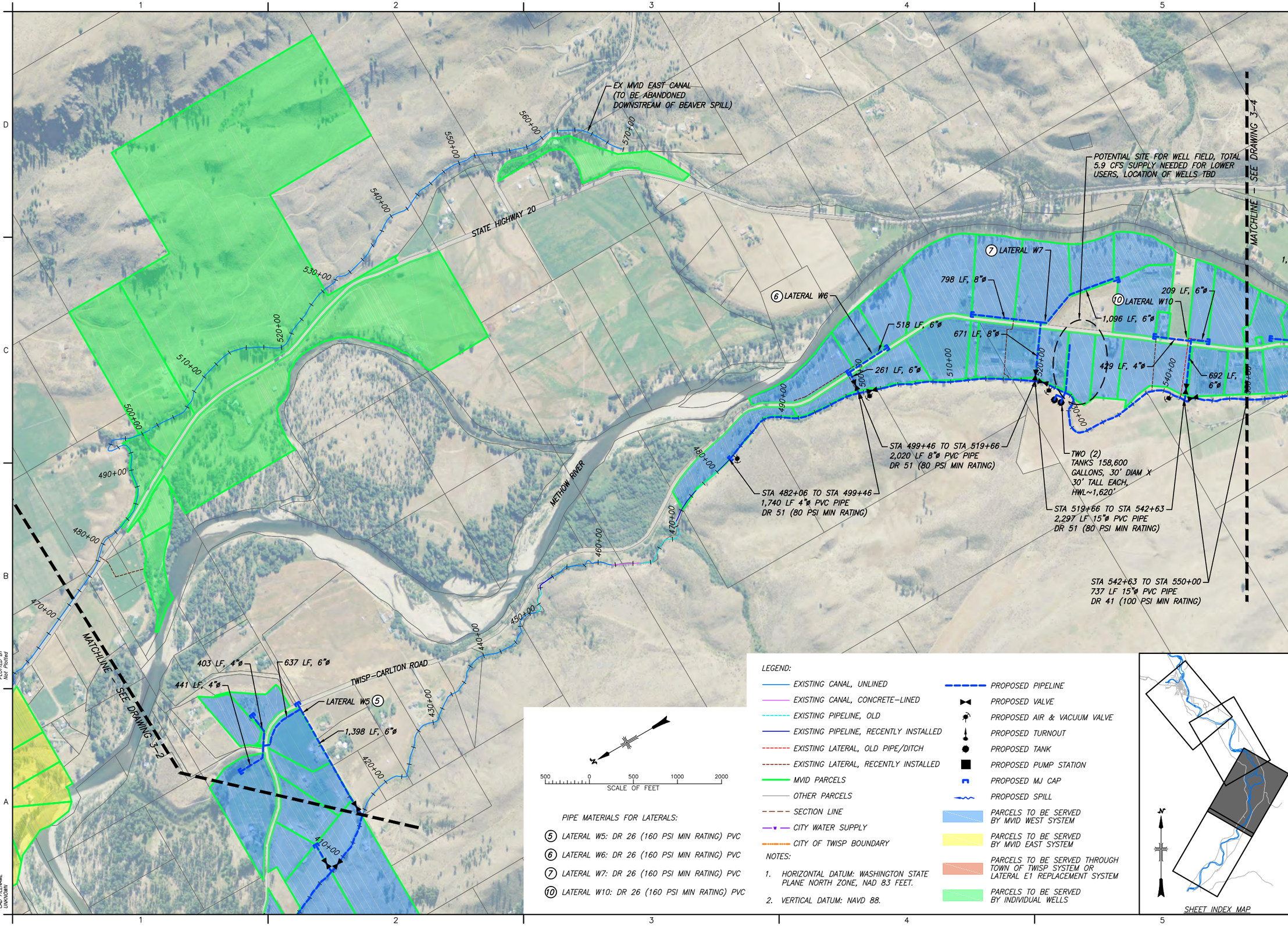

PIPE MATERIALS FOR LATERALS:

(5) LATERAL W5: DR 26 (160 PSI MIN RATING) PVC

(6) LATERAL W6: DR 26 (160 PSI MIN RATING) PVC

(7) LATERAL W7: DR 26 (160 PSI MIN RATING) PVC

(10) LATERAL W10: DR 26 (160 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
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NOTES:

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2. VERTICAL DATUM: NAVD 88.

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

COLUMBIA

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 3

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME – TITLE
APPROVED _ ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 3
CONCEPT PLAN

DRAWING 3–3

SHEET 3 OF 5

DRAWING 3-3
DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted
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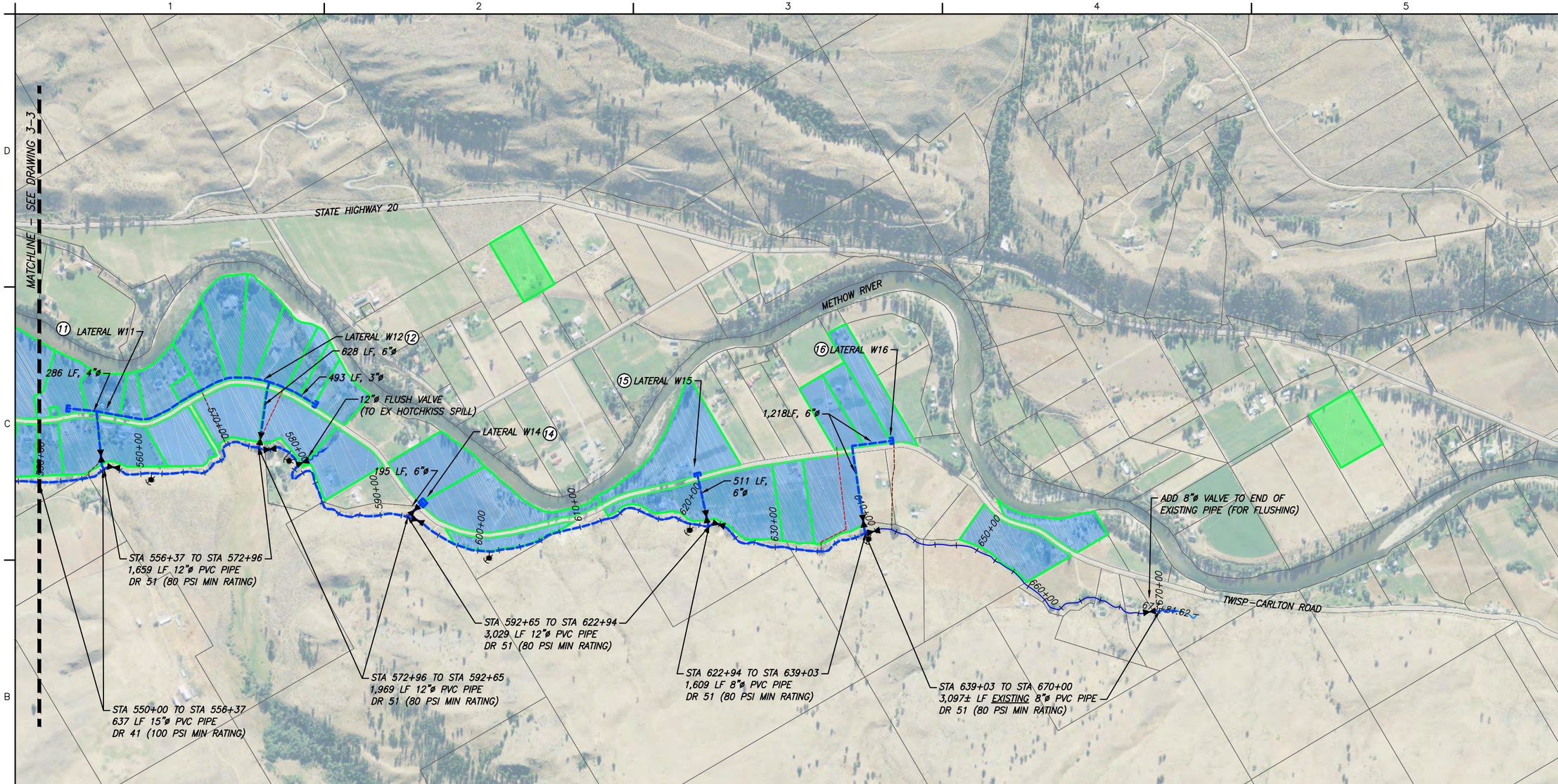

500 0 500 1000 2000
SCALE OF FEET

PIPE MATERIALS FOR LATERALS:

11 LATERAL W11: DR 26 (160 PSI MIN RATING) PVC

12 LATERAL W12: DR 26 (160 PSI MIN RATING) PVC

14 LATERAL W14: DR 26 (160 PSI MIN RATING) PVC

15 LATERAL W15: DR 26 (160 PSI MIN RATING) PVC

16 LATERAL W16: DR 26 (160 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
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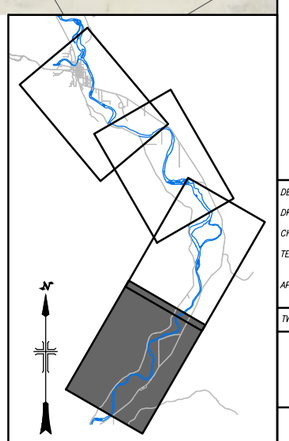

SHEET INDEX MAP

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 3

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME – TITLE
APPROVED _ ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 3
CONCEPT PLAN

DRAWING 3–4

SHEET 4 OF 5

Jul 17, 2013 12:03pm drice
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CAD FILE
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TIME PLOTTED
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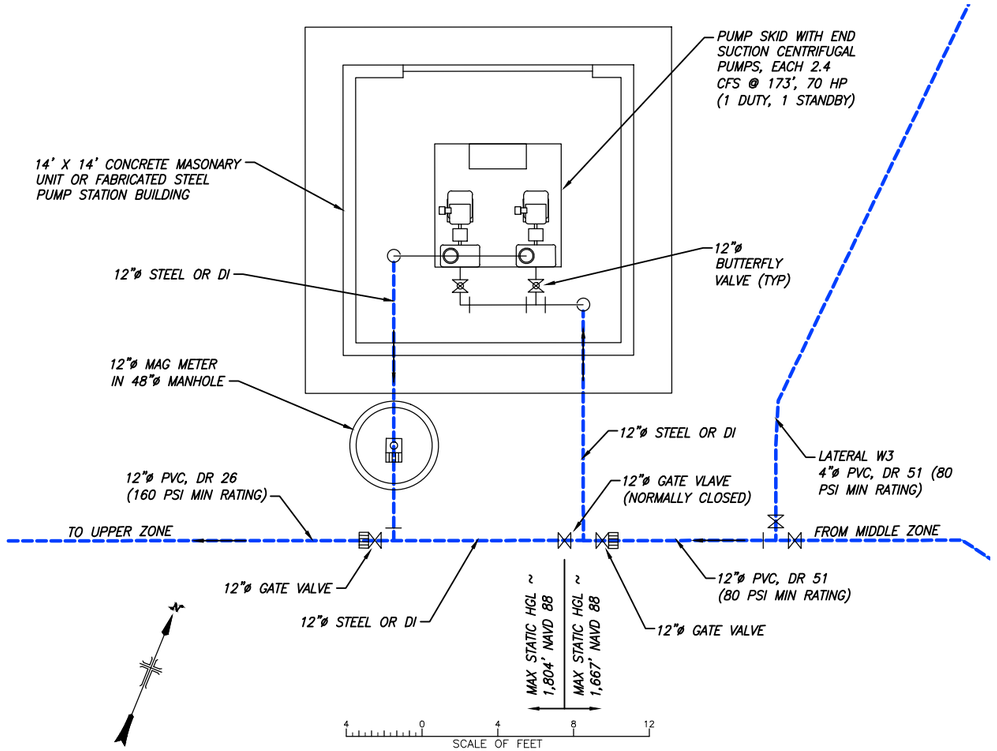
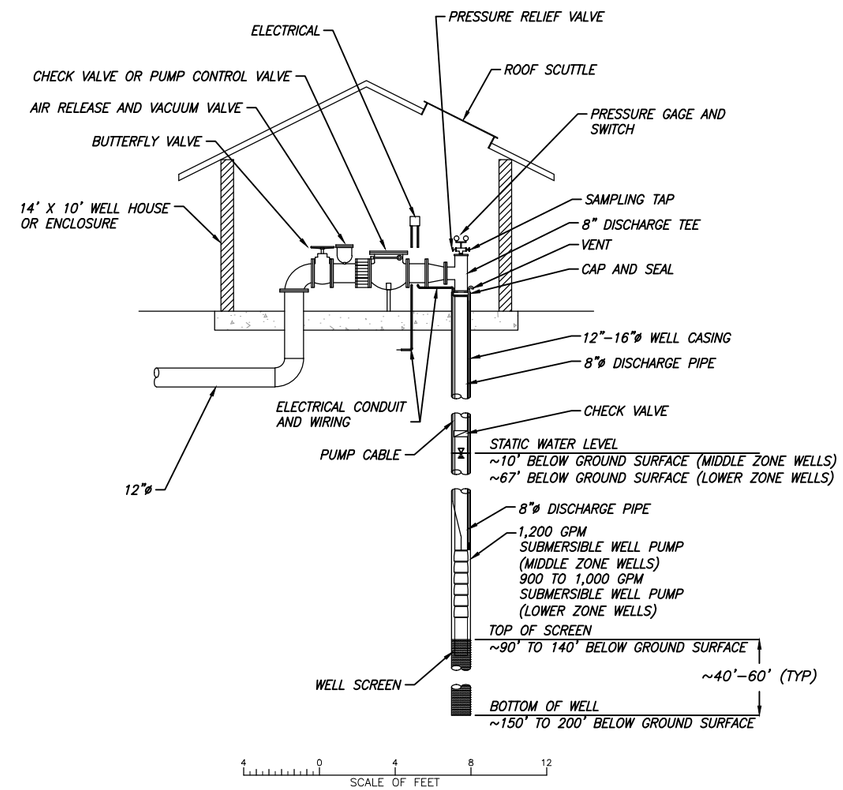
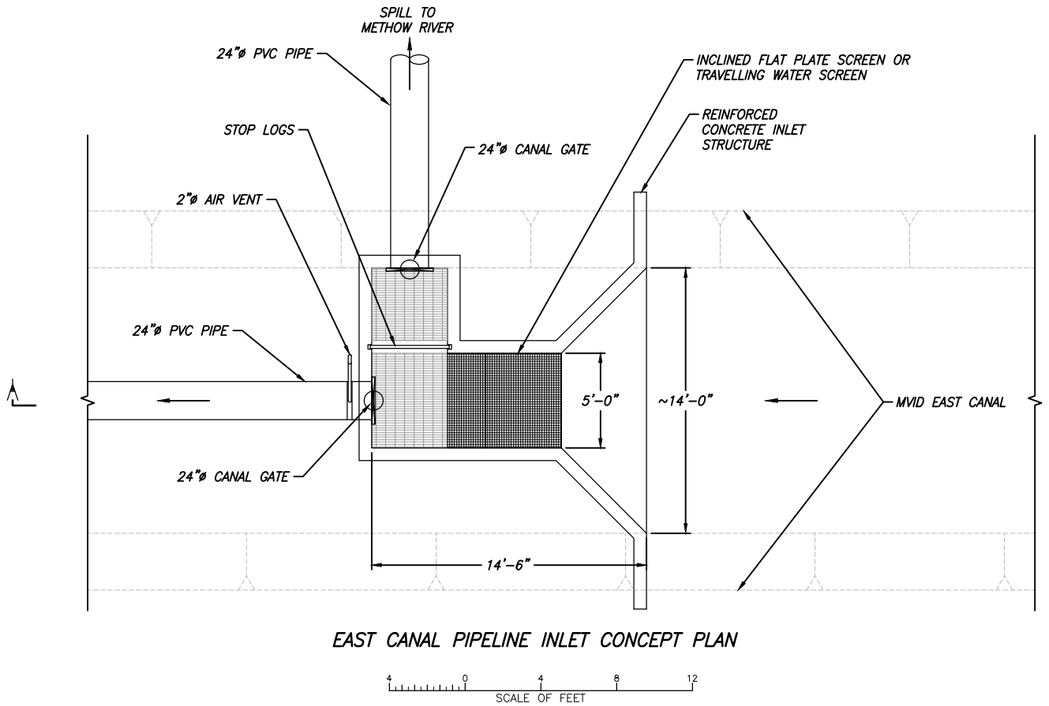
PLOTTED BY
Not Plotted



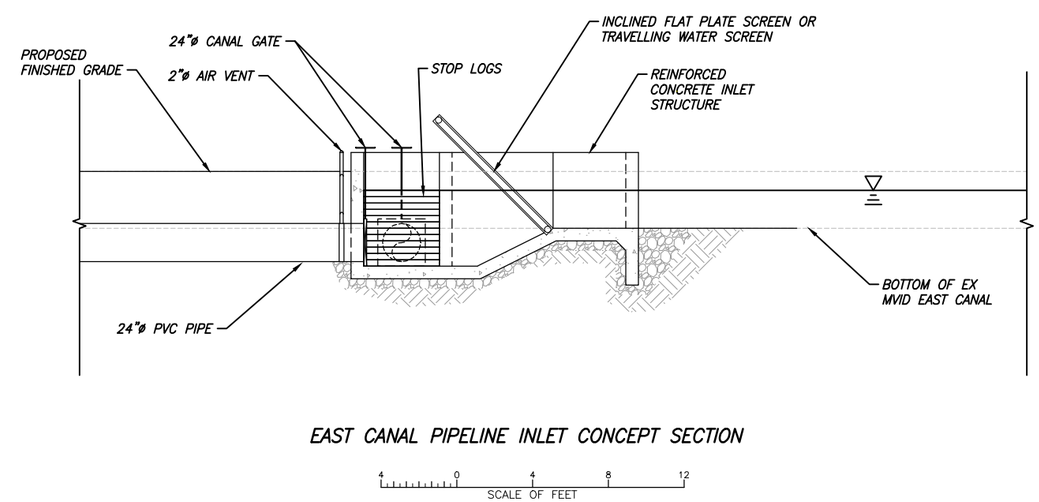
BOOSTER PUMP STATION CONCEPT PLAN



TYPICAL PRODUCTION WELL CONCEPT



EAST CANAL PIPELINE INLET CONCEPT PLAN



EAST CANAL PIPELINE INLET CONCEPT SECTION

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CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 3
CONCEPT PLAN

DRAWING 3–5

SHEET 5 OF 5

Jul 17, 2013 12:04pm drice
CAD SYSTEM
CAD FILE
CAD FILENAME
UNKNOWN

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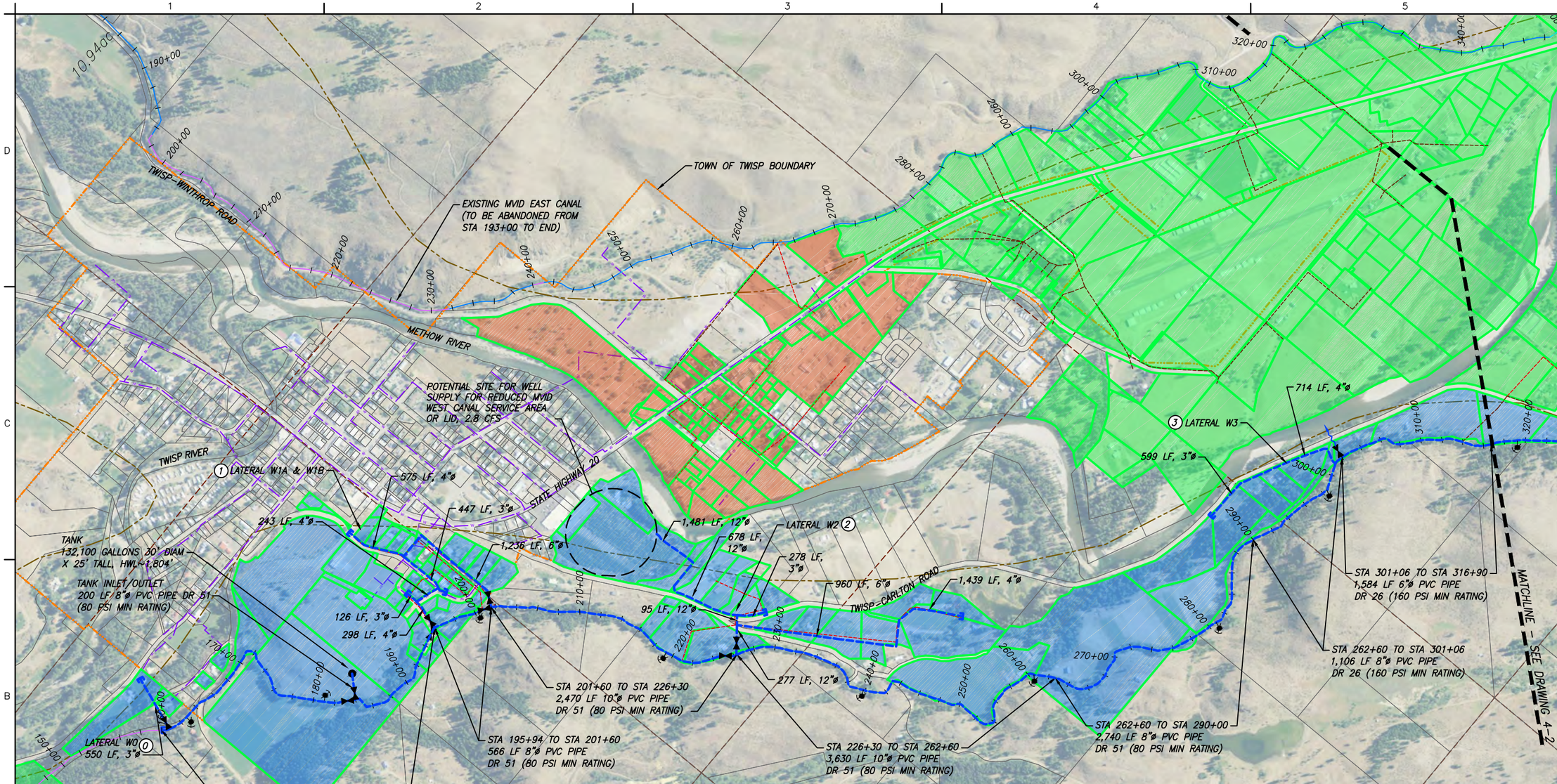
Not Plotted



500 0 500 1000 2000
SCALE OF FEET

PIPE MATERIALS FOR LATERALS:

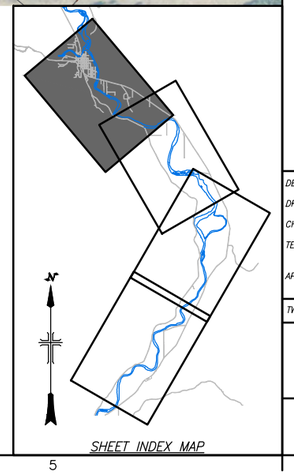
0. LATERAL W0: DR 41 (100 PSI MIN RATING) PVC
1. LATERALS W1A AND W1B: DR 51 (80 PSI MIN RATING) PVC
2. LATERAL W2: DR 26 (160 PSI MIN RATING) PVC
3. LATERAL W3: DR 51 (80 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
- MVID PARCELS
- OTHER PARCELS
- SECTION LINE
- CITY BOUNDARY
- CITY WATER SUPPLY
- EXTENTS OF ALLUVIUM (FROM GIS)
- PROPOSED PIPELINE
- PROPOSED VALVE
- PROPOSED AIR & VACUUM VALVE
- PROPOSED TURNOUT
- PROPOSED TANK
- PROPOSED PUMP STATION
- PROPOSED MJ CAP
- PROPOSED SPILL
- PARCELS TO BE SERVED BY MVID WEST SYSTEM
- PARCELS TO BE SERVED THROUGH TOWN OF TWISP SYSTEM OR LATERAL E1 REPLACEMENT SYSTEM
- PARCELS TO BE SERVED BY INDIVIDUAL WELLS

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88



SHEET INDEX MAP

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 4

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 4
CONCEPT PLAN

DRAWING 4–1

SHEET 1 OF 5

Jul 17, 2013 12:05pm drice
CAD SYSTEM
CAD 3D
CAD FILENAME
UNKNOWN

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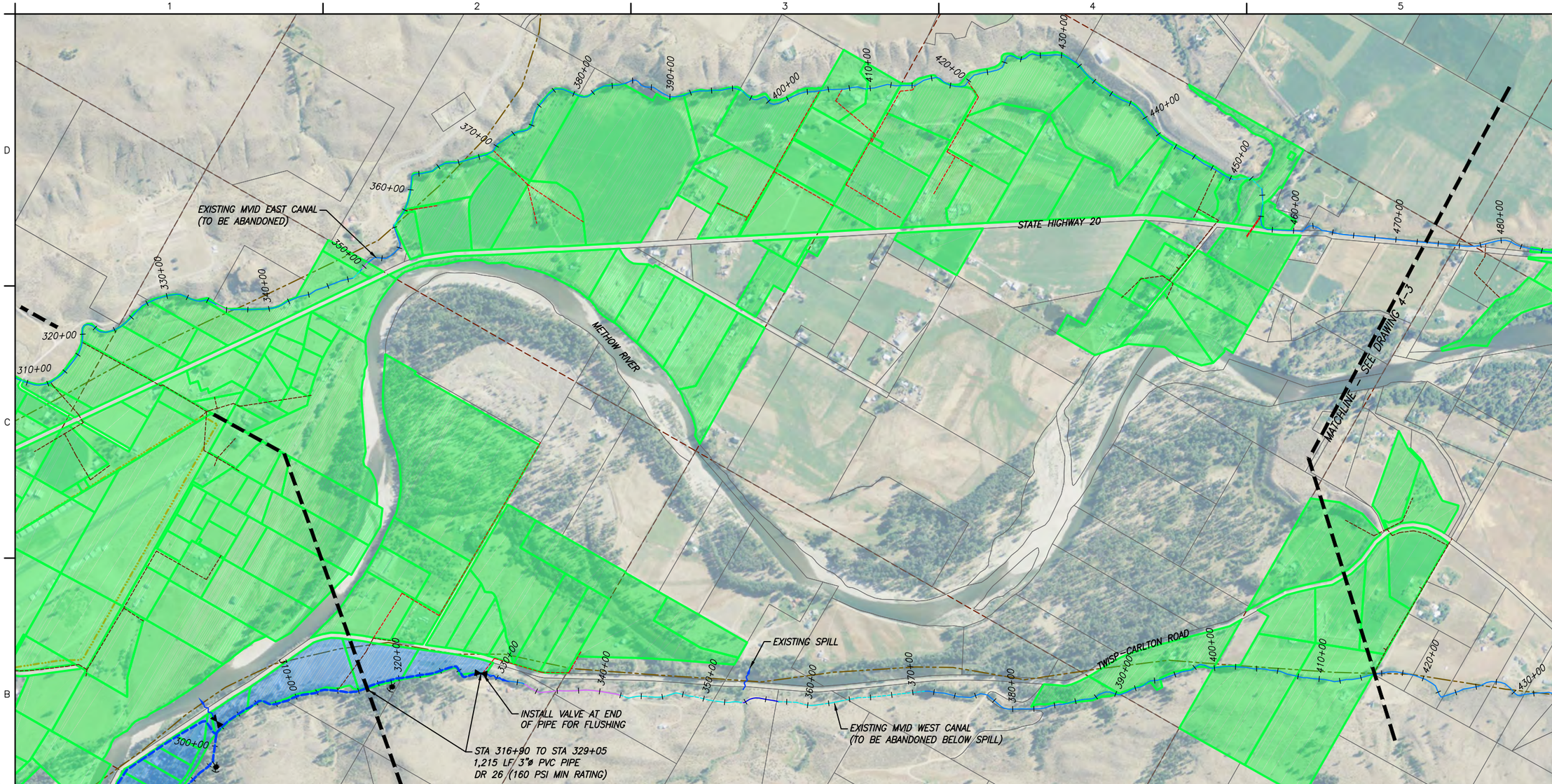
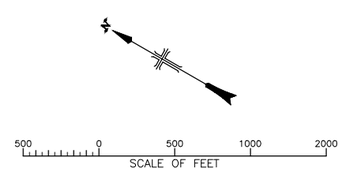
PLOTTED BY
Not Plotted





LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
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- MVID PARCELS
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- SECTION LINE
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NOTES:

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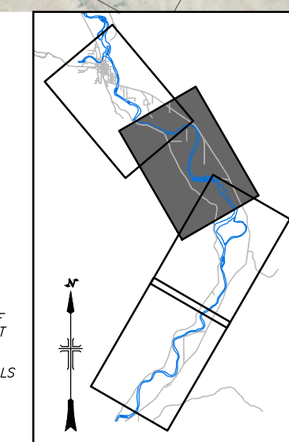
2. VERTICAL DATUM: NAVD 88



SHEET INDEX MAP

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE METHOW RIVER VALLEY
COLDWATER RIVER RECOVERY FOUNDATION

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 4

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME – TITLE
APPROVED _ ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 4
CONCEPT PLAN

DRAWING 4–2

SHEET 2 OF 5

DRAWING 4-2
DATE AND TIME PLOTTED
Not Plotted
PLOTTED BY
Not Plotted

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CAD FILENAME
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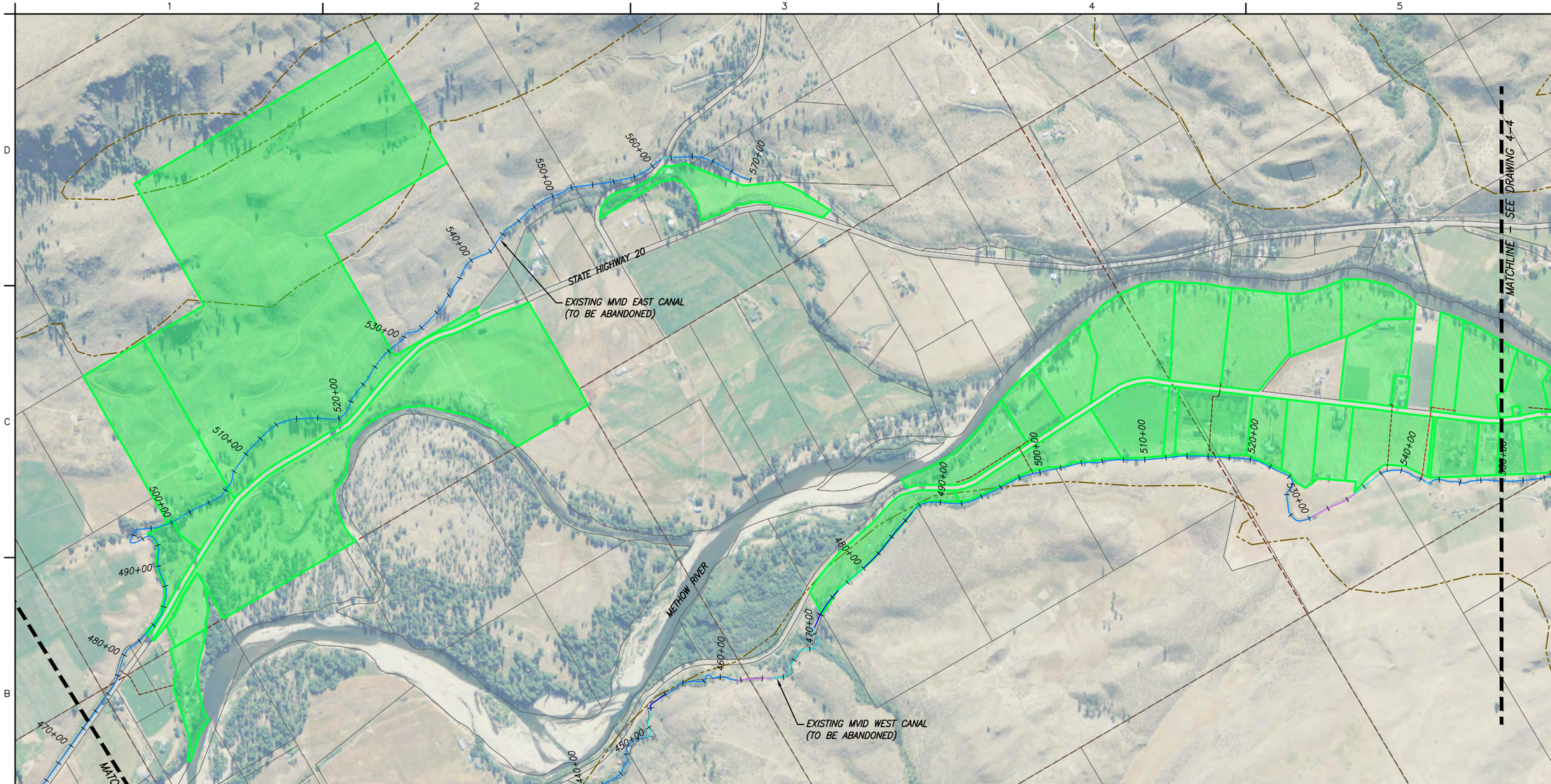

500 0 500 1000 2000
SCALE OF FEET

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
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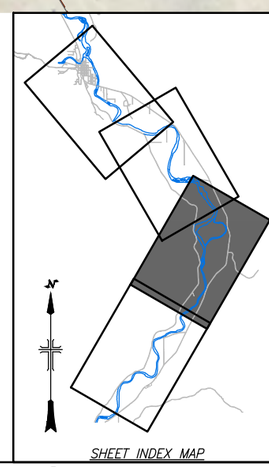

SHEET INDEX MAP

RECLAMATION
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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 4

REV. NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME – TITLE
APPROVED _ ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 4 CONCEPT PLAN

DRAWING 4–3

SHEET 3 OF 5

Jul 17, 2013 12:06pm drice
CAD SYSTEM
CAD STD
CAD FILENAME
UNKNOWN

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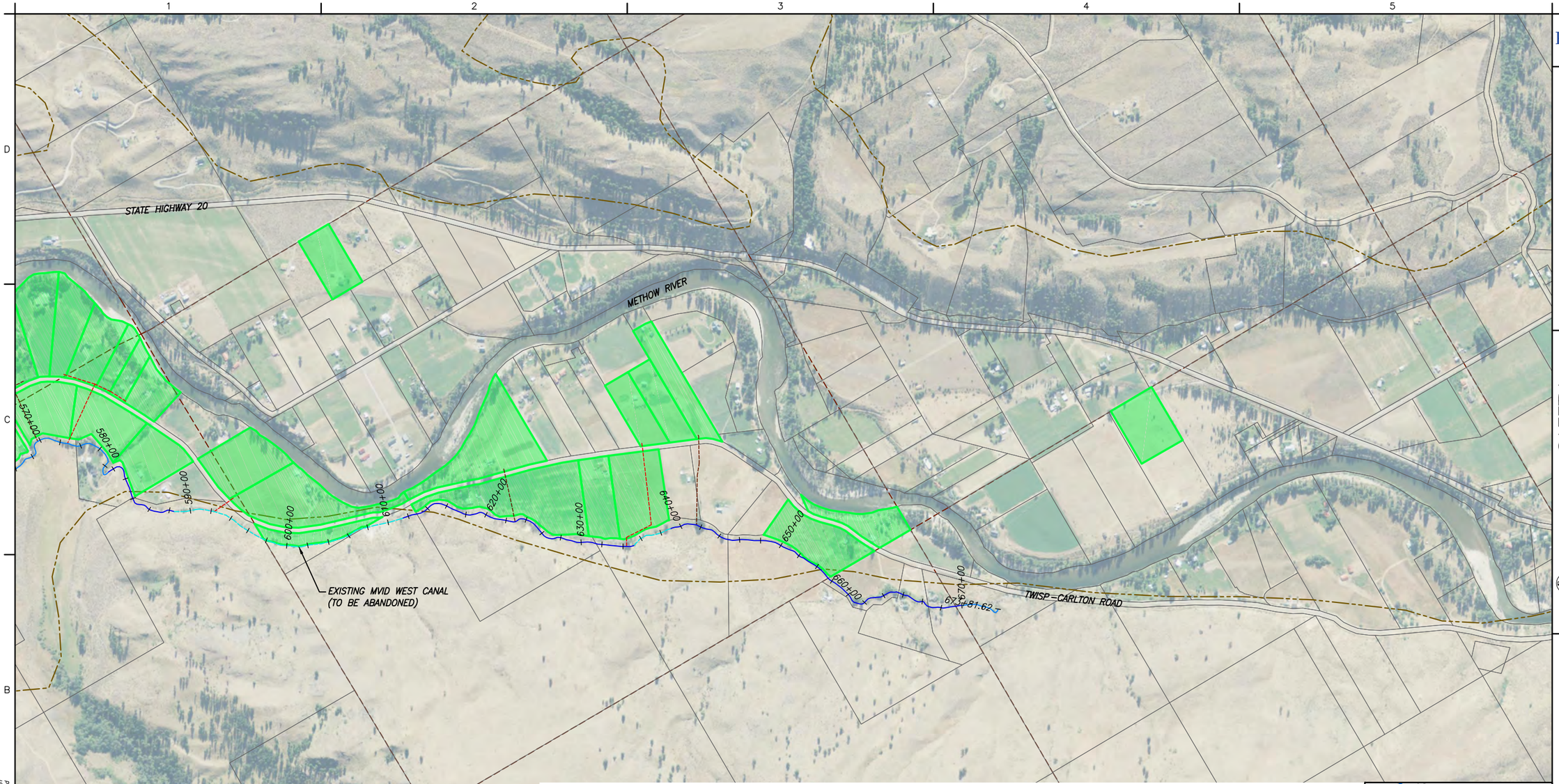
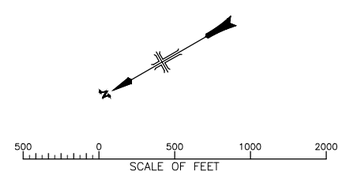
DATE AND TIME PLOTTED
Wed, Feb 06, 2013
PLOTTED BY
Not Plotted





LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
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NOTES:

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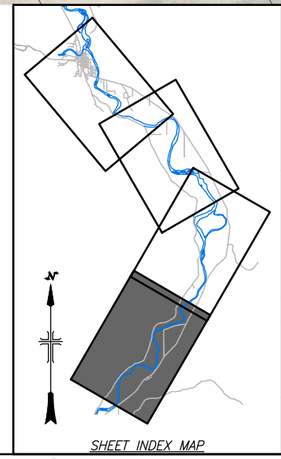

SHEET INDEX MAP

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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 4

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME – TITLE
APPROVED _ ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 4
CONCEPT PLAN

DRAWING 4–4

SHEET 4 OF 5

K:\Projects\0261-US Bureau of Reclamation\MVID Alternatives\0261-PL-004-Alt4.dwg DRAWING 4-4
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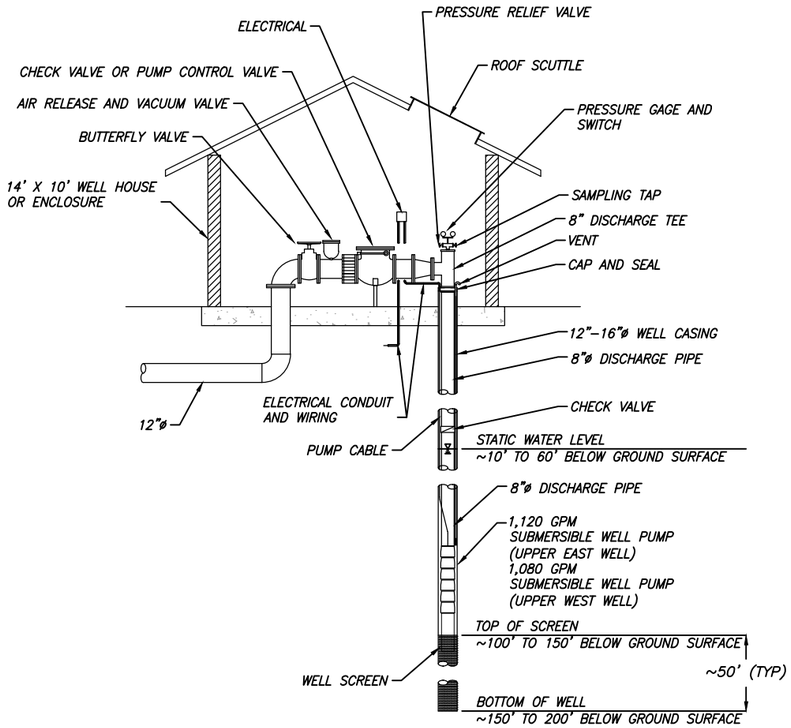
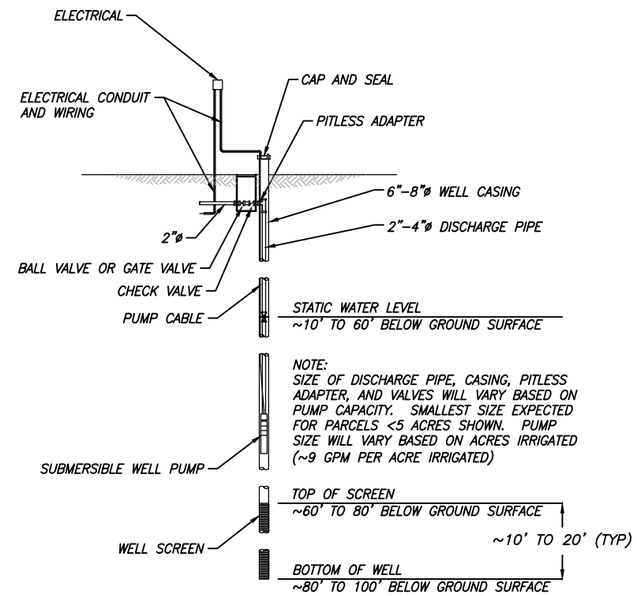


TYPICAL PRODUCTION WELL CONCEPT – UPPER WEST SYSTEM



TYPICAL INDIVIDUAL WELL CONCEPT

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BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 4

REV NO

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TWISP, WA

ALTERNATIVE 4
CONCEPT PLAN

DRAWING 4–5
SHEET 5 OF 5

Jul 17, 2013 12:07pm drice
CAD SYSTEM
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DATE AND TIME PLOTTED
Not Plotted
PLOTTED BY
Not Plotted

EXISTING MVID EAST CANAL
10.94cfs
190+00
STA 193+00
EAST PIPELINE INLET STRUCTURE
(SEE DRAWING 5-6)
SPILL TO
METHOW RIVER
200+00
TWISP-WINTHROP ROAD
210+00
220+00
230+00
240+00
250+00
260+00
270+00
280+00
290+00
300+00
310+00
320+00
340+00
STA 193+00 TO STA 286+64
9,364 LF 24"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 286+64 TO STA 314+31
2,767 LF 21"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 314+31 TO STA 319+16
485 LF 21"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
TOWN OF TWISP LIMITS
EX LATERAL E1
METHOW RIVER
TWISP RIVER
POTENTIAL SITE FOR WELL
SUPPLY FOR REDUCED MVID
WEST CANAL SERVICE AREA
OR LID, 2.8 CFS
979 LF, 12"ø
244 LF, 6"ø
727 LF, 6"ø
677 LF, 12"ø
1,279 LF, 6"ø
524 LF, 3"ø
2 LATERAL E2
545 LF, 3"ø
1,665 LF, 12"ø
330 LF, 3"ø
700 LF, 6"ø
695 LF, 6"ø
451 LF, 10"ø
1,350 LF, 12"ø
1,010 LF, 6"ø
1,044 LF, 10"ø
299 LF, 6"ø
5 LATERAL E5
4 LATERAL E4
620 LF, 10"ø
808 LF, 6"ø
673 LF, 10"ø
220 LF, 6"ø
714 LF, 4"ø
3 LATERAL W3
599 LF, 3"ø
1 LATERAL W1A & W1B
575 LF, 4"ø
447 LF, 3"ø
243 LF, 4"ø
1,236 LF, 6"ø
1,481 LF, 12"ø
678 LF, 12"ø
LATERAL W2 2
278 LF, 3"ø
960 LF, 6"ø
1,439 LF, 4"ø
TWISP-CARLTON ROAD
95 LF, 12"ø
277 LF, 12"ø
TANK
132,100 GALLONS 30' DIAM
X 25' TALL, HWL=1,804'
TANK INLET/OUTLET
200 LF 8"ø PVC PIPE DR 51
(80 PSI MIN RATING)
126 LF, 3"ø
298 LF, 4"ø
LATERAL W0
550 LF, 3"ø
0
STA 201+60 TO STA 226+30
2,470 LF 10"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 195+94 TO STA 201+60
566 LF 8"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 226+30 TO STA 262+60
3,630 LF 10"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 262+60 TO STA 290+00
2,740 LF 8"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
STA 301+06 TO STA 316+90
1,584 LF 6"ø PVC PIPE
DR 26 (160 PSI MIN RATING)
STA 262+60 TO STA 301+06
1,106 LF 8"ø PVC PIPE
DR 26 (160 PSI MIN RATING)
STA 161+00 TO STA 195+94
3,494 LF 8"ø PVC PIPE
DR 51 (80 PSI MIN RATING)
MATCHLINE - SEE DRAWING 5-2

N
500 0 500 1000 2000
SCALE OF FEET

PIPE MATERIALS FOR LATERALS:

0 LATERAL W0: DR 41 (100 PSI MIN RATING) PVC
1 LATERALS W1A AND W1B: DR 51 (80 PSI MIN RATING) PVC
2 LATERAL W2: DR 26 (160 PSI MIN RATING) PVC
3 LATERAL W3: DR 51 (80 PSI MIN RATING) PVC
2 LATERAL E2: DR 51 (80 PSI MIN RATING) PVC
4 LATERAL E4: DR 51 (80 PSI MIN RATING) PVC
5 LATERAL E5: DR 51 (80 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
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NOTES:

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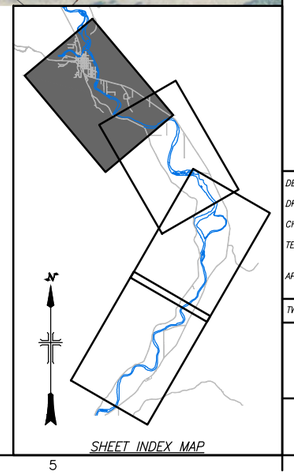

SHEET INDEX MAP

RECLAMATION
Managing Water in the West

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ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 5

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME - TITLE
APPROVED ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 5
CONCEPT PLAN

DRAWING 5-1

SHEET 1 OF 5

DRAWING 5-1
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PLOTTED BY
Not Plotted
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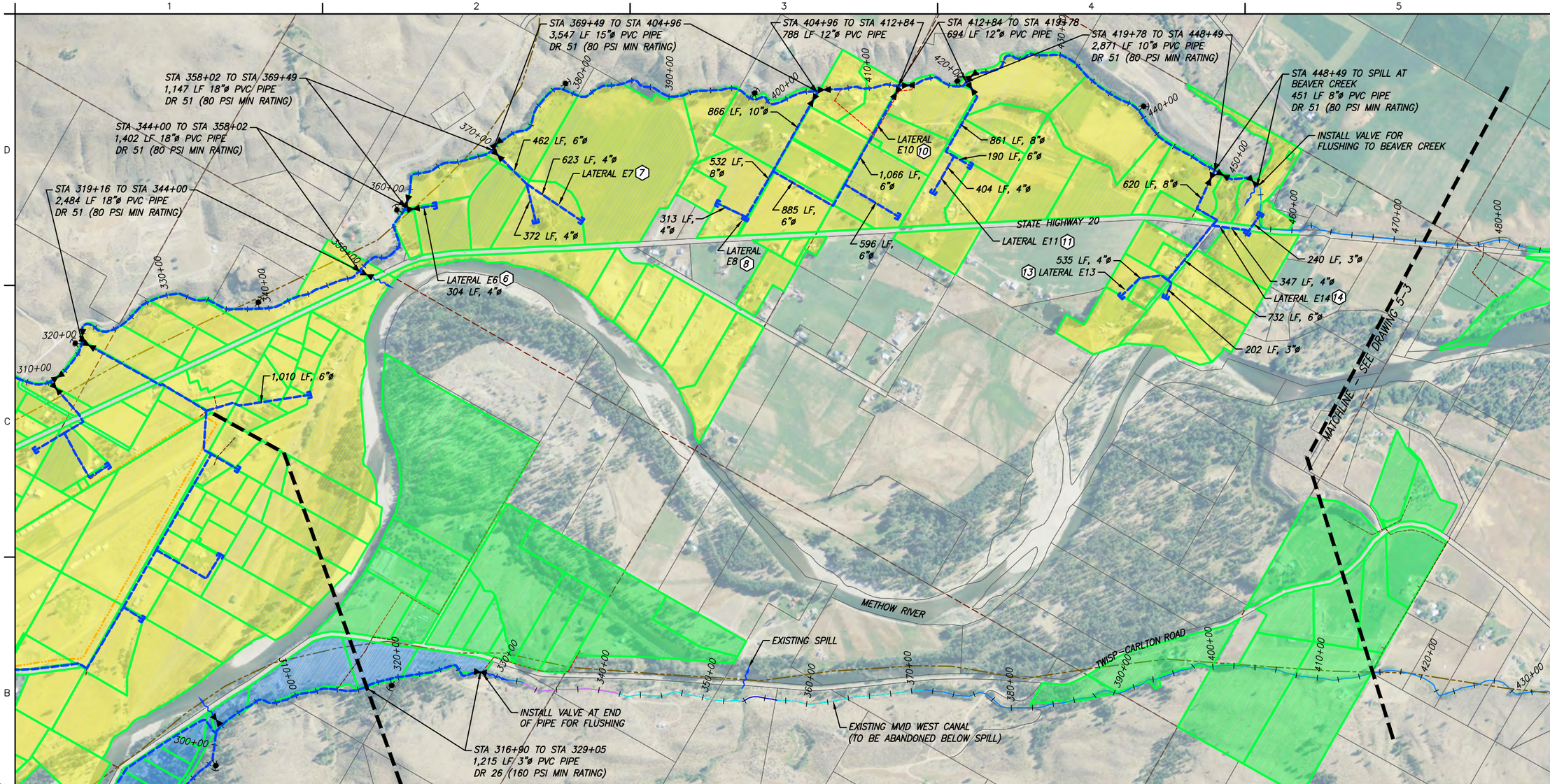

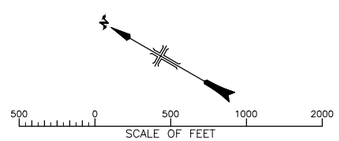

PIPE MATERIALS FOR LATERALS:

- (6) LATERAL E6: DR 51 (80 PSI MIN RATING) PVC
- (7) LATERAL E7: DR 51 (80 PSI MIN RATING) PVC
- (8) LATERAL E8: DR 41 (100 PSI MIN RATING) PVC
- (10) LATERAL E10: DR 41 (100 PSI MIN RATING) PVC
- (11) LATERAL E11: DR 41 (100 PSI MIN RATING) PVC
- (13) LATERAL E13: DR 41 (100 PSI MIN RATING) PVC
- (14) LATERAL E14: DR 41 (100 PSI MIN RATING) PVC

LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE-LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
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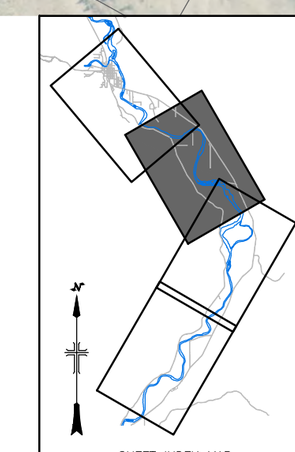

RECLAMATION
Managing Water in the West

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U.S. DEPARTMENT OF THE INTERIOR
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COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 5

REV

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

ALTERNATIVE 5
CONCEPT PLAN

DRAWING 5-2

SHEET 2 OF 5

DRAWING 5-2
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DATE AND TIME PLOTTED
Jul 17, 2013 12:08pm drice
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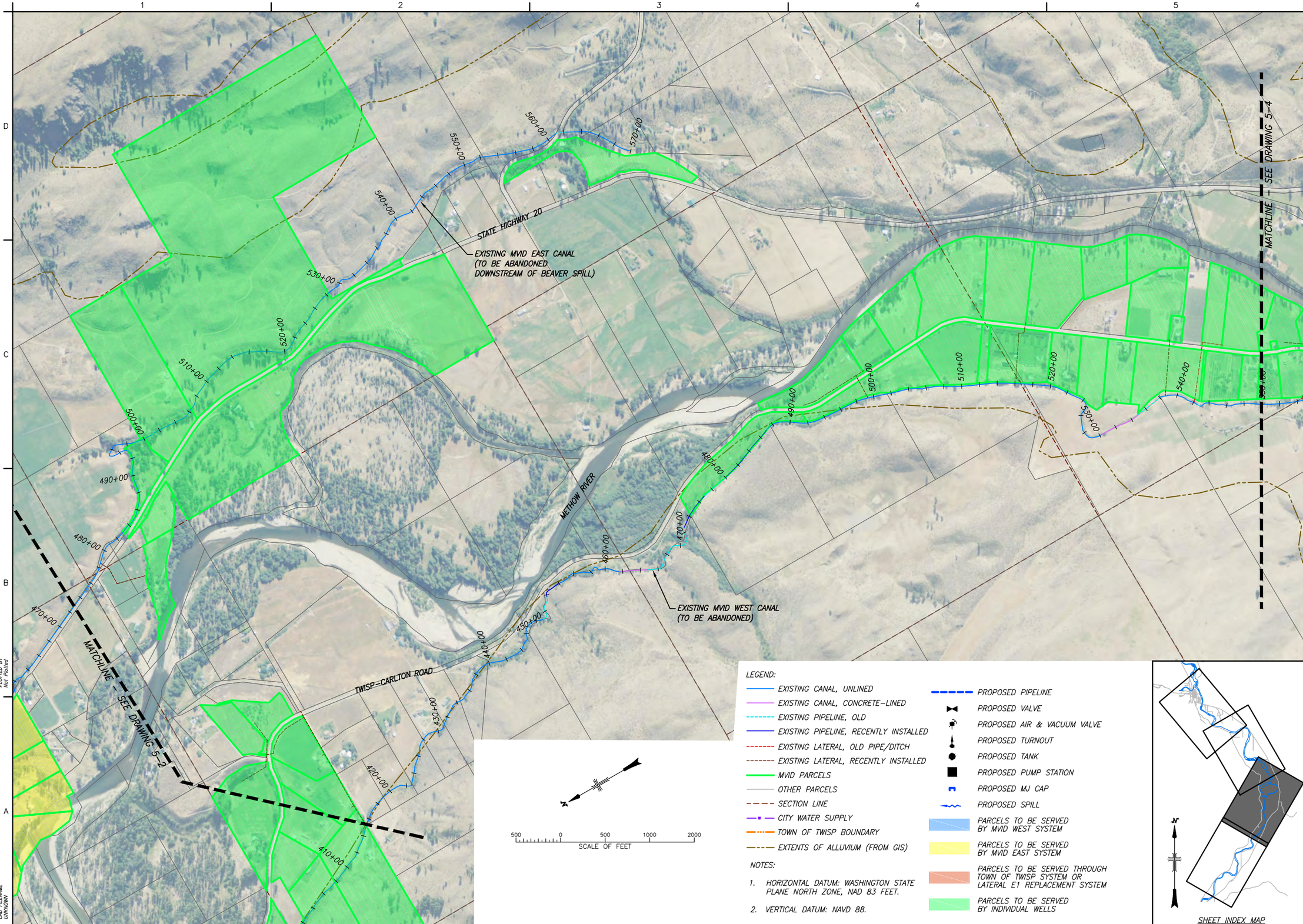
PLOTTED BY
Not Plotted



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ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 5

REV NO

DESIGNED _ D. RICE
DRAWN _ T. GRIGA
CHECKED _ R. MONTGOMERY
TECH. APPR. _ NAME - TITLE
APPROVED _ ADMINISTRATIVE APPROVAL - NAME - TITLE

TWISP, WA

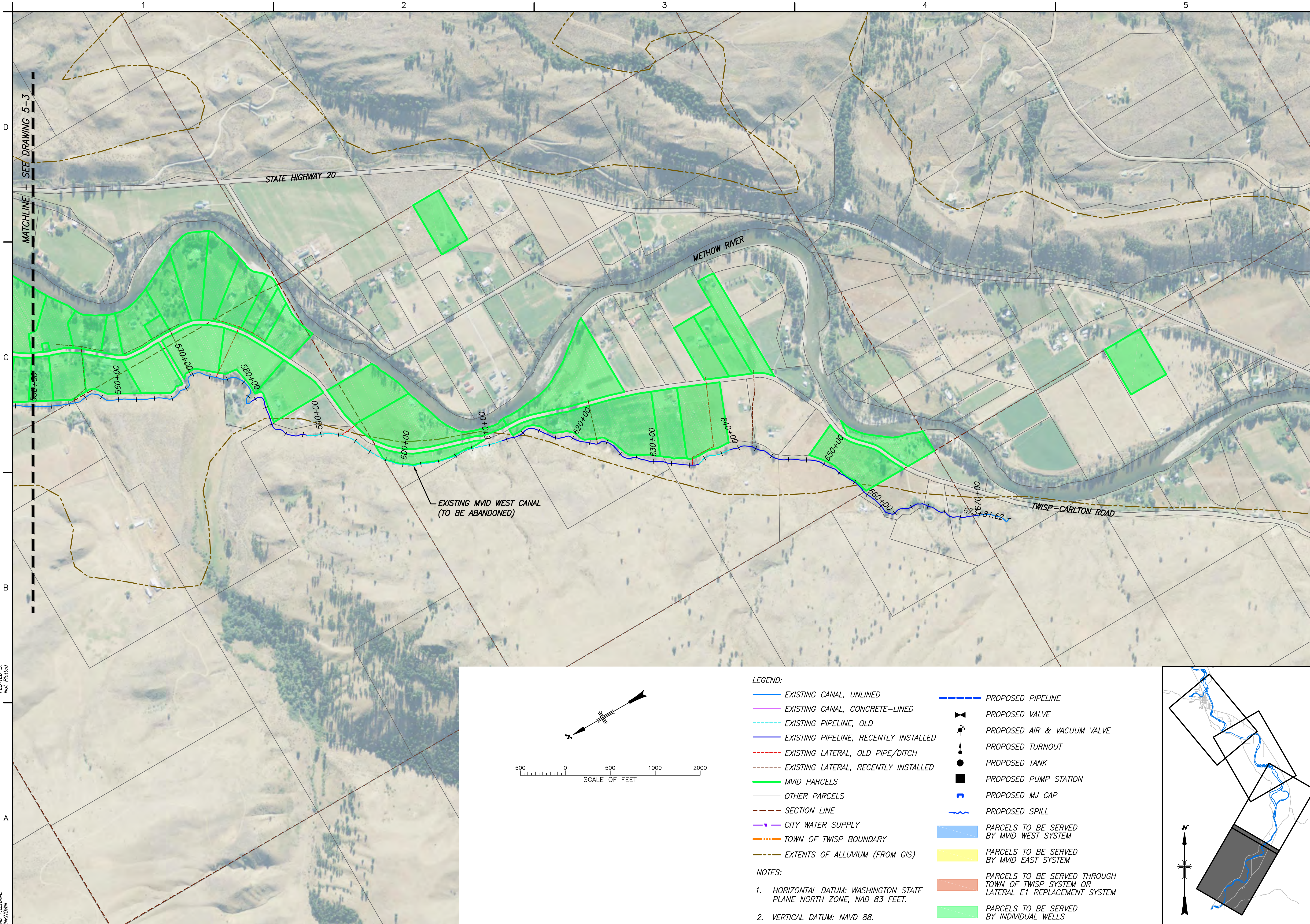
ALTERNATIVE 5
CONCEPT PLAN

DRAWING 5-3

SHEET 3 OF 5

Jul 17, 2013 12:08pm drice
CAD SYSTEM
CAD STD
CAD FILENAME
UNKNOWN

K:\Projects\0261-US Bureau of Reclamation\MVID Alternatives\0261-PL-005-AI15.dwg DRAWING 5-3
DATE AND TIME PLOTTED
Wed, Feb 06, 2013
PLOTTED BY
Not Plotted



LEGEND:

- EXISTING CANAL, UNLINED
- EXISTING CANAL, CONCRETE–LINED
- EXISTING PIPELINE, OLD
- EXISTING PIPELINE, RECENTLY INSTALLED
- EXISTING LATERAL, OLD PIPE/DITCH
- EXISTING LATERAL, RECENTLY INSTALLED
- MVID PARCELS
- OTHER PARCELS
- SECTION LINE
- CITY WATER SUPPLY
- TOWN OF TWISP BOUNDARY
- EXTENTS OF ALLUVIUM (FROM GIS)
- PROPOSED PIPELINE
- PROPOSED VALVE
- PROPOSED AIR & VACUUM VALVE
- PROPOSED TURNOUT
- PROPOSED TANK
- PROPOSED PUMP STATION
- PROPOSED MJ CAP
- PROPOSED SPILL
- PARCELS TO BE SERVED BY MVID WEST SYSTEM
- PARCELS TO BE SERVED BY MVID EAST SYSTEM
- PARCELS TO BE SERVED THROUGH TOWN OF TWISP SYSTEM OR LATERAL E1 REPLACEMENT SYSTEM
- PARCELS TO BE SERVED BY INDIVIDUAL WELLS

NOTES:

1. HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 83 FEET.
2. VERTICAL DATUM: NAVD 88.

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 5

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 5 CONCEPT PLAN

DRAWING 5–4

SHEET 4 OF 5

Jul 17, 2013 12:08pm drice
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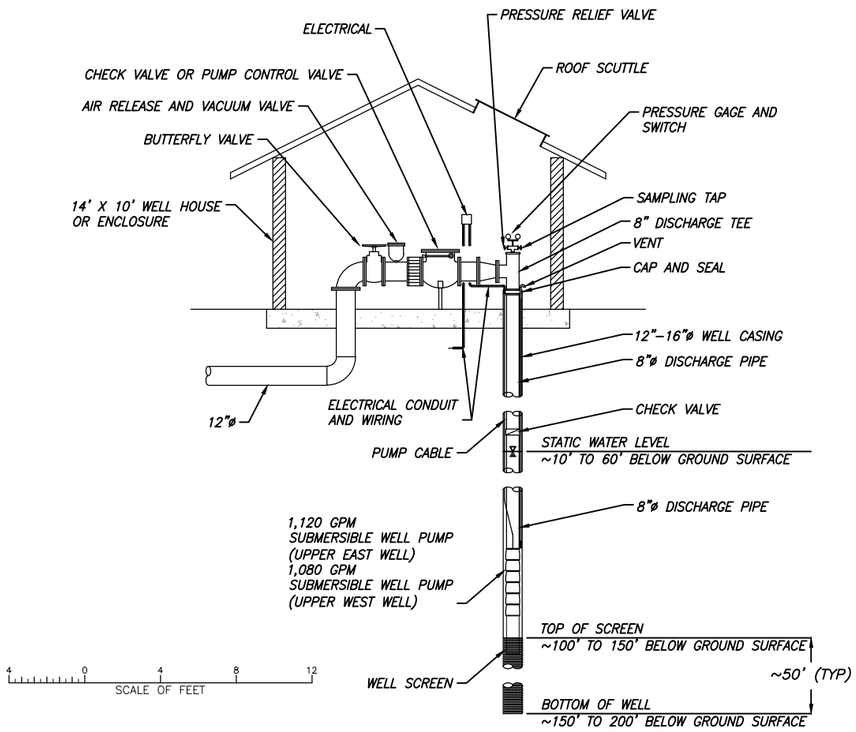
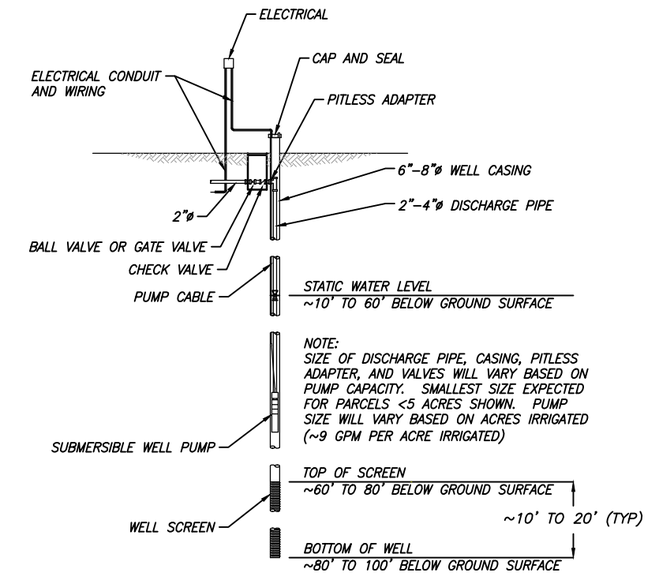
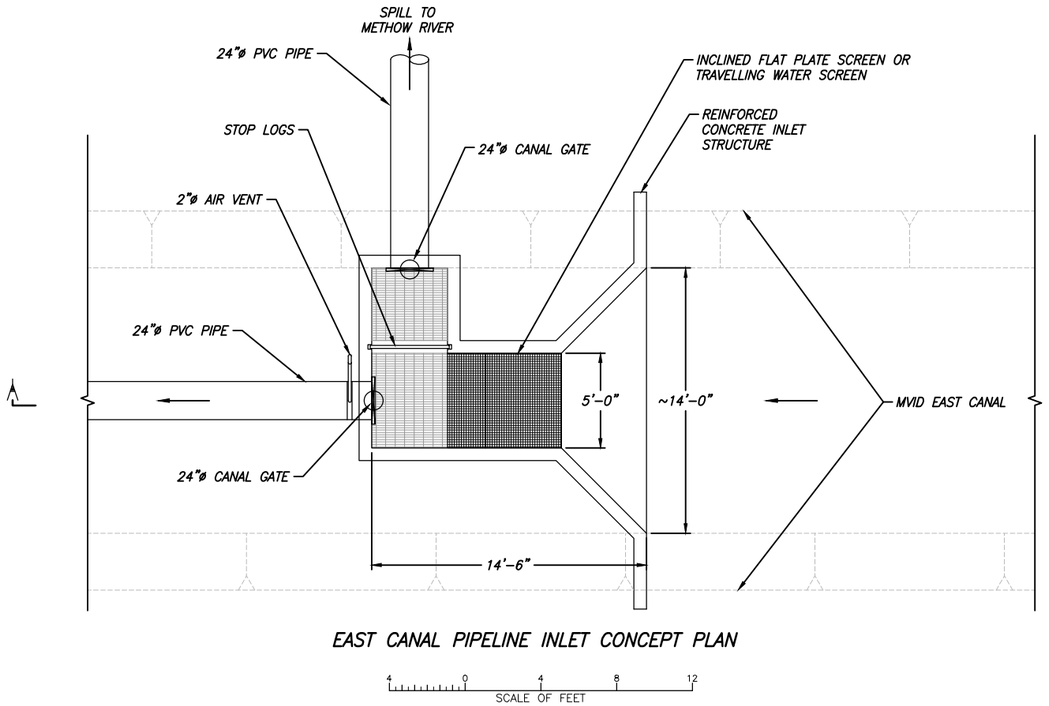
CAD SYSTEM CIVIL 3D
CAD FILENAME UNKNOWN
DATE AND TIME PLOTTED Not Plotted
PLOTTED BY Not Plotted



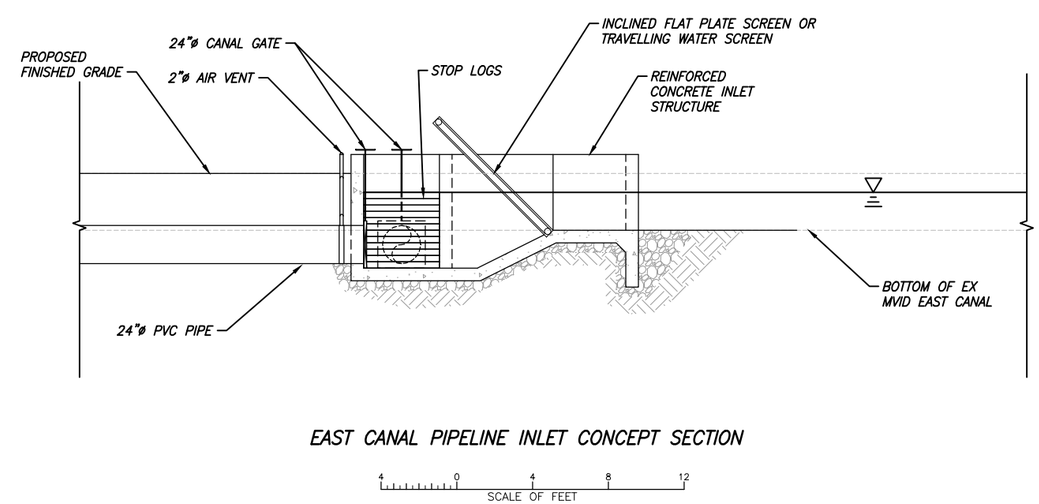
TYPICAL PRODUCTION WELL CONCEPT – UPPER WEST SYSTEM



TYPICAL INDIVIDUAL WELL CONCEPT



EAST CANAL PIPELINE INLET CONCEPT PLAN



EAST CANAL PIPELINE INLET CONCEPT SECTION

RECLAMATION
Managing Water in the West

NOT FOR CONSTRUCTION

ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA SNAKE RIVER SALMON RECOVERY FOUNDATION
METHOW RIVER VALLEY

MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE 5

REV NO

DESIGNED D. RICE
DRAWN T. GRIGA
CHECKED R. MONTGOMERY
TECH. APPR. NAME – TITLE
APPROVED ADMINISTRATIVE APPROVAL – NAME – TITLE

TWISP, WA

ALTERNATIVE 5
CONCEPT PLAN

DRAWING 5–5

SHEET 5 OF 5

Jul 17, 2013 12:10pm drice
CAD SYSTEM
CAD FILE
CAD FILENAME
UNKNOWN

K:\Projects\0261-US Bureau of Reclamation\MVID Alternatives\0261-PL-005-Al05.dwg DRAWING 5-5
DATE AND TIME PLOTTED
Not Plotted
PLOTTED BY
Not Plotted

APPENDIX B
WELL LOGS – 2013 TEST WELLS

2013 Test Well 1

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☒ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 90 ft. Depth of completed well 90 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +1.75 ft. to 79 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 19 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 1572 ft.

Static level 10 ft. below top of well Date 01-16-13

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 2 gal./min. with stem set at 78 ft. for _____ hrs.

Artesian flow _____ g.p.m. Date 01-16-13

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE 15684

Unique Ecology Well ID Tag No. BHT 570

Water Right Permit No. _____

Property Owner Name Methow Valley Irrigation District / Trout Unlimited

Well Street Address _____ Twisp-Carlton Rd. 7.7m

City Twisp County Okanogan

Location SW 1/4-1/4 NE 1/4 Sec 28 Twn 33 R 22 EWM ☒ Or WWM ☐
(s, t, r Still REQUIRED)

Lat/Long Lat Deg N 48 Lat Min/Sec 20.171
Long Deg W 120 Long Min/Sec 05.248

Tax Parcel No. (Required) 5101010001

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown sandy loam	0	5
Brown clay, round gravel, cobbles WB	5	19
Red silt, round gravel	19	25
Black sand, gravels	25	28
Lt. brown clay, gravels	28	36
Black / Dk. brown silt, gravel	36	47
Coarse - fine sand, gravel	47	53
Big gravel WB	53	62
Big gravel, sand WB	62	79
Black granite rock	79	90
Needs to be screened @ 63-79' with .40 slot screen or perferated for 500+ gpm.		

Start Date 01-15-13 Completed Date 01-16-13

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Brett Phythian

Driller/Engineer/Trainee Signature

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company Tumwater Drilling & Pump Inc.

Address P.O.Box 777 9290 Hwy 2

City, State, Zip Leavenworth , WA, 98826

Contractor's Registration No. TUWADP011LZ Date 01-21-2013

ECY 050-1-20 (Rev 02/10) *If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.*

2013 Test Well 2

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☒ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 2

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 178 ft.
Depth of completed well 168 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +1 3/4 ft. to 143 ft.
☐ Liner installed ____" Diam. from ____ ft. to ____ ft.
☐ Threaded ____" Diam. From ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 140-141'

Manufacturer's Name Alloy Machine ***

Type Stainless Model No. _____

Diam. 7 Slot size .40 from 143 ft. to 148 ft.

Diam. 7 Slot size .35 from 148 ft. to 159 ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 1527 ft.

Static level 66.5 ft. below top of well Date 01-23-13

Artesian pressure ____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest 500+ gal./min. with stem set at 140 ft. for 5 hrs.

Artesian flow ____ g.p.m. Date 01-23-13

Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE 15687

Unique Ecology Well ID Tag No. BHT 569

Water Right Permit No. _____

Property Owner Name Methow Valley Irrigation District - Trout Unlimited

Well Street Address 3.85 miles ip Twisp - Carlton Rd.

City Twisp County Okanogan

Location SW 1/4-1/4 NW 1/4 Sec 10 Twn 32 R 22 EWM ☒ Or WWM ☐
(s, t, r Still REQUIRED)

Lat/Long Lat Deg N 48 Lat Min/Sec 17.590
Long Deg W 120 Long Min/Sec 04.528

Tax Parcel No. (Required) 5130290006

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown sandy loam	0	3
Rocks, gravel, sand	3	6
Cemented cobbles, gravel,		
clay	6	17
Loose gravel	17	26
Brown silty fine sand	26	31
Cemented gravel	31	65
Gravels, sand, cobbles WB	65	90
Black / dk. brown silty grave	90	103
Heaving gravel, sands WB	103	129
Cemented gravels	129	133
Loose gravels, sand WB	133	169
Brown silty, fine sand, rocks	169	178
***Screen Info:		
7' screen .30 slot from		
159-164'		
Top @ 142' 2" from t.o.c.		
Bottom @ 167' 10" from t.o.c.		

Start Date 01-16-13 Completed Date 01-23-13

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Brett Phythian

Driller/Engineer/Trainee Signature

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No.

Driller's Signature:

Drilling Company Tumwater Drilling & Pump Inc.

Address P.O.Box 777 9290 Hwy 2

City, State, Zip Leavenworth , WA, 98826

Contractor's Registration No. TUWADP011LZ Date 01-30-2013

2013 Test Well 3

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☒ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 160 ft.
Depth of completed well 160 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +1 1/2 ft. to 136.5 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 133-134'

Manufacturer's Name Alloy Machine

Type Stainless *** Model No. _____

Diam. 7 Slot size .30 from 137 ft. to 142 ft.

Diam. 7 Slot size .35 from 142 ft. to 153 ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 22 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 1540 ft.

Static level 10 ft. below top of well Date 01-30-13

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 500+ gal./min. with stem set at 135 ft. for 5 hrs.

Artesian flow _____ g.p.m. Date 01-30-13

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE 15718

Unique Ecology Well ID Tag No. BHT 571

Water Right Permit No. _____

Property Owner Name Methow Valley Irrigation District - Janet Eileen

Well Street Address 786 Twisp-Carton Rd.

City Twisp County Okanogan

Location NW 1/4-1/4 NE 1/4 Sec 28 Twn 33 R 22 EWM ☒ Or WWM ☐
(s, t, r Still REQUIRED)

Lat/Long Lat Deg N 48 Lat Min/Sec 20.126
Long Deg W 120 Long Min/Sec 05.2107

Tax Parcel No. (Required) 4270000200

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown sand	0	1
Loose gravel, cobbles	1	6
Brown sand, gravels WB	6	22
Gravels, sands WB	22	43
Gravels, brown sand	43	109.5
Cobbles	109.5	111
Gravel, brown sand WB	111	114
Heaving sand, gravel	114	134
Sand, gravel WB	134	136
Rocks, gravel, sand WB	136	160
SCREEN INFO:		
7" screen .40 slot from		
153-158'		
Top of screen @ 135' 5" t.o.c		
Bottom @ 161' 1" t.o.c.		

Start Date 01-23-13 Completed Date 01-30-13

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Brett Phythian

Driller/Engineer/Trainee Signature

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No.

Driller's Signature:

Drilling Company Tumwater Drilling & Pump Inc.

Address P.O.Box 777 9290 Hwy 2

City, State, Zip Leavenworth , WA, 98826

Contractor's Registration No. TUWADP011LZ Date 01-30-2013

APPENDIX C
WELL LOGS FOR NEARBY WELLS

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.
Permit No. 24-29728P

(1) OWNER: Name Archie Effert Address Box 776 Twisp, WN

(2) LOCATION OF WELL: County Okanogan — NE¼ SW¼ Sec. 11 T. 33 N., R. 24 E. W.M.

...ing and distance from section or subdivision corner Tracts #18 Orchards Ranch

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 300 ft. Depth of completed well 300 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +1 ft. to 172 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☒ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations .60 in. by 12 in.
18 perforations from 167 ft. to 172 ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type ... Model No.
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☒ No ☐ To what depth? 18+ ft.
Material used in seal Puddling Clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ... Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: ... H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 135 ft. below top of well Date
Artesian pressure ... lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

...te of test
... test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Red Clay	0	2
Sand Gravel Boulders	2	60
Tan Clay	60	85
Gravel - clay	85	160
Black slate	160	172
Gray & Black shale	172	300
5-10 GPM		

RECEIVED
NOV 14 1977
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 10-6 19 77 Completed 10-11 19 77

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Akin Drilling and Dev. Inc. (Person, firm, or corporation) (Type or print)
Address Box 1499 CDA Idaho
[Signed] Thean D Lewis (Well Driller)
License No. 718 Date 10-11, 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

No. 7356—OS—(Rev. 4-71)
70-28

Well Log 11-1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ...
Permit No. ...

(1) OWNER: Name Al Flagg Address Box 181 Twisp, Wash. 98856

(2) LOCATION OF WELL: County Okanogan — SE ¼ SE ¼ Sec. 16 T. 33 N., R. 22 W.M.

Bearing and distance from section or subdivision corner Lot #2 Ray Walsh Property E of Hiway 20

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ...
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 74 ft. Depth of completed well 74 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from -0- ft. to 74 ft.
Threaded ☐ " Diam. from ... ft. to ... ft.
Welded ☑ " Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☑
Type of perforator used ...
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☑
Manufacturer's Name ...
Type ... Model No. ...
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: ...
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☑ No ☐ To what depth? 16 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? ... Depth of strata ...
Method of sealing strata off ...

(7) PUMP: Manufacturer's Name ...
Type: ... H.P. ...

(8) WATER LEVELS: Land-surface elevation above mean sea level 1725 ft.
Static level 51 ft. below top of well Date 6-8-76
Artesian pressure ... lbs. per square inch Date ...
Artesian water is controlled by ... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? ...
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ...
Bailer test 15 gal./min. with 4 ft. drawdown after 1 hrs.
Artesian flow ... g.p.m. Date 6-8-76
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Overburden	-0-	4'
Sand Gravel + boulders	4'	12'
Sand + Gravel - some clay	12'	14'
" " boulders	14'	17
Hard, Packed Sand-Gravel + Drift. Water	18'	50'
Soft Sand + Drift	51	59
Clean Sand + Gravel 50-50	60	70
Gravel + Sand 75-25	71	74

RECEIVED
JUL 1 1976
DEPARTMENT OF ECOLOGY
CENTRAL

Work started 6-4, 1976 Completed 6-8, 1976

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME McStotts Well Drilling (Person, firm, or corporation) (Type or print)
Address Box 321 Winthrop, Wash. 98862
[Signed] Richard D. McStotts (Well Driller)
License No. 304 Date 6-30, 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)
ECY-070-28

Well Log 16-2

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49954
UNIQUE WELL I.D. # ACX 721
Water Right Permit No. _____

(1) OWNER: Name John & Lauri Losinski Address PO Box 607 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan SW 1/4 SE 1/4 Sec 16 T. 33 N., R 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 20321 HWY 20 #B Twisp WA 98856

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (If more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 82 feet. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 6" Diam. from +2 ft. to 76 ft.
Welded [X] Liner installed [ ] Threaded [ ]
" Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [X] No [ ]
Manufacturer's Name Cook
Type telescopic-Platinum series Model No.
Diam. 5" Slot size .025 from 75 ft. to 80 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 53 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 78 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Silty sand	0	10
Sand; cobbles	10	30
Sand, silty; tight clay-like	30	65
Sand, some gravel	65	82

Drilled w/NUMEX under-reaming system
5.5" Drive Shoe @ 76'
5.5" Bore Hole to 80'

Work Started 10/5/99, 19. Completed 10/8/99, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 10/9/99, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 16-6

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49956
UNIQUE WELL I.D. # ACX723
Water Right Permit No.

(1) OWNER: Name Kreider-Mathisen Address PO Box 264 Carlton WA 98814

(2) LOCATION OF WELL: County Okanogan SE 1/4 SW 1/4 Sec 16 T. 33 N., R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) #8 Star Dust Drive Twiswp WA 98856

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (If more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 82 feet. Depth of completed well 82 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +2 ft. to 20 ft.
Welded [X] 4" Diam. from 10 ft. to 82 ft.
Liner installed [X]
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [X] No [ ]
Manufacturer's Name Monoflex
Type PVC Model No. S40 FT
Diam. 4" Slot size .020 from 60 ft. to 70 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 5 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 78 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand; silt; gravel	0	5
Sand; gravel; boulders	5	40
Topsoil?, brown; gravel	40	45
Hard pan like material, beige	45	50
Coarse sand, small gravel	50	70
Fine sand	70	82

Drilled w/NUMEX under-reaming system

5.5" Drive Shoe @ 20'

Work Started 10/7/99 19. Completed 10/10/99 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 10/10/99 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 16-8

ECY 050-1-20 (9/93) * * 1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 369758

(x) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W232545

Unique Ecology Well ID Tag No. Ban 801

Water Right Permit No. _____

Property Owner Name Matt Micheals

Well Street Address Hwy 20

City Twisp County Ok

Location NW 1/4-1/4 SW 1/4 Sec 16 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: (x) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
(x) New well ( ) Reconditioned *Method:* ( ) Dug (x) Bored ( ) Driven ( ) Deepened ( ) Cable (x) Rotary ( ) Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 137 ft.
Depth of completed well 137 ft.

CONSTRUCTION DETAILS
Casing Installed: (x) Welded 8" Diam. from 0 ft. to 137 ft.
( ) Liner installed _____" Diam. from _____ ft. to _____ ft.
( ) Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ( ) Yes (x) No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ( ) Yes (x) No ( ) K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam _____ Slot size _____ from _____ ft to _____ ft.

Gravel/Filter packed: ( ) Yes (x) No ( ) Size of gravel/sand _____
Materials placed from _____ ft to _____ ft.

Surface Seal: (x) Yes ( ) No To what depth? 19 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ( ) Yes (x) No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 60 ft. below top of well Date 10-1-07
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ( ) Yes (x) No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 20 gal./min. with stem set at 135 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ( ) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Overburden	0	4
grayish clay	4	19
sand + gravel	19	27
sand	27	85
sand + gravel	85	96
gravel	96	115
rocks	115	137

RECEIVED
APR 06 2010
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

RECEIVED
APR 01 2010
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 10-1-07 Completed Date 10-2-07

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

(x) Driller ( ) Engineer ( ) Trainee Name (Print) R Byron
Driller/Engineer/Trainee Signature R Byron
Driller or trainee License No. 721

Drilling Company Whistle well drilling
Address 74 ross rd
City, State, Zip Twisp Wa 98856
Contractor's Registration No. WHSTWD920DS Date 10-1-07

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

Well Log 16-10

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 369763

(x) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. ~~[illegible]~~ W232540

Unique Ecology Well ID Tag No. [redacted] Ban805

Water Right Permit No. _____

Property Owner Name Matt Michels

Well Street Address Hwy 20

City Twisp County Ok

Location NW 1/4-1/4 SW 1/4 Sec 16 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: (x) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

(x) New well ( ) Reconditioned ( ) Deepened

Method: ( ) Dug ( ) Bored ( ) Driven ( ) Cable (x) Rotary ( ) Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 90 ft.

Depth of completed well 90 ft.

CONSTRUCTION DETAILS

Casing Installed: (x) Welded 6" Diam. from Ø ft. to 90 ft.

( ) Liner installed _____" Diam. from _____ ft. to _____ ft.

( ) Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ( ) Yes (x) No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ( ) Yes (x) No ( ) K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ( ) Yes (x) No ( ) Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: (x) Yes ( ) No To what depth? 18 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ( ) Yes (x) No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 60 ft. below top of well Date 10-2-07

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ( ) Yes (x) No If yes, by whom? _____

Yield: 20 gal./min. with 0 ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 20 gal./min. with stem set at 85 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ( ) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	4
gravel & clay	4	19
Sand & gravel	19	25
Sand	25	80
Sand & gravel	80	90

RECEIVED APR 01 2010 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 10-2-07 Completed Date 10-3-07

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

(x) Driller ( ) Engineer ( ) Trainee Name (Print) R. Brum

Driller/Engineer/Trainee Signature [signature]

Driller or trainee License No. 761

Drilling Company Whistles Well Drilling

Address 74 rosi rd

City, State, Zip Twisp Wa 98856

Contractor's Registration No. Whis192OdS Date 10-3-07

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

Well Log 16-11

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)* 369617

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W232507

Unique Ecology Well ID Tag No. ALE 388

Water Right Permit No. _____

Property Owner Name Paul Christen

Well Street Address _____

City Twisp County OK

Location SE 1/4-1/4 SW 1/4 Sec 16 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 68500300009

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 77 ft.
Depth of completed well 77 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 77 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 63 ft. below top of well Date 3-27-06
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 30 gal./min. with stem set at 75 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	7
sand	7	11
clay	11	19
clay + gravel	19	27
sand + gravel	27	36
gravel	36	55
rocks	57	77

RECEIVED
APR 01 2010
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 3-27-06 Completed Date 3-27-06

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Richard Bynum
Driller/Engineer/Trainee Signature [signature]
Driller or trainee License No. 781

Drilling Company Whistle's Well Drilling
Address 74 rose rd
City, State, Zip twisp wa 98856
Contractor's Registration No. WHISTLE920DS Date 3/27/06

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

Well Log 16-17

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. /

Permit No.

(1) OWNER: Name R D Schaier Address Box 441 Twisp Wa 98856

(2) LOCATION OF WELL: County Okanogan — ¼ ¼ Sec. 26 T. 33 N., R. 22 W.M.

Bearing and distance from section or subdivision corner Lot 3 Ray Walsh Short Plat

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 93 ft. Depth of completed well 93 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 93 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Puddling clay
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 1800 ft.
Static level 55 ft. below top of well Date 3/22/78
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Top Soil	0	6
gravel (large)	6	22
sand + gravel	22	34
Boulders & gravel	34	42
sand + gravel	42	56
quick sand	56	87
Coarse sand	87	88
Coarse sand + clay	88	93

RECEIVED
MAR 28 1978
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started, 19 Completed 3/22, 19 78

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Glessner Well drilling (Person, firm, or corporation) (Type or print)

Address 142 S. Texas E. Wenatchee

[Signed] Wesley Glessner (Well Driller)

License No. 0154 Date 3/22, 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well Log 16-18

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name R.D. Shrier Address Twisp, Wn. 98856

(2) LOCATION OF WELL: County Okanogan SE ¼ SE ¼ Sec. 16 T. 33 N., R. 22 W.M.
ng and distance from section or subdivision corner Lot #3 Roy Walsh Property E of Hiway 20

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 123 ft. Depth of completed well 123 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from -0- ft. to 120 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☑ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☑
Type of perforator used .....
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☑ No ☐
Manufacturer's Name Johnson
Type Stainless Model No.
Diam. 6 Slot size 30 from 120 ft. to 123 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☑ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☑ No ☐ To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 1700 ft.
Static level 61 ft. below top of well Date Oct 26-76
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 5 gal./min. with 10 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date 10-26-76
Temperature of water Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
overburden	-0-	12'
Boulders	12'	14'
Sand Gravel Clay	14'	20'
Hard Hard Pan	20'	30'
Sand Gravel Drift	30'	67'
Water boulders	67'	70'
Coarse Sand	79'	87'
Wet Clay Mud	87'	119'
Clean Coarse Sand	119	123

RECEIVED
OCT 1 1976
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 10-19, 1976. Completed 10-26, 1976

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME McStotts Well Drilling (Person, firm, or corporation) (Type or print)

Address Box 321 Winthrop, Wn. 98862

[Signed] Richard D. McStotts (Well Driller)

License No. 304 Date 10-29, 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)
ECY-070-28

Well Log 16-19

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name R. D. Schrier Address Twisp, Wash. 98856

(2) LOCATION OF WELL: County Okanogan — SE ¼ SE ¼ Sec. 16 T. 33 N., R. 22 W.M.

Bearing and distance from section or subdivision corner LOT #2 Ray Walsh Property E of Hiway 20

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .....
New well ☐ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☑ Driven ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 137 ft. Depth of completed well 137 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from -0- ft. to 102 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☑ " Diam. from ft. to ft.

Perforations: Yes ☑ No ☐
Type of perforator used Mills Knife
SIZE of perforations 1¼" in. by 3/16 in.
2 perforations from 80 ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☑
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☑ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☑ No ☐ To what depth? 16' ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Sandy Depth of strata 15'
Method of sealing strata off Drove Pipe into Rock

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 1725 ft.
Static level 52 ft. below top of well Date 7-2-76
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 1½ gal./min. with 10 ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date 7-2-76
Temperature of water Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Overburden	-0-	4'
Hard Pan + Boulders	4'	12'
Sand + Gravel	12'	14'
" " boulders	14'	20'
" " + Drift	20'	50'
Water + Drift	50'	85'
Fine Gray Sand	85'	98'
Fractured Basalt	98'	102'
Solid Basalt	102'	137'

RECEIVED
JUL 1[illegible] 1976
DEPARTMENT OF ECOLOGY
[illegible] OFFICE

Work started 6-9, 19 76 Completed 7-2, 19 76

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME McStotts Well Drilling (Person, firm, or corporation) (Type or print)
Address Box 321 Winthrop Wash 98862
[Signed] Richard D. McStotts (Well Driller)
License No. 304 Date 7-9, 19 76

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)
ECY-070 28

Well Log 16-20

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- (X) Construction
- ( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* 154585

PROPOSED USE (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other

TYPE OF WORK Owner's number of well (if more than one) 4
(X) New Well ( ) Reconditioned Method ( ) Dug ( ) Bored ( ) Driven ( ) Deepened RLB (X) Cable (X) Rotary ( ) Jetted

DIMENSIONS Diameter of well 6 inches drilled 245 ft
Depth of completed well 245 ft

CONSTRUCTION DETAILS
Casing Installed (X) Welded 6 Diam from 0 ft to 45 ft
(X) Liner installed 4 Diam from 40 ft to 245 ft
( ) Threaded Diam from ft to ft

Perforations (X) Yes ( ) No
Type of perforator used SAW
SIZE of perfs 3 in by 1/16 in and no of perfs 80 from 140 ft to 245 ft

Screens ( ) Yes (X) No ( ) K Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ( ) Yes (X) No ( ) Size of gravel/sand
Materials placed from ft to ft

Surface Seal (X) Yes ( ) No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ( ) Yes (X) No
Type of water? Depth of strata
Method of sealing strata off

PUMP Manufacturer's Name
Type H P

WATER LEVELS Land surface elevation above mean sea level ft
Static level 60 ft below top of well Date Aug 31
Artesian pressure lbs per square inch Date
Artesian water is controlled by (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ( ) Yes (X) No If yes by whom?
Yield gal/min with ft drawdown after hrs
Yield gal/min with ft drawdown after hrs
Yield gal/min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal/min with ft drawdown after hrs
Airtest 257 gal/min with stem set at 245 ft for 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ( ) Yes (X) No

CURRENT Notice of Intent No 171562
Unique Ecology Well ID Tag No AKL 839
Water Right Permit No
Property Owner Name SEALEAI CORP H
Well Street Address 1/2 mi S of Twisp East of Hwy 20
City TWISP County OKANOGAN
Location SE 1/4 1/4 NE 1/4 Sec 16 Twn 33 R 22 EWM or WWM circle one
Lat/Long (s,t,r still REQUIRED) Lat Deg Lat Min/Sec
Long Deg Long Min/Sec
Tax Parcel No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	3
Brown clay	3	30
Gray clay	30	42
Red Rock	42	45
Gray Rock	45	56
Brown fractured	56	58
Rock	58	80
Gray Rock with	80	
fractures		245

DEPT OF ECOLOGY Received SEP 0 8 2004 CENTRAL REGION OFFICE

Start Date 8-30-04 Completed Date 8-31-04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

(X) Driller ( ) Engineer ( ) Trainee Name (Print) Rich Bynum
Driller/Engineer/Trainee Signature
Driller or Trainee License No 0781
If trainee, licensed driller s Signature and License no

Drilling Company Methow Valley Drilling
Address P.O Box 68
City State Zip Twisp Wash 98856
Contractor's Registration No METHOVVI Date Aug 31-04

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 16-22

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* 154589

CURRENT Notice of Intent No W 171562

Unique Ecology Well ID Tag No AKL 829

Water Right Permit No

Property Owner Name SEAREAL CORP

Well Street Address 1/2 mi S. of TWISP East of HWY 20

City TWISP County OKANOGAN

Location SW 1/4 1/4 SE 1/4 Sec 16 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (str still REQUIRED) Lat Deg Lat Min/Sec Long Deg Long Min/Sec

Tax Parcel No

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK Owner s number of well (if more than one) 3
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled ~~[illegible]~~ ft 120
Depth of completed well 105 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 6 Diam from 0 ft to 90 ft
☒ Liner installed 5 Diam from 85 ft to 105 ft
☐ Threaded Diam from ft to ft

Perforations ☒ Yes ☐ No
Type of perforator used Roller & saw
SIZE of perfs 1/16 in by 1 in and no of perfs 40 from 85 ft to 105 ft

Screens ☐ Yes ☒ No ☐ K Pac Location
Manufacturer s Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Materials placed from ft to ft

Surface Seal ☒ Yes ☐ No To what depth? 28 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

PUMP Manufacturer s Name
Type H P

WATER LEVELS Land surface elevation above mean sea level ft
Static level 25 ft below top of well Date Aug 29
Artesian pressure lbs per square inch Date
Artesian water is controlled by (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 10 gal /min with stem set at 100 ft for 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	5
gravel	5	20
gray fill	20	35
brown silt	35	78
brown silty gravel	78	89
Bed Rock loose conglomerate	85	120

DEPT OF ECOLOGY Received SEP 08 2004 CENTRAL REGION OFFICE

Start Date Aug 28 Completed Date Aug 30/04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum
Driller/Engineer/Trainee Signature
Driller or Trainee License No 0781

Drilling Company Methow Valley Drilling
Address PO Box 68
City State Zip Twisp Wash 98856
Contractor s Registration No METHOVA12KE Date Aug 30-04

If trainee, licensed driller s Signature and License no

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

Well Log 16-23

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 418932

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W 301331
Unique Ecology Well ID Tag No. BBT 981
Water Right Permit No. _____
Property Owner Name Wilfred Byram
Well Street Address 17 Airport Rd
City Twisp County Okanogan
Location SW 1/4-1/4 SW 1/4 Sec 16 Twn 33 R 22 ~~EWM~~ or WWM (circle one)
Lat/Long (s, t, r Still **REQUIRED**) Lat Deg. _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No. 3322170169

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 44 ft.
Depth of completed well 44 ft.

CONSTRUCTION DETAILS
Casing Installed: ☐ Welded 6" Diam. from 0 ft. to 44 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 21 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level).

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 20 gal./min. with stem set at 40 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	2
gravel	2	8
sand	8	14
sandy clay	14	24
sand	24	38
sand & gravel	38	44

RECEIVED
JUN 29 2011
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

RECEIVED
JUL 14 2011
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date MAY 19 Completed Date 5-20-2011

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R Bynum
Driller/Engineer/Trainee Signature _____
Driller or trainee License No. 781

Drilling Company Whistles Well Drilling
Address 74 Ross Rd.
City, State, Zip Twisp Wash
Contractor's Registration No. WHISTWD920D5 Date MAY 20, 2011

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 16-07

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with
Department of Ecology
Second Copy Owners Copy
Third Copy Driller's Copy

133356

WATER WELL REPORT
STATE OF WASHINGTON

Notice of Intent W 160059
UNIQUE WELL I D # AGL 913
Water Right Permit No

(1) OWNER Name ABE PETERSON (ADRIAN) Address 2700 IRVINESS DR LK HAVASU CITY AZ 86404

(2) LOCATION OF WELL County OKANOGAN SW 1/4 S E 1/4 Sec 17 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL (or nearest address) KINGFISHER DR TWISP WA 98856

TAX PARCEL NO 8852300020

(3) PROPOSED USE
- [x] Domestic
- [ ] Industrial
- [ ] Municipal
- [ ] Irrigation
- [ ] Test Well
- [ ] Other
- [ ] DeWater

(4) TYPE OF WORK
Owners number of well (if more than one)
- [x] New Well
- [ ] Deepened
- [ ] Reconditioned
- [ ] Decommission

Method
- [ ] Dug
- [x] Cable
- [ ] Rotary
- [ ] Bored
- [ ] Driven
- [ ] Jetted

(5) DIMENSIONS Diameter of well 6" inches
Drilled 40FT feet. Depth of completed well 40FT ft

(6) CONSTRUCTION DETAILS
Casing Installed
- [x] Welded 6" to 43 ft " Diam from +1 ft to 40FT ft
- [ ] Liner installed Diam from ft to ft
- [ ] Threaded Diam from ft to ft

Perforations [ ] Yes [x] No
Type of perforator used
SIZE of perforations in by in
Perforations from ft to ft

Screens [ ] Yes [x] No [ ] K Pac Location
Manufacturer s Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed [ ] Yes [x] No [ ] Size of gravel/sand
Material placed from ft to ft

Surface seal [x] Yes [ ] No To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [x] No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturers Name GRUNDFOS
Type Submersible H P 1/2

(8) WATER LEVELS Land-surface elevation above mean sea level 1600 ft
Static level 17 ft below top of well Date 5-21-2003
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap valve etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [x] No If yes by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 20 gal /min with N/A 0 ft drawdown after 1 hrs
Airtest gal /min with ft drawdown after hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? [ ] Yes [x] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
SAND GRAVEL BOULDERS	1	12
Tight silty sand, clays boulders	12	25
Clay sand, boulders	25	31
SAND GRAVEL BOULDERS	31	40FT

DEPT OF ECOLOGY Received MAY 29 2003 CENTRAL REGION OFFICE

Work Started 4 , 03 Completed 5 , 03

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name STEPHEN KREIDER License No 1492
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company COUNTRY TOWN DRILLING
(Signed) License No 1492
(Licensed Driller/Engineer)
Address PO Box 279 Carlton WA 98814

Contractor s Registration No COUNTTD131QW Date 5/23/03

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs contact the Water Resources Program at (360) 407

ECY 050-1 20 (11/98)

Well Log 17-1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission ("x" in circle) 346110

○ Construction

⊗ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* N/A

CURRENT Notice of Intent No. A133800

Unique Ecology Well ID Tag No. _____

Water Right Permit No. _____

Property Owner Name Aero Methow Rescue Service

Well Street Address 1005 HWY 20

City Twisp County Okanogan

Location NW 1/4-1/4 SE 1/4 Sec 17 Twn 33 R 22 ~~EWM~~ or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 3322170268

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☐ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 30" inches, drilled _____ ft.

Depth of completed well 12' ft.

CONSTRUCTION DETAILS

Casing Installed: ☐ Welded _____" Diam. from _____ ft. to _____ ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☐ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☐ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☐ Yes ☐ No To what depth? _____ ft.

Material used in seal _____

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level _____ ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
30" well, 12' Deep		
was ABANDONED by		
Adding 1/2 ton of		
Bentonite and		
cement pulling		
6' of Rings		
telegraphing 20		
SACKS of bentonite		
and Adding 5 yds		
of chlorided		
mush rock		

RECEIVED JUL 21 2009 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 7-2-09 Completed Date SAME

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) R. Dyum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 782

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City, State, Zip Twisp Wash 98856

Contractor's Registration No. WHISTLW092005 Date 7-2-09

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

File Original with Department of Ecology 97075
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W122602
UNIQUE WELL I D # 17FH565
Water Right Permit No _____

(1) OWNER Name Chuck Casey Address PO Box Twisp WA 98856

(2) LOCATION OF WELL County Okan SE 1/4 NW 1/4 Sec 17 T 33 N R 22 WM
(2a) STREET ADDRESS OF WELL (or nearest address) Bridge St. Twisp WA 98856
TAX PARCEL NO _____

'00 OCT 13 P1:
DEPT OF ECOLOGY FISCAL BUDGET

(3) PROPOSED USE [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK Owner's number of well (if more than one) _____
[X] New Well [ ] Deepened [ ] Reconditioned [ ] Decommission
Method [ ] Dug [ ] Cable [X] Rotary [ ] Bored [ ] Driven [ ] Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 40 feet Depth of completed well 40 ft

(6) CONSTRUCTION DETAILS
Casing Installed
[X] Welded 6" Diam from 0 ft to 40 ft
[ ] Liner installed _____" Diam from _____ ft to _____ ft
[ ] Threaded _____" Diam from _____ ft to _____ ft

Perforations [ ] Yes [X] No
Type of perforator used _____
SIZE of perforations _____ in by _____ in
_____ perforations from _____ ft to _____ ft

Screens [ ] Yes [X] No [ ] K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed [ ] Yes [X] No [ ] Size of gravel/sand _____
Material placed from _____ ft to _____ ft

Surface seal [X] Yes [ ] No To what depth? 19 ft
Material used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP Manufacturer's Name _____
Type _____ H P _____

(8) WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 10 ft below top of well Date 9-16-00
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____
(Cap, valve etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 100 gal /min with _____ ft drawdown after 2 hrs
Artesian flow _____ g p m Date 9-16-00
Temperature of water _____ Was a chemical analysis made? [ ] Yes [ ] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Over burden	0	3
Coarse Gravel	3	7
Coarse Sand	7	19
Coarse Gravel	19	40

RECEIVED
OCT 16 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 9-16-00 Completed 9-16-00

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Steve Konrad License No 1764
(Licensed Driller/Engineer)

Trainee Name _____ License No _____
Drilling Company Methow Valley Drilling
(Signed) [signature] License No 1764
(Licensed Driller/Engineer)
Address PO Box 68 Twisp WA 98856
Contractor's Registration No Methowdrlg Date 9-16-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Well Log 17-10

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

104347

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle)
- ○ Construction
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

Received DEC 03 2001 REGION OFFICE

CURRENT Notice of Intent No. W122612 ✓

Unique Ecology Well ID Tag No. AFM909

Water Right Permit No. _____

Property Owner Name Jerry Haleman

Well Street Address Burton St Twisp

City Twisp County: Okan

Location SW 1/4 - 1/4 SE 1/4 Sec 17 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft
Depth of completed well _____ ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from 0 ft to 40 ft
☐ Liner installed _____" Diam. from _____ ft to _____ ft.
☐ Threaded _____" Diam. from _____ ft to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in and no. of perfs _____ from _____ ft to _____ ft

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 20 ft below top of well Date Oct 18-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min with _____ ft. drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs
Airtest 40 gal./min with stem set at 38 ft for 2 hrs
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	1
Gravel	1	10
Silty Clay	10	24
Gravel	24	31
Sandy Gravel	31	40

Start Date 10-28-01 Completed Date 10-28-01

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Steve Kenead

Driller/Engineer/Trainee Signature [signature]

Driller or Trainee License No. 1764

Drilling Company Methow Valley Drilling

Address PO Box 68

City, State, Zip Twisp WA 98856

Contractor's Registration No. Methodiskr Date 10-29-01

If trainee, licensed driller's Signature and License no. _____

Well Log 17-18

Ecology is an Equal Opportunity Employer. ECY 050-1-20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

W
Start Card No. 047437
UNIQUE WELL I.D. # ABK535
Water Right Permit No. _____

(1) OWNER: Name Jim & Robin Madison Address PO Box 1160 Twisp WA 98856

(2) LOCATION OF WELL: County Okan SE 1/4 SW 1/4 Sec 17 T. 33 N., R. 22 W.M. P

(2a) STREET ADDRESS OF WELL (or nearest address) 1mi South of Twisp on West County Road

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 40 ft.
Welded [ ] _____" Diam. from _____ ft. to _____ ft.
Liner installed [ ] _____" Diam. from _____ ft. to _____ ft.
Threaded [ ] _____" Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 19 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 20 ft. below top of well Date 9-26-95
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

"	"	"	"
"	"	"	"

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 50 gal./min. with stem set at 38 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date 9-26-95
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
overburden	0	4
Gravel	4	10
Sand Gravel	10	21
Fine Sand	21	28
Course Sand & Gravel	28	40

OCT 17 1995

Work Started 9-26, 1995 Completed 9-26, 1995

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 68 Twisp WA 98856
(Signed) [signature] (WELL DRILLER) License No. 1764
Contractor's Registration No. METHOVD121CR Date 9-26, 1995

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

ECY 050-1-20 (9/93)

Well Log 17-19

File Original with Department of Ecology
Second Copy - Owners Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W113853
UNIQUE WELL I.D. # AEG 260
Water Right Permit No.

(1) OWNER: Name Jim Schelinski Address P.O. Box 267 Twisp Wash

(2) LOCATION OF WELL: County Okanogan NW 1/4 NW 1/4 Sec 17 T 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address)

TAX PARCEL NO.:

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
[X] New Well [ ] Deepened [ ] Reconditioned [ ] Decommission
Method: [ ] Dug [ ] Cable [X] Rotary [ ] Bored [ ] Driven [ ] Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 80 feet. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
[ ] Welded 6" Diam. from 0 ft. to 80 ft.
[ ] Liner installed " Diam. from ft. to ft.
[ ] Threaded " Diam. from ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: [ ] Yes [ ] No [ ] Size of gravel/sand
Material placed from ft. to ft.

Surface seal: [X] Yes [ ] No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 55 ft. below top of well Date 4-20-00
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? [ ] Yes [X] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
overburden	0	3
gravel	3	8
gray clay	8	24
sand	24	61
coarse sand & gravel	61	80

RECEIVED
MAY 17 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 4-20 Completed same

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Rich Bynum License No. 0781
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Methow Valley Drilling
(Signed) License No. 0781
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp Wash
Contractor's Registration No. METHOVDI121CR Date 4-22-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action Employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WellLog17.pdf

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

93174

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 129715
UNIQUE WELL I D # IFH 559
Water Right Permit No _____

(1) OWNER: Name Marcia Liebl Address PO Box 68 Twisp WA 98856

(2) LOCATION OF WELL. County Okan SW 1/4 NW 1/4 Sec 17 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL. (or nearest address) 301 Alder ST Twisp WA 98856

TAX PARCEL NO _____

'00 SEP 18 P1 47

DEPT OF ECOLOGY FISCAL MGMT

(3) PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one) _____
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 40 feet Depth of completed well 40 ft

(6) CONSTRUCTION DETAILS
Casing installed.
☒ Welded 6" Diam from 0 ft to 40 ft
☐ Liner installed _____" Diam from _____ ft to _____ ft
☐ Threaded _____" Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perforations _____ in by _____ in
_____ perforations from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Material placed from _____ ft to _____ ft

Surface seal ☒ Yes ☐ No To what depth? 19 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP Manufacturer's Name _____
Type _____ H P _____

(8) WATER LEVELS Land-surface elevation above mean sea level _____ ft
Static level 20 ft below top of well Date 9-1-00
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____
(Cap, valve, etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 75 gal./min with _____ ft drawdown after 2 hrs
Artesian flow _____ g p m Date 9-1-00
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Overburden	0	4
Coarse Gravel	4	8
Hard pan	8	12
Coarse Sand & Gravel	12	21
Coarse Gravel	21	40

RECEIVED
SEP 20 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT OF ECOLOGY
Received
SEP 25 2000

Work Started 9-1-00 Completed 9-1-00

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Steve Konrad License No 1764
(Licensed Driller/Engineer)

Trainee Name _____ License No 1764
Drilling Company Methow Valley Drilling
(Signed) Steve Konrad License No 1764
(Licensed Driller/Engineer)
Address PO Box 68 Twisp WA 98856
Contractor's Registration No Methovd 121CR Date 9-1-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action Employer For special accommodation needs contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

ECY 050-1-20 (11/98)

Well Log 17-551

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

93/75

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 129713
UNIQUE WELL I D # AFH552
Water Right Permit No

(1) OWNER Name Paul Arneson Address 515 Alder St Twisp WA 98856

(2) LOCATION OF WELL County Okan SW 1/4 NW 1/4 Sec 17 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL (or nearest address) 515 Alder Twisp WA 98856

TAX PARCEL NO

'00 SEP 18 PM 4

E

(3) PROPOSED USE. ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

DEPT OF ECOLOGY FISCAL & BUDGET

(4) TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 40 feet Depth of completed well 40 ft

(6) CONSTRUCTION DETAILS
Casing Installed
☒ Welded 6" Diam from 0 ft to 40 ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

Perforations ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft

Screens ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 19 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 20 ft below top of well Date 8-30-00
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap, valve, etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield gal./min with ft drawdown after hrs
Yield gal./min with ft drawdown after hrs
Yield gal./min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min with ft drawdown after hrs
Airtest 75 gal./min with ft drawdown after 2 hrs
Artesian flow g p m Date 8-30-00
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Overburden	0	4
Coarse Gravel	4	8
Hardpan	8	12
Coarse Sand & Gravel	12	21
Coarse Gravel	21	46

RECEIVED
SEP 20 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT OF ECOLOGY Received SEP 25 2000 CENTRAL REGION OFFICE

Work Started 8-30-00 Completed 8-30-00

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Steve Konrad License No 1764
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Methow Drilling
(Signed) License No 1764
(Licensed Driller/Engineer)
Address PO Box 68 Twisp WA 98856
Contractor's Registration No Methowd121CR Date 8-30-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs, contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

Well Log 17757

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

94477

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 118089
UNIQUE WELL I.D. # AFH 558
Water Right Permit No. _____

OWNER: Name Steve Konrad Address PO Box 53 Twisp WA 98856

(2) LOCATION OF WELL: County Okan NW 1/4 SE 1/4 Sec 17 T 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Burton-St Twisp-Town Wash 98856 K

TAX PARCEL NO.: Surface Short Plate Twisp Parcel No. 8873400100

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

'00 AUG 25 P1:46

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

DEPT OF ECOLOGY CASHMERE SECTION

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed:
☒ Welded 6" Diam. from 0 ft. to 40 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Material placed from _____ ft. to _____ ft.

Surface seal: ☒ Yes ☐ No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 10 ft. below top of well Date 7-16-00
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 150 gal./min. with _____ ft. drawdown after 2 hrs.
Artesian flow _____ g.p.m. Date 7-21-00
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Overburden	0	4
Coarse Gravel	4	10
Hard pan & Clay	10	17
Coarse Sand & Gravel	17	40

RECEIVED AUG 29 2000 DEPARTMENT OF ECOLOGY WELL DRILLING UNIT

RECEIVED AUG 31 2000 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 7-16-00 Completed 7-16-00

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Steve Konrad License No. 1764
(Licensed Driller/Engineer)

Trainee Name _____ License No. _____
Drilling Company Methow Valley Drilling
(Signed) [signature] License No. 1764
(Licensed Driller/Engineer)
Address PO Box 68 Twisp WA. 98856
Contractor's Registration No. Methowdrlck Date 7-16-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

Well Log 17-60

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49955
UNIQUE WELL I.D. # ACX 722
Water Right Permit No. _____

(1) OWNER: Name Willard Brooks Address PO Box 683 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan SW 1/4 NW 1/4 Sec 17 T. 33 N., R 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 315 4th Ave. Twisp WA 98856 E

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (If more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [X] Rotary [ ] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled _____ feet. Depth of completed well 65 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 65 ft.
Welded [X] _____ " Diam. from _____ ft. to _____ ft.
Liner installed [ ]
Threaded [ ] _____ " Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [ ] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name Grundfos
Type: 16S10-10 H.P. 1

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 42 ft. below top of well Date 10-30
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [X] No [ ] If yes, by whom? Me
Yield: 15 gal./min. with 1.5 ft. drawdown after 1 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Hard Pan	8	26
Clay & Sand	26	36
Sand; small gravel	36	58
Sand & gravel	58	60
Large gravel with sand	60	65

Work Started 10/22/99, 19. Completed 10/26/99, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 11/15/99, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 17-70

ECY 050-1-20 (9/93) * * f

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

185

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. _____

Water Right Permit No. _____

(1) OWNER: Name BOB MATTISON Address TWISP WASH

(2) LOCATION OF WELL: County [redacted] ¼ ¼ Sec 18 T 32 N., R 22 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) NEWHY STAY

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ] Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.

Drilled 162 feet. Depth of completed well 160 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 20 ft.

Welded [X] Liner installed [X] Threaded [ ] 4" Diam. from 10 ft. to 166 ft.

Perforations: Yes [X] No [ ]

Type of perforator used SKIL

SIZE of perforations _____ in. by _____ in.

2 Row perforations from 200 ft. to 265 ft.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.

Material used in seal BENTONITE

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____

Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 21 ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [ ] No [X] If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

" " " "

" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
OVERBURDEN	0	6
BROWN CLAY + GRAVEL	6	12
DECOMPOSED SHALE	12	15
GREY SHALE	15	72
DECOMPOSED SHALE	72	74
GREY SHALE	74	140
GREY SHALE	140	178
DECOMPOSED SHALE	178	179
GREY SHALE	179	252
DECOMPOSED SHALE	252	255
GREY SHALE	255	262
APPROX 20-25 GPM		

Work started 6/24, 1988 Completed 6/26, 1988

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accepted responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME MATTHEW WALLE DRILLING (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address BOX 68 TWISP WASH

(Signed) Darrell Porter (WELL DRILLER) License No. 0726

Contractor's Registration No. _____ Date 6/25, 1988

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

Well Log 18-5

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

98104

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission *("x" in circle)*
- [x] Construction
- [ ] Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W118098

Unique Ecology Well ID Tag No AFH581

Water Right Permit No _____

Property Owner Name Bob Hunt

Well Street Address Elbow Cyn

City Twisp County Okan

Location NE 1/4- 1/4 SE 1/4 Sec 20 Twn 33 R 22 EWM (circle one) WWM

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec J

Tax Parcel No _____

PROPOSED USE: [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) 1
[x] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [x] Rotary [ ] Jetted

DIMENSIONS Diameter of well 6 inches, drilled 100 ft.
Depth of completed well 100 ft

CONSTRUCTION DETAILS
Casing Installed: [x] Welded 6" Diam from 0 ft to 20 ft
[x] Liner installed 4" Diam from 10 ft to 100 ft
[ ] Threaded _____" Diam from _____ ft to _____ ft

Perforations [x] Yes [ ] No
Type of perforator used Saw
SIZE of perfs .025 in by 3 in and no of perfs 80 from 60 ft to 100 ft

Screens. [ ] Yes [x] No [ ] K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: [ ] Yes [ ] No [ ] Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal [x] Yes [ ] No To what depth? 19 ft
Materials used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [x] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS Land-surface elevation above mean sea level _____ ft.
Static level 40 ft below top of well Date 6-27-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [x] No If yes, by whom? _____
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 10 to 15 gal./min with stem set at 92 ft for 2 hrs
Artesian flow _____ g.p.m. Date 6-27-01
Temperature of water _____ Was a chemical analysis made? [ ] Yes [x] No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	4
Course Gravel	4	7
Brown Shale	7	28
Shale & Quartz	28	42
Black shale	42	80
Shale & Quartz	80	100

DEPT OF ECOLOGY Received JUL 05 2001 CENTRAL REGION OFFICE

Start Date 6-27-01 Completed Date 6-27-01

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[x] Driller [ ] Engineer [ ] Trainee Name (Print) Steve Konrad
Driller/Engineer/Trainee Signature Steve Konrad
Driller or Trainee License No 1764

If trainee, licensed driller's Signature and License no. _____

Drilling Company Methow Valley Drilling
Address PO Box 68
City, State, Zip Twisp Wa. 98836
Contractor's Registration No Methowdrlg Date 6-27-01

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 20-39

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission *("x" in circle)*

☒ Construction 301310

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W 255185

Unique Ecology Well ID Tag No. BAN 541

Water Right Permit No. _____

Property Owner Name Bob Hunt

Well Street Address _____

City Twisp County Okanogan

Location SW 1/4-1/4 NW 1/4 Sec 20 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____ E

Tax Parcel No. 3322203013

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 206 ft.

Depth of completed well 206 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 30 ft.

☒ Liner installed 4" Diam. from -10 ft. to 206 ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No liner only

Type of perforator used saw

SIZE of perfs 1/8 in. by 5 in. and no. of perfs 40 from 146 ft. to 206 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 2' 8" ft. below top of well Date 6-25-08

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 5.5 gal./min. with stem set at 205 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
brown clay bound talus	0	17
gray hard pan talus	17	29
med/hard blue gray breccia	29	116
damp blue soft breccia	116	124
med hard blue breccia	124	140
H20 med soft blue yellow breccia	140	146
med hard blue with weeping pink veins	146	175
med hard blue breccia w. H	175	206
H20 bearing veins @ 180', & 196'		

RECEIVED
JUL 01 2008
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 6-24-08 Completed Date 6-25-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MVM QUALITY DRILLING LLC TEL (509) 682-1122

Driller/Engineer/Trainee Signature NAME: MARSHALL V MILLER LIC.# 1437

Driller or trainee License No. REG#: MVM QUD L033MM

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUDL033MM Date 6-25-08

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W086459
UNIQUE WELL I.D. #
Water Right Permit No.

(1) OWNER: Name Bryan Radosevich Address Twisp Wash

(2) LOCATION OF WELL: County Okanogan SW 1/4 SE 1/4 Sec 20 T 33 N.R 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) E. of Alder Crk McClure

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
☒ New well ☐ Deepened ☐ Reconditioned
Method: ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 100 feet. Depth of completed well 100 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☒ Welded 6" Diam. from 0 ft. to 30 ft.
☒ Liner installed 4" Diam. from 0 ft. to 100 ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: ☐ Yes ☒ No Size of gravel
Gravel placed from ft. to ft.

Surface seal: ☒ Yes ☐ No To what depth? 18
Material used in seal Bentonite
Did any strata contain unusuable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 60 ft. below top of well Date 11-2-98
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 10 gal./min. with stem set at 100 ft. for 5 hrs.
Atesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
overburden	0	2
GRAVEL	2	8
Gray clay	8	28
granite	28	90
fractured granite	90	100

ORIGINAL DEPT. OF ECOLOGY Received JAN 25 1999 REGIONAL OFFICE

Work Started n/a, 19 . Completed Same 19 98

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling
(Person, Firm, or Corporation) (Type or Print)
Address P.O. Box 68 Twisp 98856
(Signed) Bryan License No. 0781
Contractor's Registration No. METHOVD/2/CC n/a 19 98

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (7/97)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

Well Log 20-41

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W 49965

UNIQUE WELL I.D. # ACX 727

Water Right Permit No.

(1) OWNER: Name Dale Johnson Address Box 581 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan NE 1/4 NW 1/4 Sec 20 T 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 961 Twisp-Carlton Rd Twisp WA 98856

TAX PARCEL NO. #8831000030

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
[ ] New Well [ ] Deepened [X] Reconditioned [ ] Decommission
Method: [ ] Dug [ ] Bored [ ] Cable [ ] Driven [X] Rotary [ ] Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 77 feet. Depth of completed well 302 ft.

(6) CONSTRUCTION DETAILS
Casing installed:
[ ] Welded " Diam. from ft. to ft.
[X] Liner installed 4 " Diam. from 8 ft. to 302 ft.
[ ] Threaded " Diam. from ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand
Material placed from ft. to ft.

Surface seal: [ ] Yes [ ] No To what depth? ft.
Material used in seal ~~Unknown-Did not Disturb~~
Did any strata contain unusable water? [ ] Yes [ ] No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Grundfos
Type: Submersible H.P. 1

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 30 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [ ] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest +2 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? [ ] Yes [ ] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Granite-like; grey-green; purple; med hard	225	280
Granite-like; Grey-green; soft; water	280	282
Granite-like; grey-green; med hard	282	302
Well deepened from 225' to 302'		

Work Started 7/6/00 Completed 7/7/00

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name S Kreider License No. 1492
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Country Town Drilling
(Signed) License No. 1492
(Licensed Driller/Engineer)
Address PO Box 279 Carlton WA 98814
Contractor's Registration No. COUNTTD131QW Date 7/17/00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Well Log 20412

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 453924

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. WE 14717

Unique Ecology Well ID Tag No. BCF 258

Water Right Permit No. _____

Property Owner Name Don Walvatne

Well Street Address 957 Old Twisp Carlton Hiway

City Twisp County Okanogan

Location NE 1/4-1/4 NW 1/4 Sec 20 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 3322200039

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 247 ft.
Depth of completed well 247 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 41 ft.
☒ Liner installed 4" Diam. from 247 ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No

Type of perforator used saw

SIZE of perfs 1/8 in. by 5 in. and no. of perfs 30 from 247 ft. to 177 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 50'6" ft. below top of well Date 6-21-12

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 3.5 gal./min. with stem set at 246 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
silty sand, gravel, cobbles	0	36
clay	36	40
med hard grey sandstone	40	112
H20 bearing fractured sandstone	112	113
grey sandstone	113	135
H20 bearing fractured ss.	135	139
grey / green sandstone	139	169
coarse soft sandstone	169	172
grey med. hard sandstone	172	209
H20 bearing, coarse sandstone	209	214
shale lensed in sandstone	214	225
H20 bearing shale lenses	225	238
grey green sandstone	238	247

Start Date 6-20 Completed Date 6-21-12

CENTRAL REGION OFFICE
JUL 02 2012
Received
DEPT OF ECOLOGY

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name: MVM QUALITY DRILLING L.L.C. TEL (509) 682-1122

Driller/Engineer/Trainee Signature NAME: MARSHALL V. MILLER, LIC. #: 1437

Driller or trainee License No. REG #: MVM QUD L936BB

If TRAINEE, Driller's Licensed No. _____

Driller's Signature MV Miller

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUDL936BB Date 6-25-12

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

WWL Log 20144

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49675
UNIQUE WELL I.D. # ACA 441
Water Right Permit No. _____

OWNER: Name Dr. Robert Hoffman Address PO Box 506 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan . NE 1/4 NE 1/4 Sec 20 T. 33 N., R 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Hoffman SP94-35 (#2) Lot 1 Airport Rd Twisp A

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1 of 4

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 83 feet. Depth of completed well 83 ft.

(6) CONSTRUCTION DETAILS:

Casing Installed: 6 " Diam. from +2 ft. to 83 ft.
Welded [X] " Diam. from ____ ft. to ____ ft.
Liner installed [ ] Threaded [ ] " Diam. from ____ ft. to ____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. ____ Slot size _____ from _____ ft. to _____ ft.
Diam. ____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 54 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 20+ gal./min. with stem set at 78 ft. for 1.5 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand; Boulders	0	7
Till, compaCTED, SILTY	7	22
Boulders; Gravel; Sand, tight	22	38
Sand; Some gravel, tight	38	55
Sand; Some gravel, damp	55	78
Gravel; Sand, tight	78	83

Drilled w/NUMEX under-reaming system

5.5" Drive Shoe @83'

RECEIVED
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work Started 11/11/97, 19. Completed 11/12/97, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 11/17/97, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 20-45

ECY 050-1-20 (9/93)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49676
UNIQUE WELL I.D. # ACA 442
Water Right Permit No. _____

OWNER: Name Dr. Robert Hoffman Address PO Box 506 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan NE 1/4 NE 1/4 Sec 33 T. 22 N., R. 20 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Hoffman SP94-35 (#2) Lot 2 Airport Rd Twisp A

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1 of 4
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 83 feet. Depth of completed well 83 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 6 " Diam. from +3 ft. to 83 ft.
Welded [X] " Diam. from ____ ft. to ____ ft.
Liner installed [ ] Threaded [ ] " Diam. from ____ ft. to ____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used ____
SIZE of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel ____
Gravel placed from ____ ft. to ____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

(7) PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

(8) WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 54 ft. below top of well Date ____
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 20+ gal./min. with stem set at 78 ft. for 1 hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand; Boulders	0	8
Till, compacted, dusty, silty	8	20
Sand; Boulders	20	25
Sand, tight	25	36
Sand with gravel, tight	36	68
Gravel with sand	68	83

Drilled w/NUMEX under-reaming system

5.5" Drive Shoe @83'

RECEIVED NOV 17 1997 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 11/13/97, 19. Completed 11/14/97, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 11/17/97, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 20-46

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 49677
UNIQUE WELL I.D. # ACA 443
Water Right Permit No.

(1) OWNER: Name Dr. Robert Hoffman Address PO Box 506 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan NE 1/4 NE 1/4 Sec 33 20 T. 22 33 N., R. 20 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Parcel #3322200071 Airport Rd Twisp A

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1 of 4
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled ____ feet. Depth of completed well ____ ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 6" Diam. from ____ ft. to ____ ft.
Welded [X] Liner installed [ ] Threaded [ ]
" Diam. from ____ ft. to ____ ft.
" Diam. from ____ ft. to ____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type ____ Model No.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ____ ft. to ____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? ____ Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: ____ H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 55 ft. below top of well Date
Artesian pressure ____ lbs. per square inch Date
Artesian water is controlled by ____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 40+ gal./min. with stem set at 78 ft. for 1 hrs.
Artesian flow ____ g.p.m. Date
Temperature of water ____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand; Gravel; Cobbles; Boulders	0	8
Boulders, cemented, tight	8	20
Sand, coarse	20	30
Sand, coarse, some gravel	30	38
Sand, medium	38	55
Sand, tight, wet, clay like	55	60
Sand; Gravel claylike	60	67
Sand, coarse; Gravel	67	78
Gravel, Sand	78	80
Gravel; Boulders; some Sand	80	83
Drilled w/NUMEX UNDER REAMING SYSTEM		
5.5" Drive Shoe @		

RECEIVED NOV 1 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 11/15/97, 19. Completed 11/16/97, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 11/17/97, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 20-47

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☒ Construction 310067

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT

Notice of Intent No. W158866

Unique Ecology Well ID Tag No. BAN 830

Water Right Permit No. _____

Property Owner Name Greg Ford & Ray Campbell

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location SW 1/4-1/4 NE 1/4 Sec 20 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☒ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 34 ft.

Depth of completed well 34 ft.

CONSTRUCTION DETAILS

Casing Installed: ☐ Welded 6" Diam. from 0 ft to 30 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 14 ft. below top of well Date 2-7-08

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 3 to 5 gal./min. with stem set at 32 ft. for 3 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	3
sand	3	12
sandy clay	12	30
decomposed rock	30	31
bedrock	31	34
set pump on 1 length of pipe plus pitless not over 29'		

RECEIVED

AUG 22 2008

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 2-6-08 Completed Date 2-7-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 0781

Drilling Company Whistle's Well Drilling

Address 74 Loss Rd

City, State, Zip Twisp Wash 98856

Contractor's Registration No. WHISTWD94LC7 Date _____

If TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 383461

(x) Construction

( ) Decommission ORIGINAL INSTALLATION Notice of Intent Number _____

CURRENT Notice of Intent No. W268015

Unique Ecology Well ID Tag No. BBT 979

Water Right Permit No. _____

Property Owner Name Jolly & Assoc.

Well Street Address _____

City Twisp County Okanogan

Location SE 1/4-1/4 NE 1/4 Sec 22 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 33 22200015

PROPOSED USE: [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

[x] New well [ ] Reconditioned [ ] Deepened

Method: [ ] Dug [ ] Bored [ ] Driven [ ] Cable [x] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 165 ft.

Depth of completed well 165 ft.

CONSTRUCTION DETAILS

Casing Installed: [x] Welded 6" Diam. from 0 ft. to 21' ft.

[ ] Liner installed 4" Diam. from 15 ft. to 165 ft.

[ ] Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: [x] Yes [ ] No

Type of perforator used saw

SIZE of perfs 1/16 in. by 2 in. and no. of perfs 100 from 80 ft. to 165 ft.

Screens: [ ] Yes [x] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [x] No [ ] Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: [x] Yes [ ] No To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? [ ] Yes [x] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 30 ft. below top of well Date 7-16-2010

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [x] No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 40+ gal./min. with stem set at 160 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? [ ] Yes [x] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Overburden	0	5
Brown clay	5	12
gray clay	12	19
granite	19	28
hard granite	28	75
soft granite	75	80
hard granite	80	82
fractured granite	82	89
hard granite	89	120
soft granite	120	145
fractured granite	145	165

RECEIVED

AUG 0 2 2010

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 7-15-2010 Completed Date 7-16-2010

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[x] Driller [ ] Engineer [ ] Trainee Name (Print) R. Bynum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 781

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City, State, Zip Twisp Wash 98856

Contractor's Registration No. WHISTWO92005 Date 7-16-2010

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 20-53

WATER WELL REPORT

State of Washington Date Printed: 12-Aug-2004 Log No. 21904

Construction/Decommission: Original Construction
Notice of Intent #:

Construction 155399

CURRENT
Notice of Intent No.: W168995
Unique Ecology Well I.D. No.: AKO245
Water Right Permit Number:

OWNER: STRICKLAND, KEITH
OWNER ADDR: PO BOX 64 TWISP, WA 98856
Well Street Address: 94 ALDER RD
City: Twisp, WA 98856 County: OKANOGAN
Location: NE 1/4 SE 1/4 Sec 20 T 33 R 22E EWM
Lat/Long: (s, t, r still REQUIRED) Lat Deg Lat Min/Sec Long Deg Long Min/Sec
Tax Parcel No.:

PROPOSED USE: DOMESTIC

TYPE OF WORK Owners's Well Number: (If more than one well) 1
NEW WELL Method: ROTARY

DIMENSIONS: Diameter of well: 6 inches
Drilled 300 ft. Depth of completed well 300 ft.

CONSTRUCTION DETAILS:
Casing installed: WELDED
6 " Dia from +2 ft. to 45 ft.
" Dia from ft. to ft.
" Dia from ft. to ft.

Liner installed:
4 " Dia from 6 ft. to 300 ft.

Perforations: Yes Used In: Liner
Type of perforator used: SKILL SAW
SIZE of perforations 6 in. by 1/8 in.
100 Perforations from 180 ft. to 280 ft.
Perforations from ft. to ft.
Perforations from ft. to ft.

Screens: No K-Pac Location:
Manufacture's Name:
Type: Model No.
Diam. slot size: from ft. to ft.
Diam. slot size: from ft. to ft.

Gravel/Filter packed: No Size of Gravel
Material placed from ft. to ft.

Surface seal: Yes To what depth 19 ft.
Seal method: Material used in seal: BENTONITE
Did any strata contain unusable water?: No
Type of water: Depth of strata
Method of sealing strata off

PUMP: Manufacture's name
Type: H.P. 0

WATER LEVELS: Land-surface elevation above mean sea level: 0 ft.
Static level 30 ft. below top of well Date 07/13/2004
Artesian Pressure: lbs per square inch Date
Artesian water controlled by

WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? No If yes, by whom?
Yield: gal/min with ft drawdown after
Yield: gal/min with ft drawdown after
Yield: gal/min with ft drawdown after

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level

Time:	Water Level	Time:	Water Level	Time:	Water Level

Date of test:
Bailer test gal/min ft drawdown after hrs.
Air test 8 gal/min w/ stem set at 299 ft. for 1 hours
Artesian flow gpm Date:
Temperature of water Was a chemical analysis made? No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure. Show thickness of aquifers and the kind and nature of the material in each stratum penetrated. Show at least one entry for each change in formation.

Material	From	To
CLAY BROWN	0	6
SHALE GRAVEL	6	35
GRANITE DECOMPOSED	35	45
GRANITE HARD	45	50
GRANITE FRACTURED W/WATER	50	51
GRANITE GREEN SALT	51	89
GRANITE FRACTURED W/WATER	89	90
GRANITE HARD	90	140
GRANITE MEDIUM	140	156
GRANITE VERY SOFT	156	157
GRANITE PURPLE MEDIUM	157	165
GRANITE GREEN MEDIUM	165	210
CONTINUED	210	210

Notes:

DEPT. OF ECOLOGY Received OCT 01 2004 CENTRAL REGION OFFICE

Work started 07/09/2004 Completed 07/13/2004

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☑ Trainee

Name: AUDIE MCCURDY License No.: 2690T
Signature: Audie M'Curdy

If trainee, Licensed driller is: MARTY RUGO License No.: 2038
Licensed Driller Signature: Marty Rugo

Drilling Company:
NAME: FOGLE PUMP & SUPPLY, INC. Shop: REPUBLIC
ADDRESS: PO Box 456
Republic, WA 99166
Phone: 5097752878 Toll Free: 8008453500
E-Mail: foglewest@rcabletv.com
FAX: 5097750498 WEB Site: www.foglepump.com

Contractor's Registration No.: FOGLEPS095L4 Date Log Created: 07/28/2004

pg 1 of 2

Well Log 20-55

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

State of Washington Date Printed: 12-Aug-2004 Log No. 21904

Construction/Decommission: Original Construction

Construction Notice of Intent #: 155399

PROPOSED USE: **DOMESTIC**

TYPE OF WORK Owners's Well Number: (If more than one well) **1PG2**

NEW WELL Method: **ROTARY**

DIMENSIONS: Diameter of well: **6** inches

Drilled **300** ft. Depth of completed well **300** ft.

CONSTRUCTION DETAILS:

Liner installed:

4 " Dia from **6** ft. to **300** ft.

Casing installed: **WELDED**

6 " Dia from **+2** ft. to **45** ft.

" Dia from ft. to ft.

" Dia from ft. to ft.

Perforations: **Yes** Used In: **Liner**

Type of perforator used: **SKILL SAW**

SIZE of perforations **6** in. by **1/8** in.

100 Perforations from **180** ft. to **280** ft.

Perforations from ft. to ft.

Perforations from ft. to ft.

Screens: **No** K-Pac Location:

Manufacture's Name:

Type: Model No.

Diam. slot size: from ft. to ft.

Diam. slot size: from ft. to ft.

Gravel/Filter packed: **No** Size of Gravel

Material placed from ft. to ft.

Surface seal: **Yes** To what depth **19** ft.

Seal method: Material used in seal: **BENTONITE**

Did any strata contain unusable water?: **No**

Type of water: Depth of strata

Method of sealing strata off

PUMP: Manufacture's name

Type: H.P. **0**

WATER LEVELS: Land-surface elevation above mean sea level: **0** ft.

Static level **30** ft. below top of well Date **07/13/2004**

Artesian Pressure: lbs per square inch Date

Artesian water controlled by

WELL TESTS: Drawdown is amount water level is lowered below static level.

Was a pump test made? **No** If yes, by whom?

Yield: gal/min with ft drawdown after

Yield: gal/min with ft drawdown after

Yield: gal/min with ft drawdown after

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level

Time:	Water Level	Time:	Water Level	Time:	Water Level

Date of test:

Bailer test gal/min ft drawdown after hrs.

Air test **8** gal/min w/ stem set at **299** ft. for **1** hours

Artesian flow gpm Date:

Temperature of water Was a chemical analysis made? **No**

CURRENT

Notice of Intent No.: **W168995**

Unique Ecology Well I.D. No.: **AKO245**

Water Right Permit Number:

J

OWNER: **STRICKLAND, KEITH**

OWNER ADDR: **PO BOX 64 TWISP, WA 98856**

Well Street Address: **94 ALDER RD.**

City: **Twisp, WA 98856** County: **OKANOGAN**

Location: **NE** 1/4 **SE** 1/4 Sec **20** T **33** R **22E** EWM

Lat/Long: (s, t, r still REQUIRED) Lat Deg Lat Min/Sec

Long Deg Long Min/Sec

Tax Parcel No.:

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure. Show thickness of aquifers and the kind and nature of the material in each stratum penetrated. Show at least one entry for each change in formation.

Material	From	To
GRANITE FRACTURED	210	212
GRANITE GREEN MEDIUM	212	248
GRANITE GREEN SOFT	248	300

DEPT. OF ECOLOGY Received OCT 0 1 2004 CENTRAL REGION OFFICE

Notes:

1/2 GPM 50 - 51, 3.5 GPM 89 - 90, 4 GPM 210 - 212

Work started **07/09/2004** Completed **07/13/2004**

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee

Name: **MARTY RUGO** License No.: **2038**

Signature: Marty Rugo

If trainee, Licensed driller is: License No.:

Licensed Driller Signature:

Drilling Company:

NAME: **FOGLE PUMP & SUPPLY, INC.** Shop: **REPUBLIC**

ADDRESS: **PO Box 456**

Republic, WA 99166

Phone: **5097752878** Toll Free: **8008453500**

E-Mail: **foglewest@rcabletv.com**

FAX: **5097750498** WEB Site: **www.foglepump.com**

Contractor's Registration No.: **FOGLEPS095L4** Date Log Created: **07/28/2004**

pg 2 of 2

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology 94539
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W129721
UNIQUE WELL I.D. # AFO 834
Water Right Permit No.

(1) OWNER: Name Ned Betty Address 6105 130th AVE NE Kirkland Wa 98033

LOCATION OF WELL: County Okanogan NE 1/4 NW 1/4 Sec 20 T 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 1mi South Twisp Carlton Hwy

TAX PARCEL NO.:

C

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☐ Welded 6" Diam. from 0 ft. to 40 ft.
☐ Liner installed " Diam. from ft. to ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft. to ft.

Surface seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 21 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 20 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date 3-29-01
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Overburden	0	4
Fine sand	4	10
brown clay	10	16
gray clay	16	28
gravel	28	40

DEPT OF ECOLOGY Received APR 30 2001 CENTRAL REGION OFFICE

Work Started 3-29, 01 Completed SAME

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name R. Bynum License No. 0781
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Methow Valley Drilling
(Signed) R. Bynum License No. 0781
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp Wash 98856
Contractor's Registration No. Methowvalley Date 3-29 01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006. Well Log 20-74

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

175748

Please print, sign and return to the Department of Ecology

Water Well Report

Original – Ecology, 1st copy – owner, 2nd copy – driller

DEPT. OF ECOLOGY Received JUL 07 2005 CENTRAL REGION OFFICE

Construction/Decommission

☒ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Current Notice of Intent No. W183405
Unique Ecology Well ID Tag No. ALF168
Water Right Permit No. E
Property Owner Name Norm McIntyre
Well Street Address 1/2 mile SW of Twisp
City Twisp County Okanogan
Location SW 1/4-1/4 NW 1/4 Sec 20 Twn 33 R 22 EWM or WWM (circle one)
Lat/Long (s, t, r still REQUIRED.) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No. _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 405 ft.
Depth of completed well 405 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 20 ft.
☒ Liner installed 4" Diam. from 4 ft. to 405 ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No
Type of perforator used SAW
SIZE of perfs 1/2 in. by 1/16 in. and no. of perfs 80 from 200 ft. to 400 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 40 ft. below top of well Date 6-19-05
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 2 to 3 gal./min. with stem set at 400 ft. for 4 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	4
decomposed granite	4	7
gray granite	7	50
yellow decomposed rock	50	61
gray granite	61	165
soft granite pink	165	190
gray granite	190	220
hard fractured rock	220	250
gray granite	250	405

Start Date 6-18 Completed Date 6-19-05

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller/Engineer/Trainee Name (Print) R. Bywater
Driller/Engineer/Trainee Signature _____
Driller or Trainee License No. 0781

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Drilling Company Methow Valley Drilling
Address P.O. Box 68 Twisp
City, State, Zip Twisp Wa 98856
Contractor's Registration No. Methovdrlcr Date 6-19-05

Ecology is an Equal Opportunity Employer. ECY 050-1-20 (Rev 2/03)

Well Log 20-75

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy Owners Copy
Third Copy Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Notice of Intent N 160063
UNIQUE WELL I D # AGL917
Water Right Permit No

142078

(1) OWNER Name Robert and Belva Hofman Address PO BOX 506 Twisp Wa 98856

(2) LOCATION OF WELL County Okanogan SW 1/4 NE 1/4 Sec 20 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL (or nearest address) B & B rd TWISP WA 98856

TAX PARCEL NO 8830910300

G

(3) PROPOSED USE
- [x] Domestic
- [ ] Industrial
- [ ] Municipal
- [ ] Irrigation
- [ ] Test Well
- [ ] Other
- [ ] DeWater

(4) TYPE OF WORK Owners number of well (if more than one) 2
- [x] New Well
- [ ] Deepened
- [ ] Reconditioned
- [ ] Decommission

Method
- [ ] Dug
- [ ] Cable
- [ ] Rotary
- [ ] Bored
- [ ] Driven
- [ ] Jetted

(5) DIMENSIONS Diameter of well 6" to 43 ft inches
Drilled 83 feet Depth of completed well 82 ft

(6) CONSTRUCTION DETAILS
Casing Installed
- [x] Welded 6" to 43 ft " Diam from +2 ft to 42 ft
- [ ] Liner installed Diam from ft to ft
- [ ] Threaded Diam from ft to ft

Perforations [ ] Yes [x] No
Type of perforator used
SIZE of perforations in by in
Perforations from ft to ft

Screens [ ] Yes [x] No [ ] K Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed [ ] Yes [ ] No [ ] Size of gravel/sand
Material placed from ft to ft

Surface seal [x] Yes [ ] No To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [x] No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturers Name none
Type H P

(8) WATER LEVELS Land surface elevation above mean sea level 1300 ft
Static level 58 ft below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap valve etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [x] No If yes by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 15 20 gal /min with stem at 75 ft drawdown after 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? [ ] Yes [x] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Topsoil	0	1
Sandy cobbles boulders	1	15
fine silty sand, cobbles damp	15	25
fine medium sand	25	50
dry sand and gravel	50	55
damp fine sand silty claylike w/ gravel	55	62
sand with gravel	62	70
gravel with sand	70	75
gravel and cobbles boulders with coarse sand	75	83

DEPT OF ECOLOGY Received NOV 12 2003 CENTRAL REGION

Work Started 11 , 3/02 Completed 11/5 , 03

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Stephen L Kreider License No 1492
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company COUNTRY TOWN DRILLING
(Signed) Stephen L Kreider License No 1492
(Licensed Driller/Engineer)
Address PO BOX 437 TWISP WA 98856
Contractor s Registration No COUNTTD131QW Date 11/6/03

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs contact the Water Resources Program at (360) 407

ECY 050-1 20 (11/98)

Well Log 20-76

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 087516
UNIQUE WELL I.D. # ACE 224
Water Right Permit No.

(1) OWNER: Name Roger Dimmestad Address 7010-54th AVE NW Pig Harbor

(2) LOCATION OF WELL: County Okanogan NW 1/4 NE 1/4 Sec 20 T. 33 N., R 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) West County Rd 3/4 mile S. of Twisp

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☐ Deepened ☐ Reconditioned ☐ Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 40 ft.
Welded ☒ " Diam. from ft. to ft.
Liner installed ☐ Threaded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level
Static level " ft. below top of well Date Sept 12, 96
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 40 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
overburden	0	3
gravel	3	8
brown clay	8	16
" " gravel	16	22
coarse sand	22	31
" " gravel	31	40

RECEIVED OCT 7 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 9-12-96, 19. Completed SAME, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 68 Twisp Wash 98856
(Signed) [signature] (WELL DRILLER) License No. 0781
Contractor's Registration No. METHOVD12CR Date 9-12, 19 96

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

ECY 050-1-20 (9/93)

Well Log 20-77

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)* 421367

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W301342

Unique Ecology Well ID Tag No. BCC048

Water Right Permit No. _____

Property Owner Name Samuel Scheinberg

Well Street Address _____

City Twisp County Okanogan

Location NE 1/4-1/4 SE 1/4 Sec 20 Twn 33 R 22 (EWM) or WWM — circle one

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 332220083

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 46 ft.

Depth of completed well 44'4" ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 36 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 35

Manufacturer's Name Johnson

Type stainless V-wire Model No. _____

Diam 6 Slot size .018 from 39'4" ft. to 44'4" ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite slurry

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 14'5" ft. below top of well Date 7/22

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 50+ gal./min. with stem set at 43 ft. for 1.5 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
silty sand	0	7
gravel + cobble	7	15
silty sand + gravel	15	21
sand + random med gravel	21	36
silty fine sand	36	38
med sand + gravel	38	45
fine sand + gravel	45	46

RECEIVED
AUG 0 3 2011
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 7/21/11 Completed Date 7/22/11

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. _____

CO: MVM QUALITY DRILLING L.L.C. TEL (509) 682-1122
NAME: MARSHALL V. MILLER, LIC. #: 1437
REG #: MVM QUD L936BB

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUDL936BB Date 8/2/11

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 20-78

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W090254
UNIQUE WELL I.D. # FCX049
Water Right Permit No. _____

OWNER: Name Stephen Setick Address 4908 - NE 100th Seattle 98125

(2) LOCATION OF WELL: County King SW 1/4 NW 1/4 Sec 20 T 33N N., R 22 E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Above Alder Cle mine

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 203 feet. Depth of completed well 203 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 20 ft.
Welded [ ] 4" Diam. from 10 ft. to 203 ft.
Liner installed [ ]
Threaded [ ] " Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. ____ Slot size _____ from _____ ft. to _____ ft.
Diam. ____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____
Static level 120 ft. below top of well Date 7-11-97
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 10 to 15 gal./min. with stem set at 200 ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
over burden	0	8
clay	3	12
Decomposed shale	12	18
gray shale	18	69
black shale	69	193
gray shale with quartz	193	203

RECEIVED JUL 25 1997

Work Started 7-10 19. Completed 7-11 19 97

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Cmethow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 68 Twisp 98856
(Signed) Byum (WELL DRILLER) License No. 0781
Contractor's Registration No. METHOVD121CR Date 7-11 19 97

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 20-79

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology 2nd copy – owner 3rd copy – driller

Construction/Decommission (x in circle) 451885

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No W273779

Unique Ecology Well ID Tag No BKF 344

Water Right Permit No _____

Property Owner Name Ted Jackson

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location NE 1/4 1/4 NW 1/4 Sec 20 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No 8831000040

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 145 ft

Depth of completed well 145 ft

CONSTRUCTION DETAILS

Casing Installed ☒ Welded 6 Diam from 0 ft to 40 ft

☐ Liner installed _____ Diam from _____ ft to _____ ft

☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____

Manufacturer s Name _____

Type _____ Model No _____

Diam _____ Slot size _____ from _____ ft to _____ ft

Diam _____ Slot size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP Manufacturer s Name _____

Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft

Static level 60 ft below top of well Date 5-4-2012

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap, valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes by whom? _____

Yield _____ gal /min with _____ ft drawdown after _____ hrs

Yield _____ gal /min with _____ ft drawdown after _____ hrs

Yield _____ gal /min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal /min with _____ ft drawdown after _____ hrs

Airtest 4 gal /min with stem set at 145 ft for 3 hrs

Artesian flow _____ g p m Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
overburden	0	4
clay	4	20
clay & gravel	20	28
clay	28	39
soft granite	39	42
hard granite	42	125
fractured granite	125	128
hard granite	128	145

DEPT OF ECOLOGY Received JUN 06 2012 CENTRAL REGION OFFICE

Start Date 5-3-2012 Completed Date 5-4-2012

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Bynum

Driller/Engineer/Trainee Signature [signature]

Driller or trainee License No 781

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City State Zip Twisp Wash 98856

Contractor s Registration No WHISTWD920DS Date June 1 2012

If TRAINEE

Driller s Licensed No _____

Driller s Signature _____

Ecology is an Equal Opportunity Employer

 The Department of Ecology does NOT warranty the Data and/or Information on this Well Report

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W089823
UNIQUE WELL I.D. # AET 802
Water Right Permit No. _____

(1) OWNER: Name Bill Lorenz Address 2248 - Fir Dee Grove Rd. Ferndale WA

(2) LOCATION OF WELL: County Okan SE 1/4 NW 1/4 Sec 21 T 33 N.R 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 2mi S. Twisp Twisp Carlton Highway F

(3) PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
☑ New well ☐ Deepened ☐ Reconditioned
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☑ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 130 feet. Depth of completed well 130 ft.

(6) CONSTRUCTION DETAILS
Casing installed:
☑ Welded 6" Diam. from 0 ft. to 130 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☑ No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: ☐ Yes ☑ No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: ☐ Yes ☑ No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: ☑ Yes ☐ No To what depth? 19'
Material used in seal Bentonite
Did any strata contain unusuable water? ☐ Yes ☑ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 80 ft. below top of well Date 11-21-98
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 15 gal./min. with stem set at 128 ft. for 2 hrs.
Atesian flow _____ g.p.m. Date 11-21-98
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☑ No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	4
Boulders	4	30
Hard pan-clay	30	70
Gray Clay	70	110
Coarse Gravel	110	130

DEPT. OF ECOLOGY CENTRAL REGION OFFICE Received NOV 1 1998

Work Started 11-21, 1998. Completed 11-21, 1998.

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (Person, Firm, or Corporation) (Type of Print)
Address Po Box 68 Twisp WA 98856
(Signed) Bynn License No. 0781
Contractor's Registration No. Methovd 121CR Date 11-21, 1998

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (7/97)

Well Log 21-2

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W089824
UNIQUE WELL I.D. # AET 803
Water Right Permit No. _____

(1) OWNER: Name Bill Lorenz Address 2248 - Alder Grove Rd. Ferndale WA

(2) LOCATION OF WELL: County Okan SE 1/4 NW 1/4 Sec 21 T. 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 2 mile S. Twisp Carlton Hyway F

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Deepened ☐ Reconditioned
Method: ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 80 feet. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☒ Welded 6" Diam. from 0 ft. to 80 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: ☐ Yes ☒ No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: ☒ Yes ☐ No To what depth? 19
Material used in seal Bentonite
Did any strata contain unusuable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 40 ft. below top of well Date 11-21-98
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 40 gal./min. with stem set at 78 ft. for 2 hrs.
Atesian flow _____ g.p.m. Date 11-21-98
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
cover burden	0	4
Boulder & Gravel	4	24
Coarse Gravel	24	40
Sand & Gravel	40	60
Coarse Gravel	60	80

DEPT. OF ECOLOGY CENTRAL REGION OFFICE Received JAN 4 1999

Work Started 11-21, 19 98. Completed 11-21, 19 98.

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (Person, Firm, or Corporation) (Type or Print)
Address PO Box 68 Twisp WA
(Signed) [signature] License No. 1764
Contractor's Registration No. 1764 Date 11-21, 19 98
Methowdrlcr
(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (7/97)

Well Log 21-3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission (*"x" in circle*)
☒ Construction 444198
○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

DEPT OF ECOLOGY Received JAN 05 2012 CENTRAL REGIONAL OFFICE

CURRENT
Notice of Intent No. WE 13746
Unique Ecology Well ID Tag No. AEG 309
Water Right Permit No. G4-33041
Property Owner Name Chelan County PUD
Well Street Address 820 A Twisp Carlton RD.
City Twisp County Okanogan -24
Location NW 1/4-1/4 SE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)
Lat/Long (s, t, r Still **REQUIRED**) Lat Deg 48 Lat Min/Sec 20.524
Long Deg 120 Long Min/Sec 05.315
Tax Parcel No. 5101140002

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☒ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 1
☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☒ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 12 inches, drilled 170 ft.
Depth of completed well 164 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 12" Diam. from +2' ft. to 170' ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes. ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 105
Manufacturer's Name Johnson
Type Tele Model No. _____
Diam. 10 Slot size 40 from 110' ft. to 160' ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite chips
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: Sub H.P. 60

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 12 ft. below top of well Date 12/1/11
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? ITC
Yield: 1091 gal./min. with 12.42 ft. drawdown after 1 hrs.
Yield: 1600 gal./min. with 19.01 ft drawdown after 1 hrs.
Yield: 2035 gal./min. with 25.55 ft. drawdown after 1 hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
5:56	2.13	5:59	.42	8:00	.17
5:57	.44	6:00	.42	9:00	.14
5:58	.42	7:00	.25	10:00	.11

Date of test 12/1/11 – 12/5/11
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date 11/30
Temperature of water 47.8 Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Sand	0	6
Sand & Gravel	6	78
Sand	78	86
Sand & Gravel	86	164
Sand & Gravel (Silt Locked)	164	170

Start Date 10/11/11 Completed Date 12/5/11

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) DAVID SIMMONS
Driller/Engineer/Trainee Signature David Simmons
Driller or trainee License No. 2850

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Drilling Company IRRIGATION TECH & CONTROL INC
Address 4956 Contractors DR.
City, State, Zip East Wenatchee WA 98802
Contractor's Registration No. IRRIGTC0840J Date 12/5/11

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 21-8

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 105112
UNIQUE WELL I.D. # AGL 692
Water Right Permit No. _____

(1) OWNER: Name Corkey Barker Address Twisp Lot 2 Hippoet Rd

(2) LOCATION OF WELL: County Okan SW 1/4 NE 1/4 Sec. 21 T. 33 N., R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Twisp River Airport Road

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 5
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 40 ft.
Welded [X] Liner installed [ ] Threaded [ ]
" Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 19 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 20 ft. below top of well Date 6-25
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airlift 20 gal./min. with stem set at 38 ft. for 2 hrs.
Artesian flow g.p.m. Date 6-25
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	2
gravel	2	6
brown clay	6	22
coarse sand & gravel	22	40

RECEIVED
JUL 15 1998
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work Started 6-25, 19. Completed same, 1998

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 68 Twisp WA 98856
(Signed) Bynum (WELL DRILLER) License No. 0781
Contractor's Registration No. methowdrlwa Date 6-25, 1998

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 21-11

ECY 050-1-20 (6/93) * * I

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☒ Construction 307493

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 254883

Unique Ecology Well ID Tag No. APE 545

Water Right Permit No. _____

Property Owner Name Dave Davis

Well Street Address _____

City Twisp County Okanogan

Location NW 1/4-1/4 NE 1/4 Sec 21 Twn 33 R 22 (EWM) or WWM circle one

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 68500700005 B

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 104 ft.

Depth of completed well 91 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +3 ft. to 91 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 82

Manufacturer's Name Johnson

Type Stainless Slot Model No. _____

Diam. 6 Slot size .016 from 91 ft. to 86 ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 65 ft. below top of well Date 8-14-08

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

20 gpm air lift estimate

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
large cobbles sand & gravel	0	16
silty sand + gravel	16	22
large cobbles	22	27
sand + gravel	27	35
sand, random gravel	35	45
silty sand & gravel	45	56
coarse sand	56	90
sand & gravel	90	91
sand	91	104

RECEIVED AUG 19 2008 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 8-4-08 Completed Date 8-14-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) ~~MVM QUALITY DRILLING LLC TEL (509) 682-1122~~

Driller/Engineer/Trainee Signature NAME: MARSHALL V. MILLER, LIC.# 1437

Driller or trainee License No. REG#: MVM QUD L033MM

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUDL033MM Date 8-14-08

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

Well Log 21-13

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission *("x" in circle)* 397900

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W 274652

Unique Ecology Well ID Tag No. BBJ 778

Water Right Permit No. _____

Property Owner Name Gary Beard

Well Street Address 20383 Hwy 20

City Twisp County Okanogan

Location NE 1/4-1/4 NE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 3322 210136

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 84 ft.
Depth of completed well 84 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +2 ft. to 77 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 73
Manufacturer's Name Alloy
Type Telescoping Model No. S.S.
Diam. 8 Slot size 20 from 78 ft. to 83 ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 47 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☒ Yes ☐ No If yes, by whom? _____
Yield 20 gal./min. with 9" ft. drawdown after 2 hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 20 gal./min. with stem set at 84 ft. for 3 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top Soil	0	1
Boulders, Gravel, Sand	1	48
Sand, Gravel, Water-silty	48	77
Large Gravel---water	77	
some sand--silt		84
Granite	84	

RECEIVED
DEC 08 2010
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date NOv. 9, 2010 Completed Date NOv. 10

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Joe Booth
Driller/Engineer/Trainee Signature [signature]
Driller or trainee License No. X 0564

Drilling Company Okanogan Drilling
Address 48 Rodeo Trail Rd.
City, State, Zip Okanogan, Wa. 98840
Contractor's Registration No. OKANODD941RJ Date NOv. 12, 2010

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 21-15

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 350479

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W268018
Unique Ecology Well ID Tag No. BAP 218
Water Right Permit No. _____
Property Owner Name George Doupious
Well Street Address Twisp Carlton Rd
City Twisp County Okanogan
Location SW 1/4-1/4 SE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)
Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No. 510105 0001

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 1
☒ New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft.
Depth of completed well 40 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 40 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 20 ft. below top of well Date Feb 20 09
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 75 gal./min. with stem set at 40 ft. for 1/2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
overburden	0	2
gravel	2	14
hard pan	14	26
sand	26	35
gravel	35	40

RECEIVED
AUG 26 2009
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 9-20 Completed Date 9-21-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Bynum
Driller/Engineer/Trainee Signature _____
Driller or trainee License No. 781

Drilling Company Whistles Well Drilling
Address 74 Ross Rd
City, State, Zip Twisp Wa 98856
Contractor's Registration No. WHISTWD920D5 Date 9-21-09

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 31-16

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 350478

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W268019

Unique Ecology Well ID Tag No. BAP219

Water Right Permit No. _____

Property Owner Name George Goupious

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location SW 1/4-1/4 SE 1/4 Sec 21 Twn 33 R 22 ~~EWM~~ or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 5101050001

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 2

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft.

Depth of completed well 40 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 40 ft.

☐ Liner installed _____" Diam. from _____ ft to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 20 ft. below top of well Date 2-21-09

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 75 gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Overburden	0	6
gravel	6	13
gray hard pan	13	22
fine sand	22	31
gravel	31	40

RECEIVED AUG 26 2009 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 2-21-09 Completed Date 2-21-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Bynum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 781

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City, State, Zip Twisp Wash. 98856

Contractor's Registration No. WHISTLW092005 Date 2-21-09

If TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 350477

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 268020

Unique Ecology Well ID Tag No. BAP 220

Water Right Permit No. _____

Property Owner Name George Goupious

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location SW 1/4-1/4 SE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 5101050001

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft.

Depth of completed well 40 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 40 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 16 ft. below top of well Date 2-22-09

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 20 gal./min. with stem set at 40 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Overburden	0	4
Sand	4	15
silty clay	15	26
Sand	26	37
Sand & gravel	37	40

RECEIVED

AUG 26 2009

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 2-21-09 Completed Date 2-22-09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Dynum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 781

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City, State, Zip Twisp Wash 98856

Contractor's Registration No. Whistwo92005 Date 2-22-09

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

Well Log 21-18

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle) 369749

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 268021

Unique Ecology Well ID Tag No. BAP 221

Water Right Permit No. _____

Property Owner Name George Goupious

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location SW 1/4-1/4 SE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 510105000 1

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 4

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft.

Depth of completed well 40 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from 0 ft. to 40 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 15 ft. below top of well Date 2-22-09

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 20 gal./min. with stem set at 40 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Overburden	0	9
Silty Clay	9	22
Fine sand	22	35
Coarse sand & gravel	35	40

RECEIVED APR 01 2010 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

RECEIVED AUG 26 2009 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 2-22-09 Completed Date SAME

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Bynum

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 781

Drilling Company Whistle's Well Drilling

Address 74 Ross Rd

City, State, Zip Twisp Wash 98856

Contractor's Registration No. WHISTWD820DS Date 2-22-09

If TRAINEE, **Driller's Licensed No.** _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

Well Log 21-19

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 057863
UNIQUE WELL I.D. # ACA 450
Water Right Permit No. _____

(1) OWNER: Name Henry Roberts Jr. Address E 6707 Upriver Dr Spokane WA 99207

LOCATION OF WELL: County Okanogan SW 1/4 NW 1/4 Sec 21 T 33 N., R 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 877F Twisp Carlton County Rd

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (If more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 73'6" feet. Depth of completed well 73'6" ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 75 ft.
Welded [X] Liner installed [ ] Threaded [ ]
" Diam. from ft. to ft.
" Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name None
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 33'6" ft. below top of well Date 8/19/95
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 15 gal./min. with stem set at 70 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Loamy sand	0	5
Cemented gravel, boulders; beige	5	30
Cemented gravels, beige, silts	30	45
Cemented gravels, Med beige	45	63
Wet, silty sand, gravel, tight	63'	
Very silty sand, gravel, tight	63	71
Bedrock, green, sedimentary	71	73
highly fractured		
Drilled w/Numex under-reaming system		
5.5" Drive Shoe @ 73'		

AUG 2 0 1995

Work Started 8/18/1995 Completed 8/19/95

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) _____ (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 8/22/95

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

ECY 050-1-20 (9/93)

Well Log 21-22

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

5577 Start Card No. 081217

Water Right Permit No. _____

H

(1) OWNER: Name John East Man Address 2599 Hwy 20 Sedro Wooley

(2) LOCATION OF WELL: County Okanogan SE ¼ NE ¼ Sec. 21 T. 33 N., R. 22 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) 1¼ Due S. Twisp Airport

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam from 0 ft. to 40 ft.
Welded [ ] Liner installed [ ] Threaded [ ] _____" Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam _____ Slot size _____ from _____ ft. to _____ ft.
Diam _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal _____
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 13 ft. below top of well Date 9-28-91
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 70 gal./min. with stem set at 35 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	2
gravel	2	13
hard pan & gravel	13	16
sand & gravel	16	28
sand	28	35
sand & gravel	35	40

Work started 9-28-91, 19__ Completed Same, 19__

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 68 Twisp Wash 98856
(Signed) Byrum (WELL DRILLER) License No. 0781
Contractor's Registration No. METHOVDIC921 Date 9-28, 19 91

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) 1329 3

Well Log 21-25

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent IW C86375
UNIQUE WELL I.D. # ACL 719
Water Right Permit No. _____

(1) OWNER: Name John Ellis Address 15C 28 56th Ave N.W. Stanwood, Wa. 98292

(2) LOCATION OF WELL: County Okanogan SE 1/4 SE 1/4 Sec 21 T 33 N.R. 22E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) _____

TAX PARCEL NO.: _____

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
[X] New Well [ ] Deepened [ ] Reconditioned [ ] Decommission
Method: [ ] Dug [X] Cable [ ] Rotary [ ] Bored [ ] Driven [ ] Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 45 feet. Depth of completed well 44 ft.

(6) CONSTRUCTION DETAILS
Casing installed:
[X] Welded 6" Diam. from +1.5 ft. to 40 ft.
[ ] Liner installed _____" Diam. from _____ ft. to _____ ft.
[ ] Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: [ ] Yes [X] No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.

Screens: [X] Yes [ ] No [X] K-Pac Location 39
Manufacturer's Name JOHNSON
Type STAINLESS V-WIRE Model No. _____
Diam. 6T Slot Size .040 from 39 ft. to 44 ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand _____
Material placed from _____ ft. to _____ ft.

Surface seal: [X] Yes [ ] No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 9 ft. below top of well Date 5-13-00
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 75+ gal./min. with 0 ft. drawdown after 4 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Top Soil	0	4
Sand	4	8
Sand Gravel / Cobles	8	13
Clay & Silt	13	22
Sand & Gravel	22	38
Gravel & Sand	38	44
Sand & Silt	44	45

RECEIVED MAY 31 2000 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 4-28-00 Completed 5-13-00

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Abe Windle License No. 1421
(Licensed Driller/Engineer)

Trainee Name _____ License No. _____
Drilling Company Windle Enterprises
(Signed) Abe L. Windle License No. 1421
(Licensed Driller/Engineer)
Address P.O. Box 279 Brewster, Wa. 98812
Contractor's Registration No. WINOLE121PR Date 5-26-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

Well Log 21-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

(3) Flood plain

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission ("x" in circle)

☒ Construction 313956

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W254889

Unique Ecology Well ID Tag No. APE 462

Water Right Permit No. _____

Property Owner Name John Lomison

Well Street Address Twisp Airport Rd

City Twisp County Okanogan

Location SW 1/4-1/4 NE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 332221013 5

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 66 ft.

Depth of completed well 51.5 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +3 ft. to 51.5 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot size _____ from _____ ft. to _____ ft

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 14 ft. below top of well Date 9-16-08

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 16+ gal./min. with stem set at 50 ft. for 1.5 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
sandy loam	0	6
silty sand & gravel	6	22
clean sand & gravel	22	35
sand & random gravel	35	47
coarse sand & mixed gravel	47	53
lot of higher proportion		
sand & random gravel	53	66
recommend test pumping		
for sand free volume potential		

RECEIVED

SEP 19 2008

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 9-16-08 Completed Date 9-16-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MVM QUALITY DRILLING LLC

Driller/Engineer/Trainee Signature MARSHALL V. J MILLER

Driller or trainee License No. LC#1437 PH# 509 682 1122

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUDL033NM Date 9-17-08

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Well Log 21-27

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

05 rd well

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle)

☒ Construction 313955

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W254890

Unique Ecology Well ID Tag No. APE 460

Water Right Permit No. _____

Property Owner Name John Lomson

Well Street Address Twisp Airport Rd

City Twisp County Okanogan

Location SW 1/4-1/4 NE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 33222 10130

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 1

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 49 ft.

Depth of completed well 44 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +3 ft. to 46.5 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 20 ft. below top of well Date 9-15

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 16 gal./min. with stem set at 44 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
sandy loam	0	6
silty sand & gravel	6	25
sand & gravel	25	39
sand	39	43
sand & gravel	43	47
sand	47	49
2" gravel packed cone		

RECEIVED SEP 19 2008 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 9-15-08 Completed Date 9-15-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) MVM QUALITY DRILLING LLC

Driller/Engineer/Trainee Signature MARSHALL V. MILLER PH 509 682-1122

Driller or trainee License No. LIC # 1437

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Drilling Company MVM Quality Drilling, L.L.C.

Address 22905 Riverview Rd.

City, State, Zip Chelan, WA 98816

Contractor's Registration No. MVMQUD L033MM Date 9-17-08

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

(2) Cluster

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission ("x" in circle)
☒ Construction 313954
○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W254891 x

Unique Ecology Well ID Tag No. APE 461
Water Right Permit No. _____
Property Owner Name John Lomison
Well Street Address Twisp Airport Rd
City Twisp County Okanogan
Location SW 1/4-1/4 NE 1/4 Sec 21 Twn 33 R 22 EWM or WWM (circle one)
Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No. 33222 10126

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) 2
☒ New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 49 ft.
Depth of completed well 46.5 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 8" Diam. from 43 ft. to 46.5 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 14 ft. below top of well Date 9-15-08
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 25 gal./min. with stem set at 45 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
sand, gravel, cobbles	0	15
silty sand & gravel	15	23
gravel	23	25
sand	25	43
sand & gravel	43	49
1' gravel packed core		

RECEIVED
SEP 19 2008
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 9-15-08 Completed Date 9-15-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (print) MVM Quality Drilling, LLC
Driller/Engineer/Trainee Signature Marshall V. Miller 509 682-1122
Driller or trainee License No. LLC# 1437

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

Drilling Company MVM Quality Drilling, L.L.C.
Address 22905 Riverview Rd.
City, State, Zip Chelan, WA 98816
Contractor's Registration No. MVMQUDL033MM Date 9-17-08

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 21-29

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File: Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W105143
UNIQUE WELL I.D. # BEG 286
Water Right Permit No. _____

(1) OWNER: Name Robert Ebbert Address PO Box 445 Twisp WA 98856

(2) LOCATION OF WELL: County Okan NE 1/4 NW 1/4 Sec 21 T. 33 N. R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 4 East Twisp Airport Hwy 20 C

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (If more than one) _____
Abandoned [ ] New well [ ] Deepened [ ] Reconditioned [ ] Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 140 feet. Depth of completed well 140 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 140 ft.
Welded [X] _____" Diam. from _____ ft. to _____ ft.
Liner installed [ ] _____" Diam. from _____ ft. to _____ ft.
Threaded [ ]

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 15 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 61 ft. below top of well Date 8-24
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airlift 15 gal./min. with stem set at _____ ft. for 4 hrs.
Artesian flow _____ g.p.m. Date 8-25-98
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
overburden	0	3
gravel	3	10
clay	10	24
gravel & clay	24	48
sand	48	100
silt	100	110
clay	110	130
hard pan	130	135
cemented sand & gravel	135	140

RECEIVED SEP 1 4 1998 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

RECEIVED SEP 14 1998 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work Started 8-24 1998 Completed 8-24 1998

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 68 Twisp WA
(Signed) Bynum (WELL DRILLER) License No. 0781
Contractor's Registration No. MEVDRI812 Date 8-24- 1998

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 21-43

ECY 050-1-20 (5/93) * * f

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology ~~95540~~
Second Copy - Owner's Copy
Third Copy - Driller's Copy 29521S

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W114828
UNIQUE WELL I.D. # ACE 127
Water Right Permit No.

OWNER: Name Ross Barnard Address 82 Twisp Airport Rd Twisp 98856

(2) LOCATION OF WELL: County Okanogan SW FEB 2 NW 1/4 Sec 21 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Same as above

TAX PARCEL NO.:

DEPT. OF ECOLOGY FISCAL

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☐ Welded 6" Diam. from 0 ft. to 40 ft.
☐ Liner installed " Diam. from ft. to ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft. to ft.

Surface seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 20 ft. below top of well Date 9-15-99
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 to 40 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
overburden	0	3
clay & gravel	3	20
clay	20	24
sand	24	34
coarse sand & gravel	34	40

RECEIVED
MAR 01 2001
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT. OF ECOLOGY Received MAR 05 2001 CENTRAL REGION OFFICE

Work Started 9-15 Completed same 99

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name R. Bynum License No. 0787
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Methow Valley Drilling
(Signed) R. Bynum License No. 0787
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp Wash 98856
Contractor's Registration No. METHOVO 12CR Date 9-15 99

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

Well Log 21-44

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction 139371
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number*

CURRENT Notice of Intent No W 170408
Unique Ecology Well ID Tag No AKH 741
Water Right Permit No
Property Owner Name Tori Karpenko
Well Street Address None
City Twisp County Okanogan
Location SW 1/4 1/4 SE 1/4 Sec 21 Twn 33 R 22 (EWM) or WWM circle one
Lat/Long (s t r still REQUIRED) Lat Deg Lat Min/Sec
Long Deg Long Min/Sec
Tax Parcel No

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK Owner s number of well (if more than one)
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 8 inches, drilled 42 ft
Depth of completed well 38 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 8 Diam from 42 ft to 38 ft
☐ Liner installed Diam from ft to ft
☐ Threaded Diam from ft to ft

Perforations ☐ Yes ☒ No
Type of perforator used
SIZE of perfs in by in and no of perfs from ft to ft

Screens ☐ Yes ☒ No ☐ K Pac Location
Manufacturer s Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Materials placed from ft to ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

PUMP Manufacturer s Name
Type H P

WATER LEVELS Land surface elevation above mean sea level ft
Static level 15 ft below top of well Date 9-22-03
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 30 gal /min with stem set at 37 ft for 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
sandy loam	0	6
coarse sand	6	14
sand & gravel	14	23
coarse sand	23	36
clean gravel	36	38
sand	38	42

DEPT OF ECOLOGY Received SEP 25 2003 CENTRAL REGION OFFICE

Start Date 9-22-03 Completed Date 9-22-03

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Marshall Miller
Driller/Engineer/Trainee Signature MV Miller
Driller or Trainee License No 1437
Drilling Company MVM Quality Drilling
Address 22905 Riverview Rd
City State Zip Chelan, WA 98816
Contractor s Registration No MVMQUDLO033MM Date 9-23-03

If trainee, licensed driller s Signature and License no

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

Well Log 21-45

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

3470

Start Card No. 081005

Water Right Permit No. A

(1) OWNER: Name Barbara Meadors Address HCR 393, Twisp WA-9885

(2) LOCATION OF WELL: County Okan NE ¼ NE ¼ Sec. 28 T. 35 N., R. 22 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) I

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 40 ft.
Welded [X] " Diam. from ft. to ft.
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ]

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 21 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.
Airtest 70 gal./min. with stem set at 35 ft. for 1 hr. hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
OVERBORDEN	0	4
COURSE SAND GRAVEL	4	27
FINE BRN SAND	27	35
COURSE SAND GRAVEL	35	40

RECEIVED 1990 DEPARTMENT OF ECOLOGY CENTRAL REGIONAL OFFICE

Work started Aug 4, 19 90 Completed Same, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 68 Twisp Wa
(Signed) Darrell Rentz (WELL DRILLER) License No. 0426
Contractor's Registration No. MethoVdRIC Date Aug 4, 19 90

(USE ADDITIONAL SHEETS IF NECESSARY)

Well Log 28-1

ECY 050-1-20 (10-87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☒ Construction 254419

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 225757

Unique Ecology Well ID Tag No. ATH 550

Water Right Permit No. _____

Property Owner Name Brice Butler

Well Street Address 10059 Lake Shore Blvd.

City Seattle County Okanogan

Location NW 1/4-1/4 NE 1/4 Sec 28 Twn 33 R 22 EWM or WWM (circle one) B

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 505 ft.

Depth of completed well 505 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 135 ft.

☒ Liner installed 4" Diam. from -5 ft. to 505 ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 80 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 97 ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☐ No If yes, by whom? _____

Yield: 1 gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 1 gal./min. with stem set at 505 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top Soil	0	3
Gravel, Boulders	3	40
Gravel, Large	40	85
Sand & Gravel	85	95
Sand-Wet	95	105
Cemented Sand & Gravel-Wet	105	125
Brown Sticky Wet Clay	125	133
Quartzite	133	135
Broken Quartzite W/a	135	
Trace of Water		136
Med. Hard Quartzite	136	275
Broken Quartzite W/a	275	
Trace of Water		290
Broken Quartzite	290	310
Hard Quartzite	310	455
Med. Hard Quartzite	455	505

DEPT OF ECOLOGY Received JAN 11 2007 CENTRAL REGION OFFICE

Start Date Oct. 11, 2006 Completed Date Oct. 13, 2006

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Joseph L. Booth

Driller/Engineer/Trainee Signature Joseph L. Booth

Driller or trainee License No. 0564

Drilling Company Okanogan Drilling

Address 48 Rodeo Trail Rd.

City, State, Zip Okanogan, Wa. 98840

Contractor's Registration No. Okanodd119LT Date Oct. 18, 2006

If TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Well Log 28-3

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction 148628
○ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

CURRENT Notice of Intent No W 154857

Unique Ecology Well ID Tag No AKL 842

Water Right Permit No _____

Property Owner Name Janet Eileen B

Well Street Address _____

City TWISP County OKANOGAN

Location NW 1/4 1/4 NE 1/4 Sec 28 Twn 33 R 22 ~~EWM~~ circle one or WWM

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
☒ New Well ☐ Reconditioned Method ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 8 inches drilled 38 ft
Depth of completed well 38 ft

CONSTRUCTION DETAILS
Casing Installed ☐ Welded 6 Diam from 0 ft to 38 ft
☐ Liner installed _____ Diam from _____ ft to _____ ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 20 ft below top of well Date 4-13-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 50 gal /min with stem set at _____ ft for _____ hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	1
gravel sand	1	10
gray clay & gravel	10	18
coarse sand & gravel	18	38

Start Date 4-13-04 Completed Date Same

DEPT OF ECOLOGY Received APR 19 2004 CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No 0781

Drilling Company Methow Valley Drilling
Address PO Box 68
City State Zip TWISP WA 98856
Contractor s Registration No Methoviz2cl Date 4-13-04

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 4 20 (Rev 4/01)

Well Log 28-6

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 05318

Water Right Permit No. AAI278

(1) OWNER: Name Steve Ward Address P.O. Box 854, Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan NE ¼ SE ¼ Sec 28 T 33 N., R 22 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) West of Okanogan Cty Rd. #9015; N of McClure Mt. Access Rd.

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [ ] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 38 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 38 ft.
Welded [ ] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 12 ft. below top of well Date 4/14
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30-40 gal./min. with stem set at 35 ft. for 1 hrs.
Artesian flow g.p.m. Date 4/14
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
TOP SOIL, SANDY	0	5
CEMENTED COBBLES, SAND, GRAVEL, GREY	5	20
SANDY SILT, DAMP	20	32
SAND, GRAVEL	32	38

26

Work started 4/13/'94, 19. Completed 4/14/'94, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME COUNTRY TOWN DRILLING (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address P.O. Box 279, Carlton WA 98814

(Signed) [signature] (WELL DRILLER) License No. 1492

Contractor's Registration No. COUNTTD131QW Date 4/23/'94, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Well Log 28-7

ECY 050-1-20 (10/87) 1329

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

110949

WATER WELL REPORT

ECOLOGY Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission *("x" in circle)*
- ○ Construction
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W154901

Unique Ecology Well ID Tag No. AGM 929

Water Right Permit No. _____

Property Owner Name Bert Northcott

Well Street Address 4 mi S. Twisp on Twisp Carlton Rd

City Twisp County: Okanogan

Location SE 1/4- 1/4 NW 1/4 Sec 34 Twn 33 R 22 EWM or WWM *circle one*

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 80 ft
Depth of completed well 80 ft

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from 0 ft to 80 ft
☐ Liner installed _____" Diam from _____ ft to _____ ft
☐ Threaded _____" Diam from _____ ft to _____ ft

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 48 ft below top of well Date Feb 28
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 35 gal/min with stem set at 80 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
overburden	0	2
gravel	2	10
Fine silt	10	17
clay	17	34
Fine silt	34	51
coarse sand	51	74
sand & gravel	74	80

Start Date 2-28 Completed Date Same 02

DEPT OF ECOLOGY Received APR 0 2 2002 CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No. 0781
Drilling Company Methow Valley Drilling
Address P.O. Box 68
City, State, Zip Twisp Wa 98856
Contractor's Registration No. METHOVD121CL Date 2-28-02

If trainee, licensed driller's Signature and License no. _____

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

WellLog 34-1

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return to the Department of Ecology

Water Well Report

Original – Ecology, 1st copy – owner, 2nd copy – driller

Construction/Decommission

☒ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 254744

Current Notice of Intent No. 22652
Unique Ecology Well ID Tag No. APG676
Water Right Permit No.
Property Owner Name Charlie Snow
Well Street Address Surface Lane
City Twisp County Okanogan
Location NW 1/4-1/4 SE 1/4 Sec 34 Twn 33 R 22 EWM ☒ or WWM ☐ circle one
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No.

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK: Owner's number of well (if more than one)
☒ New well ☐ *Reconditioned* ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 100 ft.
Depth of completed well 97 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 8" Diam. from +2 ft. to 97 ft.
☐ Liner installed ____" Diam. from ____ ft. to ____ ft.
☐ Threaded ____" Diam. from ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand
Materials placed from ____ ft. to ____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.
Material used in seal bentonite slurry
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

PUMP: Manufacturer's Name
Type: H.P.

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 64 ft. below top of well Date 11/8/06
Artesian pressure ____ lbs. per square inch Date
Artesian water is controlled by (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 15+ gal./min. with stem set at 96 ft. for 2 hrs.
Artesian flow ____ g.p.m. Date
Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
loam	0	6
sand, gravel, + <12 boulders	6	13
large gravel, small cobble	13	19
J Coarse sand	19	20
large round gravel	20	38
fine sand + silt	38	58
fine wet sand	58	86
coarse sand w/ random gravel	86	90
gravel w/ light sand J	90	97

DEPT OF ECOLOGY Received DEC 07 2006 CENTRAL REGION OFFICE

Start Date 11/8/06 Completed Date 11/8/06

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Driller/Engineer/Trainee Name (Print) CO: MVM QUALITY DRILLING LLC TEL (509) 682-1122
Driller/Engineer/Trainee Signature NAME: MARSHALL V. MILLER, LIC.# 1437
Driller or trainee License No. 2706 REG#: MVM QUD L033MM

Drilling Company MVM Quality Drilling, L.L.C.
Address 22905 Riverview Rd.
City, State, Zip Chelan, WA 98816
Contractor's Registration No. MVMQUDL033MM Date 11/9/06

If TRAINEE,
Driller's Licensed No.
Driller's Signature

Ecology is an Equal Opportunity Employer. ECY 050-1-20 (Rev 2/03)

Well Log 34-6

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. IV 047423
UNIQUE WELL I.D. # ABX 541
Water Right Permit No. _____

(1) OWNER: Name David Beach-LEE Borde Address HCR 73 Box 346 Twisp WA

(2) LOCATION OF WELL: County Okan NW 1/4 SE 1/4 Sec 34 T. 33 N., R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 3 South of Twisp W. County Rd K

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater ☐ Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (If more than one) _____
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 114 feet. Depth of completed well 114 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 114 ft.
Welded ☒ _____" Diam. from _____ ft. to _____ ft.
Liner installed ☐
Threaded ☐ _____" Diam. from _____ ft. to _____ ft.

Perforations: Yes ☐ No ☒
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. ____ Slot size _____ from _____ ft. to _____ ft.
Diam. ____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 19 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 60 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 50 gal./min. with stem set at 112 ft. for 3 hrs.
Artesian flow _____ g.p.m. Date 8-20-95
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	4
Coarse Gravel	4	12
Coarse Gravel/Sand	12	24
Clay Brown Hard pan	24	39
Silty Sand	39	74
Coarse Gravel	74	114

Work Started 8-20-95, 19. Completed Aug 20, 1995

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 68 Twisp
(Signed) [signature] (WELL DRILLER) License No. 1764
Contractor's Registration No. Methovdrlg Date Aug 20, 1994

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Well Log 34-8

ECY 050-1-20 (9/93) * * f

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W089833
UNIQUE WELL I.D. # AET 813
Water Right Permit No. _____

(1) OWNER: Name James Hunter Address 1243 Holiday Drive Batavia IL 60510

(2) LOCATION OF WELL: County Okanogan NE 1/4 NE 1/4 Sec 34 T 33 N.R. 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) Off Hwy 153 A

(3) PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New well ☐ Deepened ☐ Reconditioned
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 100 feet. Depth of completed well 96 ft.

(6) CONSTRUCTION DETAILS
Casing installed:
☐ Welded 6" Diam. from 0 ft. to 96 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: ☐ Yes ☒ No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: ☒ Yes ☐ No To what depth? 18
Material used in seal Bentonite
Did any strata contain unusuable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 60 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 40 to 50 gal./min. with stem set at 90 ft. for 1 hrs.
Atesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	1
gravel	1	13
gray hardpan	13	24
hard silt	24	33
brown sand	33	61
brown sand & gravel	60	63
brown sand	63	90
coarse sand & gravel	90	97
coarse sand	97	100

DEPT. OF ECOLOGY Received MAY 20 1998 CENTRAL REGIONAL OFFICE

Work Started 12-30, 19____. Completed Same, 19 98

WELL CONSTRUCTION CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.
NAME Methow Valley Drilling (Person, Firm, or Corporation) (Type of Print)
Address P.O. Box 68 Twisp, WA 98856
(Signed) [signature] License No. 0281
Contractor's Registration No. METHOVDI21CE Date _____, 19 ___

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (7/97)

Well Log 34-10

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W113870
UNIQUE WELL I.D. # AGT824
Water Right Permit No. _____

(1) OWNER: Name Jim Hunter Address PO Box Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan NE 1/4 NE 1/4 Sec 34 T 23 N.R 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) HWY 153 A

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) 2 Replacement
[X] New well [ ] Deepened [ ] Reconditioned
Method: [ ] Dug [ ] Bored [ ] Cable [ ] Driven [X] Rotary [ ] Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 80 feet. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
[ ] Welded 6" Diam. from 0 ft. to 80 ft.
[ ] Liner installed " Diam. from ft. to ft.
[ ] Threaded " Diam. from ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: [ ] Yes [X] No
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: [ ] Yes [X] No Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: [X] Yes [ ] No To what depth? 18
Material used in seal Bentonite
Did any strata contain unusuable water? [ ] Yes [X] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 58 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [ ] No If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 30 gal./min. with stem set at 80 ft. for 2 hrs.
Atesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	1
Sand	1	8
Clay	8	15
Hard pan	15	23
Sand	23	39
Fine sand	39	65
Coarse sand & gravel	65	80

RECEIVED MAY 19 1999 DEPARTMENT OF ECOLOGY WELL DRILLING UNIT

DEPT. OF ECOLOGY CENTRAL REGION OFFICE Received MAY 21 1999

Work Started 4-20, 19____. Completed same, 19 99

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (Person, Firm, or Corporation) (Type or Print)
Address P.O. Box 68 Twisp 98856
(Signed) Bynum License No. 0781
Contractor's Registration No. METHOVDR121CR Date 4-20, 19 99

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (7/97)

Well Log 34-12

File Original with Department of Ecology 94858
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W129735
UNIQUE WELL I.D. # AFQ841
Water Right Permit No Water Cert #945

(1) OWNER Name James Huntlee Address 1243 Holloday Drive Batavia IL 60510

(2) LOCATION OF WELL County Okanogan NE 1/4 NE 1/4 Sec 34 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL (or nearest address) HWY 1753 A

TAX PARCEL NO

(3) PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS Diameter of well 8 inches
Drilled 100 feet Depth of completed well 100 ft

(6) CONSTRUCTION DETAILS
Casing Installed
☐ Welded 8" Diam from 0 ft to 100 ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

Perforations ☒ Yes ☐ No
Type of perforator used Roller
SIZE of perforations 1/8 in by 1 in
60 perforations from 90 ft to 100 ft

Screens ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H.P.

(8) WATER LEVELS Land surface elevation above mean sea level ft
Static level 60 ft below top of well Date 11-15-00
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield gal./min. with ft. drawdown after hrs.
Yield gal./min. with ft. drawdown after hrs.
Yield gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 200 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Overburden	0	6
brown sandy clay	6	22
fine sand	22	41
coarse sand	41	65
coarse sand & gravel	65	90
gravel	90	100

RECEIVED
DEC 15 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 11-15, 00 Completed Same

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Steve Konrad License No 1764
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company Methow Valley Drilling
(Signed) Steve Konrad License No 1764
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp Wash
Contractor's Registration No Methovv121CK Date 11-16-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Well Log 34-14

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1 20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

2 ½ 7 1

WATER WELL REPORT

ECOLOGY Original & 1st copy - Ecology 2nd copy owner, 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction 151226
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W177453

Unique Ecology Well ID Tag No ARL 662

Water Right Permit No _____

Property Owner Name Kevin McKown

Well Street Address 1009 Twisp Carlton Hwy

City Carlton County Okanogan

Location SW 1/4 NW 1/4 Sec 34 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec E

Tax Parcel No _____

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 112 ft
Depth of completed well 112 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 6 Diam from +2 ft to 112 ft
☐ Liner installed _____ Diam from _____ ft to _____ ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☒ Yes ☐ No ☒ K Pac Location 102'
Manufacturer's Name Johnson
Type V-slot Model No _____
Diam 6 Slot Size .025 from 102 ft to 107 ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 7.3 ft below top of well Date 6-8-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Airtest 257 gal/min with stem set at 111 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
top soil	0	6
dry blow sand	6	40
silty fine sand	40	95
clean large pea gravel	95	112

DEPT OF ECOLOGY Received JUN 14 2004 CENTRAL REGION OFFICE

Start Date 6/7/04 Completed Date 6/8/04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Marshall Miller
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No 1437

Drilling Company MVM Quality Drilling
Address 22905 Riverview Rd
City State Zip Chelan, WA 98816
Contractor's Registration No MVMQUDL0033MM Date 6-8-04

If trainee, licensed driller's Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 34-15

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 101719

(X) Construction

( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W122668

Unique Ecology Well ID Tag No. AFH 580

Water Right Permit No. _____

Property Owner Name Larry Surface

Well Street Address HCR 73 Box 360

City Twisp County: Okan

Location NE 1/4- 1/4 NW 1/4 Sec 34 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

[X] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 95 ft

Depth of completed well 95 ft

CONSTRUCTION DETAILS

Casing Installed: [X] Welded 6" Diam from 0 ft to 95 ft

[ ] Liner installed _____" Diam from _____ ft to _____ ft

[ ] Threaded _____" Diam from _____ ft to _____ ft

Perforations: [ ] Yes [X] No

Type of perforator used _____

SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens: [ ] Yes [X] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot Size _____ from _____ ft to _____ ft

Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal: [X] Yes [ ] No To what depth? 21 ft

Materials used in seal Bentonite

Did any strata contain unusable water? [ ] Yes [X] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft

Static level 60 ft below top of well Date 6-23-01

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [ ] No If yes, by whom? _____

Yield _____ gal./min. with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level.

Date of test _____

Bailer test _____ gal./min with _____ ft drawdown after _____ hrs

Airtest 20 gal./min with stem set at 93 ft for 2 hrs

Artesian flow _____ g p m Date 6-25-01

Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	7
Coarse Gravel	7	16
Hardpan Clay	16	26
Silty Sand	26	65
Coarse Gravel and	65	80
Coarse Gravel	80	95

DEPT OF ECOLOGY Received JUL 16 2001 CENTRAL REGION OFFICE

Start Date 6-23-01 Completed Date 6-24-01

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Richard Byman

Driller/Engineer/Trainee Signature [signature]

Driller or Trainee License No. 0781

If trainee, licensed driller's Signature and License no. _____

Drilling Company Methow Valley Drilling

Address PO Box 68

City, State, Zip Twisp WA 98856

Contractor's Registration No. Methowvalley Date 6-24-01

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 34-16

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 101718

(X) Construction

( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W-122667

Unique Ecology Well ID Tag No. AFH 589

Water Right Permit No. _____

Property Owner Name Larry Surface

Well Street Address HCR 73 Box 360

City Twisp County: Okan

Location NE 1/4- 1/4 NW 1/4 Sec 34 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

[X] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 270 ft

Depth of completed well 270 ft

CONSTRUCTION DETAILS

Casing Installed: [X] Welded 6" Diam. from 0 ft to 270 ft

[ ] Liner installed _____" Diam from _____ ft to _____ ft

[ ] Threaded _____" Diam from _____ ft to _____ ft.

Perforations: [ ] Yes [X] No

Type of perforator used _____

SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens: [ ] Yes [X] No [ ] K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot Size _____ from _____ ft to _____ ft

Diam. _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal: [X] Yes [ ] No To what depth? 21 ft

Materials used in seal Bentonite

Did any strata contain unusable water? [ ] Yes [X] No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft

Static level 60 ft below top of well Date June 26-01

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap,valve, etc)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? [ ] Yes [X] No If yes, by whom? _____

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min with _____ ft drawdown after _____ hrs

Airtest 20 gal./min with stem set at 269 ft for 2 hrs

Artesian flow _____ g p m Date 6-25-01

Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	2
gravel sandy	2	19
brown clay	19	28
gray clay & gravel	28	45
coarse sand	45	110
fine sand	110	155
coarse sand	155	215
coarse sand some gravel	215	220
silty clay	220	260
coarse sand & gravel	260	270

Start Date 6-24-01 Completed Date 6-26-01

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Steve Konrad

Driller/Engineer/Trainee Signature Steve Konrad

Driller or Trainee License No 1764

If trainee, licensed driller's Signature and License no. _____

Drilling Company Methow Valley Drilling

Address PO Box 68

City, State, Zip Twisp WA 98856

Contractor's Registration No. Methovdrlg Date 6-26-01

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Well Log 34-17

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 10/7/2

(X) Construction
( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W122669

Unique Ecology Well ID Tag No. AFH 579

Water Right Permit No. _____

Property Owner Name Larry Sueface

Well Street Address HCR 73 Box 360

City Twisp County: Okan

Location NE 1/4- 1/4 NW 1/4 Sec 34 Twn 33 R 22 EWM or WWM (circle one)

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK: Owner's number of well (if more than one) 3

[X] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [ ] Cable [X] Rotary [ ] Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 95 ft
Depth of completed well 95 ft

CONSTRUCTION DETAILS

Casing Installed: [X] Welded 6" Diam from 0 ft to 95 ft
[ ] Liner installed _____" Diam. from _____ ft to _____ ft
[ ] Threaded _____" Diam. from _____ ft to _____ ft

Perforations: [ ] Yes [X] No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens: [ ] Yes [X] No [ ] K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam. _____ Slot Size _____ from _____ ft to _____ ft
Diam. _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: [ ] Yes [ ] No [ ] Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal: [X] Yes [ ] No To what depth? 21 ft
Materials used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 60 ft below top of well Date 6-23-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom? _____
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal./min. with _____ ft drawdown after _____ hrs
Yield _____ gal./min. with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 20 gal./min with stem set at 93 ft for 2 hrs
Artesian flow _____ g p m Date 6-23-01
Temperature of water _____ Was a chemical analysis made? [ ] Yes [X] No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	7
Coarse Gravel	7	15
Hardpan Clay	15	26
Silty Sand	26	64
Coarse Sand	64	80
Coarse Gravel	80	95

DEPT OF ECOLOGY Received JUL 18 2001 CENTRAL REGION

Start Date 6-22-01 Completed Date 6-23-01

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Steve Konrad

Driller/Engineer/Trainee Signature Steve Konrad

Driller or Trainee License No. 1764

If trainee, licensed driller's Signature and License no. _____

Drilling Company Methow Valley Drilling

Address PO Box 68

City, State, Zip Twisp WA 98856

Contractor's Registration No Methowdrlg Date 6-23-01

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 34-18

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology 95538
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W129 863
UNIQUE WELL I D # AGB 404
Water Right Permit No Cert # 945 (CS4-MVIDC 112 Vanduvort)

(1) OWNER Name Lester Madge Vanduvort Address P.O. Box 1163 Twisp WA 98856

(2) LOCATION OF WELL County Okanogan NE 1/4 NE 1/4 Sec 34 T 33 N R 22 WM

(2a) STREET ADDRESS OF WELL. (or nearest address)

TAX PARCEL NO

A

(3) PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS Diameter of well 8 inches
Drilled 48 feet Depth of completed well 45.5 ft

(6) CONSTRUCTION DETAILS
Casing Installed
☒ Welded 8" Diam from +2 ft to 45.5 ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

Perforations ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft

Screens ☒ Yes ☐ No ☐ K-Pac Location 39
Manufacturer's Name Johnson
Type Stainless / Telescoping Model No
Diam 8 Slot Size .025 from 45 ft to 40 ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land surface elevation above mean sea level ft
Static level 11 ft below top of well Date 2-22-2001
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap, valve, etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 50 gal./min with — ft drawdown after 3 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Sandy loam	0	4
Sandy / gravel	4	16
dark sand	16	18
Clay brown sand	18	20
angular gravel	20	26
coarse sand	26	35
coarse sand, random pea gravel	35	48

DEPT OF ECOLOGY RECEIVED MAR 05 2001 CENTRAL REGION OFFICE

Work Started 2-22- 2001 Completed 2-22 2001

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Marshall Miller License No 1437
(Licensed Driller/Engineer)

Trainee Name License No

Drilling Company MM Quality Drilling, LLC

(Signed) M V Miller License No 1437
(Licensed Driller/Engineer)

Address 22905 Riverview Rd., Chelan, WA 98816

Contractor's Registration No MVMQUDL033MM Date 2-23 2001

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs, contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

Well Log 3410

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 049684
UNIQUE WELL I.D. # ACX701
Water Right Permit No.

OWNER: Name Robert Roseland Address PO Box 662 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan - SE 1/4 SE 1/4 Sec 34 T. 33 N., R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 3322340223 Parcel # R

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [ ] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 64 feet. Depth of completed well 64 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 ft. to 59 ft.
Welded [X] " Diam. from ft. to ft.
Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [X] No [ ]
Manufacturer's Name
Type telescoping stainless Model No.
Diam. 6 Slot size .006 from 59 ft. to 64 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [ ] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 33 ft. below top of well Date 7/20/98
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 25 gal./min. with 10 ft. dr[illegible] 1 hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand, brown silty	0	8
Sand, brown silty coarse	8	32
Sand, brown with some gravel	33	48
Sand, brown silty very fine	48	56
Sand, brown med. coarse ; with some gravel	56	63
Sand, brown medium	63	
Drilled with cable tool		

RECEIVED
AUG 24 1998
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 7/15/98 Completed 7/19/98

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) Ken Engle (WELL DRILLER) License No. 1390
Contractor's Registration No. COUNTTD131QW Date 7/25/98

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6800. The TDD number is (206) 407-6006.

AUG 3 1998

ECY 050-1-20 (9/93)

Well Log 34-20

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

State of Washington Date Printed: 19-Oct-2007 Log No. 0

Construction / Decommission: Original Construction Notice

Construction 274799

PROPOSED USE: DOMESTIC

TYPE OF WORK: Owners's Well Number: (If more than one well)

NEW WELL Method: ROTARY

DIMENSIONS Diameter of well: 6 inches

Drilled 200 ft. Depth of completed well 196 ft.

CONSTRUCTION DETAILS: Casing installed WELDED

6 " Dia from +2 ft. to 191 ft.

5 " Dia from 187 ft. to 191 ft.

" Dia from ft. to ft.

Liner installed:

" Dia from ft. to ft.

Perforations: No Used In:

Type of perforator used

SIZE of perforations in. b in.

Perforation from ft. to ft.

Perforation from ft. to ft.

Perforation from ft. to ft.

Screens: Yes K-Pac Location 187

Manufacture's Name JOHNSON

Type: SLOTTED Model No STAINLESS STEEL

Diam. 6 slot size .25 from 191 ft. to 196 ft.

Diam. slot size from ft. to ft.

Gravel/Filter packed: No Size of Gravel

Material placed fro ft. to ft.

Surface seal: Yes To what depth 190 ft.

Seal method: Material used in seal BENTONITE

Did any strata contain unusable water No

Type of water Depth of strata

Method of sealing strata off

PUMP: Manufacture's name

Type: H.P. 0

WATER LEVELS Land-surface elevation above mean sea level: 0 ft.

Static level 60 ft. below top of well Date 08/24/2007

Artesian Pressure lbs per square inch Date

Artesian water controlled by

WELL TESTS: Drawdown is amount water level is lowered below static level.

Was a pump test made No If yes, by whom

Yield gal/min with ft drawdown after

Yield gal/min with ft drawdown after

Yield gal/min with ft drawdown after

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level

Time:	Water Level	Time:	Water Level	Time:	Water Level

Date of test:

Bailer test gal/min ft drawdown after hrs.

Air test 30 gal/min w/ stem set at 195 ft. for 1 hours

Artesian flow gpm Date

Temperature of water Was a chemical analysis made No

CURRENT

Notice of Intent No.: W209909

Unique Ecology Well I.D. No APB400

Water Right Permit Number:

OWNER: THOMAS, SANDRA K

OWNER ADD 11805 60TH ST NE

LAKE STEVENS, WA 98258

E

Well Add SURFACE LANE

City: Twisp, WA 98856 County: Okanogan

Location: SW 1/4 NW 1/4 Sec 34 T 33 R 22E EW

Lat/Long: (s, t, r still REQUIRED) Lat Deg Lat Min/Sec Long Deg Long Min/Se

Tax Parcel No.: 3322340257

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure. Show thickness of aquifiers and the kind and nature of the material in each stratum penetrated. Show at least one entry for each change in formation.

Material	From	To
SANDY LOAM	0	2
SAND GRAVEL COBBLE	2	25
SAND BROWN SOME GRAVEL	25	115
SAND GRAVEL WATER	115	122
SAND FINE WET	122	155
SAND FINE SILTY WET	155	175
MED SAND WET	175	191
COARSE SAND WATER	191	200

Notes:

Work starte 08/23/2007 Complete 08/24/2007

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee

Name: MARTY RUGO License No.: 2038

Signature: Marty Rugo

If trainee, Licensed driller is: License No.:

Licensed Driller Signature

Drilling Company:

NAME: FOGLE PUMP & SUPPLY, INC. SHOP: REPUBLIC

ADDRESS: PO Box 456

Republic, WA 99166

Phone: Toll Free: 8008453504

E-Mail: leslie@foglepump.com

FAX: 5097750498 WEB Site: www.foglepump.com

Contractor's Registration No.: FOGLEPS095L4 Date Log Created: 09/06/200

DEPT OF ECOLOGY Received OCT 24 2007 CENTRAL REGION OFFICE

Well Log 34-21

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 204331

Water Right Permit No. _____

(1) OWNER: Name ED SCHACHTSEIEDER Address _____

(2) LOCATION OF WELL: County KITTITAS NE. NE. Sec. 4 T. 32 N. R. 22 WM

(2a) STREET ADDDRESS OF WELL (or nearest address) _____

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]

Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well _____ inches.

Drilled _____ feet. Depth of completed well _____ ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 80 ft.

Welded [X] Liner installed [ ] Threaded [ ] _____" Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]

Type of perforator used _____

SIZE of perforations _____ in. by _____ in.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.

Material used in seal BENTONITE

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____

Type _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 59 ft. below top of well Date _____

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Artest 30 gal./min. with stem set at 75 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
OVERBURDEN	0	2
COURSE SAND GRAVEL	2	34
COURSE BRN SAND	34	62
COURSE SAND GRAVEL	62	80

Work started 5/15 19 93 Completed 5/15 19 93

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME METHOW VALLEY DRILL (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address PO BOX 68 TWISP WASH

(Signed) [signature] (WELL DRILLER) License No. 0426

Contractor's Registration No. METHOWDRLR Date 5/15 19 93

Well Log 3-1

USE ADDITIONAL SHEETS IF NECESSARY

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 49694
UNIQUE WELL I.D. # ACX 714
Water Right Permit No. _____

(1) OWNER: Name Mary Gaylord Address PO Box 592 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan SW 1/4 SE 1/4 Sec 3 T. 32 N., R. 22 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 470 Twisp/ Carlton Westside Rd, Twisp, WA 98856

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 80 feet. Depth of completed well 75 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +2 ft. to 75 ft.
Welded [X] " Diam. from ft. to ft.
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ]

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [X] No [ ]
Manufacturer's Name
Type Model No.
Diam 4.75 Slot size .017 from 75 ft. to 80 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Grundfos
Type: Submersible H.P. 1

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 38 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 40-50 gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Silt, sand, cobbles	0	20
Sand, coarse	20	45
Fine grey clay	45	60
Fine sand, medium fine	60	80

Drilled w/NUMEX under-reaming system

Work Started 6/14/99, 19. Completed 6/21/99, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) [signature] (WELL DRILLER) License No. 1492
Contractor's Registration No. ~~COUNTTD131QW~~ Date ~~6/25/99~~, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

DEPT. OF ECOLOGY JUL 2 1999 Received REGION OFFICE

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

ECY 050-1-20 (9/93)

Well Log 3-9

File Original with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W122363
UNIQUE WELL I.D. # AFH 175
Water Right Permit No. Certificate #945 #57

(1) OWNER: Name Rudolf Schade Address 2681 HWY 153 Twisp 98856

(2) LOCATION OF WELL: County Okanogan SW 1/4 SE 1/4 Sec 3 T 32 N.R 22 WM

(2a) STREET ADDRESS OF WELL: (or nearest address) same

TAX PARCEL NO.:

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater water Certificate 945

(4) TYPE OF WORK: Owner's number of well (if more than one)
[X] New Well [ ] Deepened [ ] Reconditioned [ ] Decommission
Method: [ ] Dug [ ] Cable [X] Rotary [ ] Bored [ ] Driven [ ] Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 253 feet. Depth of completed well 253 ft.

(6) CONSTRUCTION DETAILS
Casing installed:
[X] Welded 6 " Diam. from 0 ft. to 253 ft.
[ ] Liner installed " Diam. from ft. to ft.
[ ] Threaded " Diam. from ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: [ ] Yes [X] No [ ] K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot Size from ft. to ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: [ ] Yes [X] No [ ] Size of gravel/sand
Material placed from ft. to ft.

Surface seal: [X] Yes [ ] No To what depth? 18 ft.
Material used in seal
Did any strata contain unusable water? [ ] Yes [X] No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 50 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [X] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 75 gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? [ ] Yes [X] No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Overburden	0	2
Clay & gravel	2	10
Clay	10	21
Blue silt (Dry)	21	44
Fine sand	44	55
Coarse sand	55	72
Fine sand	72	105
medium sand	105	161
gray sandy clay	161	180
Coarse sand	180	236
Coarse sand & gravel	236	253

DEPT OF ECOLOGY
CASHIERING SECTION
00 MAY 26 P2:22

RECEIVED
MAY 31 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT OF ECOLOGY
JUN 5 2000
RECEIVED

Work Started 5-10 Completed 5-12-00

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Rich Bynum License No. 0781
(Licensed Driller/Engineer)

Trainee Name License No.
Drilling Company Methow Valley Drilling
(Signed) Richard T. Bynum License No. 0781
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp 98856
Contractor's Registration No. MEthOV012IC Date 5-12-00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Well Log 9 of 9

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
(X) Construction 150495
( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W170037

Unique Ecology Well ID Tag No AKL 661

Water Right Permit No F

Property Owner Name John Sinclair

Well Street Address 1414 Twisp Carlton Hiway

City Carlton County Okanogan

Location SE 1/4 1/4 NW 1/4 Sec 10 Twn 32 R 25 EWM or WWM (circle one)

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK Owner's number of well (if more than one) _____
(X) New Well ( ) Reconditioned *Method* ( ) Dug ( ) Bored ( ) Driven ( ) Deepened ( ) Cable (X) Rotary ( ) Jetted

DIMENSIONS Diameter of well 8 inches drilled 68 ft
Depth of completed well 66 ft

CONSTRUCTION DETAILS
Casing Installed (X) Welded 8 Diam from +2 ft to 66 ft
( ) Liner installed _____ Diam from _____ ft to _____ ft
( ) Threaded _____ Diam from _____ ft to _____ ft

Perforations ( ) Yes (X) No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ( ) Yes (X) No ( ) K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ( ) Yes (X) No ( ) Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal (X) Yes ( ) No To what depth? 18 ft
Materials used in seal bentonite
Did any strata contain unusable water? ( ) Yes (X) No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 44 ft below top of well Date 6-7-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ( ) Yes ( ) No If yes by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Airtest 100+ gal/min with stem set at 65 ft for 1 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ( ) Yes (X) No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
sandy loam	0	4
boulders	4	12
reddish sand & gravel	12	22
hard bound talus	22	44
reddish sand & gravel	44	62
2" gravel	62	68

If volumes greater than 30 gpm are desired MVM recommends screening for highest volume potential

DEPT OF ECOLOGY Received JUN 14 2004 CENTRAL REGION OFFICE

Start Date 6-7 Completed Date 6-7-04

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

(X) Driller ( ) Engineer ( ) Trainee Name (Print) Marshall Miller

Driller/Engineer/Trainee Signature M V Miller

Driller or Trainee License No 1437

If trainee, licensed driller's _____
Signature and License no _____

Drilling Company MVM Quality Drilling
Address 22905 Riverview Rd
City State Zip Chelan, WA 98816
Contractor's Registration No MVMQUDL0033MM Date 6-8-04

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 10-14

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle) 14/051

☒ Construction

○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

DEPT OF ECOLOGY Received OCT 28 2003 CENTRAL REGIONAL OFFICE

CURRENT Notice of Intent No W154947

Unique Ecology Well ID Tag No AKh803

Water Right Permit No _____

Property Owner Name Kristina W. Booth

Well Street Address 391 Twisp Carlton Rd

City Carlton County Okanogan

Location NW 1/4 1/4 SW 1/4 Sec 10 Twn 32 R 22 EWM or WWM (circle one)

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner's number of well (if more than one) 1

☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 100 ft

Depth of completed well 100 ft

CONSTRUCTION DETAILS

Casing Installed ☒ Welded 6 Diam from 0 ft to 100 ft

☐ Liner installed _____ Diam from _____ ft to _____ ft

☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☒ Yes ☐ No

Type of perforator used torch

SIZE of perfs 18 in by 3 in and no of perfs 40 from 90 ft to 100 ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot Size _____ from _____ ft to _____ ft

Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft

Materials used in seal bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP Manufacturer's Name _____

Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft

Static level 60 ft below top of well Date 10-8-03

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes by whom? _____

Yield _____ gal/min with _____ ft drawdown after _____ hrs

Yield _____ gal/min with _____ ft drawdown after _____ hrs

Yield _____ gal/min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal/min with _____ ft drawdown after _____ hrs

Airtest 75 to 100 gal/min with stem set at 95 ft for 1 hrs

Artesian flow _____ g p m Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	4
gravel	4	14
brown clay & gravel	14	31
silt	31	45
sand	45	56
brown clay	56	65
coarse sand & gravel	65	100

Start Date 10-8-03 Completed Date same

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum

Driller/Engineer/Trainee Signature [signature]

Driller or Trainee License No 0281

Drilling Company Methow Valley Drilling

Address P.O. Box 68

City State Zip Twisp Wash 98856

Contractor's Registration No METHOVO121CR Date 10-8-03

If trainee, licensed driller's Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well-log 10-15

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

113876

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- ○ Construction
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W122689

Unique Ecology Well ID Tag No AGM 694

Water Right Permit No _____

Property Owner Name Mark Raymond

Well Street Address OFF 153 Benson Cr.

City Twisp County Okan

Location NE 1/4 1/4 NE 1/4 Sec 10 Twn 32 R 22 EWM or WWM (circle one)

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner's number of well (if more than one) _____
☐ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches, drilled 204 ft
Depth of completed well 204 ft

CONSTRUCTION DETAILS
Casing Installed ☐ Welded 6 Diam from 0 ft to 204 ft
☐ Liner installed _____ Diam from _____ ft to _____ ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☐ No ☒ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Cement
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 140 ft below top of well Date 5-11-02
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 20 gal./min with stem set at 200 ft for 2 hrs
Artesian flow _____ g p m Date 5/1-02
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
overburden	0	2
gravel	2	10
brown silty clay	10	31
cemented sand & gravel	31	145
silt	145	168
coarse sand	168	196
coarse sand & gravel	196	204

DEPT OF ECOLOGY Received MAY 29 2002 CENTRAL REGION OFFICE

Start Date 5-10 02 Completed Date 5-10-02

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Steve Konrad
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No 1764

If trainee, licensed driller s Signature and License no _____

Drilling Company Methow Valley Drilling
Address PO Box 68
City State Zip Twisp Wa 98856
Contractor s Registration No Methow 1264 Date 5-10-02

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

Well Log 10-19

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 057755

Water Right Permit No.

(1) OWNER: Name DENNIS FARMER Address CARLTON WASH

(2) LOCATION OF WELL: County Okan SW SW Sec 16 T 32 N, R 22 W M

(2a) STREET ADDRESS OF WELL (or nearest address) South of Twisp on County Rd.

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] DeWater [ ] Test Well [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 1

Abandoned [ ] New well [X] Method: Dug [ ] Bored [ ] Deepened [ ] Cable [ ] Driven [ ] Reconditioned [ ] Rotary [X] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 77 feet. Depth of completed well 77 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam from 0 ft. to 77 ft.

Welded [X] " Diam from ft. to ft.

Perforated [ ] " Diam from ft. to ft.

Threaded [ ]

Perforations: Yes [ ] No [X]

Type of perforator used

SIZE of perforations in by in

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes [ ] No [X]

Manufacturer's Name

Type Model No.

Diam Slot size from ft. to ft.

Diam Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel

Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 21 ft.

Material used in seal Bentonite

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? Depth of strata

Method of sealing strata off

(7) PUMP: Manufacturer's Name

Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.

Static level 54 ft. below top of well Date

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [ ] No [ ] If yes, by whom?

Yield gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest 40 gal./min. with stem set at 75 ft. for 1 hrs.

Artesian flow gpm Date

Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
OVERBURDEN	0	4
COARSE SAND & GRAVEL	4	16
FINE BRN SAND	16	31
COARSE GRAVEL	31	51
COARSE SAND & GRAVEL	51	77

Work started 10/20 19 Completed 10/20 1991

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address PO. Box 68 Twisp, Wa 98856

(Signed) Darrell Porter (WELL CONSTRUCTOR) License No. 0426

Contractor's Registration No. Methovl121cf Date 10/20 1991

Well Log 16-109

USE ADDITIONAL SHEETS IF NECESSARY!

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction 150124
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W154862 ✓

Unique Ecology Well ID Tag No ARL 817

Water Right Permit No CS4MUID #31

Property Owner Name Dick Pendergast F

Well Street Address Twisp Carlton Rd

City Twisp County Okanogan

Location SE 1/4 1/4 NW 1/4 Sec 16 Twn 32 R 22 EWM or WWM (circle one)

Lat/Long (s t r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☒ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 60 ft
Depth of completed well 60 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 6 Diam from 0 ft to 60 ft
☐ Liner installed _____ Diam from _____ ft to _____ ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☒ Yes ☐ No
Type of perforator used Roller
SIZE of perfs 1/8 in by 1 in and no of perfs 30 from 55 ft to 60 ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 28 ft below top of well Date 5-03-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 50 gal /min with stem set at 60 ft for 1 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	4
gravel	4	12
brown clay & gravel	12	23
coarse sand & gravel	23	32
silty gravel	32	55
coarse sand & gravel	55	60

Start Date 5-3-04 Completed Date 5-3-04

DEPT OF ECOLOGY Received MAY 25 2004 CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bylum

Driller/Engineer/Trainee Signature _____

Driller or Trainee License No 0781

Drilling Company Methow Valley Drill

Address P.O Box 68

City State Zip Twisp Wa 98856

Contractor s Registration No Methowvalldr Date 5-3-04

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

Well Log 16-110

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W122360
UNIQUE WELL I.D. # AFH 198
Water Right Permit No. Water rights 3935 #107

75280

(1) OWNER: Name Don Hutson & Pat Hutson Address 220 Carlton Twisp Rd Twisp

(2) LOCATION OF WELL: County Okanogan SW 1/4 SW 1/4 Sec 16 T 32 N.R. 22 WM
(2a) STREET ADDRESS OF WELL: (or nearest address) S.16
TAX PARCEL NO.: N

(3) PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) ____
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☐ Bored ☐ Cable ☐ Driven ☒ Rotary ☐ Jetted

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 80 feet. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS
Casing Installed:
☐ Welded 6" Diam. from 0 ft. to 80 ft.
☐ Liner installed ____" Diam. from ____ ft. to ____ ft.
☐ Threaded ____" Diam. from ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No
Type of perforator used ____
SIZE of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ____
Manufacturer's Name ____
Type ____ Model No. ____
Diam. ____ Slot Size ____ from ____ ft. to ____ ft.
Diam. ____ Slot Size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand ____
Material placed from ____ ft. to ____ ft.

Surface seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Cement
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

(7) PUMP: Manufacturer's Name ____
Type: ____ H.P. ____

(8) WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 40 ft. below top of well Date 4-26-00
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? ____
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ____
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 100 gal./min. with ____ ft. drawdown after ____ hrs.
Artesian flow ____ g.p.m. Date ____
Temperature of water ____ Was a chemical analysis made? ☐ Yes ☒ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Overburden	0	3
brown sandy clay	3	14
gray clay & gravel	14	28
coarse sand	28	46
coarse sand & gravel	46	70
coarse sand	70	75
coarse sand & gravel	75	80

RECEIVED
MAY 31 2000
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

DEPT. OF ECOLOGY JUN 5 2000 Received NORTHWEST REGIONAL OFFICE

Work Started 4-26, 00. Completed same

WELL CONSTRUCTION CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Rick Bynum License No. 0781
(Licensed Driller/Engineer)
Trainee Name ____ License No. ____
Drilling Company ____
(Signed) [signature] License No. 0781
(Licensed Driller/Engineer)
Address P.O. Box 68 Twisp 98856
Contractor's Registration No. Methovo121CR Date 4-26, 00

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006.

ECY 050-1-20 (11/98)

Well Log 16-113

WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 101688
- ○ Construction
- ○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. (W) 122666

Unique Ecology Well ID Tag No. AFQ 821

Water Right Permit No. MVID 003935 CS4-MVID@44

Property Owner Name IAN Jefferds

Well Street Address _____

City Twisp County: Okan

Location SW 1/4- 1/4 NE 1/4 Sec 16 Twn 32 R 22 EWM circle one

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☒ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method.* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 55 ft
Depth of completed well 55 ft

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 8" Diam. from 0 ft. to 55 ft
☐ Liner installed ____" Diam. from ____ ft to ____ ft
☐ Threaded ____" Diam from ____ ft to ____ ft.

Perforations: ☒ Yes ☐ No
Type of perforator used Roller
SIZE of perfs 1/4 in by 1 in and no of perfs 100 from 45 ft. to 55 ft

Screens: ☒ Yes ☒ No ☐ K-Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 15 ft below top of well Date 8-1-01
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
Yield. _____ gal./min with _____ ft drawdown after _____ hrs
Yield. _____ gal./min with _____ ft drawdown after _____ hrs
Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min with _____ ft drawdown after _____ hrs
Airtest 200 gal./min. with stem set at 50 ft for 4 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	2
gravel	2	13
silty clay	13	28
coarse sand & gravel	28	55

Start Date 8-1-01 Completed Date SAM

DEPT OF ECOLOGY Received AUG 2 CENTRAL REGION FAX

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) R. Byman
Driller/Engineer/Trainee Signature _____
Driller or Trainee License No. 0731

Drilling Company Methow Valley Drilling
Address P.O. Box 68
City, State, Zip Twisp, Wash 98856
Contractor's Registration No. Methowvalle 8-1-01

If trainee, licensed driller's Signature and License no. _____

Well tag 16-121

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
☒ Construction 151228
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W154888 2

Unique Ecology Well ID Tag No AKh822

Water Right Permit No _____

Property Owner Name Lou Brummett

Well Street Address 248 Twisp Carlton Rd

City Twisp County Okanogan

Location NW 1/4 1/4 SE 1/4 Sec 16 Twn 32 R 22 ~~EWM~~ WWM circle one

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No K

PROPOSED USE ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 40 ft
Depth of completed well 40 ft

CONSTRUCTION DETAILS
Casing Installed ☒ Welded 6 Diam from 0 ft to 40 ft
☐ Liner installed _____ Diam from _____ ft to _____ ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal ☒ Yes ☐ No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 24 ft below top of well Date 5-22-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal /min with _____ ft drawdown after _____ hrs
Airtest 20+ gal /min with stem set at 40 ft for 1 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Overburden	0	1
boulders	1	17
Red silty clay	17	28
Coarse sand	28	36
Coarse sand & gravel	36	40

DEPT OF ECOLOGY Received JUN 16 2004 CENTRAL REGION OFFICE

Start Date 5-22-04 Completed Date Same

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Rich Bynum
Driller/Engineer/Trainee Signature [signature]
Driller or Trainee License No 0781

Drilling Company Methow Valley Drilling
Address P.O. Box 68
City State Zip Twisp Wa 98856
Contractor s Registration No Methowvalco Date 5-22-04

If trainee, licensed driller's Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050-130 (Rev 4/01)

Well Log 18-130

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Construction/Decommission (x in circle)
- [x] Construction 152749
- [ ] Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W160418

Unique Ecology Well ID Tag No AFH 629

Water Right Permit No E

Property Owner Name Lucas + Lindsay Evans

Well Street Address 239 Twisp Carlton Rd.

City Twisp County Okanogan

Location SW 1/4 1/4 NW 1/4 Sec 16 Twn 32N R 22 EWM or WWM (circle one)

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No _____

PROPOSED USE [x] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [ ] Irrigation [ ] Test Well [ ] Other _____

TYPE OF WORK Owner s number of well (if more than one) _____
[x] New Well [ ] Reconditioned *Method* [ ] Dug [ ] Bored [ ] Driven [ ] Deepened [x] Cable [ ] Rotary [ ] Jetted

DIMENSIONS Diameter of well 6 inches drilled 73 1/2 ft
Depth of completed well 73 ft

CONSTRUCTION DETAILS
Casing Installed [x] Welded 6 Diam from +1 1/2 ft to 73 ft
[ ] Liner installed _____ Diam from _____ ft to _____ ft
[ ] Threaded _____ Diam from _____ ft to _____ ft

Perforations [ ] Yes [x] No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens [ ] Yes [x] No [ ] K Pac Location _____
Manufacturer s Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed [ ] Yes [x] No [ ] Size of gravel/sand _____
Materials placed from _____ ft to _____ ft

Surface Seal [x] Yes [ ] No To what depth? 18 ft
Materials used in seal Bentonite
Did any strata contain unusable water? [ ] Yes [x] No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP Manufacturer s Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 49 ft below top of well Date 7-16-04
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [x] No If yes by whom? _____
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Yield _____ gal /min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test 20 gal /min with 4 ft drawdown after 4 hrs
Airtest _____ gal /min with stem set at _____ ft for _____ hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? [ ] Yes [x] No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Top Soil	0	1
Consolidated Sand & Gravel	1	18
Cobles, Sand & Gravel	18	25
Sand	25	34
Clay bound Sand	34	57
Sand & Gravel	57	73
Sand	73	—?

Start Date 7-8-04 Completed Date 7-16-04

JUL 28 2004
DEPARTMENT OF ECOLOGY
DEPT OF ECOLOGY FISCAL SECTION 01 JUL 26 PM 1:17
DEPT OF ECOLOGY Received JUL 28 2004 CENTRAL REGION OFFICE

WELL CONSTRUCTION CERTIFICATION I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

[x] Driller [ ] Engineer [ ] Trainee Name (Print) Abe L. Windle
Driller/Engineer/Trainee Signature Abe L. Windle
Driller or Trainee License No 1421

Drilling Company Windle Enterprises
Address P.O. Box 279
City State Zip Brewster, Wa. 98812
Contractor s Registration No WINDLE 121PR Date 7-23-04

If trainee, licensed driller s Signature and License no _____

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

28212

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W05322

Water Right Permit No. AAI283

(1) OWNER: Name Martin Erkala Address 224-B1 Twisp-Carlton Rd Carlton WA 98814

(2) LOCATION OF WELL: County Okanogan SE ¼ SE ¼ Sec. 16 T. 32 N., R. 22 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) 224-A Twisp Carlton Rd Carlton WA 98814

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one)

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]

Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.

Drilled 100 feet. Depth of completed well 100 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 95 ft.

Welded [X] Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [ ]

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes [X] No [ ]

Manufacturer's Name Johnson

Type Stainless Wire Wound Model No. WS-304

Diam. 4.65 Slot size 16 from 95 ft. to 100 ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel

Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? Depth of strata

Method of sealing strata off

(7) PUMP: Manufacturer's Name None

Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.

Static level 25 ft. below top of well Date 7/15/94

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [ ] No [ ] If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest 100 gal./min. with stem set at 95 ft. for 2 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Loamy sand	0	5
Sand - cobles	5	8
Hardpan; Boulders; Tan	8	28
Silt & Sand; fine to coarse	28	50
Sand; Fine to coarse	50	100

Drilled w/ undr-reaming System
NUMEX 5.5" Drive Shoe @ 43'

5.5" Bore Hole 43' to 102'

RECEIVED JUL 18 1994

Work started 7/11/94. Completed 7/15/94

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address PO Box 279 Carlton WA 98814

(Signed) [signature] (WELL DRILLER) License No. 1492

Contractor's Registration No. COUNTTD131QW Date 7/15/94, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Well Log 16-182

CY 050-1-20 (10/87) -1329- 3

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 216113

Water Right Permit No. _____

(1) OWNER: Name Rich Holmglea Address 2593 Lk Cavanaugh Rd Mt Vernon

(2) LOCATION OF WELL: County Okanogan SE NW Sec 16 - 32 N. R 22 W.M.

(2) STREET ADDDRESS OF WELL (or nearest address) 3½ mi N. Carlton West Co. Rd

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 60 feet. Depth of completed well 60 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 0 ft. to 60 ft.
Welded [ ] _____" Diam. from _____ ft. to _____ ft.
Liner installed [ ]
Threaded [ ] _____" Diam. from _____ ft. to _____ ft.

Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in by _____ in
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.

Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 30 ft. below top of well Date 5/9/93
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [X] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Artesian 40 gal./min. with stem set at 53 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Overburden	0	2
gravel	2	14
sand & gravel	14	35
coarse sand	35	50
coarse sand & gravel	50	60

Work started 5/9/93, 19__ Completed SAME, 19__

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Methow Valley Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address P.O. Box 68 Twisp WA 98856
(Signed) [signature] License No. 0781
WELL DRILLER
Contractor's Registration No. METHOVDRIZL Date 5/9, 1993

Well Log 16-135

(USE ADDITIONAL SHEETS IF NECESSARY)

WATER WELL REPORT

ECOLOGY Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("x" in circle) 101686

- (X) Construction
- ( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 122665

Unique Ecology Well ID Tag No. AFG 820

Water Right Permit No. C54-MVID-52

Property Owner Name Rick Holmgren

Well Street Address _____

City Twisp County: Okan

Location NW 1/4- 1/4 SE 1/4 (SE) Sec 16 Twn 32 R 22 EWM or WWM (circle one)

Lat/Long: (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☒ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled _____ ft

Depth of completed well _____ ft

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from 0 ft to 60 ft

☐ Liner installed _____" Diam. from _____ ft to _____ ft

☐ Threaded _____" Diam from _____ ft to _____ ft

Perforations: ☒ Yes ☐ No

Type of perforator used Roller

SIZE of perfs 1/4 in by 1 in and no of perfs 100 from 50 ft to 60 ft

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No _____

Diam _____ Slot Size _____ from _____ ft to _____ ft

Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft

Materials used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H P _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft

Static level 30 ft below top of well Date 8-1-01

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap,valve, etc)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min with _____ ft drawdown after _____ hrs

Yield: _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min with _____ ft drawdown after _____ hrs

Airtest 100 gal./min with stem set at 35 ft for 4 hrs

Artesian flow _____ g p m Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
Over burden	0	1
gravel	1	8
sand	8	14
sandy clay	14	22
fine silt	22	39
coarse sand & gravel	39	60

DEPT OF ECOLOGY Received AUG 27 2001 CENTRAL REGION OFFICE

Start Date 8-1-01 Completed Date same

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) Steve Konrad

Driller/Engineer/Trainee Signature Steve Konrad

Driller or Trainee License No. 1764

If trainee, licensed driller's Signature and License no. _____

Drilling Company Methow Valley Drilling

Address P.O. Box 68

City, State, Zip Twisp Wa 98856

Contractor's Registration No. Methovoi231CR Date _____

Well Log 16-137

Ecology is an Equal Opportunity Employer. ECY 050-1-20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No. 21-29728P

(1) OWNER: Name Archie Effert Address Box 776 Twisp, WN

(2) LOCATION OF WELL: County Okanogan — NE¼ SW¼ Sec. 11 T. 33 N., R. 21 E. W.M.
...ing and distance from section or subdivision corner Tracts #18 Orchards Ranch

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 300 ft. Depth of completed well 300 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +1 ft. to 172 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations .200 in. by .12 in.
18 perforations from 167 ft. to 172 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18+ ft.
Material used in seal Puddling Clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 135 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Red Clay	0	2
Sand Gravel Boulders	2	60
Tan Clay	60	85
Gravel - clay	85	160
Black shale	160	172
Gray & Black shale	172	300
5-10 GPM		

RECEIVED
NOV 14 1977
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 10-6 19 77 Completed 10-11 19 77

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Ayer Drilling and Dev. Inc. (Person, firm, or corporation) (Type or print)
Address Box 1499 CdA Idaho
[Signed] Thean D Lewis (Well Driller)
License No. 718 Date 10-11, 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

No. 7356—OS—(Rev. 4-71)
70-28

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Twisp Well Log 11-1

File Original with Department of Ecology 98085
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

USGS Well

Notice of Intent R040318

UNIQUE WELL I D # ACX 744

Water Right Permit No

(1) OWNER Name Barry & Connie Swanson Address 2113 116th NE Lake Stevens WA 9825

(2) LOCATION OF WELL County Okanogan SW 1/4 SE 1/4 Sec 11 T 33 N R 21 WM

(2a) STREET ADDRESS OF WELL (or nearest address) 291 H Twisp River Road Twisp WA

TAX PARCEL NO 3321110013

(3) PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☒ Other ☐ DeWater

(4) TYPE OF WORK Owner's number of well (if more than one) 1
☒ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method ☐ Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) DIMENSIONS Diameter of well 6 inches
Drilled 32 feet Depth of completed well 30 ft

(6) CONSTRUCTION DETAILS
Casing installed
☒ Welded 6" Diam from +2 ft to 30 ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

Perforations ☒ Yes ☐ No
Type of perforator used steel
SIZE of perforations 2 in by 1/4 in
20 perforations from 25 ft to 30 ft

Screens ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? 18 ft
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 9.9 ft below top of well Date 5/3/01
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap, valve, etc)

(9) WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield gal /min with ft drawdown after hrs
Yield gal./min with ft drawdown after hrs
Yield gal /min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 3+ gal./min with 27 ft drawdown after 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
Topsoil	0	3
Silty sand, cobbles	3	10
Clay, sand, gravel, cobbles, boulders	10	18
Clay, sand, gravel, boulders	18	27
Wet, silty sand, gravel, tight	27	30

DEPT OF ECOLOGY Received JUN 11 2001 CENTRAL REGION OFFICE

Work Started 5/1/01 Completed 5/3/01

WELL CONSTRUCTION CERTIFICATION

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Type or Print Name Stephen Kreider License No 1492
(Licensed Driller/Engineer)

Trainee Name License No
Drilling Company Country Town Drilling
(Signed) Stephen L Kreider License No 1492
(Licensed Driller/Engineer)
Address PO Box 279 Carlton WA 98814
Contractor's Registration No COUNTTD131QW Date 5/30/01

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer For special accommodation needs contact the Water Resources Program at (360) 407-6600 The TDD number is (360) 407-6006

ECY 050 1-20 (11/98)

Twisp Well Log 112

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 049952
UNIQUE WELL I.D. # ACX 719
Water Right Permit No.

(1) OWNER: Name Duff McDaniels Address 10611 Samish Is Rd Bow WA 98232

(2) LOCATION OF WELL: County Okanogan SW 1/4 SW 1/4 Sec 11 T 33 N, R 21 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Parcel #3321110030 Twisp WA

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (If more than one) 1
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 70 feet. Depth of completed well 70 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 52" Diam. from +2 ft. to 50 ft.
Welded [X] 4" Diam. from 10 ft. to 50 ft.
Liner installed [X]
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [X] No [ ]
Manufacturer's Name Western Well Screen & Pipe
Type 4X3 Prepack-PRE 4X3-15' Model No. 10/20
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [X] No [ ] Size of gravel 10/20
Gravel placed from prepack ft. to 49-64 ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Grundfos
Type: Submersible H.P. .5

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 20 ft. below top of well Date 12/6
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [X] No [ ] If yes, by whom? Stephen
Yield: 1 gal./min. with 30 ft. drawdown after 2 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 1 gal./min. with stem set at 60 ft. for 6 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sands	0	7
Sand & boulders	7	18
Fine sand & silt	18	35
Fine sand & clays	35	51
Fine sand	51	63
Sand & fractured shale	63	64
Shale	64	70
Drilled W/NUMEX under-reaming system		
5.5" Drive Shoe @ 50'		
~~5.5" Bore Hole 10-70'~~		
Tested negative for Hydrogen Sulfide		

Work Started 11/29/99 Completed 12/10/99

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Country Town Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address PO Box 279 Carlton WA 98814
(Signed) (WELL DRILLER) License No. 1492
Contractor's Registration No. COUNTTD131QW Date 12/13/99
(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

Twisp Well Log 11-7

ECY 050-1-20 (9/93)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

State of Washington Date Printed: 25-Oct-2012 Log No. 0

Construction / Decommission: Original Construction Notice 468263

Construction

PROPOSED USE: **DOMESTIC**

TYPE OF WORK: Owners's Well Number: (If more than one well) 1

NEW WELL Method: **ROTARY**

DIMENSIONS: Diameter of well: **6** inches

Drilled **140** ft. Depth of completed well **140** ft.

CONSTRUCTION DETAILS:

Liner installed: **PVC**

4 " Dia from **8** ft. to **140** ft.

Casing installed **WELDED**

6 " Dia from **+2** ft. to **22** ft.

" Dia from ft. to ft.

" Dia from ft. to ft.

Perforations: **Yes** Used In: **LINER**

Type of perforator used **SKILL SAW**

SIZE of perforations **1/8** in. by **7** in.

120 Perforations from **80** ft. to **140** ft.

Perforations from ft. to ft.

Perforations from ft. to ft.

Screens: **0** K-Pac Location:

Manufacture's Name

Type: Model No

Diam. slot size: from ft. to ft.

Diam. slot size: from ft. to ft.

Gravel/Filter packed: **No** Size of Gravel

Material placed fro ft. to ft.

Surface seal: **Yes** To what depth **22** ft.

Seal method: Material used in seal **BENT/CASING**

Did any strata contain unusable water **No**

Type of water Depth of strata

Method of sealing strata off

PUMP: Manufacture's name

Type: H.P. **0**

WATER LEVELS Land-surface elevation above mean sea level: **0** ft.

Static level **30** ft. below top of well Date **10/09/2012**

Artesian Pressure lbs per square inch Date

Artesian water controlled by

WELL TESTS: Drawdown is amount water level is lowered below static level.

Was a pump test made **No** If yes, by whom

Yield: gal/min with ft drawdown after

Yield: gal/min with ft drawdown after

Yield: gal/min with ft drawdown after

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level

Time:	Water Level	Time:	Water Level	Time:	Water Level

Date of test:

Bailer test gal/min ft drawdown after hrs.

Air test **4** gal/min w/ stem set at **139** ft. for **1** hours

Artesian flow gpm Date

Temperature of water Was a chemical analysis made **No**

CURRENT

Notice of Intent No.: **WE15310**

Unique Ecology Well I.D. No **BCA895**

Water Right Permit Number:

OWNER: **MERZ, JERRY**

OWNER ADD **11 CUB CREEK RD**

WINTHROP, WA 98862

Well Add **217 TWISP RD**

City: **Twisp, WA 98856** County: **Okanogan**

Location: **NE** 1/4 **SE** 1/4 Sec **11** T **33** R **21** EW

Lat/Long: (s, t, r still REQUIRED) Lat Deg Lat Min/Sec

Long Deg Long Min/Se

Tax Parcel No.: 3321110052

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure. Show thickness of aquifiers and the kind and nature of the material in each stratum penetrated. Show at least one entry for each change in formation.

Material	From	To
GRAVEL SAND	0	16
GRAVEL SAND WET	16	17
SHALE GRAY SOFT	17	32
SHALE BROWN SOFT	32	45
SHALE PURPLE SOFT	45	94
SHALE BROWN SOFT	94	95
SHALE GRAY SOFT	95	100
SHALE GRAY VERY SOFT WET	100	101
SHALE BROWN SOFT	101	108
SHALE GRAY SOFT	108	109
SHALE GRAY MED HARD	109	139
SHALE PURPLE MED HARD	139	140

Notes:

DEPT OF ECOLOGY Received NOV 28 2012 CENTRAL REGION OFFICE

Work starte **10/08/2012** Complete **10/09/2012**

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee

Name: **AUDIE MCCURDY** License No.: **2690**

Signature:

If trainee, Licensed driller is License No.:

Licensed Driller Signature

Drilling Company:

NAME: **FOGLE PUMP & SUPPLY, INC.** Shop: **REPUBLIC**

ADDRESS: **PO Box 456**

Republic, WA 99166

Phone: **5097752878** Toll Free: **8008453500**

E-Mail: **leslie@foglepump.com**

FAX: **5097750498** WEB Site: **www.foglepump.com**

Contractor's Registration No.: **FOGLEPS095L4** Date Log Created: **10/25/2012**

Twisp Well Log 11-10

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

6288 Start Card No. 023553

Water Right Permit No. _____

(1) OWNER: Name RANDY BUCKLEY Address _____

(2) LOCATION OF WELL: County OKANOGAN SW ¼ SE ¼ Sec. 11 T. 33 N., R. 21 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) POOLMAN CREEK RD APPROX 7 MILES W OF TWISP

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater [ ] Industrial [ ] Test Well [ ] Municipal [ ] Other

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [ ] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 66 feet. Depth of completed well 64 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +2 ft. to 64 ft.
Welded [X] _____ " Diam. from _____ ft. to _____ ft.
Liner installed [ ] _____ " Diam. from _____ ft. to _____ ft.
Threaded [ ]
Perforations: Yes [ ] No [X]
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
Screens: Yes [ ] No [X]
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Gravel packed: Yes [ ] No [X] Size of gravel _____
Gravel placed from _____ ft. to _____ ft.
Surface seal: Yes [X] No [ ] To what depth? 18' ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes [ ] No [ ]
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name NONE
Type: _____ H.P. _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 49 ft. below top of well Date 6/28/91
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
" " " "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airlift 20 gal./min. with stem set at 60 ft. for 2 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes [ ] No [X]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
SILTY LOAM	0	5
HARD PAN, COBBLES, DRY	5	20
DRY SAND & LT COBBLES	20	30
~~30 33~~ DAMP SAND, GRAVEL	30	33
GRAVEL WET	33	35
CLAY GREY FINE	35	50
CLAY, GREY WITH SM GRAVEL	50	60
TAN CLAY, GRAVEL SMALL	60	63
GRAVEL, SAND SMALL, WATER	63	64
BED ROCK, BLACK, MED HARD (ARGILLITE OR SLATE?)	64	66

JUN 30 [illegible]

Work started 6/25, 19 Completed 6/28, 1991

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME [signature] COUNTRY TOWN DRILLING (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address POBOX 638 TWISP WA

(Signed) [signature] (WELL DRILLER) License No. 1492

Contractor's Registration No. COUNTTDI131LK4 Date 6/28/91, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Twisp Well Log 11-17

ECY 050-1-20 (10/87) 1329

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission ("x" in circle) 323985

☒ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT Notice of Intent No. W 270959

Unique Ecology Well ID Tag No. APE 487

Water Right Permit No. _____

Property Owner Name Russell-Post

Well Street Address 226 Twisp River Rd

City Twisp County Okanogan

Location NE 1/4-1/4 SE 1/4 Sec 11 Twn 33 R 21 EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. 3321110056

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned ☐ Deepened

Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 206 ft.

Depth of completed well 204 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 20 ft.

☒ Liner installed 4" Diam. from -10 ft. to 204 ft.

☐ Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No line only

Type of perforator used saw

SIZE of perfs 1/8 in. by 5 in. and no. of perfs 50 from 204 ft. to 154 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____

Manufacturer's Name _____

Type _____ Model No. _____

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Diam _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal bentonite slurry

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 41 ft. below top of well Date 12/9/08

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 204 gal./min. with stem set at 205 ft. for .5 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
claybound talus	0	14
blue gray shale firm	14	59
damp blue shale, soft	59	64
blue medium hard shale	64	140
with H2O bearing pink vein at 99'		
broken H2O bearing blue shale	140	146
coarse cuttings red shale	146	166
blue hard shale with minor	166	176
green veins		
H2O bearing creamy gray	176	178
shale		
blue green shale	178	190
gray H2O bearing shale	190	206
Drilled as emergency well - start notice approved by phone to D.O.E.		

RECEIVED DEC 12 2008 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 12-3-08 Completed Date 12-3-08

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☐ Driller ☐ Engineer ☐ Trainee Name (Print) CO: MVM QUALITY DRILLING LLC TEL (509) 682-1122

Driller/Engineer/Trainee Signature NAME: MARSHALL V. MILLER, LIC# 1437

Driller or trainee License No. REG#: MVM QUD L033MM

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Drilling Company _____

Address MVM Quality Drilling LLC

City, State, Zip 22905 Riverview Rd Chelan, WA 98816

Contractor's Registration No. MVMQUDL033MM Date 12-5-08

Ecology is an Equal Opportunity Employer

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original& I st copy -Ecology, 2nd copy -owner, 3rd copy -driller

Construction/Decommission *("x" in circle)* 319674

☒ Construction

O Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number*

CURRENT Notice of Intent. No. w209912

Unique Ecology Well ID Tag No. AGL933

Water Right Permit No.

Property Owner Name Gale Gilmore N

Well Street Address 75 Poorman Creek Rd

City TWISP WA 98856 County: Okanogan County

Location SW 1/4 SW 1/4 Sec 12 Twn 33 R 21e EWM Or WWM *circle one*

Lat/Long:: (s,t,r still REQUIRED) Lat Deg Lat Min/Sec Long Deg Long Min/Sec

Tax Parcel No. 3321120051

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK: Owner's number of well (if more than one)

☒ New Well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 45 ft.

Depth of completed well 42 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" Diam. from +2 ft. to 42 ft.

☐ Liner installed " Diam. from ft. to ft.

☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No

Type of perforator used

Size of perfs in. by in. and no. of perfs from ft. to ft.

Screens: ☐ Yes ☒ No ☐ K-pac Location

Manufacturer's Name

Type Model No.

Diam. Slot Size from ft. to ft.

Diam Slot Size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand

Materials placed from ft. to ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft

Materials used in seal BENTONITE

Did any strata contain unusable water? ☒ Yes ☐ No

Type of water? Depth of strata 6-12ft

Method of sealing strata off Bentonite to claylike layer at 12 ft

PUMP: Manufacturer's Name Aqua duty

Type: Submersible H.P. 1/2

WATER LEVELS: Land-surface elevation above mean sea level 1500 ft.

Static level 4.5 ft. below top of well Date 9/10/2008

Artesian pressure lbs per square inch Date

Artesian water is controlled by (cap,valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level.

Was a pump test made? ☐ Yes ☐ No If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. draw down after Ins.

Airtest 25 gal./min. with stem set at 40 ft. for 19ft hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top soils	0	3
Sand gravel cobbles boulders	3	8
very siltey sand, gravel , boulder	8	12
gray clay fine Sand course sand mix	12	26
sand gravel, very silty tight. boulders	26	36
course sand, gravel cobbles	36	42
unusable water sealed off with benonite		
granular and chips from 0 to 18 ft		

RECEIVED OCT 17 2008 DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 9/3/2008 Completed Date 9/5/2008

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Stephen L Kreider

Driller/Engineer/Trainee Signature Stephen L Kreider

Driller or Trainee License No. 1492

Drilling Company Country Town Drilling

Address PO BOX 279 Carlton Wa 98814

City, State, Zip CARLTON WA 98814

If trainee, licensed driller's Contractor's 1492 9/10/2008

Twisp Well Log 12-2

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 47310

UNIQUE WELL I.D. # AAF08

Water Right Permit No.

(1) OWNER: Name Scott Edson Address P.O. Box 252 Twisp WA 98856

(2) LOCATION OF WELL: County Okanogan W½ SW ¼ Sec. 12 T. 33 N., R. 21 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) Lot 3

Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]

Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.

Drilled 52 feet. Depth of completed well 50 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam from +2 ft. to 50 ft.

Welded [X] " Diam. from ft. to ft.

Liner installed [ ] Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [X] No [ ]

Type of perforator used Torch

SIZE of perforations 1/4 in. by 4 in.

4 perforations from 50 ft. to 49 ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes [ ] No [X]

Manufacturer's Name

Type Model No.

Diam. Slot size from ft. to ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel

Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.

Material used in seal

Did any strata contain unusable water? Yes [ ] No [X]

Type of water? Depth of strata

Method of sealing strata off

(7) PUMP: Manufacturer's Name

Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level

Static level 15 ft. below top of well Date 6-23-94

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes [ ] No [X] If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest 30 gal./min. with stem set at 49 ft. for 1 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
top soil	0	4
sand + gravel	4	15
black sandy clay	15	35
clay bound gravel	35	45
clean shale gravel	45	50
shale bedrock	50	52

RECEIVED JUL 12 1994 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 6-23, 19. Completed 6-24, 19 94

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME MVM Quality Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 760 Highland Rd. 98813

(Signed) MV Miller (WELL DRILLER) License No. 1437

Contractor's Registration No. MVMQU138NO Date 7-8, 19 94

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

Twisp Well Log 12-7

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 47311
UNIQUE WELL I.D. # AAF 088
Water Right Permit No.

(1) OWNER: Name Scott Edson Address P.O. Box 252 Twisp WA 9885

(2) LOCATION OF WELL: County Okanogan W½ SW ¼ Sec. 12 T. 33 N., R. 21 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address)

(3) PROPOSED USE: [X] Domestic [ ] Irrigation [ ] DeWater Industrial [ ] Test Well [ ] Municipal [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) Lot 4
Abandoned [ ] New well [X] Deepened [ ] Reconditioned [ ]
Method: Dug [ ] Cable [ ] Rotary [X] Bored [ ] Driven [ ] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 47 feet. Depth of completed well 45 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +2 ft. to 45 ft.
Welded [X] " Diam. from ft. to ft.
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ]
Perforations: Yes [X] No [ ]
Type of perforator used torch
SIZE of perforations ¼ in. by 4 in.
4 perforations from 45 ft. to 44 ft.
perforations from ft. to ft.
perforations from ft. to ft.
Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.
Gravel packed: Yes [ ] No [X] Size of gravel
Gravel placed from ft. to ft.
Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 15 ft. below top of well Date 6-24-94
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.))

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 44 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Top soil	0	4
sand & gravel	4	15
black sandy clay	15	35
clay bound shale gravel	35	40
cheaper shale gravel	40	45
tighter gravel	45	47

RECEIVED JUL 12 1994 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 6-24, 19. Completed 6-24, 19 94

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME MVM Quality Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 760 Highland Rd 98813
(Signed) MVM (WELL DRILLER) License No. 1431
Contractor's Registration No. MVMQUD138NO Date 7-8, 19 94

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 060-1-20 (10/87) -1329-

Twisp Well Log 12-8

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

APPENDIX D
HYDRAULIC ANALYSIS

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS UPSTREAM OF ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,758.20 feet
- -HGL at High End of System = 1,804.40 feet
- -Pressure at High End of System = 20.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				PS Discharge Line	300+89.00	1,598.70										1,833.52	101.7
Main M-W-04	PS Discharge Line	300+89.00	1,598.70	MVID Lateral W2	226+30.00	1,735.00	7,459	12	2.38	3.0	2.5	18.6	1.9	1,833.52	101.7	1,813.11	33.8
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,813.11	33.8	1,809.37	29.8
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,809.37	29.8	1,808.39	29.3
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,808.39	29.4	1,804.40	20.0
LATERAL W0																	
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	3	0.03	0.6	0.7	0.4	0.0	1,804.40	20.0	1,804.01	59.9
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,808.39	29.4	1,807.98	42.0
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,807.98	42.0	1,807.72	44.0
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,807.98	42.0	1,807.97	42.0
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,807.72	44.1	1,807.68	42.7
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.26	1.3	1.2	1.5	0.1	1,809.37	29.8	1,807.72	42.7
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,807.72	42.8	1,805.48	46.5
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,813.11	33.8	1,812.71	66.1
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,812.71	66.2	1,812.53	70.4
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,812.53	70.4	1,812.20	74.1
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,812.53	70.4	1,811.50	76.9
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1,481	4	0.12	1.4	2.1	3.1	0.3	1,811.50	76.9	1,808.10	92.7
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,812.71	66.2	1,811.34	65.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.6	5.1	0.5	1,811.34	65.6	1,805.72	89.1

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS UPSTREAM OF ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,758.20 feet
- -HGL at High End of System = 1,781.30 feet
- -Pressure at High End of System = 10.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				PS Discharge Line	300+89.00	1,598.70										1,810.42	91.7
Main M-W-04	PS Discharge Line	300+89.00	1,598.70	MVID Lateral W2	226+30.00	1,735.00	7,459	12	2.38	3.0	2.5	18.6	1.9	1,810.42	91.7	1,790.01	23.8
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,790.01	23.8	1,786.27	19.8
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,786.27	19.8	1,785.29	19.3
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,785.29	19.3	1,781.30	10.0
LATERAL W0																	
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	4	0.03	0.3	0.2	0.1	0.0	1,781.30	10.0	1,781.20	50.0
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,785.29	19.3	1,784.88	32.0
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,784.88	32.0	1,784.62	34.0
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,784.88	32.0	1,784.87	32.0
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,784.62	34.1	1,784.58	32.7
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.26	1.3	1.2	1.5	0.1	1,786.27	19.8	1,784.62	32.7
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,784.62	32.8	1,782.38	36.5
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,790.01	23.8	1,789.61	56.1
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,789.61	56.2	1,789.43	60.4
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,789.43	60.4	1,789.10	64.1
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,789.43	60.4	1,788.40	66.9
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1,481	4	0.12	1.4	2.1	3.1	0.3	1,788.40	66.9	1,785.00	82.7
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,789.61	56.2	1,788.24	55.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.6	5.1	0.5	1,788.24	55.6	1,782.62	79.1

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS UPSTREAM OF ROACH SPIL

Input	
Calculation	
Output	

BY: David Rice, P.E.
DATE: 11-Apr-13

SUCTION WATER SURFACE ELEVATIONS (METHOW RIVER):			
ELEV	1530.0	feet	Invert at Diversion
HWL	1538.6	feet	Wet Well (High River)
LWL	1534.7	feet	Wet Well (Low River)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1598.7	feet	Pipe Invert at Ex MVID Ditch	
HIGH	1833.5	feet =	101.68	psi
LWL	1810.4	feet =	91.68	psi

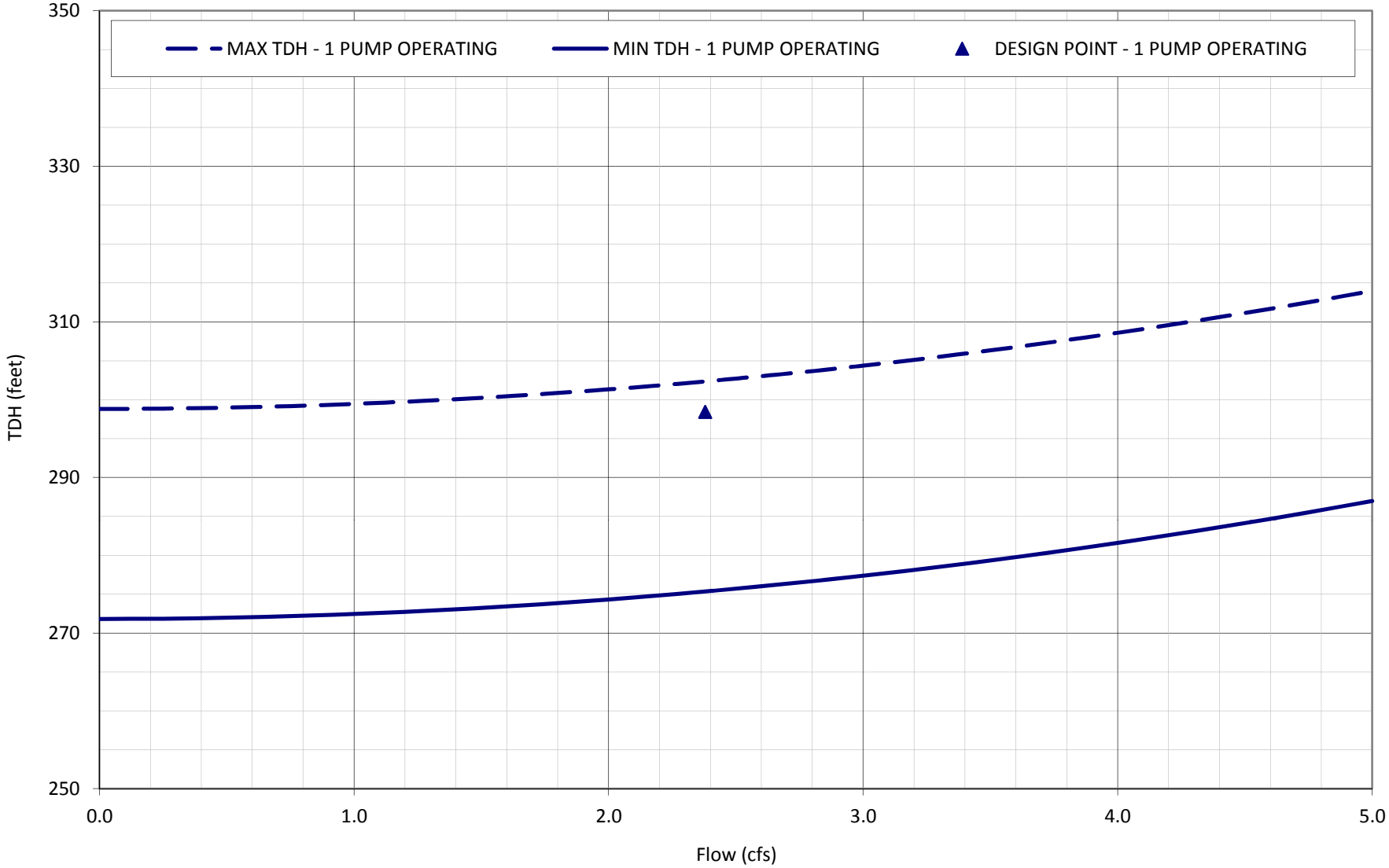
PIPE	SUCTION PIPING		PS PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					12	12		12
O.D. (in)					12.5	12.5		12.5
I.D. (in)					12	12		12
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		326
K					10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1068	2.4	298	115.1
*Assumes	70%	Efficiency		

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	12-inch (fps)	12-inch (fps)	-inch (fps)	12-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0					271.8	298.8	294.9						
112	0.2	0.32	0.32		0.32			0.0	0.0	0.0	0.0					271.9	298.9	295.0						
224	0.5	0.64	0.64		0.64			0.0	0.0	0.1	0.0					272.0	299.0	295.1						
337	0.7	0.95	0.95		0.95			0.0	0.1	0.2	0.0					272.2	299.2	295.3						
449	1.0	1.27	1.27		1.27			0.1	0.2	0.4	0.0					272.5	299.5	295.6						
561	1.2	1.59	1.59		1.59			0.1	0.2	0.6	0.0					272.8	299.8	295.9						
673	1.5	1.91	1.91		1.91			0.2	0.3	0.8	0.0					273.2	300.2	296.3						
785	1.7	2.23	2.23		2.23			0.3	0.5	1.2	0.0					273.8	300.8	296.9						
898	2.0	2.55	2.55		2.55			0.4	0.6	1.5	0.1					274.3	301.3	297.4						
1010	2.2	2.86	2.86		2.86			0.4	0.7	1.9	0.1					275.0	302.0	298.1						
1068	**2.4**	**3.03**	**3.03**		**3.03**			**0.5**	**0.8**	**2.1**	**0.1**					**275.3**	**302.3**	**298.4**						
1234	2.7	3.50	3.50		3.50			0.7	1.1	2.9	0.1					276.5	303.5	299.6						
1346	3.0	3.82	3.82		3.82			0.8	1.2	3.4	0.1					277.4	304.4	300.5						
1459	3.2	4.14	4.14		4.14			0.9	1.4	4.0	0.1					278.3	305.3	301.4						
1571	3.5	4.46	4.46		4.46			1.1	1.7	4.6	0.2					279.3	306.3	302.4						
1683	3.7	4.77	4.77		4.77			1.2	1.9	5.3	0.2					280.4	307.4	303.5						
1795	4.0	5.09	5.09		5.09			1.4	2.1	6.0	0.2					281.6	308.6	304.7						
1907	4.2	5.41	5.41		5.41			1.6	2.4	6.8	0.2					282.8	309.8	305.9						
2020	4.5	5.73	5.73		5.73			1.8	2.6	7.6	0.3					284.1	311.1	307.2						
2132	4.7	6.05	6.05		6.05			2.0	2.9	8.5	0.3					285.5	312.5	308.6						
2244	5.0	6.37	6.37		6.37			2.2	3.2	9.4	0.3					287.0	314.0	310.1						

MVID Alternatives Evaluation Report
System Curve - Alternative 1 - West Canal - River Pump Station to Users Upstream of Roach Spill



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,598.00 feet
- -HGL at High End of System = 1,667.30 feet
- -Pressure at High End of System = 30.01 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				PS Discharge Line	300+94.00	1,598.00										1,667.30	30.0
Main M-W-05	PS Discharge Line	300+94.00	1,598.00	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	1,596	18	8.49	4.8	3.6	5.8	0.6	1,667.30	30.0	1,660.92	32.8
Main M-W-06	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	2,649	18	7.57	4.3	2.9	7.8	0.8	1,660.92	32.8	1,652.38	31.7
Main M-W-07	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	18	6.91	3.9	2.5	17.9	1.8	1,652.38	31.7	1,632.72	31.1
Main M-W-08	MVID Lateral W5	415+40.00	1,560.95	MVID Lateral W6	499+46.00	1,548.60	8,406	18	5.89	3.3	1.8	15.5	1.6	1,632.72	31.1	1,615.65	29.0
Main M-W-09	MVID Lateral W6	499+46.00	1,548.60	MVID Lateral W7	519+66.00	1,545.50	2,020	15	5.36	4.4	3.8	7.6	0.8	1,615.65	29.0	1,607.28	26.8
Main M-W-10	MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,607.28	26.8	1,601.37	25.0
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,601.37	25.0	1,599.17	24.7
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.48	3.2	2.7	4.4	0.4	1,599.17	24.7	1,594.29	23.5
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,594.29	23.5	1,590.94	23.0
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,590.94	23.0	1,588.38	27.3
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,588.38	27.3	1,584.55	26.9
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,584.55	26.9	1,583.92	30.9
LATERAL W3																	
Lateral W3-1	PS Discharge at Lateral W3		1,574.80	Midpoint of Lateral W3		1,556.00	747	4	0.13	1.5	2.4	1.8	0.2	1,667.30	40.1	1,665.31	47.3
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,665.31	47.4	1,663.25	45.6
LATERAL W4																	
Lateral W4-1	Main at Lateral W4 (N Branch)		1,585.10	Tee, Lateral W4-2		1,542.00	1,400	8	0.92	2.6	3.1	4.3	0.4	1,660.92	32.9	1,656.22	49.5
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,656.22	49.5	1,655.69	53.6
Lateral W4-3	Tee, Lateral W4-2		1,542.00	Tee, Lateral W4-4		1,538.30	963	6	0.42	2.1	2.9	2.8	0.3	1,656.22	49.5	1,653.17	49.7
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,653.17	49.8	1,652.77	54.0
Lateral W4-5	Tee, Lateral W4-4		1,538.30	End of Laterals W4-5/W4-8		1,525.40	1,402	6	0.29	1.5	1.4	2.0	0.2	1,652.77	49.6	1,650.56	54.2
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,650.58	54.2	1,649.95	55.4
Lateral W4-7	Tee, Lateral W-4-7		1,525.80	End of Lateral W4-7		1,520.00	546	3	0.02	0.4	0.3	0.2	0.0	1,651.23	54.4	1,651.05	56.7
Lateral W4-8	Tee, Lateral W-4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	6	0.38	1.9	2.4	0.6	0.1	1,651.23	54.4	1,650.58	54.2
Lateral W4-9	Main at Lateral W4 (S Branch)		1,579.10	Tee, Lateral W-4-7		1,525.80	378	6	0.41	2.1	2.7	1.0	0.1	1,652.38	31.8	1,651.23	54.3
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,632.72	30.6	1,631.33	30.0
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,632.72	31.1	1,627.16	39.5
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,627.16	39.5	1,626.31	37.4
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,626.31	37.4	1,624.55	31.4
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.5	0.7	0.1	1,626.31	37.4	1,625.59	54.4
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,615.65	29.1	1,615.02	48.1
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,615.02	48.1	1,613.76	48.4
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,607.28	26.8	1,605.22	41.2
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,605.22	41.3	1,603.80	40.6
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,603.80	40.6	1,602.73	44.5
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,601.37	25.0	1,598.94	37.6
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,598.94	37.7	1,596.63	36.6
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,596.63	36.7	1,596.37	37.4
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.45	2.3	3.3	1.8	0.2	1,599.17	24.7	1,597.18	44.7
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,597.18	44.7	1,596.31	41.3
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.31	1.6	1.6	2.8	0.3	1,596.31	44.3	1,593.22	38.6
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.30	1.5	1.5	1.0	0.1	1,594.29	23.6	1,593.23	38.6
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,593.23	38.7	1,590.53	38.3
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,590.94	23.0	1,590.56	50.0
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,588.38	27.3	1,587.88	48.9
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,584.55	26.9	1,582.56	46.6

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,598.00 feet
- -HGL at High End of System = 1,644.20 feet
- -Pressure at High End of System = 20.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				PS Discharge Line	300+94.00	1,598.00										1,644.20	20.0
Main M-W-05	PS Discharge Line	300+94.00	1,598.00	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	1,596	18	8.49	4.8	3.6	5.8	0.6	1,644.20	20.0	1,637.82	22.8
Main M-W-06	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	2,649	18	7.57	4.3	2.9	7.8	0.8	1,637.82	22.8	1,629.28	21.7
Main M-W-07	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	18	6.91	3.9	2.5	17.9	1.8	1,629.28	21.7	1,609.62	21.1
Main M-W-08	MVID Lateral W5	415+40.00	1,560.95	MVID Lateral W6	499+46.00	1,548.60	8,406	18	5.89	3.3	1.8	15.5	1.6	1,609.62	21.1	1,592.55	19.0
Main M-W-09	MVID Lateral W6	499+46.00	1,548.60	MVID Lateral W7	519+66.00	1,545.50	2,020	15	5.36	4.4	3.8	7.6	0.8	1,592.55	19.0	1,584.18	16.7
Main M-W-10	MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,584.18	16.7	1,578.27	15.0
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,578.27	15.0	1,576.07	14.7
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.48	3.2	2.7	4.4	0.4	1,576.07	14.7	1,571.19	13.5
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,571.19	13.5	1,567.84	13.0
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,567.84	13.0	1,565.28	17.3
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,565.28	17.3	1,561.45	16.9
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,561.45	16.9	1,560.82	20.9
LATERAL W3																	
Lateral W3-1	PS Discharge at Lateral W3		1,574.80	Midpoint of Lateral W3		1,556.00	747	4	0.13	1.5	2.4	1.8	0.2	1,644.20	30.1	1,642.21	37.3
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,642.21	37.4	1,640.15	35.6
LATERAL W4																	
Lateral W4-1	Main at Lateral W4 (N Branch)		1,585.10	Tee, Lateral W4-2		1,542.00	1,400	8	0.92	2.6	3.1	4.3	0.4	1,637.82	22.8	1,633.12	39.5
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,633.12	39.5	1,632.59	43.6
Lateral W4-3	Tee, Lateral W4-2		1,542.00	Tee, Lateral W4-4		1,538.30	963	6	0.42	2.1	2.9	2.8	0.3	1,633.12	39.5	1,630.07	39.7
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,630.07	39.8	1,629.67	44.0
Lateral W4-5	Tee, Lateral W4-4		1,538.30	End of Laterals W4-5/W4-8		1,525.40	1,402	6	0.29	1.5	1.4	2.0	0.2	1,629.67	39.6	1,627.46	44.2
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,627.48	44.2	1,626.85	45.4
Lateral W4-7	Tee, Lateral W-4-7		1,525.80	End of Lateral W4-7		1,520.00	546	3	0.02	0.4	0.3	0.2	0.0	1,628.13	44.3	1,627.95	46.7
Lateral W4-8	Tee, Lateral W-4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	6	0.38	1.9	2.4	0.6	0.1	1,628.13	44.3	1,627.48	44.2
Lateral W4-9	Main at Lateral W4 (S Branch)		1,579.10	Tee, Lateral W-4-7		1,525.80	378	6	0.41	2.1	2.7	1.0	0.1	1,629.28	21.7	1,628.13	44.3
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,609.62	20.6	1,608.23	20.0
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,609.62	21.1	1,604.06	29.5
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,604.06	29.5	1,603.21	27.4
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,603.21	27.4	1,601.45	21.4
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.5	0.7	0.1	1,603.21	27.4	1,602.49	44.4
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,592.55	19.0	1,591.92	38.1
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,591.92	38.1	1,590.66	38.4
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,584.18	16.8	1,582.12	31.2
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,582.12	31.3	1,580.70	30.6
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,580.70	30.6	1,579.63	34.5
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,578.27	15.0	1,575.84	27.6
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,575.84	27.7	1,573.53	26.6
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,573.53	26.7	1,573.27	27.4
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.45	2.3	3.3	1.8	0.2	1,576.07	14.7	1,574.08	34.7
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,574.08	34.7	1,573.21	31.3
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.31	1.6	1.6	2.8	0.3	1,573.21	34.3	1,570.12	28.6
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.30	1.5	1.5	1.0	0.1	1,571.19	13.6	1,570.13	28.6
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,570.13	28.7	1,567.43	28.3
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,567.84	13.0	1,567.46	40.0
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,565.28	17.3	1,564.78	38.9
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,561.45	16.9	1,559.46	36.6

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 1 - WEST CANAL - METHOW RIVER PUMP STATION SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF ROACH SPIL

Input	
Calculation	
Output	

BY: David Rice, P.E.
DATE: 11-Apr-13

SUCTION WATER SURFACE ELEVATIONS (METHOW RIVER):			
ELEV	1530.0	feet	Invert at Diversion
HWL	1538.6	feet	Wet Well (High River)
LWL	1534.7	feet	Wet Well (Low River)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1598.0	feet		Pipe Invert at Ex MVID Ditch
HIGH	1667.3	feet =	30.01	psi
LWL	1644.2	feet =	20.00	psi

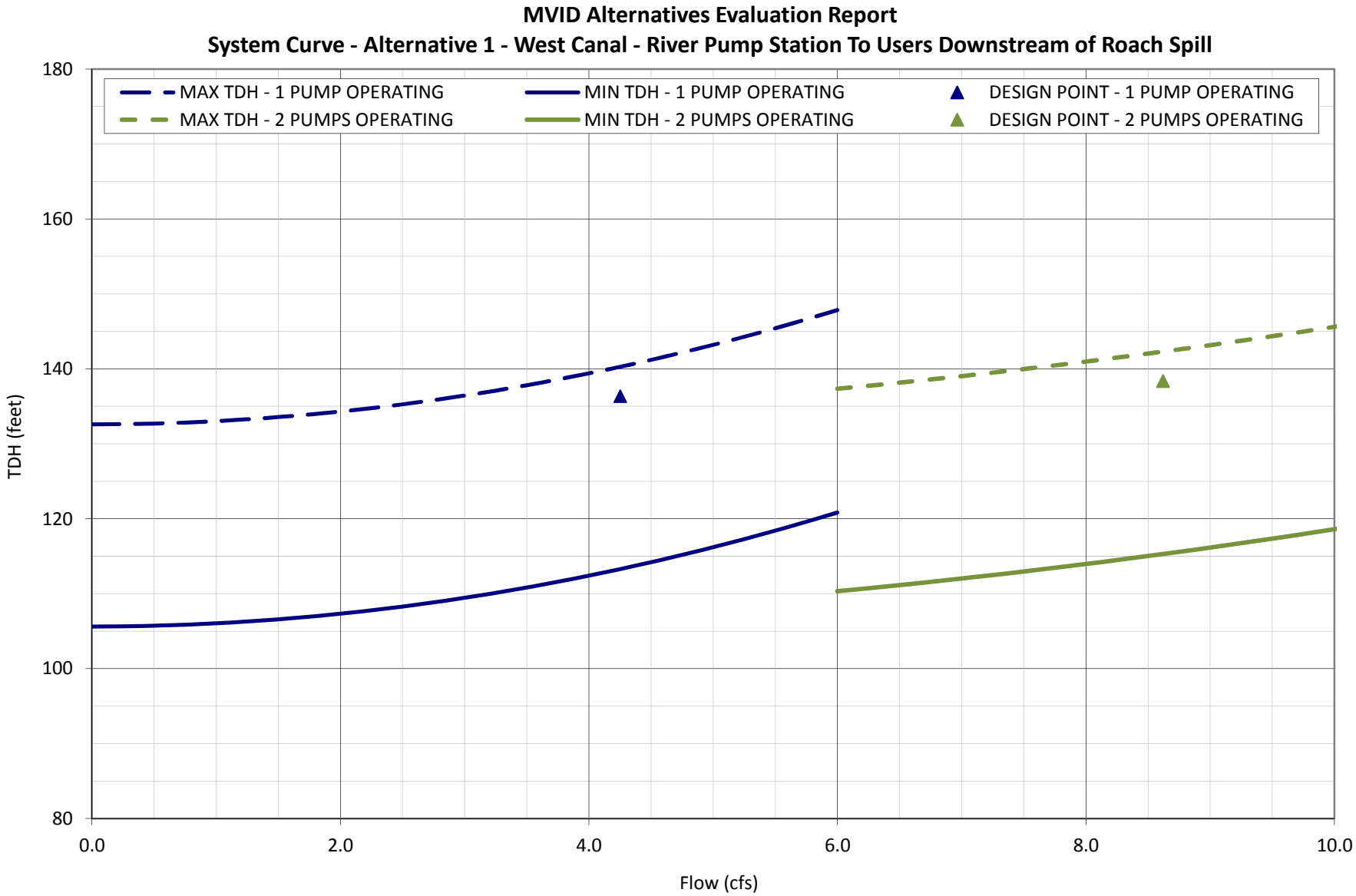
PIPE PROPERTIES	SUCTION PIPING		PS PIPING				DISCHARGE PIPING	
	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					12	12		18
O.D. (in)					12.5	12.5		18.5
I.D. (in)					12	12		18
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		308
K					10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1908	4.3	136	94.0
2	3869	8.6	138	193.3

**Assumes 70% Efficiency*

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	12-inch (fps)	12-inch (fps)	-inch (fps)	18-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0	0.0	0.0			105.6	132.6	128.7	105.6	132.6	128.7			
224	0.5	0.64	0.64		0.28			0.0	0.0	0.1	0.0	0.0	0.0			105.7	132.7	128.8	105.6	132.6	128.7			
449	1.0	1.27	1.27		0.57			0.0	0.0	0.4	0.0	0.1	0.0			106.0	133.0	129.1	105.7	132.7	128.8			
673	1.5	1.91	1.91		0.85			0.0	0.0	0.8	0.0	0.2	0.0			106.6	133.6	129.7	105.9	132.9	129.0			
898	2.0	2.55	2.55		1.13			0.1	0.1	1.5	0.1	0.4	0.0			107.3	134.3	130.4	106.1	133.1	129.2			
1122	2.5	3.18	3.18		1.41			0.1	0.1	2.4	0.1	0.6	0.0			108.3	135.3	131.4	106.4	133.4	129.5			
1346	3.0	3.82	3.82		1.70			0.2	0.2	3.4	0.1	0.8	0.0			109.4	136.4	132.5	106.8	133.8	129.9			
1571	3.5	4.46	4.46		1.98			0.2	0.2	4.6	0.2	1.2	0.0			110.8	137.8	133.9	107.2	134.2	130.3			
1795	4.0	5.09	5.09		2.26			0.3	0.3	6.0	0.2	1.5	0.1			112.4	139.4	135.5	107.7	134.7	130.8			
1908	**4.3**	**5.41**	**5.41**		**2.41**			**0.3**	**0.3**	**6.8**	**0.2**	**1.7**	**0.1**			**113.3**	**140.3**	**136.4**	**108.0**	**135.0**	**131.1**			
2020	4.5	5.73	5.73		2.55			0.4	0.3	7.6	0.3	1.9	0.1			114.2	141.2	137.3	108.3	135.3	131.4			
2244	5.0	6.37	6.37		2.83			0.4	0.4	9.4	0.3	2.4	0.1			116.2	143.2	139.3	108.9	135.9	132.0			
2468	5.5	7.00	7.00		3.11			0.5	0.5	11.4	0.4	2.9	0.1			118.4	145.4	141.5	109.6	136.6	132.7			
2693	6.0	7.64	7.64		3.39			0.6	0.6	13.6	0.4	3.4	0.1			120.8	147.8	143.9	110.3	137.3	133.4			
2917	6.5	8.27	8.27		3.68			0.7	0.7	15.9	0.5	4.0	0.1			123.5	150.5	146.6	111.1	138.1	134.2			
3142	7.0	8.91	8.91		3.96			0.9	0.8	18.5	0.6	4.6	0.2			126.3	153.3	149.4	112.0	139.0	135.1			
3366	7.5	9.55	9.55		4.24			1.0	0.9	21.2	0.6	5.3	0.2			129.4	156.4	152.5	113.0	140.0	136.1			
3590	8.0	10.18	10.18		4.53			1.1	1.0	24.2	0.7	6.0	0.2			132.6	159.6	155.7	114.0	141.0	137.1			
3869	**8.6**	**10.97**	**10.97**		**4.88**			**1.3**	**1.2**	**28.1**	**0.8**	**7.0**	**0.2**			**136.9**	**163.9**	**160.0**	**115.3**	**142.3**	**138.4**			
4039	9.0	11.46	11.46		5.09			1.4	1.2	30.6	0.9	7.6	0.3			139.7	166.7	162.8	116.2	143.2	139.3			
4264	9.5	12.09	12.09		5.38			1.6	1.4	34.1	1.0	8.5	0.3			143.6	170.6	166.7	117.3	144.3	140.4			
4488	10.0	12.73	12.73		5.66			1.7	1.5	37.7	1.1	9.4	0.3			147.7	174.7	170.8	118.6	145.6	141.7			
4712	10.5	13.37	13.37		5.94			1.9	1.7	41.6	1.2	10.4	0.3			152.0	179.0	175.1	119.9	146.9	143.0			
4937	11.0	14.00	14.00		6.22			2.1	1.8	45.7	1.3	11.4	0.4			156.5	183.5	179.6	121.3	148.3	144.4			
5161	11.5	14.64	14.64		6.51			2.3	2.0	49.9	1.4	12.5	0.4			161.2	188.2	184.3	122.7	149.7	145.8			
5386	12.0	15.28	15.28		6.79			2.5	2.1	54.4	1.5	13.6	0.4			166.1	193.1	189.2	124.2	151.2	147.3			
5610	12.5	15.91	15.91		7.07			2.7	2.3	59.0	1.7	14.7	0.5			171.3	198.3	194.4	125.8	152.8	148.9			


MVID Alternatives Evaluation Report
System Curve - Alternative 1 - West Canal - River Pump Station To Users Downstream of Roach Spill
MAX TDH - 1 PUMP OPERATING
MIN TDH - 1 PUMP OPERATING
DESIGN POINT - 1 PUMP OPERATING
MAX TDH - 2 PUMPS OPERATING
MIN TDH - 2 PUMPS OPERATING
DESIGN POINT - 2 PUMPS OPERATING
TDH (feet)
180
160
140
120
100
80
0.0
2.0
4.0
6.0
8.0
10.0
Flow (cfs)

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVES 1, 2, 3, AND 5 - EAST CANAL - PIPELINE OPERATING FULL FROM SUBMERGED INLET - TO LATERALS E2 THROUGH E14** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:	-Plastic Pipe, C =	140	
	-Elevation at Pipe Inlet =	1,652.00	feet
	-HGL at Pipe Inlet =	1,657.00	feet
	-Pressure at Pipe Inlet =	2.17	psi
	-Future Static HGL =	1,662.00	feet (Elevation of River at Existing Diversion/Head Gate)

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				Pipe Inlet Structure	193+00.00	1,652.00										1,657.00	2.2
Main M-E-01	Pipe Inlet Structure	193+00.00	1,652.00	Tee, Lateral E2	286+64.00	1,609.00	9,364	24	10.00	3.2	1.2	11.3	1.1	1,657.00	2.2	1,644.53	15.4
Main M-E-02	Tee, Lateral E2	286+64.00	1,609.00	Tee, Lateral E4	314+31.00	1,606.00	2,767	21	7.75	3.2	1.4	4.0	0.4	1,644.53	15.4	1,640.12	14.8
Main M-E-03	Tee, Lateral E4	314+31.00	1,606.00	Tee, Lateral E5	319+16.00	1,605.00	485	21	6.97	2.9	1.2	0.6	0.1	1,640.12	14.8	1,639.48	14.9
Main M-E-04	Tee, Lateral E5	319+16.00	1,605.00	Tee, Lateral E6	358+02.00	1,575.50	3,886	18	4.70	2.7	1.2	4.7	0.5	1,639.48	14.9	1,634.29	25.5
Main M-E-05	Tee, Lateral E6	358+02.00	1,575.50	Tee, Lateral E7	369+49.00	1,574.00	1,147	18	4.39	2.5	1.1	1.2	0.1	1,634.29	25.5	1,632.93	25.5
Main M-E-06	Tee, Lateral E7	369+49.00	1,574.00	Tee, Lateral E8	404+96.00	1,570.00	3,547	15	3.96	3.2	2.2	7.6	0.8	1,632.93	25.5	1,624.54	23.6
Main M-E-07	Tee, Lateral E8	404+96.00	1,570.00	Tee, Lateral E10	412+84.00	1,564.00	788	12	2.00	2.5	1.8	1.4	0.1	1,624.54	23.6	1,622.97	25.5
Main M-E-08	Tee, Lateral E10	412+84.00	1,564.00	Tee, Lateral E11	419+78.00	1,562.00	694	12	1.81	2.3	1.5	1.0	0.1	1,622.97	25.6	1,621.83	25.9
Main M-E-09	Tee, Lateral E11	419+78.00	1,562.00	Tee, Lateral E13	448+49.00	1,558.00	2,871	10	1.16	2.1	1.6	4.6	0.5	1,621.83	25.9	1,616.78	25.4
Main M-E-10	Tee, Lateral E13	448+49.00	1,558.00	Beaver Creek Spill	453+00.00	1,540.00	451	8	0.00	0.0	0.0	0.0	0.0	1,616.78	25.5	1,616.78	33.2
LATERAL E2																	
Lateral E2-1	Main at Lateral E2		1,609.00	End of Lateral E2-1		1,606.00	979	12	2.02	2.6	1.8	1.8	0.2	1,644.53	15.4	1,642.55	15.8
Lateral E2-2	End of Lateral E2-1		1,606.00	End of Lateral E2-2		1,604.00	677	12	1.49	1.9	1.0	0.7	0.1	1,642.55	15.8	1,641.78	16.4
Lateral E2-3	End of Lateral E2-2		1,604.00	End of Lateral E2-3		1,594.00	1,665	12	1.40	1.8	0.9	1.6	0.2	1,641.78	16.4	1,640.06	19.9
Lateral E2-4	End of Lateral E2-3		1,594.00	End of Lateral E2-4		1,592.00	673	10	0.51	0.9	0.3	0.2	0.0	1,640.06	20.0	1,639.80	20.7
Lateral E2-5	End of Lateral E2-4		1,592.00	End of Lateral E2-5		1,586.00	620	10	0.01	0.0	0.0	0.0	0.0	1,639.80	20.7	1,639.80	23.3
Lateral E2-6	End of Lateral E2-5		1,586.00	End of Lateral E2-6		1,552.00	808	6	0.39	2.0	2.6	2.1	0.2	1,639.80	23.3	1,637.52	37.0
Lateral E2-7	End of Lateral E2-1		1,606.00	End of Lateral E2-7		1,602.00	727	6	0.27	1.4	1.3	0.9	0.1	1,642.55	15.8	1,641.51	17.1
Lateral E2-8	End of Lateral E2-1		1,606.00	End of Lateral E2-8		1,606.00	244	6	0.26	1.3	1.2	0.3	0.0	1,642.55	15.8	1,642.23	15.7
Lateral E2-9	End of Lateral E2-8		1,606.00	End of Lateral E2-9		1,564.00	1,279	6	0.14	0.7	0.4	0.5	0.1	1,642.23	15.7	1,641.66	33.6
Lateral E2-10	End of Lateral E2-8		1,606.00	End of Lateral E2-10		1,560.00	524	3	0.07	1.4	3.2	1.7	0.2	1,642.23	15.7	1,640.41	34.8
Lateral E2-11	End of Lateral E2-2		1,604.00	End of Lateral E2-11		1,562.00	545	3	0.03	0.6	0.6	0.3	0.0	1,641.78	16.4	1,641.44	34.4
Lateral E2-12	End of Lateral E2-4		1,592.00	End of Lateral E2-12		1,558.00	220	6	0.50	2.5	4.0	0.9	0.1	1,639.80	20.7	1,638.82	35.0
LATERAL E4																	
Lateral E4-1	Main at Lateral E4		1,606.00	End of Lateral E4-1		1,598.00	695	6	0.36	1.8	2.2	1.5	0.2	1,640.06	14.8	1,638.37	17.5
Lateral E4-2	End of Lateral E4-1		1,598.00	End of Lateral E4-2		1,596.00	330	3	0.07	1.4	2.9	1.0	0.1	1,638.37	17.5	1,637.32	17.9
Lateral E4-3	End of Lateral E4-1		1,598.00	End of Lateral E4-3		1,602.00	700	6	0.24	1.2	1.0	0.7	0.1	1,638.37	17.5	1,637.58	15.4
LATERAL E5																	
Lateral E5-1	Main at Lateral E5		1,605.00	End of Lateral E5-1		1,600.00	1,350	12	2.15	2.7	2.1	2.8	0.3	1,644.53	17.1	1,641.46	18.0
Lateral E5-2	End of Lateral E5-1		1,600.00	End of Lateral E5-2		1,596.00	451	10	1.43	2.6	2.3	1.1	0.1	1,641.46	18.0	1,640.30	19.2
Lateral E5-3	End of Lateral E5-2		1,596.00	End of Lateral E5-3		1,586.00	1,044	10	1.11	2.0	1.5	1.6	0.2	1,641.46	19.7	1,639.75	23.3
Lateral E5-4	End of Lateral E5-1		1,600.00	End of Lateral E5-4		1,592.00	1,010	6	0.47	2.4	3.6	3.6	0.4	1,641.46	18.0	1,637.50	19.7
Lateral E5-5	End of Lateral E5-2		1,596.00	End of Lateral E5-5		1,548.00	299	6	0.31	1.6	1.7	0.5	0.1	1,640.30	19.2	1,639.74	39.7
LATERAL E6																	
Lateral E6-1	Main at Lateral E6		1,575.50	End of Lateral E6-1		1,560.00	304	4	0.08	0.9	1.0	0.3	0.0	1,634.29	25.5	1,633.96	32.0
LATERAL E7																	
Lateral E7-1	Main at Lateral E7		1,574.00	End of Lateral E7-1		1,549.00	462	6	0.34	1.8	2.0	0.9	0.1	1,632.93	25.5	1,631.90	35.9
Lateral E7-2	End of Lateral E7-1		1,549.00	End of Lateral E7-2		1,546.00	623	4	0.10	1.2	1.5	0.9	0.1	1,631.90	35.9	1,630.86	36.7
Lateral E7-3	End of Lateral E7-1		1,549.00	End of Lateral E7-3		1,545.00	372	4	0.16	1.8	3.5	1.3	0.1	1,631.90	35.9	1,630.48	37.0
LATERAL E8																	
Lateral E8-1	Main at Lateral E8		1,570.00	End of Lateral E8-1		1,528.00	866	10	1.29	2.4	1.9	1.7	0.2	1,624.54	23.6	1,622.69	41.0
Lateral E8-2	End of Lateral E8-1		1,528.00	End of Lateral E8-2		1,524.00	885	6	0.11	0.6	0.2	0.2	0.0	1,622.69	41.0	1,622.45	42.6
Lateral E8-3	End of Lateral E8-1		1,528.00	End of Lateral E8-3		1,530.00	532	8	0.89	2.5	2.9	1.5	0.2	1,622.69	41.0	1,621.00	39.4
Lateral E8-4	End of Lateral E8-3		1,530.00	End of Lateral E8-4		1,529.00	313	4	0.15	1.7	3.2	1.0	0.1	1,621.00	39.4	1,619.92	39.4

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVES 1, 2, 3, AND 5 - EAST CANAL - PIPELINE OPERATING FULL FROM SUBMERGED INLET - TO LATERALS E2 THROUGH E14** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:	-Plastic Pipe, C =	140	
	-Elevation at Pipe Inlet =	1,652.00	feet
	-HGL at Pipe Inlet =	1,657.00	feet
	-Pressure at Pipe Inlet =	2.17	psi
	-Future Static HGL =	1,662.00	feet (Elevation of River at Existing Diversion/Head Gate)

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
LATERAL E10																	
Lateral E10-1	Main at Lateral E10		1,564.00	End of Lateral E10-1		1,524.00	1,066	6	0.15	0.8	0.5	0.5	0.0	1,622.97	25.6	1,622.44	42.6
Lateral E10-2	End of Lateral E10-1		1,524.00	End of Lateral E10-2		1,525.00	596	6	0.18	0.9	0.6	0.4	0.0	1,622.44	42.7	1,622.03	42.0
LATERAL E11																	
Lateral E11-1	Main at Lateral E11		1,562.00	End of Lateral E11-1		1,524.00	861	8	0.53	1.5	1.1	1.0	0.1	1,621.83	25.9	1,620.76	41.9
Lateral E11-2	End of Lateral E11-1		1,524.00	End of Lateral E11-2		1,523.00	404	4	0.14	1.7	2.9	1.2	0.1	1,620.76	41.9	1,619.46	41.8
Lateral E11-3	End of Lateral E11-1		1,524.00	End of Lateral E11-3		1,520.00	190	6	0.23	1.2	1.0	0.2	0.0	1,620.76	41.9	1,620.56	43.5
LATERAL E13																	
Lateral E13-1	Main at Lateral E13		1,558.00	End of Lateral E13-1		1,542.00	620	8	0.70	2.0	1.9	1.2	0.1	1,616.78	25.5	1,615.50	31.8
Lateral E13-2	End of Lateral E13-1		1,542.00	End of Lateral E13-2		1,526.00	732	6	0.40	2.0	2.7	2.0	0.2	1,615.50	31.8	1,613.34	37.8
Lateral E13-3	End of Lateral E13-2		1,526.00	End of Lateral E13-3		1,512.00	535	4	0.16	1.8	3.4	1.8	0.2	1,615.50	38.8	1,613.48	43.9
Lateral E13-4	End of Lateral E13-2		1,526.00	End of Lateral E13-4		1,517.00	202	3	0.06	1.3	2.7	0.5	0.1	1,613.34	37.8	1,612.74	41.5
LATERAL E14																	
Lateral E14-1	End of Lateral E13-1		1,542.00	End of Lateral E14-1		1,548.00	347	4	0.17	1.9	3.9	1.3	0.1	1,615.50	31.8	1,614.03	28.6
Lateral E14-2	End of Lateral E14-1		1,548.00	End of Lateral E14-2		1,552.00	240	3	0.07	1.4	3.2	0.8	0.1	1,614.03	28.6	1,613.19	26.5

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,758.20	feet
	-HGL at High End of System =	1,804.40	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				Booster PS Discharge Line	301+06.00	1,604.00										1,833.57	99.4
Main M-W-04	Booster PS Discharge Line	301+06.00	1,604.00	MVID Lateral W2	226+30.00	1,735.00	7,476	12	2.38	3.0	2.5	18.6	1.9	1,833.57	99.5	1,813.11	33.8
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,813.11	33.8	1,809.37	29.8
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,809.37	29.8	1,808.39	29.3
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,808.39	29.4	1,804.40	20.0
LATERAL W0																	
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	3	0.03	0.6	0.7	0.4	0.0	1,804.40	20.0	1,804.01	59.9
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,808.39	29.4	1,807.98	42.0
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,807.98	42.0	1,807.72	44.0
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,807.98	42.0	1,807.97	42.0
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,807.72	44.1	1,807.68	42.7
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1236	6	0.26	1.3	1.2	1.5	0.1	1,809.37	29.8	1,807.72	42.7
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,807.72	42.8	1,805.48	46.5
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,813.11	33.8	1,812.71	66.1
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,812.71	66.2	1,812.53	70.4
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,812.53	70.4	1,812.20	74.1
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,812.53	70.4	1,811.50	76.9
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1481	4	0.12	1.4	2.1	3.1	0.3	1,811.50	76.9	1,808.10	92.7
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,812.71	66.2	1,811.34	65.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1439	4	0.16	1.8	3.6	5.1	0.5	1,811.34	65.6	1,805.72	89.1

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,758.20 feet
- -HGL at High End of System = 1,781.30 feet
- -Pressure at High End of System = 10.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				Booster PS Discharge Line	301+06.00	1,604.00										1,810.47	89.4
Main M-W-04	Booster PS Discharge Line	301+06.00	1,604.00	MVID Lateral W2	226+30.00	1,735.00	7,476	12	2.38	3.0	2.5	18.6	1.9	1,810.47	89.5	1,790.01	23.8
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,790.01	23.8	1,786.27	19.8
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,786.27	19.8	1,785.29	19.3
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,785.29	19.3	1,781.30	10.0
LATERAL W0																	
Lateral W-00	Main at Lateral W0		1,758.20	End of Pipe		1,665.70	550	4	0.15	1.7	3.2	1.7	0.2	1,781.30	10.0	1,779.39	49.2
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,785.29	19.3	1,784.88	32.0
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,784.88	32.0	1,784.62	34.0
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,784.88	32.0	1,784.87	32.0
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,784.62	34.1	1,784.58	32.7
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1236	6	0.26	1.3	1.2	1.5	0.1	1,786.27	19.8	1,784.62	32.7
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,784.62	32.8	1,782.38	36.5
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,790.01	23.8	1,789.61	56.1
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,789.61	56.2	1,789.43	60.4
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,789.43	60.4	1,789.10	64.1
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,789.43	60.4	1,788.40	66.9
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1481	4	0.12	1.4	2.1	3.1	0.3	1,788.40	66.9	1,785.00	82.7
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,789.61	56.2	1,788.24	55.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1439	4	0.16	1.8	3.6	5.1	0.5	1,788.24	55.6	1,782.62	79.1

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPIL

Input	BY: David Rice
Calculation	DATE: 11-Apr-13
Output	

SUCTION HGL/PRESSURE (AT SUCTION SIDE OF BPS)				
ELEV	1598.0	feet	Pipe Invert at Booster Pump	
HWL	1667.3	feet	30.01	psi
LWL	1644.9	feet	20.31	psi

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1604.0	feet	Pipe Invert at Ex MVID Ditch	
HIGH	1833.6	feet =	99.40	psi
LWL	1810.5	feet =	89.40	psi

107.7264

PIPE PROPERTIES	SUCTION PIPING TRANS.	SUCTION PIPING TRANS.	PS PIPING HEADER	PS PIPING TO PUMP	PS PIPING FR. PUMP	PS PIPING HEADER	DISCHARGE PIPING TRANS.	DISCHARGE PIPING TRANS.
NOM. DIAM. (in)	12		12	12	12	12		12
O.D. (in)	12.5		12.5	12.5	12.5	12.5		12.5
I.D. (in)	12		12	12	12	12		12
MATERIAL	STEEL		STEEL	STEEL	STEEL	STEEL		HDPE
C	110		110	110	110	110		140
LENGTH (feet)	20		10	10	10	10		326
K	10		3	5	10	5		3.5

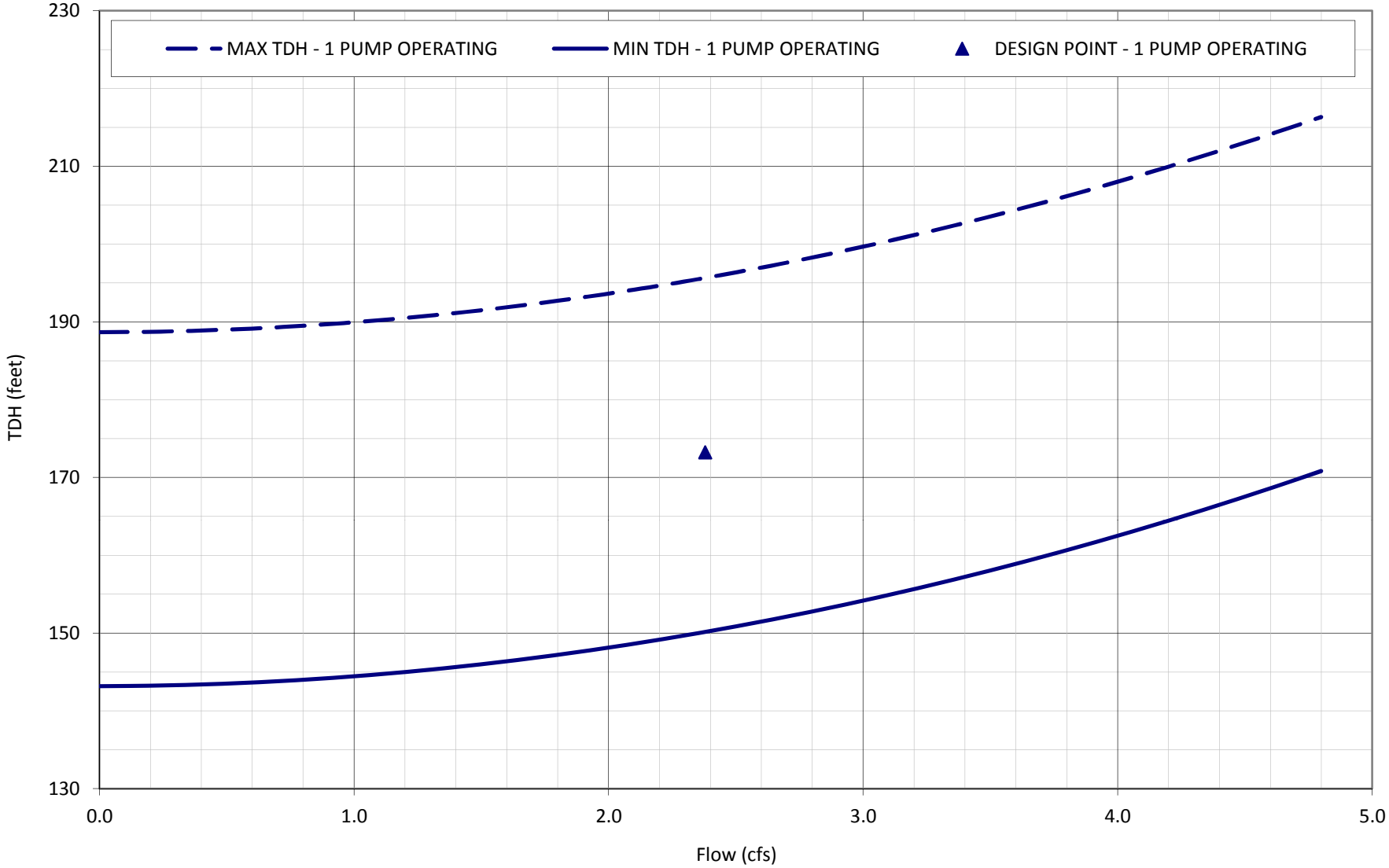
PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1,068	2.4	173	66.8

**Assumes 70% Efficiency*

TOTAL FLOW (gpm)	TOTAL FLOW (cfs)	VELOCITIES 12-inch (fps)	VELOCITIES 12-inch (fps)	VELOCITIES 12-inch (fps)	VELOCITIES 12-inch (fps)	SUCTION LOSSES Minor (feet)	SUCTION LOSSES Friction (feet)	DISCHARGE LOSSES Minor (feet)	DISCHARGE LOSSES Friction (feet)	PS LOSSES - 1 PUMP Minor (feet)	PS LOSSES - 1 PUMP Friction (feet)	PS LOSSES - 2 PUMPS Minor (feet)	PS LOSSES - 2 PUMPS Friction (feet)	PS LOSSES - 3 PUMPS Minor (feet)	PS LOSSES - 3 PUMPS Friction (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MIN (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MAX (feet)	TOTAL DYNAMIC HEAD - 1 PUMP DESIGN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS DESIGN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS DESIGN (feet)
0	0.0	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0					143.2	188.7	166.3						
108	0.2	0.31	0.31	0.31	0.31	0.0	0.0	0.0	0.0	0.0	0.0					143.2	188.7	166.3						
215	0.5	0.61	0.61	0.61	0.61	0.1	0.0	0.0	0.0	0.1	0.0					143.5	189.0	166.6						
323	0.7	0.92	0.92	0.92	0.92	0.1	0.1	0.0	0.1	0.3	0.0					143.8	189.3	166.9						
431	1.0	1.22	1.22	1.22	1.22	0.2	0.2	0.1	0.2	0.5	0.0					144.3	189.8	167.4						
539	1.2	1.53	1.53	1.53	1.53	0.4	0.2	0.1	0.2	0.8	0.0					145.0	190.5	168.1						
646	1.4	1.83	1.83	1.83	1.83	0.5	0.3	0.2	0.3	1.2	0.1					145.8	191.3	168.9						
754	1.7	2.14	2.14	2.14	2.14	0.7	0.4	0.2	0.4	1.6	0.1					146.7	192.2	169.8						
862	1.9	2.44	2.44	2.44	2.44	0.9	0.5	0.3	0.5	2.1	0.1					147.7	193.2	170.8						
969	2.2	2.75	2.75	2.75	2.75	1.2	0.7	0.4	0.7	2.7	0.1					148.9	194.4	172.0						
1068	**2.4**	**3.03**	**3.03**	**3.03**	**3.03**	**1.4**	**0.8**	**0.5**	**0.8**	**3.3**	**0.2**					**150.1**	**195.6**	**173.2**						
1185	2.6	3.36	3.36	3.36	3.36	1.8	1.0	0.6	1.0	4.0	0.2					151.7	197.2	174.8						
1292	2.9	3.67	3.67	3.67	3.67	2.1	1.2	0.7	1.2	4.8	0.2					153.3	198.8	176.4						
1400	3.1	3.97	3.97	3.97	3.97	2.4	1.3	0.9	1.3	5.6	0.3					155.0	200.5	178.1						
1508	3.4	4.28	4.28	4.28	4.28	2.8	1.5	1.0	1.5	6.5	0.3					156.9	202.4	180.0						
1616	3.6	4.58	4.58	4.58	4.58	3.3	1.7	1.1	1.7	7.5	0.3					158.9	204.4	182.0						
1723	3.8	4.89	4.89	4.89	4.89	3.7	2.0	1.3	2.0	8.5	0.4					161.0	206.5	184.1						
1831	4.1	5.19	5.19	5.19	5.19	4.2	2.2	1.5	2.2	9.6	0.4					163.3	208.8	186.4						
1939	4.3	5.50	5.50	5.50	5.50	4.7	2.4	1.6	2.4	10.8	0.5					165.7	211.2	188.8						
2046	4.6	5.80	5.80	5.80	5.80	5.2	2.7	1.8	2.7	12.0	0.5					168.2	213.7	191.3						
2154	4.8	6.11	6.11	6.11	6.11	5.8	3.0	2.0	3.0	13.3	0.6					170.8	216.3	193.9						

MVID Alternatives Evaluation Report
System Curve - Alternative 2 - West Canal - Booster Pump Station To Users Upstream of Roach Spill



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,598.00 feet
- -HGL at High End of System = 1,667.30 feet
- -Pressure at High End of System = 30.01 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-06	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	2,649	12	2.66	3.4	3.1	8.1	0.8	1,681.79	44.5	1,672.89	38.0
Main M-W-05	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	Booster Pump Suction	301+06.00	1,598.00	1,584	12	2.73	3.5	3.2	5.1	0.5	1,672.89	38.0	1,667.30	30.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-07	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	18	6.91	3.9	2.5	17.9	1.8	1,672.89	38.0	1,653.24	40.0
Main M-W-08	MVID Lateral W5	415+40.00	1,560.95	MVID Lateral W6	499+46.00	1,548.60	8,406	18	5.89	3.3	1.8	15.5	1.6	1,653.24	40.0	1,636.16	37.9
Main M-W-09	MVID Lateral W6	499+46.00	1,548.60	MVID Lateral W7	519+66.00	1,545.50	2,020	15	5.36	4.4	3.8	7.6	0.8	1,636.16	37.9	1,627.79	35.6
Main M-W-10	MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,627.79	35.6	1,621.88	33.9
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,621.88	33.9	1,619.68	33.6
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.47	3.1	2.7	4.4	0.4	1,619.68	33.6	1,614.82	32.4
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,614.82	32.4	1,611.47	31.9
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,611.47	31.9	1,608.91	36.2
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,608.91	36.2	1,605.07	35.8
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,605.07	35.8	1,604.45	39.8
LATERAL W3																	
Lateral W3-1	Booster Pump Suction		1,598.00	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.5	2.4	2.1	0.2	1,667.30	30.0	1,665.01	47.2
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,665.01	47.2	1,662.96	45.4
LATERAL W4																	
Lateral W4-1	Tee, Lateral W4-2		1,542.00	Main at Lateral W4 (N Branch)		1,585.10	1,400	8	0.40	1.1	0.7	0.9	0.1	1,673.92	57.2	1,672.90	38.0
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,673.92	57.2	1,673.39	61.2
Lateral W4-3	Tee, Lateral W4-4		1,538.30	Tee, Lateral W4-2		1,542.00	963	8	0.70	2.0	1.9	1.8	0.2	1,675.89	59.6	1,673.92	57.1
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,675.89	59.6	1,675.49	63.9
Lateral W4-5	End of Laterals W4-5/W4-8		1,525.40	Tee, Lateral W4-4		1,538.30	1,402	8	0.95	2.7	3.3	4.6	0.5	1,680.95	67.4	1,675.89	59.6
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,681.57	67.7	1,680.95	68.9
Lateral W4-7	Well Field/Tee to Lateral W4-7		1,525.80	End of Lateral W4-7		1,520.00	546	20	11.00	5.0	3.5	1.9	0.2	1,682.92	68.1	1,680.81	69.6
Lateral W4-8	Well Field/Tee to Lateral W4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	8	1.18	3.4	4.9	1.2	0.1	1,682.92	68.1	1,681.57	67.6
Lateral W4-9	Well Field/Tee to Lateral W4-7		1,525.80	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	378	20	9.57	4.4	2.7	1.0	0.1	1,682.92	68.1	1,681.79	44.5
				Well Field/Tee to Lateral W4-7		1,525.80										1,682.92	68.0
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,653.24	39.5	1,651.84	38.9
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,653.24	40.0	1,647.67	48.4
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,647.67	48.4	1,646.82	46.3
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,646.82	46.3	1,645.06	40.3
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.5	0.7	0.1	1,646.82	46.3	1,646.10	63.3
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,636.16	37.9	1,635.53	57.0
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,635.53	57.0	1,634.27	57.3
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,627.79	35.7	1,625.73	50.1
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,625.73	50.1	1,624.31	49.5
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,624.31	49.5	1,623.24	53.4
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,621.88	33.9	1,619.45	46.5
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,619.45	46.6	1,617.14	45.5
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,617.14	45.6	1,616.88	46.3
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.45	2.3	3.3	1.8	0.2	1,619.68	33.6	1,617.65	53.5
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,617.65	53.6	1,616.78	50.1
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.30	1.5	1.6	2.7	0.3	1,616.78	53.2	1,613.78	47.5
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.29	1.5	1.5	0.9	0.1	1,614.82	32.5	1,613.79	47.5
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,613.79	47.6	1,611.10	47.2
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,611.47	31.9	1,611.09	58.9
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,608.91	36.2	1,608.41	57.8
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,605.07	35.8	1,603.09	55.5

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,598.70 feet
- -HGL at High End of System = 1,644.90 feet
- -Pressure at High End of System = 20.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-06	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	2,649	12	2.66	3.4	3.1	8.1	0.8	1,659.39	34.8	1,650.49	28.3
Main M-W-05	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	Booster Pump Suction	301+06.00	1,598.70	1,584	12	2.73	3.5	3.2	5.1	0.5	1,650.49	28.3	1,644.90	20.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-07	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	18	6.91	3.9	2.5	17.9	1.8	1,650.49	28.3	1,630.84	30.3
Main M-W-08	MVID Lateral W5	415+40.00	1,560.95	MVID Lateral W6	499+46.00	1,548.60	8,406	18	5.89	3.3	1.8	15.5	1.6	1,630.84	30.3	1,613.76	28.2
Main M-W-09	MVID Lateral W6	499+46.00	1,548.60	MVID Lateral W7	519+66.00	1,545.50	2,020	15	5.36	4.4	3.8	7.6	0.8	1,613.76	28.2	1,605.39	25.9
Main M-W-10	MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,605.39	25.9	1,599.48	24.2
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,599.48	24.2	1,597.28	23.9
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.47	3.1	2.7	4.4	0.4	1,597.28	23.9	1,592.42	22.7
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,592.42	22.7	1,589.07	22.2
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,589.07	22.2	1,586.51	26.5
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,586.51	26.5	1,582.67	26.1
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,582.67	26.1	1,582.05	30.1
LATERAL W3																	
Lateral W3-1	Booster Pump Suction		1,598.70	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.5	2.4	2.1	0.2	1,644.90	20.0	1,642.61	37.5
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,642.61	37.5	1,640.56	35.7
LATERAL W4																	
Lateral W4-1	Tee, Lateral W4-2		1,542.00	Main at Lateral W4 (N Branch)		1,585.10	1,400	8	0.40	1.1	0.7	0.9	0.1	1,651.52	47.5	1,650.50	28.3
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,651.52	47.5	1,650.99	51.5
Lateral W4-3	Tee, Lateral W4-4		1,538.30	Tee, Lateral W4-2		1,542.00	963	8	0.70	2.0	1.9	1.8	0.2	1,653.49	49.9	1,651.52	47.4
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,653.49	49.9	1,653.09	54.2
Lateral W4-5	End of Laterals W4-5/W4-8		1,525.40	Tee, Lateral W4-4		1,538.30	1,402	8	0.95	2.7	3.3	4.6	0.5	1,658.55	57.7	1,653.49	49.9
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,659.17	58.0	1,658.55	59.2
Lateral W4-7	Well Field/Tee to Lateral W4-7		1,525.80	End of Lateral W4-7		1,520.00	546	20	11.00	5.0	3.5	1.9	0.2	1,660.52	58.4	1,658.41	59.9
Lateral W4-8	Well Field/Tee to Lateral W4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	8	1.18	3.4	4.9	1.2	0.1	1,660.52	58.4	1,659.17	57.9
Lateral W4-9	Well Field/Tee to Lateral W4-7		1,525.80	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	378	20	9.57	4.4	2.7	1.0	0.1	1,660.52	58.4	1,659.39	34.8
				Well Field/Tee to Lateral W4-7		1,525.80										1,660.52	58.3
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,630.84	29.8	1,629.44	29.2
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,630.84	30.3	1,625.27	38.7
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,625.27	38.7	1,624.42	36.6
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,624.42	36.6	1,622.66	30.6
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.5	0.7	0.1	1,624.42	36.6	1,623.70	53.6
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,613.76	28.2	1,613.13	47.3
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,613.13	47.3	1,611.87	47.6
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,605.39	26.0	1,603.33	40.4
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,603.33	40.4	1,601.91	39.8
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,601.91	39.8	1,600.84	43.7
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,599.48	24.2	1,597.05	36.8
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,597.05	36.9	1,594.74	35.8
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,594.74	35.9	1,594.48	36.6
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.45	2.3	3.3	1.8	0.2	1,597.28	23.9	1,595.25	43.8
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,595.25	43.9	1,594.38	40.4
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.30	1.5	1.6	2.7	0.3	1,594.38	43.5	1,591.38	37.8
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.29	1.5	1.5	0.9	0.1	1,592.42	22.8	1,591.39	37.8
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,591.39	37.9	1,588.70	37.5
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,589.07	22.2	1,588.69	49.2
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,586.51	26.5	1,586.01	48.1
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,582.67	26.1	1,580.69	45.8

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 2 - WEST CANAL - WELL FIELD SERVING SINGLE PRESSURIZED SYSTEM - TO USERS DOWNSTREAM OF DROP NEAR ROACH SPIL

Input	
Calculation	
Output	

BY: David Rice
DATE: 11-Apr-13

SUCTION WATER SURFACE ELEVATIONS (GROUNDWATER):			
ELEV	1525.0	feet	Well Elevation
HWL	1515.0	feet	Wet Well (High GW)
LWL	1455.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT CONNECTION TO LATERAL W-4):				
ELEV	1525.8	feet	Pipe Invert at Lateral W4-9	
HIGH	1682.9	feet =	68.03	psi
LWL	1660.5	feet =	58.33	psi

PIPE	SUCTION PIPING		WELL PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					12	12		21
O.D. (in)					12.5	12.5		21.5
I.D. (in)					12	12		21
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	100		40
K					10	5		3

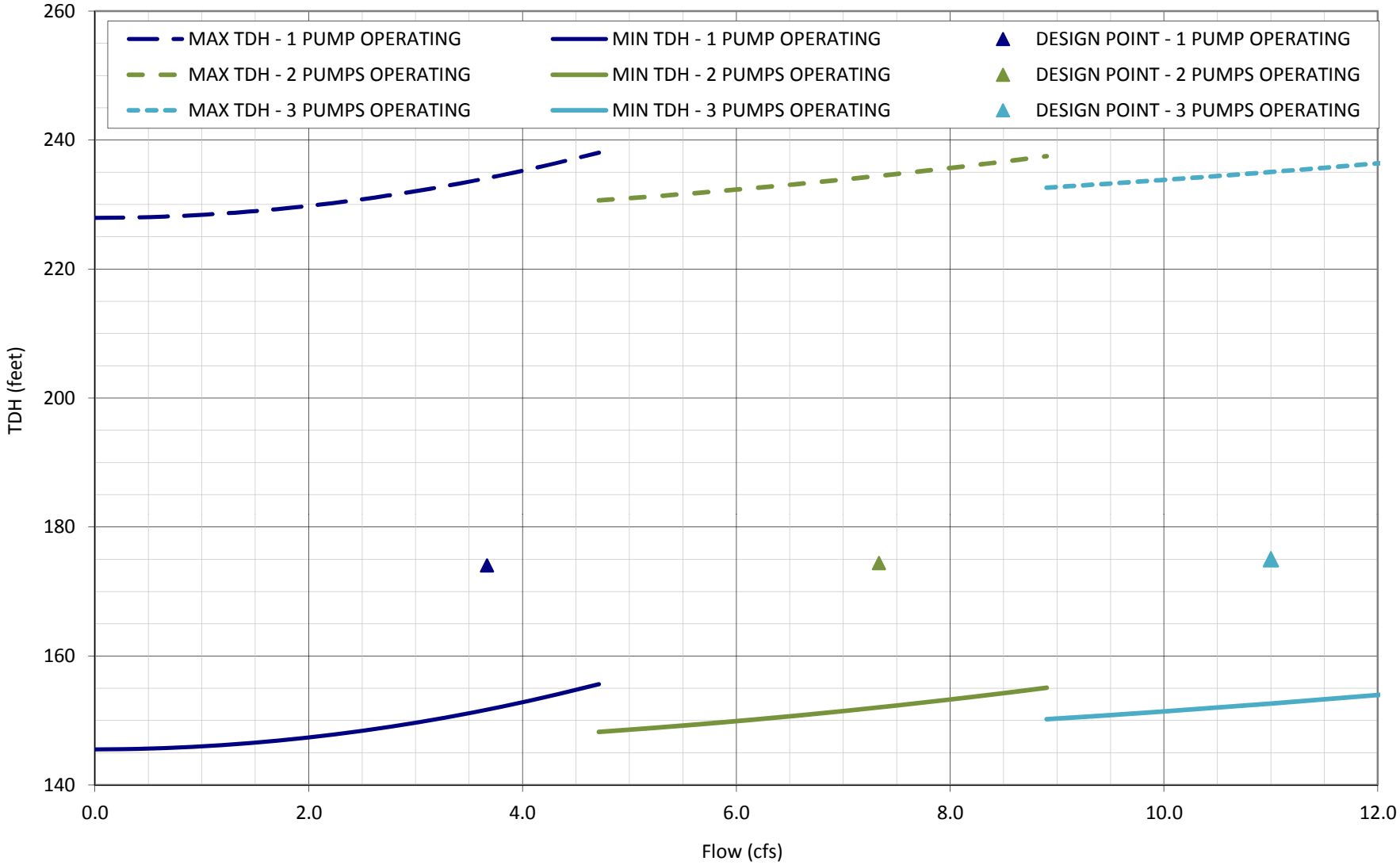
PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1,646	3.7	174	103.4
2	3,291	7.3	174	207.3
3	4,937	11.0	175	312.0

**Assumes 70% Efficiency*

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	12-inch (fps)	12-inch (fps)	-inch (fps)	21-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145.5	227.9	167.9	145.5	227.9	167.9	145.5	227.9	167.9
235	0.5	0.67	0.67		0.22			0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	145.7	228.1	168.1	145.6	228.0	168.0	145.5	227.9	167.9
470	1.0	1.33	1.33		0.44			0.0	0.0	0.4	0.1	0.1	0.0	0.0	0.0	146.0	228.4	168.4	145.7	228.1	168.1	145.6	228.0	168.0
705	1.6	2.00	2.00		0.65			0.0	0.0	0.9	0.2	0.2	0.1	0.1	0.0	146.7	229.1	169.1	145.8	228.2	168.2	145.7	228.1	168.1
940	2.1	2.67	2.67		0.87			0.0	0.0	1.7	0.3	0.4	0.1	0.2	0.0	147.6	230.0	170.0	146.1	228.5	168.5	145.8	228.2	168.2
1176	2.6	3.33	3.33		1.09			0.1	0.0	2.6	0.5	0.6	0.1	0.3	0.1	148.7	231.1	171.1	146.4	228.8	168.8	145.9	228.3	168.3
1411	3.1	4.00	4.00		1.31			0.1	0.0	3.7	0.7	0.9	0.2	0.4	0.1	150.1	232.5	172.5	146.7	229.1	169.1	146.1	228.5	168.5
1646	3.7	4.67	4.67		1.52			0.1	0.0	5.1	1.0	1.3	0.3	0.6	0.1	151.7	234.1	174.1	147.2	229.6	169.6	146.3	228.7	168.7
1881	4.2	5.34	5.34		1.74			0.1	0.0	6.6	1.2	1.7	0.3	0.7	0.2	153.5	235.9	175.9	147.7	230.1	170.1	146.6	229.0	169.0
2116	4.7	6.00	6.00		1.96			0.2	0.0	8.4	1.5	2.1	0.4	0.9	0.2	155.6	238.0	178.0	148.2	230.6	170.6	146.9	229.3	169.3
2351	5.2	6.67	6.67		2.18			0.2	0.0	10.4	1.8	2.6	0.5	1.2	0.2	158.0	240.4	180.4	148.9	231.3	171.3	147.2	229.6	169.6
2586	5.8	7.34	7.34		2.40			0.3	0.0	12.5	2.2	3.1	0.6	1.4	0.3	160.6	243.0	183.0	149.6	232.0	172.0	147.5	229.9	169.9
2821	6.3	8.00	8.00		2.61			0.3	0.0	14.9	2.6	3.7	0.7	1.7	0.3	163.4	245.8	185.8	150.3	232.7	172.7	147.9	230.3	170.3
3056	6.8	8.67	8.67		2.83			0.4	0.0	17.5	3.0	4.4	0.8	1.9	0.4	166.4	248.8	188.8	151.1	233.5	173.5	148.3	230.7	170.7
3291	7.3	9.34	9.34		3.05			0.4	0.1	20.3	3.4	5.1	1.0	2.3	0.4	169.7	252.1	192.1	152.0	234.4	174.4	148.7	231.1	171.1
3527	7.9	10.00	10.00		3.27			0.5	0.1	23.3	3.9	5.8	1.1	2.6	0.5	173.3	255.7	195.7	153.0	235.4	175.4	149.2	231.6	171.6
3762	8.4	10.67	10.67		3.48			0.6	0.1	26.5	4.4	6.6	1.2	2.9	0.6	177.1	259.5	199.5	154.0	236.4	176.4	149.7	232.1	172.1
3997	8.9	11.34	11.34		3.70			0.6	0.1	29.9	4.9	7.5	1.4	3.3	0.6	181.1	263.5	203.5	155.1	237.5	177.5	150.2	232.6	172.6
4232	9.4	12.00	12.00		3.92			0.7	0.1	33.6	5.5	8.4	1.5	3.7	0.7	185.3	267.7	207.7	156.2	238.6	178.6	150.8	233.2	173.2
4467	10.0	12.67	12.67		4.14			0.8	0.1	37.4	6.0	9.3	1.7	4.2	0.8	189.8	272.2	212.2	157.4	239.8	179.8	151.4	233.8	173.8
4702	10.5	13.34	13.34		4.36			0.9	0.1	41.4	6.6	10.4	1.8	4.6	0.9	194.6	277.0	217.0	158.7	241.1	181.1	152.0	234.4	174.4
4937	11.0	14.00	14.00		4.57			1.0	0.1	45.7	7.3	11.4	2.0	5.1	1.0	199.5	281.9	221.9	160.0	242.4	182.4	152.6	235.0	175.0
5172	11.5	14.67	14.67		4.79			1.1	0.1	50.1	7.9	12.5	2.2	5.6	1.0	204.8	287.2	227.2	161.4	243.8	183.8	153.3	235.7	175.7
5407	12.0	15.34	15.34		5.01			1.2	0.1	54.8	8.6	13.7	2.4	6.1	1.1	210.2	292.6	232.6	162.9	245.3	185.3	154.0	236.4	176.4
5642	12.6	16.01	16.01		5.23			1.3	0.1	59.7	9.3	14.9	2.6	6.6	1.2	215.9	298.3	238.3	164.4	246.8	186.8	154.8	237.2	177.2
5878	13.1	16.67	16.67		5.44			1.4	0.2	64.7	10.0	16.2	2.8	7.2	1.3	221.8	304.2	244.2	166.0	248.4	188.4	155.6	238.0	178.0
6113	13.6	17.34	17.34		5.66			1.5	0.2	70.0	10.8	17.5	3.0	7.8	1.4	228.0	310.4	250.4	167.7	250.1	190.1	156.4	238.8	178.8
6348	14.1	18.01	18.01		5.88			1.6	0.2	75.5	11.6	18.9	3.2	8.4	1.5	234.4	316.8	256.8	169.4	251.8	191.8	157.2	239.6	179.6

MVID Alternatives Evaluation Report
System Curve - Alternative 2 - West Canal - Well Pumps to Supply Entire System



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,758.20	feet
	-HGL at High End of System =	1,804.40	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				Booster PS Discharge Line	301+06.00	1,604.00										1,833.96	99.6
Main M-W-04	Booster PS Discharge Line	301+06.00	1,604.00	MVID Lateral W2	226+30.00	1,735.00	7,476	12	2.38	3.0	2.5	18.6	1.9	1,833.96	99.6	1,813.50	34.0
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,813.50	34.0	1,809.76	30.0
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,809.76	30.0	1,808.78	29.5
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,808.78	29.5	1,804.79	20.2
LATERAL W0																	
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	3	0.03	0.6	0.7	0.4	0.0	1,804.79	20.2	1,804.40	20.0
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,808.78	29.5	1,808.38	42.2
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,808.38	42.2	1,808.11	44.2
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,808.38	42.2	1,808.37	42.2
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,808.11	44.2	1,808.07	42.9
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.27	1.4	1.3	1.6	0.2	1,809.76	30.0	1,808.00	42.9
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,808.00	42.9	1,805.75	46.7
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,813.50	34.0	1,813.10	66.3
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,813.10	66.3	1,812.93	70.5
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,812.93	70.6	1,812.59	74.3
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,812.93	70.6	1,811.89	77.0
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1,481	4	0.12	1.4	2.1	3.1	0.3	1,811.89	77.1	1,808.50	92.9
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,813.10	66.3	1,811.73	65.7
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.6	5.1	0.5	1,811.73	65.7	1,806.11	89.2

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:
- -Plastic Pipe, C = 140
- -Elevation at High End of System = 1,758.20 feet
- -HGL at High End of System = 1,781.30 feet
- -Pressure at High End of System = 10.0 psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE																	
				Booster PS Discharge Line	301+06.00	1,604.00										1,810.86	89.6
Main M-W-04	Booster PS Discharge Line	301+06.00	1,604.00	MVID Lateral W2	226+30.00	1,735.00	7,476	12	2.38	3.0	2.5	18.6	1.9	1,810.86	89.6	1,790.40	24.0
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,790.40	24.0	1,786.66	20.0
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,786.66	20.0	1,785.68	19.5
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,785.68	19.5	1,781.69	10.2
LATERAL W0																	
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,765.00	550	3	0.03	0.6	0.7	0.4	0.0	1,781.69	10.2	1,781.30	10.0
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,785.68	19.5	1,785.28	32.2
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	1.0	0.2	0.0	1,785.28	32.2	1,785.01	34.2
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.2	0.1	0.0	0.0	1,785.28	32.2	1,785.27	32.2
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,785.01	34.2	1,784.97	32.9
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.27	1.4	1.3	1.6	0.2	1,786.66	20.0	1,784.90	32.9
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.8	3.6	2.0	0.2	1,784.90	32.9	1,782.65	36.7
LATERAL W2																	
Lateral W2-0A	Main at Lateral W2		1,735.00	Tee on W side of Highway		1,660.00	277	8	0.58	1.7	1.3	0.4	0.0	1,790.40	24.0	1,790.00	56.3
Lateral W2-0B	Tee on W side of Highway		1,660.00	Tee on E side of Highway		1,650.00	95	6	0.31	1.6	1.7	0.2	0.0	1,790.00	56.3	1,789.83	60.5
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,789.83	60.6	1,789.49	64.3
Lateral W2-2	Tee on E side of Highway		1,650.00	Mid N Branch, E of Highway		1,634.00	678	6	0.28	1.4	1.4	0.9	0.1	1,789.83	60.6	1,788.79	67.0
Lateral W2-3	Mid N Branch, E of Highway		1,634.00	End of N Branch, E of Highway		1,594.00	1,481	4	0.12	1.4	2.1	3.1	0.3	1,788.79	67.1	1,785.40	82.9
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,790.00	56.3	1,788.63	55.7
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.6	5.1	0.5	1,788.63	55.7	1,783.01	79.2

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - BPS TO USERS UPSTREAM OF DROP NEAR ROACH SPIL

Input	BY: David Rice
Calculation	DATE: 11-Apr-13
Output	

SUCTION WATER SURFACE ELEVATIONS (METHOW RIVER):				
ELEV	1,598.7	feet	Pipe Invert at Booster Pump	
HWL	1,668.0	feet	30.01	psi
LWL	1,644.9	feet	20.00	psi

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1,604.0	feet	Pipe Invert at Ex MVID Ditch	
HIGH	1,834.0	feet =	99.57	psi
LWL	1,810.9	feet =	89.57	psi

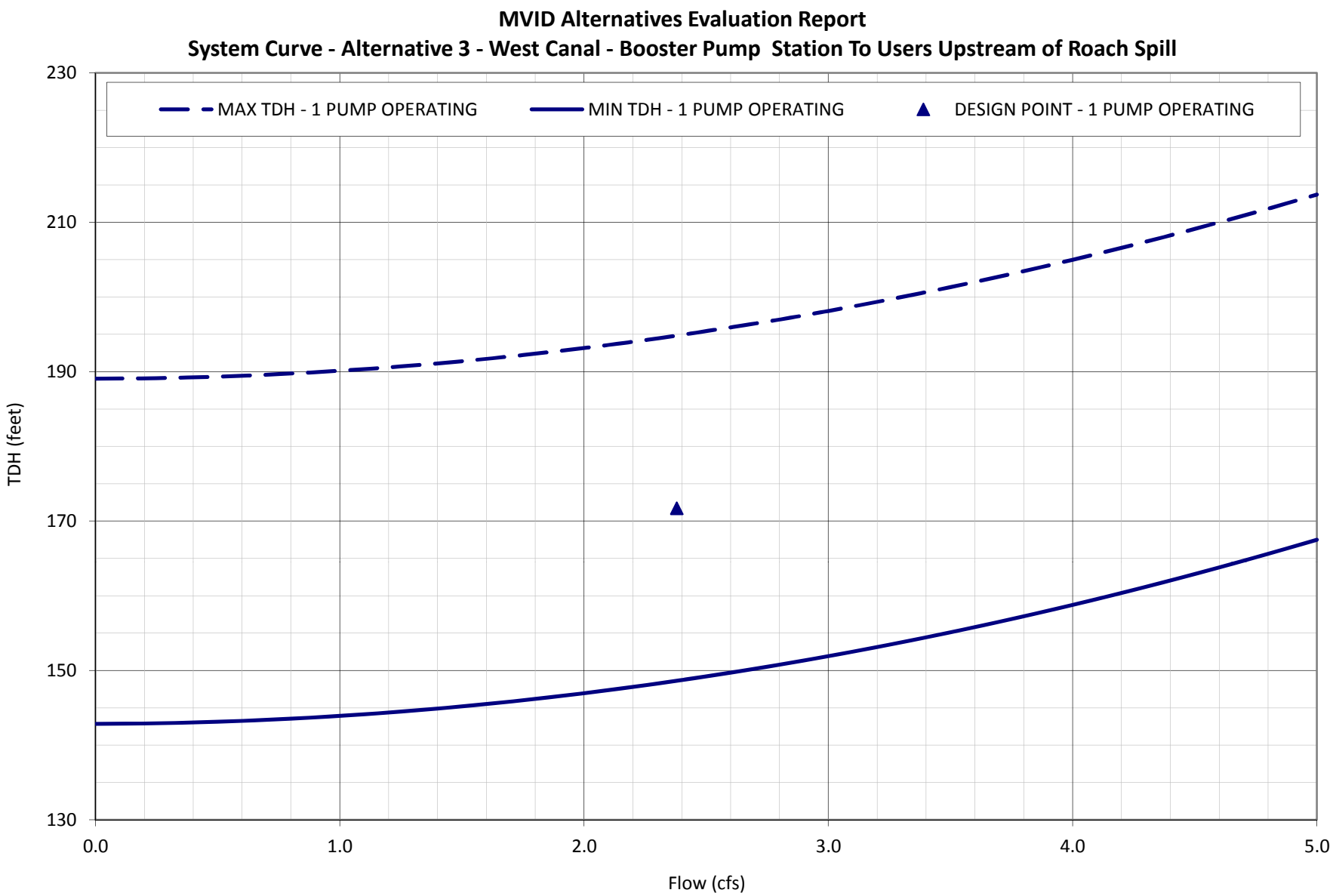
PIPE PROPERTIES	SUCTION PIPING TRANS.	SUCTION PIPING TRANS.	PS PIPING HEADER	PS PIPING TO PUMP	PS PIPING FR. PUMP	PS PIPING HEADER	DISCHARGE PIPING TRANS.	DISCHARGE PIPING TRANS.
NOM. DIAM. (in)	12				12	12		12
O.D. (in)	12.5				12.5	12.5		12.5
I.D. (in)	12				12	12		12
MATERIAL	STEEL				STEEL	STEEL		HDPE
C	110				110	110		140
LENGTH (feet)	40				10	10		326
K	10				10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1,068	2.4	172	66.2

**Assumes 70% Efficiency*

TOTAL FLOW (gpm)	TOTAL FLOW (cfs)	VELOCITIES 12-inch (fps)	VELOCITIES 12-inch (fps)	VELOCITIES -inch (fps)	VELOCITIES 12-inch (fps)	SUCTION LOSSES Minor (feet)	SUCTION LOSSES Friction (feet)	DISCHARGE LOSSES Minor (feet)	DISCHARGE LOSSES Friction (feet)	PS LOSSES - 1 PUMP Minor (feet)	PS LOSSES - 1 PUMP Friction (feet)	PS LOSSES - 2 PUMPS Minor (feet)	PS LOSSES - 2 PUMPS Friction (feet)	PS LOSSES - 3 PUMPS Minor (feet)	PS LOSSES - 3 PUMPS Friction (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MIN (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MAX (feet)	TOTAL DYNAMIC HEAD - 1 PUMP DESIGN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS DESIGN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS DESIGN (feet)
0	0.0	0.00	0.00		0.00	0.0	0.0	0.0	0.0	0.0	0.0					142.9	189.1	166.0						
112	0.2	0.32	0.32		0.32	0.0	0.0	0.0	0.0	0.0	0.0					142.9	189.1	166.0						
224	0.5	0.64	0.64		0.64	0.1	0.0	0.0	0.0	0.1	0.0					143.1	189.3	166.2						
337	0.7	0.95	0.95		0.95	0.1	0.1	0.0	0.1	0.2	0.0					143.5	189.7	166.6						
449	1.0	1.27	1.27		1.27	0.3	0.2	0.1	0.2	0.4	0.0					143.9	190.1	167.0						
561	1.2	1.59	1.59		1.59	0.4	0.2	0.1	0.2	0.6	0.0					144.5	190.7	167.6						
673	1.5	1.91	1.91		1.91	0.6	0.3	0.2	0.3	0.8	0.0					145.2	191.4	168.3						
785	1.7	2.23	2.23		2.23	0.8	0.5	0.3	0.5	1.2	0.0					146.0	192.2	169.1						
898	2.0	2.55	2.55		2.55	1.0	0.6	0.4	0.6	1.5	0.1					147.0	193.2	170.1						
1010	2.2	2.86	2.86		2.86	1.3	0.7	0.4	0.7	1.9	0.1					148.0	194.2	171.1						
1068	**2.4**	**3.03**	**3.03**		**3.03**	**1.4**	**0.8**	**0.5**	**0.8**	**2.1**	**0.1**					**148.6**	**194.8**	**171.7**						
1234	2.7	3.50	3.50		3.50	1.9	1.1	0.7	1.1	2.9	0.1					150.5	196.7	173.6						
1346	3.0	3.82	3.82		3.82	2.3	1.2	0.8	1.2	3.4	0.1					151.9	198.1	175.0						
1459	3.2	4.14	4.14		4.14	2.7	1.4	0.9	1.4	4.0	0.1					153.5	199.7	176.6						
1571	3.5	4.46	4.46		4.46	3.1	1.7	1.1	1.7	4.6	0.2					155.1	201.3	178.2						
1683	3.7	4.77	4.77		4.77	3.5	1.9	1.2	1.9	5.3	0.2					156.9	203.1	180.0						
1795	4.0	5.09	5.09		5.09	4.0	2.1	1.4	2.1	6.0	0.2					158.8	205.0	181.9						
1907	4.2	5.41	5.41		5.41	4.5	2.4	1.6	2.4	6.8	0.2					160.8	207.0	183.9						
2020	4.5	5.73	5.73		5.73	5.1	2.6	1.8	2.6	7.6	0.3					162.9	209.1	186.0						
2132	4.7	6.05	6.05		6.05	5.7	2.9	2.0	2.9	8.5	0.3					165.1	211.3	188.2						
2244	5.0	6.37	6.37		6.37	6.3	3.2	2.2	3.2	9.4	0.3					167.5	213.7	190.6						


MVID Alternatives Evaluation Report
System Curve - Alternative 3 - West Canal - Booster Pump Station To Users Upstream of Roach Spill
MAX TDH - 1 PUMP OPERATING
MIN TDH - 1 PUMP OPERATING
DESIGN POINT - 1 PUMP OPERATING
TDH (feet)
230
210
190
170
150
130
0.0
1.0
2.0
3.0
4.0
5.0
Flow (cfs)

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO USERS FROM LATERAL 5 UPSTREAM TO DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,598.70	feet
	-HGL at High End of System =	1,668.00	feet
	-Pressure at High End of System =	30.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-06	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	2,649	12	2.68	3.4	3.1	8.2	0.8	1,682.62	44.9	1,673.59	38.3
Main M-W-05	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	Booster Pump Suction	301+06.00	1,598.70	1,584	12	2.73	3.5	3.2	5.1	0.5	1,673.59	38.3	1,668.00	30.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-07	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	8	1.02	2.9	3.7	26.9	2.7	1,673.59	38.3	1,643.98	36.0
LATERAL W3																	
Lateral W3-1	Booster Pump Suction		1,598.70	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.5	2.4	2.1	0.2	1,668.00	30.0	1,665.71	47.5
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,665.71	47.5	1,663.66	45.7
LATERAL W4																	
Lateral W4-1	Tee, Lateral W4-2		1,542.00	Main at Lateral W4 (N Branch)		1,585.10	1,400	8	0.38	1.1	0.6	0.8	0.1	1,674.45	57.4	1,673.52	38.3
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,674.45	57.4	1,673.92	61.5
Lateral W4-3	Tee, Lateral W4-4		1,538.30	Tee, Lateral W4-2		1,542.00	963	8	0.68	1.9	1.8	1.7	0.2	1,676.32	59.8	1,674.45	57.3
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,676.32	59.8	1,675.92	64.0
Lateral W4-5	End of Laterals W4-5/W4-8		1,525.40	Tee, Lateral W4-4		1,538.30	1,402	8	0.93	2.7	3.2	4.4	0.4	1,681.18	67.5	1,676.32	59.8
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,681.80	67.8	1,681.18	69.0
Lateral W4-7	Well Field/Tee to Lateral W4-7		1,525.80	End of Lateral W4-7		1,520.00	546	16	5.11	3.7	2.5	1.4	0.1	1,683.19	68.2	1,681.68	70.0
Lateral W4-8	Well Field/Tee to Lateral W4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	8	1.20	3.4	5.0	1.3	0.1	1,683.19	68.2	1,681.80	67.7
Lateral W4-9	Well Field/Tee to Lateral W4-7		1,525.80	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	378	16	3.70	2.6	1.4	0.5	0.1	1,683.19	68.2	1,682.62	44.8
				Well Field/Tee to Lateral W4-7		1,525.80										1,683.19	68.2
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,643.98	35.5	1,642.58	34.9
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,643.98	36.0	1,638.41	44.3
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,638.41	44.4	1,637.57	42.2
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,637.57	42.3	1,635.80	36.3
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.4	0.6	0.1	1,637.57	42.3	1,636.89	59.3

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO USERS FROM LATERAL 5 UPSTREAM TO DROP NEAR ROACH SPILL** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,598.70	feet
	-HGL at High End of System =	1,644.90	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-06	MVID Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	2,649	12	2.68	3.4	3.1	8.2	0.8	1,659.52	34.8	1,650.49	28.3
Main M-W-05	MVID Lateral W4 (N Branch)	316+90.00	1,585.10	Booster Pump Suction	301+06.00	1,598.70	1,584	12	2.73	3.5	3.2	5.1	0.5	1,650.49	28.3	1,644.90	20.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-07	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	MVID Lateral W5	415+40.00	1,560.95	7,201	8	1.02	2.9	3.7	26.9	2.7	1,650.49	28.3	1,620.88	25.9
LATERAL W3																	
Lateral W3-1	Booster Pump Suction		1,598.70	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.5	2.4	2.1	0.2	1,644.90	20.0	1,642.61	37.5
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	3.1	1.9	0.2	1,642.61	37.5	1,640.56	35.7
LATERAL W4																	
Lateral W4-1	Tee, Lateral W4-2		1,542.00	Main at Lateral W4 (N Branch)		1,585.10	1,400	8	0.38	1.1	0.6	0.8	0.1	1,651.35	47.4	1,650.42	28.3
Lateral W4-2	Tee, Lateral W4-2		1,542.00	End of Lateral W4-2		1,532.00	584	6	0.21	1.1	0.8	0.5	0.0	1,651.35	47.4	1,650.82	51.5
Lateral W4-3	Tee, Lateral W4-4		1,538.30	Tee, Lateral W4-2		1,542.00	963	8	0.68	1.9	1.8	1.7	0.2	1,653.22	49.8	1,651.35	47.3
Lateral W4-4	Tee, Lateral W4-4		1,538.30	End of Lateral W4-4		1,528.00	327	3	0.04	0.8	1.1	0.4	0.0	1,653.22	49.8	1,652.82	54.0
Lateral W4-5	End of Laterals W4-5/W4-8		1,525.40	Tee, Lateral W4-4		1,538.30	1,402	8	0.93	2.7	3.2	4.4	0.4	1,658.08	57.5	1,653.22	49.8
Lateral W4-6	End of Laterals W4-5/W4-8		1,525.40	End of Lateral W4-6		1,521.90	170	6	0.45	2.3	3.3	0.6	0.1	1,658.70	57.8	1,658.08	59.0
Lateral W4-7	Well Field/Tee to Lateral W4-7		1,525.80	End of Lateral W4-7		1,520.00	546	16	5.11	3.7	2.5	1.4	0.1	1,660.09	58.2	1,658.58	60.0
Lateral W4-8	Well Field/Tee to Lateral W4-7		1,525.80	End of Laterals W4-5/W4-8		1,525.40	251	8	1.20	3.4	5.0	1.3	0.1	1,660.09	58.2	1,658.70	57.7
Lateral W4-9	Well Field/Tee to Lateral W4-7		1,525.80	Main at Lateral W4 (S Branch)	343+39.00	1,579.10	378	16	3.70	2.6	1.4	0.5	0.1	1,660.09	58.2	1,659.52	34.8
				Well Field/Tee to Lateral W4-7		1,525.80										1,660.09	58.1
LATERAL W5																	
Lateral W5-1	Main at Lateral W5 (N Branch)		1,562.05	End of Lateral W5-1		1,562.00	358	4	0.16	1.8	3.6	1.3	0.1	1,620.88	25.5	1,619.48	24.9
Lateral W5-2A	Main at Lateral W5 (S Branch)		1,560.95	First Tee, Lateral W5-2		1,536.00	1,398	6	0.47	2.4	3.6	5.1	0.5	1,620.88	26.0	1,615.31	34.3
Lateral W5-2B	First Tee, Lateral W5-2		1,536.00	Tee to Laterals W5-3/W5-4		1,540.00	637	6	0.26	1.3	1.2	0.8	0.1	1,615.31	34.4	1,614.47	32.2
Lateral W5-3	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-3		1,552.00	403	4	0.17	1.9	4.0	1.6	0.2	1,614.47	32.3	1,612.70	26.3
Lateral W5-4	Tee to Laterals W5-3/W5-4		1,540.00	End of Lateral W5-4		1,500.00	441	4	0.10	1.1	1.4	0.6	0.1	1,614.47	32.3	1,613.79	49.3

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO USERS FROM LATERAL 5 UPSTREAM TO DROP NEAR ROACH SPIL

Input	BY: David Rice
Calculation	DATE: 11-Apr-13
Output	

SUCTION WATER SURFACE ELEVATIONS (WELL FIELD):			
ELEV	1525.0	feet	Well Elevation
HWL	1515.0	feet	Wet Well (High GW)
LWL	1455.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1525.8	feet		Pipe Invert at Lateral W4-9
HIGH	1683.2	feet =	68.15	psi
LWL	1660.1	feet =	58.15	psi

PIPE	SUCTION PIPING		WELL PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					10	10		15
O.D. (in)					10.5	10.5		15.5
I.D. (in)					10	10		15
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		40
K					10	5		3.5

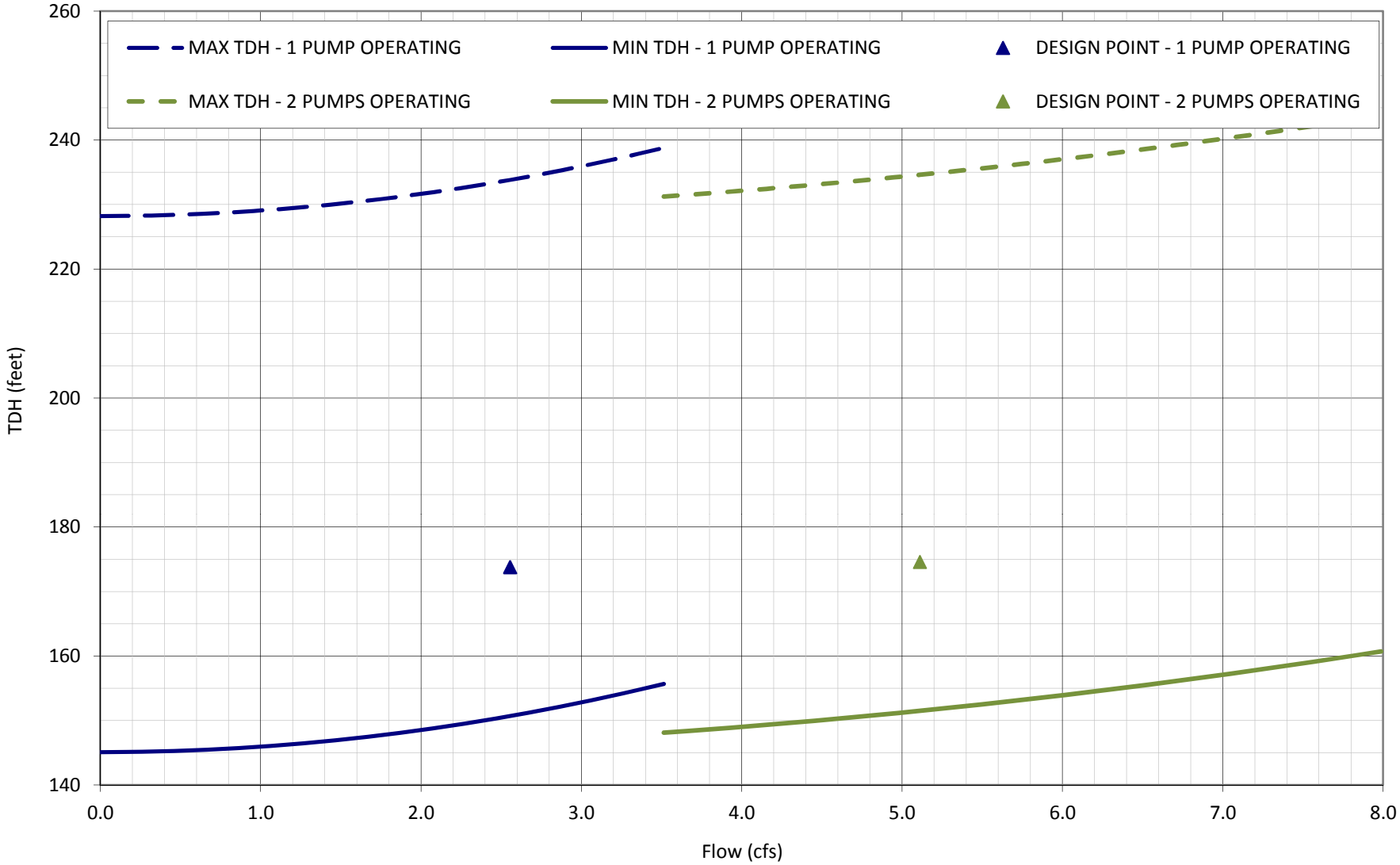
PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1,147.10	2.6	174	72.0
2	2,294.00	5.1	175	144.6

**Assumes 70% Efficiency*

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	10-inch (fps)	10-inch (fps)	-inch (fps)	15-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0	0.0	0.0			145.1	228.2	168.2	145.1	228.2	168.2			
143	0.3	0.59	0.59		0.26			0.0	0.0	0.1	0.0	0.0	0.0			145.2	228.3	168.3	145.1	228.2	168.2			
287	0.6	1.17	1.17		0.52			0.0	0.0	0.3	0.0	0.1	0.0			145.4	228.5	168.5	145.2	228.3	168.3			
430	1.0	1.76	1.76		0.78			0.0	0.0	0.7	0.0	0.2	0.0			145.9	229.0	169.0	145.3	228.4	168.4			
574	1.3	2.34	2.34		1.04			0.1	0.0	1.3	0.1	0.3	0.0			146.5	229.6	169.6	145.5	228.6	168.6			
717	1.6	2.93	2.93		1.30			0.1	0.0	2.0	0.1	0.5	0.0			147.3	230.4	170.4	145.7	228.8	168.8			
860	1.9	3.51	3.51		1.56			0.1	0.0	2.9	0.1	0.7	0.0			148.3	231.4	171.4	146.0	229.1	169.1			
1004	2.2	4.10	4.10		1.82			0.2	0.0	3.9	0.2	1.0	0.0			149.4	232.5	172.5	146.3	229.4	169.4			
1147	**2.6**	**4.69**	**4.69**		**2.08**			**0.2**	**0.0**	**5.1**	**0.2**	**1.3**	**0.1**			**150.7**	**233.8**	**173.8**	**146.7**	**229.8**	**169.8**			
1291	2.9	5.27	5.27		2.34			0.3	0.0	6.5	0.3	1.6	0.1			152.2	235.3	175.3	147.1	230.2	170.2			
1434	3.2	5.86	5.86		2.60			0.4	0.1	8.0	0.3	2.0	0.1			153.8	236.9	176.9	147.6	230.7	170.7			
1577	3.5	6.44	6.44		2.86			0.4	0.1	9.7	0.4	2.4	0.1			155.7	238.8	178.8	148.1	231.2	171.2			
1721	3.8	7.03	7.03		3.12			0.5	0.1	11.5	0.5	2.9	0.1			157.7	240.8	180.8	148.7	231.8	171.8			
1864	4.2	7.61	7.61		3.38			0.6	0.1	13.5	0.5	3.4	0.1			159.8	242.9	182.9	149.3	232.4	172.4			
2008	4.5	8.20	8.20		3.64			0.7	0.1	15.7	0.6	3.9	0.2			162.2	245.3	185.3	150.0	233.1	173.1			
2151	4.8	8.79	8.79		3.90			0.8	0.1	18.0	0.7	4.5	0.2			164.7	247.8	187.8	150.7	233.8	173.8			
2294	**5.1**	**9.37**	**9.37**		**4.16**			**0.9**	**0.1**	**20.5**	**0.8**	**5.1**	**0.2**			**167.4**	**250.5**	**190.5**	**151.5**	**234.6**	**174.6**			
2438	5.4	9.96	9.96		4.43			1.1	0.2	23.1	0.9	5.8	0.2			170.3	253.4	193.4	152.3	235.4	175.4			
2581	5.8	10.54	10.54		4.69			1.2	0.2	25.9	1.0	6.5	0.3			173.3	256.4	196.4	153.2	236.3	176.3			
2725	6.1	11.13	11.13		4.95			1.3	0.2	28.8	1.1	7.2	0.3			176.5	259.6	199.6	154.1	237.2	177.2			
2868	6.4	11.71	11.71		5.21			1.5	0.2	32.0	1.2	8.0	0.3			179.9	263.0	203.0	155.1	238.2	178.2			
3011	6.7	12.30	12.30		5.47			1.6	0.2	35.2	1.3	8.8	0.4			183.5	266.6	206.6	156.1	239.2	179.2			
3155	7.0	12.89	12.89		5.73			1.8	0.2	38.7	1.4	9.7	0.4			187.2	270.3	210.3	157.2	240.3	180.3			
3298	7.3	13.47	13.47		5.99			1.9	0.3	42.3	1.5	10.6	0.4			191.1	274.2	214.2	158.3	241.4	181.4			
3442	7.7	14.06	14.06		6.25			2.1	0.3	46.0	1.6	11.5	0.5			195.2	278.3	218.3	159.5	242.6	182.6			
3585	8.0	14.64	14.64		6.51			2.3	0.3	49.9	1.8	12.5	0.5			199.4	282.5	222.5	160.7	243.8	183.8			

MVID Alternatives Evaluation Report
System Curve - Alternative 3 - West Canal - Well Supply to Middle/Upper System



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO LOWER SYSTEM USERS** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,550.40	feet
	-HGL at High End of System =	1,619.70	feet
	-Pressure at High End of System =	30.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
				Well /MVID Lateral W7	519+66.00	1,545.50										1,632.82	37.8
Main M-W-09	Well /MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W6	499+46.00	1,548.60	2,020	8	0.88	2.5	2.8	5.7	0.6	1,632.82	37.8	1,626.50	33.7
Main M-W-08	MVID Lateral W6	499+46.00	1,548.60	End Pipe	482+06.00	1,550.40	1,740	4	0.16	1.8	3.6	6.2	0.6	1,626.50	33.7	1,619.70	30.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-10	Well /MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,632.82	33.7	1,626.91	36.0
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,626.91	36.0	1,624.71	35.8
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.48	3.2	2.7	4.5	0.4	1,624.71	35.8	1,619.81	34.6
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,619.81	34.6	1,616.46	34.1
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,616.46	34.1	1,613.90	38.4
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,613.90	38.4	1,610.07	38.0
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,610.07	38.0	1,609.44	41.9
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,626.50	33.8	1,625.86	52.8
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,625.86	52.8	1,624.60	53.1
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,632.82	37.8	1,630.76	52.3
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,630.76	52.3	1,629.34	51.7
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,629.34	51.7	1,628.26	55.5
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,626.91	36.1	1,624.47	48.7
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,624.47	48.7	1,622.17	47.7
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,622.17	47.7	1,621.91	48.5
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.44	2.2	3.2	1.8	0.2	1,624.71	35.8	1,622.76	55.8
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,622.76	55.8	1,621.89	52.3
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.30	1.5	1.6	2.7	0.3	1,621.89	55.4	1,618.89	49.7
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.30	1.5	1.6	1.0	0.1	1,619.81	34.6	1,618.72	49.7
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,618.72	49.7	1,616.02	49.4
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,616.46	34.1	1,616.08	61.1
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,613.90	38.4	1,613.40	59.9
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,610.07	38.0	1,608.08	57.6

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO LOWER SYSTEM USERS** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MIN PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,550.40	feet
	-HGL at High End of System =	1,596.60	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
				Well /MVID Lateral W7	519+66.00	1,545.50										1,609.72	27.8
Main M-W-09	Well /MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W6	499+46.00	1,548.60	2,020	8	0.88	2.5	2.8	5.7	0.6	1,609.72	27.8	1,603.40	23.7
Main M-W-08	MVID Lateral W6	499+46.00	1,548.60	End Pipe	482+06.00	1,550.40	1,740	4	0.16	1.8	3.6	6.2	0.6	1,603.40	23.7	1,596.60	20.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-10	Well /MVID Lateral W7	519+66.00	1,545.50	MVID Lateral W10	542+63.00	1,543.70	2,297	15	4.14	3.4	2.3	5.4	0.5	1,609.72	23.7	1,603.81	26.0
Main M-W-11	MVID Lateral W10	542+63.00	1,543.70	MVID Lateral W11	556+37.00	1,542.10	1,374	15	3.21	2.6	1.5	2.0	0.2	1,603.81	26.0	1,601.61	25.8
Main M-W-12	MVID Lateral W11	556+37.00	1,542.10	MVID Lateral W12	572+96.00	1,539.90	1,659	12	2.48	3.2	2.7	4.5	0.4	1,601.61	25.8	1,596.71	24.6
Main M-W-13	MVID Lateral W12	572+96.00	1,539.90	MVID Lateral W14	592+65.00	1,537.80	1,969	12	1.84	2.3	1.5	3.0	0.3	1,596.71	24.6	1,593.36	24.1
Main M-W-14	MVID Lateral W14	592+65.00	1,537.80	MVID Lateral W15	622+94.00	1,525.30	3,029	12	1.26	1.6	0.8	2.3	0.2	1,593.36	24.1	1,590.80	28.4
Main M-W-15	MVID Lateral W15	622+94.00	1,525.30	MVID Lateral W16	639+03.00	1,522.40	1,609	8	0.76	2.2	2.2	3.5	0.3	1,590.80	28.4	1,586.97	28.0
Main M-W-16	MVID Lateral W16	639+03.00	1,522.40	End Pipe (Existing)	670+00.00	1,512.62	3,097	8	0.20	0.6	0.2	0.6	0.1	1,586.97	28.0	1,586.34	31.9
LATERAL W6																	
Lateral W6-0	Main at Lateral W6		1,548.60	Tee, Lateral W6		1,504.00	261	6	0.36	1.8	2.2	0.6	0.1	1,603.40	23.7	1,602.76	42.8
Lateral W6-1	Tee, Lateral W6		1,504.00	End of Lateral W6-1		1,502.00	518	6	0.36	1.8	2.2	1.1	0.1	1,602.76	42.8	1,601.50	43.1
LATERAL W7																	
Lateral W7-0	Main at Lateral W7		1,545.50	Tee, Lateral W7		1,510.00	671	8	0.87	2.5	2.8	1.9	0.2	1,609.72	27.8	1,607.66	42.3
Lateral W7-1	Tee, Lateral W7		1,510.00	End of Lateral W7-1		1,510.00	798	8	0.65	1.9	1.6	1.3	0.1	1,607.66	42.3	1,606.24	41.7
Lateral W7-2	Tee, Lateral W7		1,510.00	End of Lateral W7-2		1,500.00	1,096	6	0.22	1.1	0.9	1.0	0.1	1,606.24	41.7	1,605.16	45.5
LATERAL W10																	
Lateral W10-0	Main at Lateral W10		1,543.70	Tee, Lateral W10		1,512.00	692	6	0.44	2.2	3.2	2.2	0.2	1,603.81	26.0	1,601.37	38.7
Lateral W10-1	Tee, Lateral W10		1,512.00	End of Lateral W10-1		1,512.00	429	4	0.19	2.2	4.9	2.1	0.2	1,601.37	38.7	1,599.07	37.7
Lateral W10-2	Tee, Lateral W10		1,512.00	End of Lateral W10-2		1,510.00	209	6	0.25	1.3	1.1	0.2	0.0	1,599.07	37.7	1,598.81	38.5
LATERAL W11																	
Lateral W11-0	Main at Lateral W11		1,542.10	Tee, Lateral W11		1,494.00	552	6	0.44	2.2	3.2	1.8	0.2	1,601.61	25.8	1,599.66	45.8
Lateral W11-1	Tee, Lateral W11		1,494.00	End of Lateral W11-1		1,501.00	286	4	0.14	1.6	2.8	0.8	0.1	1,599.66	45.8	1,598.79	42.3
Lateral W11-2	Tee, Lateral W11		1,494.00	End of Laterals W11-2/W12-0		1,504.00	1,726	6	0.30	1.5	1.6	2.7	0.3	1,598.79	45.4	1,595.79	39.7
LATERAL W12																	
Lateral W12-0	Main at Lateral W12		1,539.90	End of Laterals W11-2/W12-0		1,504.00	628	6	0.30	1.5	1.6	1.0	0.1	1,596.71	24.6	1,595.62	39.7
Lateral W12-1	End of Laterals W11-2/W12-0		1,504.00	End of Lateral W12-1		1,502.00	493	3	0.09	1.8	5.0	2.5	0.2	1,595.62	39.7	1,592.92	39.4
LATERAL W14																	
Lateral W14-1	Main at Lateral W14		1,537.80	Tee at end of Lateral W14-1		1,475.00	195	6	0.32	1.6	1.8	0.3	0.0	1,593.36	24.1	1,592.98	51.1
LATERAL W15																	
Lateral W15-1	Main at Lateral W15		1,525.30	Tee at end of Lateral W14-1		1,475.00	511	6	0.22	1.1	0.9	0.5	0.0	1,590.80	28.4	1,590.30	49.9
LATERAL W16																	
Lateral W16-1	Main at Lateral W16		1,522.40	Tee at end of Lateral W14-1		1,475.00	1,218	6	0.29	1.5	1.5	1.8	0.2	1,586.97	28.0	1,584.98	47.6

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 3 - WEST CANAL - WELL FIELDS SERVING TWO PRESSURIZED SYSTEMS - TO LOWER SYSTEM USERS

Input	BY: David Rice
Calculation	DATE: 11-Apr-13
Output	

SUCTION WATER SURFACE ELEVATIONS (WELL FIELD):			
ELEV	1513.0	feet	Well Elevation
HWL	1446.0	feet	Wet Well (High GW)
LWL	1383.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1545.5	feet	Pipe Invert at Lateral W4-9	
HIGH	1632.8	feet =	37.81	psi
LWL	1609.7	feet =	27.81	psi

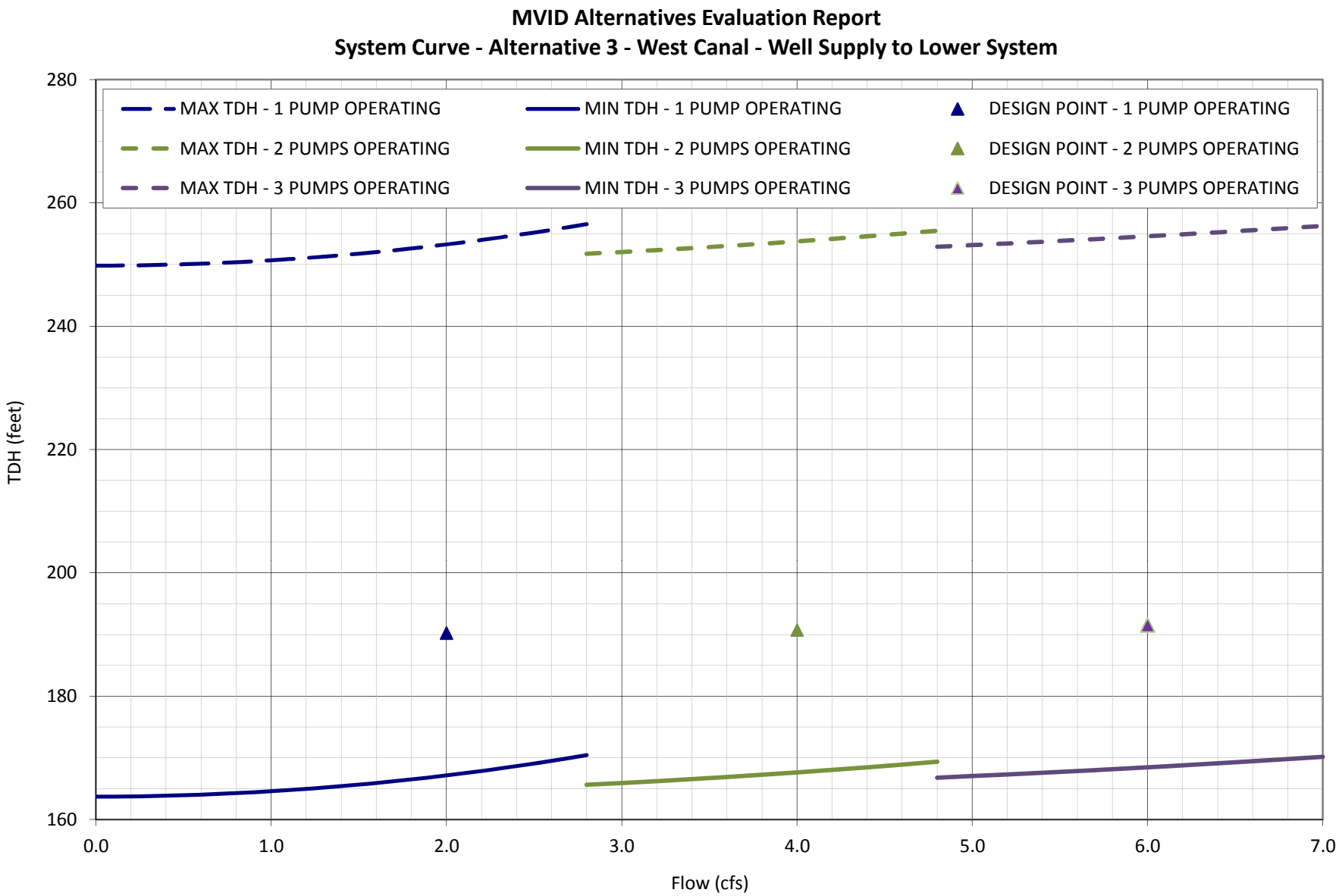
PIPE	SUCTION PIPING		WELL PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					10	10		15
O.D. (in)					10.5	10.5		15.5
I.D. (in)					10	10		15
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		40
K					10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	897.70	2.0	190	61.7
2	1,795.40	4.0	191	123.7
3	2,693.10	6.0	192	186.3

**Assumes 70% Efficiency*

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	10-inch (fps)	10-inch (fps)	-inch (fps)	15-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.7	249.8	186.8	163.7	249.8	186.8	163.7	249.8	186.8
90	0.2	0.37	0.37		0.16			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.8	249.9	186.9	163.7	249.8	186.8	163.7	249.8	186.8
180	0.4	0.73	0.73		0.33			0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	163.9	250.0	187.0	163.8	249.9	186.9	163.7	249.8	186.8
269	0.6	1.10	1.10		0.49			0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	164.0	250.1	187.1	163.8	249.9	186.9	163.8	249.9	186.9
359	0.8	1.47	1.47		0.65			0.0	0.0	0.5	0.0	0.1	0.0	0.1	0.0	164.3	250.4	187.4	163.9	250.0	187.0	163.8	249.9	186.9
449	1.0	1.83	1.83		0.81			0.0	0.0	0.8	0.0	0.2	0.0	0.1	0.0	164.6	250.7	187.7	164.0	250.1	187.1	163.9	250.0	187.0
539	1.2	2.20	2.20		0.98			0.1	0.0	1.1	0.1	0.3	0.0	0.1	0.0	165.0	251.1	188.1	164.1	250.2	187.2	163.9	250.0	187.0
628	1.4	2.57	2.57		1.14			0.1	0.0	1.5	0.1	0.4	0.0	0.2	0.0	165.4	251.5	188.5	164.2	250.3	187.3	164.0	250.1	187.1
718	1.6	2.93	2.93		1.30			0.1	0.0	2.0	0.1	0.5	0.0	0.2	0.0	165.9	252.0	189.0	164.4	250.5	187.5	164.1	250.2	187.2
808	1.8	3.30	3.30		1.47			0.1	0.0	2.5	0.1	0.6	0.0	0.3	0.0	166.5	252.6	189.6	164.5	250.6	187.6	164.2	250.3	187.3
898	2.0	3.67	3.67		1.63			0.1	0.0	3.1	0.1	0.8	0.0	0.3	0.0	167.2	253.3	190.3	164.7	250.8	187.8	164.3	250.4	187.4
987	2.2	4.03	4.03		1.79			0.2	0.0	3.8	0.2	0.9	0.0	0.4	0.0	167.9	254.0	191.0	164.9	251.0	188.0	164.4	250.5	187.5
1,077	2.4	4.40	4.40		1.96			0.2	0.0	4.5	0.2	1.1	0.1	0.5	0.0	168.7	254.8	191.8	165.1	251.2	188.2	164.5	250.6	187.6
1,167	2.6	4.77	4.77		2.12			0.2	0.0	5.3	0.2	1.3	0.1	0.6	0.0	169.5	255.6	192.6	165.4	251.5	188.5	164.6	250.7	187.7
1,257	2.8	5.13	5.13		2.28			0.3	0.0	6.1	0.3	1.5	0.1	0.7	0.0	170.4	256.5	193.5	165.7	251.8	188.8	164.8	250.9	187.9
1,347	3.0	5.50	5.50		2.44			0.3	0.1	7.0	0.3	1.8	0.1	0.8	0.0	171.4	257.5	194.5	165.9	252.0	189.0	164.9	251.0	188.0
1,436	3.2	5.87	5.87		2.61			0.4	0.1	8.0	0.3	2.0	0.1	0.9	0.0	172.5	258.6	195.6	166.2	252.3	189.3	165.1	251.2	188.2
1,526	3.4	6.23	6.23		2.77			0.4	0.1	9.1	0.4	2.3	0.1	1.0	0.0	173.6	259.7	196.7	166.6	252.7	189.7	165.3	251.4	188.4
1,616	3.6	6.60	6.60		2.93			0.5	0.1	10.1	0.4	2.5	0.1	1.1	0.1	174.8	260.9	197.9	166.9	253.0	190.0	165.4	251.5	188.5
1,706	3.8	6.97	6.97		3.10			0.5	0.1	11.3	0.4	2.8	0.1	1.3	0.1	176.1	262.2	199.2	167.3	253.4	190.4	165.6	251.7	188.7
1,795	4.0	7.33	7.33		3.26			0.6	0.1	12.5	0.5	3.1	0.1	1.4	0.1	177.4	263.5	200.5	167.7	253.8	190.8	165.8	251.9	188.9
1,885	4.2	7.70	7.70		3.42			0.6	0.1	13.8	0.5	3.5	0.1	1.5	0.1	178.8	264.9	201.9	168.1	254.2	191.2	166.1	252.2	189.2
1,975	4.4	8.07	8.07		3.59			0.7	0.1	15.2	0.6	3.8	0.2	1.7	0.1	180.3	266.4	203.4	168.5	254.6	191.6	166.3	252.4	189.4
2,065	4.6	8.43	8.43		3.75			0.8	0.1	16.6	0.6	4.1	0.2	1.8	0.1	181.8	267.9	204.9	168.9	255.0	192.0	166.5	252.6	189.6
2,154	4.8	8.80	8.80		3.91			0.8	0.1	18.0	0.7	4.5	0.2	2.0	0.1	183.4	269.5	206.5	169.4	255.5	192.5	166.8	252.9	189.9
2,244	5.0	9.17	9.17		4.07			0.9	0.1	19.6	0.7	4.9	0.2	2.2	0.1	185.1	271.2	208.2	169.9	256.0	193.0	167.0	253.1	190.1
2,334	5.2	9.53	9.53		4.24			1.0	0.1	21.2	0.8	5.3	0.2	2.4	0.1	186.8	272.9	209.9	170.4	256.5	193.5	167.3	253.4	190.4
2,424	5.4	9.90	9.90		4.40			1.1	0.2	22.8	0.9	5.7	0.2	2.5	0.1	188.6	274.7	211.7	170.9	257.0	194.0	167.6	253.7	190.7
2,514	5.6	10.27	10.27		4.56			1.1	0.2	24.6	0.9	6.1	0.3	2.7	0.1	190.5	276.6	213.6	171.4	257.5	194.5	167.9	254.0	191.0
2,603	5.8	10.63	10.63		4.73			1.2	0.2	26.3	1.0	6.6	0.3	2.9	0.1	192.4	278.5	215.5	172.0	258.1	195.1	168.2	254.3	191.3
2,693	6.0	11.00	11.00		4.89			1.3	0.2	28.2	1.0	7.0	0.3	3.1	0.1	194.4	280.5	217.5	172.5	258.6	195.6	168.5	254.6	191.6
2,783	6.2	11.37	11.37		5.05			1.4	0.2	30.1	1.1	7.5	0.3	3.3	0.1	196.5	282.6	219.6	173.1	259.2	196.2	168.8	254.9	191.9
2,873	6.4	11.73	11.73		5.22			1.5	0.2	32.1	1.2	8.0	0.3	3.6	0.2	198.7	284.8	221.8	173.7	259.8	196.8	169.1	255.2	192.2
2,962	6.6	12.10	12.10		5.38			1.6	0.2	34.1	1.2	8.5	0.3	3.8	0.2	200.9	287.0	224.0	174.4	260.5	197.5	169.5	255.6	192.6
3,052	6.8	12.47	12.47		5.54			1.7	0.2	36.2	1.3	9.1	0.4	4.0	0.2	203.1	289.2	226.2	175.0	261.1	198.1	169.8	255.9	192.9
3,142	7.0	12.83	12.83		5.70			1.8	0.2	38.4	1.4	9.6	0.4	4.3	0.2	205.5	291.6	228.6	175.7	261.8	198.8	170.2	256.3	193.3


MVID Alternatives Evaluation Report
System Curve - Alternative 3 - West Canal - Well Supply to Lower System
MAX TDH - 1 PUMP OPERATING
MIN TDH - 1 PUMP OPERATING
DESIGN POINT - 1 PUMP OPERATING
MAX TDH - 2 PUMPS OPERATING
MIN TDH - 2 PUMPS OPERATING
DESIGN POINT - 2 PUMPS OPERATING
MAX TDH - 3 PUMPS OPERATING
MIN TDH - 3 PUMPS OPERATING
DESIGN POINT - 3 PUMPS OPERATING
TDH (feet)
280
260
240
220
200
180
160
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Flow (cfs)

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 4 - WEST CANAL - TO USERS AT UPSTREAM END OF CANAL NOT CONVERTED TO INDIVIDUAL WELL SYSTEMS** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,758.20	feet
	-HGL at High End of System =	1,804.40	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,813.50	34.0	1,809.76	30.0
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,809.76	30.0	1,808.78	29.5
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,808.78	29.5	1,804.79	20.2
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	3	0.03	0.6	0.7	0.4	0.0	1,804.79	20.2	1,804.40	20.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-04N	MVID Lateral W2	226+30.00	1,735.00	Turnout along Main M-W-04	262+60.00	1,715.80	3,630	10	1.13	2.1	1.5	5.5	0.6	1,813.50	34.0	1,807.42	39.7
Main M-W-04S	Turnout along Main M-W-04	262+60.00	1,715.80	MVID Lateral W3	301+06.00	1,604.00	3,846	8	0.60	1.7	1.4	5.4	0.5	1,807.42	39.7	1,801.49	85.5
Main M-W-05	MVID Lateral W3	301+06.00	1,604.00	Station 316+90	316+90.00	1,585.10	1,584	6	0.27	1.4	1.3	2.1	0.2	1,801.49	85.6	1,799.23	92.7
Main M-W-06	Station 316+90	316+90.00	1,585.10	End of Pipe	329+05.00	1,582.56	1,215	3	0.04	0.8	1.1	1.3	0.1	1,799.23	92.8	1,797.75	93.2
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,808.78	29.5	1,808.37	42.2
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	0.9	0.2	0.0	1,808.37	42.2	1,808.13	44.2
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.3	0.2	0.0	0.0	1,808.37	42.2	1,808.35	42.2
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,808.13	44.3	1,808.09	42.9
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.26	1.3	1.3	1.5	0.2	1,809.76	30.0	1,808.06	42.9
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.9	3.7	2.1	0.2	1,808.06	42.9	1,805.74	46.7
LATERAL W2																	
Lateral W2-0A	Tee on W side of Highway		1,660.00	Main at Lateral W2		1,735.00	277	12	2.19	2.8	2.1	0.6	0.1	1,808.07	64.2	1,807.42	31.4
Lateral W2-0B	Tee on E side of Highway		1,650.00	Tee on W side of Highway		1,660.00	95	12	2.46	3.1	2.6	0.3	0.0	1,808.35	68.6	1,808.07	64.1
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,808.35	68.6	1,808.02	72.3
Lateral W2-2	Mid N Branch, E of Highway		1,634.00	Tee on E side of Highway		1,650.00	678	12	2.65	3.4	3.0	2.1	0.2	1,810.61	76.5	1,808.35	68.6
Lateral W2-3	Well Field/End of N Br, E of Hwy		1,594.00	Mid N Branch, E of Highway		1,634.00	1,481	12	2.77	3.5	3.3	4.9	0.5	1,815.99	96.2	1,810.61	76.5
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,808.07	64.2	1,806.73	63.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.4	4.9	0.5	1,806.73	63.6	1,801.31	87.2
				Well Field/End of N Br, E of Hwy		1,594.00										1,815.99	96.1
LATERAL W3																	
Lateral W3-1	Main at Lateral W3		1,604.00	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.4	2.3	1.9	0.2	1,801.49	85.6	1,799.35	105.4
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	2.9	1.7	0.2	1,799.35	105.4	1,797.47	103.7

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 4 - WEST CANAL - TO USERS AT UPSTREAM END OF CANAL NOT CONVERTED TO INDIVIDUAL WELL SYSTEMS

Input	
Calculation	
Output	

BY: David Rice
DATE: 11-Apr-13

SUCTION WATER SURFACE ELEVATIONS (WELL FIELD):			
ELEV	1596.0	feet	Well Elevation
HWL	1576.0	feet	Wet Well (High GW)
LWL	1556.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1594.0	feet	Pipe Invert at Lateral W2-3	
HIGH	1816.0	feet =	96.12	psi
LWL	1792.9	feet =	86.11	psi

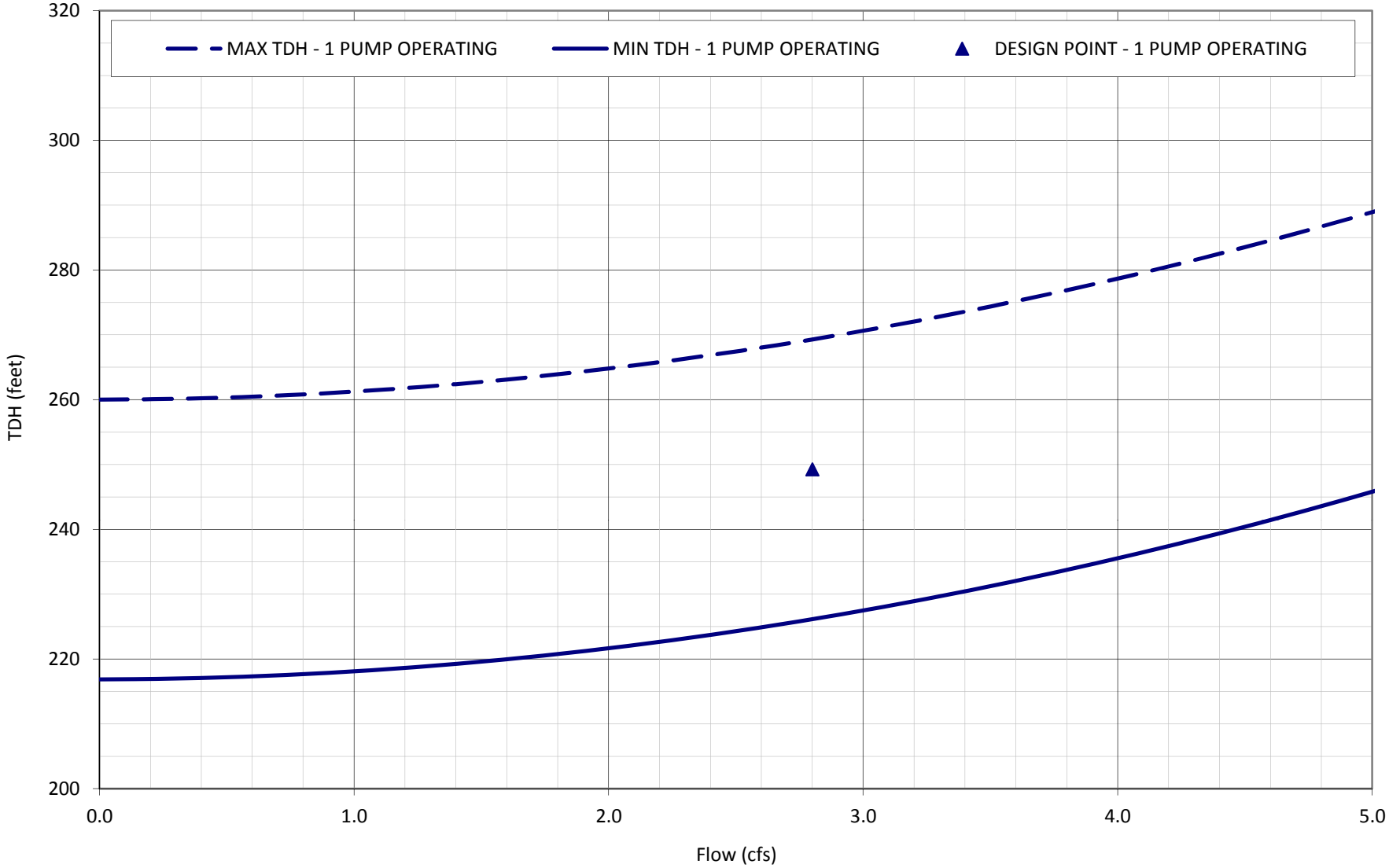
PIPE	SUCTION PIPING		PS PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					10	10		12
O.D. (in)					10.5	10.5		12.5
I.D. (in)					10	10		12
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		326
K					10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1257	2.8	249	113.1
*Assumes	70%	Efficiency		

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	10-inch (fps)	10-inch (fps)	-inch (fps)	12-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00	0.0	0.0	0.0	0.0	0.0	0.0					216.9	260.0	240.0						
126	0.3	0.51	0.51		0.36	0.0	0.0	0.0	0.0	0.1	0.0					217.0	260.1	240.1						
251	0.6	1.03	1.03		0.71	0.0	0.1	0.0	0.1	0.2	0.0					217.3	260.4	240.4						
377	0.8	1.54	1.54		1.07	0.0	0.1	0.1	0.1	0.6	0.0					217.7	260.9	240.9						
503	1.1	2.05	2.05		1.43	0.0	0.2	0.1	0.2	1.0	0.0					218.4	261.5	241.5						
629	1.4	2.57	2.57		1.78	0.0	0.3	0.2	0.3	1.5	0.1					219.3	262.4	242.4						
754	1.7	3.08	3.08		2.14	0.0	0.4	0.2	0.4	2.2	0.1					220.3	263.4	243.4						
880	2.0	3.59	3.59		2.50	0.0	0.6	0.3	0.6	3.0	0.1					221.5	264.6	244.6						
1006	2.2	4.11	4.11		2.85	0.0	0.7	0.4	0.7	3.9	0.2					222.9	266.0	246.0						
1131	2.5	4.62	4.62		3.21	0.0	0.9	0.6	0.9	5.0	0.2					224.4	267.5	247.5						
1257	**2.8**	**5.13**	**5.13**		**3.57**	**0.0**	**1.1**	**0.7**	**1.1**	**6.1**	**0.3**					**226.1**	**269.3**	**249.3**						
1383	3.1	5.65	5.65		3.92	0.0	1.3	0.8	1.3	7.4	0.3					228.1	271.2	251.2						
1508	3.4	6.16	6.16		4.28	0.0	1.5	1.0	1.5	8.8	0.4					230.1	273.3	253.3						
1634	3.6	6.67	6.67		4.64	0.0	1.8	1.2	1.8	10.4	0.4					232.4	275.5	255.5						
1760	3.9	7.19	7.19		4.99	0.0	2.0	1.4	2.0	12.0	0.5					234.8	277.9	257.9						
1886	4.2	7.70	7.70		5.35	0.0	2.3	1.6	2.3	13.8	0.5					237.4	280.5	260.5						
2011	4.5	8.22	8.22		5.70	0.0	2.6	1.8	2.6	15.7	0.6					240.2	283.3	263.3						
2137	4.8	8.73	8.73		6.06	0.0	2.9	2.0	2.9	17.7	0.7					243.1	286.3	266.3						
2263	5.0	9.24	9.24		6.42	0.0	3.3	2.2	3.3	19.9	0.8					246.3	289.4	269.4						
2388	5.3	9.76	9.76		6.77	0.0	3.6	2.5	3.6	22.2	0.8					249.6	292.7	272.7						
2514	5.6	10.27	10.27		7.13	0.0	4.0	2.8	4.0	24.6	0.9					253.0	296.1	276.1						

MVID Alternatives Evaluation Report
System Curve - Alternative 4 - To Users at Upstream End of Canal Not Converted to Individual Well Systems



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALL ALTERNATIVES - EAST CANAL - TO USERS WITHIN CITY OF TWISP (LATERAL E1 REPLACEMENT BY WELL AND PRESSURIZED PIPE SYSTEM)** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:

-Plastic Pipe, C =	140	
-Elevation at High End of System =	1,612.90	feet
-HGL at High End of System =	1,682.20	feet
-Pressure at High End of System =	30.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
LATERAL E1A																	
Lateral E1A-1	Well Field		1,578.70	Bend to Lateral E1A-2		1,612.90	1,320	12	1.91	2.4	1.7	2.2	0.2	1,684.60	45.9	1,682.20	30.0
Lateral E1A-2	Bend to Lateral E1A-2		1,612.90	Tee to Lateral E1A-3		1,570.40	790	6	0.38	1.9	2.4	1.9	0.2	1,682.20	30.0	1,680.08	47.5
Lateral E1A-3	Tee to Lateral E1A-3		1,570.40	End of Lateral E1A-3		1,567.40	1,000	6	0.25	1.3	1.1	1.1	0.1	1,680.08	47.5	1,678.84	48.3
				Well Field		1,578.70										1,684.60	45.9
LATERAL E1B																	
Lateral E1B-1	Well Field		1,578.70	Tee to Lateral E1B-5		1,573.80	300	8	0.73	2.1	2.0	0.6	0.1	1,684.60	45.9	1,683.94	47.7
Lateral E1B-2	Tee to Lateral E1B-5		1,573.80	Tee to Lateral E1B-6		1,575.35	370	8	0.55	1.6	1.2	0.4	0.0	1,683.94	47.7	1,683.45	46.8
Lateral E1B-3	Tee to Lateral E1B-6		1,575.35	Tee to Lateral E1B-7		1,576.50	200	8	0.42	1.2	0.7	0.1	0.0	1,683.45	46.8	1,683.30	46.2
Lateral E1B-4	Tee to Lateral E1B-7		1,576.50	Tee to Laterals E1B-8/E1B-9		1,574.70	630	6	0.39	2.0	2.6	1.6	0.2	1,683.30	46.3	1,681.52	46.3
Lateral E1B-5	Tee to Lateral E1B-5		1,573.80	End of Lateral E1B-5		1,569.50	800	6	0.15	0.8	0.4	0.3	0.0	1,683.94	47.7	1,683.56	49.4
Lateral E1B-6	Tee to Lateral E1B-6		1,575.35	End of Lateral E1B-6		1,575.00	1,200	6	0.13	0.7	0.3	0.4	0.0	1,683.45	46.8	1,683.01	46.8
Lateral E1B-7	Tee to Lateral E1B-7		1,576.50	End of Lateral E1B-7		1,577.30	660	6	0.22	1.1	0.9	0.6	0.1	1,683.30	46.3	1,682.65	45.6
Lateral E1B-8	Tee to Laterals E1B-8/E1B-9		1,574.70	End of Lateral E1B-8		1,572.80	280	4	0.13	1.5	2.4	0.7	0.1	1,681.52	46.3	1,680.78	46.8
Lateral E1B-9	Tee to Laterals E1B-8/E1B-9		1,574.70	End of Lateral E1B-9		1,563.50	860	4	0.18	2.1	4.4	3.8	0.4	1,681.52	46.3	1,677.34	49.3

PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALL ALTERNATIVES - EAST CANAL - TO USERS WITHIN CITY OF TWISP (LATERAL E1 REPLACEMENT BY WELL AND PRESSURIZED PIPE SYSTEM)** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,612.90	feet
	-HGL at High End of System =	1,659.06	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
LATERAL E1A																	
Lateral E1A-1	Well Field		1,578.70	Bend to Lateral E1A-2		1,612.90	1,320	12	1.91	2.4	1.7	2.2	0.2	1,661.46	35.9	1,659.06	20.0
Lateral E1A-2	Bend to Lateral E1A-2		1,612.90	Tee to Lateral E1A-3		1,570.40	790	6	0.38	1.9	2.4	1.9	0.2	1,659.06	20.0	1,656.94	37.5
Lateral E1A-3	Tee to Lateral E1A-3		1,570.40	End of Lateral E1A-3		1,567.40	1,000	6	0.25	1.3	1.1	1.1	0.1	1,656.94	37.5	1,655.70	38.2
				Well Field		1,578.70										1,661.46	35.8
LATERAL E1B																	
Lateral E1B-1	Well Field		1,578.70	Tee to Lateral E1B-5		1,573.80	300	8	0.73	2.1	2.0	0.6	0.1	1,661.46	35.9	1,660.80	37.7
Lateral E1B-2	Tee to Lateral E1B-5		1,573.80	Tee to Lateral E1B-6		1,575.35	370	8	0.55	1.6	1.2	0.4	0.0	1,660.80	37.7	1,660.31	36.8
Lateral E1B-3	Tee to Lateral E1B-6		1,575.35	Tee to Lateral E1B-7		1,576.50	200	8	0.42	1.2	0.7	0.1	0.0	1,660.31	36.8	1,660.16	36.2
Lateral E1B-4	Tee to Lateral E1B-7		1,576.50	Tee to Laterals E1B-8/E1B-9		1,574.70	630	6	0.39	2.0	2.6	1.6	0.2	1,660.16	36.2	1,658.38	36.2
Lateral E1B-5	Tee to Lateral E1B-5		1,573.80	End of Lateral E1B-5		1,569.50	800	6	0.15	0.8	0.4	0.3	0.0	1,660.80	37.7	1,660.42	39.4
Lateral E1B-6	Tee to Lateral E1B-6		1,575.35	End of Lateral E1B-6		1,575.00	1,200	6	0.13	0.7	0.3	0.4	0.0	1,660.31	36.8	1,659.87	36.7
Lateral E1B-7	Tee to Lateral E1B-7		1,576.50	End of Lateral E1B-7		1,577.30	660	6	0.22	1.1	0.9	0.6	0.1	1,660.16	36.2	1,659.51	35.6
Lateral E1B-8	Tee to Laterals E1B-8/E1B-9		1,574.70	End of Lateral E1B-8		1,572.80	280	4	0.13	1.5	2.4	0.7	0.1	1,658.38	36.3	1,657.64	36.7
Lateral E1B-9	Tee to Laterals E1B-8/E1B-9		1,574.70	End of Lateral E1B-9		1,563.50	860	4	0.18	2.1	4.4	3.8	0.4	1,658.38	36.3	1,654.20	39.3

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALL ALTERNATIVES - EAST CANAL - TO USERS WITHIN CITY OF TWISP (LATERAL E1 REPLACEMENT BY WELL AND PRESSURIZED PIPE SYSTEM

Input	
Calculation	
Output	

BY: David Rice
DATE: 11-Apr-13

SUCTION WATER SURFACE ELEVATIONS (WELL FIELD):			
ELEV	1578.7	feet	Well Elevation
HWL	1559.0	feet	Wet Well (High GW)
LWL	1539.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1578.7	feet		Pipe Invert at Lateral E1
HIGH	1684.6	feet =	45.86	psi
LWL	#REF!	feet =	#REF!	psi

PIPE	SUCTION PIPING		WELL PIPING				DISCHARGE PIPING	
PROPERTIES	TRANS.	TRANS.	HEADER	TO PUMP	FR. PUMP	HEADER	TRANS.	TRANS.
NOM. DIAM. (in)					10	10		12
O.D. (in)					10.5	10.5		12.5
I.D. (in)					10	10		12
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		40
K					10	5		3.5

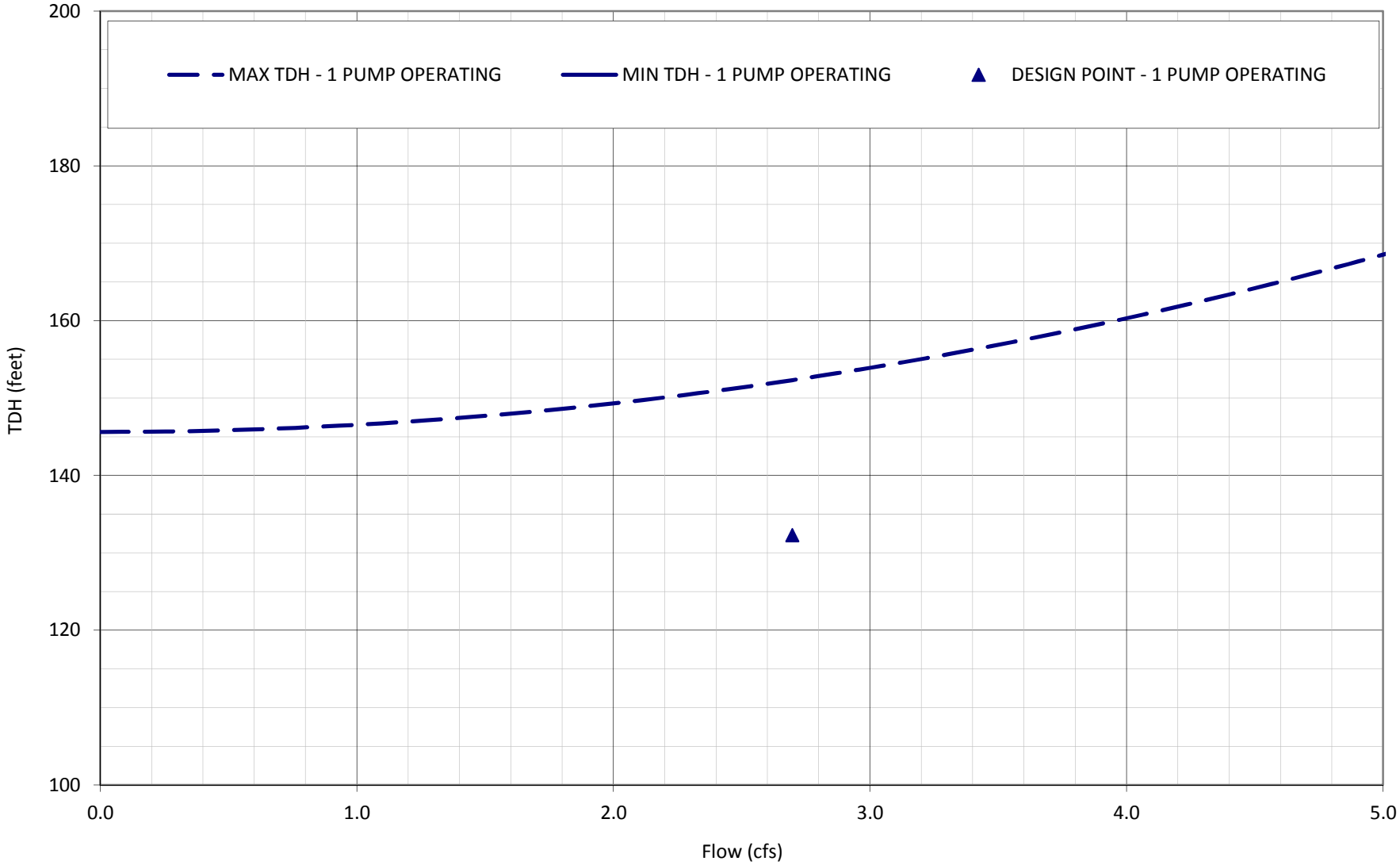
PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1,211	2.7	132	57.8

**Assumes 70% Efficiency*

TOTAL FLOW		VELOCITIES				SUCTION LOSSES		DISCHARGE LOSSES		PS LOSSES - 1 PUMP		PS LOSSES - 2 PUMPS		PS LOSSES - 3 PUMPS		TOTAL DYNAMIC HEAD - 1 PUMP			TOTAL DYNAMIC HEAD - 2 PUMPS			TOTAL DYNAMIC HEAD - 3 PUMPS		
(gpm)	(cfs)	10-inch (fps)	10-inch (fps)	-inch (fps)	12-inch (fps)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	Minor (feet)	Friction (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)	MIN (feet)	MAX (feet)	DESIGN (feet)
0	0.0	0.00	0.00		0.00			0.0	0.0	0.0	0.0	0.0	0.0			#REF!	145.6	125.6						
152	0.3	0.62	0.62		0.43			0.0	0.0	0.1	0.0	0.0	0.0			#REF!	145.7	125.7						
304	0.7	1.24	1.24		0.86			0.0	0.0	0.4	0.0	0.1	0.0			#REF!	146.0	126.0						
456	1.0	1.86	1.86		1.29			0.1	0.0	0.8	0.0	0.2	0.0			#REF!	146.6	126.6						
608	1.4	2.48	2.48		1.72			0.2	0.0	1.4	0.1	0.4	0.0			#REF!	147.3	127.3						
760	1.7	3.10	3.10		2.16			0.3	0.1	2.2	0.1	0.6	0.0			#REF!	148.3	128.3						
912	2.0	3.72	3.72		2.59			0.4	0.1	3.2	0.1	0.8	0.0			#REF!	149.4	129.4						
1064	2.4	4.35	4.35		3.02			0.5	0.1	4.4	0.2	1.1	0.1			#REF!	150.8	130.8						
1211	**2.7**	**4.94**	**4.94**		**3.43**			**0.6**	**0.1**	**5.7**	**0.2**	**1.4**	**0.1**			**#REF!**	**152.3**	**132.3**						
1368	3.0	5.59	5.59		3.88			0.8	0.2	7.3	0.3	1.8	0.1			#REF!	154.2	134.2						
1520	3.4	6.21	6.21		4.31			1.0	0.2	9.0	0.4	2.2	0.1			#REF!	156.1	136.1						
1672	3.7	6.83	6.83		4.74			1.2	0.2	10.9	0.4	2.7	0.1			#REF!	158.4	138.4						
1824	4.1	7.45	7.45		5.17			1.5	0.3	12.9	0.5	3.2	0.1			#REF!	160.8	140.8						
1976	4.4	8.07	8.07		5.60			1.7	0.3	15.2	0.6	3.8	0.2			#REF!	163.4	143.4						
2128	4.7	8.69	8.69		6.04			2.0	0.4	17.6	0.7	4.4	0.2			#REF!	166.2	146.2						
2280	5.1	9.31	9.31		6.47			2.3	0.4	20.2	0.8	5.1	0.2			#REF!	169.3	149.3						
2470	5.5	10.09	10.09		7.01			2.7	0.5	23.7	0.9	5.9	0.2			#REF!	173.3	153.3						
2584	5.8	10.55	10.55		7.33			2.9	0.5	25.9	1.0	6.5	0.3			#REF!	176.0	156.0						
2736	6.1	11.18	11.18		7.76			3.3	0.6	29.1	1.1	7.3	0.3			#REF!	179.6	159.6						
2888	6.4	11.80	11.80		8.19			3.6	0.6	32.4	1.2	8.1	0.3			#REF!	183.5	163.5						
3040	6.8	12.42	12.42		8.62			4.0	0.7	35.9	1.3	9.0	0.4			#REF!	187.6	167.6						
3192	7.1	13.04	13.04		9.05			4.5	0.8	39.6	1.4	9.9	0.4			#REF!	191.8	171.8						
3344	7.4	13.66	13.66		9.49			4.9	0.8	43.5	1.6	10.9	0.4			#REF!	196.3	176.3						
3496	7.8	14.28	14.28		9.92			5.3	0.9	47.5	1.7	11.9	0.5			#REF!	201.0	181.0						
3648	8.1	14.90	14.90		10.35			5.8	1.0	51.7	1.8	12.9	0.5			#REF!	205.9	185.9						
3800	8.5	15.52	15.52		10.78			6.3	1.0	56.1	2.0	14.0	0.5			#REF!	211.1	191.1						

MVID Alternatives Evaluation Report
System Curve - All Alternatives - East Canal - Lateral E1 Replacement With Well and Pressurized Pipe



PIPELINE SIZING CALCULATION

PROJECT: **MVID ALTERNATIVES EVALUATION REPORT** BY: David Rice

ALTERNATIVE: **ALTERNATIVE 5 - WEST CANAL - TO USERS AT UPSTREAM END OF CANAL NOT CONVERTED TO INDIVIDUAL WELL SYSTEMS** DATE: 4/11/2013

HYDRAULIC PROFILE FOR PRESSURE FLOW CONDITIONS - MAX PRESSURE:

ASSUMES:			
	-Plastic Pipe, C =	140	
	-Elevation at High End of System =	1,758.20	feet
	-HGL at High End of System =	1,804.40	feet
	-Pressure at High End of System =	20.0	psi

Input
Calculation
Output
Check

Reach	Upstream End	Upstream Station[1]	Upstream Elevation (Feet)	Downstream End	Downstream Station[1]	Downstream Elevation (Feet)	Reach Length (Feet)	Pipe I.D. (Inches)	Flow (cfs)	Velocity (fps)	Headloss Gradient (feet/ 1,000 feet)	Headloss (feet)	Est. Minor Loss (feet)	Upstream HGL (feet)	Upstream Pressure (psi)	Downstream HGL (feet)	Downstream Pressure (psi)
MAIN LINE - UPSTREAM OF WELL																	
Main M-W-03	MVID Lateral W2	226+30.00	1,735.00	MVID Lateral W1B	201+60.00	1,740.55	2,470	10	1.07	2.0	1.4	3.4	0.3	1,813.50	34.0	1,809.76	30.0
Main M-W-02	MVID Lateral W1B	201+60.00	1,740.55	MVID Lateral W1A	195+94.00	1,740.64	566	8	0.64	1.8	1.6	0.9	0.1	1,809.76	30.0	1,808.78	29.5
Main M-W-01	MVID Lateral W1A	195+94.00	1,740.64	MVID Lateral W0	161+00.00	1,758.20	3,494	8	0.51	1.5	1.0	3.6	0.4	1,808.78	29.5	1,804.79	20.2
Lateral W-00	MVID Lateral W0		1,758.20	End of Pipe		1,665.70	550	3	0.03	0.6	0.7	0.4	0.0	1,804.79	20.2	1,804.40	20.0
MAIN LINE - DOWNSTREAM OF WELL																	
Main M-W-04N	MVID Lateral W2	226+30.00	1,735.00	Turnout along Main M-W-04	262+60.00	1,715.80	3,630	10	1.13	2.1	1.5	5.5	0.6	1,813.50	34.0	1,807.42	39.7
Main M-W-04S	Turnout along Main M-W-04	262+60.00	1,715.80	MVID Lateral W3	301+06.00	1,604.00	3,846	8	0.60	1.7	1.4	5.4	0.5	1,807.42	39.7	1,801.49	85.5
Main M-W-05	MVID Lateral W3	301+06.00	1,604.00	Station 316+90	316+90.00	1,585.10	1,584	6	0.27	1.4	1.3	2.1	0.2	1,801.49	85.6	1,799.23	92.7
Main M-W-06	Station 316+90	316+90.00	1,585.10	End of Pipe	329+05.00	1,582.56	1,215	3	0.04	0.8	1.1	1.3	0.1	1,799.23	92.8	1,797.75	93.2
LATERAL W1																	
Lateral W1A-0	Main at Lateral W1A		1,740.64	First Tee, Lateral 1A		1,711.00	298	4	0.09	1.0	1.2	0.4	0.0	1,808.78	29.5	1,808.37	42.2
Lateral W1A-1	First Tee, Lateral 1A		1,711.00	Second Tee, Lateral 1A		1,706.00	243	4	0.08	0.9	0.9	0.2	0.0	1,808.37	42.2	1,808.13	44.2
Lateral W1A-2	First Tee, Lateral 1A		1,711.00	End of Lateral 1A Branch		1,711.00	126	3	0.01	0.3	0.2	0.0	0.0	1,808.37	42.2	1,808.35	42.2
Lateral W1A-3	Second Tee, Lateral 1A		1,706.00	Tee With Lateral 1B		1,709.00	447	3	0.01	0.2	0.1	0.0	0.0	1,808.13	44.3	1,808.09	42.9
Lateral W1B-1	Main at Lateral W1B		1,740.55	Tee With Lateral 1A		1,709.00	1,236	6	0.26	1.3	1.3	1.5	0.2	1,809.76	30.0	1,808.06	42.9
Lateral W1B-2	Tee With Lateral 1A		1,709.00	End of Lateral 1B		1,698.00	575	4	0.16	1.9	3.7	2.1	0.2	1,808.06	42.9	1,805.74	46.7
LATERAL W2																	
Lateral W2-0A	Tee on W side of Highway		1,660.00	Main at Lateral W2		1,735.00	277	12	2.19	2.8	2.1	0.6	0.1	1,808.07	64.2	1,807.42	31.4
Lateral W2-0B	Tee on E side of Highway		1,650.00	Tee on W side of Highway		1,660.00	95	12	2.46	3.1	2.6	0.3	0.0	1,808.35	68.6	1,808.07	64.1
Lateral W2-1	Tee on E side of Highway		1,650.00	End of S Branch, E of Highway		1,641.00	278	3	0.04	0.8	1.1	0.3	0.0	1,808.35	68.6	1,808.02	72.3
Lateral W2-2	Mid N Branch, E of Highway		1,634.00	Tee on E side of Highway		1,650.00	678	12	2.65	3.4	3.0	2.1	0.2	1,810.61	76.5	1,808.35	68.6
Lateral W2-3	Well Field/End of N Br, E of Hwy		1,594.00	Mid N Branch, E of Highway		1,634.00	1,481	12	2.77	3.5	3.3	4.9	0.5	1,815.99	96.2	1,810.61	76.5
Lateral W2-4	Tee on W side of Highway		1,660.00	Mid S Branch, W of Highway		1,660.00	960	6	0.27	1.4	1.3	1.2	0.1	1,808.07	64.2	1,806.73	63.5
Lateral W2-5	Mid S Branch, W of Highway		1,660.00	End of S Branch, W of Highway		1,600.00	1,439	4	0.16	1.8	3.4	4.9	0.5	1,806.73	63.6	1,801.31	87.2
				Well Field/End of N Br, E of Hwy		1,594.00										1,815.99	96.1
LATERAL W3																	
Lateral W3-1	Main at Lateral W3		1,604.00	Midpoint of Lateral W3		1,556.00	859	4	0.13	1.4	2.3	1.9	0.2	1,801.49	85.6	1,799.35	105.4
Lateral W3-2	Midpoint of Lateral W3		1,556.00	End of Lateral W3		1,558.00	599	3	0.07	1.4	2.9	1.7	0.2	1,799.35	105.4	1,797.47	103.7

SYSTEM CURVE CALCULATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT
ALTERNATIVE: ALTERNATIVE 5 - WEST CANAL - TO USERS AT UPSTREAM END OF CANAL NOT CONVERTED TO INDIVIDUAL WELL SYSTEMS

Input	BY: David Rice
Calculation	DATE: 11-Apr-13
Output	

SUCTION WATER SURFACE ELEVATIONS (WELL FIELD):			
ELEV	1596.0	feet	Well Elevation
HWL	1576.0	feet	Wet Well (High GW)
LWL	1556.0	feet	Wet Well (Low GW)

DISCHARGE HGL/PRESSURE (AT PIPELINE IN MVID DITCH):				
ELEV	1594.0	feet	Pipe Invert at Lateral W2-3	
HIGH	1816.0	feet =	96.12	psi
LWL	1792.9	feet =	86.11	psi

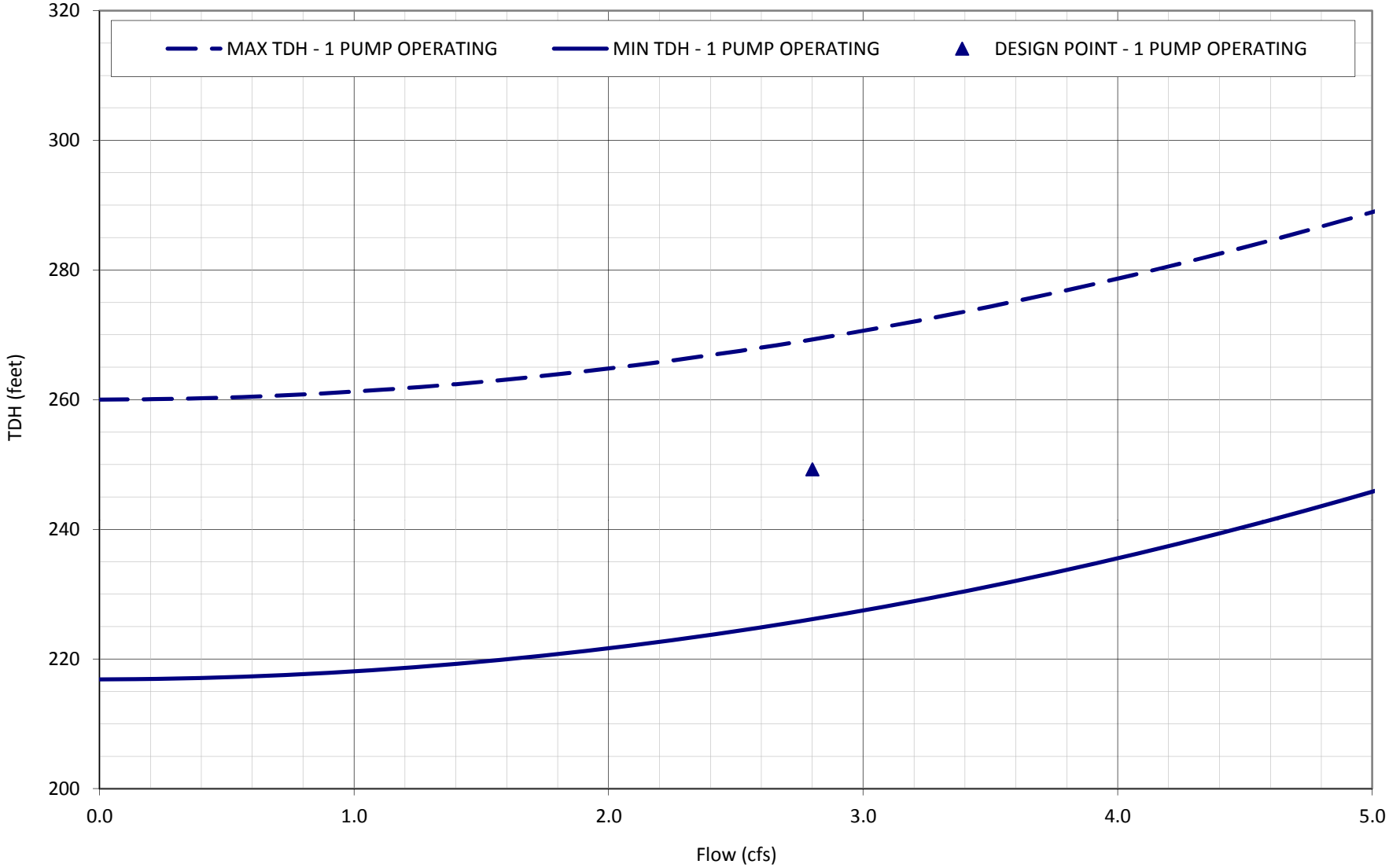
PIPE PROPERTIES	SUCTION PIPING TRANS.	SUCTION PIPING TRANS.	PS PIPING HEADER	PS PIPING TO PUMP	PS PIPING FR. PUMP	PS PIPING HEADER	DISCHARGE PIPING TRANS.	DISCHARGE PIPING TRANS.
NOM. DIAM. (in)					10	10		12
O.D. (in)					10.5	10.5		12.5
I.D. (in)					10	10		12
MATERIAL					STEEL	STEEL		HDPE
C					110	110		140
LENGTH (feet)					10	10		326
K					10	5		3.5

PROPOSED DESIGN POINTS:

PUMPS ON	FLOW (GPM)	FLOW (CFS)	TDH (FT)	POWER (HP)*
1	1257	2.8	249	113.1
*Assumes	70%	Efficiency		

TOTAL FLOW (gpm)	TOTAL FLOW (cfs)	VELOCITIES 10-inch (fps)	VELOCITIES 10-inch (fps)	VELOCITIES -inch (fps)	VELOCITIES 12-inch (fps)	SUCTION LOSSES Minor (feet)	SUCTION LOSSES Friction (feet)	DISCHARGE LOSSES Minor (feet)	DISCHARGE LOSSES Friction (feet)	PS LOSSES - 1 PUMP Minor (feet)	PS LOSSES - 1 PUMP Friction (feet)	PS LOSSES - 2 PUMPS Minor (feet)	PS LOSSES - 2 PUMPS Friction (feet)	PS LOSSES - 3 PUMPS Minor (feet)	PS LOSSES - 3 PUMPS Friction (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MIN (feet)	TOTAL DYNAMIC HEAD - 1 PUMP MAX (feet)	TOTAL DYNAMIC HEAD - 1 PUMP DESIGN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 2 PUMPS DESIGN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MIN (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS MAX (feet)	TOTAL DYNAMIC HEAD - 3 PUMPS DESIGN (feet)
0	0.0	0.00	0.00		0.00	0.0	0.0	0.0	0.0	0.0	0.0					216.9	260.0	240.0						
126	0.3	0.51	0.51		0.36	0.0	0.0	0.0	0.0	0.1	0.0					217.0	260.1	240.1						
251	0.6	1.03	1.03		0.71	0.0	0.1	0.0	0.1	0.2	0.0					217.3	260.4	240.4						
377	0.8	1.54	1.54		1.07	0.0	0.1	0.1	0.1	0.6	0.0					217.7	260.9	240.9						
503	1.1	2.05	2.05		1.43	0.0	0.2	0.1	0.2	1.0	0.0					218.4	261.5	241.5						
629	1.4	2.57	2.57		1.78	0.0	0.3	0.2	0.3	1.5	0.1					219.3	262.4	242.4						
754	1.7	3.08	3.08		2.14	0.0	0.4	0.2	0.4	2.2	0.1					220.3	263.4	243.4						
880	2.0	3.59	3.59		2.50	0.0	0.6	0.3	0.6	3.0	0.1					221.5	264.6	244.6						
1006	2.2	4.11	4.11		2.85	0.0	0.7	0.4	0.7	3.9	0.2					222.9	266.0	246.0						
1131	2.5	4.62	4.62		3.21	0.0	0.9	0.6	0.9	5.0	0.2					224.4	267.5	247.5						
1257	2.8	5.13	5.13		3.57	0.0	1.1	0.7	1.1	6.1	0.3					226.1	269.3	249.3						
1383	3.1	5.65	5.65		3.92	0.0	1.3	0.8	1.3	7.4	0.3					228.1	271.2	251.2						
1508	3.4	6.16	6.16		4.28	0.0	1.5	1.0	1.5	8.8	0.4					230.1	273.3	253.3						
1634	3.6	6.67	6.67		4.64	0.0	1.8	1.2	1.8	10.4	0.4					232.4	275.5	255.5						
1760	3.9	7.19	7.19		4.99	0.0	2.0	1.4	2.0	12.0	0.5					234.8	277.9	257.9						
1886	4.2	7.70	7.70		5.35	0.0	2.3	1.6	2.3	13.8	0.5					237.4	280.5	260.5						
2011	4.5	8.22	8.22		5.70	0.0	2.6	1.8	2.6	15.7	0.6					240.2	283.3	263.3						
2137	4.8	8.73	8.73		6.06	0.0	2.9	2.0	2.9	17.7	0.7					243.1	286.3	266.3						
2263	5.0	9.24	9.24		6.42	0.0	3.3	2.2	3.3	19.9	0.8					246.3	289.4	269.4						
2388	5.3	9.76	9.76		6.77	0.0	3.6	2.5	3.6	22.2	0.8					249.6	292.7	272.7						
2514	5.6	10.27	10.27		7.13	0.0	4.0	2.8	4.0	24.6	0.9					253.0	296.1	276.1						

MVID Alternatives Evaluation Report
System Curve - Alternative 5 - To Users at Upstream End of Canal Not Converted to Individual Well Systems



PRELIMINARY FISH SCREEN EVALUATION
PROJECT: MVID ALTERNATIVES EVALUATION REPORT

APPLICABLE CRITERIA:

National Marine Fisheries Science Anadromous Salmonid Passage Facility Design
Chapeter 11 - Fish Screen Bypass Facilities

Washington State Department of Fish and Wildlife Fish Protection Screen Guidelines

Location and Orientation:
-Where possible, screen should be constructed at point of diversion with screen face parallel to river flow.
-For screens constructed at the bankline, the screen face must be aligned with the adjacent bankline.
-Screen facilities must be designed to function properly within the full range of stream hydraulic conditions.

Approach Velocity:
$V_{approach}$ = 0.4 fps max. (active screens)
0.2 fps max. (passive screens)

Effective Screen Area:
$A_{screen\ min.} = Q_{max}/V_{approach}$

Sweeping Velocity:
V_{sweep} = 0.8 ft/s min. (or > $V_{approach}$ if screen is 6' or longer)
3 ft/s max.

Screen Material:
$A_{open\ min.}$ = 0.087 inches (wire mesh, 14 gauge max.)
$A_{open\ min.}$ = 1.75 mm (profile bar, slotted)
$A_{open\ min.}$ = 0.097 inches (circular openings, perforated plate)
$A_{open\ min.}$ = 0.097 inches on diagonal (square openings)
A_{open} = 27% X A_{screen}

Submergence:
D_{screen} = 1 radius (for end of pipe screen, below water surface)

Clearance:
L_{clear} = 1 radius (for end of pipe screen, around screen)

SCREEN SIZING:

Assumptions:
Screen Type = Fixed Plate, Active (Self-Cleaning), at Angle of 45°
F.O.S. = 27%

Q_{max} (CFS)	$V_{approach}$ (FPS)	$A_{screen\ min.}$ (SF)	$A_{screen\ with\ F.O.S.}$ (SF)	$H_{screen\ proposed}$ (FT)	$L_{screen\ min.}$ (FT)
0	0.4	0.00	0.00	3.0	0.0
2	0.4	5.00	6.35	3.0	2.1
4	0.4	10.00	12.70	3.0	4.2
6	0.4	15.00	19.05	3.0	6.4
8	0.4	20.00	25.40	3.0	8.5
10	0.4	25.00	31.75	3.0	10.6
11	**0.4**	**27.50**	**34.93**	**3.0**	**11.6**
12	0.4	30.00	38.10	3.0	12.7

APPENDIX E
OPINIONS OF PROBABLE COSTS

Methow Valley Irrigation District - Alternatives Evaluation Report
Opinion of Probable Costs

D. Rice
17-Jul-13

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	UNIT	UNIT COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Pressure Pipelines - Main and Laterals																		
Miscellaneous Site Work																		
Temporary and Permanent Access	LS	VARIES	1	$25,000	1	$25,000	1	$22,000	1	$8,000	1	$16,000	0	$0	1	$2,000	1	$2,000
Temporary Erosion and Sediment Control	LS	VARIES	1	$58,000	1	$58,000	1	$53,000	1	$19,000	1	$38,000	0	$0	1	$5,000	1	$6,000
Removal and Disposal of Existing Facilities	LS	VARIES	1	$39,000	1	$39,000	1	$35,000	1	$13,000	1	$25,000	0	$0	1	$3,000	1	$4,000
Construction Surveying	LS	VARIES	1	$77,000	1	$77,000	1	$71,000	1	$25,000	1	$51,000	0	$0	1	$7,000	1	$8,000
Clearing and Grubbing	AC	$3,000	27	$81,000	27	$81,000	24	$72,000	9	$27,000	18	$54,000	0	$0	2	$6,000	3	$9,000
Subtotal - Miscellaneous Site Work				**$280,000**		**$280,000**		**$253,000**		**$92,000**		**$184,000**		**$0**		**$23,000**		**$29,000**
Earthwork																		
Trench Excavation and Stockpile, Soil	CY	$6	10,256	$61,537	10,190	$61,138	7,305	$43,831	2,421	$14,525	4,539	$27,231	0	$0	933	$5,596	714	$4,282
Trench Excavation and Stockpile, Rock	CY	$15	2,564	$38,461	2,547	$38,211	1,826	$27,394	605	$9,078	1,135	$17,019	0	$0	233	$3,498	178	$2,676
Trench Backfill (imported material)	CY	$30	14,563	$436,896	14,458	$433,735	11,116	$333,481	3,753	$112,603	6,612	$198,375	0	$0	1,326	$39,774	1,101	$33,026
Trench Backfill (native material)	CY	$8	21,282	$170,257	21,300	$170,403	18,658	$149,261	6,624	$52,992	10,336	$82,691	0	$0	1,865	$14,920	2,145	$17,158
Subtotal - Earthwork				**$707,151**		**$703,486**		**$553,966**		**$189,198**		**$325,316**		**$0**		**$63,787**		**$57,142**
Pipe, Fittings, and Appurtenances																		
24-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$37	0	$0	0	$0	0	$0	0	$0	9,364	$346,468	0	$0	0	$0	0	$0
21-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$31	0	$0	0	$0	0	$0	0	$0	3,252	$100,812	0	$0	0	$0	0	$0
18-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$26	19,852	$516,152	15,607	$405,782	0	$0	0	$0	5,033	$130,858	0	$0	0	$0	0	$0
15-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$19	2,020	$38,380	2,020	$38,380	3,671	$69,749	0	$0	3,547	$67,393	0	$0	0	$0	0	$0
12-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$13	6,370	$82,810	10,603	$137,839	17,260	$224,380	0	$0	6,153	$79,989	0	$0	0	$0	1,320	$17,160
10-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$10	2,470	$24,700	2,470	$24,700	2,470	$24,700	6,100	$61,000	5,659	$56,590	0	$0	0	$0	0	$0
8-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$8	4,060	$32,480	4,060	$32,480	14,890	$119,120	6,800	$54,400	451	$3,608	0	$0	0	$0	870	$6,960
6-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$6	1,236	$7,416	1,236	$7,416	1,236	$7,416	1,236	$7,416	6,444	$38,664	0	$0	0	$0	5,080	$30,480
4-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$4	1,116	$4,464	1,116	$4,464	2,856	$11,424	1,116	$4,464	1,299	$5,196	0	$0	0	$0	1,140	$4,560
3-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$3	573	$1,719	573	$1,719	573	$1,719	573	$1,719	1,399	$4,197	0	$0	0	$0	0	$0
15-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$21	3,671	$77,091	3,671	$77,091	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
12-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$14	6,657	$93,198	6,657	$93,198	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
10-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$10	0	$0	0	$0	0	$0	0	$0	866	$8,660	0	$0	0	$0	0	$0
8-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$8	3,009	$24,072	1,609	$12,872	1,469	$11,752	0	$0	2,013	$16,104	0	$0	0	$0	0	$0
6-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$6	3,748	$22,488	0	$0	7,606	$45,636	0	$0	3,469	$20,814	0	$0	0	$0	0	$0
4-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$4	747	$2,988	859	$3,436	1,574	$6,296	0	$0	1,599	$6,396	0	$0	0	$0	0	$0
3-inch DR 41 (100 PSI) PVC Pipe and Fittings	LF	$3	2,022	$6,066	1,149	$3,447	1,642	$4,926	550	$1,650	442	$1,326	0	$0	0	$0	0	$0
20-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$53	0	$0	924	$48,972	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
16-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$45	0	$0	0	$0	924	$41,580	0	$0	0	$0	0	$0	0	$0	0	$0
12-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$21	1,089	$22,869	1,106	$23,226	1,106	$23,226	2,531	$53,151	0	$0	0	$0	5,650	$118,650	0	$0
10-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$17	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
8-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$13	1,746	$22,698	5,762	$74,906	4,293	$55,809	1,106	$14,378	0	$0	0	$0	1,000	$13,000	0	$0
6-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$10	11,374	$113,740	12,128	$121,280	4,522	$45,220	2,544	$25,440	0	$0	0	$0	0	$0	0	$0
4-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$6	4,837	$29,022	4,837	$29,022	4,122	$24,732	1,439	$8,634	0	$0	0	$0	0	$0	0	$0
3-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$5	771	$3,855	1,098	$5,490	605	$3,025	1,493	$7,465	0	$0	0	$0	0	$0	0	$0
21-inch Gate Valve with Valve Box	EA	$7,000	0	$0	2	$14,000	0	$0	0	$0	1	$7,000	0	$0	0	$0	0	$0
20-inch Gate Valve with Valve Box	EA	$6,500	0	$0	2	$13,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
18-inch Gate Valve with Valve Box	EA	$5,800	6	$34,800	3	$17,400	0	$0	0	$0	2	$11,600	0	$0	0	$0	0	$0
16-inch Gate Valve with Valve Box	EA	$5,000	0	$0	0	$0	2	$10,000	0	$0	0	$0	0	$0	0	$0	0	$0
15-inch Gate Valve with Valve Box	EA	$4,500	3	$13,500	3	$13,500	5	$22,500	0	$0	1	$4,500	0	$0	0	$0	0	$0
12-inch Gate Valve with Valve Box	EA	$1,500	7	$10,500	6	$9,000	7	$10,500	1	$1,500	5	$7,500	0	$0	14	$21,000	0	$0
10-inch Gate Valve with Valve Box	EA	$1,300	1	$1,300	1	$1,300	1	$1,300	2	$2,600	1	$1,300	0	$0	0	$0	1	$1,300
8-inch Gate Valve with Valve Box	EA	$1,100	8	$8,800	8	$8,800	9	$9,900	4	$4,400	2	$2,200	0	$0	2	$2,200	1	$1,100
6-inch Gate Valve with Valve Box	EA	$800	10	$8,000	10	$8,000	10	$8,000	2	$1,600	3	$2,400	0	$0	0	$0	4	$3,200
4-inch Gate Valve with Valve Box	EA	$600	2	$1,200	2	$1,200	2	$1,200	2	$1,200	1	$600	0	$0	0	$0	5	$3,000
3-inch Gate Valve with Valve Box	EA	$500	1	$500	1	$500	1	$500	1	$500	0	$0	0	$0	0	$0	0	$0
Air and Vacuum Release Valve Assembly	EA	$2,500	26	$65,000	26	$65,000	23	$57,500	8	$20,000	12	$30,000	0	$0	0	$0	4	$10,000
12-inch Flush Valve Assembly	EA	$2,000	3	$6,000	3	$6,000	2	$4,000	0	$0	0	$0	0	$0	0	$0	0	$0
8-inch Flush Valve Assembly	EA	$1,500	1	$1,500	1	$1,500	1	$1,500	1	$1,500	2	$3,000	0	$0	0	$0	0	$0
Turnout Connection	EA	$2,500	166	$415,000	166	$415,000	166	$415,000	87	$217,500	180	$450,000	0	$0	0	$0	71	$177,500
Metered Irrigation Service (Lateral E1)	EA	$3,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	71	$213,000	0	$0
Pipeline Inlet Control Structure	LS	VARIES	0	$0	0	$0	0	$0	0	$0	1	$46,000	0	$0	0	$0	0	$0
New Spill Pipe and Ditch	LS	VARIES	0	$0	0	$0	0	$0	0	$0	1	$20,000	0	$0	0	$0	0	$0
Other Appurtenances and Features	LS	VARIES	1	$56,000	1	$57,000	1	$36,000	1	$12,000	1	$62,000	0	$0	1	$7,000	1	$3,000
Subtotal - Pipe, Fittings, and Appurtenances				**$1,748,308**		**$1,776,920**		**$1,298,610**		**$502,517**		**$1,535,175**		**$0**		**$374,850**		**$258,260**
Subtotal Pay Items - Pressure Pipelines - Main and Laterals				**$2,735,000**		**$2,760,000**		**$2,106,000**		**$784,000**		**$2,044,000**		**$0**		**$462,000**		**$344,000**
Mobilization / Demobilization	7.5%			$205,125		$207,000		$157,950		$58,800		$153,300		$0		$34,650		$25,800
Unlisted Items	10.0%			$273,500		$276,000		$210,600		$78,400		$204,400		$0		$46,200		$34,400
Sales Tax	7.7%			$210,595		$212,520		$162,162		$60,368		$157,388		$0		$35,574		$26,488
Total Construction Contract - Pressure Pipelines - Main and Laterals				**$3,424,000**		**$3,456,000**		**$2,637,000**		**$982,000**		**$2,559,000**		**$0**		**$578,000**		**$431,000**
Contingencies	20.0%			$684,800		$691,200		$527,400		$196,400		$511,800		$0		$115,600		$86,200
Total Field Cost - Pressure Pipelines - Main and Laterals				**$4,109,000**		**$4,147,000**		**$3,164,000**		**$1,178,000**		**$3,071,000**		**$0**		**$694,000**		**$517,000**

	SUBTOTALS (ASSUME LATERAL E1 CUSTOMERS WILL BE SERVED THROUGH TOWN OF TWIPS SYSTEM)														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL
Pressure Pipelines - Main and Laterals															
Miscellaneous Site Work															
Temporary and Permanent Access	$25,000	$18,000	$43,000	$25,000	$18,000	$43,000	$22,000	$18,000	$40,000	$8,000	$2,000	$10,000	$8,000	$18,000	$26,000
Temporary Erosion and Sediment Control	$58,000	$43,000	$101,000	$58,000	$43,000	$101,000	$53,000	$43,000	$96,000	$19,000	$5,000	$24,000	$19,000	$43,000	$62,000
Removal and Disposal of Existing Facilities	$39,000	$28,000	$67,000	$39,000	$28,000	$67,000	$35,000	$28,000	$63,000	$13,000	$3,000	$16,000	$13,000	$28,000	$41,000
Construction Surveying	$77,000	$58,000	$135,000	$77,000	$58,000	$135,000	$71,000	$58,000	$129,000	$25,000	$7,000	$32,000	$25,000	$58,000	$83,000
Clearing and Grubbing	$81,000	$60,000	$141,000	$81,000	$60,000	$141,000	$72,000	$60,000	$132,000	$27,000	$6,000	$33,000	$27,000	$60,000	$87,000
Subtotal - Miscellaneous Site Work	**$280,000**	**$207,000**	**$487,000**	**$280,000**	**$207,000**	**$487,000**	**$253,000**	**$207,000**	**$460,000**	**$92,000**	**$23,000**	**$115,000**	**$92,000**	**$207,000**	**$299,000**
Earthwork															
Trench Excavation and Stockpile, Soil	$61,537	$32,827	$94,365	$61,138	$32,827	$93,965	$43,831	$32,827	$76,658	$14,525	$5,596	$20,121	$14,525	$32,827	$47,352
Trench Excavation and Stockpile, Rock	$38,461	$20,517	$58,978	$38,211	$20,517	$58,728	$27,394	$20,517	$47,911	$9,078	$3,498	$12,576	$9,078	$20,517	$29,595
Trench Backfill (imported material)	$436,896	$238,149	$675,044	$433,735	$238,149	$671,884	$333,481	$238,149	$571,629	$112,603	$39,774	$152,377	$112,603	$238,149	$350,752
Trench Backfill (native material)	$170,257	$97,611	$267,868	$170,403	$97,611	$268,013	$149,261	$97,611	$246,871	$52,992	$14,920	$67,911	$52,992	$97,611	$150,603
Subtotal - Earthwork	**$707,151**	**$389,104**	**$1,096,255**	**$703,486**	**$389,104**	**$1,092,590**	**$553,966**	**$389,104**	**$943,070**	**$189,198**	**$63,787**	**$252,986**	**$189,198**	**$389,104**	**$578,302**
Pipe, Fittings, and Appurtenances															
24-inch DR 51 (80 PSI) PVC Pipe and Fittings	$0	$346,468	$346,468	$0	$346,468	$346,468	$0	$346,468	$346,468	$0	$0	$0	$0	$346,468	$346,468
21-inch DR 51 (80 PSI) PVC Pipe and Fittings	$0	$100,812	$100,812	$0	$100,812	$100,812	$0	$100,812	$100,812	$0	$0	$0	$0	$100,812	$100,812
18-inch DR 51 (80 PSI) PVC Pipe and Fittings	$516,152	$130,858	$647,010	$405,782	$130,858	$536,640	$0	$130,858	$130,858	$0	$0	$0	$0	$130,858	$130,858
15-inch DR 51 (80 PSI) PVC Pipe and Fittings	$38,380	$67,393	$105,773	$38,380	$67,393	$105,773	$69,749	$67,393	$137,142	$0	$0	$0	$0	$67,393	$67,393
12-inch DR 51 (80 PSI) PVC Pipe and Fittings	$82,810	$79,989	$162,799	$137,839	$79,989	$217,828	$224,380	$79,989	$304,369	$0	$0	$0	$0	$79,989	$79,989
10-inch DR 51 (80 PSI) PVC Pipe and Fittings	$24,700	$56,590	$81,290	$24,700	$56,590	$81,290	$24,700	$56,590	$81,290	$61,000	$0	$61,000	$61,000	$56,590	$117,590
8-inch DR 51 (80 PSI) PVC Pipe and Fittings	$32,480	$3,608	$36,088	$32,480	$3,608	$36,088	$119,120	$3,608	$122,728	$54,400	$0	$54,400	$54,400	$3,608	$58,008
6-inch DR 51 (80 PSI) PVC Pipe and Fittings	$7,416	$38,664	$46,080	$7,416	$38,664	$46,080	$7,416	$38,664	$46,080	$7,416	$0	$7,416	$7,416	$38,664	$46,080
4-inch DR 51 (80 PSI) PVC Pipe and Fittings	$4,464	$5,196	$9,660	$4,464	$5,196	$9,660	$11,424	$5,196	$16,620	$4,464	$0	$4,464	$4,464	$5,196	$9,660
3-inch DR 51 (80 PSI) PVC Pipe and Fittings	$1,719	$4,197	$5,916	$1,719	$4,197	$5,916	$1,719	$4,197	$5,916	$1,719	$0	$1,719	$1,719	$4,197	$5,916
15-inch DR 41 (100 PSI) PVC Pipe and Fittings	$77,091	$0	$77,091	$77,091	$0	$77,091	$0	$0	$0	$0	$0	$0	$0	$0	$0
12-inch DR 41 (100 PSI) PVC Pipe and Fittings	$93,198	$0	$93,198	$93,198	$0	$93,198	$0	$0	$0	$0	$0	$0	$0	$0	$0
10-inch DR 41 (100 PSI) PVC Pipe and Fittings	$0	$8,660	$8,660	$0	$8,660	$8,660	$0	$8,660	$8,660	$0	$0	$0	$0	$8,660	$8,660
8-inch DR 41 (100 PSI) PVC Pipe and Fittings	$24,072	$16,104	$40,176	$12,872	$16,104	$28,976	$11,752	$16,104	$27,856	$0	$0	$0	$0	$16,104	$16,104
6-inch DR 41 (100 PSI) PVC Pipe and Fittings	$22,488	$20,814	$43,302	$0	$20,814	$20,814	$45,636	$20,814	$66,450	$0	$0	$0	$0	$20,814	$20,814
4-inch DR 41 (100 PSI) PVC Pipe and Fittings	$2,988	$6,396	$9,384	$3,436	$6,396	$9,832	$6,296	$6,396	$12,692	$0	$0	$0	$0	$6,396	$6,396
3-inch DR 41 (100 PSI) PVC Pipe and Fittings	$6,066	$1,326	$7,392	$3,447	$1,326	$4,773	$4,926	$1,326	$6,252	$1,650	$0	$1,650	$1,650	$1,326	$2,976
20-inch DR 26 (160 PSI) PVC Pipe and Fittings	$0	$0	$0	$48,972	$0	$48,972	$0	$0	$0	$0	$0	$0	$0	$0	$0
16-inch DR 26 (160 PSI) PVC Pipe and Fittings	$0	$0	$0	$0	$0	$0	$41,580	$0	$41,580	$0	$0	$0	$0	$0	$0
12-inch DR 26 (160 PSI) PVC Pipe and Fittings	$22,869	$118,650	$141,519	$23,226	$118,650	$141,876	$23,226	$118,650	$141,876	$53,151	$118,650	$171,801	$53,151	$118,650	$171,801
10-inch DR 26 (160 PSI) PVC Pipe and Fittings	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8-inch DR 26 (160 PSI) PVC Pipe and Fittings	$22,698	$13,000	$35,698	$74,906	$13,000	$87,906	$55,809	$13,000	$68,809	$14,378	$13,000	$27,378	$14,378	$13,000	$27,378
6-inch DR 26 (160 PSI) PVC Pipe and Fittings	$113,740	$0	$113,740	$121,280	$0	$121,280	$45,220	$0	$45,220	$25,440	$0	$25,440	$25,440	$0	$25,440
4-inch DR 26 (160 PSI) PVC Pipe and Fittings	$29,022	$0	$29,022	$29,022	$0	$29,022	$24,732	$0	$24,732	$8,634	$0	$8,634	$8,634	$0	$8,634
3-inch DR 26 (160 PSI) PVC Pipe and Fittings	$3,855	$0	$3,855	$5,490	$0	$5,490	$3,025	$0	$3,025	$7,465	$0	$7,465	$7,465	$0	$7,465
21-inch Gate Valve with Valve Box	$0	$7,000	$7,000	$14,000	$7,000	$21,000	$0	$7,000	$7,000	$0	$0	$0	$0	$7,000	$7,000
20-inch Gate Valve with Valve Box	$0	$0	$0	$13,000	$0	$13,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
18-inch Gate Valve with Valve Box	$34,800	$11,600	$46,400	$17,400	$11,600	$29,000	$0	$11,600	$11,600	$0	$0	$0	$0	$11,600	$11,600
16-inch Gate Valve with Valve Box	$0	$0	$0	$0	$0	$0	$10,000	$0	$10,000	$0	$0	$0	$0	$0	$0
15-inch Gate Valve with Valve Box	$13,500	$4,500	$18,000	$13,500	$4,500	$18,000	$22,500	$4,500	$27,000	$0	$0	$0	$0	$4,500	$4,500
12-inch Gate Valve with Valve Box	$10,500	$28,500	$39,000	$9,000	$28,500	$37,500	$10,500	$28,500	$39,000	$1,500	$21,000	$22,500	$1,500	$28,500	$30,000
10-inch Gate Valve with Valve Box	$1,300	$1,300	$2,600	$1,300	$1,300	$2,600	$1,300	$1,300	$2,600	$2,600	$0	$2,600	$2,600	$1,300	$3,900
8-inch Gate Valve with Valve Box	$8,800	$4,400	$13,200	$8,800	$4,400	$13,200	$9,900	$4,400	$14,300	$4,400	$2,200	$6,600	$4,400	$4,400	$8,800
6-inch Gate Valve with Valve Box	$8,000	$2,400	$10,400	$8,000	$2,400	$10,400	$8,000	$2,400	$10,400	$1,600	$0	$1,600	$1,600	$2,400	$4,000
4-inch Gate Valve with Valve Box	$1,200	$600	$1,800	$1,200	$600	$1,800	$1,200	$600	$1,800	$1,200	$0	$1,200	$1,200	$600	$1,800
3-inch Gate Valve with Valve Box	$500	$0	$500	$500	$0	$500	$500	$0	$500	$500	$0	$500	$500	$0	$500
Air and Vacuum Release Valve Assembly	$65,000	$30,000	$95,000	$65,000	$30,000	$95,000	$57,500	$30,000	$87,500	$20,000	$0	$20,000	$20,000	$30,000	$50,000
12-inch Flush Valve Assembly	$6,000	$0	$6,000	$6,000	$0	$6,000	$4,000	$0	$4,000	$0	$0	$0	$0	$0	$0
8-inch Flush Valve Assembly	$1,500	$3,000	$4,500	$1,500	$3,000	$4,500	$1,500	$3,000	$4,500	$1,500	$0	$1,500	$1,500	$3,000	$4,500
Turnout Connection	$415,000	$450,000	$865,000	$415,000	$450,000	$865,000	$415,000	$450,000	$865,000	$217,500	$0	$217,500	$217,500	$450,000	$667,500
Metered Irrigation Service (Lateral E1)	$0	$213,000	$213,000	$0	$213,000	$213,000	$0	$213,000	$213,000	$0	$213,000	$213,000	$0	$213,000	$213,000
Pipeline Inlet Control Structure	$0	$46,000	$46,000	$0	$46,000	$46,000	$0	$46,000	$46,000	$0	$0	$0	$0	$46,000	$46,000
New Spill Pipe and Ditch	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$0	$0	$0	$20,000	$20,000
Other Appurtenances and Features	$56,000	$69,000	$125,000	$57,000	$69,000	$126,000	$36,000	$69,000	$105,000	$12,000	$7,000	$19,000	$12,000	$69,000	$81,000
Subtotal - Pipe, Fittings, and Appurtenances	**$1,748,308**	**$1,910,025**	**$3,658,333**	**$1,776,920**	**$1,910,025**	**$3,686,945**	**$1,298,610**	**$1,910,025**	**$3,208,635**	**$502,517**	**$374,850**	**$877,367**	**$502,517**	**$1,910,025**	**$2,412,542**
Subtotal Pay Items - Pressure Pipelines - Main and Laterals	**$2,735,000**	**$2,506,000**	**$5,241,000**	**$2,760,000**	**$2,506,000**	**$5,266,000**	**$2,106,000**	**$2,506,000**	**$4,612,000**	**$784,000**	**$462,000**	**$1,246,000**	**$784,000**	**$2,506,000**	**$3,290,000**
Mobilization / Demobilization	$205,125	$187,950	$393,075	$207,000	$187,950	$394,950	$157,950	$187,950	$345,900	$58,800	$34,650	$93,450	$58,800	$187,950	$246,750
Unlisted Items	$273,500	$250,600	$524,100	$276,000	$250,600	$526,600	$210,600	$250,600	$461,200	$78,400	$46,200	$124,600	$78,400	$250,600	$329,000
Sales Tax	$210,595	$192,962	$403,557	$212,520	$192,962	$405,482	$162,162	$192,962	$355,124	$60,368	$35,574	$95,942	$60,368	$192,962	$253,330
Total Construction Contract - Pressure Pipelines - Main and Laterals	**$3,424,000**	**$3,137,000**	**$6,561,000**	**$3,456,000**	**$3,137,000**	**$6,593,000**	**$2,637,000**	**$3,137,000**	**$5,774,000**	**$982,000**	**$578,000**	**$1,560,000**	**$982,000**	**$3,137,000**	**$4,119,000**
Contingencies	$684,800	$627,400	$1,312,200	$691,200	$627,400	$1,318,600	$527,400	$627,400	$1,154,800	$196,400	$115,600	$312,000	$196,400	$627,400	$823,800
Total Field Cost - Pressure Pipelines - Main and Laterals	**$4,109,000**	**$3,765,000**	**$7,874,000**	**$4,147,000**	**$3,765,000**	**$7,912,000**	**$3,164,000**	**$3,765,000**	**$6,929,000**	**$1,178,000**	**$694,000**	**$1,872,000**	**$1,178,000**	**$3,765,000**	**$4,943,000**

Methow Valley Irrigation District - Alternatives Evaluation Report
Opinion of Probable Costs

D. Rice
17-Jul-13

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	UNIT	UNIT COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST
MVID Water Supply and Pumping Facilities																		
Miscellaneous Site Work																		
Diversion and Care of Water	LS	VARIES	1	$30,000	1	$10,000	1	$10,000	1	$5,000	0	$0	0	$0	1	$0	1	$5,000
Temporary and Permanent Access	LS	VARIES	1	$10,000	1	$15,000	1	$20,000	1	$10,000	0	$0	0	$0	1	$0	1	$10,000
Temporary Erosion and Sediment Control	LS	VARIES	1	$10,000	1	$15,000	1	$15,000	1	$8,000	0	$0	0	$0	1	$0	1	$8,000
Construction Surveying	LS	VARIES	1	$5,000	1	$5,000	1	$10,000	1	$2,500	0	$0	0	$0	1	$0	1	$2,500
Clearing and Grubbing	AC	$3,500	0.8	$2,800	0.6	$2,100	0.8	$2,800	0.5	$1,750	0.0	$0	0.0	$0	0.6	$2,100	0.6	$2,100
Subtotal - Miscellaneous Site Work				**$57,800**		**$47,100**		**$57,800**		**$27,250**		**$0**		**$0**		**$2,100**		**$27,600**
Earthwork																		
Structure & Trench Excavation, Soil	CY	$6	1,715	$10,291	58	$347	151	$906	14	$85	0	$0	0	$0	12	$74	16	$98
Structure &Trench Excavation, Rock	CY	$15	429	$6,432	14	$217	38	$566	4	$53	0	$0	0	$0	3	$46	4	$61
Structure & Trench Backfill, Imported Material	CY	$30	282	$8,463	43	$1,290	168	$5,028	20	$603	0	$0	0	$0	19	$585	23	$704
Structure & Trench Backfill, Native Material	CY	$8	1,542	$12,336	66	$524	226	$1,810	28	$225	0	$0	0	$0	32	$254	33	$268
Waste/Disposal of Excess Material	CY	$5	650	$3,251	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Subtotal - Earthwork				**$40,773**		**$2,379**		**$8,310**		**$967**		**$0**		**$0**		**$958**		**$1,131**
Discharge Pipe, Fittings, and Appurtenances																		
8-inch DR 26 (160 PSI) PVC Pipe and Fittings	LF	$13	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	120	$1,560	0	$0
12-inch DR 11 (160 PSI) HDPE Pipe and Fittings	LF	$35	326	$11,410	0	$0	0	$0	100	$3,500	0	$0	0	$0	0	$0	0	$0
12-inch DR 17 (100 PSI) HDPE Pipe and Fittings	LF	$25	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	120	$3,000
16-inch DR 11 (160 PSI) HDPE Pipe and Fittings	LF	$54	0	$0	0	$0	670	$36,180	0	$0	0	$0	0	$0	0	$0	0	$0
18-inch DR 11 (160 PSI) HDPE Pipe and Fittings	LF	$67	308	$20,636	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
20-inch DR 11 (160 PSI) HDPE Pipe and Fittings	LF	$82	0	$0	120	$9,840	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
8-inch Gate Valve with Valve Box	EA	$1,100	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	1	$1,100	0	$0
12-inch Gate Valve with Valve Box	EA	$1,500	1	$1,500	3	$4,500	5	$7,500	1	$1,500	0	$0	0	$0	0	$0	1	$1,500
16-inch Gate Valve with Valve Box	EA	$5,000	0	$0	0	$0	1	$5,000	0	$0	0	$0	0	$0	0	$0	0	$0
18-inch Gate Valve with Valve Box	EA	$5,800	1	$5,800	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
20-inch Gate Valve with Valve Box	EA	$6,500	0	$0	1	$6,500	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Subtotal - Discharge Pipe, Fittings, and Appurtenances				**$39,346**		**$20,840**		**$48,680**		**$5,000**		**$0**		**$0**		**$2,660**		**$4,500**
Pump Station and Intake Facilities																		
Reinforced Concrete Pump Station Wet Well	LS	VARIES	1	$150,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Concrete Masonry Unit Pump Station Building	SF	$125	450	$56,250	196	$24,500	196	$24,500	0	$0	0	$0	0	$0	0	$0	0	$0
Debris Rack	LS	VARIES	1	$8,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Steel Supports for Fish Screen	LS	VARIES	1	$25,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Wedge Wire or Profile Bar Inclined Plate Screen	SF	$300	36	$10,800	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Air Blast Self-Cleaning System	LS	VARIES	1	$95,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Vertical Turbine Pump, 2.4 CFS, 115 HP	EA	$32,000	2	$64,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Vertical Turbine Pump, 4.3 CFS, 95 HP	EA	$28,000	3	$84,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
End Suction Centrifugal Pump, 2.4 CFS, 70 HP	EA	$21,000	0	$0	2	$42,000	2	$42,000	0	$0	0	$0	0	$0	0	$0	0	$0
3-Phase Power Extension	LS	VARIES	1	$15,000	1	$20,000	1	$20,000	0	$0	0	$0	0	$0	0	$0	0	$0
Electrical and Controls	LS	VARIES	1	$110,000	1	$25,000	1	$25,000	0	$0	0	$0	0	$0	0	$0	0	$0
Pump Station Pipe, Fittings, Valves, Meter	LS	VARIES	1	$50,000	1	$15,000	1	$15,000	0	$0	0	$0	0	$0	0	$0	0	$0
Subtotal - Pump Station and Intake Facilies				**$668,050**		**$126,500**		**$126,500**		**$0**		**$0**		**$0**		**$0**		**$0**
Groundwater Production Wells																		
Well House	EA	$20,000	0	$0	3	$60,000	5	$100,000	1	$20,000	0	$0	0	$0	1	$20,000	1	$20,000
200-Foot Deep 12-inch Well with Casing	EA	$60,000	0	$0	3	$180,000	5	$300,000	1	$60,000	0	$0	0	$0	0	$0	1	$60,000
50-Foot 12-inch Well Screen	EA	$10,000	0	$0	3	$30,000	5	$50,000	1	$10,000	0	$0	0	$0	0	$0	1	$10,000
150-Foot Deep 8-inch Well with Casing	EA	$15,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	1	$15,000	0	$0
30-Foot 8-inch Well Screen	EA	$5,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	1	$5,000	0	$0
Submersible Well Pump, 4.2 CFS, 120 HP	EA	$32,000	0	$0	3	$96,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Well Pump, 2.6 CFS, 75 HP	EA	$25,000	0	$0	0	$0	2	$50,000	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Well Pump, 2.2 CFS, 70 HP	EA	$24,000	0	$0	0	$0	3	$72,000	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Well Pump, 2.8 CFS, 115 HP	EA	$31,000	0	$0	0	$0	0	$0	2	$62,000	0	$0	0	$0	0	$0	0	$0
Submersible Well Pump, 2.7 CFS, 60 HP	EA	$21,500	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	2	$43,000
Submersible Well Pump, 1.6 CFS, 55 HP	EA	$20,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	1	$20,000	0	$0
Test, Modify Ex Town Well No. 4	LS	$12,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	1	$12,000	0	$0
3-Phase Power Extension	LS	VARIES	0	$0	1	$20,000	1	$20,000	1	$20,000	0	$0	0	$0	1	$10,000	1	$20,000
Electrical and Controls	LS	VARIES	0	$0	1	$90,000	1	$140,000	1	$35,000	0	$0	0	$0	1	$16,000	1	$30,000
Pump Station Pipe, Fittings, Valves, Meter	LS	VARIES	0	$0	1	$30,000	1	$50,000	1	$15,000	0	$0	0	$0	1	$9,000	1	$15,000
Upgrades to Nearby Impacted Wells	LS	VARIES	1	$0	1	$60,000	1	$80,000	0	$0	0	$0	0	$0	0	$0	0	$0
Subtotal - Groundwater Production Wells				**$0**		**$566,000**		**$862,000**		**$222,000**		**$0**		**$0**		**$107,000**		**$198,000**
Subtotal Pay Items - MVID Water Supply and Pumping Facilities				**$806,000**		**$763,000**		**$1,103,000**		**$255,000**		**$0**		**$0**		**$113,000**		**$231,000**
Mobilization / Demobilization	7.5%			$60,450		$57,225		$82,725		$19,125		$0		$0		$8,475		$17,325
Unlisted Items	10.0%			$80,600		$76,300		$110,300		$25,500		$0		$0		$11,300		$23,100
Sales Tax	7.7%			$62,062		$58,751		$84,931		$19,635		$0		$0		$8,701		$17,787
Total Construction Contract - MVID Water Supply and Pumping Facilities				**$1,009,000**		**$955,000**		**$1,381,000**		**$319,000**		**$0**		**$0**		**$141,000**		**$289,000**
Contingencies	20.0%			$201,800		$191,000		$276,200		$63,800		$0		$0		$28,200		$57,800
Total Field Cost - MVID Water Supply and Pumping Facilities				**$1,211,000**		**$1,146,000**		**$1,657,000**		**$383,000**		**$0**		**$0**		**$169,000**		**$347,000**

	SUBTOTALS (ASSUME LATERAL E1 CUSTOMERS WILL BE SERVED THROUGH TOWN OF TWIPS SYSTEM)														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL
MVID Water Supply and Pumping Facilities															
Miscellaneous Site Work															
Diversion and Care of Water	$30,000	$0	$30,000	$10,000	$0	$10,000	$10,000	$0	$10,000	$5,000	$0	$5,000	$5,000	$0	$5,000
Temporary and Permanent Access	$10,000	$0	$10,000	$15,000	$0	$15,000	$20,000	$0	$20,000	$10,000	$0	$10,000	$10,000	$0	$10,000
Temporary Erosion and Sediment Control	$10,000	$0	$10,000	$15,000	$0	$15,000	$15,000	$0	$15,000	$8,000	$0	$8,000	$8,000	$0	$8,000
Construction Surveying	$5,000	$0	$5,000	$5,000	$0	$5,000	$10,000	$0	$10,000	$2,500	$0	$2,500	$2,500	$0	$2,500
Clearing and Grubbing	$2,800	$2,100	$4,900	$2,100	$2,100	$4,200	$2,800	$2,100	$4,900	$1,750	$2,100	$3,850	$1,750	$2,100	$3,850
Subtotal - Miscellaneous Site Work	**$57,800**	**$2,100**	**$59,900**	**$47,100**	**$2,100**	**$49,200**	**$57,800**	**$2,100**	**$59,900**	**$27,250**	**$2,100**	**$29,350**	**$27,250**	**$2,100**	**$29,350**
Earthwork															
Structure & Trench Excavation, Soil	$10,291	$74	$10,365	$347	$74	$421	$906	$74	$979	$85	$74	$159	$85	$74	$159
Structure &Trench Excavation, Rock	$6,432	$46	$6,478	$217	$46	$263	$566	$46	$612	$53	$46	$99	$53	$46	$99
Structure & Trench Backfill, Imported Material	$8,463	$585	$9,048	$1,290	$585	$1,875	$5,028	$585	$5,613	$603	$585	$1,188	$603	$585	$1,188
Structure & Trench Backfill, Native Material	$12,336	$254	$12,589	$524	$254	$778	$1,810	$254	$2,064	$225	$254	$479	$225	$254	$479
Waste/Disposal of Excess Material	$3,251	$0	$3,251	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal - Earthwork	**$40,773**	**$958**	**$41,731**	**$2,379**	**$958**	**$3,336**	**$8,310**	**$958**	**$9,268**	**$967**	**$958**	**$1,924**	**$967**	**$958**	**$1,924**
Discharge Pipe, Fittings, and Appurtenances															
8-inch DR 26 (160 PSI) PVC Pipe and Fittings	$0	$1,560	$1,560	$0	$1,560	$1,560	$0	$1,560	$1,560	$0	$1,560	$1,560	$0	$1,560	$1,560
12-inch DR 11 (160 PSI) HDPE Pipe and Fittings	$11,410	$0	$11,410	$0	$0	$0	$0	$0	$0	$3,500	$0	$3,500	$3,500	$0	$3,500
12-inch DR 17 (100 PSI) HDPE Pipe and Fittings	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
16-inch DR 11 (160 PSI) HDPE Pipe and Fittings	$0	$0	$0	$0	$0	$0	$36,180	$0	$36,180	$0	$0	$0	$0	$0	$0
18-inch DR 11 (160 PSI) HDPE Pipe and Fittings	$20,636	$0	$20,636	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
20-inch DR 11 (160 PSI) HDPE Pipe and Fittings	$0	$0	$0	$9,840	$0	$9,840	$0	$0	$0	$0	$0	$0	$0	$0	$0
8-inch Gate Valve with Valve Box	$0	$1,100	$1,100	$0	$1,100	$1,100	$0	$1,100	$1,100	$0	$1,100	$1,100	$0	$1,100	$1,100
12-inch Gate Valve with Valve Box	$1,500	$0	$1,500	$4,500	$0	$4,500	$7,500	$0	$7,500	$1,500	$0	$1,500	$1,500	$0	$1,500
16-inch Gate Valve with Valve Box	$0	$0	$0	$0	$0	$0	$5,000	$0	$5,000	$0	$0	$0	$0	$0	$0
18-inch Gate Valve with Valve Box	$5,800	$0	$5,800	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
20-inch Gate Valve with Valve Box	$0	$0	$0	$6,500	$0	$6,500	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal - Discharge Pipe, Fittings, and Appurtenances	**$39,346**	**$2,660**	**$42,006**	**$20,840**	**$2,660**	**$23,500**	**$48,680**	**$2,660**	**$51,340**	**$5,000**	**$2,660**	**$7,660**	**$5,000**	**$2,660**	**$7,660**
Pump Station and Intake Facilities															
Reinforced Concrete Pump Station Wet Well	$150,000	$0	$150,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Concrete Masonry Unit Pump Station Building	$56,250	$0	$56,250	$24,500	$0	$24,500	$24,500	$0	$24,500	$0	$0	$0	$0	$0	$0
Debris Rack	$8,000	$0	$8,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Steel Supports for Fish Screen	$25,000	$0	$25,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Wedge Wire or Profile Bar Inclined Plate Screen	$10,800	$0	$10,800	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Air Blast Self-Cleaning System	$95,000	$0	$95,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Vertical Turbine Pump, 2.4 CFS, 115 HP	$64,000	$0	$64,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Vertical Turbine Pump, 4.3 CFS, 95 HP	$84,000	$0	$84,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End Suction Centrifugal Pump, 2.4 CFS, 70 HP	$0	$0	$0	$42,000	$0	$42,000	$42,000	$0	$42,000	$0	$0	$0	$0	$0	$0
3-Phase Power Extension	$15,000	$0	$15,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$0	$0	$0	$0	$0	$0
Electrical and Controls	$110,000	$0	$110,000	$25,000	$0	$25,000	$25,000	$0	$25,000	$0	$0	$0	$0	$0	$0
Pump Station Pipe, Fittings, Valves, Meter	$50,000	$0	$50,000	$15,000	$0	$15,000	$15,000	$0	$15,000	$0	$0	$0	$0	$0	$0
Subtotal - Pump Station and Intake Facilies	**$668,050**	**$0**	**$668,050**	**$126,500**	**$0**	**$126,500**	**$126,500**	**$0**	**$126,500**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Groundwater Production Wells															
Well House	$0	$20,000	$20,000	$60,000	$20,000	$80,000	$100,000	$20,000	$120,000	$20,000	$20,000	$40,000	$20,000	$20,000	$40,000
200-Foot Deep 12-inch Well with Casing	$0	$0	$0	$180,000	$0	$180,000	$300,000	$0	$300,000	$60,000	$0	$60,000	$60,000	$0	$60,000
50-Foot 12-inch Well Screen	$0	$0	$0	$30,000	$0	$30,000	$50,000	$0	$50,000	$10,000	$0	$10,000	$10,000	$0	$10,000
150-Foot Deep 8-inch Well with Casing	$0	$15,000	$15,000	$0	$15,000	$15,000	$0	$15,000	$15,000	$0	$15,000	$15,000	$0	$15,000	$15,000
30-Foot 8-inch Well Screen	$0	$5,000	$5,000	$0	$5,000	$5,000	$0	$5,000	$5,000	$0	$5,000	$5,000	$0	$5,000	$5,000
Submersible Well Pump, 4.2 CFS, 120 HP	$0	$0	$0	$96,000	$0	$96,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
Submersible Well Pump, 2.6 CFS, 75 HP	$0	$0	$0	$0	$0	$0	$50,000	$0	$50,000	$0	$0	$0	$0	$0	$0
Submersible Well Pump, 2.2 CFS, 70 HP	$0	$0	$0	$0	$0	$0	$72,000	$0	$72,000	$0	$0	$0	$0	$0	$0
Submersible Well Pump, 2.8 CFS, 115 HP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$62,000	$0	$62,000	$62,000	$0	$62,000
Submersible Well Pump, 2.7 CFS, 60 HP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Submersible Well Pump, 1.6 CFS, 55 HP	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000
Test, Modify Ex Town Well No. 4	$0	$12,000	$12,000	$0	$12,000	$12,000	$0	$12,000	$12,000	$0	$12,000	$12,000	$0	$12,000	$12,000
3-Phase Power Extension	$0	$10,000	$10,000	$20,000	$10,000	$30,000	$20,000	$10,000	$30,000	$20,000	$10,000	$30,000	$20,000	$10,000	$30,000
Electrical and Controls	$0	$16,000	$16,000	$90,000	$16,000	$106,000	$140,000	$16,000	$156,000	$35,000	$16,000	$51,000	$35,000	$16,000	$51,000
Pump Station Pipe, Fittings, Valves, Meter	$0	$9,000	$9,000	$30,000	$9,000	$39,000	$50,000	$9,000	$59,000	$15,000	$9,000	$24,000	$15,000	$9,000	$24,000
Upgrades to Nearby Impacted Wells	$0	$0	$0	$60,000	$0	$60,000	$80,000	$0	$80,000	$0	$0	$0	$0	$0	$0
Subtotal - Groundwater Production Wells	**$0**	**$107,000**	**$107,000**	**$566,000**	**$107,000**	**$673,000**	**$862,000**	**$107,000**	**$969,000**	**$222,000**	**$107,000**	**$329,000**	**$222,000**	**$107,000**	**$329,000**
Subtotal Pay Items - MVID Water Supply and Pumping Facilities	**$806,000**	**$113,000**	**$919,000**	**$763,000**	**$113,000**	**$876,000**	**$1,103,000**	**$113,000**	**$1,216,000**	**$255,000**	**$113,000**	**$368,000**	**$255,000**	**$113,000**	**$368,000**
Mobilization / Demobilization	$60,450	$8,475	$68,925	$57,225	$8,475	$65,700	$82,725	$8,475	$91,200	$19,125	$8,475	$27,600	$19,125	$8,475	$27,600
Unlisted Items	$80,600	$11,300	$91,900	$76,300	$11,300	$87,600	$110,300	$11,300	$121,600	$25,500	$11,300	$36,800	$25,500	$11,300	$36,800
Sales Tax	$62,062	$8,701	$70,763	$58,751	$8,701	$67,452	$84,931	$8,701	$93,632	$19,635	$8,701	$28,336	$19,635	$8,701	$28,336
Total Construction Contract - MVID Water Supply and Pumping Facilities	**$1,009,000**	**$141,000**	**$1,150,000**	**$955,000**	**$141,000**	**$1,096,000**	**$1,381,000**	**$141,000**	**$1,522,000**	**$319,000**	**$141,000**	**$460,000**	**$319,000**	**$141,000**	**$460,000**
Contingencies	$201,800	$28,200	$230,000	$191,000	$28,200	$219,200	$276,200	$28,200	$304,400	$63,800	$28,200	$92,000	$63,800	$28,200	$92,000
Total Field Cost - MVID Water Supply and Pumping Facilities	**$1,211,000**	**$169,000**	**$1,380,000**	**$1,146,000**	**$169,000**	**$1,315,000**	**$1,657,000**	**$169,000**	**$1,826,000**	**$383,000**	**$169,000**	**$552,000**	**$383,000**	**$169,000**	**$552,000**

Methow Valley Irrigation District - Alternatives Evaluation Report
Opinion of Probable Costs

D. Rice
17-Jul-13

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	UNIT	UNIT COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Individual Well Supply Facilities																		
Convert User to Individual Well, <1 Acre	EA	$9,500	2	$19,000	2	$19,000	2	$19,000	7	$66,500	1	$9,500	32	$304,000	0	$0	0	$0
Convert User to Individual Well, 1-5 Acres	EA	$10,700	5	$53,500	5	$53,500	5	$53,500	46	$492,200	6	$64,200	117	$1,251,900	0	$0	0	$0
Convert User to Individual Well, 5-10 Acres	EA	$13,400	1	$13,400	1	$13,400	1	$13,400	29	$388,600	1	$13,400	33	$442,200	0	$0	0	$0
Convert User to Individual Well, >10 Acres	EA	$34,700	0	$0	0	$0	0	$0	5	$173,500	0	$0	6	$208,200	0	$0	0	$0
Subtotal Pay Items - Individual Well Supply Facilities				**$86,000**		**$86,000**		**$86,000**		**$1,121,000**		**$87,000**		**$2,206,000**		**$0**		**$0**
Mobilization / Demobilization	7.5%			$6,450		$6,450		$6,450		$84,075		$6,525		$165,450		$0		$0
Unlisted Items	10.0%			$8,600		$8,600		$8,600		$112,100		$8,700		$220,600		$0		$0
Sales Tax	7.7%			$6,622		$6,622		$6,622		$86,317		$6,699		$169,862		$0		$0
Total Construction Contract - Individual Well Supply Facilities				**$108,000**		**$108,000**		**$108,000**		**$1,403,000**		**$109,000**		**$2,762,000**		**$0**		**$0**
Contingencies	20.0%			$21,600		$21,600		$21,600		$280,600		$21,800		$552,400		$0		$0
Total Field Cost - Individual Well Supply Facilities				**$130,000**		**$130,000**		**$130,000**		**$1,684,000**		**$131,000**		**$3,314,000**		**$0**		**$0**

	SUBTOTALS (ASSUME LATERAL E1 CUSTOMERS WILL BE SERVED THROUGH TOWN OF TWIPS SYSTEM)														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL
Individual Well Supply Facilities															
Convert User to Individual Well, <1 Acre	$19,000	$9,500	$28,500	$19,000	$9,500	$28,500	$19,000	$9,500	$28,500	$66,500	$304,000	$370,500	$66,500	$9,500	$76,000
Convert User to Individual Well, 1-5 Acres	$53,500	$64,200	$117,700	$53,500	$64,200	$117,700	$53,500	$64,200	$117,700	$492,200	$1,251,900	$1,744,100	$492,200	$64,200	$556,400
Convert User to Individual Well, 5-10 Acres	$13,400	$13,400	$26,800	$13,400	$13,400	$26,800	$13,400	$13,400	$26,800	$388,600	$442,200	$830,800	$388,600	$13,400	$402,000
Convert User to Individual Well, >10 Acres	$0	$0	$0	$0	$0	$0	$0	$0	$0	$173,500	$208,200	$381,700	$173,500	$0	$173,500
Subtotal Pay Items - Individual Well Supply Facilities	**$86,000**	**$87,000**	**$173,000**	**$86,000**	**$87,000**	**$173,000**	**$86,000**	**$87,000**	**$173,000**	**$1,121,000**	**$2,206,000**	**$3,327,000**	**$1,121,000**	**$87,000**	**$1,208,000**
Mobilization / Demobilization	$6,450	$6,525	$12,975	$6,450	$6,525	$12,975	$6,450	$6,525	$12,975	$84,075	$165,450	$249,525	$84,075	$6,525	$90,600
Unlisted Items	$8,600	$8,700	$17,300	$8,600	$8,700	$17,300	$8,600	$8,700	$17,300	$112,100	$220,600	$332,700	$112,100	$8,700	$120,800
Sales Tax	$6,622	$6,699	$13,321	$6,622	$6,699	$13,321	$6,622	$6,699	$13,321	$86,317	$169,862	$256,179	$86,317	$6,699	$93,016
Total Construction Contract - Individual Well Supply Facilities	**$108,000**	**$109,000**	**$217,000**	**$108,000**	**$109,000**	**$217,000**	**$108,000**	**$109,000**	**$217,000**	**$1,403,000**	**$2,762,000**	**$4,165,000**	**$1,403,000**	**$109,000**	**$1,512,000**
Contingencies	$21,600	$21,800	$43,400	$21,600	$21,800	$43,400	$21,600	$21,800	$43,400	$280,600	$552,400	$833,000	$280,600	$21,800	$302,400
Total Field Cost - Individual Well Supply Facilities	**$130,000**	**$131,000**	**$261,000**	**$130,000**	**$131,000**	**$261,000**	**$130,000**	**$131,000**	**$261,000**	**$1,684,000**	**$3,314,000**	**$4,998,000**	**$1,684,000**	**$131,000**	**$1,815,000**

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	UNIT	UNIT COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Water Storage Facilities																		
Miscellaneous Site Work																		
Temporary and Permanent Access	LS	VARIES	1	$12,000	1	$12,000	1	$16,000	1	$4,000	0	$0	0	$0	0	$0	0	$0
Temporary Erosion and Sediment Control	LS	VARIES	1	$12,000	1	$12,000	1	$16,000	1	$4,000	0	$0	0	$0	0	$0	0	$0
Construction Surveying	LS	VARIES	1	$4,500	1	$4,500	1	$6,000	1	$1,500	0	$0	0	$0	0	$0	0	$0
Clearing and Grubbing	AC	$3,500	0.8	$2,625	0.75	$2,625	1.0	$3,500	0.3	$875	0.0	$0	0.0	$0	0.0	$0	0.0	$0
Subtotal - Miscellaneous Site Work				**$31,125**		**$31,125**		**$41,500**		**$10,375**		**$0**		**$0**		**$0**		**$0**
Earthwork																		
Structure & Trench Excavation, Soil	CY	$6	845	$5,069	845	$5,069	1,114	$6,681	285	$1,712	0	$0	0	$0	0	$0	0	$0
Structure & Trench Excavation, Rock	CY	$15	211	$3,168	211	$3,168	278	$4,176	71	$1,070	0	$0	0	$0	0	$0	0	$0
Structure & Trench Backfill, Imported Material	CY	$30	213	$6,379	213	$6,379	270	$8,111	81	$2,420	0	$0	0	$0	0	$0	0	$0
Structure & Trench Backfill, Native Material	CY	$8	939	$7,512	939	$7,512	1,241	$9,930	335	$2,683	0	$0	0	$0	0	$0	0	$0
Waste/Disposal of Excess Material	CY	$5	150	$750	150	$750	200	$1,000	50	$250	0	$0	0	$0	0	$0	0	$0
Subtotal - Earthwork				**$22,878**		**$22,878**		**$29,899**		**$8,135**		**$0**		**$0**		**$0**		**$0**
Inlet/Outlet Pipe, Fittings, and Appurtenances																		
8-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$8	200	$1,600	200	$1,600	280	$2,240	200	$1,600	0	$0	0	$0	0	$0	0	$0
15-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$19	0	$0	0	$0	120	$2,280	0	$0	0	$0	0	$0	0	$0	0	$0
18-inch DR 51 (80 PSI) PVC Pipe and Fittings	LF	$26	120	$3,120	120	$3,120	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
8-inch Gate Valve	EA	$1,100.00	3	$3,300	3	$3,300	4	$4,400	1	$1,100	0	$0	0	$0	0	$0	0	$0
15-inch Gate Valve	EA	$4,500.00	0	$0	0	$0	1	$4,500	0	$0	0	$0	0	$0	0	$0	0	$0
18-inch Gate Valve	EA	$5,800.00	1	$5,800	1	$5,800	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Other Appurtenances	LS	VARIES	1	$6,000	1	$6,000	1	$8,000	1	$2,000	0	$0	0	$0	0	$0	0	$0
Subtotal - Inlet/Outlet Pipe, Fittings, and Appurtenances				**$19,820**		**$19,820**		**$21,420**		**$4,700**		**$0**		**$0**		**$0**		**$0**
Storage Tanks																		
Reinforced Concrete Tank (30' Diam X 25' Tall)	EA	$132,100	1	$132,100	1	$132,100	1	$132,100	1	$132,100	0	$0	0	$0	0	$0	0	$0
Reinforced Concrete Tank (30' Diam X 30' Tall)	EA	$158,600		$0		$0	3	$475,800		$0	0	$0	0	$0	0	$0	0	$0
Reinforced Concrete Tank (30' Diam X 45' Tall)	EA	$237,900	2	$475,800	2	$475,800		$0		$0	0	$0	0	$0	0	$0	0	$0
Pipe, Fittings, and Appurtenances	LS	VARIES	1	$75,000	1	75000	1	$100,000	1	$25,000	0	$0	0	$0	0	$0	0	$0
Subtotal - Storage Tanks				**$682,900**		**$682,900**		**$707,900**		**$157,100**		**$0**		**$0**		**$0**		**$0**
Subtotal Pay Items - Water Storage Facilities				**$757,000**		**$757,000**		**$801,000**		**$180,000**		**$0**		**$0**		**$0**		**$0**
Mobilization / Demobilization	7.5%			$56,775		$56,775		$60,075		$13,500		$0		$0		$0		$0
Unlisted Items	10.0%			$75,700		$75,700		$80,100		$18,000		$0		$0		$0		$0
Sales Tax	7.7%			$58,289		$58,289		$61,677		$13,860		$0		$0		$0		$0
Total Construction Contract - Water Storage Facilities				**$948,000**		**$948,000**		**$1,003,000**		**$225,000**		**$0**		**$0**		**$0**		**$0**
Contingencies	20.0%			$189,600		$189,600		$200,600		$45,000		$0		$0		$0		$0
Total Field Cost - Water Storage Facilities				**$1,138,000**		**$1,138,000**		**$1,204,000**		**$270,000**		**$0**		**$0**		**$0**		**$0**

	SUBTOTALS (ASSUME LATERAL E1 CUSTOMERS WILL BE SERVED THROUGH TOWN OF TWIPS SYSTEM)														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL
Water Storage Facilities															
Miscellaneous Site Work															
Temporary and Permanent Access	$12,000	$0	$12,000	$12,000	$0	$12,000	$16,000	$0	$16,000	$4,000	$0	$4,000	$4,000	$0	$4,000
Temporary Erosion and Sediment Control	$12,000	$0	$12,000	$12,000	$0	$12,000	$16,000	$0	$16,000	$4,000	$0	$4,000	$4,000	$0	$4,000
Construction Surveying	$4,500	$0	$4,500	$4,500	$0	$4,500	$6,000	$0	$6,000	$1,500	$0	$1,500	$1,500	$0	$1,500
Clearing and Grubbing	$2,625	$0	$2,625	$2,625	$0	$2,625	$3,500	$0	$3,500	$875	$0	$875	$875	$0	$875
Subtotal - Miscellaneous Site Work	**$31,125**	**$0**	**$31,125**	**$31,125**	**$0**	**$31,125**	**$41,500**	**$0**	**$41,500**	**$10,375**	**$0**	**$10,375**	**$10,375**	**$0**	**$10,375**
Earthwork															
Structure & Trench Excavation, Soil	$5,069	$0	$5,069	$5,069	$0	$5,069	$6,681	$0	$6,681	$1,712	$0	$1,712	$1,712	$0	$1,712
Structure & Trench Excavation, Rock	$3,168	$0	$3,168	$3,168	$0	$3,168	$4,176	$0	$4,176	$1,070	$0	$1,070	$1,070	$0	$1,070
Structure & Trench Backfill, Imported Material	$6,379	$0	$6,379	$6,379	$0	$6,379	$8,111	$0	$8,111	$2,420	$0	$2,420	$2,420	$0	$2,420
Structure & Trench Backfill, Native Material	$7,512	$0	$7,512	$7,512	$0	$7,512	$9,930	$0	$9,930	$2,683	$0	$2,683	$2,683	$0	$2,683
Waste/Disposal of Excess Material	$750	$0	$750	$750	$0	$750	$1,000	$0	$1,000	$250	$0	$250	$250	$0	$250
Subtotal - Earthwork	**$22,878**	**$0**	**$22,878**	**$22,878**	**$0**	**$22,878**	**$29,899**	**$0**	**$29,899**	**$8,135**	**$0**	**$8,135**	**$8,135**	**$0**	**$8,135**
Inlet/Outlet Pipe, Fittings, and Appurtenances															
8-inch DR 51 (80 PSI) PVC Pipe and Fittings	$1,600	$0	$1,600	$1,600	$0	$1,600	$2,240	$0	$2,240	$1,600	$0	$1,600	$1,600	$0	$1,600
15-inch DR 51 (80 PSI) PVC Pipe and Fittings	$0	$0	$0	$0	$0	$0	$2,280	$0	$2,280	$0	$0	$0	$0	$0	$0
18-inch DR 51 (80 PSI) PVC Pipe and Fittings	$3,120	$0	$3,120	$3,120	$0	$3,120	$0	$0	$0	$0	$0	$0	$0	$0	$0
8-inch Gate Valve	$3,300	$0	$3,300	$3,300	$0	$3,300	$4,400	$0	$4,400	$1,100	$0	$1,100	$1,100	$0	$1,100
15-inch Gate Valve	$0	$0	$0	$0	$0	$0	$4,500	$0	$4,500	$0	$0	$0	$0	$0	$0
18-inch Gate Valve	$5,800	$0	$5,800	$5,800	$0	$5,800	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Appurtenances	$6,000	$0	$6,000	$6,000	$0	$6,000	$8,000	$0	$8,000	$2,000	$0	$2,000	$2,000	$0	$2,000
Subtotal - Inlet/Outlet Pipe, Fittings, and Appurtenances	**$19,820**	**$0**	**$19,820**	**$19,820**	**$0**	**$19,820**	**$21,420**	**$0**	**$21,420**	**$4,700**	**$0**	**$4,700**	**$4,700**	**$0**	**$4,700**
Storage Tanks															
Reinforced Concrete Tank (30' Diam X 25' Tall)	$132,100	$0	$132,100	$132,100	$0	$132,100	$132,100	$0	$132,100	$132,100	$0	$132,100	$132,100	$0	$132,100
Reinforced Concrete Tank (30' Diam X 30' Tall)	$0	$0	$0	$0	$0	$0	$475,800	$0	$475,800	$0	$0	$0	$0	$0	$0
Reinforced Concrete Tank (30' Diam X 45' Tall)	$475,800	$0	$475,800	$475,800	$0	$475,800	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipe, Fittings, and Appurtenances	$75,000	$0	$75,000	$75,000	$0	$75,000	$100,000	$0	$100,000	$25,000	$0	$25,000	$25,000	$0	$25,000
Subtotal - Storage Tanks	**$682,900**	**$0**	**$682,900**	**$682,900**	**$0**	**$682,900**	**$707,900**	**$0**	**$707,900**	**$157,100**	**$0**	**$157,100**	**$157,100**	**$0**	**$157,100**
Subtotal Pay Items - Water Storage Facilities	**$757,000**	**$0**	**$757,000**	**$757,000**	**$0**	**$757,000**	**$801,000**	**$0**	**$801,000**	**$180,000**	**$0**	**$180,000**	**$180,000**	**$0**	**$180,000**
Mobilization / Demobilization	$56,775	$0	$56,775	$56,775	$0	$56,775	$60,075	$0	$60,075	$13,500	$0	$13,500	$13,500	$0	$13,500
Unlisted Items	$75,700	$0	$75,700	$75,700	$0	$75,700	$80,100	$0	$80,100	$18,000	$0	$18,000	$18,000	$0	$18,000
Sales Tax	$58,289	$0	$58,289	$58,289	$0	$58,289	$61,677	$0	$61,677	$13,860	$0	$13,860	$13,860	$0	$13,860
Total Construction Contract - Water Storage Facilities	**$948,000**	**$0**	**$948,000**	**$948,000**	**$0**	**$948,000**	**$1,003,000**	**$0**	**$1,003,000**	**$225,000**	**$0**	**$225,000**	**$225,000**	**$0**	**$225,000**
Contingencies	$189,600	$0	$189,600	$189,600	$0	$189,600	$200,600	$0	$200,600	$45,000	$0	$45,000	$45,000	$0	$45,000
Total Field Cost - Water Storage Facilities	**$1,138,000**	**$0**	**$1,138,000**	**$1,138,000**	**$0**	**$1,138,000**	**$1,204,000**	**$0**	**$1,204,000**	**$270,000**	**$0**	**$270,000**	**$270,000**	**$0**	**$270,000**

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	UNIT	UNIT COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Total Field Cost - Without Individual Wells				**$6,458,000**		**$6,431,000**		**$6,025,000**		**$1,831,000**		**$3,071,000**		**$0**		**$863,000**		**$864,000**
Engineering, Permitting and Administration	20.0%			$1,291,600		$1,286,200		$1,205,000		$366,200		$614,200		$0		$172,600		$172,800
Allowance:Land Acquisition-Main and Laterals	LS	VARIES	1	$5,000	1	$5,000	1	$5,000	1	$5,000	1	$5,000	0	$0	1	$5,000	1	$5,000
Allowance: Land Acquisition-Wells, Pumping	LS	VARIES	1	$0	1	$56,000	1	$103,500	1	$28,000	0	$0	0	$0	0	$0	0	$0
Allowance: Land Acquisition-Storage	LS	VARIES	1	$20,000	1	$20,000	1	$20,000	1	$20,000	0	$0	0	$0	0	$0	0	$0
Total Project Cost - Without Individual Wells				**$7,775,000**		**$7,798,000**		**$7,359,000**		**$2,250,000**		**$3,690,000**		**$0**		**$1,041,000**		**$1,042,000**
Cost for Converting Users to Individual Wells				$130,000		$130,000		$130,000		$1,684,000		$131,000		$3,314,000		$0		$0
Total Project Cost - Without Individual Wells				**$7,905,000**		**$7,928,000**		**$7,489,000**		**$3,934,000**		**$3,821,000**		**$3,314,000**		**$1,041,000**		**$1,042,000**

	SUBTOTALS														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL	WEST	EAST W/ E1	TOTAL
Total Field Cost - Without Individual Wells	**$6,458,000**	**$3,934,000**	**$10,392,000**	**$6,431,000**	**$3,934,000**	**$10,365,000**	**$6,025,000**	**$3,934,000**	**$9,959,000**	**$1,831,000**	**$863,000**	**$2,694,000**	**$1,831,000**	**$3,934,000**	**$5,765,000**
Engineering, Permitting and Administration	$1,291,600	$786,800	$2,078,400	$1,286,200	$786,800	$2,073,000	$1,205,000	$786,800	$1,991,800	$366,200	$172,600	$538,800	$366,200	$786,800	$1,153,000
Allowance:Land Acquisition-Main and Laterals	$5,000	$10,000	$15,000	$5,000	$10,000	$15,000	$5,000	$10,000	$15,000	$5,000	$5,000	$10,000	$5,000	$10,000	$15,000
Allowance: Land Acquisition-Wells, Pumping	$0	$0	$0	$56,000	$0	$56,000	$103,500	$0	$103,500	$28,000	$0	$28,000	$28,000	$0	$28,000
Allowance: Land Acquisition-Storage	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000	$20,000	$0	$20,000
Total Project Cost - Without Individual Wells	**$7,775,000**	**$4,731,000**	**$12,506,000**	**$7,798,000**	**$4,731,000**	**$12,529,000**	**$7,359,000**	**$4,731,000**	**$12,090,000**	**$2,250,000**	**$1,041,000**	**$3,291,000**	**$2,250,000**	**$4,731,000**	**$6,981,000**
Cost for Converting Users to Individual Wells	$130,000	$131,000	$261,000	$130,000	$131,000	$261,000	$130,000	$131,000	$261,000	$1,684,000	$3,314,000	$4,998,000	$1,684,000	$131,000	$1,815,000
Total Project Cost - Without Individual Wells	**$7,905,000**	**$4,862,000**	**$12,767,000**	**$7,928,000**	**$4,862,000**	**$12,790,000**	**$7,489,000**	**$4,862,000**	**$12,351,000**	**$3,934,000**	**$4,355,000**	**$8,289,000**	**$3,934,000**	**$4,862,000**	**$8,796,000**

Methow Valley Irrigation District - Alternatives Evaluation Report
Opinion of Probable Costs
Long-term Operating Costs (Operations and Maintenance, Pumping Power, and Replacement Fund Costs)

D. Rice
17-Jul-13

			WEST CANAL IMPROVEMENTS								EAST CANAL IMPROVEMENTS				LATERAL E1 IMPROVEMENTS			
			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVES 4 & 5		EAST PIPELINE ALTERNATIVES 1-3, 5		MAX IND WELLS ALTERNATIVE 4		UPGRADE/SERVE FROM TWISP SYSTEM		REPLACE WITH WELL/PIPE SYSTEM	
ITEM	**UNIT**	**UNIT COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**
Annual Operations and Maintenance Cost[1]				**$56,500**		**$57,500**		**$58,000**		**$28,000**		**$31,700**						**$10,000**
Lateral E1 Cost[2]																		
MVID Cost to Twisp for Water System Annual O&M																$12,000		
MVID Administrative Cost																$7,000		
Lateral E1 Annual Service Agreement Cost																**$19,000**		
Annual Replacement Fund Cost[1]				**$48,559**		**$49,516**		**$51,812**		**$15,993**		**$15,831**						**$9,638**
Pumping Power Costs[3]																		
Monthly Basic Charge (3-Phase Power)	/EA/MO	$12.00	1	$12.00	2	$24.00	3	$36.00	1	$12.00							1	$12.00
Seasonal Energy Charge																		
APR	/kWh	$0.0328	40,955	$1,343.34	53,712	$1,761.75	55,726	$1,827.82	15,442	$506.50							8,057	$264.26
MAY	/kWh	$0.0328	50,785	$1,665.74	66,603	$2,184.57	69,100	$2,266.50	19,148	$628.07							9,990	$327.69
JUN	/kWh	$0.0328	63,890	$2,095.61	83,791	$2,748.34	86,933	$2,851.40	22,237	$729.37							11,280	$369.97
JUL	/kWh	$0.0328	84,641	$2,776.23	111,005	$3,640.96	115,167	$3,777.49	31,914	$1,046.78							16,651	$546.14
AUG	/kWh	$0.0328	84,641	$2,776.23	111,005	$3,640.96	115,167	$3,777.49	31,914	$1,046.78							16,651	$546.14
SEP	/kWh	$0.0328	73,720	$2,418.01	96,682	$3,171.16	100,307	$3,290.07	27,796	$911.71							14,180	$465.10
Monthly Demand Charge	/kW/MO	$3.00	384	$1,152.57	373	$1,119.00	373	$1,119.00	86	$257.37							45	$134.28
Total Annual Pumping Costs				**$20,063**		**$24,006**		**$24,721**		**$6,485**		**$0**						**$3,397**
Total Annual Operating Costs[4]				**$125,100**		**$131,000**		**$134,500**		**$50,500**		**$47,500**				**$19,000**		**$23,000**

	SUBTOTALS (ASSUME LATERAL E1 CUSTOMERS WILL BE SERVED THROUGH TOWN OF TWIPS SYSTEM)														
	ALTERNATIVE 1			ALTERNATIVE 2			ALTERNATIVE 3			ALTERNATIVE 4			ALTERNATIVE 5		
ITEM	**WEST**	**EAST W/ E1**	**TOTAL**	**WEST**	**EAST W/ E1**	**TOTAL**	**WEST**	**EAST W/ E1**	**TOTAL**	**WEST**	**EAST W/ E1**	**TOTAL**	**WEST**	**EAST W/ E1**	**TOTAL**
Annual Operations and Maintenance Cost[1]	**$56,500**	**$31,700**	**$88,200**	**$57,500**	**$31,700**	**$89,200**	**$58,000**	**$31,700**	**$89,700**	**$28,000**	**$0**	**$28,000**	**$28,000**	**$31,700**	**$59,700**
Lateral E1 Cost[2]															
MVID Cost to Twisp for Water System Annual O&M															
MVID Administrative Cost															
Lateral E1 Annual Service Agreement Cost	**$0**	**$19,000**	**$19,000**	**$0**	**$19,000**	**$19,000**	**$0**	**$19,000**	**$19,000**	**$0**	**$19,000**	**$19,000**	**$0**	**$19,000**	**$19,000**
Annual Replacement Fund Cost[1]	**$48,559**	**$15,831**	**$64,390**	**$49,516**	**$15,831**	**$65,347**	**$51,812**	**$15,831**	**$67,643**	**$15,993**	**$0**	**$15,993**	**$15,993**	**$15,831**	**$31,824**
Pumping Power Costs[3]															
Monthly Basic Charge (3-Phase Power)															
Seasonal Energy Charge															
APR															
MAY															
JUN															
JUL															
AUG															
SEP															
Monthly Demand Charge															
Total Annual Pumping Costs	**$20,063**	**$0**	**$20,063**	**$24,006**	**$0**	**$24,006**	**$24,721**	**$0**	**$24,721**	**$6,485**	**$0**	**$6,485**	**$6,485**	**$0**	**$6,485**
Total Annual Operating Costs[4]	**$125,100**	**$66,500**	**$191,600**	**$131,000**	**$66,500**	**$197,500**	**$134,500**	**$66,500**	**$201,000**	**$50,500**	**$19,000**	**$69,500**	**$50,500**	**$66,500**	**$117,000**

Notes:
1) See life cycle cost analysis, in 2013 dollars.
2) Lateral E1 Costs include estimated cost that MVID would contribute to Town of Twisp for O&M minus a credit for water rights leased by MVID to the Town of Twisp.
3) Pumping power costs are based on 2013 Okanogan PUD Electrical Rate Schedule 6 (Irrigation Service).
4) Rounded to nearest $100, includes O&M, Replacement Fund, and Power Costs.

APPENDIX F
OPINIONS OF PROBABLE INDIVIDUAL WELL CONSTRUCTION COSTS

Methow Valley Irrigation District - Alternatives Evaluation Report
Opinion of Probable Costs - Individual Wells

D. Rice
17-Jul-13

Assumed Well Depth	100 feet bgs
Assumed Static Water Depth	50 feet bgs
Assumed Well Discharge Pressure	40 psi

			1 Acre		4 Acres		5 Acres		10 Acres		15 Acres		20 Acres		30 Acres		38 Acres	
			9 gpm		36 gpm		45 gpm		90 gpm		135 gpm		180 gpm		274 gpm		344 gpm	
ITEM	**UNIT**	**UNIT COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**
100-Foot Deep 6-inch Well with Casing and Surface Seal	LS	$6,000.00	1	$6,000	1	$6,000	1	$6,000	1	$6,000	1	$6,000	1	$6,000	1	$6,000		$0
100-Foot Deep 8-inch Well with Casing and Surface Seal	LS	$10,000.00		$0		$0		$0		$0		$0		$0		$0	1	$10,000
6-inch Well Screen	LF	$100.00	10	$1,000	10	$1,000	10	$1,000	10	$1,000	10	$1,000	10	$1,000	10	$1,000		$0
8-inch Well Screen	LF	$150.00		$0		$0		$0		$0		$0		$0		$0	18	$2,700
Submersible Well Pump and Appurtenances, 1 HP	LS	$1,500.00	1	$1,500		$0		$0		$0		$0		$0		$0		$0
Submersible Well Pump and Appurtenances, 2 HP	LS	$2,000.00		$0	1	$2,000		$0		$0		$0		$0		$0		$0
Submersible Well Pump and Appurtenances, 2 1/2 HP	LS	$2,400.00		$0		$0	1	$2,400		$0		$0		$0		$0		$0
Submersible Well Pump and Appurtenances, 5 HP	LS	$4,300.00		$0		$0		$0	1	$4,300		$0		$0		$0		$0
Submersible Well Pump and Appurtenances, 7.5 HP	LS	$6,000.00		$0		$0		$0		$0	1	$6,000		$0		$0		$0
Submersible Well Pump and Appurtenances, 10 HP	LS	$8,000.00		$0		$0		$0		$0		$0	1	$8,000		$0		$0
Submersible Well Pump and Appurtenances, 15 HP	LS	$10,500.00		$0		$0		$0		$0		$0		$0	1	$10,500		$0
Submersible Well Pump and Appurtenances, 20 HP	LS	$12,000.00		$0		$0		$0		$0		$0		$0		$0	1	$12,000
Pipe, Fittings, Valves, Meter	LS	VARIES	1	$500	1	$700	1	$800	1	$1,200	1	$1,900	1	$2,500	1	$4,500	1	$5,000
Electrical and Controls	LS	VARIES	1	$500	1	$500	1	$500	1	$900	1	$1,500	1	$2,000	1	$4,500	1	$5,000
Subtotal				**$9,500**		**$10,200**		**$10,700**		**$13,400**		**$16,400**		**$19,500**		**$26,500**		**$34,700**
Mobilization / Demobilization	7.5%			$713		$765		$803		$1,005		$1,230		$1,463		$1,988		$2,603
Unlisted Items	10.0%			$950		$1,020		$1,070		$1,340		$1,640		$1,950		$2,650		$3,470
Sales Tax	7.7%			$732		$785		$824		$1,032		$1,263		$1,502		$2,041		$2,672
Total Construction Contract - Individual Wells				**$11,900**		**$12,800**		**$13,400**		**$16,800**		**$20,500**		**$24,400**		**$33,200**		**$43,400**
Contingencies	20.0%			$2,380		$2,560		$2,680		$3,360		$4,100		$4,880		$6,640		$8,680
Total Field Cost - MVID Water Supply and Pumping Facilities				**$14,300**		**$15,400**		**$16,100**		**$20,200**		**$24,600**		**$29,300**		**$39,800**		**$52,100**

Well Pump Sizing:									
Min Pump Size Required	HP	0.5	1.9	2.3	4.6	6.9	9.3	14.1	17.7
Recommended Pump Size	HP	0.5	2.0	2.5	5.0	7.5	10.0	15.0	20.0

Annual Pumping Power Costs (Per Okanogan County PUD Rates)

				1 Acre		4 Acres		5 Acres		10 Acres		15 Acres		20 Acres		30 Acres		38 Acres	
				9 gpm		36 gpm		45 gpm		90 gpm		135 gpm		180 gpm		274 gpm		344 gpm	
ITEM		**UNIT**	**UNIT COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**
Monthly Basic Charge (3-Phase Power)		/EA/MO	$12.00	1	$12.00	1	$12.00	1	$12.00	1	$12.00	1	$12.00	1	$12.00	1	$12.00	1	$12.00
Seasonal Energy Charge																			
	APR	/kWh	$0.0328	67	$2.20	269	$8.81	336	$11.01	671	$22.02	1,007	$33.03	1,343	$44.04	2,014	$66.07	2,686	$88.09
	MAY	/kWh	$0.0328	83	$2.73	333	$10.92	416	$13.65	833	$27.31	1,249	$40.96	1,665	$54.61	2,498	$81.92	3,330	$109.23
	JUN	/kWh	$0.0328	94	$3.08	376	$12.33	470	$15.42	940	$30.83	1,410	$46.25	1,880	$61.66	2,820	$92.49	3,760	$123.32
	JUL	/kWh	$0.0328	139	$4.55	555	$18.20	694	$22.76	1,388	$45.51	2,081	$68.27	2,775	$91.02	4,163	$136.54	5,550	$182.05
	AUG	/kWh	$0.0328	139	$4.55	555	$18.20	694	$22.76	1,388	$45.51	2,081	$68.27	2,775	$91.02	4,163	$136.54	5,550	$182.05
	SEP	/kWh	$0.0328	115	$3.79	462	$15.15	577	$18.94	1,155	$37.88	1,732	$56.82	2,310	$75.76	3,464	$113.63	4,619	$151.51
Monthly Demand Charge		/kW/MO	$3.00	0.37	$1.12	1.49	$4.48	1.87	$5.60	3.73	$11.19	5.60	$16.79	7.46	$22.38	11.19	$33.57	14.92	$44.76
Total Annual Pumping Costs					**$100**		**$182**		**$210**		**$348**		**$486**		**$624**		**$901**		**$1,177**
Total Annual Pumping Cost/Acre					**$100**		**$46**		**$42**		**$35**		**$32**		**$31**		**$30**		**$31**

Notes:

1) Pumping power costs are based on 2013 Okanogan PUD Electrical Rate Schedule 6 (Irrigation Service).

Annual Pumping Power Costs (Per Okanogan County Electrical Co-Op Rates)

				1 Acre		4 Acres		5 Acres		10 Acres		15 Acres		20 Acres		30 Acres		38 Acres	
				9 gpm		36 gpm		45 gpm		90 gpm		135 gpm		180 gpm		274 gpm		344 gpm	
ITEM		**UNIT**	**UNIT COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**	**QTY**	**COST**
Monthly Base Charge (1-Phase Power)		/EA/MO	$43.00	1	$43.00	1	$43.00	1	$43.00	1	$43.00	1	$43.00	1	$43.00	1	$43.00		
Monthly Base Charge (3-Phase Power)		/EA/MO	$53.00															1	$53.00
Energy Charge																			
	APR	/kWh	$0.0460	67	$3.09	269	$12.35	336	$15.44	671	$30.88	1,007	$46.33	1,343	$61.77	2,014	$92.65	2,686	$123.54
	MAY	/kWh	$0.0460	83	$3.83	333	$15.32	416	$19.15	833	$38.30	1,249	$57.44	1,665	$76.59	2,498	$114.89	3,330	$153.19
	JUN	/kWh	$0.0460	94	$4.32	376	$17.30	470	$21.62	940	$43.24	1,410	$64.86	1,880	$86.48	2,820	$129.71	3,760	$172.95
	JUL	/kWh	$0.0460	139	$6.38	555	$25.53	694	$31.91	1,388	$63.83	2,081	$95.74	2,775	$127.66	4,163	$191.48	5,550	$255.31
	AUG	/kWh	$0.0460	139	$6.38	555	$25.53	694	$31.91	1,388	$63.83	2,081	$95.74	2,775	$127.66	4,163	$191.48	5,550	$255.31
	SEP	/kWh	$0.0460	115	$5.31	462	$21.25	577	$26.56	1,155	$53.12	1,732	$79.68	2,310	$106.24	3,464	$159.36	4,619	$212.48
Monthly Demand Charge		/kW/MO	$3.00	0.00	$0.00	0.00	$0.00	0.00	$0.00	0.00	$0.00	0.00	$0.00	0.00	$0.00	0.00	$0.00	0.00	$0.00
Total Annual Pumping Costs					**$287**		**$375**		**$405**		**$551**		**$698**		**$844**		**$1,138**		**$1,491**
Total Annual Pumping Cost/Acre					**$287**		**$94**		**$81**		**$55**		**$47**		**$42**		**$37**		**$39**

Notes:

1) Pumping power costs are based on 2013 Okanogan County Electrical Co-Operative Rates for 1-Phase Irrigation Service (parcels 10 Acres and smaller) or 3-Phase Irrigation Service (parcels 10 Acres and larger).

APPENDIX G
LIFE CYCLE COST ANALYSIS

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis
Alternative 1 - West Canal - River Pump Station and Pressurized Delivery System

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

ASSUMPTIONS:	PIPE/INFRASTRUCTURE	PUMPS/ELEC	STORAGE	OVERALL PROJECT
Estimated Capital Cost (Total Field Cost[1]):	$4,908,862	$411,138	$1,138,000	$6,458,000
Interest on Replacement Fund:				3.00%
Rate of Inflation:				3.00%
Life Cycle:	50 Years	25 Years	50 Years	50 Years

SUMMARY OF REPLACEMENT COSTS:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE		OVERALL PROJECT	
	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]
Estimated Project Replacement Cost:								
To Replace 25% of Proposed Facility		$5,379,997		$215,208		$1,247,221		
To Replace 50% of Proposed Facility		$10,759,995		$430,416		$2,494,443		
To Replace 100% of Proposed Facility	$4,908,862	$21,519,990	$411,138	$860,832	$1,138,000	$4,988,885	$6,458,000	
Disposal and Removal Cost:								
To Replace 25% of Proposed Facility		$39,455		$3,141		$9,864		
To Replace 50% of Proposed Facility		$78,910		$6,281		$19,728		
To Replace 100% of Proposed Facility	$36,000	$157,821	$6,000	$12,563	$9,000	$39,455	$51,000	
Total Replacement Cost:								
To Replace 25% of Proposed Facility		**$5,419,453**		**$218,349**		**$1,257,085**		
To Replace 50% of Proposed Facility		**$10,838,905**		**$436,697**		**$2,514,170**		
To Replace 100% of Proposed Facility	**$4,944,862**	**$21,677,810**	**$417,138**	**$873,394**	**$1,147,000**	**$5,028,340**	**$6,509,000**	

REPLACEMENT FUND SUMMARY:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE	
	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50
Annual Deposit Required (Assume Equal Deposit Made Each Year Through Life Cycle of Facility):						
To Replace 25% of Proposed Facility	$48,046	$48,046	$5,989	$12,539	$11,145	$11,145
To Replace 50% of Proposed Facility	$96,092	$96,092	$11,978	$25,079	$22,289	$22,289
To Replace 100% of Proposed Facility	$192,185	$192,185	$23,955	$50,157	$44,579	$44,579
Deposit Required at **Year 1** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$25,466		$4,297		$5,907	
To Replace 50% of Proposed Facility	$50,932		$8,593		$11,814	
To Replace 100% of Proposed Facility	$101,864		$17,186		$23,628	
Deposit Required at **Year 25** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$51,767		$8,734		$12,008	
To Replace 50% of Proposed Facility	$103,534		$17,468		$24,016	
To Replace 100% of Proposed Facility	$207,069		$34,936		$48,031	
Deposit Required at **Year 50** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$108,389		$18,287		$25,142	
To Replace 50% of Proposed Facility	$216,778		$36,574		$50,283	
To Replace 100% of Proposed Facility	$433,556		$73,148		$100,567	

OVERALL REPLACEMENT FUND SUMMARY:		
Component	**Probable % Replaced**	**Life Cycle Years**
Pipelines	25%	50
Well Supply/Pumping	100%	25
Storage	25%	50
Annual Deposit Required (Equal Deposit Each Year)		
Years 1-25		$83,146
Years 26-50		$109,348
Annual Deposit Required (Deposits Increase at Rate of Inflation)		
Year 1		$48,559
Year 25		$98,711
Year 50		$206,679

LIFE CYCLE COSTS:

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Capital Expenses:	**$6,458,000**																									
Replacement Expenses:																										
For 25% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$218,349
For 50% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$436,697
For 100% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$873,394
For 25% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$25,466	$26,230	$27,017	$27,827	$28,662	$29,522	$30,408	$31,320	$32,260	$33,227	$34,224	$35,251	$36,308	$37,398	$38,520	$39,675	$40,866	$42,091	$43,354	$44,655	$45,994	$47,374	$48,796	$50,259	$51,767
Interest		$0	$764	$1,574	$2,432	$3,339	$4,299	$5,314	$6,386	$7,517	$8,710	$9,968	$11,294	$12,690	$14,160	$15,707	$17,334	$19,044	$20,841	$22,729	$24,712	$26,793	$28,977	$31,267	$33,669	$36,187
End of Year Balance		**$25,466**	**$52,460**	**$81,051**	**$111,310**	**$143,311**	**$177,133**	**$212,854**	**$250,560**	**$290,337**	**$332,274**	**$376,467**	**$423,011**	**$472,010**	**$523,568**	**$577,795**	**$634,804**	**$694,714**	**$757,647**	**$823,730**	**$893,097**	**$965,884**	**$1,042,235**	**$1,122,298**	**$1,206,226**	**$1,294,180**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$50,932	$52,460	$54,034	$55,655	$57,325	$59,044	$60,816	$62,640	$64,519	$66,455	$68,448	$70,502	$72,617	$74,795	$77,039	$79,351	$81,731	$84,183	$86,708	$89,310	$91,989	$94,749	$97,591	$100,519	$103,534
Interest		$0	$1,528	$3,148	$4,863	$6,679	$8,599	$10,628	$12,771	$15,034	$17,420	$19,936	$22,588	$25,381	$28,321	$31,414	$34,668	$38,088	$41,683	$45,459	$49,424	$53,586	$57,953	$62,534	$67,338	$72,374
End of Year Balance		**$50,932**	**$104,920**	**$162,102**	**$222,619**	**$286,623**	**$354,265**	**$425,709**	**$501,120**	**$580,673**	**$664,548**	**$752,933**	**$846,023**	**$944,021**	**$1,047,137**	**$1,155,590**	**$1,269,608**	**$1,389,428**	**$1,515,293**	**$1,647,461**	**$1,786,194**	**$1,931,769**	**$2,084,471**	**$2,244,596**	**$2,412,453**	**$2,588,361**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$101,864	$104,920	$108,068	$111,310	$114,649	$118,088	$121,631	$125,280	$129,038	$132,910	$136,897	$141,004	$145,234	$149,591	$154,079	$158,701	$163,462	$168,366	$173,417	$178,619	$183,978	$189,497	$195,182	$201,038	$207,069
Interest		$0	$3,056	$6,295	$9,726	$13,357	$17,197	$21,256	$25,543	$30,067	$34,840	$39,873	$45,176	$50,761	$56,641	$62,828	$69,335	$76,176	$83,366	$90,918	$98,848	$107,172	$115,906	$125,068	$134,676	$144,747
End of Year Balance		**$101,864**	**$209,840**	**$324,203**	**$445,239**	**$573,245**	**$708,531**	**$851,418**	**$1,002,241**	**$1,161,346**	**$1,329,096**	**$1,505,866**	**$1,692,046**	**$1,888,041**	**$2,094,273**	**$2,311,180**	**$2,539,217**	**$2,778,855**	**$3,030,587**	**$3,294,921**	**$3,572,388**	**$3,863,538**	**$4,168,941**	**$4,489,192**	**$4,824,905**	**$5,176,721**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$4,297	$4,425	$4,558	$4,695	$4,836	$4,981	$5,130	$5,284	$5,443	$5,606	$5,774	$5,947	$6,126	$6,310	$6,499	$6,694	$6,895	$7,101	$7,315	$7,534	$7,760	$7,993	$8,233	$8,480	$8,734
Interest		$0	$129	$266	$410	$563	$725	$897	$1,077	$1,268	$1,470	$1,682	$1,905	$2,141	$2,389	$2,650	$2,924	$3,213	$3,516	$3,835	$4,169	$4,520	$4,889	$5,275	$5,680	$6,105
End of Year Balance		**$4,297**	**$8,851**	**$13,675**	**$18,780**	**$24,179**	**$29,885**	**$35,912**	**$42,273**	**$48,984**	**$56,060**	**$63,516**	**$71,369**	**$79,636**	**$88,334**	**$97,483**	**$107,101**	**$117,209**	**$127,827**	**$138,976**	**$150,680**	**$162,960**	**$175,841**	**$189,349**	**$203,509**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$8,593	$8,851	$9,116	$9,390	$9,672	$9,962	$10,261	$10,568	$10,885	$11,212	$11,548	$11,895	$12,252	$12,619	$12,998	$13,388	$13,789	$14,203	$14,629	$15,068	$15,520	$15,986	$16,465	$16,959	$17,468
Interest		$0	$258	$531	$820	$1,127	$1,451	$1,793	$2,155	$2,536	$2,939	$3,364	$3,811	$4,282	$4,778	$5,300	$5,849	$6,426	$7,033	$7,670	$8,339	$9,041	$9,778	$10,550	$11,361	$12,211
End of Year Balance		**$8,593**	**$17,702**	**$27,349**	**$37,559**	**$48,358**	**$59,770**	**$71,824**	**$84,547**	**$97,969**	**$112,120**	**$127,032**	**$142,737**	**$159,271**	**$176,668**	**$194,966**	**$214,203**	**$234,418**	**$255,654**	**$277,953**	**$301,359**	**$325,920**	**$351,683**	**$378,699**	**$407,019**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$17,186	$17,702	$18,233	$18,780	$19,343	$19,923	$20,521	$21,137	$21,771	$22,424	$23,097	$23,790	$24,503	$25,238	$25,995	$26,775	$27,579	$28,406	$29,258	$30,136	$31,040	$31,971	$32,930	$33,918	$34,936
Interest		$0	$516	$1,062	$1,641	$2,254	$2,901	$3,586	$4,309	$5,073	$5,878	$6,727	$7,622	$8,564	$9,556	$10,600	$11,698	$12,852	$14,065	$15,339	$16,677	$18,082	$19,555	$21,101	$22,722	$24,421
End of Year Balance		**$17,186**	**$35,403**	**$54,698**	**$75,119**	**$96,715**	**$119,540**	**$143,648**	**$169,094**	**$195,937**	**$224,239**	**$254,063**	**$285,475**	**$318,542**	**$353,337**	**$389,932**	**$428,406**	**$468,837**	**$511,308**	**$555,905**	**$602,718**	**$651,840**	**$703,366**	**$757,397**	**$814,037**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$5,907	$6,084	$6,267	$6,455	$6,648	$6,848	$7,053	$7,265	$7,483	$7,707	$7,939	$8,177	$8,422	$8,675	$8,935	$9,203	$9,479	$9,763	$10,056	$10,358	$10,669	$10,989	$11,319	$11,658	$12,008
Interest		$0	$177	$365	$564	$775	$997	$1,233	$1,481	$1,744	$2,020	$2,312	$2,620	$2,944	$3,285	$3,643	$4,021	$4,417	$4,834	$5,272	$5,732	$6,215	$6,721	$7,253	$7,810	$8,394
End of Year Balance		**$5,907**	**$12,169**	**$18,800**	**$25,819**	**$33,242**	**$41,087**	**$49,373**	**$58,119**	**$67,346**	**$77,074**	**$87,324**	**$98,121**	**$109,487**	**$121,446**	**$134,024**	**$147,248**	**$161,144**	**$175,742**	**$191,071**	**$207,161**	**$224,045**	**$241,755**	**$260,326**	**$279,794**	**$300,195**
Storage Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$11,814	$12,169	$12,534	$12,910	$13,297	$13,696	$14,107	$14,530	$14,966	$15,415	$15,877	$16,353	$16,844	$17,349	$17,870	$18,406	$18,958	$19,527	$20,113	$20,716	$21,338	$21,978	$22,637	$23,316	$24,016
Interest		$0	$354	$730	$1,128	$1,549	$1,995	$2,465	$2,962	$3,487	$4,041	$4,624	$5,239	$5,887	$6,569	$7,287	$8,041	$8,835	$9,669	$10,545	$11,464	$12,430	$13,443	$14,505	$15,620	$16,788
End of Year Balance		**$11,814**	**$24,337**	**$37,601**	**$51,638**	**$66,484**	**$82,175**	**$98,747**	**$116,239**	**$134,692**	**$154,147**	**$174,649**	**$196,242**	**$218,973**	**$242,892**	**$268,048**	**$294,496**	**$322,289**	**$351,484**	**$382,142**	**$414,322**	**$448,089**	**$483,510**	**$520,652**	**$559,588**	**$600,391**
Storage Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$23,628	$24,337	$25,067	$25,819	$26,594	$27,392	$28,213	$29,060	$29,931	$30,829	$31,754	$32,707	$33,688	$34,699	$35,740	$36,812	$37,916	$39,054	$40,225	$41,432	$42,675	$43,955	$45,274	$46,632	$48,031
Interest		$0	$709	$1,460	$2,256	$3,098	$3,989	$4,930	$5,925	$6,974	$8,082	$9,249	$10,479	$11,775	$13,138	$14,573	$16,083	$17,670	$19,337	$21,089	$22,928	$24,859	$26,885	$29,011	$31,239	$33,575
End of Year Balance		**$23,628**	**$48,674**	**$75,201**	**$103,277**	**$132,969**	**$164,349**	**$197,493**	**$232,478**	**$269,383**	**$308,294**	**$349,298**	**$392,483**	**$437,946**	**$485,783**	**$536,097**	**$588,991**	**$644,578**	**$702,969**	**$764,283**	**$828,644**	**$896,178**	**$967,019**	**$1,041,304**	**$1,119,175**	**$1,200,782**
Operations and Maintenance Expenses:																										
Staff Salaries[4]		$15,000	$15,450	$15,914	$16,391	$16,883	$17,389	$17,911	$18,448	$19,002	$19,572	$20,159	$20,764	$21,386	$22,028	$22,689	$23,370	$24,071	$24,793	$25,536	$26,303	$27,092	$27,904	$28,742	$29,604	$30,492
Benefits[4]		$3,200	$3,296	$3,395	$3,497	$3,602	$3,710	$3,821	$3,936	$4,054	$4,175	$4,301	$4,430	$4,562	$4,699	$4,840	$4,985	$5,135	$5,289	$5,448	$5,611	$5,780	$5,953	$6,132	$6,315	$6,505
Transportation Costs[4]		$2,700	$2,781	$2,864	$2,950	$3,039	$3,130	$3,224	$3,321	$3,420	$3,523	$3,629	$3,737	$3,850	$3,965	$4,084	$4,207	$4,333	$4,463	$4,597	$4,734	$4,877	$5,023	$5,173	$5,329	$5,489
Utilities, Phones, Communications[4]		$1,230	$1,267	$1,305	$1,344	$1,384	$1,426	$1,469	$1,513	$1,558	$1,605	$1,653	$1,703	$1,754	$1,806	$1,860	$1,916	$1,974	$2,033	$2,094	$2,157	$2,222	$2,288	$2,357	$2,428	$2,500
Maintenance, Small Repairs, Supplies[4]		$4,870	$5,016	$5,167	$5,322	$5,481	$5,646	$5,815	$5,989	$6,169	$6,354	$6,545	$6,741	$6,943	$7,152	$7,366	$7,587	$7,815	$8,049	$8,291	$8,540	$8,796	$9,060	$9,331	$9,611	$9,900
Contracted Labor Costs[4]		$3,000	$3,090	$3,183	$3,278	$3,377	$3,478	$3,582	$3,690	$3,800	$3,914	$4,032	$4,153	$4,277	$4,406	$4,538	$4,674	$4,814	$4,959	$5,107	$5,261	$5,418	$5,581	$5,748	$5,921	$6,098
Total West Canal O&M Expenses		**$30,000**	**$30,900**	**$31,827**	**$32,782**	**$33,765**	**$34,778**	**$35,822**	**$36,896**	**$38,003**	**$39,143**	**$40,317**	**$41,527**	**$42,773**	**$44,056**	**$45,378**	**$46,739**	**$48,141**	**$49,585**	**$51,073**	**$52,605**	**$54,183**	**$55,809**	**$57,483**	**$59,208**	**$60,984**
Administration[5]		$26,500	$27,295	$28,114	$28,957	$29,826	$30,721	$31,642	$32,592	$33,569	$34,576	$35,614	$36,682	$37,783	$38,916	$40,084	$41,286	$42,525	$43,800	$45,114	$46,468	$47,862	$49,298	$50,777	$52,300	$53,869
Total West Canal O&M + Aministration Expenses		**$56,500**	**$58,195**	**$59,941**	**$61,739**	**$63,591**	**$65,499**	**$67,464**	**$69,488**	**$71,573**	**$73,720**	**$75,931**	**$78,209**	**$80,555**	**$82,972**	**$85,461**	**$88,025**	**$90,666**	**$93,386**	**$96,187**	**$99,073**	**$102,045**	**$105,107**	**$108,260**	**$111,508**	**$114,853**
Pumping Power Expense		**$20,063**	**$20,664**	**$21,284**	**$21,923**	**$22,581**	**$23,258**	**$23,956**	**$24,674**	**$25,415**	**$26,177**	**$26,962**	**$27,771**	**$28,604**	**$29,463**	**$30,346**	**$31,257**	**$32,195**	**$33,160**	**$34,155**	**$35,180**	**$36,235**	**$37,322**	**$38,442**	**$39,595**	**$40,783**
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

NOTES:
1) Total Field Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2) Current Cost is equal to the Engineer's opinion of the probable total field cost for the project at beginning of project life. Total field costs have been separated into Pipeline and Ditch Lining costs for the life cycle cost analysis because the pipeline and ditch lining have different life cycles.
3) Future cost is value at end of life cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
4) Numbers are for West Canal O&M Only.
5) Adminstrative Costs for West Canal Only.

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis (Cont.)
Alternative 1 - West Canal - River Pump Station and Pressurized Delivery System

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

TOTAL REPLACEMENT COST SUMMARY: (ESTIMATED PRESENT VALUE OF REPLACEMENT COSTS THROUGH 50-YEAR LIFE OF OVERALL PROJECT)	**PIPE/ INFRA.**	**PUMPS**	**STORAGE**	**OVERALL PROJECT**
Probable % of Facility Replaced	25%	100%	25%	
Life Cycle of Facility	50	25	50	
Assumes Equal Deposit Made to Replacement Fund Each Year:				
Overall (Per Probable % of Facility Replaced)				**$2,357,242**
25% Replacement	$1,236,216	$208,569	$286,750	
50% Replacement	$2,472,431	$417,138	$573,500	
100% Replacement	$4,944,862	$834,276	$1,147,000	
Assumes Deposits to Replacement Fund Increase at Rate of Inflation:				
Overall (Per Probable % of Facility Replaced)				**$2,368,463**
25% Replacement	$1,236,216	$208,569	$297,972	
50% Replacement	$2,472,431	$417,138	$595,944	
100% Replacement	$4,944,862	$834,276	$1,191,887	

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,419,453
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,838,905
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$21,677,810
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$457,173
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$914,347
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,828,694
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,257,085
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,514,170
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,028,340
$53,320	$54,920	$56,567	$58,264	$60,012	$61,813	$63,667	$65,577	$67,544	$69,571	$71,658	$73,808	$76,022	$78,303	$80,652	$83,071	$85,563	$88,130	$90,774	$93,497	$96,302	$99,191	$102,167	$105,232	$108,389
$38,825	$41,590	$44,485	$47,517	$50,690	$54,011	$57,486	$61,120	$64,921	$68,895	$73,049	$77,391	$81,927	$86,665	$91,614	$96,782	$102,178	$107,810	$113,688	$119,822	$126,221	$132,897	$139,860	$147,121	$154,691
$1,386,326	**$1,482,836**	**$1,583,888**	**$1,689,669**	**$1,800,372**	**$1,916,196**	**$2,037,349**	**$2,164,046**	**$2,296,512**	**$2,434,978**	**$2,579,686**	**$2,730,884**	**$2,888,832**	**$3,053,800**	**$3,226,065**	**$3,405,918**	**$3,593,659**	**$3,789,599**	**$3,994,061**	**$4,207,381**	**$4,429,904**	**$4,661,993**	**$4,904,020**	**$5,156,372**	**$0**
$106,640	$109,840	$113,135	$116,529	$120,025	$123,626	$127,334	$131,154	$135,089	$139,142	$143,316	$147,615	$152,044	$156,605	$161,303	$166,142	$171,127	$176,260	$181,548	$186,995	$192,605	$198,383	$204,334	$210,464	$216,778
$77,651	$83,180	$88,970	$95,033	$101,380	$108,022	$114,972	$122,241	$129,843	$137,791	$146,099	$154,781	$163,853	$173,330	$183,228	$193,564	$204,355	$215,620	$227,376	$239,644	$252,443	$265,794	$279,720	$294,241	$309,382
$2,772,652	**$2,965,671**	**$3,167,776**	**$3,379,338**	**$3,600,743**	**$3,832,391**	**$4,074,697**	**$4,328,092**	**$4,593,024**	**$4,869,957**	**$5,159,371**	**$5,461,768**	**$5,777,664**	**$6,107,599**	**$6,452,131**	**$6,811,837**	**$7,187,319**	**$7,579,199**	**$7,988,123**	**$8,414,761**	**$8,859,809**	**$9,323,986**	**$9,808,039**	**$10,312,745**	**$0**
$213,281	$219,679	$226,270	$233,058	$240,050	$247,251	$254,669	$262,309	$270,178	$278,283	$286,632	$295,231	$304,088	$313,210	$322,607	$332,285	$342,253	$352,521	$363,096	$373,989	$385,209	$396,765	$408,668	$420,928	$433,556
$155,302	$166,359	$177,940	$190,067	$202,760	$216,045	$229,943	$244,482	$259,686	$275,581	$292,197	$309,562	$327,706	$346,660	$366,456	$387,128	$408,710	$431,239	$454,752	$479,287	$504,886	$531,589	$559,439	$588,482	$618,765
$5,545,304	**$5,931,343**	**$6,335,553**	**$6,758,677**	**$7,201,487**	**$7,664,782**	**$8,149,394**	**$8,656,185**	**$9,186,048**	**$9,739,913**	**$10,318,742**	**$10,923,535**	**$11,555,329**	**$12,215,199**	**$12,904,261**	**$13,623,674**	**$14,374,637**	**$15,158,397**	**$15,976,246**	**$16,829,523**	**$17,719,617**	**$18,647,971**	**$19,616,079**	**$20,625,489**	**$0**
$8,996	$9,266	$9,544	$9,830	$10,125	$10,429	$10,742	$11,064	$11,396	$11,738	$12,090	$12,453	$12,826	$13,211	$13,607	$14,015	$14,436	$14,869	$15,315	$15,774	$16,248	$16,735	$17,237	$17,754	$18,287
$0	$270	$556	$859	$1,180	$1,519	$1,877	$2,256	$2,655	$3,077	$3,521	$3,990	$4,483	$5,002	$5,549	$6,123	$6,727	$7,362	$8,029	$8,730	$9,465	$10,236	$11,045	$11,894	$12,783
$8,996	**$18,532**	**$28,631**	**$39,321**	**$50,625**	**$62,573**	**$75,192**	**$88,511**	**$102,562**	**$117,377**	**$132,988**	**$149,430**	**$166,739**	**$184,952**	**$204,108**	**$224,247**	**$245,410**	**$267,641**	**$290,985**	**$315,489**	**$341,202**	**$368,173**	**$396,455**	**$426,103**	**$0**
$17,992	$18,532	$19,088	$19,660	$20,250	$20,858	$21,483	$22,128	$22,792	$23,475	$24,180	$24,905	$25,652	$26,422	$27,214	$28,031	$28,872	$29,738	$30,630	$31,549	$32,495	$33,470	$34,474	$35,509	$36,574
$0	$540	$1,112	$1,718	$2,359	$3,038	$3,754	$4,511	$5,311	$6,154	$7,043	$7,979	$8,966	$10,004	$11,097	$12,246	$13,455	$14,725	$16,058	$17,459	$18,929	$20,472	$22,090	$23,787	$25,566
$17,992	**$37,063**	**$57,263**	**$78,641**	**$101,250**	**$125,145**	**$150,383**	**$177,022**	**$205,125**	**$234,754**	**$265,976**	**$298,860**	**$333,478**	**$369,904**	**$408,216**	**$448,493**	**$490,820**	**$535,282**	**$581,971**	**$630,979**	**$682,404**	**$736,346**	**$792,911**	**$852,207**	**$0**
$35,984	$37,063	$38,175	$39,321	$40,500	$41,715	$42,967	$44,256	$45,583	$46,951	$48,359	$49,810	$51,304	$52,843	$54,429	$56,062	$57,744	$59,476	$61,260	$63,098	$64,991	$66,941	$68,949	$71,017	$73,148
$0	$1,080	$2,224	$3,436	$4,718	$6,075	$7,509	$9,023	$10,621	$12,307	$14,085	$15,959	$17,932	$20,009	$22,194	$24,493	$26,910	$29,449	$32,117	$34,918	$37,859	$40,944	$44,181	$47,575	$51,132
$35,984	**$74,127**	**$114,526**	**$157,282**	**$202,501**	**$250,291**	**$300,766**	**$354,045**	**$410,249**	**$469,508**	**$531,952**	**$597,721**	**$666,957**	**$739,809**	**$816,432**	**$896,987**	**$981,640**	**$1,070,565**	**$1,163,942**	**$1,261,958**	**$1,364,807**	**$1,472,692**	**$1,585,822**	**$1,704,414**	**$0**
$12,368	$12,739	$13,121	$13,515	$13,920	$14,338	$14,768	$15,211	$15,667	$16,138	$16,622	$17,120	$17,634	$18,163	$18,708	$19,269	$19,847	$20,443	$21,056	$21,687	$22,338	$23,008	$23,698	$24,409	$25,142
$9,006	$9,647	$10,319	$11,022	$11,758	$12,528	$13,334	$14,177	$15,059	$15,981	$16,944	$17,951	$19,004	$20,103	$21,251	$22,449	$23,701	$25,007	$26,371	$27,794	$29,278	$30,827	$32,442	$34,126	$35,882
$321,569	**$343,955**	**$367,395**	**$391,932**	**$417,611**	**$444,477**	**$472,579**	**$501,968**	**$532,694**	**$564,813**	**$598,379**	**$633,450**	**$670,088**	**$708,353**	**$748,311**	**$790,030**	**$833,578**	**$879,028**	**$926,454**	**$975,935**	**$1,027,551**	**$1,081,386**	**$1,137,526**	**$1,196,062**	**$0**
$24,736	$25,478	$26,243	$27,030	$27,841	$28,676	$29,536	$30,422	$31,335	$32,275	$33,243	$34,241	$35,268	$36,326	$37,416	$38,538	$39,694	$40,885	$42,112	$43,375	$44,676	$46,016	$47,397	$48,819	$50,283
$18,012	$19,294	$20,637	$22,044	$23,516	$25,057	$26,669	$28,355	$30,118	$31,962	$33,889	$35,903	$38,007	$40,205	$42,501	$44,899	$47,402	$50,015	$52,742	$55,587	$58,556	$61,653	$64,883	$68,252	$71,764
$643,139	**$687,911**	**$734,791**	**$783,864**	**$835,221**	**$888,954**	**$945,158**	**$1,003,935**	**$1,065,388**	**$1,129,625**	**$1,196,757**	**$1,266,900**	**$1,340,175**	**$1,416,706**	**$1,496,623**	**$1,580,060**	**$1,667,156**	**$1,758,055**	**$1,852,909**	**$1,951,871**	**$2,055,103**	**$2,162,772**	**$2,275,053**	**$2,392,123**	**$0**
$49,472	$50,956	$52,485	$54,060	$55,681	$57,352	$59,072	$60,845	$62,670	$64,550	$66,487	$68,481	$70,536	$72,652	$74,831	$77,076	$79,388	$81,770	$84,223	$86,750	$89,352	$92,033	$94,794	$97,638	$100,567
$36,023	$38,588	$41,275	$44,087	$47,032	$50,113	$53,337	$56,710	$60,236	$63,923	$67,778	$71,805	$76,014	$80,411	$85,002	$89,797	$94,804	$100,029	$105,483	$111,175	$117,112	$123,306	$129,766	$136,503	$143,527
$1,286,277	**$1,375,822**	**$1,469,582**	**$1,567,729**	**$1,670,442**	**$1,777,907**	**$1,890,317**	**$2,007,871**	**$2,130,777**	**$2,259,250**	**$2,393,514**	**$2,533,801**	**$2,680,350**	**$2,833,412**	**$2,993,246**	**$3,160,119**	**$3,334,311**	**$3,516,111**	**$3,705,817**	**$3,903,741**	**$4,110,206**	**$4,325,545**	**$4,550,105**	**$4,784,246**	**$0**
$31,407	$32,349	$33,319	$34,319	$35,348	$36,409	$37,501	$38,626	$39,785	$40,979	$42,208	$43,474	$44,778	$46,122	$47,505	$48,931	$50,398	$51,910	$53,468	$55,072	$56,724	$58,426	$60,178	$61,984	$63,843
$6,700	$6,901	$7,108	$7,321	$7,541	$7,767	$8,000	$8,240	$8,487	$8,742	$9,004	$9,274	$9,553	$9,839	$10,134	$10,439	$10,752	$11,074	$11,406	$11,749	$12,101	$12,464	$12,838	$13,223	$13,620
$5,653	$5,823	$5,997	$6,177	$6,363	$6,554	$6,750	$6,953	$7,161	$7,376	$7,597	$7,825	$8,060	$8,302	$8,551	$8,808	$9,072	$9,344	$9,624	$9,913	$10,210	$10,517	$10,832	$11,157	$11,492
$2,575	$2,653	$2,732	$2,814	$2,899	$2,986	$3,075	$3,167	$3,262	$3,360	$3,461	$3,565	$3,672	$3,782	$3,895	$4,012	$4,133	$4,257	$4,384	$4,516	$4,651	$4,791	$4,935	$5,083	$5,235
$10,197	$10,503	$10,818	$11,142	$11,476	$11,821	$12,175	$12,541	$12,917	$13,304	$13,704	$14,115	$14,538	$14,974	$15,423	$15,886	$16,363	$16,854	$17,359	$17,880	$18,416	$18,969	$19,538	$20,124	$20,728
$6,281	$6,470	$6,664	$6,864	$7,070	$7,282	$7,500	$7,725	$7,957	$8,196	$8,442	$8,695	$8,956	$9,224	$9,501	$9,786	$10,080	$10,382	$10,694	$11,014	$11,345	$11,685	$12,036	$12,397	$12,769
$62,813	**$64,698**	**$66,639**	**$68,638**	**$70,697**	**$72,818**	**$75,002**	**$77,252**	**$79,570**	**$81,957**	**$84,416**	**$86,948**	**$89,557**	**$92,244**	**$95,011**	**$97,861**	**$100,797**	**$103,821**	**$106,936**	**$110,144**	**$113,448**	**$116,851**	**$120,357**	**$123,968**	**$127,687**
$55,485	$57,150	$58,864	$60,630	$62,449	$64,322	$66,252	$68,240	$70,287	$72,395	$74,567	$76,804	$79,109	$81,482	$83,926	$86,444	$89,037	$91,708	$94,460	$97,293	$100,212	$103,219	$106,315	$109,505	$112,790
$118,298	**$121,847**	**$125,503**	**$129,268**	**$133,146**	**$137,140**	**$141,255**	**$145,492**	**$149,857**	**$154,353**	**$158,983**	**$163,753**	**$168,665**	**$173,725**	**$178,937**	**$184,305**	**$189,834**	**$195,529**	**$201,395**	**$207,437**	**$213,660**	**$220,070**	**$226,672**	**$233,472**	**$240,476**
$42,007	**$43,267**	**$44,565**	**$45,902**	**$47,279**	**$48,697**	**$50,158**	**$51,663**	**$53,213**	**$54,809**	**$56,453**	**$58,147**	**$59,891**	**$61,688**	**$63,539**	**$65,445**	**$67,408**	**$69,430**	**$71,513**	**$73,659**	**$75,869**	**$78,145**	**$80,489**	**$82,904**	**$85,391**
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis
Alternative 2 - West Canal - Groundwater Well Supply and Pressurized Delivery System

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

ASSUMPTIONS:	PIPE/INFRASTRUCTURE	PUMPS/ELEC	STORAGE	OVERALL PROJECT
Estimated Capital Cost (Total Field Cost[1]):	$4,851,742	$441,258	$1,138,000	$6,431,000
Interest on Replacement Fund:				3.00%
Rate of Inflation:				3.00%
Life Cycle:	50 Years	25 Years	50 Years	50 Years

SUMMARY OF REPLACEMENT COSTS:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE		OVERALL PROJECT	
	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]
Estimated Project Replacement Cost:								
To Replace 25% of Proposed Facility		$5,317,395		$230,974		$1,247,221		
To Replace 50% of Proposed Facility		$10,634,790		$461,948		$2,494,443		
To Replace 100% of Proposed Facility	$4,851,742	$21,269,581	$441,258	$923,896	$1,138,000	$4,988,885	$6,431,000	
Disposal and Removal Cost:								
To Replace 25% of Proposed Facility		$41,647		$3,141		$9,864		
To Replace 50% of Proposed Facility		$83,294		$6,281		$19,728		
To Replace 100% of Proposed Facility	$38,000	$166,588	$6,000	$12,563	$9,000	$39,455	$53,000	
Total Replacement Cost:								
To Replace 25% of Proposed Facility		**$5,359,042**		**$234,115**		**$1,257,085**		
To Replace 50% of Proposed Facility		**$10,718,085**		**$468,229**		**$2,514,170**		
To Replace 100% of Proposed Facility	**$4,889,742**	**$21,436,169**	**$447,258**	**$936,459**	**$1,147,000**	**$5,028,340**	**$6,484,000**	

REPLACEMENT FUND SUMMARY:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE	
	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50
Annual Deposit Required (Assume Equal Deposit Made Each Year Through Life Cycle of Facility):						
To Replace 25% of Proposed Facility	$47,511	$47,511	$6,421	$13,445	$11,145	$11,145
To Replace 50% of Proposed Facility	$95,021	$95,021	$12,843	$26,889	$22,289	$22,289
To Replace 100% of Proposed Facility	$190,042	$190,042	$25,685	$53,779	$44,579	$44,579
Deposit Required at **Year 1** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$25,182		$4,607		$5,907	
To Replace 50% of Proposed Facility	$50,364		$9,214		$11,814	
To Replace 100% of Proposed Facility	$100,729		$18,427		$23,628	
Deposit Required at **Year 25** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$51,190		$9,365		$12,008	
To Replace 50% of Proposed Facility	$102,380		$18,729		$24,016	
To Replace 100% of Proposed Facility	$204,761		$37,458		$48,031	
Deposit Required at **Year 50** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$107,181		$19,607		$25,142	
To Replace 50% of Proposed Facility	$214,362		$39,215		$50,283	
To Replace 100% of Proposed Facility	$428,723		$78,429		$100,567	

OVERALL REPLACEMENT FUND SUMMARY:		
Component	**Probable % Replaced**	**Life Cycle Years**
Pipelines	25%	50
Well Supply/Pumping	100%	25
Storage	25%	50
Annual Deposit Required (Equal Deposit Each Year)		
Years 1-25		$84,340
Years 26-50		$112,434
Annual Deposit Required (Deposits Increase at Rate of Inflation)		
Year 1		$49,516
Year 25		$100,656
Year 50		$210,752

LIFE CYCLE COSTS:

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Capital Expenses:	**$6,431,000**													
Replacement Expenses:														
For 25% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$25,182	$25,938	$26,716	$27,517	$28,343	$29,193	$30,069	$30,971	$31,900	$32,857	$33,843	$34,858	$35,904
Interest		$0	$755	$1,556	$2,404	$3,302	$4,251	$5,255	$6,314	$7,433	$8,613	$9,857	$11,168	$12,549
End of Year Balance		**$25,182**	**$51,875**	**$80,147**	**$110,069**	**$141,714**	**$175,158**	**$210,482**	**$247,767**	**$287,100**	**$328,570**	**$372,270**	**$418,296**	**$466,749**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$50,364	$51,875	$53,432	$55,034	$56,686	$58,386	$60,138	$61,942	$63,800	$65,714	$67,685	$69,716	$71,808
Interest		$0	$1,511	$3,113	$4,809	$6,604	$8,503	$10,509	$12,629	$14,866	$17,226	$19,714	$22,336	$25,098
End of Year Balance		**$50,364**	**$103,751**	**$160,295**	**$220,138**	**$283,428**	**$350,316**	**$420,964**	**$495,534**	**$574,200**	**$657,140**	**$744,540**	**$836,592**	**$933,498**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$100,729	$103,751	$106,863	$110,069	$113,371	$116,772	$120,275	$123,884	$127,600	$131,428	$135,371	$139,432	$143,615
Interest		$0	$3,022	$6,225	$9,618	$13,208	$17,006	$21,019	$25,258	$29,732	$34,452	$39,428	$44,672	$50,196
End of Year Balance		**$100,729**	**$207,501**	**$320,589**	**$440,276**	**$566,855**	**$700,633**	**$841,927**	**$991,069**	**$1,148,401**	**$1,314,281**	**$1,489,080**	**$1,673,185**	**$1,866,995**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$4,607	$4,745	$4,887	$5,034	$5,185	$5,340	$5,501	$5,666	$5,836	$6,011	$6,191	$6,377	$6,568
Interest		$0	$138	$285	$440	$604	$778	$961	$1,155	$1,360	$1,576	$1,803	$2,043	$2,296
End of Year Balance		**$4,607**	**$9,490**	**$14,662**	**$20,136**	**$25,925**	**$32,043**	**$38,505**	**$45,326**	**$52,521**	**$60,108**	**$68,102**	**$76,522**	**$85,386**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$9,214	$9,490	$9,775	$10,068	$10,370	$10,681	$11,001	$11,331	$11,671	$12,022	$12,382	$12,754	$13,136
Interest		$0	$276	$569	$880	$1,208	$1,555	$1,923	$2,310	$2,720	$3,151	$3,606	$4,086	$4,591
End of Year Balance		**$9,214**	**$18,980**	**$29,324**	**$40,271**	**$51,849**	**$64,086**	**$77,010**	**$90,652**	**$105,043**	**$120,215**	**$136,204**	**$153,044**	**$170,771**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$18,427	$18,980	$19,549	$20,136	$20,740	$21,362	$22,003	$22,663	$23,343	$24,043	$24,764	$25,507	$26,273
Interest		$0	$553	$1,139	$1,759	$2,416	$3,111	$3,845	$4,621	$5,439	$6,303	$7,213	$8,172	$9,183
End of Year Balance		**$18,427**	**$37,960**	**$58,648**	**$80,543**	**$103,699**	**$128,172**	**$154,020**	**$181,303**	**$210,085**	**$240,431**	**$272,408**	**$306,088**	**$341,543**
Storage Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$5,907	$6,084	$6,267	$6,455	$6,648	$6,848	$7,053	$7,265	$7,483	$7,707	$7,939	$8,177	$8,422
Interest		$0	$177	$365	$564	$775	$997	$1,233	$1,481	$1,744	$2,020	$2,312	$2,620	$2,944
End of Year Balance		**$5,907**	**$12,169**	**$18,800**	**$25,819**	**$33,242**	**$41,087**	**$49,373**	**$58,119**	**$67,346**	**$77,074**	**$87,324**	**$98,121**	**$109,487**
Storage Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$11,814	$12,169	$12,534	$12,910	$13,297	$13,696	$14,107	$14,530	$14,966	$15,415	$15,877	$16,353	$16,844
Interest		$0	$354	$730	$1,128	$1,549	$1,995	$2,465	$2,962	$3,487	$4,041	$4,624	$5,239	$5,887
End of Year Balance		**$11,814**	**$24,337**	**$37,601**	**$51,638**	**$66,484**	**$82,175**	**$98,747**	**$116,239**	**$134,692**	**$154,147**	**$174,649**	**$196,242**	**$218,973**
Storage Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$23,628	$24,337	$25,067	$25,819	$26,594	$27,392	$28,213	$29,060	$29,931	$30,829	$31,754	$32,707	$33,688
Interest		$0	$709	$1,460	$2,256	$3,098	$3,989	$4,930	$5,925	$6,974	$8,082	$9,249	$10,479	$11,775
End of Year Balance		**$23,628**	**$48,674**	**$75,201**	**$103,277**	**$132,969**	**$164,349**	**$197,493**	**$232,478**	**$269,383**	**$308,294**	**$349,298**	**$392,483**	**$437,946**
Operations and Maintenance Expenses:														
Staff Salaries[4]		$15,000	$15,450	$15,914	$16,391	$16,883	$17,389	$17,911	$18,448	$19,002	$19,572	$20,159	$20,764	$21,386
Benefits[4]		$3,200	$3,296	$3,395	$3,497	$3,602	$3,710	$3,821	$3,936	$4,054	$4,175	$4,301	$4,430	$4,562
Transportation Costs[4]		$2,700	$2,781	$2,864	$2,950	$3,039	$3,130	$3,224	$3,321	$3,420	$3,523	$3,629	$3,737	$3,850
Utilities, Phones, Communications[4]		$1,230	$1,267	$1,305	$1,344	$1,384	$1,426	$1,469	$1,513	$1,558	$1,605	$1,653	$1,703	$1,754
Maintenance, Small Repairs, Supplies[4]		$5,370	$5,531	$5,697	$5,868	$6,044	$6,225	$6,412	$6,604	$6,803	$7,007	$7,217	$7,433	$7,656
Contracted Labor Costs[4]		$3,500	$3,605	$3,713	$3,825	$3,939	$4,057	$4,179	$4,305	$4,434	$4,567	$4,704	$4,845	$4,990
Total West Canal O&M Expenses		**$31,000**	**$31,930**	**$32,888**	**$33,875**	**$34,891**	**$35,937**	**$37,016**	**$38,126**	**$39,270**	**$40,448**	**$41,661**	**$42,911**	**$44,199**
Administration[5]		$26,500	$27,295	$28,114	$28,957	$29,826	$30,721	$31,642	$32,592	$33,569	$34,576	$35,614	$36,682	$37,783
Total West Canal O&M + Aministration Expenses		**$57,500**	**$59,225**	**$61,002**	**$62,832**	**$64,717**	**$66,658**	**$68,658**	**$70,718**	**$72,839**	**$75,024**	**$77,275**	**$79,593**	**$81,981**
Pumping Power Expense		**$24,006**	**$24,726**	**$25,468**	**$26,232**	**$27,019**	**$27,829**	**$28,664**	**$29,524**	**$30,410**	**$31,322**	**$32,262**	**$33,230**	**$34,226**
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**

Year	14	15	16	17	18	19	20	21	22	23	24	25
Capital Expenses:												
Replacement Expenses:												
For 25% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$234,115
For 50% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$468,229
For 100% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$936,459
For 25% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$36,981	$38,090	$39,233	$40,410	$41,622	$42,871	$44,157	$45,482	$46,846	$48,252	$49,699	$51,190
Interest	$14,002	$15,532	$17,141	$18,832	$20,609	$22,476	$24,436	$26,494	$28,654	$30,919	$33,294	$35,783
End of Year Balance	**$517,732**	**$571,354**	**$627,728**	**$686,970**	**$749,201**	**$814,548**	**$883,142**	**$955,118**	**$1,030,618**	**$1,109,788**	**$1,192,781**	**$1,279,754**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$73,962	$76,181	$78,466	$80,820	$83,245	$85,742	$88,314	$90,964	$93,693	$96,503	$99,398	$102,380
Interest	$28,005	$31,064	$34,281	$37,664	$41,218	$44,952	$48,873	$52,989	$57,307	$61,837	$66,587	$71,567
End of Year Balance	**$1,035,464**	**$1,142,709**	**$1,255,456**	**$1,373,940**	**$1,498,403**	**$1,629,097**	**$1,766,284**	**$1,910,236**	**$2,061,235**	**$2,219,576**	**$2,385,561**	**$2,559,508**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$147,923	$152,361	$156,932	$161,640	$166,489	$171,484	$176,628	$181,927	$187,385	$193,007	$198,797	$204,761
Interest	$14,002	$15,532	$17,141	$18,832	$20,609	$22,476	$24,436	$26,494	$28,654	$30,919	$33,294	$35,783
End of Year Balance	**$2,070,929**	**$2,285,418**	**$2,510,912**	**$2,747,879**	**$2,996,805**	**$3,258,193**	**$3,532,567**	**$3,820,471**	**$4,122,471**	**$4,439,151**	**$4,771,123**	**$5,119,017**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$6,765	$6,968	$7,177	$7,392	$7,614	$7,843	$8,078	$8,320	$8,570	$8,827	$9,092	$9,365
Interest	$2,562	$2,841	$3,136	$3,445	$3,770	$4,112	$4,470	$4,847	$5,242	$5,656	$6,091	$6,546
End of Year Balance	**$94,712**	**$104,522**	**$114,835**	**$125,672**	**$137,057**	**$149,011**	**$161,560**	**$174,727**	**$188,538**	**$203,022**	**$218,204**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$13,530	$13,936	$14,354	$14,785	$15,229	$15,685	$16,156	$16,641	$17,140	$17,654	$18,184	$18,729
Interest	$5,123	$5,683	$6,271	$6,890	$7,540	$8,223	$8,941	$9,694	$10,484	$11,312	$12,181	$13,092
End of Year Balance	**$189,425**	**$209,044**	**$229,670**	**$251,345**	**$274,114**	**$298,022**	**$323,119**	**$349,453**	**$377,077**	**$406,043**	**$436,408**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$27,061	$27,873	$28,709	$29,570	$30,457	$31,371	$32,312	$33,281	$34,280	$35,308	$36,367	$37,458
Interest	$10,246	$11,365	$12,543	$13,780	$15,081	$16,447	$17,881	$19,387	$20,967	$22,625	$24,363	$26,184
End of Year Balance	**$378,850**	**$418,088**	**$459,339**	**$502,690**	**$548,227**	**$596,045**	**$646,238**	**$698,907**	**$754,153**	**$812,086**	**$872,816**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$8,675	$8,935	$9,203	$9,479	$9,763	$10,056	$10,358	$10,669	$10,989	$11,319	$11,658	$12,008
Interest	$3,285	$3,643	$4,021	$4,417	$4,834	$5,272	$5,732	$6,215	$6,721	$7,253	$7,810	$8,394
End of Year Balance	**$121,446**	**$134,024**	**$147,248**	**$161,144**	**$175,742**	**$191,071**	**$207,161**	**$224,045**	**$241,755**	**$260,326**	**$279,794**	**$300,195**
Storage Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$17,349	$17,870	$18,406	$18,958	$19,527	$20,113	$20,716	$21,338	$21,978	$22,637	$23,316	$24,016
Interest	$6,569	$7,287	$8,041	$8,835	$9,669	$10,545	$11,464	$12,430	$13,443	$14,505	$15,620	$16,788
End of Year Balance	**$242,892**	**$268,048**	**$294,496**	**$322,289**	**$351,484**	**$382,142**	**$414,322**	**$448,089**	**$483,510**	**$520,652**	**$559,588**	**$600,391**
Storage Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$34,699	$35,740	$36,812	$37,916	$39,054	$40,225	$41,432	$42,675	$43,955	$45,274	$46,632	$48,031
Interest	$13,138	$14,573	$16,083	$17,670	$19,337	$21,089	$22,928	$24,859	$26,885	$29,011	$31,239	$33,575
End of Year Balance	**$485,783**	**$536,097**	**$588,991**	**$644,578**	**$702,969**	**$764,283**	**$828,644**	**$896,178**	**$967,019**	**$1,041,304**	**$1,119,175**	**$1,200,782**
Operations and Maintenance Expenses:												
Staff Salaries[4]	$22,028	$22,689	$23,370	$24,071	$24,793	$25,536	$26,303	$27,092	$27,904	$28,742	$29,604	$30,492
Benefits[4]	$4,699	$4,840	$4,985	$5,135	$5,289	$5,448	$5,611	$5,780	$5,953	$6,132	$6,315	$6,505
Transportation Costs[4]	$3,965	$4,084	$4,207	$4,333	$4,463	$4,597	$4,734	$4,877	$5,023	$5,173	$5,329	$5,489
Utilities, Phones, Communications[4]	$1,806	$1,860	$1,916	$1,974	$2,033	$2,094	$2,157	$2,222	$2,288	$2,357	$2,428	$2,500
Maintenance, Small Repairs, Supplies[4]	$7,886	$8,123	$8,366	$8,617	$8,876	$9,142	$9,416	$9,699	$9,990	$10,289	$10,598	$10,916
Contracted Labor Costs[4]	$5,140	$5,294	$5,453	$5,616	$5,785	$5,959	$6,137	$6,321	$6,511	$6,706	$6,908	$7,115
Total West Canal O&M Expenses	**$45,525**	**$46,890**	**$48,297**	**$49,746**	**$51,238**	**$52,775**	**$54,359**	**$55,989**	**$57,669**	**$59,399**	**$61,181**	**$63,017**
Administration[5]	$38,916	$40,084	$41,286	$42,525	$43,800	$45,114	$46,468	$47,862	$49,298	$50,777	$52,300	$53,869
Total West Canal O&M + Aministration Expenses	**$84,441**	**$86,974**	**$89,583**	**$92,271**	**$95,039**	**$97,890**	**$100,827**	**$103,851**	**$106,967**	**$110,176**	**$113,481**	**$116,886**
Pumping Power Expense	**$35,253**	**$36,311**	**$37,400**	**$38,522**	**$39,678**	**$40,868**	**$42,094**	**$43,357**	**$44,658**	**$45,997**	**$47,377**	**$48,799**
Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

NOTES:
1) Total Field Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2) Current Cost is equal to the Engineer's opinion of the probable total field cost for the project at beginning of project life. Total field costs have been separated into Pipeline and Ditch Lining costs for the life cycle cost analysis because the pipeline and ditch lining have different life cycles.
3) Future cost is value at end of life cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
4) Numbers are for West Canal O&M Only.
5) Adminstrative Costs for West Canal Only.

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis (Cont.)
Alternative 2 - West Canal - Groundwater Well Supply and Pressurized Delivery System

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

TOTAL REPLACEMENT COST SUMMARY: (ESTIMATED PRESENT VALUE OF REPLACEMENT COSTS THROUGH 50-YEAR LIFE OF OVERALL PROJECT)	**PIPE/ INFRA.**	**PUMPS**	**STORAGE**	**OVERALL PROJECT**
Probable % of Facility Replaced	25%	100%	25%	
Life Cycle of Facility	50	25	50	
Assumes Equal Deposit Made to Replacement Fund Each Year:				
Overall (Per Probable % of Facility Replaced)				**$2,403,702**
25% Replacement	$1,222,436	$223,629	$286,750	
50% Replacement	$2,444,871	$447,258	$573,500	
100% Replacement	$4,889,742	$894,516	$1,147,000	
Assumes Deposits to Replacement Fund Increase at Rate of Inflation:				
Overall (Per Probable % of Facility Replaced)				**$2,414,923**
25% Replacement	$1,222,436	$223,629	$297,972	
50% Replacement	$2,444,871	$447,258	$595,944	
100% Replacement	$4,889,742	$894,516	$1,191,887	

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,359,042
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,718,085
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$21,436,169
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$490,184
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$980,369
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,960,737
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,257,085
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,514,170
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,028,340
$52,726	$54,308	$55,937	$57,615	$59,343	$61,124	$62,957	$64,846	$66,792	$68,795	$70,859	$72,985	$75,174	$77,430	$79,753	$82,145	$84,610	$87,148	$89,762	$92,455	$95,229	$98,086	$101,028	$104,059	$107,181
$38,393	$41,126	$43,989	$46,987	$50,125	$53,409	$56,845	$60,439	$64,198	$68,127	$72,235	$76,528	$81,013	$85,699	$90,593	$95,703	$101,039	$106,608	$112,421	$118,486	$124,814	$131,416	$138,301	$145,481	$152,967
$1,370,873	**$1,466,307**	**$1,566,233**	**$1,670,835**	**$1,780,303**	**$1,894,836**	**$2,014,638**	**$2,139,924**	**$2,270,913**	**$2,407,836**	**$2,550,930**	**$2,700,443**	**$2,856,631**	**$3,019,759**	**$3,190,105**	**$3,367,953**	**$3,553,601**	**$3,747,357**	**$3,949,540**	**$4,160,481**	**$4,380,525**	**$4,610,026**	**$4,849,355**	**$5,098,895**	**$0**
$105,452	$108,615	$111,874	$115,230	$118,687	$122,247	$125,915	$129,692	$133,583	$137,591	$141,718	$145,970	$150,349	$154,859	$159,505	$164,290	$169,219	$174,296	$179,525	$184,910	$190,458	$196,171	$202,056	$208,118	$214,362
$76,785	$82,252	$87,978	$93,974	$100,250	$106,818	$113,690	$120,878	$128,395	$136,255	$144,470	$153,056	$162,027	$171,398	$181,186	$191,406	$202,077	$213,216	$224,841	$236,972	$249,629	$262,831	$276,602	$290,961	$305,934
$2,741,745	**$2,932,613**	**$3,132,465**	**$3,341,669**	**$3,560,606**	**$3,789,672**	**$4,029,277**	**$4,279,848**	**$4,541,826**	**$4,815,671**	**$5,101,860**	**$5,400,886**	**$5,713,261**	**$6,039,518**	**$6,380,209**	**$6,735,906**	**$7,107,202**	**$7,494,714**	**$7,899,080**	**$8,320,963**	**$8,761,049**	**$9,220,052**	**$9,698,710**	**$10,197,789**	**$0**
$210,903	$217,231	$223,748	$230,460	$237,374	$244,495	$251,830	$259,385	$267,166	$275,181	$283,437	$291,940	$300,698	$309,719	$319,010	$328,581	$338,438	$348,591	$359,049	$369,821	$380,915	$392,343	$404,113	$416,236	$428,723
$153,571	$164,505	$175,957	$187,948	$200,500	$213,636	$227,380	$241,757	$256,791	$272,510	$288,940	$306,112	$324,053	$342,796	$362,371	$382,813	$404,154	$426,432	$449,683	$473,945	$499,258	$525,663	$553,203	$581,923	$611,867
$5,483,491	**$5,865,226**	**$6,264,931**	**$6,683,338**	**$7,121,212**	**$7,579,344**	**$8,058,554**	**$8,559,695**	**$9,083,652**	**$9,631,343**	**$10,203,720**	**$10,801,771**	**$11,426,522**	**$12,079,037**	**$12,760,419**	**$13,471,812**	**$14,214,404**	**$14,989,428**	**$15,798,160**	**$16,641,925**	**$17,522,098**	**$18,440,104**	**$19,397,420**	**$20,395,579**	**$0**
$9,646	$9,935	$10,233	$10,540	$10,856	$11,182	$11,517	$11,863	$12,219	$12,585	$12,963	$13,352	$13,752	$14,165	$14,590	$15,027	$15,478	$15,943	$16,421	$16,913	$17,421	$17,944	$18,482	$19,036	$19,607
$0	$289	$596	$921	$1,265	$1,628	$2,013	$2,419	$2,847	$3,299	$3,776	$4,278	$4,807	$5,363	$5,949	$6,565	$7,213	$7,894	$8,609	$9,360	$10,148	$10,975	$11,843	$12,752	$13,706
$9,646	**$19,870**	**$30,699**	**$42,160**	**$54,281**	**$67,091**	**$80,621**	**$94,902**	**$109,968**	**$125,852**	**$142,591**	**$160,220**	**$178,779**	**$198,307**	**$218,846**	**$240,439**	**$263,130**	**$286,967**	**$311,996**	**$338,270**	**$365,839**	**$394,757**	**$425,082**	**$456,871**	**$0**
$19,291	$19,870	$20,466	$21,080	$21,712	$22,364	$23,035	$23,726	$24,437	$25,170	$25,926	$26,703	$27,504	$28,330	$29,179	$30,055	$30,956	$31,885	$32,842	$33,827	$34,842	$35,887	$36,964	$38,073	$39,215
$0	$579	$1,192	$1,842	$2,530	$3,257	$4,025	$4,837	$5,694	$6,598	$7,551	$8,555	$9,613	$10,727	$11,898	$13,131	$14,426	$15,788	$17,218	$18,720	$20,296	$21,950	$23,685	$25,505	$27,412
$19,291	**$39,740**	**$61,398**	**$84,319**	**$108,561**	**$134,182**	**$161,242**	**$189,805**	**$219,936**	**$251,704**	**$285,181**	**$320,440**	**$357,558**	**$396,614**	**$437,692**	**$480,877**	**$526,260**	**$573,933**	**$623,993**	**$676,540**	**$731,678**	**$789,515**	**$850,164**	**$913,742**	**$0**
$38,582	$39,740	$40,932	$42,160	$43,425	$44,727	$46,069	$47,451	$48,875	$50,341	$51,851	$53,407	$55,009	$56,659	$58,359	$60,110	$61,913	$63,770	$65,683	$67,654	$69,684	$71,774	$73,927	$76,145	$78,429
$0	$1,157	$2,384	$3,684	$5,059	$6,514	$8,051	$9,675	$11,388	$13,196	$15,102	$17,111	$19,226	$21,453	$23,797	$26,262	$28,853	$31,576	$34,436	$37,440	$40,592	$43,901	$47,371	$51,010	$54,824
$38,582	**$79,479**	**$122,795**	**$168,639**	**$217,123**	**$268,363**	**$322,483**	**$379,609**	**$439,872**	**$503,409**	**$570,362**	**$640,880**	**$715,115**	**$793,228**	**$875,383**	**$961,755**	**$1,052,520**	**$1,147,866**	**$1,247,986**	**$1,353,079**	**$1,463,355**	**$1,579,030**	**$1,700,328**	**$1,827,483**	**$0**
$12,368	$12,739	$13,121	$13,515	$13,920	$14,338	$14,768	$15,211	$15,667	$16,138	$16,622	$17,120	$17,634	$18,163	$18,708	$19,269	$19,847	$20,443	$21,056	$21,687	$22,338	$23,008	$23,698	$24,409	$25,142
$9,006	$9,647	$10,319	$11,022	$11,758	$12,528	$13,334	$14,177	$15,059	$15,981	$16,944	$17,951	$19,004	$20,103	$21,251	$22,449	$23,701	$25,007	$26,371	$27,794	$29,278	$30,827	$32,442	$34,126	$35,882
$321,569	**$343,955**	**$367,395**	**$391,932**	**$417,611**	**$444,477**	**$472,579**	**$501,968**	**$532,694**	**$564,813**	**$598,379**	**$633,450**	**$670,088**	**$708,353**	**$748,311**	**$790,030**	**$833,578**	**$879,028**	**$926,454**	**$975,935**	**$1,027,551**	**$1,081,386**	**$1,137,526**	**$1,196,062**	**$0**
$24,736	$25,478	$26,243	$27,030	$27,841	$28,676	$29,536	$30,422	$31,335	$32,275	$33,243	$34,241	$35,268	$36,326	$37,416	$38,538	$39,694	$40,885	$42,112	$43,375	$44,676	$46,016	$47,397	$48,819	$50,283
$18,012	$19,294	$20,637	$22,044	$23,516	$25,057	$26,669	$28,355	$30,118	$31,962	$33,889	$35,903	$38,007	$40,205	$42,501	$44,899	$47,402	$50,015	$52,742	$55,587	$58,556	$61,653	$64,883	$68,252	$71,764
$643,139	**$687,911**	**$734,791**	**$783,864**	**$835,221**	**$888,954**	**$945,158**	**$1,003,935**	**$1,065,388**	**$1,129,625**	**$1,196,757**	**$1,266,900**	**$1,340,175**	**$1,416,706**	**$1,496,623**	**$1,580,060**	**$1,667,156**	**$1,758,055**	**$1,852,909**	**$1,951,871**	**$2,055,103**	**$2,162,772**	**$2,275,053**	**$2,392,123**	**$0**
$49,472	$50,956	$52,485	$54,060	$55,681	$57,352	$59,072	$60,845	$62,670	$64,550	$66,487	$68,481	$70,536	$72,652	$74,831	$77,076	$79,388	$81,770	$84,223	$86,750	$89,352	$92,033	$94,794	$97,638	$100,567
$36,023	$38,588	$41,275	$44,087	$47,032	$50,113	$53,337	$56,710	$60,236	$63,923	$67,778	$71,805	$76,014	$80,411	$85,002	$89,797	$94,804	$100,029	$105,483	$111,175	$117,112	$123,306	$129,766	$136,503	$143,527
$1,286,277	**$1,375,822**	**$1,469,582**	**$1,567,729**	**$1,670,442**	**$1,777,907**	**$1,890,317**	**$2,007,871**	**$2,130,777**	**$2,259,250**	**$2,393,514**	**$2,533,801**	**$2,680,350**	**$2,833,412**	**$2,993,246**	**$3,160,119**	**$3,334,311**	**$3,516,111**	**$3,705,817**	**$3,903,741**	**$4,110,206**	**$4,325,545**	**$4,550,105**	**$4,784,246**	**$0**
$31,407	$32,349	$33,319	$34,319	$35,348	$36,409	$37,501	$38,626	$39,785	$40,979	$42,208	$43,474	$44,778	$46,122	$47,505	$48,931	$50,398	$51,910	$53,468	$55,072	$56,724	$58,426	$60,178	$61,984	$63,843
$6,700	$6,901	$7,108	$7,321	$7,541	$7,767	$8,000	$8,240	$8,487	$8,742	$9,004	$9,274	$9,553	$9,839	$10,134	$10,439	$10,752	$11,074	$11,406	$11,749	$12,101	$12,464	$12,838	$13,223	$13,620
$5,653	$5,823	$5,997	$6,177	$6,363	$6,554	$6,750	$6,953	$7,161	$7,376	$7,597	$7,825	$8,060	$8,302	$8,551	$8,808	$9,072	$9,344	$9,624	$9,913	$10,210	$10,517	$10,832	$11,157	$11,492
$2,575	$2,653	$2,732	$2,814	$2,899	$2,986	$3,075	$3,167	$3,262	$3,360	$3,461	$3,565	$3,672	$3,782	$3,895	$4,012	$4,133	$4,257	$4,384	$4,516	$4,651	$4,791	$4,935	$5,083	$5,235
$11,244	$11,581	$11,928	$12,286	$12,655	$13,034	$13,425	$13,828	$14,243	$14,670	$15,110	$15,564	$16,031	$16,512	$17,007	$17,517	$18,043	$18,584	$19,141	$19,716	$20,307	$20,916	$21,544	$22,190	$22,856
$7,328	$7,548	$7,775	$8,008	$8,248	$8,495	$8,750	$9,013	$9,283	$9,562	$9,849	$10,144	$10,448	$10,762	$11,085	$11,417	$11,760	$12,112	$12,476	$12,850	$13,236	$13,633	$14,042	$14,463	$14,897
$64,907	**$66,854**	**$68,860**	**$70,926**	**$73,054**	**$75,245**	**$77,502**	**$79,828**	**$82,222**	**$84,689**	**$87,230**	**$89,847**	**$92,542**	**$95,318**	**$98,178**	**$101,123**	**$104,157**	**$107,282**	**$110,500**	**$113,815**	**$117,229**	**$120,746**	**$124,369**	**$128,100**	**$131,943**
$55,485	$57,150	$58,864	$60,630	$62,449	$64,322	$66,252	$68,240	$70,287	$72,395	$74,567	$76,804	$79,109	$81,482	$83,926	$86,444	$89,037	$91,708	$94,460	$97,293	$100,212	$103,219	$106,315	$109,505	$112,790
$120,392	**$124,004**	**$127,724**	**$131,556**	**$135,503**	**$139,568**	**$143,755**	**$148,067**	**$152,509**	**$157,085**	**$161,797**	**$166,651**	**$171,651**	**$176,800**	**$182,104**	**$187,567**	**$193,194**	**$198,990**	**$204,960**	**$211,109**	**$217,442**	**$223,965**	**$230,684**	**$237,604**	**$244,733**
$50,263	**$51,771**	**$53,324**	**$54,923**	**$56,571**	**$58,268**	**$60,016**	**$61,817**	**$63,671**	**$65,581**	**$67,549**	**$69,575**	**$71,663**	**$73,812**	**$76,027**	**$78,308**	**$80,657**	**$83,077**	**$85,569**	**$88,136**	**$90,780**	**$93,503**	**$96,308**	**$99,198**	**$102,174**
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis
Alternative 3 - West Canal - Groundwater Well Supply and Two Pressurized Delivery Systems

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

ASSUMPTIONS:	PIPE/INFRASTRUCTURE	PUMPS/ELEC	STORAGE	OVERALL PROJECT
Estimated Capital Cost (Total Field Cost[1]):	$4,265,286	$555,714	$1,204,000	$6,025,000
Interest on Replacement Fund:				3.00%
Rate of Inflation:				3.00%
Life Cycle:	50 Years	25 Years	50 Years	50 Years

SUMMARY OF REPLACEMENT COSTS:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE		OVERALL PROJECT	
	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]
Estimated Project Replacement Cost:								
To Replace 25% of Proposed Facility		$4,674,653		$290,885		$1,319,556		
To Replace 50% of Proposed Facility		$9,349,306		$581,771		$2,639,111		
To Replace 100% of Proposed Facility	$4,265,286	$18,698,613	$555,714	$1,163,542	$1,204,000	$5,278,223	$6,025,000	
Disposal and Removal Cost:								
To Replace 25% of Proposed Facility		$26,303		$7,328		$10,412		
To Replace 50% of Proposed Facility		$52,607		$14,656		$20,824		
To Replace 100% of Proposed Facility	$24,000	$105,214	$14,000	$29,313	$9,500	$41,647	$47,500	
Total Replacement Cost:								
To Replace 25% of Proposed Facility		**$4,700,957**		**$298,214**		**$1,329,967**		
To Replace 50% of Proposed Facility		**$9,401,913**		**$596,427**		**$2,659,935**		
To Replace 100% of Proposed Facility	**$4,289,286**	**$18,803,827**	**$569,714**	**$1,192,855**	**$1,213,500**	**$5,319,870**	**$6,072,500**	

REPLACEMENT FUND SUMMARY:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE	
	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50
Annual Deposit Required (Assume Equal Deposit Made Each Year Through Life Cycle of Facility):						
To Replace 25% of Proposed Facility	$41,676	$41,676	$8,179	$17,126	$11,791	$11,791
To Replace 50% of Proposed Facility	$83,353	$83,353	$16,359	$34,252	$23,582	$23,582
To Replace 100% of Proposed Facility	$166,705	$166,705	$32,717	$68,503	$47,163	$47,163
Deposit Required at **Year 1** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$22,090		$5,868		$6,250	
To Replace 50% of Proposed Facility	$44,180		$11,736		$12,499	
To Replace 100% of Proposed Facility	$88,359		$23,472		$24,998	
Deposit Required at **Year 25** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$44,904		$11,929		$12,704	
To Replace 50% of Proposed Facility	$89,808		$23,857		$25,408	
To Replace 100% of Proposed Facility	$179,616		$47,714		$50,816	
Deposit Required at **Year 50** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$94,019		$24,976		$26,599	
To Replace 50% of Proposed Facility	$188,038		$49,951		$53,199	
To Replace 100% of Proposed Facility	$376,077		$99,903		$106,397	

OVERALL REPLACEMENT FUND SUMMARY:		
Component	**Probable % Replaced**	**Life Cycle Years**
Pipelines	25%	50
Well Supply/Pumping	100%	25
Storage	25%	50
Annual Deposit Required (Equal Deposit Each Year)		
Years 1-25		$86,185
Years 26-50		$121,970
Annual Deposit Required (Deposits Increase at Rate of Inflation)		
Year 1		$51,812
Year 25		$105,322
Year 50		$220,521

LIFE CYCLE COSTS:

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Capital Expenses:	**$6,025,000**																									
Replacement Expenses:																										
For 25% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$298,214
For 50% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$596,427
For 100% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,192,855
For 25% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$22,090	$22,753	$23,435	$24,138	$24,862	$25,608	$26,376	$27,168	$27,983	$28,822	$29,687	$30,577	$31,495	$32,440	$33,413	$34,415	$35,448	$36,511	$37,606	$38,735	$39,897	$41,094	$42,326	$43,596	$44,904
Interest		$0	$663	$1,365	$2,109	$2,897	$3,729	$4,609	$5,539	$6,520	$7,555	$8,647	$9,797	$11,008	$12,283	$13,625	$15,036	$16,519	$18,078	$19,716	$21,436	$23,241	$25,135	$27,122	$29,205	$31,389
End of Year Balance		**$22,090**	**$45,505**	**$70,305**	**$96,553**	**$124,311**	**$153,649**	**$184,635**	**$217,342**	**$251,845**	**$288,222**	**$326,556**	**$366,930**	**$409,432**	**$454,155**	**$501,193**	**$550,644**	**$602,611**	**$657,200**	**$714,522**	**$774,693**	**$837,830**	**$904,059**	**$973,507**	**$1,046,308**	**$1,122,602**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$44,180	$45,505	$46,870	$48,276	$49,725	$51,216	$52,753	$54,335	$55,965	$57,644	$59,374	$61,155	$62,990	$64,879	$66,826	$68,830	$70,895	$73,022	$75,213	$77,469	$79,793	$82,187	$84,653	$87,192	$89,808
Interest		$0	$1,325	$2,730	$4,218	$5,793	$7,459	$9,219	$11,078	$13,040	$15,111	$17,293	$19,593	$22,016	$24,566	$27,249	$30,072	$33,039	$36,157	$39,432	$42,871	$46,482	$50,270	$54,244	$58,410	$62,778
End of Year Balance		**$44,180**	**$91,010**	**$140,611**	**$193,105**	**$248,623**	**$307,298**	**$369,270**	**$434,683**	**$503,689**	**$576,444**	**$653,111**	**$733,860**	**$818,865**	**$908,310**	**$1,002,385**	**$1,101,287**	**$1,205,221**	**$1,314,400**	**$1,429,045**	**$1,549,386**	**$1,675,660**	**$1,808,117**	**$1,947,014**	**$2,092,616**	**$2,245,203**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$88,359	$91,010	$93,740	$96,553	$99,449	$102,433	$105,506	$108,671	$111,931	$115,289	$118,747	$122,310	$125,979	$129,759	$133,651	$137,661	$141,791	$146,044	$150,426	$154,939	$159,587	$164,374	$169,306	$174,385	$179,616
Interest		$0	$2,651	$5,461	$8,437	$11,586	$14,917	$18,438	$22,156	$26,081	$30,221	$34,587	$39,187	$44,032	$49,132	$54,499	$60,143	$66,077	$72,313	$78,864	$85,743	$92,963	$100,540	$108,487	$116,821	$125,557
End of Year Balance		**$88,359**	**$182,020**	**$281,221**	**$386,210**	**$497,246**	**$614,596**	**$738,539**	**$869,366**	**$1,007,378**	**$1,152,888**	**$1,306,222**	**$1,467,719**	**$1,637,730**	**$1,816,620**	**$2,004,770**	**$2,202,574**	**$2,410,442**	**$2,628,800**	**$2,858,090**	**$3,098,771**	**$3,351,321**	**$3,616,235**	**$3,894,027**	**$4,185,233**	**$4,490,406**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$5,868	$6,044	$6,225	$6,412	$6,605	$6,803	$7,007	$7,217	$7,433	$7,656	$7,886	$8,123	$8,366	$8,617	$8,876	$9,142	$9,417	$9,699	$9,990	$10,290	$10,598	$10,916	$11,244	$11,581	$11,929
Interest		$0	$176	$363	$560	$769	$991	$1,224	$1,471	$1,732	$2,007	$2,297	$2,602	$2,924	$3,263	$3,619	$3,994	$4,388	$4,802	$5,237	$5,694	$6,174	$6,677	$7,205	$7,758	$8,338
End of Year Balance		**$5,868**	**$12,088**	**$18,676**	**$25,649**	**$33,023**	**$40,816**	**$49,047**	**$57,736**	**$66,901**	**$76,565**	**$86,748**	**$97,473**	**$108,764**	**$120,644**	**$133,139**	**$146,276**	**$160,081**	**$174,582**	**$189,809**	**$205,793**	**$222,566**	**$240,159**	**$258,607**	**$277,947**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$11,736	$12,088	$12,451	$12,824	$13,209	$13,605	$14,014	$14,434	$14,867	$15,313	$15,772	$16,246	$16,733	$17,235	$17,752	$18,284	$18,833	$19,398	$19,980	$20,579	$21,197	$21,833	$22,488	$23,162	$23,857
Interest		$0	$352	$725	$1,121	$1,539	$1,981	$2,449	$2,943	$3,464	$4,014	$4,594	$5,205	$5,848	$6,526	$7,239	$7,988	$8,777	$9,605	$10,475	$11,389	$12,348	$13,354	$14,410	$15,516	$16,677
End of Year Balance		**$11,736**	**$24,176**	**$37,353**	**$51,297**	**$66,045**	**$81,632**	**$98,095**	**$115,471**	**$133,803**	**$153,130**	**$173,496**	**$194,946**	**$217,527**	**$241,288**	**$266,279**	**$292,552**	**$320,161**	**$349,164**	**$379,619**	**$411,587**	**$445,131**	**$480,318**	**$517,215**	**$555,893**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$23,472	$24,176	$24,902	$25,649	$26,418	$27,211	$28,027	$28,868	$29,734	$30,626	$31,545	$32,491	$33,466	$34,470	$35,504	$36,569	$37,666	$38,796	$39,960	$41,159	$42,393	$43,665	$44,975	$46,324	$47,714
Interest		$0	$704	$1,451	$2,241	$3,078	$3,963	$4,898	$5,886	$6,928	$8,028	$9,188	$10,410	$11,697	$13,052	$14,477	$15,977	$17,553	$19,210	$20,950	$22,777	$24,695	$26,708	$28,819	$31,033	$33,354
End of Year Balance		**$23,472**	**$48,353**	**$74,705**	**$102,595**	**$132,091**	**$163,264**	**$196,189**	**$230,943**	**$267,605**	**$306,259**	**$346,992**	**$389,892**	**$435,055**	**$482,576**	**$532,558**	**$585,103**	**$640,322**	**$698,328**	**$759,238**	**$823,173**	**$890,262**	**$960,635**	**$1,034,429**	**$1,111,787**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$6,250	$6,437	$6,630	$6,829	$7,034	$7,245	$7,462	$7,686	$7,917	$8,154	$8,399	$8,651	$8,910	$9,178	$9,453	$9,737	$10,029	$10,330	$10,639	$10,959	$11,287	$11,626	$11,975	$12,334	$12,704
Interest		$0	$187	$386	$597	$819	$1,055	$1,304	$1,567	$1,845	$2,138	$2,446	$2,772	$3,114	$3,475	$3,855	$4,254	$4,674	$5,115	$5,578	$6,064	$6,575	$7,111	$7,673	$8,263	$8,880
End of Year Balance		**$6,250**	**$12,874**	**$19,890**	**$27,316**	**$35,169**	**$43,469**	**$52,236**	**$61,489**	**$71,250**	**$81,542**	**$92,387**	**$103,810**	**$115,834**	**$128,487**	**$141,795**	**$155,785**	**$170,487**	**$185,931**	**$202,149**	**$219,172**	**$237,034**	**$255,771**	**$275,419**	**$296,015**	**$317,600**
Storage Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$12,499	$12,874	$13,260	$13,658	$14,068	$14,490	$14,925	$15,372	$15,833	$16,308	$16,798	$17,302	$17,821	$18,355	$18,906	$19,473	$20,057	$20,659	$21,279	$21,917	$22,575	$23,252	$23,949	$24,668	$25,408
Interest		$0	$375	$772	$1,193	$1,639	$2,110	$2,608	$3,134	$3,689	$4,275	$4,893	$5,543	$6,229	$6,950	$7,709	$8,508	$9,347	$10,229	$11,156	$12,129	$13,150	$14,222	$15,346	$16,525	$17,761
End of Year Balance		**$12,499**	**$25,748**	**$39,781**	**$54,632**	**$70,339**	**$86,939**	**$104,472**	**$122,978**	**$142,501**	**$163,084**	**$184,774**	**$207,619**	**$231,669**	**$256,974**	**$283,589**	**$311,570**	**$340,974**	**$371,862**	**$404,297**	**$438,343**	**$474,068**	**$511,542**	**$550,838**	**$592,031**	**$635,200**
Storage Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$24,998	$25,748	$26,520	$27,316	$28,136	$28,980	$29,849	$30,745	$31,667	$32,617	$33,595	$34,603	$35,641	$36,711	$37,812	$38,946	$40,115	$41,318	$42,558	$43,834	$45,149	$46,504	$47,899	$49,336	$50,816
Interest		$0	$750	$1,545	$2,387	$3,278	$4,220	$5,216	$6,268	$7,379	$8,550	$9,785	$11,086	$12,457	$13,900	$15,418	$17,015	$18,694	$20,458	$22,312	$24,258	$26,301	$28,444	$30,693	$33,050	$35,522
End of Year Balance		**$24,998**	**$51,496**	**$79,561**	**$109,264**	**$140,678**	**$173,878**	**$208,943**	**$245,956**	**$285,002**	**$326,169**	**$369,549**	**$415,239**	**$463,337**	**$513,948**	**$567,178**	**$623,140**	**$681,948**	**$743,725**	**$808,594**	**$876,686**	**$948,136**	**$1,023,084**	**$1,101,676**	**$1,184,062**	**$1,270,400**
Operations and Maintenance Expenses:																										
Staff Salaries[4]		$15,000	$15,450	$15,914	$16,391	$16,883	$17,389	$17,911	$18,448	$19,002	$19,572	$20,159	$20,764	$21,386	$22,028	$22,689	$23,370	$24,071	$24,793	$25,536	$26,303	$27,092	$27,904	$28,742	$29,604	$30,492
Benefits[4]		$3,200	$3,296	$3,395	$3,497	$3,602	$3,710	$3,821	$3,936	$4,054	$4,175	$4,301	$4,430	$4,562	$4,699	$4,840	$4,985	$5,135	$5,289	$5,448	$5,611	$5,780	$5,953	$6,132	$6,315	$6,505
Transportation Costs[4]		$2,700	$2,781	$2,864	$2,950	$3,039	$3,130	$3,224	$3,321	$3,420	$3,523	$3,629	$3,737	$3,850	$3,965	$4,084	$4,207	$4,333	$4,463	$4,597	$4,734	$4,877	$5,023	$5,173	$5,329	$5,489
Utilities, Phones, Communications[4]		$1,230	$1,267	$1,305	$1,344	$1,384	$1,426	$1,469	$1,513	$1,558	$1,605	$1,653	$1,703	$1,754	$1,806	$1,860	$1,916	$1,974	$2,033	$2,094	$2,157	$2,222	$2,288	$2,357	$2,428	$2,500
Maintenance, Small Repairs, Supplies[4]		$5,670	$5,840	$6,015	$6,196	$6,382	$6,573	$6,770	$6,973	$7,183	$7,398	$7,620	$7,849	$8,084	$8,327	$8,576	$8,834	$9,099	$9,372	$9,653	$9,942	$10,241	$10,548	$10,864	$11,190	$11,526
Contracted Labor Costs[4]		$3,700	$3,811	$3,925	$4,043	$4,164	$4,289	$4,418	$4,551	$4,687	$4,828	$4,972	$5,122	$5,275	$5,434	$5,597	$5,764	$5,937	$6,116	$6,299	$6,488	$6,683	$6,883	$7,090	$7,302	$7,521
Total West Canal O&M Expenses		**$31,500**	**$32,445**	**$33,418**	**$34,421**	**$35,454**	**$36,517**	**$37,613**	**$38,741**	**$39,903**	**$41,100**	**$42,333**	**$43,603**	**$44,911**	**$46,259**	**$47,647**	**$49,076**	**$50,548**	**$52,065**	**$53,627**	**$55,235**	**$56,893**	**$58,599**	**$60,357**	**$62,168**	**$64,033**
Administration[5]		$26,500	$27,295	$28,114	$28,957	$29,826	$30,721	$31,642	$32,592	$33,569	$34,576	$35,614	$36,682	$37,783	$38,916	$40,084	$41,286	$42,525	$43,800	$45,114	$46,468	$47,862	$49,298	$50,777	$52,300	$53,869
Total West Canal O&M + Aministration Expenses		**$58,000**	**$59,740**	**$61,532**	**$63,378**	**$65,280**	**$67,238**	**$69,255**	**$71,333**	**$73,473**	**$75,677**	**$77,947**	**$80,286**	**$82,694**	**$85,175**	**$87,730**	**$90,362**	**$93,073**	**$95,865**	**$98,741**	**$101,703**	**$104,754**	**$107,897**	**$111,134**	**$114,468**	**$117,902**
Pumping Power Expense		**$24,721**	**$25,462**	**$26,226**	**$27,013**	**$27,823**	**$28,658**	**$29,518**	**$30,403**	**$31,316**	**$32,255**	**$33,223**	**$34,219**	**$35,246**	**$36,303**	**$37,392**	**$38,514**	**$39,670**	**$40,860**	**$42,085**	**$43,348**	**$44,648**	**$45,988**	**$47,368**	**$48,789**	**$50,252**
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

NOTES:
1) Total Field Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2) Current Cost is equal to the Engineer's opinion of the probable total field cost for the project at beginning of project life. Total field costs have been separated into Pipeline and Ditch Lining costs for the life cycle cost analysis because the pipeline and ditch lining have different life cycles.
3) Future cost is value at end of life cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
4) Numbers are for West Canal O&M Only.
5) Adminstrative Costs for West Canal Only.

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis (Cont.)
Alternative 3 - West Canal - Groundwater Well Supply and Two Pressurized Delivery Systems

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

TOTAL REPLACEMENT COST SUMMARY: (ESTIMATED PRESENT VALUE OF REPLACEMENT COSTS THROUGH 50-YEAR LIFE OF OVERALL PROJECT)	**PIPE/ INFRA.**	**PUMPS**	**STORAGE**	**OVERALL PROJECT**
Probable % of Facility Replaced	25%	100%	25%	
Life Cycle of Facility	50	25	50	
Assumes Equal Deposit Made to Replacement Fund Each Year:				
Overall (Per Probable % of Facility Replaced)				**$2,515,125**
25% Replacement	$1,072,322	$284,857	$303,375	
50% Replacement	$2,144,643	$569,714	$606,750	
100% Replacement	$4,289,286	$1,139,428	$1,213,500	
Assumes Deposits to Replacement Fund Increase at Rate of Inflation:				
Overall (Per Probable % of Facility Replaced)				**$2,526,997**
25% Replacement	$1,072,322	$284,857	$315,247	
50% Replacement	$2,144,643	$569,714	$630,495	
100% Replacement	$4,289,286	$1,139,428	$1,260,990	

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,700,957
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$9,401,913
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$18,803,827
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$624,393
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,248,786
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,497,573
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,329,967
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,659,935
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,319,870
$46,251	$47,639	$49,068	$50,540	$52,056	$53,618	$55,226	$56,883	$58,590	$60,347	$62,158	$64,022	$65,943	$67,921	$69,959	$72,058	$74,220	$76,446	$78,740	$81,102	$83,535	$86,041	$88,622	$91,281	$94,019
$33,678	$36,076	$38,587	$41,217	$43,970	$46,851	$49,865	$53,017	$56,314	$59,761	$63,365	$67,130	$71,065	$75,175	$79,468	$83,951	$88,631	$93,517	$98,616	$103,936	$109,487	$115,278	$121,318	$127,616	$134,183
$1,202,531	**$1,286,245**	**$1,373,901**	**$1,465,658**	**$1,561,683**	**$1,662,152**	**$1,767,243**	**$1,877,143**	**$1,992,047**	**$2,112,156**	**$2,237,678**	**$2,368,831**	**$2,505,839**	**$2,648,935**	**$2,798,363**	**$2,954,371**	**$3,117,222**	**$3,287,185**	**$3,464,540**	**$3,649,578**	**$3,842,600**	**$4,043,919**	**$4,253,858**	**$4,472,755**	**$0**
$92,502	$95,277	$98,136	$101,080	$104,112	$107,236	$110,453	$113,766	$117,179	$120,695	$124,315	$128,045	$131,886	$135,843	$139,918	$144,116	$148,439	$152,892	$157,479	$162,203	$167,070	$172,082	$177,244	$182,561	$188,038
$67,356	$72,152	$77,175	$82,434	$87,939	$93,701	$99,729	$106,035	$112,629	$119,523	$126,729	$134,261	$142,130	$150,350	$158,936	$167,902	$177,262	$187,033	$197,231	$207,872	$218,975	$230,556	$242,635	$255,232	$268,365
$2,405,062	**$2,572,491**	**$2,747,801**	**$2,931,315**	**$3,123,367**	**$3,324,303**	**$3,534,485**	**$3,754,286**	**$3,984,094**	**$4,224,311**	**$4,475,356**	**$4,737,662**	**$5,011,678**	**$5,297,871**	**$5,596,725**	**$5,908,743**	**$6,234,444**	**$6,574,370**	**$6,929,080**	**$7,299,156**	**$7,685,200**	**$8,087,838**	**$8,507,717**	**$8,945,510**	**$0**
$185,005	$190,555	$196,272	$202,160	$208,224	$214,471	$220,905	$227,532	$234,358	$241,389	$248,631	$256,090	$263,773	$271,686	$279,836	$288,231	$296,878	$305,785	$314,958	$324,407	$334,139	$344,163	$354,488	$365,123	$376,077
$134,712	$144,304	$154,349	$164,868	$175,879	$187,402	$199,458	$212,069	$225,257	$239,046	$253,459	$268,521	$284,260	$300,701	$317,872	$335,804	$354,525	$374,067	$394,462	$415,745	$437,949	$461,112	$485,270	$510,463	$536,731
$4,810,123	**$5,144,982**	**$5,495,603**	**$5,862,630**	**$6,246,734**	**$6,648,607**	**$7,068,971**	**$7,508,572**	**$7,968,188**	**$8,448,623**	**$8,950,712**	**$9,475,323**	**$10,023,356**	**$10,595,742**	**$11,193,450**	**$11,817,485**	**$12,468,888**	**$13,148,739**	**$13,858,160**	**$14,598,311**	**$15,370,400**	**$16,175,675**	**$17,015,434**	**$17,891,020**	**$0**
$12,286	$12,655	$13,035	$13,426	$13,828	$14,243	$14,671	$15,111	$15,564	$16,031	$16,512	$17,007	$17,517	$18,043	$18,584	$19,142	$19,716	$20,308	$20,917	$21,544	$22,191	$22,856	$23,542	$24,248	$24,976
$0	$369	$759	$1,173	$1,611	$2,074	$2,564	$3,081	$3,627	$4,202	$4,809	$5,449	$6,123	$6,832	$7,578	$8,363	$9,188	$10,055	$10,966	$11,923	$12,927	$13,980	$15,085	$16,244	$17,459
$12,286	**$25,310**	**$39,104**	**$53,703**	**$69,142**	**$85,460**	**$102,694**	**$120,886**	**$140,076**	**$160,310**	**$181,631**	**$204,087**	**$227,727**	**$252,602**	**$278,764**	**$306,269**	**$335,173**	**$365,536**	**$397,419**	**$430,886**	**$466,003**	**$502,839**	**$541,466**	**$581,959**	**$0**
$24,573	$25,310	$26,069	$26,851	$27,657	$28,487	$29,341	$30,221	$31,128	$32,062	$33,024	$34,015	$35,035	$36,086	$37,169	$38,284	$39,432	$40,615	$41,834	$43,089	$44,381	$45,713	$47,084	$48,497	$49,951
$0	$737	$1,519	$2,346	$3,222	$4,149	$5,128	$6,162	$7,253	$8,405	$9,619	$10,898	$12,245	$13,664	$15,156	$16,726	$18,376	$20,110	$21,932	$23,845	$25,853	$27,960	$30,170	$32,488	$34,918
$24,573	**$50,620**	**$78,208**	**$107,405**	**$138,285**	**$170,920**	**$205,388**	**$241,772**	**$280,153**	**$320,619**	**$363,262**	**$408,174**	**$455,454**	**$505,204**	**$557,529**	**$612,538**	**$670,346**	**$731,072**	**$794,838**	**$861,771**	**$932,006**	**$1,005,678**	**$1,082,933**	**$1,163,917**	**$0**
$49,146	$50,620	$52,139	$53,703	$55,314	$56,973	$58,682	$60,443	$62,256	$64,124	$66,048	$68,029	$70,070	$72,172	$74,337	$76,567	$78,864	$81,230	$83,667	$86,177	$88,762	$91,425	$94,168	$96,993	$99,903
$0	$1,474	$3,037	$4,692	$6,444	$8,297	$10,255	$12,323	$14,506	$16,809	$19,237	$21,796	$24,490	$27,327	$30,312	$33,452	$36,752	$40,221	$43,864	$47,690	$51,706	$55,920	$60,341	$64,976	$69,835
$49,146	**$101,240**	**$156,416**	**$214,811**	**$276,569**	**$341,839**	**$410,777**	**$483,543**	**$560,306**	**$641,239**	**$726,523**	**$816,348**	**$910,909**	**$1,010,408**	**$1,115,057**	**$1,225,076**	**$1,340,693**	**$1,462,144**	**$1,589,675**	**$1,723,542**	**$1,864,011**	**$2,011,357**	**$2,165,866**	**$2,327,835**	**$0**
$13,085	$13,478	$13,882	$14,298	$14,727	$15,169	$15,624	$16,093	$16,576	$17,073	$17,585	$18,113	$18,656	$19,216	$19,792	$20,386	$20,998	$21,628	$22,277	$22,945	$23,633	$24,342	$25,072	$25,825	$26,599
$9,528	$10,206	$10,917	$11,661	$12,440	$13,255	$14,107	$14,999	$15,932	$16,907	$17,927	$18,992	$20,105	$21,268	$22,483	$23,751	$25,075	$26,457	$27,900	$29,405	$30,976	$32,614	$34,322	$36,104	$37,962
$340,213	**$363,897**	**$388,696**	**$414,655**	**$441,822**	**$470,246**	**$499,978**	**$531,070**	**$563,578**	**$597,559**	**$633,071**	**$670,176**	**$708,937**	**$749,422**	**$791,697**	**$835,834**	**$881,906**	**$929,991**	**$980,168**	**$1,032,517**	**$1,087,126**	**$1,144,082**	**$1,203,477**	**$1,265,406**	**$0**
$26,170	$26,955	$27,764	$28,597	$29,455	$30,338	$31,249	$32,186	$33,152	$34,146	$35,171	$36,226	$37,312	$38,432	$39,585	$40,772	$41,996	$43,255	$44,553	$45,890	$47,266	$48,684	$50,145	$51,649	$53,199
$19,056	$20,413	$21,834	$23,322	$24,879	$26,509	$28,215	$29,999	$31,864	$33,815	$35,854	$37,984	$40,211	$42,536	$44,965	$47,502	$50,150	$52,914	$55,799	$58,810	$61,951	$65,228	$68,645	$72,209	$75,924
$680,426	**$727,794**	**$777,392**	**$829,311**	**$883,645**	**$940,493**	**$999,956**	**$1,062,141**	**$1,127,157**	**$1,195,118**	**$1,266,142**	**$1,340,352**	**$1,417,875**	**$1,498,843**	**$1,583,393**	**$1,671,667**	**$1,763,813**	**$1,859,983**	**$1,960,335**	**$2,065,035**	**$2,174,252**	**$2,288,164**	**$2,406,954**	**$2,530,812**	**$0**
$52,340	$53,911	$55,528	$57,194	$58,910	$60,677	$62,497	$64,372	$66,303	$68,292	$70,341	$72,451	$74,625	$76,864	$79,170	$81,545	$83,991	$86,511	$89,106	$91,779	$94,533	$97,369	$100,290	$103,298	$106,397
$38,112	$40,826	$43,668	$46,644	$49,759	$53,019	$56,430	$59,997	$63,728	$67,629	$71,707	$75,969	$80,421	$85,072	$89,931	$95,004	$100,300	$105,829	$111,599	$117,620	$123,902	$130,455	$137,290	$144,417	$151,849
$1,360,852	**$1,455,588**	**$1,554,784**	**$1,658,622**	**$1,767,290**	**$1,880,985**	**$1,999,912**	**$2,124,282**	**$2,254,314**	**$2,390,235**	**$2,532,284**	**$2,680,704**	**$2,835,750**	**$2,997,686**	**$3,166,786**	**$3,343,335**	**$3,527,626**	**$3,719,965**	**$3,920,670**	**$4,130,070**	**$4,348,505**	**$4,576,329**	**$4,813,908**	**$5,061,624**	**$0**
$31,407	$32,349	$33,319	$34,319	$35,348	$36,409	$37,501	$38,626	$39,785	$40,979	$42,208	$43,474	$44,778	$46,122	$47,505	$48,931	$50,398	$51,910	$53,468	$55,072	$56,724	$58,426	$60,178	$61,984	$63,843
$6,700	$6,901	$7,108	$7,321	$7,541	$7,767	$8,000	$8,240	$8,487	$8,742	$9,004	$9,274	$9,553	$9,839	$10,134	$10,439	$10,752	$11,074	$11,406	$11,749	$12,101	$12,464	$12,838	$13,223	$13,620
$5,653	$5,823	$5,997	$6,177	$6,363	$6,554	$6,750	$6,953	$7,161	$7,376	$7,597	$7,825	$8,060	$8,302	$8,551	$8,808	$9,072	$9,344	$9,624	$9,913	$10,210	$10,517	$10,832	$11,157	$11,492
$2,575	$2,653	$2,732	$2,814	$2,899	$2,986	$3,075	$3,167	$3,262	$3,360	$3,461	$3,565	$3,672	$3,782	$3,895	$4,012	$4,133	$4,257	$4,384	$4,516	$4,651	$4,791	$4,935	$5,083	$5,235
$11,872	$12,228	$12,595	$12,973	$13,362	$13,763	$14,175	$14,601	$15,039	$15,490	$15,955	$16,433	$16,926	$17,434	$17,957	$18,496	$19,051	$19,622	$20,211	$20,817	$21,442	$22,085	$22,747	$23,430	$24,133
$7,747	$7,979	$8,219	$8,465	$8,719	$8,981	$9,250	$9,528	$9,814	$10,108	$10,411	$10,724	$11,045	$11,377	$11,718	$12,070	$12,432	$12,805	$13,189	$13,584	$13,992	$14,412	$14,844	$15,289	$15,748
$65,954	**$67,933**	**$69,971**	**$72,070**	**$74,232**	**$76,459**	**$78,753**	**$81,115**	**$83,549**	**$86,055**	**$88,637**	**$91,296**	**$94,035**	**$96,856**	**$99,761**	**$102,754**	**$105,837**	**$109,012**	**$112,282**	**$115,651**	**$119,120**	**$122,694**	**$126,375**	**$130,166**	**$134,071**
$55,485	$57,150	$58,864	$60,630	$62,449	$64,322	$66,252	$68,240	$70,287	$72,395	$74,567	$76,804	$79,109	$81,482	$83,926	$86,444	$89,037	$91,708	$94,460	$97,293	$100,212	$103,219	$106,315	$109,505	$112,790
$121,439	**$125,082**	**$128,835**	**$132,700**	**$136,681**	**$140,781**	**$145,005**	**$149,355**	**$153,835**	**$158,451**	**$163,204**	**$168,100**	**$173,143**	**$178,337**	**$183,688**	**$189,198**	**$194,874**	**$200,720**	**$206,742**	**$212,944**	**$219,333**	**$225,913**	**$232,690**	**$239,671**	**$246,861**
$51,760	**$53,313**	**$54,912**	**$56,559**	**$58,256**	**$60,004**	**$61,804**	**$63,658**	**$65,568**	**$67,535**	**$69,561**	**$71,648**	**$73,797**	**$76,011**	**$78,291**	**$80,640**	**$83,059**	**$85,551**	**$88,118**	**$90,761**	**$93,484**	**$96,288**	**$99,177**	**$102,152**	**$105,217**
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis
Alternative 4 and 5 - West Canal - Groundwater Well Supply and Pressurized Delivery Systems to Upper West Side

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

ASSUMPTIONS:	PIPE/INFRASTRUCTURE	PUMPS/ELEC	STORAGE	OVERALL PROJECT
Estimated Capital Cost (Total Field Cost[1]):	$1,384,798	$176,202	$270,000	$1,831,000
Interest on Replacement Fund:				3.00%
Rate of Inflation:				3.00%
Life Cycle:	50 Years	25 Years	50 Years	50 Years

SUMMARY OF REPLACEMENT COSTS:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE		OVERALL PROJECT	
	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]
Estimated Project Replacement Cost:								
To Replace 25% of Proposed Facility		$1,517,706		$92,232		$295,914		
To Replace 50% of Proposed Facility		$3,035,412		$184,464		$591,827		
To Replace 100% of Proposed Facility	$1,384,798	$6,070,824	$176,202	$368,928	$270,000	$1,183,655	$1,831,000	
Disposal and Removal Cost:								
To Replace 25% of Proposed Facility		$7,672		$2,094		$2,192		
To Replace 50% of Proposed Facility		$15,344		$4,188		$4,384		
To Replace 100% of Proposed Facility	$7,000	$30,687	$4,000	$8,375	$2,000	$8,768	$13,000	
Total Replacement Cost:								
To Replace 25% of Proposed Facility		**$1,525,378**		**$94,326**		**$298,106**		
To Replace 50% of Proposed Facility		**$3,050,756**		**$188,651**		**$596,211**		
To Replace 100% of Proposed Facility	**$1,391,798**	**$6,101,512**	**$180,202**	**$377,303**	**$272,000**	**$1,192,422**	**$1,844,000**	

REPLACEMENT FUND SUMMARY:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE	
	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50
Annual Deposit Required (Assume Equal Deposit Made Each Year Through Life Cycle of Facility):						
To Replace 25% of Proposed Facility	$13,523	$13,523	$2,587	$5,417	$2,643	$2,643
To Replace 50% of Proposed Facility	$27,046	$27,046	$5,174	$10,834	$5,286	$5,286
To Replace 100% of Proposed Facility	$54,093	$54,093	$10,349	$21,668	$10,571	$10,571
Deposit Required at **Year 1** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$7,168		$1,856		$1,401	
To Replace 50% of Proposed Facility	$14,336		$3,712		$2,802	
To Replace 100% of Proposed Facility	$28,671		$7,424		$5,603	
Deposit Required at **Year 25** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$14,571		$3,773		$2,848	
To Replace 50% of Proposed Facility	$29,141		$7,546		$5,695	
To Replace 100% of Proposed Facility	$58,282		$15,092		$11,390	
Deposit Required at **Year 50** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$30,508		$7,900		$5,962	
To Replace 50% of Proposed Facility	$61,015		$15,800		$11,924	
To Replace 100% of Proposed Facility	$122,030		$31,600		$23,848	

OVERALL REPLACEMENT FUND SUMMARY:		
Component	**Probable % Replaced**	**Life Cycle Years**
Pipelines	25%	50
Well Supply/Pumping	100%	25
Storage	25%	50
Annual Deposit Required (Equal Deposit Each Year)		
Years 1-25		$26,515
Years 26-50		$37,834
Annual Deposit Required (Deposits Increase at Rate of Inflation)		
Year 1		$15,993
Year 25		$32,510
Year 50		$68,069

LIFE CYCLE COSTS:

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Capital Expenses:	**$1,831,000**																									
Replacement Expenses:																										
For 25% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$94,326
For 50% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$188,651
For 100% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$377,303
For 25% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$7,168	$7,383	$7,604	$7,832	$8,067	$8,309	$8,559	$8,815	$9,080	$9,352	$9,633	$9,922	$10,220	$10,526	$10,842	$11,167	$11,502	$11,847	$12,203	$12,569	$12,946	$13,334	$13,734	$14,146	$14,571
Interest		$0	$215	$443	$684	$940	$1,210	$1,496	$1,797	$2,116	$2,452	$2,806	$3,179	$3,572	$3,986	$4,421	$4,879	$5,360	$5,866	$6,397	$6,955	$7,541	$8,156	$8,801	$9,477	$10,185
End of Year Balance		**$7,168**	**$14,766**	**$22,813**	**$31,330**	**$40,337**	**$49,856**	**$59,911**	**$70,524**	**$81,719**	**$93,523**	**$105,962**	**$119,062**	**$132,854**	**$147,365**	**$162,628**	**$178,674**	**$195,537**	**$213,250**	**$231,850**	**$251,374**	**$271,861**	**$293,351**	**$315,886**	**$339,509**	**$364,264**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$14,336	$14,766	$15,209	$15,665	$16,135	$16,619	$17,117	$17,631	$18,160	$18,705	$19,266	$19,844	$20,439	$21,052	$21,684	$22,334	$23,004	$23,694	$24,405	$25,137	$25,892	$26,668	$27,468	$28,292	$29,141
Interest		$0	$430	$886	$1,369	$1,880	$2,420	$2,991	$3,595	$4,231	$4,903	$5,611	$6,358	$7,144	$7,971	$8,842	$9,758	$10,720	$11,732	$12,795	$13,911	$15,082	$16,312	$17,601	$18,953	$20,371
End of Year Balance		**$14,336**	**$29,531**	**$45,626**	**$62,659**	**$80,674**	**$99,713**	**$119,822**	**$141,047**	**$163,438**	**$187,046**	**$211,923**	**$238,125**	**$265,707**	**$294,731**	**$325,256**	**$357,348**	**$391,073**	**$426,500**	**$463,700**	**$502,748**	**$543,722**	**$586,702**	**$631,772**	**$679,017**	**$728,529**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$28,671	$29,531	$30,417	$31,330	$32,270	$33,238	$34,235	$35,262	$36,320	$37,409	$38,531	$39,687	$40,878	$42,104	$43,368	$44,669	$46,009	$47,389	$48,811	$50,275	$51,783	$53,337	$54,937	$56,585	$58,282
Interest		$0	$860	$1,772	$2,738	$3,760	$4,840	$5,983	$7,189	$8,463	$9,806	$11,223	$12,715	$14,287	$15,942	$17,684	$19,515	$21,441	$23,464	$25,590	$27,822	$30,165	$32,623	$35,202	$37,906	$40,741
End of Year Balance		**$28,671**	**$59,062**	**$91,251**	**$125,318**	**$161,348**	**$199,426**	**$239,643**	**$282,094**	**$326,877**	**$374,092**	**$423,846**	**$476,249**	**$531,415**	**$589,461**	**$650,513**	**$714,697**	**$782,146**	**$852,999**	**$927,400**	**$1,005,497**	**$1,087,445**	**$1,173,405**	**$1,263,544**	**$1,358,035**	**$1,457,058**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$1,856	$1,912	$1,969	$2,028	$2,089	$2,152	$2,216	$2,283	$2,351	$2,422	$2,494	$2,569	$2,646	$2,726	$2,807	$2,892	$2,978	$3,068	$3,160	$3,255	$3,352	$3,453	$3,556	$3,663	$3,773
Interest		$0	$56	$115	$177	$243	$313	$387	$465	$548	$635	$727	$823	$925	$1,032	$1,145	$1,263	$1,388	$1,519	$1,657	$1,801	$1,953	$2,112	$2,279	$2,454	$2,637
End of Year Balance		**$1,856**	**$3,824**	**$5,907**	**$8,113**	**$10,445**	**$12,910**	**$15,514**	**$18,262**	**$21,161**	**$24,218**	**$27,439**	**$30,831**	**$34,402**	**$38,160**	**$42,112**	**$46,267**	**$50,634**	**$55,221**	**$60,037**	**$65,093**	**$70,398**	**$75,963**	**$81,798**	**$87,915**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$3,712	$3,824	$3,938	$4,056	$4,178	$4,303	$4,433	$4,565	$4,702	$4,844	$4,989	$5,138	$5,293	$5,451	$5,615	$5,783	$5,957	$6,136	$6,320	$6,509	$6,705	$6,906	$7,113	$7,326	$7,546
Interest		$0	$111	$229	$354	$487	$627	$775	$931	$1,096	$1,270	$1,453	$1,646	$1,850	$2,064	$2,290	$2,527	$2,776	$3,038	$3,313	$3,602	$3,906	$4,224	$4,558	$4,908	$5,275
End of Year Balance		**$3,712**	**$7,647**	**$11,815**	**$16,226**	**$20,890**	**$25,820**	**$31,028**	**$36,524**	**$42,322**	**$48,435**	**$54,877**	**$61,662**	**$68,805**	**$76,320**	**$84,225**	**$92,535**	**$101,268**	**$110,441**	**$120,074**	**$130,186**	**$140,796**	**$151,926**	**$163,596**	**$175,831**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$7,424	$7,647	$7,876	$8,113	$8,356	$8,607	$8,865	$9,131	$9,405	$9,687	$9,978	$10,277	$10,585	$10,903	$11,230	$11,567	$11,914	$12,271	$12,639	$13,019	$13,409	$13,811	$14,226	$14,653	$15,092
Interest		$0	$223	$459	$709	$974	$1,253	$1,549	$1,862	$2,191	$2,539	$2,906	$3,293	$3,700	$4,128	$4,579	$5,053	$5,552	$6,076	$6,626	$7,204	$7,811	$8,448	$9,116	$9,816	$10,550
End of Year Balance		**$7,424**	**$15,294**	**$23,629**	**$32,451**	**$41,781**	**$51,641**	**$62,055**	**$73,048**	**$84,644**	**$96,871**	**$109,754**	**$123,324**	**$137,609**	**$152,640**	**$168,449**	**$185,070**	**$202,536**	**$220,883**	**$240,149**	**$260,372**	**$281,592**	**$303,851**	**$327,193**	**$351,661**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):																										
Deposits		$1,401	$1,443	$1,486	$1,531	$1,577	$1,624	$1,673	$1,723	$1,774	$1,828	$1,883	$1,939	$1,997	$2,057	$2,119	$2,182	$2,248	$2,315	$2,385	$2,456	$2,530	$2,606	$2,684	$2,765	$2,848
Interest		$0	$42	$87	$134	$184	$236	$292	$351	$413	$479	$548	$621	$698	$779	$864	$953	$1,048	$1,146	$1,250	$1,359	$1,474	$1,594	$1,720	$1,852	$1,991
End of Year Balance		**$1,401**	**$2,886**	**$4,458**	**$6,123**	**$7,883**	**$9,743**	**$11,708**	**$13,782**	**$15,970**	**$18,277**	**$20,708**	**$23,268**	**$25,964**	**$28,800**	**$31,783**	**$34,918**	**$38,214**	**$41,676**	**$45,311**	**$49,126**	**$53,130**	**$57,330**	**$61,734**	**$66,350**	**$71,188**
Storage Replacement Fund (For Funding Replacement of 50% of System):																										
Deposits		$2,802	$2,886	$2,972	$3,061	$3,153	$3,248	$3,345	$3,446	$3,549	$3,655	$3,765	$3,878	$3,994	$4,114	$4,238	$4,365	$4,496	$4,631	$4,770	$4,913	$5,060	$5,212	$5,368	$5,529	$5,695
Interest		$0	$84	$173	$267	$367	$473	$585	$703	$827	$958	$1,097	$1,242	$1,396	$1,558	$1,728	$1,907	$2,095	$2,293	$2,501	$2,719	$2,948	$3,188	$3,440	$3,704	$3,981
End of Year Balance		**$2,802**	**$5,771**	**$8,917**	**$12,246**	**$15,766**	**$19,487**	**$23,417**	**$27,565**	**$31,941**	**$36,555**	**$41,416**	**$46,537**	**$51,927**	**$57,599**	**$63,565**	**$69,837**	**$76,428**	**$83,351**	**$90,621**	**$98,252**	**$106,260**	**$114,660**	**$123,468**	**$132,701**	**$142,377**
Storage Replacement Fund (For Funding Replacement of 100% of System):																										
Deposits		$5,603	$5,771	$5,944	$6,123	$6,306	$6,496	$6,691	$6,891	$7,098	$7,311	$7,530	$7,756	$7,989	$8,228	$8,475	$8,730	$8,991	$9,261	$9,539	$9,825	$10,120	$10,424	$10,736	$11,058	$11,390
Interest		$0	$168	$346	$535	$735	$946	$1,169	$1,405	$1,654	$1,916	$2,193	$2,485	$2,792	$3,116	$3,456	$3,814	$4,190	$4,586	$5,001	$5,437	$5,895	$6,376	$6,880	$7,408	$7,962
End of Year Balance		**$5,603**	**$11,543**	**$17,833**	**$24,491**	**$31,532**	**$38,974**	**$46,834**	**$55,130**	**$63,882**	**$73,109**	**$82,833**	**$93,074**	**$103,855**	**$115,199**	**$127,130**	**$139,674**	**$152,855**	**$166,702**	**$181,242**	**$196,505**	**$212,520**	**$229,319**	**$246,935**	**$265,402**	**$284,754**
Operations and Maintenance Expenses:																										
Staff Salaries[4]		$9,000	$9,270	$9,548	$9,835	$10,130	$10,433	$10,746	$11,069	$11,401	$11,743	$12,095	$12,458	$12,832	$13,217	$13,613	$14,022	$14,442	$14,876	$15,322	$15,782	$16,255	$16,743	$17,245	$17,762	$18,295
Benefits[4]		$1,820	$1,875	$1,931	$1,989	$2,048	$2,110	$2,173	$2,238	$2,306	$2,375	$2,446	$2,519	$2,595	$2,673	$2,753	$2,836	$2,921	$3,008	$3,098	$3,191	$3,287	$3,386	$3,487	$3,592	$3,700
Transportation Costs[4]		$1,500	$1,545	$1,591	$1,639	$1,688	$1,739	$1,791	$1,845	$1,900	$1,957	$2,016	$2,076	$2,139	$2,203	$2,269	$2,337	$2,407	$2,479	$2,554	$2,630	$2,709	$2,790	$2,874	$2,960	$3,049
Utilities, Phones, Communications[4]		$530	$546	$562	$579	$597	$614	$633	$652	$671	$692	$712	$734	$756	$778	$802	$826	$850	$876	$902	$929	$957	$986	$1,016	$1,046	$1,077
Maintenance, Small Repairs, Supplies[4]		$1,100	$1,133	$1,167	$1,202	$1,238	$1,275	$1,313	$1,353	$1,393	$1,435	$1,478	$1,523	$1,568	$1,615	$1,664	$1,714	$1,765	$1,818	$1,873	$1,929	$1,987	$2,046	$2,108	$2,171	$2,236
Contracted Labor Costs[4]		$4,250	$4,378	$4,509	$4,644	$4,783	$4,927	$5,075	$5,227	$5,384	$5,545	$5,712	$5,883	$6,059	$6,241	$6,429	$6,621	$6,820	$7,025	$7,235	$7,452	$7,676	$7,906	$8,143	$8,388	$8,639
Total West Canal O&M Expenses		**$18,200**	**$18,746**	**$19,308**	**$19,888**	**$20,484**	**$21,099**	**$21,732**	**$22,384**	**$23,055**	**$23,747**	**$24,459**	**$25,193**	**$25,949**	**$26,727**	**$27,529**	**$28,355**	**$29,206**	**$30,082**	**$30,984**	**$31,914**	**$32,871**	**$33,857**	**$34,873**	**$35,919**	**$36,997**
Administration[5]		$9,800	$10,094	$10,397	$10,709	$11,030	$11,361	$11,702	$12,053	$12,414	$12,787	$13,170	$13,565	$13,972	$14,392	$14,823	$15,268	$15,726	$16,198	$16,684	$17,184	$17,700	$18,231	$18,778	$19,341	$19,921
Total West Canal O&M + Aministration Expenses		**$28,000**	**$28,840**	**$29,705**	**$30,596**	**$31,514**	**$32,460**	**$33,433**	**$34,436**	**$35,470**	**$36,534**	**$37,630**	**$38,759**	**$39,921**	**$41,119**	**$42,353**	**$43,623**	**$44,932**	**$46,280**	**$47,668**	**$49,098**	**$50,571**	**$52,088**	**$53,651**	**$55,260**	**$56,918**
Pumping Power Expense		**$6,485**	**$6,680**	**$6,880**	**$7,087**	**$7,299**	**$7,518**	**$7,744**	**$7,976**	**$8,216**	**$8,462**	**$8,716**	**$8,977**	**$9,247**	**$9,524**	**$9,810**	**$10,104**	**$10,407**	**$10,719**	**$11,041**	**$11,372**	**$11,713**	**$12,065**	**$12,427**	**$12,800**	**$13,184**
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

NOTES:
1) Total Field Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2) Current Cost is equal to the Engineer's opinion of the probable total field cost for the project at beginning of project life. Total field costs have been separated into Pipeline and Ditch Lining costs for the life cycle cost analysis because the pipeline and ditch lining have different life cycles.
3) Future cost is value at end of life cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
4) Numbers are for West Canal O&M Only.
5) Adminstrative Costs for West Canal Only.

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis (Cont.)
Alternative 4 and 5 - West Canal - Groundwater Well Supply and Pressurized Delivery Systems to Upper West Side

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

TOTAL REPLACEMENT COST SUMMARY: (ESTIMATED PRESENT VALUE OF REPLACEMENT COSTS THROUGH 50-YEAR LIFE OF OVERALL PROJECT)	**PIPE/ INFRA.**	**PUMPS**	**STORAGE**	**OVERALL PROJECT**
Probable % of Facility Replaced	25%	100%	25%	
Life Cycle of Facility	50	25	50	
Assumes Equal Deposit Made to Replacement Fund Each Year:				
Overall (Per Probable % of Facility Replaced)				**$776,354**
25% Replacement	$347,950	$90,101	$68,000	
50% Replacement	$695,899	$180,202	$136,000	
100% Replacement	$1,391,798	$360,404	$272,000	
Assumes Deposits to Replacement Fund Increase at Rate of Inflation:				
Overall (Per Probable % of Facility Replaced)				**$779,015**
25% Replacement	$347,949	$90,101	$70,661	
50% Replacement	$695,899	$180,202	$141,322	
100% Replacement	$1,391,798	$360,404	$282,645	

26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,525,378
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,050,756
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,101,512
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$197,497
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$394,994
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$789,989
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$298,106
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$596,211
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,192,422
$15,008	$15,458	$15,922	$16,399	$16,891	$17,398	$17,920	$18,458	$19,011	$19,582	$20,169	$20,774	$21,397	$22,039	$22,700	$23,382	$24,083	$24,805	$25,550	$26,316	$27,106	$27,919	$28,756	$29,619	$30,508
$10,928	$11,706	$12,521	$13,374	$14,267	$15,202	$16,180	$17,203	$18,273	$19,392	$20,561	$21,783	$23,059	$24,393	$25,786	$27,241	$28,759	$30,345	$31,999	$33,725	$35,527	$37,406	$39,365	$41,409	$43,540
$390,200	**$417,364**	**$445,807**	**$475,580**	**$506,739**	**$539,339**	**$573,439**	**$609,100**	**$646,384**	**$685,357**	**$726,087**	**$768,644**	**$813,101**	**$859,533**	**$908,020**	**$958,642**	**$1,011,484**	**$1,066,634**	**$1,124,182**	**$1,184,224**	**$1,246,856**	**$1,312,181**	**$1,380,302**	**$1,451,330**	**$0**
$30,015	$30,916	$31,843	$32,799	$33,783	$34,796	$35,840	$36,915	$38,023	$39,163	$40,338	$41,548	$42,795	$44,079	$45,401	$46,763	$48,166	$49,611	$51,099	$52,632	$54,211	$55,837	$57,513	$59,238	$61,015
$21,856	$23,412	$25,042	$26,748	$28,535	$30,404	$32,360	$34,406	$36,546	$38,783	$41,121	$43,565	$46,119	$48,786	$51,572	$54,481	$57,518	$60,689	$63,998	$67,451	$71,053	$74,811	$78,731	$82,818	$87,080
$780,400	**$834,728**	**$891,613**	**$951,160**	**$1,013,478**	**$1,078,678**	**$1,146,878**	**$1,218,200**	**$1,292,769**	**$1,370,715**	**$1,452,174**	**$1,537,288**	**$1,626,201**	**$1,719,066**	**$1,816,039**	**$1,917,283**	**$2,022,968**	**$2,133,268**	**$2,248,365**	**$2,368,448**	**$2,493,712**	**$2,624,361**	**$2,760,605**	**$2,902,661**	**$0**
$60,031	$61,832	$63,687	$65,597	$67,565	$69,592	$71,680	$73,830	$76,045	$78,327	$80,676	$83,097	$85,590	$88,157	$90,802	$93,526	$96,332	$99,222	$102,198	$105,264	$108,422	$111,675	$115,025	$118,476	$122,030
$43,712	$46,824	$50,084	$53,497	$57,070	$60,809	$64,721	$68,813	$73,092	$77,566	$82,243	$87,130	$92,237	$97,572	$103,144	$108,962	$115,037	$121,378	$127,996	$134,902	$142,107	$149,623	$157,462	$165,636	$174,160
$1,560,800	**$1,669,456**	**$1,783,227**	**$1,902,321**	**$2,026,955**	**$2,157,356**	**$2,293,757**	**$2,436,400**	**$2,585,537**	**$2,741,430**	**$2,904,349**	**$3,074,576**	**$3,252,403**	**$3,438,132**	**$3,632,078**	**$3,834,566**	**$4,045,935**	**$4,266,535**	**$4,496,730**	**$4,736,896**	**$4,987,425**	**$5,248,723**	**$5,521,210**	**$5,805,322**	**$0**
$3,886	$4,003	$4,123	$4,247	$4,374	$4,505	$4,640	$4,780	$4,923	$5,071	$5,223	$5,379	$5,541	$5,707	$5,878	$6,055	$6,236	$6,423	$6,616	$6,815	$7,019	$7,230	$7,446	$7,670	$7,900
$0	$117	$240	$371	$510	$656	$811	$974	$1,147	$1,329	$1,521	$1,724	$1,937	$2,161	$2,397	$2,645	$2,906	$3,180	$3,469	$3,771	$4,089	$4,422	$4,771	$5,138	$5,522
$3,886	**$8,006**	**$12,369**	**$16,986**	**$21,870**	**$27,031**	**$32,482**	**$38,236**	**$44,307**	**$50,706**	**$57,450**	**$64,553**	**$72,031**	**$79,899**	**$88,174**	**$96,874**	**$106,016**	**$115,620**	**$125,705**	**$136,290**	**$147,398**	**$159,049**	**$171,267**	**$184,075**	**$0**
$7,772	$8,006	$8,246	$8,493	$8,748	$9,010	$9,281	$9,559	$9,846	$10,141	$10,446	$10,759	$11,082	$11,414	$11,757	$12,109	$12,472	$12,847	$13,232	$13,629	$14,038	$14,459	$14,893	$15,340	$15,800
$0	$233	$480	$742	$1,019	$1,312	$1,622	$1,949	$2,294	$2,658	$3,042	$3,447	$3,873	$4,322	$4,794	$5,290	$5,812	$6,361	$6,937	$7,542	$8,177	$8,844	$9,543	$10,276	$11,045
$7,772	**$16,011**	**$24,737**	**$33,973**	**$43,740**	**$54,062**	**$64,965**	**$76,473**	**$88,613**	**$101,413**	**$114,901**	**$129,107**	**$144,061**	**$159,797**	**$176,348**	**$193,747**	**$212,032**	**$231,240**	**$251,409**	**$272,580**	**$294,796**	**$318,099**	**$342,534**	**$368,150**	**$0**
$15,545	$16,011	$16,492	$16,986	$17,496	$18,021	$18,561	$19,118	$19,692	$20,283	$20,891	$21,518	$22,163	$22,828	$23,513	$24,218	$24,945	$25,693	$26,464	$27,258	$28,076	$28,918	$29,786	$30,679	$31,600
$0	$466	$961	$1,484	$2,038	$2,624	$3,244	$3,898	$4,588	$5,317	$6,085	$6,894	$7,746	$8,644	$9,588	$10,581	$11,625	$12,722	$13,874	$15,085	$16,355	$17,688	$19,086	$20,552	$22,089
$15,545	**$32,022**	**$49,475**	**$67,945**	**$87,480**	**$108,125**	**$129,930**	**$152,946**	**$177,226**	**$202,825**	**$229,801**	**$258,213**	**$288,123**	**$319,595**	**$352,695**	**$387,495**	**$424,065**	**$462,480**	**$502,818**	**$545,161**	**$589,592**	**$636,197**	**$685,069**	**$736,300**	**$0**
$2,933	$3,021	$3,112	$3,205	$3,301	$3,400	$3,502	$3,607	$3,715	$3,827	$3,942	$4,060	$4,182	$4,307	$4,436	$4,569	$4,707	$4,848	$4,993	$5,143	$5,297	$5,456	$5,620	$5,788	$5,962
$2,136	$2,288	$2,447	$2,614	$2,788	$2,971	$3,162	$3,362	$3,571	$3,790	$4,018	$4,257	$4,506	$4,767	$5,039	$5,324	$5,620	$5,930	$6,254	$6,591	$6,943	$7,310	$7,693	$8,093	$8,509
$76,257	**$81,566**	**$87,124**	**$92,943**	**$99,032**	**$105,403**	**$112,068**	**$119,037**	**$126,323**	**$133,940**	**$141,900**	**$150,217**	**$158,905**	**$167,979**	**$177,455**	**$187,348**	**$197,675**	**$208,453**	**$219,700**	**$231,434**	**$243,674**	**$256,440**	**$269,753**	**$283,634**	**$0**
$5,866	$6,042	$6,223	$6,410	$6,602	$6,800	$7,004	$7,214	$7,431	$7,654	$7,883	$8,120	$8,363	$8,614	$8,873	$9,139	$9,413	$9,695	$9,986	$10,286	$10,595	$10,912	$11,240	$11,577	$11,924
$4,271	$4,575	$4,894	$5,227	$5,577	$5,942	$6,324	$6,724	$7,142	$7,579	$8,036	$8,514	$9,013	$9,534	$10,079	$10,647	$11,241	$11,860	$12,507	$13,182	$13,886	$14,620	$15,386	$16,185	$17,018
$152,514	**$163,131**	**$174,249**	**$185,886**	**$198,065**	**$210,807**	**$224,135**	**$238,074**	**$252,647**	**$267,880**	**$283,799**	**$300,433**	**$317,810**	**$335,958**	**$354,910**	**$374,696**	**$395,350**	**$416,906**	**$439,399**	**$462,867**	**$487,348**	**$512,881**	**$539,507**	**$567,269**	**$0**
$11,732	$12,084	$12,446	$12,820	$13,204	$13,600	$14,008	$14,429	$14,862	$15,307	$15,767	$16,240	$16,727	$17,229	$17,745	$18,278	$18,826	$19,391	$19,973	$20,572	$21,189	$21,825	$22,479	$23,154	$23,848
$8,543	$9,151	$9,788	$10,455	$11,153	$11,884	$12,648	$13,448	$14,284	$15,159	$16,073	$17,028	$18,026	$19,069	$20,157	$21,295	$22,482	$23,721	$25,014	$26,364	$27,772	$29,241	$30,773	$32,370	$34,036
$305,028	**$326,263**	**$348,497**	**$371,772**	**$396,129**	**$421,614**	**$448,270**	**$476,147**	**$505,293**	**$535,759**	**$567,599**	**$600,866**	**$635,619**	**$671,916**	**$709,819**	**$749,392**	**$790,700**	**$833,812**	**$878,799**	**$925,735**	**$974,696**	**$1,025,761**	**$1,079,014**	**$1,134,538**	**$0**
$18,844	$19,409	$19,992	$20,591	$21,209	$21,845	$22,501	$23,176	$23,871	$24,587	$25,325	$26,085	$26,867	$27,673	$28,503	$29,358	$30,239	$31,146	$32,081	$33,043	$34,034	$35,055	$36,107	$37,190	$38,306
$3,811	$3,925	$4,043	$4,164	$4,289	$4,418	$4,550	$4,687	$4,827	$4,972	$5,121	$5,275	$5,433	$5,596	$5,764	$5,937	$6,115	$6,298	$6,487	$6,682	$6,883	$7,089	$7,302	$7,521	$7,746
$3,141	$3,235	$3,332	$3,432	$3,535	$3,641	$3,750	$3,863	$3,979	$4,098	$4,221	$4,347	$4,478	$4,612	$4,751	$4,893	$5,040	$5,191	$5,347	$5,507	$5,672	$5,843	$6,018	$6,198	$6,384
$1,110	$1,143	$1,177	$1,213	$1,249	$1,286	$1,325	$1,365	$1,406	$1,448	$1,491	$1,536	$1,582	$1,630	$1,679	$1,729	$1,781	$1,834	$1,889	$1,946	$2,004	$2,064	$2,126	$2,190	$2,256
$2,303	$2,372	$2,443	$2,517	$2,592	$2,670	$2,750	$2,833	$2,918	$3,005	$3,095	$3,188	$3,284	$3,382	$3,484	$3,588	$3,696	$3,807	$3,921	$4,039	$4,160	$4,285	$4,413	$4,545	$4,682
$8,899	$9,166	$9,440	$9,724	$10,015	$10,316	$10,625	$10,944	$11,272	$11,611	$11,959	$12,318	$12,687	$13,068	$13,460	$13,864	$14,280	$14,708	$15,149	$15,604	$16,072	$16,554	$17,051	$17,562	$18,089
$38,107	**$39,250**	**$40,427**	**$41,640**	**$42,889**	**$44,176**	**$45,501**	**$46,867**	**$48,273**	**$49,721**	**$51,212**	**$52,749**	**$54,331**	**$55,961**	**$57,640**	**$59,369**	**$61,150**	**$62,985**	**$64,874**	**$66,820**	**$68,825**	**$70,890**	**$73,016**	**$75,207**	**$77,463**
$20,519	$21,135	$21,769	$22,422	$23,094	$23,787	$24,501	$25,236	$25,993	$26,773	$27,576	$28,403	$29,255	$30,133	$31,037	$31,968	$32,927	$33,915	$34,932	$35,980	$37,060	$38,171	$39,317	$40,496	$41,711
$58,626	**$60,385**	**$62,196**	**$64,062**	**$65,984**	**$67,963**	**$70,002**	**$72,102**	**$74,265**	**$76,493**	**$78,788**	**$81,152**	**$83,586**	**$86,094**	**$88,677**	**$91,337**	**$94,077**	**$96,899**	**$99,806**	**$102,801**	**$105,885**	**$109,061**	**$112,333**	**$115,703**	**$119,174**
$13,579	**$13,986**	**$14,406**	**$14,838**	**$15,283**	**$15,742**	**$16,214**	**$16,700**	**$17,201**	**$17,718**	**$18,249**	**$18,797**	**$19,360**	**$19,941**	**$20,539**	**$21,156**	**$21,790**	**$22,444**	**$23,117**	**$23,811**	**$24,525**	**$25,261**	**$26,019**	**$26,799**	**$27,603**
26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis
Alternatives 1, 2, 3, and 5 - East Canal - Replacement Pipeline

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

ASSUMPTIONS:	PIPE/INFRASTRUCTURE	PUMPS/ELEC	STORAGE	OVERALL PROJECT
Estimated Capital Cost (Total Field Cost[1]):	$3,071,000	$0	$0	$3,071,000
Interest on Replacement Fund:				3.00%
Rate of Inflation:				3.00%
Life Cycle:	50 Years	25 Years	50 Years	50 Years

SUMMARY OF REPLACEMENT COSTS:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE		OVERALL PROJECT	
	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]	CURRENT[2]	FUTURE[3]
Estimated Project Replacement Cost:								
To Replace 25% of Proposed Facility		$3,365,744		$0		$0		
To Replace 50% of Proposed Facility		$6,731,488		$0		$0		
To Replace 100% of Proposed Facility	$3,071,000	$13,462,975	$0	$0	$0	$0	$3,071,000	
Disposal and Removal Cost:								
To Replace 25% of Proposed Facility		$3,288		$0		$0		
To Replace 50% of Proposed Facility		$6,576		$0		$0		
To Replace 100% of Proposed Facility	$3,000	$13,152	$0	$0	$0	$0	$3,000	
Total Replacement Cost:								
To Replace 25% of Proposed Facility		**$3,369,032**		**$0**		**$0**		
To Replace 50% of Proposed Facility		**$6,738,064**		**$0**		**$0**		
To Replace 100% of Proposed Facility	**$3,074,000**	**$13,476,127**	**$0**	**$0**	**$0**	**$0**	**$3,074,000**	

REPLACEMENT FUND SUMMARY:	PIPE/INFRASTRUCTURE		PUMPS/ELEC		STORAGE	
	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50	YEARS 1 - 25	YEARS 26 - 50
Annual Deposit Required (Assume Equal Deposit Made Each Year Through Life Cycle of Facility):						
To Replace 25% of Proposed Facility	$29,868	$29,868	$0	$0	$0	$0
To Replace 50% of Proposed Facility	$59,736	$59,736	$0	$0	$0	$0
To Replace 100% of Proposed Facility	$119,473	$119,473	$0	$0	$0	$0
Deposit Required at **Year 1** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$15,831		$0		$0	
To Replace 50% of Proposed Facility	$31,662		$0		$0	
To Replace 100% of Proposed Facility	$63,324		$0		$0	
Deposit Required at **Year 25** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$32,181		$0		$0	
To Replace 50% of Proposed Facility	$64,363		$0		$0	
To Replace 100% of Proposed Facility	$128,725		$0		$0	
Deposit Required at **Year 50** (Assume Deposits Increase at the Rate of Inflation):						
To Replace 25% of Proposed Facility	$67,381		$0		$0	
To Replace 50% of Proposed Facility	$134,761		$0		$0	
To Replace 100% of Proposed Facility	$269,523		$0		$0	

OVERALL REPLACEMENT FUND SUMMARY:		
Component	**Probable % Replaced**	**Life Cycle Years**
Pipelines	25%	50
Well Supply/Pumping	100%	25
Storage	25%	50
Annual Deposit Required (Equal Deposit Each Year)		
Years 1-25		$29,868
Years 26-50		$29,868
Annual Deposit Required (Deposits Increase at Rate of Inflation)		
Year 1		$15,831
Year 25		$32,181
Year 50		$67,381

LIFE CYCLE COSTS:

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Capital Expenses:	**$3,071,000**													
Replacement Expenses:														
For 25% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pump/Electrical Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$15,831	$16,306	$16,795	$17,299	$17,818	$18,353	$18,903	$19,470	$20,054	$20,656	$21,276	$21,914	$22,571
Interest		$0	$475	$978	$1,512	$2,076	$2,673	$3,303	$3,970	$4,673	$5,415	$6,197	$7,021	$7,889
End of Year Balance		**$15,831**	**$32,612**	**$50,386**	**$69,196**	**$89,090**	**$110,116**	**$132,322**	**$155,762**	**$180,489**	**$206,560**	**$234,032**	**$262,967**	**$293,428**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$31,662	$32,612	$33,590	$34,598	$35,636	$36,705	$37,806	$38,941	$40,109	$41,312	$42,551	$43,828	$45,143
Interest		$0	$950	$1,957	$3,023	$4,152	$5,345	$6,607	$7,939	$9,346	$10,829	$12,394	$14,042	$15,778
End of Year Balance		**$31,662**	**$65,224**	**$100,771**	**$138,393**	**$178,180**	**$220,231**	**$264,644**	**$311,524**	**$360,979**	**$413,120**	**$468,065**	**$525,935**	**$586,855**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$63,324	$65,224	$67,181	$69,196	$71,272	$73,410	$75,613	$77,881	$80,217	$82,624	$85,103	$87,656	$90,285
Interest		$0	$1,900	$3,913	$6,046	$8,304	$10,691	$13,214	$15,879	$18,691	$21,659	$24,787	$28,084	$31,556
End of Year Balance		**$63,324**	**$130,448**	**$201,543**	**$276,785**	**$356,361**	**$440,462**	**$529,289**	**$623,048**	**$721,957**	**$826,240**	**$936,130**	**$1,051,869**	**$1,173,711**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 50% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 100% of System):														
Deposits		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Operations and Maintenance Expenses:														
Staff Salaries[4]		$10,000	$10,300	$10,609	$10,927	$11,255	$11,593	$11,941	$12,299	$12,668	$13,048	$13,439	$13,842	$14,258
Benefits[4]		$2,020	$2,081	$2,143	$2,207	$2,274	$2,342	$2,412	$2,484	$2,559	$2,636	$2,715	$2,796	$2,880
Transportation Costs[4]		$2,300	$2,369	$2,440	$2,513	$2,589	$2,666	$2,746	$2,829	$2,914	$3,001	$3,091	$3,184	$3,279
Utilities, Phones, Communications[4]		$730	$752	$774	$798	$822	$846	$872	$898	$925	$952	$981	$1,010	$1,041
Maintenance, Small Repairs, Supplies[4]		$1,400	$1,442	$1,485	$1,530	$1,576	$1,623	$1,672	$1,722	$1,773	$1,827	$1,881	$1,938	$1,996
Contracted Labor Costs[4]		$3,450	$3,554	$3,660	$3,770	$3,883	$3,999	$4,119	$4,243	$4,370	$4,501	$4,637	$4,776	$4,919
Total East Canal O&M Expenses		**$19,900**	$20,497	$21,112	$21,745	$22,398	$23,070	$23,762	$24,474	$25,209	$25,965	$26,744	$27,546	$28,373
Administration[5]		$11,800	$12,154	$12,519	$12,894	$13,281	$13,679	$14,090	$14,513	$14,948	$15,396	$15,858	$16,334	$16,824
Total East Canal O&M + Aministration Expenses		**$31,700**	**$32,651**	**$33,631**	**$34,639**	**$35,679**	**$36,749**	**$37,851**	**$38,987**	**$40,157**	**$41,361**	**$42,602**	**$43,880**	**$45,197**
Pumping Power Expense		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**

Year	14	15	16	17	18	19	20	21	22	23	24	25
Capital Expenses:												
Replacement Expenses:												
For 25% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pipeline and Infrastructure Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Pump/Electrical Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 25% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 50% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
For 100% Storage Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$23,249	$23,946	$24,664	$25,404	$26,166	$26,951	$27,760	$28,593	$29,451	$30,334	$31,244	$32,181
Interest	$8,803	$9,764	$10,776	$11,839	$12,956	$14,130	$15,362	$16,656	$18,013	$19,437	$20,930	$22,496
End of Year Balance	**$325,479**	**$359,189**	**$394,629**	**$431,873**	**$470,995**	**$512,076**	**$555,199**	**$600,447**	**$647,911**	**$697,683**	**$749,857**	**$804,534**
Pipeline RPipeline and Infrastructure Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$46,497	$47,892	$49,329	$50,809	$52,333	$53,903	$55,520	$57,185	$58,901	$60,668	$62,488	$64,363
Interest	$17,606	$19,529	$21,551	$23,678	$25,912	$28,260	$30,725	$33,312	$36,027	$38,875	$41,861	$44,991
End of Year Balance	**$650,958**	**$718,379**	**$789,259**	**$863,745**	**$941,990**	**$1,024,153**	**$1,110,397**	**$1,200,895**	**$1,295,822**	**$1,395,365**	**$1,499,714**	**$1,609,068**
Pipeline Pipeline and Infrastructure Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$92,994	$95,784	$98,657	$101,617	$104,666	$107,806	$111,040	$114,371	$117,802	$121,336	$124,976	$128,725
Interest	$35,211	$39,057	$43,103	$47,356	$51,825	$56,519	$61,449	$66,624	$72,054	$77,749	$83,722	$89,983
End of Year Balance	**$1,301,916**	**$1,436,758**	**$1,578,518**	**$1,727,490**	**$1,883,981**	**$2,048,305**	**$2,220,794**	**$2,401,789**	**$2,591,645**	**$2,790,730**	**$2,999,428**	**$3,218,137**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Pump/Electrical Equipment Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 25% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 50% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Storage Replacement Fund (For Funding Replacement of 100% of System):												
Deposits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End of Year Balance	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Operations and Maintenance Expenses:												
Staff Salaries[4]	$14,685	$15,126	$15,580	$16,047	$16,528	$17,024	$17,535	$18,061	$18,603	$19,161	$19,736	$20,328
Benefits[4]	$2,966	$3,055	$3,147	$3,242	$3,339	$3,439	$3,542	$3,648	$3,758	$3,871	$3,987	$4,106
Transportation Costs[4]	$3,378	$3,479	$3,583	$3,691	$3,802	$3,916	$4,033	$4,154	$4,279	$4,407	$4,539	$4,675
Utilities, Phones, Communications[4]	$1,072	$1,104	$1,137	$1,171	$1,207	$1,243	$1,280	$1,318	$1,358	$1,399	$1,441	$1,484
Maintenance, Small Repairs, Supplies[4]	$2,056	$2,118	$2,181	$2,247	$2,314	$2,383	$2,455	$2,529	$2,604	$2,683	$2,763	$2,846
Contracted Labor Costs[4]	$5,066	$5,218	$5,375	$5,536	$5,702	$5,873	$6,050	$6,231	$6,418	$6,611	$6,809	$7,013
Total East Canal O&M Expenses	$29,224	$30,101	$31,004	$31,934	$32,892	$33,878	$34,895	$35,942	$37,020	$38,130	$39,274	$40,453
Administration[5]	$17,329	$17,849	$18,384	$18,936	$19,504	$20,089	$20,691	$21,312	$21,951	$22,610	$23,288	$23,987
Total East Canal O&M + Aministration Expenses	**$46,553**	**$47,949**	**$49,388**	**$50,869**	**$52,395**	**$53,967**	**$55,586**	**$57,254**	**$58,971**	**$60,740**	**$62,563**	**$64,440**
Pumping Power Expense	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Year	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

NOTES:
1) Total Field Cost is from the Engineer's Opinion of Probable Costs, which includes construction costs and contingency.
2) Current Cost is equal to the Engineer's opinion of the probable total field cost for the project at beginning of project life. Total field costs have been separated into Pipeline and Ditch Lining costs for the life cycle cost analysis because the pipeline and ditch lining have different life cycles.
3) Future cost is value at end of life cycle of the facility, or the current cost inflated at the rate shown through the life cycle of the facility.
4) Salary assumes the equiavalent of 1/10 full-time employee.

MVID Alternatives Evaluation Report
Life Cycle Cost Analysis (Cont.)
Alternative 4E - Groundwater Well Supply and Pressurized Delivery Systems to Upper East Side

Input Cells - Assumed or Given Values
Input Cells - Adjust Using Goal Seek Tool to Make Replacement Account Balance at end of Life Cycle Equal to Future Value of Replacement Cost

TOTAL REPLACEMENT COST SUMMARY: (ESTIMATED PRESENT VALUE OF REPLACEMENT COSTS THROUGH 50-YEAR LIFE OF OVERALL PROJECT)	**PIPE/ INFRA.**	**PUMPS**	**STORAGE**	**OVERALL PROJECT**
Probable % of Facility Replaced	25%	100%	25%	
Life Cycle of Facility	50	25	50	
Assumes Equal Deposit Made to Replacement Fund Each Year:				
Overall (Per Probable % of Facility Replaced)				**$768,500**
25% Replacement	$768,500	$0	$0	
50% Replacement	$1,537,000	$0	$0	
100% Replacement	$3,074,000	$0	$0	
Assumes Deposits to Replacement Fund Increase at Rate of Inflation:				
Overall (Per Probable % of Facility Replaced)				**$768,500**
25% Replacement	$768,500	$0	$0	
50% Replacement	$1,537,000	$0	$0	
100% Replacement	$3,074,000	$0	$0	

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,369,032
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$6,738,064
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13,476,127
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$33,147	$34,141	$35,165	$36,220	$37,307	$38,426	$39,579	$40,766	$41,989	$43,249	$44,547	$45,883	$47,259	$48,677	$50,138	$51,642	$53,191	$54,787	$56,430	$58,123	$59,867	$61,663	$63,513	$65,418	$67,381
$24,136	$25,855	$27,654	$29,539	$31,512	$33,576	$35,736	$37,996	$40,359	$42,829	$45,412	$48,110	$50,930	$53,876	$56,952	$60,165	$63,519	$67,021	$70,675	$74,488	$78,466	$82,616	$86,945	$91,458	$96,165
$861,817	**$921,813**	**$984,633**	**$1,050,392**	**$1,119,211**	**$1,191,213**	**$1,266,529**	**$1,345,291**	**$1,427,639**	**$1,513,717**	**$1,603,675**	**$1,697,669**	**$1,795,858**	**$1,898,411**	**$2,005,501**	**$2,117,308**	**$2,234,018**	**$2,355,825**	**$2,482,930**	**$2,615,541**	**$2,753,874**	**$2,898,153**	**$3,048,610**	**$3,205,487**	**$0**
$66,294	$68,282	$70,331	$72,441	$74,614	$76,852	$79,158	$81,533	$83,979	$86,498	$89,093	$91,766	$94,519	$97,354	$100,275	$103,283	$106,382	$109,573	$112,860	$116,246	$119,734	$123,326	$127,025	$130,836	$134,761
$48,272	$51,709	$55,309	$59,078	$63,024	$67,153	$71,473	$75,992	$80,717	$85,658	$90,823	$96,221	$101,860	$107,751	$113,905	$120,330	$127,038	$134,041	$141,349	$148,976	$156,932	$165,232	$173,889	$182,917	$192,329
$1,723,634	**$1,843,625**	**$1,969,265**	**$2,100,784**	**$2,238,421**	**$2,382,427**	**$2,533,057**	**$2,690,582**	**$2,855,278**	**$3,027,435**	**$3,207,351**	**$3,395,337**	**$3,591,716**	**$3,796,822**	**$4,011,002**	**$4,234,615**	**$4,468,035**	**$4,711,650**	**$4,965,859**	**$5,231,082**	**$5,507,748**	**$5,796,306**	**$6,097,220**	**$6,410,973**	**$0**
$132,587	$136,565	$140,662	$144,882	$149,228	$153,705	$158,316	$163,066	$167,958	$172,996	$178,186	$183,532	$189,038	$194,709	$200,550	$206,567	$212,764	$219,146	$225,721	$232,493	$239,467	$246,651	$254,051	$261,672	$269,523
$96,544	$103,418	$110,618	$118,156	$126,047	$134,305	$142,946	$151,983	$161,435	$171,317	$181,646	$192,441	$203,720	$215,503	$227,809	$240,660	$254,077	$268,082	$282,699	$297,952	$313,865	$330,465	$347,778	$365,833	$384,658
$3,447,268	**$3,687,251**	**$3,938,530**	**$4,201,568**	**$4,476,843**	**$4,764,853**	**$5,066,115**	**$5,381,164**	**$5,710,556**	**$6,054,869**	**$6,414,701**	**$6,790,674**	**$7,183,432**	**$7,593,644**	**$8,022,003**	**$8,469,230**	**$8,936,071**	**$9,423,299**	**$9,931,719**	**$10,462,163**	**$11,015,495**	**$11,592,611**	**$12,194,441**	**$12,821,946**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
$20,938	$21,566	$22,213	$22,879	$23,566	$24,273	$25,001	$25,751	$26,523	$27,319	$28,139	$28,983	$29,852	$30,748	$31,670	$32,620	$33,599	$34,607	$35,645	$36,715	$37,816	$38,950	$40,119	$41,323	$42,562
$4,229	$4,356	$4,487	$4,622	$4,760	$4,903	$5,050	$5,202	$5,358	$5,518	$5,684	$5,855	$6,030	$6,211	$6,397	$6,589	$6,787	$6,991	$7,200	$7,416	$7,639	$7,868	$8,104	$8,347	$8,598
$4,816	$4,960	$5,109	$5,262	$5,420	$5,583	$5,750	$5,923	$6,100	$6,283	$6,472	$6,666	$6,866	$7,072	$7,284	$7,503	$7,728	$7,960	$8,198	$8,444	$8,698	$8,959	$9,227	$9,504	$9,789
$1,528	$1,574	$1,622	$1,670	$1,720	$1,772	$1,825	$1,880	$1,936	$1,994	$2,054	$2,116	$2,179	$2,245	$2,312	$2,381	$2,453	$2,526	$2,602	$2,680	$2,761	$2,843	$2,929	$3,017	$3,107
$2,931	$3,019	$3,110	$3,203	$3,299	$3,398	$3,500	$3,605	$3,713	$3,825	$3,939	$4,058	$4,179	$4,305	$4,434	$4,567	$4,704	$4,845	$4,990	$5,140	$5,294	$5,453	$5,617	$5,785	$5,959
$7,224	$7,440	$7,663	$7,893	$8,130	$8,374	$8,625	$8,884	$9,151	$9,425	$9,708	$9,999	$10,299	$10,608	$10,926	$11,254	$11,592	$11,939	$12,298	$12,667	$13,047	$13,438	$13,841	$14,256	$14,684
$41,666	$42,916	$44,204	$45,530	$46,896	$48,303	$49,752	$51,244	$52,781	$54,365	$55,996	$57,676	$59,406	$61,188	$63,024	$64,915	$66,862	$68,868	$70,934	$73,062	$75,254	$77,511	$79,837	$82,232	$84,699
$24,707	$25,448	$26,211	$26,998	$27,807	$28,642	$29,501	$30,386	$31,298	$32,236	$33,204	$34,200	$35,226	$36,282	$37,371	$38,492	$39,647	$40,836	$42,061	$43,323	$44,623	$45,962	$47,340	$48,761	$50,223
$66,373	**$68,364**	**$70,415**	**$72,527**	**$74,703**	**$76,944**	**$79,253**	**$81,630**	**$84,079**	**$86,601**	**$89,199**	**$91,875**	**$94,632**	**$97,471**	**$100,395**	**$103,407**	**$106,509**	**$109,704**	**$112,995**	**$116,385**	**$119,877**	**$123,473**	**$127,177**	**$130,992**	**$134,922**
$0	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50