FIRST LEVEL SCREENING – *WEEG 2015*

APPLICANT NAME: Marion Upper Ditch Company	**CONTROL NUMBER:** 53
APPLICANT LOCATION: Kamas, UT	**TASK AREA:** AB
PROJECT NAME: Marion Upper & Lower Ditches Piping Project	**BOR $:** 1,000,000 **Cost Share $:** 1,480,500

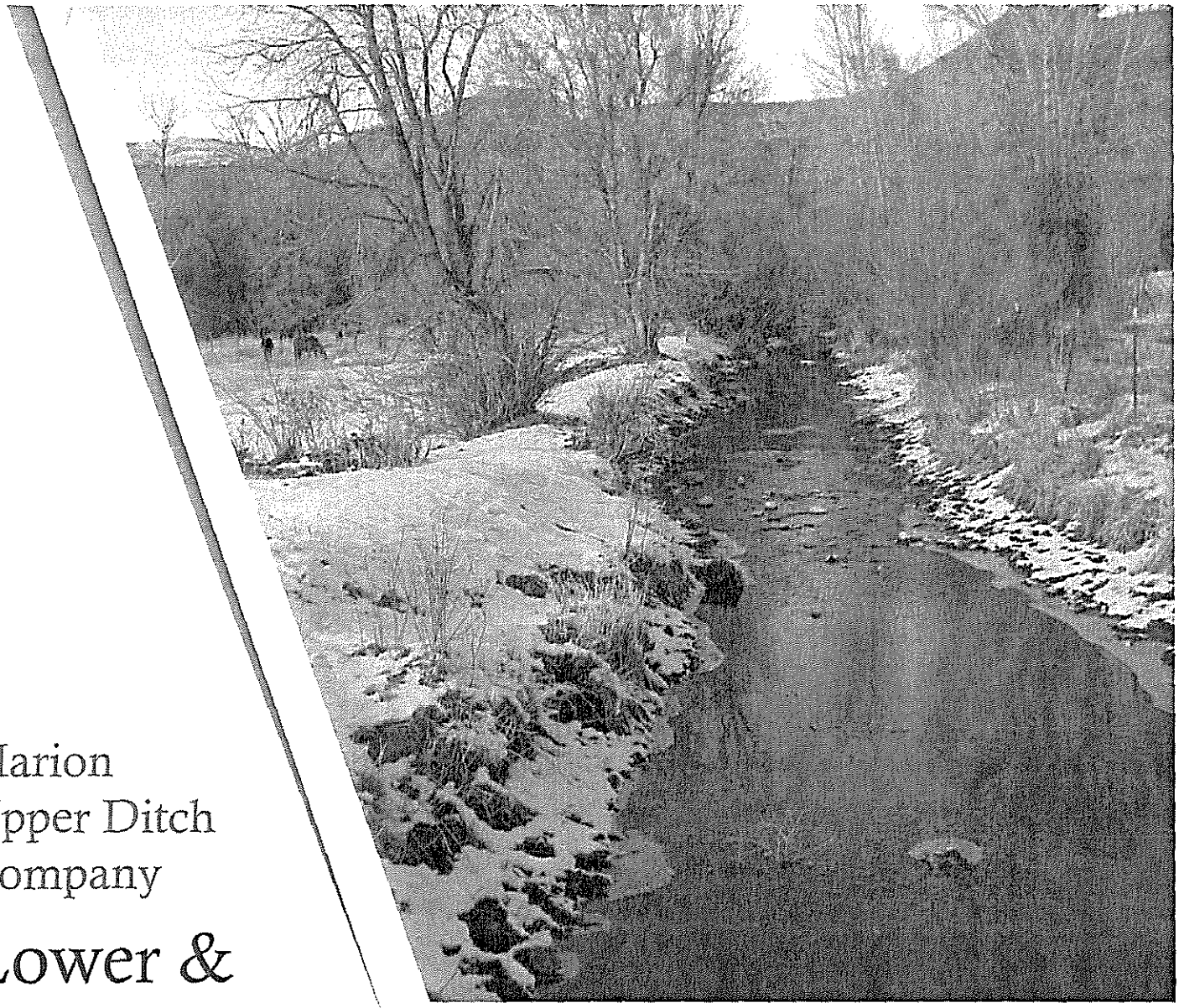
	SCREENING FACTOR	COMPLETE	COMMENTS
1	Eligibility requirements		
	• Eligible applicant in a Reclamation state	✓YES __NO	
	• 50% or more non-Federal cost share	✓YES __NO	
	• Authorized funding amount ($1 Million total – no more than $500,000 a year)	✓YES __NO	Year-to-year funding not addressed
	• Funding Group I or II	__I ✓II	
	• Length of project (9/30/17 – FG I or 9/30/18 – FG II)	✓YES __NO	10/31/17
2	Proper format and length (75 pages)	__YES __NO	
3	Proposal content		
	• SF-424 (authorized signature)	✓YES __NO	g.gov
	• SF-424B or SF-424D (authorized signature)	✓YES __NO	g.gov
	• Title page	✓YES __NO	
	• Table of contents	✓YES __NO	
	TECHNICAL PROPOSAL/EVALUATION CRITERIA (No More Than 50 Pages)		
	• Executive summary	✓YES __NO	
	• Background data	✓YES __NO	
	• Technical Project description	✓YES __NO	
	• Evaluation Criteria	✓YES __NO	
	• Project Benefits/Performance Measures	✓YES __NO	
	• Potential Environmental Impact Desc.	✓YES __NO	
	• Required Permits/Approvals, if applicable	✓YES __NO	will obtain
	• Letters of Project Support	✓YES __NO	
	• Official Resolution (Required 30 Days After)	__YES ✓NO	w/in 30 days
	PROJECT BUDGET		
	• Funding Plan	✓YES __NO	
	• Letters of Funding Commitment	__YES ✓NO	$1,030,500 requested from UT WRB
	• Budget Proposal	✓YES __NO	
	• Budget Narrative	✓YES __NO	Light
	• SF-424A or SF-424C	✓YES __NO	

1st Level Screening Comments (Screening Committee Member):

Summary Comments (Grants Officer):

Applicant is eligible for consideration during the Second Level Evaluation phase X **Yes** ____ **No**

Grants Officer _____ **Date** 1/26/15



Marion
Upper Ditch
Company

Lower & Upper Ditch Piping Project

WaterSMART: Water & Energy Efficiency Grants for FY2015

FOA No. R15AS00002

Applicant Contact

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150 West 2100 North
Kamas, UT 84036

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Executive Summary

Applicant Info

The date, applicant name, city, county, and state

» Date: January 23, 2015

» Applicant name: Marion Upper Ditch Company (MUDC)

» City, County, State: Oakley, Summit County, Utah

» Project Manager
  - Name: Brian Deeter, PE
  - Title: Project Manager/Engineer
  - Telephone: (801) 547- 0393
  - E-mail:brd@jub.com

» Project funding request: $1,000,000

Project Summary

The Marion Upper & Lower Ditch Piping Project will include piping two ditches one within the Marion Upper Ditch Company (MUDC) and the other within the Marion Lower Ditch Company (MLDC). In a water loss study performed by NRCS it was determined that the Marion Ditches (Upper and Lower) had measured seepage water losses of 38%. This project will combine, enclose, pressurize, and meter two existing open, gravity-flow ditches. By combining and enclosing the ditches water seepage, evaporation and waste out the end of the ditches will be eliminated. The project includes replacing 7.9 miles of open ditch with 6.25 miles of pressurized pipe with pipe diameters ranging from 14 inches to 32 inches and installing 4 meters. Several of the shareholders on the canal currently use pumps to pressurize their water for irrigation. Many of the pumps will be removed with the development of this project and associated energy costs will be reduced.

This project will conserve a total of 2,919 acre-feet annually

- 2,562 acre-feet in conveyance losses
- 357 acre-feet lost as spill water at the end of the ditches

By reducing and eliminating pumps, more than **74,598 kWh per year of energy will be saved at a cost savings to users of $2,844.20 each year.**

This project includes the design and installation of a micro-hydro power generation unit. By using the excess pressure, approximately **10,656 kWh can be generated each year**.

The Marion Upper Ditch Company is the applicant, will provide the matching funds, and will manage the project. This project will benefit both the Upper and Lower Ditch Companies and all users. Historically there has been conflict between the Marion Upper and Marion Lower Ditch Companies regarding water usage. This project will be a cooperative effort with both companies collaborating to implement these system improvements.

Schedule

State the length of time and estimated completion date for the project

The Marion Upper and Lower Ditch Project will be completed over a period of two years. Environmental and design will begin in October 2015 and will be completed by July of 2016. Following design, construction will begin in October of 2016 and be completed by May of 2017. The project will be put into service and final reporting will be done in April and May 2017.

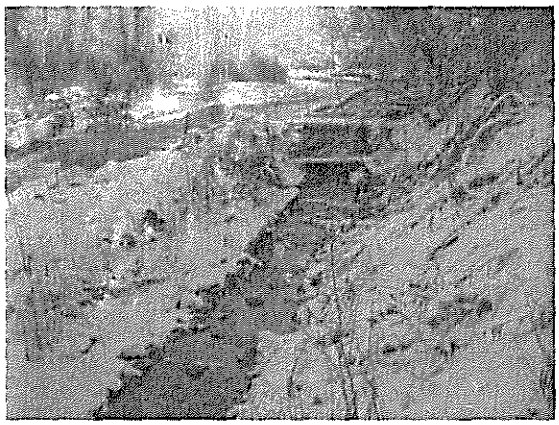
Federal Facility

Whether or not the project is located on a Federal Facility

Water conserved by this project will directly benefit the Echo and Smith & Morehouse reservoirs and the Rockport Reservoir downstream.

Both of the Ditch Companies receive their water from a Weber River diversion and have rights to water in Echo Reservoir – part of Reclamation's Weber River Project.

Background Data



The Marion Upper and Lower Ditches are located in the Kamas Valley in unincorporated Summit County. The service area is bordered by the cities of Oakley and Kamas and is 45 miles (72 km) east of Salt Lake City. With an elevation of 6,500 feet, this area it is a gateway to the Uinta Mountains. The scenic route Weber Canyon Road follows the Weber River to its headwaters; it also follows the Smith and Morehouse Creek to its reservoir in its own scenic canyon 15 miles (24 km) from Oakley. Other neighboring towns are Marion and Peoa. (Please see Attachment A for Project Location Map)

Water Supply

Describe the source of water supply, the water rights involved, current water uses (i.e., agricultural, municipal, domestic, or industrial), the number of water users served, and the current and projected water demand. Also, identify potential shortfalls in water supply. If water is primarily used for irrigation, describe major crops and total acres served.

The Marion Upper and Lower Ditches share a common diversion out of the Weber River just north of Oakley Utah. They also share a common channel for the first 2,400 feet after the diversion. Roughly 80% of the service area is irrigated using sprinkler systems with a large percentage relying on pumping to provide the required pressure. The development of this project will conserve 3,222 acre-feet of water per year. This project will conserve a large volume of water lost due to seepage and over allocation as well as reduce energy use and costs as it eliminates pumps and/or reduces pump sizes used to operate sprinklers.

√ *Source of water supply*: Both of the Marion Ditches Company's water is supplied by a diversion from the Weber River, Echo Reservoir and the Smith & Morehouse Reservoir. They also have a water right on Seymour Spring which can provide up to .28 cfs. The ditch companies take flood water from the Weber River first, after the river flows lower they are required to irrigate from their storage water in the reservoirs.

√ *Water Rights*: The Marion Ditch Companies hold the following water rights:

Marion Upper Ditch Company

Water Right #	Volume (acre-feet)	Source	Nature of Use	Acreage
35-8676	1503.7	Weber River	Irrigation	487.9
35-10314	151.1	Weber River	Irrigation	63.7
35-1685	204.4	Seymour Spring	Irrigation	551.6

Marion Lower Ditch Company

Water Right #	Flow (cfs)	Source	Nature of Use	Acreage
35-8643	11.76	Weber River	Irrigation	Unevaluated
35-8663	8.56	Weber River	Irrigation	Unevaluated

√ *Current water uses*:

MUDC has 9 shareholders and MLDC has 8 shareholders. The nature of the water use is 100% agricultural.

√ *Current and projected water demand*:

The average annual water demand in both the Upper and Lower Ditches is 6,743 acre-feet. In normal years, they may have a small holdover of 30 to 42 acre-feet. During drier years, they will use their entire water right. The following tables show the water deliveries over the last five years.

UPPER MARION DITCH Natural Flow and Storage Water Deliveries

Year	From River (acre-feet)	From Reservoir (acre-feet)
2009	4140	512
2010	2920	524
2011	3503	522
2012	2204	541
2013	2741	664
5-yr Average	3101.6	552.6

LOWER MARION DITCH Natural Flow and Storage Water Deliveries

Year	From River (acre-feet)	From Reservoir (acre-feet)
2009	3124	448
2010	2604	436
2011	2902	428
2012	1962	538
2013	2398	603
5-yr Average	2598	490.6

The State of Utah Governor's Office of Planning and Budget created an Economic and Demographic Projections Report which shows Summit County as the 3rd fastest growing county in the State with a growth rate of 2.2% over the last 10 years. This significant growth has already began to impact the Kamas Valley and will place additional demands on the water supply as more residential and commercial development comes to this area.

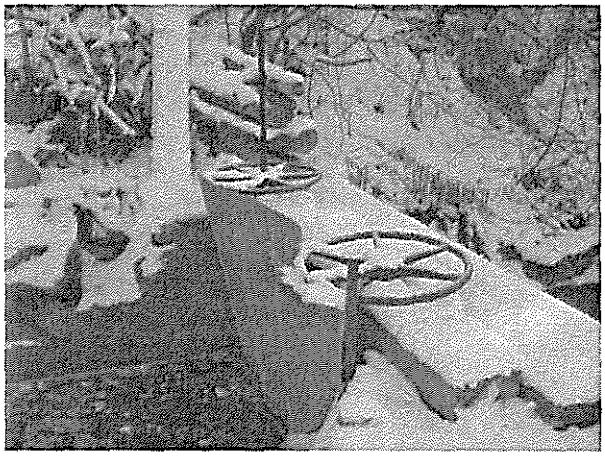
√ *Potential shortfalls in water supply*: Because of losses in the system, the Companies often face water shortages at the end of the irrigation season. To compensate for water losses, additional water is released in the ditch in order to reach the users at the end of the line.

Drought is also a threat to their water supply and has caused the Companies to deplete their water storage twice in the last 10 years.

√ *Crops and total acres served*: The Marion Upper Ditch serves approximately 552 acres and Lower Ditch approximately 508 acres for a total of 1,060 acres served. Major crops include hay, alfalfa, grasses and grains. At least 50% of the irrigated acreage is farm land that provides the livelihood for these local farmers.

Water Delivery System

Describe the applicant's water delivery system as appropriate. For agricultural systems, please include the miles of canals, miles of laterals, and existing irrigation improvements (i.e., type, miles, and acres). For municipal systems, please include the number of connections and/or number of water users served and any other relevant information describing the system.



The Marion Upper and Lower Ditches have a common diversion at the Weber River; 2,400 feet downstream of the Weber River diversion the main canal splits into the Upper Marion and Lower Marion Ditches. The Upper Ditch has a 22,600-foot waterway that covers 552 acres of irrigated lands. The Marion Lower Ditch comprises a 19,000 foot waterway irrigating 508 acres. Some of the Lower Ditch's water is delivered via 3,100 feet of an existing 18-inch pipe from the Upper Ditch. This was constructed in 1997 to provide pressure to 288 acres of the Lower Ditch service area. This portion of gravity-fed pipe will remain in place. One share of water is allocated to each acre watered. This project will impact 100% of the total service area and 100% of the users. The project will combine two ditches and will result in approximately 31,000 feet of pressurized pipe replacing about 42,000 feet of open ditch.

Energy Efficiency

If the application includes renewable energy or energy efficiency elements, describe existing energy sources and current energy uses.

Pumps are used by 43% of the Marion Ditch Companies' water users. This project will eliminate pumps required by users and reduce electrical loads on many others. The current

electrical load on all of the user pumps is 112 kW. This project will reduce that total load by 27% to 82 kW. This will save $2,844 and 74,598 kWh annually.

Part of this project will be the design and installation of a micro-hydro power generation unit to take advantage of the excess pressure that will be created on the water system. It is estimated that this will produce 10,656 kWh per year.

Relationship with Reclamation

Identify any past working relationships with Reclamation. This should include the date(s), description of prior relationships with Reclamation, and a description of the projects(s).

MUDC and MLDC both receive Reclamation project water from Echo Reservoir –part of Reclamation's Weber River Project.

Water conserved by this project will directly benefit the Echo and Smith & Morehouse reservoirs and the Rockport Reservoir downstream, which are all Reclamation projects.

Technical Project Description

Describe the work in detail, including specific activities that will be accomplished as a result of this project. This description shall have sufficient detail to permit a comprehensive evaluation of the proposal.

This Project will replace 7.9 miles of open ditch with 6.25 miles of pressurized pipe. The existing diversion will remain but a new screening structure will be constructed. Four meters will be installed: one at the Weber River diversion and at three other locations within the system. See Attachment A for a map of the project location.

The ditches will be piped with HDPE pipe of varying pipe sizes ranging from 14 inches to 32 inches over the length of the project. The pipe will be installed within the existing ditches. At street crossings, the pipe will be installed in existing culverts or by an open cut across the pavement depending on existing conditions. As the pipeline is constructed, existing pumps will be eliminated where possible. However if pumps are still required, the irrigators will be able to replace the existing pump with smaller pumps. **It is estimated that by eliminating and downsizing pumps $2,844 and 74,598 kWh will be saved annually.**

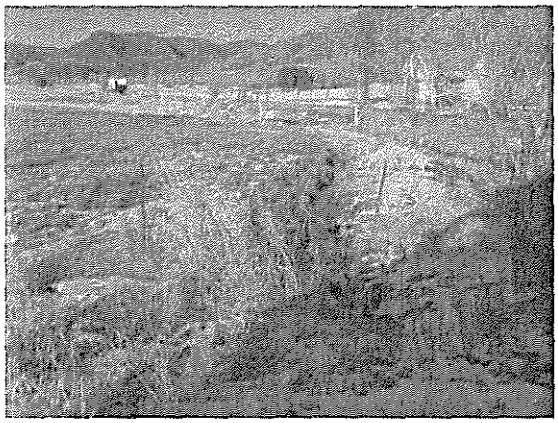
The 2,919 acre-feet of water conserved will help meet the demands during drought years and will allow both Companies to have sufficient supply from their Weber River Diversions. This allows the water that currently flows into the Upper Ditch from Seymour Spring to be made available for lease within the service area. Because of the quality of the spring, this water could feasibly be used for culinary or secondary water in Oakley City to reduce the strain on their City's water system.

Evaluation Criteria

Evaluation Criteria A: Water Conservation

Subcriterion A.1: Quantifiable Water Savings

Describe the amount of water saved. *For projects that conserve water, please state the estimated amount of water expected to be conserved (in acre-feet per year) as a direct result of this project. Please provide sufficient detail supporting how the estimate was determined, including all supporting calculations.*



A 2014 study conducted by the NRCS of the Marion Ditches concluded that 38% of the water is being lost to seepage in the open ditches. (See Attachment B for NRCS Water Loss Study) There is also 1 cfs flowrate of "carry water" that is required to get the water in the ditch to the end users. This water spills at the end and is also lost to the system. With this project 2,919 acre-feet of water will be conserved. The 2,919 acre-feet is based on the following calculations.

Total diversion x 38% = seepage losses

6,743 acre-feet x 38% = 2,562 acre-feet

"Carry Water" x irrigation season = "carry water" spilled at end of ditch

1 cfs x 1.98 acre-feet per day/cfs x 180 days = 357 acre-feet

Total water conserved = 2,562 acre-feet + 357 acre-feet = 2,919 acre-feet

- *Average annual acre-feet of water supply.*

The average annual water supply for the Marion Ditch Companies is 6,743 acre-feet.

- *Where is the water currently going ((e.g., back to the stream, spilled at the end of the ditch, seeping into the ground, etc.)?*

Most of the water is lost through seepage into the underlying gravels, root uptake, and evaporation. 1 cfs of "carry water" is also spilled at the end of the ditch. This is required to "carry" water to the end users.

- *Where will the conserved water go?*

Conserved water will provide first to allow shareholders their full allocation of water, then available for downstream users including Echo Reservoir and Rockport Reservoir.

(1) Canal Lining/Piping

a) *How has the estimated average annual water savings that will result from the project been determined? Please provide all relevant calculations, assumptions, and supporting data.*

A 2014 study conducted by the NRCS of the Marion Ditches concluded that 38% of the water is being lost to seepage in the open ditches. (See Attachment B for NRCS Water Loss Study) There is also 1 cfs flowrate of "carry water" that is required to get the water in the ditch to the end users. This is also lost to the system. With this project 2,919 acre-feet of water will be conserved. The 2,919 acre-feet is based on the following calculations.

Total diversion * 38% = seepage losses

6,743 acre-feet * 38% = 2,562 acre-feet

"Carry Water" * irrigation season = "carry water" lost at end of ditch

1 cfs * 1.98 acre-feet per day/cfs * 180 days = 357 acre-feet

Total water conserved = 2,562 acre-feet + 357 acre-feet = 2,919 acre-feet

b) *How have average annual canal seepage losses been determined? Have ponding and/or inflow/outflow tests been conducted to determine seepage rates under varying conditions? If so, please provide detailed descriptions of testing methods and all results. If not, please provide an explanation of the method(s) used to calculate seepage losses. All estimates should be supported with multiple sets of data/measurements from representative sections of canals.*

The NRCS conducted an inflow/outflow test to determine the seepage losses in the ditch. The NRCS used an Acoustic Doppler Current Profiler (ADCP) – StreamPro to measure the canal at multiple locations. Soil and geology data was also reviewed in the water loss study.

c) *What are the expected post-project seepage/leakage losses and how were these estimates determined (e.g., can data specific to the type of material being used in the project be provided)?*

Conveyance water losses and losses at the end of the system will be eliminated by the proposed project. The water system will be piped and enclosed with fused HDPE so no seepage, evaporation or spills will occur in the delivery system. With a closed system, no "carry" water will be needed and no water will spill out the end of the ditches.

d) *What are the anticipated annual transit loss reductions in terms of acre-feet per mile for the overall project and for each section of canal included in the project?*

Annual transit losses are 434 acre-feet per mile (2,562 acre-feet/5.9 miles) which is consistent for the entire project.

e) How will actual canal loss seepage reductions be verified?

Seepage loss reductions will be verified through monthly meter readings in the new pipeline. This data will then be analyzed and compared monthly to the historical meter reading and to the 2014 NRCS Water Loss Study. This comparison will determine the amount of water conserved.

f) Include a detailed description of the materials being used:

- 31,000 feet of HDPE pipe with diameters ranging from 14 inches to 32 inches.
- Mainline meters
- 15 turnouts will be constructed ranging in size from 2- to 18-inches.

Subcriterion A.2: Percentage of Total Supply

Provide the percentage of total water supply conserved: *State the applicant's total average annual water supply in acre-feet.*

Please use the following formula:

$$\frac{\text{2,919 acre-feet}}{\text{6,743 acre-feet}} = \mathbf{48\%}$$

Evaluation Criteria B: Energy-Water Nexus

Subcriterion B.1: Implementing Renewable Energy Projects Related to Water Management and Delivery

This project will include installing a micro-hydro power generation unit on one of the center pivot irrigation systems in order to generate power to run the electric pivot motor. The combination of an electrical center pivot and hydro turbine is generally a good match when available pressure exceeds the requirements of the irrigation system by 40 pounds per square inch (PSI) or more. This is the case with this proposed hydro project. The system receives irrigation water from a pressurized pipeline which provides 70 PSI of operating pressure at the pivot point, 40 PSI more than required to operate the pivot and the end gun.

The hydro project plan is to design and install the system using "pump to turbine technology" using proven equipment that has performed well in similar applications. For example, micro-hydro turbines made by Cornell Pump Company that work with a range of heads, flows and pressures. The basic method of sizing this system include: assessing the

flow (the volume of water passing through the pipe), determining the residual (additional) pressure available, calculating any pipe or other head and flow losses and evaluating the technical requirements of the irrigation system.

Describe the amount of energy capacity. *For projects that implement renewable energy systems, state the estimated amount of capacity (in kilowatts) of the system. Please provide sufficient detail supporting the stated estimate, including all calculations in support of the estimate.*

Net head available: 92 feet

Flow Rate: 250 gpm (0.56 cfs)

Efficiency: 85%

Maximum power generated = (Net head (feet) x flow (cfs) x efficiency x 62.4)/737 = 3.7 kW

Describe the amount of energy generated. *For projects that implement renewable energy systems, state the estimated amount of energy that the system will generate (in kilowatt hours per year). Please provide sufficient detail supporting the stated estimate, including all calculations in support of the estimate.*

With the proper piping and valving, this micro-turbine can operate continually throughout the irrigation season. The result would be a "net metering" scenario. Net metering is an electricity sales arrangement for consumers who develop small renewable energy facilities. Under a net metering agreement, generated electricity is used directly by an adjacent facility. Meters record electricity usage in both directions, meaning electricity can either be consumed from the grid or the excess generated electricity can be exported back onto the grid. In many cases, a generating facility might not use all the locally-generated electricity, resulting in a credit from the utility.

3.7 kW x 120 days x 24 hours = 10,656 kilowatt- hours per year

•*Expected environmental benefits of the renewable energy system*

This renewable energy project will reduce the required electricity generated by the local utility company reducing carbon-related emissions associated with coal-fired or natural-gas powered power generation facilities.

•*Any expected reduction in the use of energy currently supplied through a Reclamation project*

Power in the area is supplied from multiple sources. One of which is a hydro power generator at the nearby Rockport Reservoir, a Reclamation Project. The amount of power generated with this project is small enough that it will **not have** any impact on the Reclamation power generation facilities.

•Anticipated beneficiaries, other than the applicant, of the renewable energy system

Reducing the use of fossil fuels and carbon emissions benefits the environment as a whole. Easing the demand on local utilities benefits all utility users and keeps prices stable.

•Expected water needs of the renewable energy system

The expected water need to for this renewable energy project is the same amount of water that is already being delivered to the center pivot irrigation system. The water resource is already available for power generation.

Subcriterion No. B.2: Increasing Energy Efficiency in Water Management

Describe any energy efficiencies that are expected to result from implementation of the water conservation or water management project (e.g., reduced pumping).

•Please provide sufficient detail supporting the calculation of any energy savings expected to result from water conservation improvements. If quantifiable energy savings are expected to result from water conservation improvements, please provide sufficient details and supporting calculations. If quantifying energy savings, please state the estimated amount in kilowatt hours per year.

Pumps are used by 43% of the Marion Ditch Companies' water users. This project will eliminate some pumps and reduce electrical loads on all others. The current electrical load on these pumps is 112 kW. This project will reduce that load by 27% to 82 kW. This will save $2,844 and 74,598 kWh per year. This 74,598 kWh per year shown in the following calculations. (Please see Attachment C for full energy calculations.)

ENERGY SAVINGS ON THE MARION DITCHES					
Irrigated Acres	Existing Electrical Load	New Electrical Load	Electrical Load Savings	kWh savings	Financial Savings
22.4	8.55	7.24	1.32	2430.16	$91.65
46.7	17.83	15.08	2.74	5066.36	$193.17
96.4	36.80	31.70	5.096	9412.36	$358.87
133	50.78	41.40	9.37	17314.57	$660.15
42.7	16.30	14.30	2.00	3705.93	$141.30
22	8.40	0	8.40	15357.69	$591.49
30	11.45	0	11.45	21155.02	$806.58
			TOTALS	**74,598.05**	**$2,844.20**

•Please describe the current pumping requirements and the types of pumps (e.g., size) currently being used. How would the proposed project impact the current pumping requirements?

Of the 551.6 acres irrigated with the Upper Ditch water, 341.2 are irrigated using pumped water.

PUMPS ON MARION DITCH SYSTEM	
Size	Acres
2 – 7.5 HP	22.4
40 HP	46.7
50 HP	96.4
10 HP and 30 HP	133
40 HP VFD Pump	42.7
2 – 10 HP Pumps	22
10 HP Pump	30

Piping the canals will allow for the elimination of two of these pumps and reduce the electrical load on the other five saving $2,844.20 and 74,598.05 kWh in energy savings.

•Please indicate whether you energy savings estimate originates from the point of diversion, or whether the estimate is based upon an alternate site of origin.

The energy savings estimates are based on the point of diversion.

•Does the calculation include the energy required to treat the water?

No. The water supply is untreated irrigation water.

•Will the project result in reduced vehicle miles driven, in turn reducing carbon emissions? Please provide supporting details and calculations. Describe any renewable energy components that will result in minimal energy savings/production (e.g., installing small-scale solar as part of a SCADA system).

This project will help the Marion Ditch Companies manage their water more efficiently. They will no longer need to drive the ditches to conduct visual inspections as the system will now be enclosed. There will be savings in emissions/fuel but not substantial enough to calculate.

Evaluation Criterion C: Benefits to Endangered Species

For projects that will directly benefit federally-recognized candidate species, please include the following elements:

•What is the relationship of the species to water supply?

The U.S. Fish and Wildlife Service lists endangered species known to or believed to occur in Summit County. These species are listed as part of the Upper Colorado River Endangered Fish Recovery Program.

Humpback Chub (*Gila cypha*) - Endangered

Colorado pikeminnow (*Ptychocheilus Lucius)* – Endangered

Razorback sucker *(Xyrauchen texanus)* – Endangered

Bonytail (*Gila elegans)* - Endangered

This project enhances the flows in the Weber River and will therefore benefit the habitat of these sensitive species.

The Humpback Chub Recovery Plan identifies stream alteration for irrigation as a possible cause in the decline of the species: "The decline of the humpback chub may be due to a combination of factors such as: stream alteration (dams, irrigation, dewatering, and channelization)... Reductions in flows may have altered river hydraulics to the extent that humpback chub habitat has been reduced or altered significantly."

Colorado pikeminnow need high spring flows to "maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats".

This project will directly improve two factors found to contribute to the decline of the Colorado pikeminnow: water diverted from rivers and flood irrigation contributing to poor water quality.

The Utah Department of Natural Resources/Division of Wildlife Resources identifies the Bonneville cutthroat trout and Bluehead sucker as native fish species found in the Weber River. These species are covered by conservation agreements with the U.S. Fish and Wildlife Service. UDWR's approach to conserving and managing these species focuses on removing unnecessary barriers to fish migration. Stable and connecting flows are necessary for migration.

By conserving water and allowing for less flood irrigation the water will remain in the Weber River and local reservoirs which provide the habitat for these species.

•What is the extent to which the proposed project would reduce the likelihood of listing or would otherwise improve the status of these species?

This project enhances the flows in the Weber River and will therefore benefit the habitat of these sensitive species. The Weber River has been kept at the minimal fish load since the end of the 2014 irrigation season to conserve water in reservoirs due to low precipitation. When the projected annual water savings are realized by this project, approximately 75% of the water saved will remain in the reservoirs to enhance the fish and wildlife habitat and protect against drought and low river flows.

For projects that will directly accelerate the recovery of threatened or endangered species or address designated critical habitats, please include the following elements:

(1) How is the species adversely affected by a Reclamation project?

N/A

(2) Is the species subject to a recovery plan or conservation plan under the ESA?

Yes. The species listed are part of the Upper Colorado River Endangered Fish Program.

(3) What is the extent to which the proposed project would reduce the likelihood of listing or would otherwise improve the status of the species?

It is unknown whether the project will reduce the likelihood of list the species, but diverting less water from the Weber River and nearby reservoirs will make more water available to maintain the habitat of these species.

Evaluation Criterion D: Water Marketing

- *Estimated amount of water to be marketed*

  This project will allow .28 cfs of water from Seymour Springs to be available to lease to nearby cities or towns.

- *A detailed description of the mechanism through which water will be marketed (e.g., individual sale, contribution to an existing market, the creation of a new water market, or construction of a recharge facility)*

The water conserved by this project will allow the Marion Ditch Companies to discontinue the use of water from Seymour Springs. This water will now be potentially available to lease to neighboring Oakley City as culinary water or irrigation water for new customers. Oakley already uses a portion of Seymour Springs in their system. This project would allow them to use 100% of the spring. Oakley City and the surrounding areas have experienced significant growth and projections show that this population growth will continue. It is estimated that this could provide water for 20 new customers in Oakley City.

- *A description of any legal issues pertaining to water marketing(e.g., restrictions under Reclamation law or contracts, individual project authorities, or State water laws)*

Utah State Law does not allow for water marketing or banking at this time. However, the proposed scenario would be a lease of water to an existing system, which is allowed under law.

Evaluation Criterion E: Other Contributions to Water Supply Sustainability

Subcriterion E.1: Addressing Adaptation Strategies in a WaterSMART Basin Study

The Marion Ditch Companies' service area has not yet been included in a WaterSMART Basin Study. The Marion Ditches are located in the Weber River Basin and fall under the 2009 Utah State Water Plan *Weber River Basin: Planning for the Future*

Subcriterion E.2: Expediting Future On-Farm Irrigation Improvements

Include a detailed listing of the fields and acreage that may be improved in the future.

Upon completion of this project, the Marion Ditch Companies will require users to convert from flood irrigation to efficient sprinkler systems. The following table describes the acreage that can be converted.

Flood Irrigated Acreage in Marion Ditch Companies

Acreage	Current Irrigation Method	Water Saved through Sprinklers
11.5	Flood Irrigation	34.5
28.5	Flood Irrigation	85.5
27.5	Flood Irrigation	82.5
33.5	Flood Irrigation	100.5
TOTAL 101		303 acre-feet/year

- *Describe in detail the on-farm improvements that can be made as a result of this project. Include discussion of any planned or ongoing efforts by farmers/ranchers that receive water from the applicant.*

About 119.8 acres on the ditch are currently flood-irrigated wasting water, causing erosion, lowering water quality, and increasing mineral loads. This project will create the opportunity for on-farm sprinkler-usage so 101 acres can move from a flood-irrigation system to efficient sprinkler systems.

The Marion Ditch Companies have already received letters of intent from two water users to investigate the use of NRCS funding programs in converting from flood irrigation to sprinkler systems. (See "Letters of Project Support'.)

- *Provide a detailed explanation of how the proposed WaterSMART Grant project would help to expedite such on-farm efficiency improvements.*

Piping the system will create the pressures necessary to operate an on-farm sprinkling system on the acreage that is currently flood-irrigated.

- *Fully describe the on-farm water conservation or water use efficiency benefits that would result from the enabled on-farm component of this project. Estimate the potential on-farm water savings that could result in acre-feet per year. Include support or backup documentation for any calculations or assumptions.*

Paul W. Brown, in a paper presented at the 2008 UC Davis Alfalfa & Forage Symposium entitled "Flood vs. Pivot Irrigation for Forage Crops: What are the Advantages and Disadvantages" stated: "the potential annual savings associated with switching from flood to center pivot irrigation should fall in the range of 1.5 – 3.0 acre-feet/acre". **If 101 acres within Marion's service area used sprinklers rather than flood irrigation, it would result in 151.5 to 303 acre-feet saved per year.**

- *Projects that include significant on-farm irrigation improvements should demonstrate the eligibility, commitment, and number or percentage of shareholders who plan to participate in any available NRCS funding programs. Applicants should provide letters of intent from farmers/ranchers in the affected project areas.*

Two of the four water users that currently use flood irrigation have provided the Marion Ditch Companies with letters stating their intent to look into NRCS funding to convert from flood irrigation to efficient sprinkler systems.

- *Describe the extent to which this project complements an existing or newly awarded NRCS funded project.*

The Water Master estimates there have been 15-20 NRCS-sponsored improvement projects completed in the Marion service area over the last 40 years. This project will complement them by providing enough pressure to allow the last of those using flood irrigation to convert to sprinklers.

Subcriterion E.3: Building Drought Resiliency

- *Explain in detail the existing or recent drought conditions in the project area. Describe the severity and duration of drought conditions in the project area. Describe how the water source that is the focus of this project (river, aquifer, or other source of supply) is impacted by drought.*

Utah is the second driest state in the United States. Compounding the limited availability of water has been three years of below-average precipitation. At the end of the water year ending September 2014, total precipitation in the Weber/Ogden River Basin was at 32 inches. This is 20% below the 30-year average annual precipitation for this basin and is now the third year that has fallen between 20-30% below average. Soil moisture in the Weber River basin is at a 25-year low. Given the low amount of precipitation and unusually warm temperatures in the basin during the fall and early winter, it is anticipated that snowpack and precipitation will be below average again in 2015.

Reservoirs fed by the Weber River have also been impacted. As of July 1, 2014, the following reservoirs showed below-average storage amounts.

"If the Weber River does not come up and flow so that the rights of the water come up to a certain level, there will not be water in the Kamas and Oakley area for farmers to water their cattle,"

- Dave Ure Summit County Council

East Canyon Reservoir: 34% below average

Rockport Reservoir: 19.3% below average

Echo Reservoir: 39% below average

The Weber River has been kept at the minimal fish load since the end of the 2014 irrigation season to conserve water in reservoirs.

- *Describe the impacts that are occurring now or are expected to occur as a result of drought conditions. Provide a detailed explanation of how the proposed WaterSMART Grant project will improve the reliability of water supplies during times of drought. For example, will the proposed project prevent the loss of permanent crops and/or minimize economic losses from drought conditions? Will the project improve the reliability of water supplies for people, agriculture, and/or the environment during times of drought?*

Drought is always a concern in a water-short basin. In the last 10 years, drought has twice caused the Marion Ditch Companies to deplete their storage reservoir by mid-July preventing farmers from producing a second crop. This has negatively impacted crop yields and is especially damaging as 50% of the acreage provides the source of income to these local farmers.

Subcriterion E.4: Other Water Supply Sustainability Benefits

- *Will the project make water available to address a specific concern? For example:*
  - *Will the project directly address a heightened competition for finite water supplies and over-allocation (e.g., population growth)?*

The State of Utah Governor's Office of Planning and Budget created an Economic and Demographic Projections Report which shows Summit County as the 3rd fastest growing county in the State with a population growth rate of 2.2% over the last 10 years. This significant growth has already began to impact the Kamas Valley and will place additional demands on the system as more residential and commercial development comes to this area.

This project will better manage the water available by preventing waste and conserving energy. It also allows for the possibility of making Seymour Springs' water available to Oakley City for secondary or culinary uses; this will reduce the impact of rapid growth.

  - *Describe how the water source that is the focus of this project (river, aquifer, or other source of supply) is impacted by climate variation.*

Variation in the climate has caused three years of below-average precipitation. At the end of the water year September 2014, total precipitation in the Weber/Ogden River Basin was at 32 inches. This is 20% below the 30-year average annual precipitation for this basin and is now the third year that has fallen between 20-30% below average. Soil moisture in the Weber River basin is at a 25-year low. Given the low amount of precipitation and unusually warm temperatures in the basin during the fall and early winter, it is anticipated that snowpack and precipitation will be below average again in 2015.

  - *Will the project help to address an issue that could potentially result in an interruption to the water supply if unresolved?*

Water conservation in the Marion Ditch Companies' service area will allow water to remain in the Weber River and local reservoirs. This can act as a buffer against climate variability, drought, and shortages.

Sections of the open ditch run along the hillside very close to the edge. At times the ditch has become blocked with debris, water spills over the side of the ditch bank and the bank has breached. This causes flooding in the land below and impacting agricultural land and local residents. A closed system reduces the risk of catastrophic breeches.

Will the project make additional water available for Indian tribes?

There are no known Indian tribes in the service area. The Environmental Review conducted as part of this project will investigate tribal or cultural assets in the area.

- *Will the project make water available for rural or economically disadvantaged communities?*

Yes this will make project more available a rural, economically disadvantaged community. Marion Ditch Companies' service area is located in unincorporated Summit County, this rural area has a population of approximately 635 people. The per capita income is $26,235 which is 2.9% less than the U.S. average of $28,051. The unemployment rate is 9.5 which 0.2 higher than the national average 9.3.

- *Does the project promote and encourage collaboration among parties?*

Yes. Historically there has been conflict between the Marion Upper and Marion Lower Ditch Companies regarding water usage. This project will be a cooperative effort with both companies collaborating to implement these system improvements. The Marion Upper Ditch Company will sponsor and manage the project but the improvements will benefit both companies and all users.

This is also a collaborative effort with the NRCS. Their Water Loss Study identified the significant water losses occurring in the system. A Letter of Support from Bronson Smart, PE, State Conservation Engineer with NRCS, is included in this application.

- *Is there widespread support for the project?*

Yes. All Board Members from both the Upper and Lower Ditch Companies support this project and see the benefits that will come from water conservation and energy efficiency.

- *What is the significance of the collaboration/support? Is there frequently tension or litigation over water in the basin?*

The collaboration between the two companies is significant as it will promote cooperation in the future. Combining the two ditch companies has been considered in the past but given the tension between them, that idea was dismissed. Preventing conveyance losses will provide water to users all along the delivery system, not just at the beginning. This will ease the tension and allow the ditch companies to work jointly for better, more efficient water management and a more holistic view of the water supply in the area.

- *Will the project help to prevent a water-related crisis or conflict?*

As stated above, enclosing the system will remove the risk of a breach along the hillside. Conserving and better managing the water will prevent conflict between water users and water companies as the supply will be sufficient to water crops through the entire irrigation season.

- *Is the possibility of future water conservation improvements by other water users enhanced by completion of this project?*

  Piping and enclosing the ditches opens the possibility for on-farm improvements in converting about 101 acres from flood irrigation to sprinkler systems.

Will the project increase awareness of water and/or energy conservation and efficiency efforts?

Yes, with the implementation of the hydro portion of the project and the ability to eliminate and reduce the need for pumps the water users will directly realize the benefits of this project.

- *Will the project serve as an example of water and/or energy conservation and efficiency within a community?*

The Marion Ditch Companies are small entities but these improvements to their system will have a large impact on their crop yield, efficiency in their water use, opportunity for hydro power and energy savings, and the cost of doing business that can be an example for other small irrigation companies. Other small entities and municipalities can look to the Marion Ditch Companies' approach to water conservation and implement similar methods.

- *Will the project increase the capability of future water conservation or energy efficiency efforts for use by others?*

Yes. In addition to reducing flood irrigation in the area, this project will also allow for individual pumps on the system to be eliminated or downsized.

- *Does the project integrate water and energy components?*

Yes. Both water and energy will be conserved through less pumping.

A micro-hyrdo power generation unit will also be designed and installed to produce 10,656 kWh per year.

Evaluation Criterion F: Implementation and Results

Subcriterion No. F.1: Project Planning

(1) Identify any district-wide, or system-wide, planning that provides support for the proposed project. This could include a Water Conservation Plan, SOR, Basin Study, drought contingency plan, or other planning efforts done to determine the priority of this project in relation to other potential projects.

The Marion Ditches are located in the Weber River Basin and fall under the 2009 Utah State Water Plan *Weber River Basin: Planning for the Future.*

(2) Describe how the project conforms to and meets the goals of any applicable planning efforts, and identify any aspect of the project that implements a feature of an existing water plan(s).

The plan states: "Increasing the water supply in the Snyderville Basin and Park City area is a top priority of Summit County officials, local water providers and WBWCD."

The proposed project will keep more water in the Weber River and the reservoirs that provide water to the Park City area.

Subcriterion No. F.2: Readiness to Proceed

Points may be awarded based upon the extent to which the proposed project is capable of proceeding upon entering into a financial assistance agreement.

The Marion Ditch Companies are ready to proceed with the project. Preliminary project planning has been completed, a hydraulic model has been created to calculate pressures and determine pipe alignments, and MUDC will be providing matching funds for the project. The environmental will be completed by March 2016 and engineering design will be completed by July 2016. The actual construction will take place October 2016 – May 2017

Describe the implementation plan of the proposed project. Please include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates.

The Marion Upper and Lower Ditch Project will be completed over a period of two years.

FY2016													
Milestone/Task	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Sign WaterSMART Contracts													
Environmental Document													
Permitting													
Design													
Bidding													
Award													
Materials Procurement													
Mobilization													
	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17
FY2017													
Install Pipe													
Construct Hydro													

Please explain any permits that will be required, along with the process for obtaining such permits. Identify and describe any engineering or design work performed specifically in support of the proposed project.

A Stream Alteration Permit will be requested from the Utah Division of Water Rights and the US Army Corps of Engineers.

A FERC permit will be required for the hydro generator. It is expected to take 3 to 6 months to obtain the permit. MUDC is anticipating qualifying for a "Qualified Conduit Hydropower Facility" under the provision of the Hydropower Regulatory Efficiency Act of 2013 or a Conduit Exemption.

The preliminary planning has been completed for this project. A hydraulic model identifying pressures and a possible pipe alignment has been created. The engineer has determined the piping material and given opinions of probable construction and design costs.

Subcriterion No. F.3: Performance Measures

Provide a brief summary describing the performance measure that will be used to quantify actual benefits upon completion of the project (e.g., water saved, marketed, or better managed, or energy saved).

This project includes the installation of four water meters at strategic locations along within the main diversion system. The water will be metered at these locations and the volumes/flow rates will be compared with the historic volumes and flow rates diverted from the river. This will give a comparison by which to measure water savings.

Subcriterion No. F.4: Reasonableness of Costs

Please include information related to the total project cost, annual acre-feet conserved, energy capacity, or other project benefits and the expected life of the improvement(s).

Total project cost: $2,480,500

Annual acre-feet conserved: 2,919 acre-feet/year

Energy savings: 74,598 kWh/year,

Cost Savings $2,844.20/year

Energy generation: 10,656 kWh/year

For all projects involving physical improvements, specify the expected life of the improvement in number of years and provide support for the expectation (e.g., manufacturer's guarantee, industry accepted life-expectancy, description of corrosion mitigation for ferrous pipe and fittings, etc.).

Expected life of the improvements: The manufacturer of the HDPE pipe estimates their product to have a 50-year life-expectancy. The proposed meters have no moving parts and

the electrical components should last 20 years. The hydro unit also has a life expectancy of 20 years. (Please see Attachment D for manufacturer documentation.)

Evaluation Criterion G: Additional Non-Federal Funding

$$\frac{\$1{,}480{,}000 \text{ Non-Federal Funding}}{\$2{,}480{,}500 \text{ Total Project Cost}} = 60\%$$

Evaluation Criterion H: Connection to Reclamation Project Activities

(1) How is the proposed project connected to Reclamation project activities?

This project is in the Weber River Basin wherein many Reclamation facilities are located. The water conserved will directly benefit Echo Reservoir and Rockport Reservoir .

(2) Does the applicant receive Reclamation project water?

Yes. The Marion Ditch Companies receive their water from a Weber River diversion and has rights to water in Echo Reservoirs –part of Reclamation's Weber River Project.

(3) Is the project on Reclamation project lands or involving Reclamation facilities?

No.

(4) Is the project in the same basin as a Reclamation project or activity?

Yes. This project is in the Weber River Basin which contains many Reclamation projects including:

- East Canyon Reservoir
- Rockport Reservoir
- Lost Creek Reservoir
- Echo Reservoir
- Arthur V. Watkins Reservoir (formerly Willard)
- Causey Dam
- Pineview Reservoir

(5) Will the proposed work contribute water to a basin where a Reclamation project is located?

Yes. This project with result in 2,919 acre-feet saved. This water will remain in the basin in the Weber River or the Echo or Rockport Reservoir.

(6) Will the project help Reclamation meet trust responsibilities to Tribes?

No,

Environmental and Cultural Resources Compliance

1. *Will the project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.*

   The work will include the installation of pipe, most of which will be along the existing ditch alignment. Construction will take place after the irrigation season so there will not be water in the ditches.

   Best practices will be employed for dust control and noxious weed management. Surface vegetation will be restored upon completion of the project.

2. *Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?*

   There are no known threatened or endangered species in the direct project area. An assessment of threatened or endangered species will be conducted as part of the environmental document.

3. *Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "waters of the United States?" If so, please describe and estimate any impacts the project may have.*

   The Marion Ditch Companies are unaware of any wetlands in the project area. However, the environmental document will include an assessment of wetlands and biology.

4. *When was the water delivery system constructed?*

   The system was originally constructed between 1876 and 1885. In 1997, some of the ditches were piped, creating a small pressurized system.

5. *Will the project result in any modification of or effects to, individual features of an irrigation system (e.g., head gates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.*

   No. This project will pipe and enclose the existing open ditches.

6. *Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.*

The Marion Ditch Companies are **not** aware of any buildings, structures, or features that would be eligible for listing on the National Register of Historic Places. A cultural resource inventory will be conducted as part of the environmental document.

7. *Are there any known archeological sites in the proposed project area?*

   The Marion Ditch Companies are unaware of any archeological sites in the project area. The environmental document will include an archeological inventory

8. *Will the project have a disproportionately high and adverse effect on low income or minority populations?*

   No, this project will **not** have an adverse effect on low income or minority populations.

9. *Will the project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?*

   The Marion Ditch Companies are unaware of Indian tribal lands or sacred sites in the project area. The environmental document will include an inventory.

10. *Will the project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?*

    No. A closed irrigation system will help control noxious weeks and invasive trees. Best practices will be employed during construction to prevent the spread of noxious weeds.

Required Permits or Approvals

Applicants must state in the application whether any permits or approvals are required and explain the plan for obtaining such permits or approvals.

A Stream Alteration Permit will be required. An application will be submitted to the State Engineer's office, the Utah Division of Water Rights and the U.S. Army Corps of Engineers. The consulting engineer will submit an application when the design layout and cross sections have been determined.

A FERC permit will be required for the hydro generator. It is expected to take 3 to 6 months to obtain the permit. MUDC is anticipating qualifying for a "Qualified Conduit Hydropower Facility" under the provision of the Hydropower Regulatory Efficiency Act of 2013 or a Conduit Exemption.

Letters of Project Support

USDA

January 14, 2015

Bureau of Reclamation
Attn: Mr. Shaun Wilken
Denver Federal Center, Bldg. 67, Rm. 152
6th Avenue and Kipling Street
Denver, CO 80225

Dear Mr. Wilken,

NRCS is pleased to write in support of the Marion Ditch Company's application to the WaterSMART: Water and Energy Efficiency grant program. In 2014, NRCS conducted a Water Loss Study of Marion's system and found that 38% of their water is lost to seepage. The proposed project will pipe the ditches and create an entirely closed system to eliminate those seepage losses.

Piping the Marion Ditch will also allow participants who use water out of the canal to participate in NRCS programs to upgrade their on farm irrigation systems for more efficient on farm use as well.

The proposed project will help the District to be resilient to drought or shortages and better manage the water in their system. NRCS supports the Marion Ditch Company in their dedication to address the water needs of our area.

If you have any questions please contact me at (801) 524-4559.

Sincerely,

/s/

Bronson Smart, PE

Cc: Kent Peterson, Marion Ditch Company
Bryce Wilcox, JUB Engineers

Natural Resources Conservation Service
125 South State St., Room 4010, Salt Lake City, UT 84138
Voice 801 524-4550 Fax 801 524 4403
An Equal Opportunity Provider and Employer

JoAnn Peterson
Kamas, UT 84036

Marion Upper Ditch Company
150 West 2100 North
Kamas, UT 84036

Re: Letter of Intent for On-Farm Improvements

Dear Mr. Peterson,

As an owner of __10__ acres of property in the Marion (Upper or Lower) Ditch service area, I am in full support of their application for a Bureau of Reclamation WaterSMART Grant. The efforts of the Company to enhance opportunities for its shareholders to work more efficiently and to conserve water are consistent with the goals of its users.

The WaterSMART project which involves piping the ditches, will allow users to receive pressurized water. With the development of a pressurized system an opportunity to consider converting from gravity-flow/flood irrigation to a more efficient sprinkler system will now be an option never offered in the past.

Upon the completion of the piping project, I intend to investigate utilizing a sprinkler application system to irrigate my properties and look into NRCS funding opportunities to make these improvements.

Sincerely, JoAnn Peterson

Dallas Atkinson
Floydene Atkinson
P.O. Box 846
Kamas, UT 84036

Marion Upper Ditch Company
150 West 2100 North
Kamas, UT 84036

Re: Letter of Intent for On-Farm Improvements

Dear Mr. Peterson,

As an owner of 20 acres of property in the Marion (Upper or Lower) Ditch service area, I am in full support of their application for a Bureau of Reclamation WaterSMART Grant. The efforts of the Company to enhance opportunities for its shareholders to work more efficiently and to conserve water are consistent with the goals of its users.

The WaterSMART project which involves piping the ditches, will allow users to receive pressurized water. With the development of a pressurized system an opportunity to consider converting from gravity-flow/flood irrigation to a more efficient sprinkler system will now be an option never offered in the past.

Upon the completion of the piping project, I intend to investigate utilizing a sprinkler application system to irrigate my properties and look into NRCS funding opportunities to make these improvements.

Sincerely,

Floydene Atkinson

Dallas Atkinson

Official Resolution

The Marion Ditch Companies will submit an Official Resolution within 30 days of the application deadline.

Project Budget

Funding Plan and Letters of Commitment

1. *How you will make your contribution to the cost share requirement, such as monetary and/or in-kind contributions and source funds contributed by the applicant (e.g., reserve account, tax revenue, and/or assessments).*

   The Marion Upper Ditch Company has committed to contribute $450,000 toward the project cost.

2. *Describe any in-kind costs incurred before the anticipated project start date that you seek to include as project costs. Include:*

   n/a

3. *What project expenses have been incurred*

   n/a

4. *Provide the identity and amount of funding to be provided by funding partners, as well as the required letters of commitment.*

   The Marion Upper Ditch Company has submitted an application to the Utah Board of Water Resources for a loan in the amount of $1,030,500. The Ditch Company has discussed the project with David Humphreys, the Weber River District Board Member, he is aware of the project and indicated that the Board funds more than 90% of loan requests.

5. *Describe any funding requested or received from other Federal partners. Note: other sources of Federal funding may not be counted towards your 50 percent cost share unless otherwise allowed by statute.*

   n/a

6. *Describe any pending funding requests that have not yet been approved, and explain how the project will be affected if such funding is denied.*

   As stated above, a loan application has been submitted to the Utah Board of Water Resources. The MUCD has been in communication with David Humphreys and he said the loan requests are very rarely denied; they fund more than 90% of loan requests.

   For a project with such significant water and energy savings, MUCD feels confident that they will receive the loan from the Board of Water Resources. If the funding were to be denied, they may look to the open market.

FUNDING SOURCES	*FUNDING AMOUNT*
Non-Federal Entities	$1,480,500.00
Non-Federal Subtotal	$1,480,500.00
Other Federal Entities	
Other Federal Subtotal	$0
Requested Reclamation Funding	$1,000,000.00
Total Project Funding	$2,480,500.00

Budget Proposal

FUNDING SOURCES	*% of Total Project Cost*	*Total Cost by Source*
Recipient Funding	60%	$1,480,500.00
Reclamation Funding	40%	$1,000,000.00
Other Federal Funding		$0
Totals	100%	$2,480,500.00

Budget Narrative

Salaries & Wages

No MDC salaries and wages will be included in the project budget.

Fringe Benefits

No MDC fringe benefits will be included in the project budget.

Travel

No travel will be required for this project.

Equipment

No MDC equipment will be used for this project. The equipment costs are included in the contractual amount.

Materials and Supplies

The cost of materials and supplies is outlined in the contractual breakdown.

Contractual

	Quantity	Unit	Unit Cost	Total Cost	FY16	FY17
32" HDPE DR 41 PIPE	14900	LF	$ 71.00	$ 1,057,900.00	$ 581,845.00	$ 476,055.00
24" HDPE DR 41 PIPE	4000	LF	$ 50.00	$ 200,000.00	$ 110,000.00	$ 90,000.00
18" HDPE DR 41 PIPE	5600	LF	$ 41.00	$ 229,600.00	$ 126,280.00	$ 103,320.00
14" HDPE DR 32.5 PIPE	6500	LF	$ 32.00	$ 208,000.00	$ 114,400.00	$ 93,600.00
Pipeline Appurtenances	1	LS	$ 80,000.00	$ 80,000.00		$ 80,000.00
Turnouts	15	EA	$ 2,000.00	$ 30,000.00		$ 30,000.00
Inlet Structure	1	EA	$ 200,000.00	$ 200,000.00		$ 200,000.00
System Meters	4	EA	$ 5,000.00	$ 20,000.00		$ 20,000.00
Highway & Canal Crossing	2	EA	$ 10,000.00	$ 20,000.00		$ 20,000.00
Hydro	1	LS	$ 15,000.00	$ 15,000.00		$ 15,000.00
Mobilization	1	LS	$ 100,000.00	$ 100,000.00	$ 50,000.00	$ 50,000.00
Construction Total				$ 2,160,500.00		
Design				$ 165,000.00	$ 165,000.00	
NEPA Compliance				$ 40,000.00	$ 40,000.00	
Construction Management				$ 110,000.00	$ 11,000.00	$ 99,000.00
Reporting				$ 5,000.00	$ 2,500.00	$ 2,500.00
TOTAL				**$ 2,480,500.00**	**$ 1,201,025.00**	**$1,279,475.00**

Environmental and Regulatory Compliance Costs

An Environmental Specialist will prepare the environmental documents for NEPA compliance at a cost of $40,000.

Reporting

The consulting engineer will prepare and submit the necessary progress and financial reports for the duration of the project at an estimated cost of $5,000.

Other Expenses

No other expenses will be necessary.

Indirect Costs

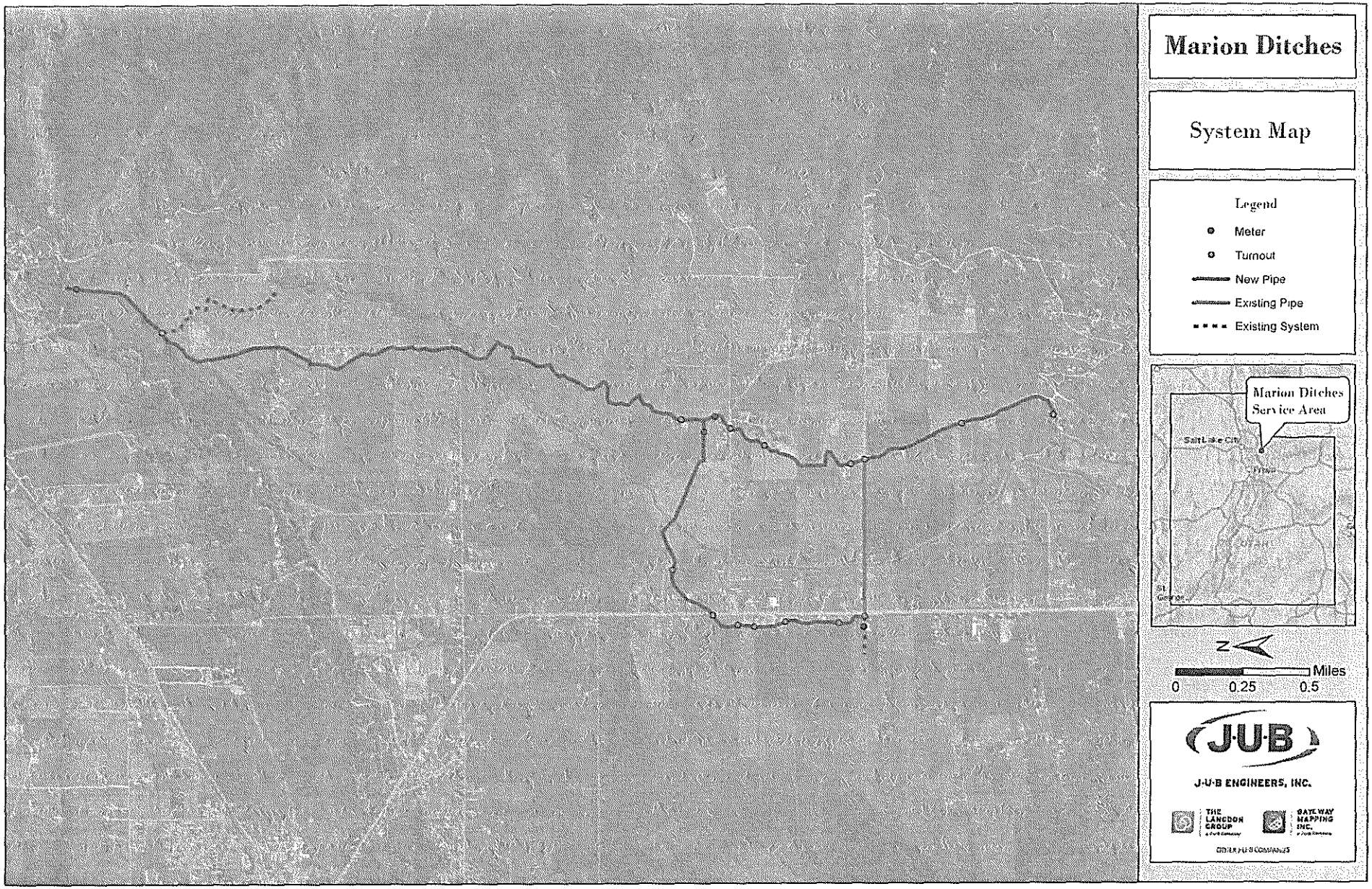
There will be no indirect costs.

Total Costs

MUDC Portion	Federal Portion	Total Cost
$1,480,500.00	$1,000,000.00	$2,480,500.00

Attachment A

Project Location Map


Marion Ditches
System Map
Legend
Meter
Turnout
New Pipe
Existing Pipe
Existing System
Marion Ditches Service Area
Salt Lake City
N
Miles
0
0.25
0.5
J-U-B
J-U-B ENGINEERS, INC.
THE LANGDON GROUP
GATEWAY MAPPING INC.

Attachment B

NRCS Water Loss Study

USDA

January 7, 2015

Upper and Lower Marion Ditch Company
c/o Kent Peterson

Dear Mr. Peterson,

Please see the attached Study outlining Water Loss in the Marion Ditch. If you have any questions please contact me at (801) 524-4559.

Sincerely,

/s/

Bronson Smart, PE

Cc: Bryce Wilcox, JUB Engineers

Attachment: Marion Ditch Water Loss Study

Natural Resources Conservation Service
125 South State St., Room 4010, Salt Lake City, UT 84138
Voice 801 524-4550 Fax 801 524 4403
An Equal Opportunity Provider and Employer

Marion Ditch Water Loss Study

A water loss study was completed for the Marion Ditch. Nathaniel Todea, NRCS Hydraulic Engineer and Kent Peterson, Marion Ditch Company water master, met on August 20, 2014 to determine measurement locations and canal to be studied. As part of this study an Acoustic Doppler Current Profiler (ADCP) - StreamPro was used to measure canal flows at three different locations. In short the upper most section had a discharge of 9.5 cfs (Diversion at Weber River), the second location approximately 1200 feet downstream of the Diversion at Weber River (Second Diversion DS of Weber Diversion) had a discharge of 12 cfs, and the last location approximately 16,100 feet downstream of the Weber Diversion at 3200 N has a discharge of 7.5 cfs. The flow at the Second Diversion DS of Weber Diversion increased due to flow paths from the Weber River that are diverted into the canal. The Marion Ditch is losing flow due to infiltration between the second diversion and 3200 N in Marion where the water begins to be delivered to shareholders. For the purposes of this study it is assumed that from the Weber River diversion to 3200 N ditch crossing that 4.5 cfs or 38% of the water is being lost. These measurements are supported by the soils information that is outlined below in the report.

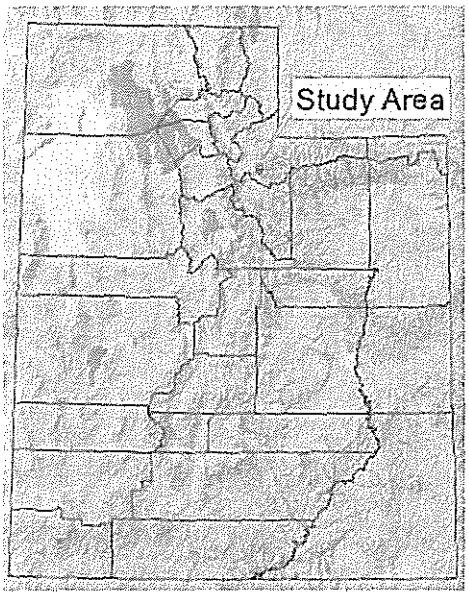
Digital Elevations Models (DEM) (5 meter auto correlated DEMs), geology maps, and soils (SSURGO) data was reviewed to become familiar with the area. The combination of the terrain (slope), geology and soils all assist in determining the cause of the losing reach. Below is a table showing the results of the multiple analyses that were part of this study.

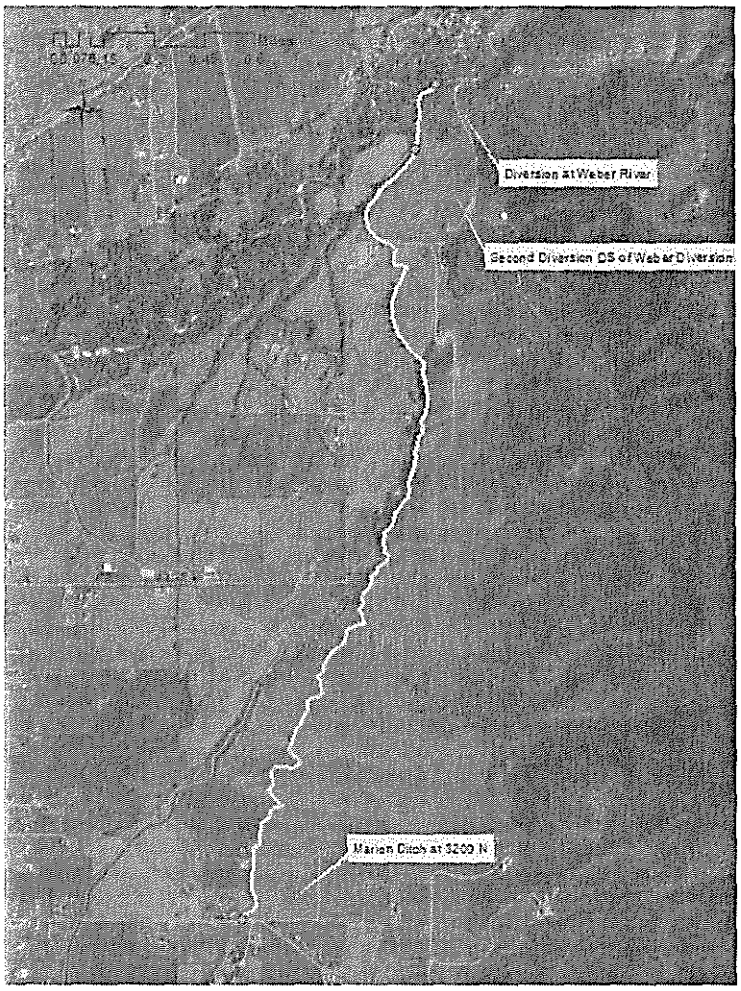
ADCP measurement	A reduction of flow by 38% percent
Soils	• Soils show drainage from higher to lower elevation • Ksat suggest that water mover from east to west • Runoff –show that MUSYM 106/139 has medium runoff and MUSYM 174 has low runoff; the potential that water flows east to west • Flows path are from Gravels to Cobbles (east to west) • The scale of mapping lends itself to using the soil survey for general planning. • It is advisable to use detailed on-site data for specific information about piping the Marion Ditch.
DEM	Elevation difference between pipe location to valley slope show flow paths are increased in this area
Geology	Flow path of geologic formation move from east to west
Other losses not considered	Evaporation / Evapotranspiration

Below are specific study results from the ADCP measurement to the review of Soil and Geology of the area.

ADCP

Measurements were taken along the channel at three places.



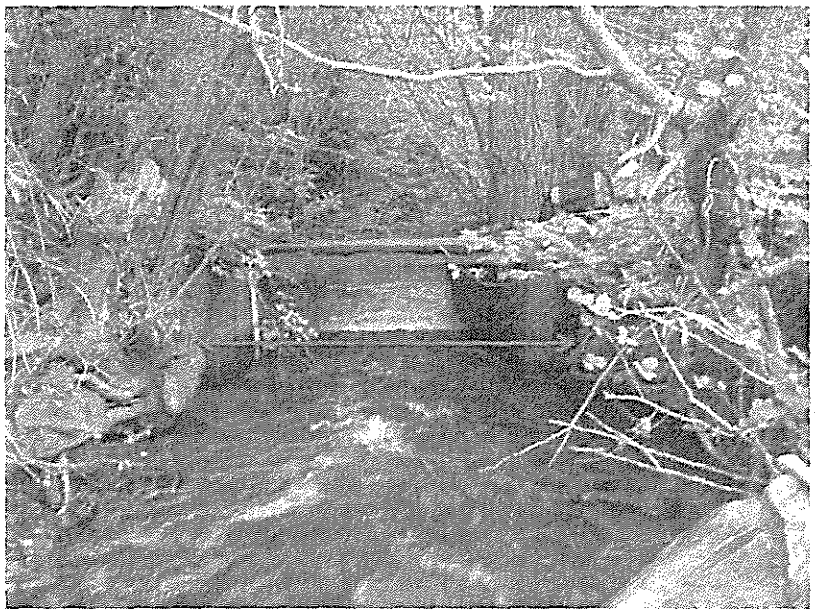


Diversion at Weber: The measurement at the Diversion at the Weber was difficult and reached the limitation of the ADCP. The measurement was taken at the upper portion of a flume. The depths were at 0.7 feet and recommended lowest depth for the ADCP is 0.5 feet. The water was very turbulent and near critical at the approach of the flume. Many measurements were taken and the best matches such as time to survey (data acquisition), total area, top width, and total Q were extracted and were determined to be reasonable and valid.

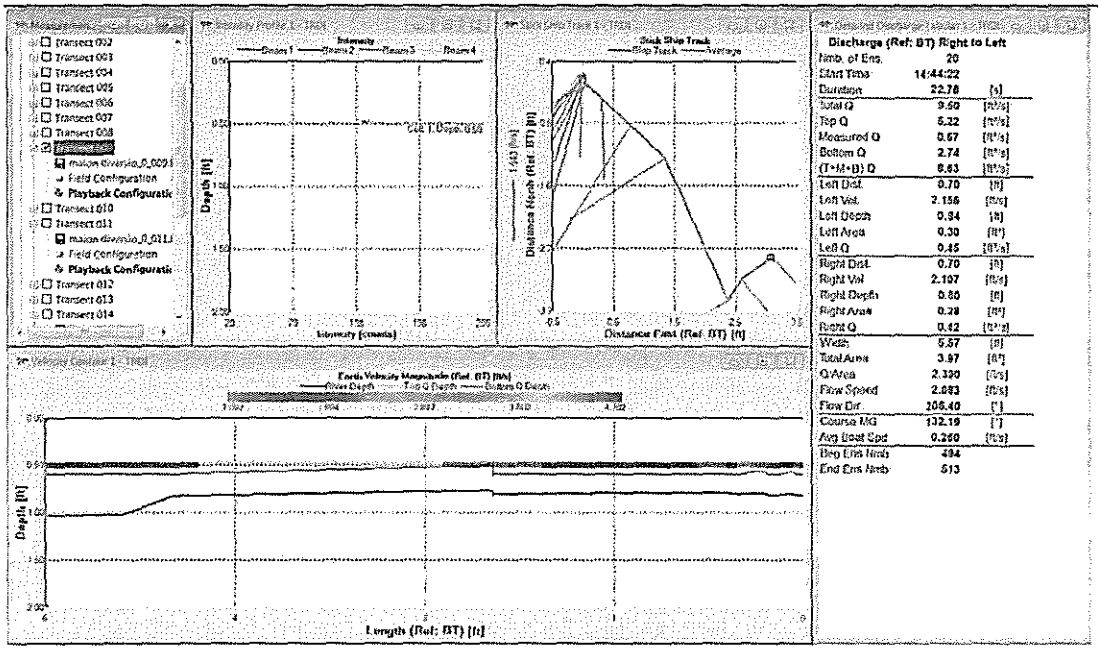
Second Diversion DS of Weber Diversion: The velocities in this section were very slow near 0.5 feet/second. This section has the highest discharge. The readings in this area were very consistent and 12 cfs is determined to be valid. The discharge difference between the Diversion at the Weber and Second Diversion DS of the Weber is 1.5 cfs. This is considered an adding reach due to groundwater and side channels of the river flowing into the canal in this location. This adding reach also may be due to the alluvial fan present throughout the area.

Marion Ditch at 3200 N: Measurements were relatively easy at this location once a procedure was determined. This is the water delivery site on the canal. Measurements were consistent and 7.5 cfs is considered valid.

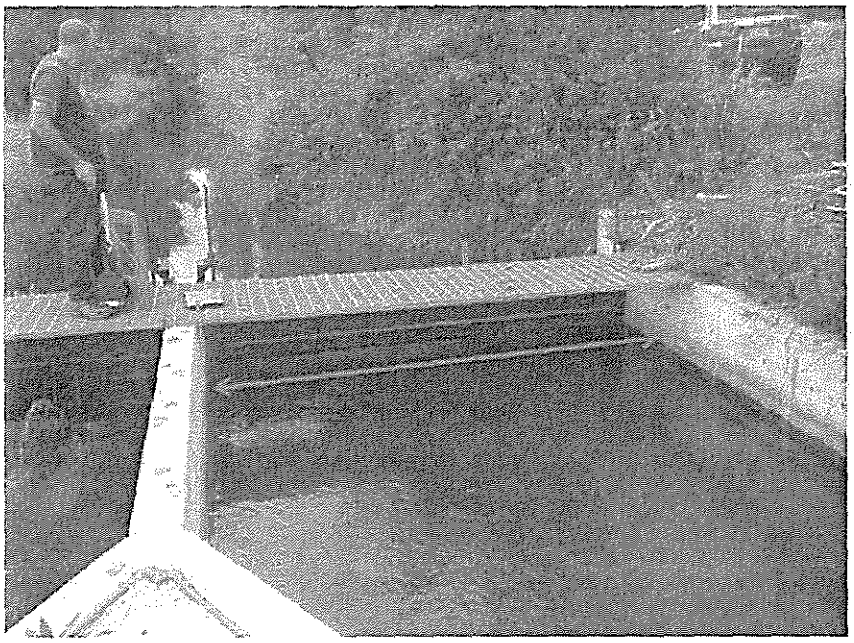
Division at Weber → <u>DISCHARGE 9.5 CFS</u>



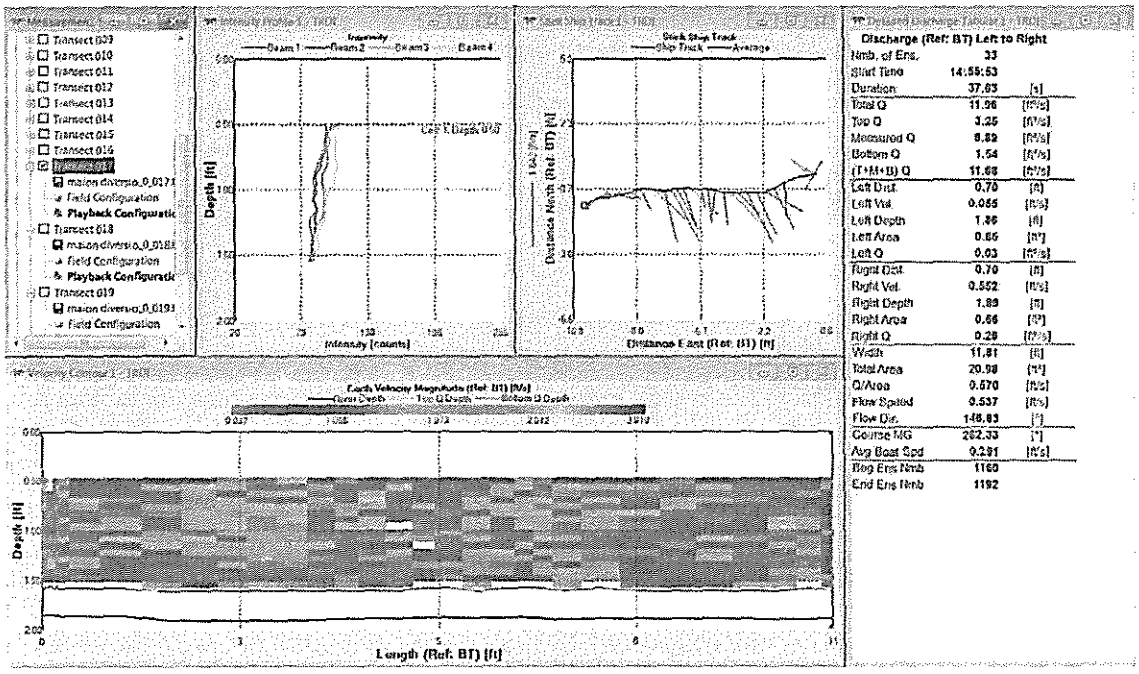
Transect	Start Bank	# Ens.	Total Q ft³/s	Delta Q %	Top Q ft³/s	Meas. Q ft³/s	Bottom Q ft³/s	Left Q ft³/s	Left Dist. ft	Right Q ft³/s	Right Dist. ft	Width ft	Total Area ft²
maion diversio009	Right	20	9.5	-0.4	5.2	0.7	2.8	0.5	0.7	0.4	0.7	5.6	4.0
maion diversio011	Right	9	10.0	4.8	6.3	0.9	2.8	0.0	0.7	0.0	0.7	5.3	3.1
maion diversio014	Left	9	9.1	-4.4	5.6	0.8	2.6	0.0	0.7	0.0	0.7	5.0	2.9
Average		12	9.5	0.0	5.7	0.8	2.7	0.2	0.7	0.1	0.7	5.3	3.4
Std Dev.		6	0.4	4.6	0.6	0.1	0.1	0.3	0.0	0.2	0.0	0.3	0.6
Std./| Avg.|		0.5	0.1	0.0	0.1	0.2	0.0	1.7	0.0	1.7	0.0	0.1	0.2



Second diversion DS of Weber Diversion → <u>DISCHARGE 12 CFS</u>

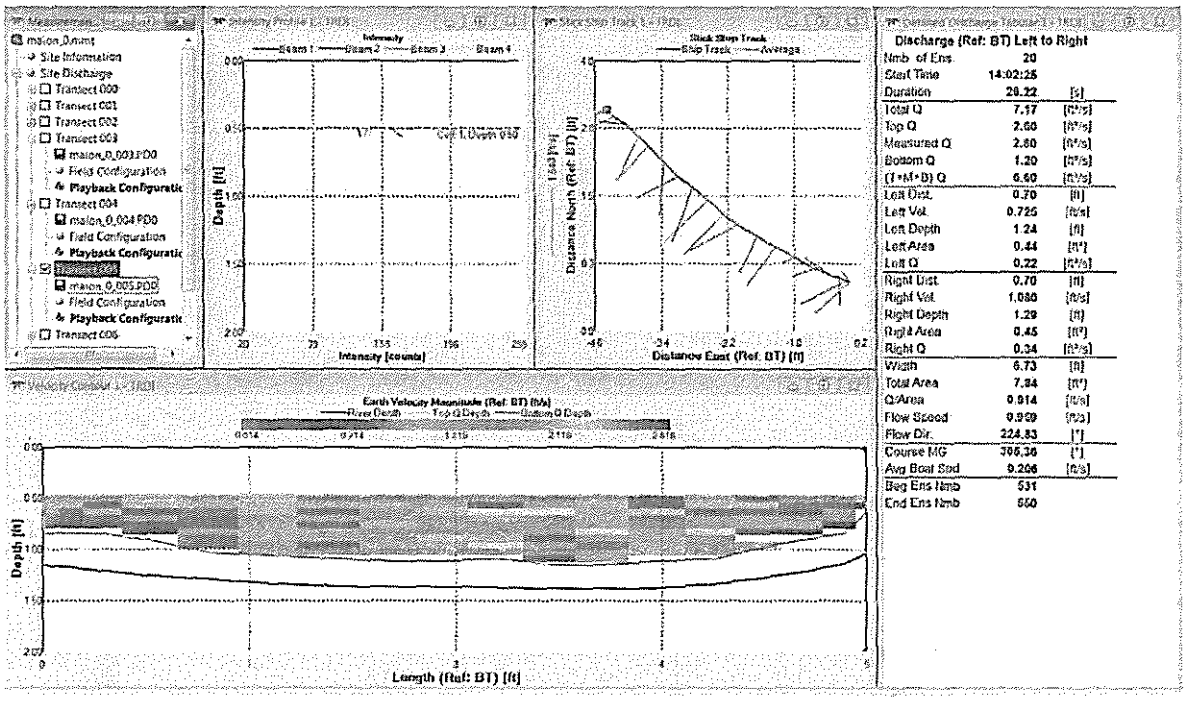


Transect	Start Bank	# Ens.	Total Q ft³/s	Delta Q %	Top Q ft³/s	Meas. Q ft³/s	Bottom Q ft³/s	Left Q ft³/s	Left Dist. Ft	Right Q ft³/s	Right Dist. ft	Width ft	Total Area ft²
marion diversio017	Left	33	11.958	0.42	3.254	6.886	1.535	0.025	0.7	0.258	0.7	11.81	20.98
marion diversio018	Right	29	12.572	5.57	3.426	6.992	1.766	0.424	0.7	-0.035	0.7	11.93	21.04
marion diversio019	Left	33	11.195	-5.99	3.108	6.18	1.554	0.247	0.7	0.141	0.7	11.94	21.03



Marion Ditch 3200 N → <u>DISCHARGE 7.2 CFS</u>

Transect	Start Bank	# Ens.	Start Time	Total Q ft³/s	Delta Q %	Top Q ft³/s	Meas. Q ft³/s	Bottom Q ft³/s	Left Q ft³/s	Left Dist. ft	Right Q ft³/s	Right Dist. ft	Width ft	Total Area ft²
marion003	Left	24	14:00:24	7.169	-0.16	2.649	2.719	1.236	0.283	0.70	0.283	0.70	6.70	7.64
marion004	Right	38	14:01:16	7.204	0.33	2.649	2.826	1.201	0.388	0.70	0.141	0.70	6.85	7.84
marion005	Left	20	14:02:26	7.169	-0.16	2.613	2.790	1.201	0.212	0.70	0.363	0.70	6.73	7.84



SOILS

General Soils Descriptions show that flow paths move from east to west. First, MUSYM 106/139 have medium runoff potential while MUSYM 174 has low runoff potential, meaning that water infiltrates more in MUSUM 174. Second, the profile material from MUSYM 106/139 is generally gravel while MUSYM 174 is cobbles. This allows water to drain from MUSYM 106/139 to MUSYM 174. Third and finally, hydraulic conductivity from MUSYM 106/139 is low while MUSYM moderately high. This also shows that the soils properties allow water to move east to west.

FIGURE ILLUSTRATING MUSYM AND GENERAL SOILS DESCRIPTION OF AREAS OF CONCERN

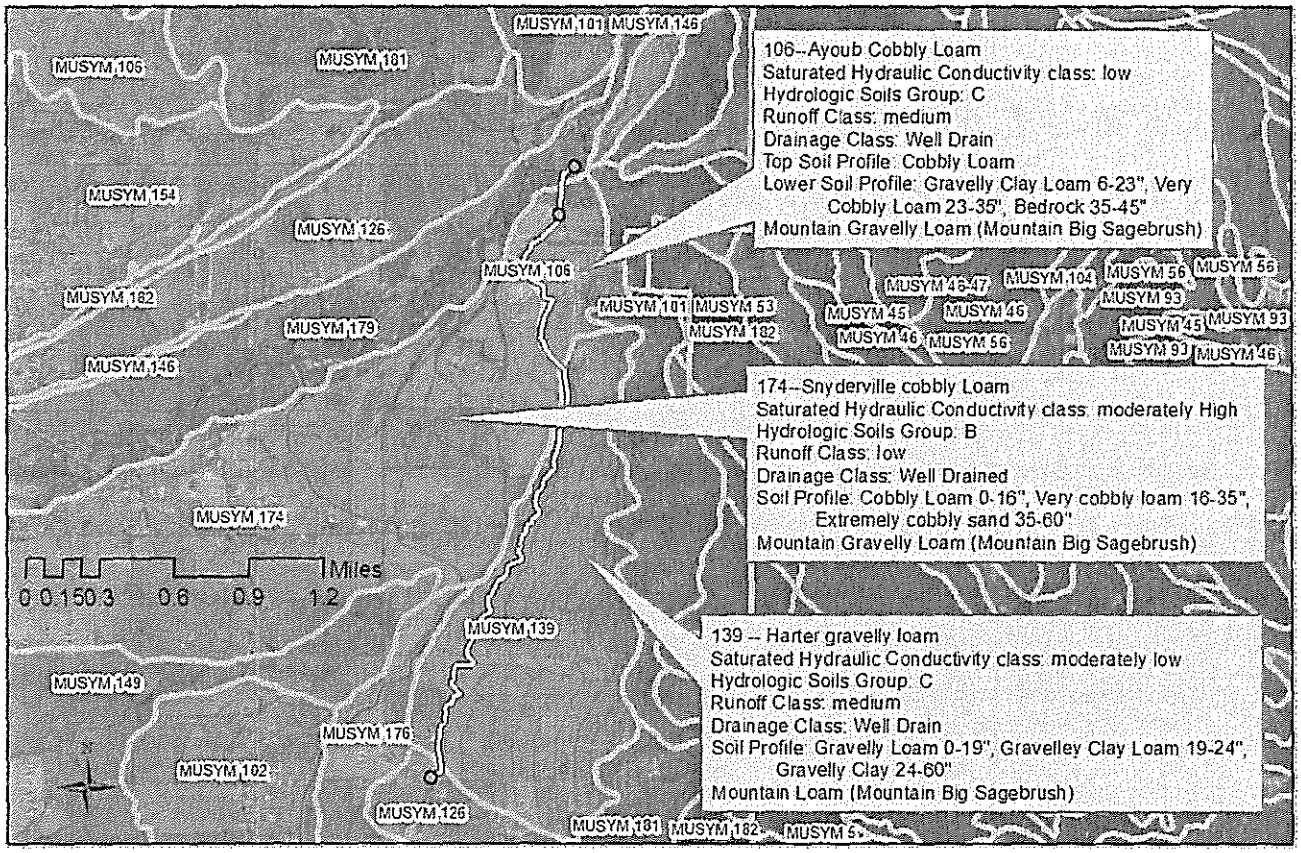
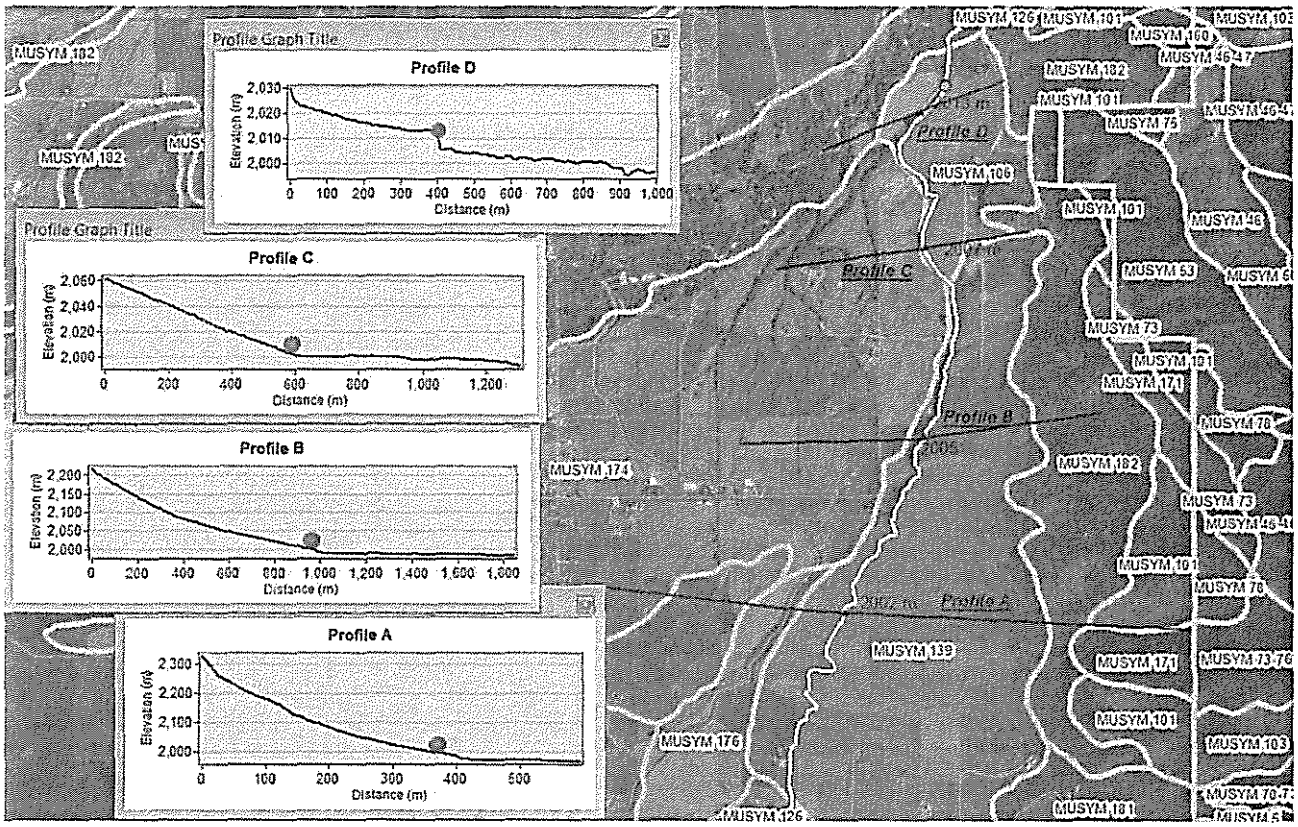
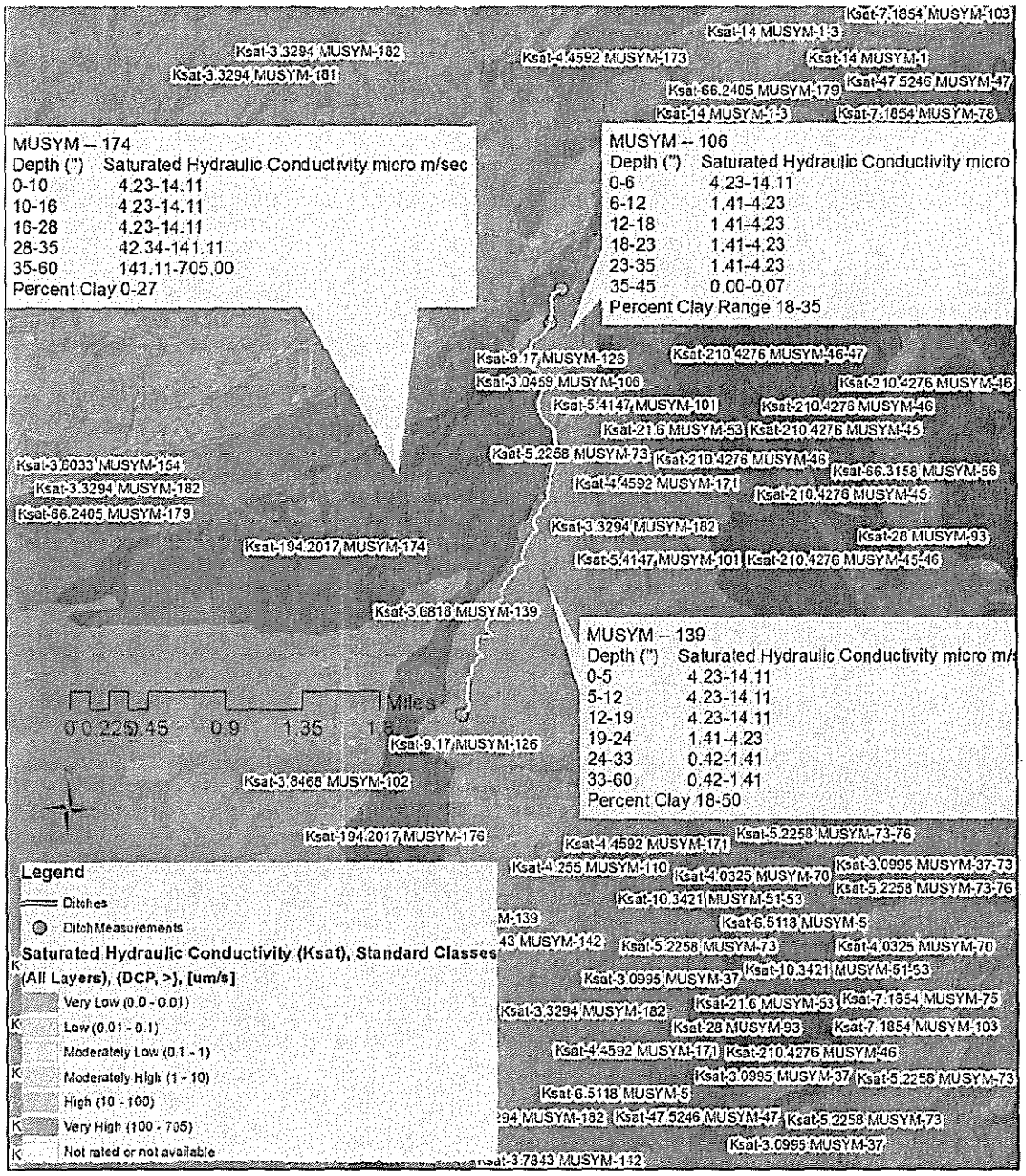


FIGURE ILLUSTRATING ELEVATION CHANGE AND FLOW PATH



KSat (hydraulic Conductivity) shows that flowpaths move from east to west, MUSYM 106/139 → 174.

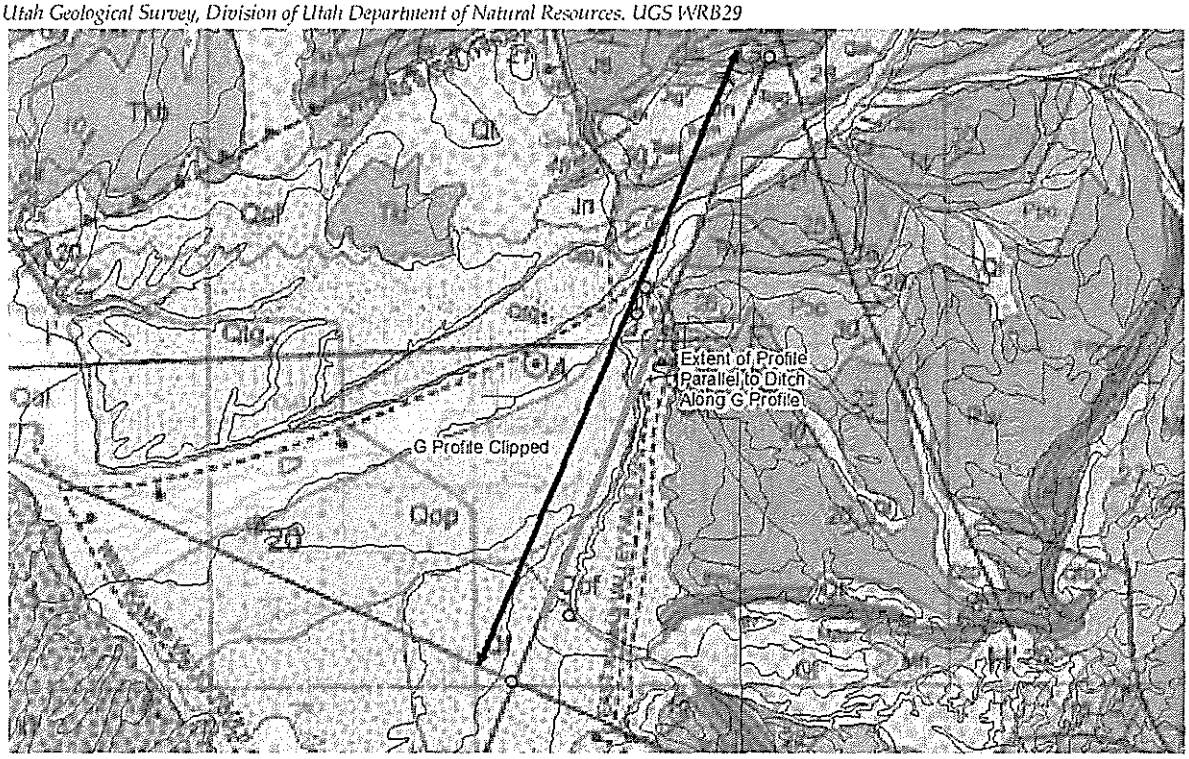
FIGURE ILLUSTRATING HYDRAULIC CONDUCTIVITY



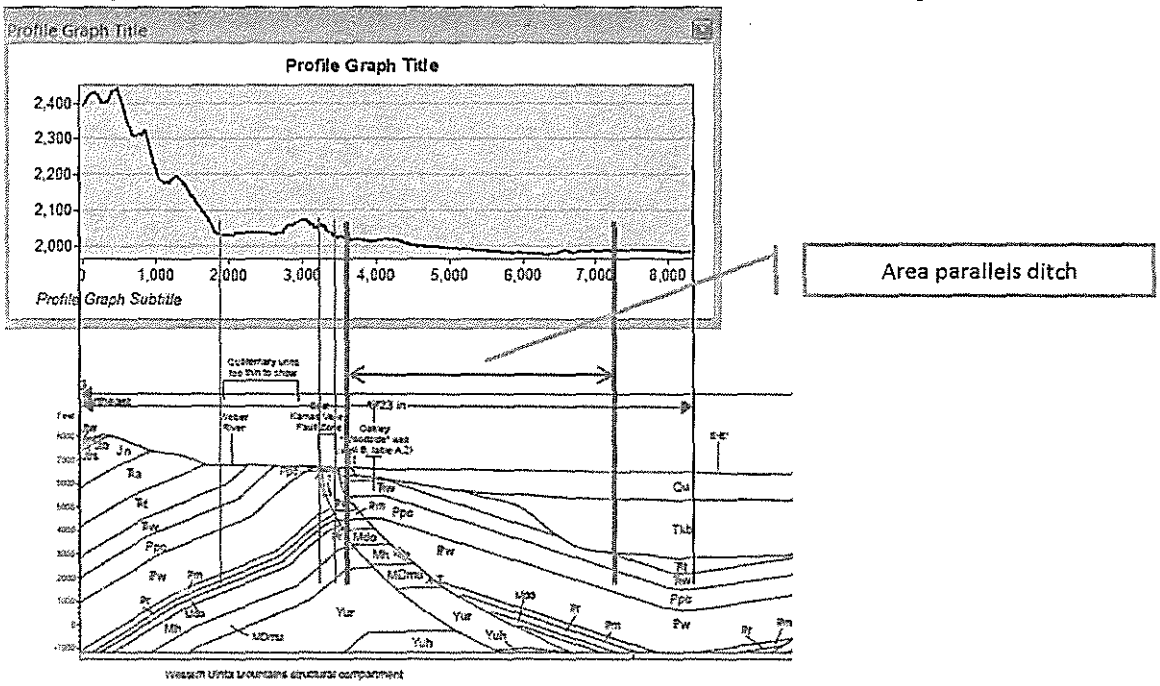
GEOLOGY

A geological map (plate 1 and 3) (Hurlow, 2002) was geo-reference and compared to 5 meter auto-correlated DEMs. Note that Qop and Qof overlap MUSYM 175 and 106/139, respectively. Qop is an "Out Wash" and Qof is "Older Alluvial-fan and debris-fan deposits". The flow paths of the geologic layers show that the water moves from east to west.

.Hurlow, Hugh A., 2002. The Geology of the Kamas-Coalville Region, Summit County, Utah and its relation to ground-water conditions. Water Resource Bulletin 29. Utah Geological Survey, Division of Utah Department of Natural Resources. UGS WRB29



Y-axis Meter Elevation X-axis Distance Meter – G Profile Clipped Brown lines illustrate are the parallels ditch Profile Mapped with ArcGIS 5 Meter Auto Correlated DEMs / Profile from G Profile Both Aligned



Codes:

Qu → **Quaternary**

Qop Outwash deposits of Pinedale age Qof Older alluvial-fan and debris-fan deposits

Tertiary

Tkb Light-gray to gray lahar, flow breccia, and tuff

Triassic

Rt Thaynes Limestone Formation

Rw Woodside Formation

Permian

Ppc Park City Formation and related rocks

Pennsylvanian

IPw Weber Sandstone

SUMMARY

In summary the measurements, soils, geology and other indicators support the 38% measured loss in the Marion Ditch. This study was completed by Bronson Smart, State Conservation Engineer and Nathaniel Todea, State Hydraulic Engineer with NRCS in cooperation with Marion Ditch Representatives.

Attachment C

Energy Savings Calculations

MARION DITCHES

DEMANDS CALCULATIONS

22-Dec-14

1 - PARAMATERS FOR ALAFALFA

RZ =	3	ft	Root Depth
MAD =	55%		Management Allowable Depletion
Etc =	0.241	in/day	Evapotranspiration

2 - PARAMATERS FOR GRASS HAY

RZ =	1.5	ft	Root Depth
MAD =	50%		Management Allowable Depletion
Etc =	0.251	in/day	Evapotranspiration

PARAMATERS FOR AGRICULTURAL SPRINKLERS

Ea =	70%		Application Efficiency
Sets =	1	Per Day	
Operating Time =	23	Hrs/Set	

PARAMETERS FOR RESIDENTIAL TURF

Etc =	0.155	in/day				
Ea =	55%		======>	Qave =	4.0	gpm/acre
Percent Irrigated =	75%			Qpeak =	8.0	gpm/acre
Peaking Factor =	2		Average Flow Multiplier			

PARAMETERS FOR GOLF COURSE TURF

Etc =	0.155	in/day				
Ea =	55%		======>	Qave =	21.3	gpm/acre
Percent Irrigated =	100%					
Watering Hours/Day =	6					

			AGRICULTURE										RESIDENTIAL
Demand Region	**Area (SF)**	**Area (Acres)**	***AM (in/ft)**	**Crop**	**Irr. Interval (days)**	**Irr. Days/Interval (days)**	**Q (cfs)**	**Q (gpm)**	**Q/A (cfs/acre)**	**Q/A (gpm/acre)**	**VOL (CF)**	**VOL (AF)**	**Q (gpm)**
Dick	217800	5	2.10	2	6	6	0.08	35.28	0.016	7.06	39048.43	0.90	-
Lehman	601128	13.80	2.10	2	6	6	0.22	97.36	0.016	7.06	107773.66	2.47	-
Wakefield	975744	22.40	2.10	2	6	6	0.35	158.03	0.016	7.06	174936.96	4.02	-
Cossey/Johnson	1106424	25.40	2.10	2	6	6	0.40	179.20	0.016	7.06	198366.02	4.55	-
Lewis	2034252	46.70	2.10	2	6	6	0.73	329.47	0.016	7.06	364712.32	8.37	-
Marion Meadows	4199184	96.40	2.10	2	6	6	1.52	680.11	0.016	7.06	752853.70	17.28	-
Venizelos/Peterson	5793480	133.00	2.10	2	6	6	2.09	938.33	0.016	7.06	1038688.20	23.85	-
Splendor View	1860012	42.70	2.10	2	6	6	0.67	301.25	0.016	7.06	333473.58	7.66	-
South End Group	7239672	166.20	2.10	2	6	6	2.61	1172.56	0.016	7.06	1297969.77	29.80	-
Mitchell	500940	11.50	2.10	2	6	6	0.18	81.13	0.016	7.06	89811.39	2.06	-
Atkinson	1241460	28.50	2.10	2	6	6	0.45	201.07	0.016	7.06	222576.04	5.11	-
Shelledy	1197900	27.50	2.10	2	6	6	0.43	194.02	0.016	7.06	214766.36	4.93	-
Bardon	958320	22.00	2.10	2	6	6	0.35	155.21	0.016	7.06	171813.09	3.94	-
McNiel/Lewis	1306800	30.00	2.10	2	6	6	0.47	211.65	0.016	7.06	234290.57	5.38	-
Blazzard	2178000	50.00	2.10	2	6	6	0.79	352.76	0.016	7.06	390484.29	8.96	-
Lower Sprinkler Group	12567060	288.50	2.10	2	6	6	4.54	2035.40	0.016	7.06	2253094.33	51.72	-
TOTALS	**43978176**	**1009.60**					**15.87**	**7122.86**			**7884658.70**	**181.01**	**0.00**
AVERAGE					**6**				**0.016**	**7.06**			
MIN					**6**								

*AVAILABLE MOISTURE

0.01571998

MARION DITCHES

DEMANDS CALCULATIONS

22-Dec-14

1 - PARAMATERS FOR ALAFALFA

RZ =	3	ft	Root Depth
MAD =	55%		Management Allowable Depletion
Etc =	0.241	in/day	Evapotranspiration

2 - PARAMATERS FOR GRASS HAY

RZ =	1.5	ft	Root Depth
MAD =	50%		Management Allowable Depletion
Etc =	0.251	in/day	Evapotranspiration

PARAMATERS FOR AGRICULTURAL SPRINKLERS

Ea =	70%		Application Efficiency
Sets =	1	Per Day	
Operating Time =	23	Hrs/Set	

PARAMETERS FOR RESIDENTIAL TURF

Etc =	0.155	in/day				
Ea =	55%		======>	Qave =	4.0	gpm/acre
Percent Irrigated =	75%			Qpeak =	8.0	gpm/acre
Peaking Factor =	2		Average Flow Multiplier			

PARAMETERS FOR GOLF COURSE TURF

Etc =	0.155	in/day				
Ea =	55%		======>	Qave =	21.3	gpm/acre
Percent Irrigated =	100%					
Watering Hours/Day =	6					

			AGRICULTURE										RESIDENTIAL
Demand Region	**Area (SF)**	**Area (Acres)**	***AM (in/ft)**	**Crop**	**Irr. Interval (days)**	**Irr. Days/Interval (days)**	**Q (cfs)**	**Q (gpm)**	**Q/A (cfs/acre)**	**Q/A (gpm/acre)**	**VOL (CF)**	**VOL (AF)**	**Q (gpm)**
Dick	217800	5	2.10	1	14	7	0.15	67.74	0.030	13.55	87483.00	2.01	-
Lehman	601128	13.80	2.10	1	14	7	0.42	186.96	0.030	13.55	241453.08	5.54	-
Wakefield	975744	22.40	2.10	1	14	7	0.68	303.48	0.030	13.55	391923.84	9.00	-
Cossey/Johnson	1106424	25.40	2.10	1	14	7	0.77	344.12	0.030	13.55	444413.64	10.20	-
Lewis	2034252	46.70	2.10	1	14	7	1.41	632.70	0.030	13.55	817091.22	18.76	-
Marion Meadows	4199184	96.40	2.10	1	14	7	2.91	1306.04	0.030	13.55	1686672.24	38.72	-
Venizelos/Peterson	5793480	133.00	2.10	1	14	7	4.01	1801.90	0.030	13.55	2327047.80	53.42	-
Splendor View	1860012	42.70	2.10	1	14	7	1.29	578.50	0.030	13.55	747104.82	17.15	-
South End Group	7239672	166.20	2.10	1	14	7	5.02	2251.69	0.030	13.55	2907934.92	66.76	-
Mitchell	500940	11.50	2.10	1	14	7	0.35	155.80	0.030	13.55	201210.90	4.62	-
Atkinson	1241460	28.50	2.10	1	14	7	0.86	386.12	0.030	13.55	498653.10	11.45	-
Shelledy	1197900	27.50	2.10	1	14	7	0.83	372.57	0.030	13.55	481156.50	11.05	-
Bardon	958320	22.00	2.10	1	14	7	0.66	298.06	0.030	13.55	384925.20	8.84	-
McNiel/Lewis	1306800	30.00	2.10	1	14	7	0.91	406.44	0.030	13.55	524898.00	12.05	-
Blazzard	2178000	50.00	2.10	1	14	7	1.51	677.40	0.030	13.55	874830.00	20.08	-
Lower Sprinkler Group	12567060	288.50	2.10	1	14	7	8.71	3908.62	0.030	13.55	5047769.10	115.88	-
TOTALS	**43978176**	**1009.60**					**30.48**	**13678.15**			**17664567.36**	**405.52**	**0.00**
AVERAGE					**14**				**0.030**	**13.55**			
MIN					**14**								

*AVAILABLE MOISTURE

0.03018737

MARION DITCHES

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22-Dec-14

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RZ =	1.5	ft	Root Depth
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Etc =	0.251	in/day	Evapotranspiration

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Sets =	1	Per Day	
Operating Time =	23	Hrs/Set	

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Etc =	0.155	in/day				
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Percent Irrigated =	75%			Qpeak =	8.0	gpm/acre
Peaking Factor =	2		Average Flow Multiplier			

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Etc =	0.155	in/day				
Ea =	55%		======>	Qave =	21.3	gpm/acre
Percent Irrigated =	100%					
Watering Hours/Day =	6					

			AGRICULTURE										RESIDENTIAL
Demand Region	**Area (SF)**	**Area (Acres)**	***AM (in/ft)**	**Crop**	**Irr. Interval (days)**	**Irr. Days/Interval (days)**	**Q (cfs)**	**Q (gpm)**	**Q/A (cfs/acre)**	**Q/A (gpm/acre)**	**VOL (CF)**	**VOL (AF)**	**Q (gpm)**
Marion Upper	24027696	551.60	2.10	1	14	7	16.65	7473.13	0.030	13.55	9651124.56	221.56	-
Marion Lower	22128480	508.00	2.10	1	14	7	15.34	6882.43	0.030	13.55	8888272.80	204.05	-
3		0.00	2.10	1	14	7	0.00	0.00	-	-	0.00	0.00	-
4		0.00			-	-	-	-	-	-	-	-	0.00
TOTALS	**46156176**	**1059.60**					**31.99**	**14355.56**			**18539397.36**	**425.61**	**0.00**
AVERAGE					**14**				**0.030**	**13.55**			
MIN					**14**								

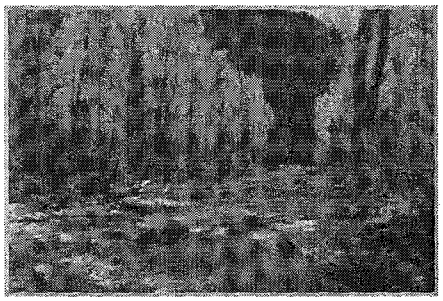
*AVAILABLE MOISTURE

Attachment D

Life Expectancy Documentation

Hydropower is Affordable

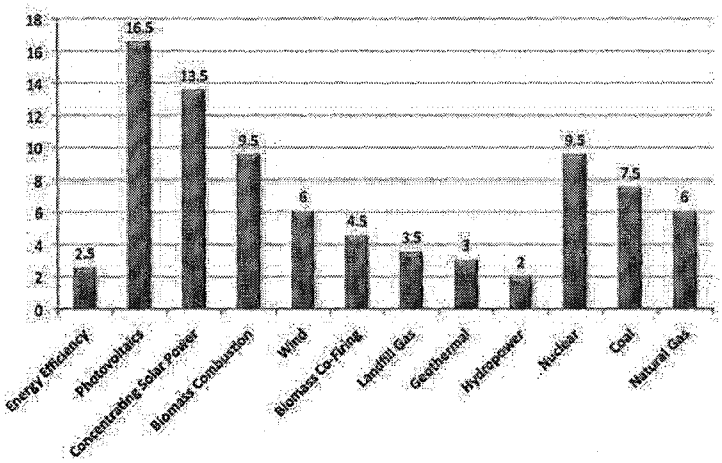
Hydropower generation benefits consumers through lower electricity costs. States that get the majority of their electricity from hydropower like Idaho, Washington, and Oregon on average have energy bills that are lower than the rest of the country. Relying only on the power of moving water, hydro prices don't depend on unpredictable changes in fuel costs.



Like 237

Hydropower offers the lowest levelized cost of electricity across all major fossil fuel and renewable energy sources, and costs even less than energy efficiency options, according to a recent study from Navigant Consulting and the American Council on Renewable Energy (ACORE).

LEVELIZED COST OF ELECTRICITY FOR VARIOUS POWER AND ENERGY EFFICIENCY OPTIONS, ¢/KWH



Assumes Federal & state incentives. CSP assumes trough technology. Natural gas price of $4.57/MMBTU. Source: Navigant Consulting, Inc. 2010

The levelized costs show above reflects the relatively low cost of hydro in terms of maintenance, operations and fuel costs when compared with other electricity sources and across a full project lifetime. For hydro projects, a longer lifespan (in the Navigant study, assumed at 50 years) means not only are costs spread across a longer timeframe but also takes into account that the power generating equipment used at these facilities can often operate for long periods of time without needing major replacements or repairs.

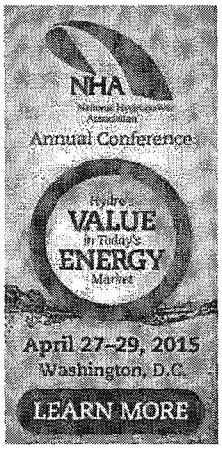
These low balance-of-system costs only make it more critical that we expand the country's hydropower capacity, but like any other major power generating source, significant up-front costs remain, and the right mix of tax and other policy incentives will foster growth of this reliable, cost-effective and clean resource. In addition, the new technologies that hold tremendous promise – such as marine and hydrokinetics – need continued R&D funding in order to reach their full potential. Learn more about the

IN YOUR REGION

Hydropower is helping to keep the lights on in every U.S. state. The top-ten hydropower generating states are:

1. **Washington**
2. **Oregon**
3. **New York**
4. **California**
5. **Alabama**
6. **Tennessee**
7. **Montana**
8. **Idaho**
9. **North Carolina**
10. **Arizona**

Learn more about hydropower in your state.



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continued R&D funding in order to reach their full potential. Learn more about the policies that support hydro development.

A look at the installed project costs – as opposed to levelized electricity costs – for various types and sizes of hydro projects reveals a wide range, and a number of technologies need continued or expanded federal incentives, supportive tax and regulatory environments and other support to improve and deploy at the project level.

Hydropower Technology	MW Range	Installed Cost ($/kW)	Discussion
Conventional Hydro (impoundment)	50 (average)	$1,000-$5,000	A mature technology, conventional hydro falls at the lower end of the range of installed costs, particularly for upgrade projects at existing sites. New dams and greenfield sites are more expensive.
Microhydro	< 0.1	$4,000-$6,000	The installed cost for low-impact hydro systems is not expected to decline in the near term.
Run of River (diversion.	Approx. 10	$1,500-$6,000	Similar to conventional hydro, installed costs for run-of-river can vary widely.
Pumped Storage	>500	$1,010-$4,500	Traditional pumped storage is a proven technology and costs are not expected to decline going forward. The new underground pumped storage technology has been quoted at $2,000/kW and cost declines can be expected going forward, if the concept proves itself.

Source: Navigant Study

New types of hydro that have yet to be widely deployed also carry different costs.

Marine Technology	Expected Commercial Cost	Discussion
Wave	Installed Cost (in 2020) is expected to be approximately $2,500/kW	Wave technology is still under development and needs R&D support to realize the promise of ocean power.

Source: Navigant Study

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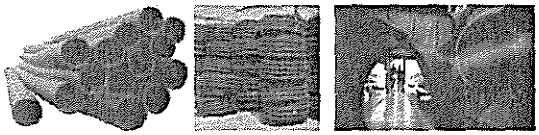

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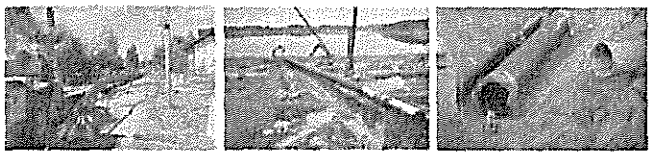
• ISO DP 4427 • DIN 8074/ DIN 8077 • AS / NZ 4130 - 1997	• IS- 4984-95 • IS-14333-96

HDPE PIPE : APPLICATIONS

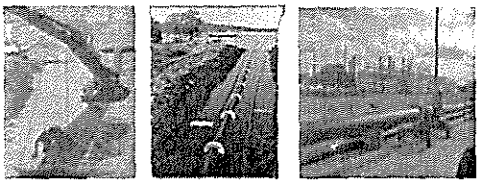
- **Septic Tank / Leach Bed Lines, Condensates, Aeration & Caustic Lines**
- **Conveying corrosive effluents of chemical & other process industries like Petrochemicals, Dyestuff, Paints, Rayon & Fertilizers**
- **Handling Saline Water, Sea water intake, Sea water airconditioning**
- **Suction & delivery of Water with Pump sets**
- **Hydro transport systems - Cement / clinker, Coal, sand slurry & other abrasive slurries iron ore, Fly ash conveyance, etc**
- **Water & Wastewater Treatment plants / Corrosive & Reclaimed Water**
- **Sprinkler Irrigation Systems & Drip Irrigation Systems**
- **Handles edible oils, fruit juices & pulps , Milk and other Food Materials**
- **For Air Conditioning & Ducting**
- **Swimming Pool Piping**
- **Sewer, storm & Sanitary Pipelines**
- **Diffusers , Outfalls & Dredging Applications**
- **Treats Radio-active waste**
- **Conveys acids, alkalis & other highly corrosive chemicals (Chemical & Process Piping)**
- **Submarine & Underwater pipelines**
- **Fish Farming**

MUNICIPAL ENGINEERING :



Typical case of relining, sewage discharge & new large diameter piping

INDUSTRIAL ENGINEERING & MARINE INSTALLATIONS :



Sea water intakes, dredging projects & effluent discharge lines all prefer HDPE (PE) PIPES

TYPICAL PHYSICAL PROPERTIES OF HDPE PIPE :

1. Abrasion Resistance	In tests conducted in USA, it has been proved that **HDPE** is superior even to X-52 grade steel when it comes to conveyance of iron ore water slurry. The performance ratio is 3:1 in favour of **HDPE**
2. Flexibility	The flexibility of **HDPE** pipe allows it to curved under,over & around obstacles as

	well as directional changes. In some cases, the flexibility of **HDPE** pipe reduces the need for fittings & saves installation costs. It can be bent to a minimum radius of 20 to 40 times the pipe diameter
3. Flow Factors	**HDPE** pipe has a smooth inner surface. A "C" factor of 150 is recommended in the William – Hazen formula. HDPE offers the unique advantage of choosing a pipe of a lower dimension for same flow of liquid over steel or cement pipes. Smooth inner walls & lower friction lead to energy saving in pumping of liquids.
4. Life Expectancy	The hydrostatic design basis of **HDPE** pipe is based on extensive testing data evaluated & standardized by industry methods. **HDPE** has a projected life expectancy of 50 years transporting water at 30 deg **C.**
5. Lightweight	It is lighter than Mild steel, Stainless steel, Concrete & Cast iron. It is easier to handle & install as compared to above materials. Density = .95kg/cm2
6. Pressure Ratings	Depending on size & application, **HDPE** pipes as available in PN-2.5, PN-4, PN-6, PN-8, PN-10, PN-12.5 & PN-16 (PN = kg/cm2)
7. Toughness	**HDPE** has low notch sensitivity, high tear strength & excellent scratch & abrasion resistance. Its resistance to environmental stress cracking is outstanding
8. UV Protection	Black **HDPE** pipe containing 2 to 2.5% carbon black can be safely stored outside in the sun without damage from UV exposure.
9. Welding	**HDPE** pipe can be joined by mechanical & butt fusion methods. In butt fusion, the strength of the joint is stronger than the pipe itself & the welding is homogenous. It can be flanged, tapped, reduced like other piping materials.
10. Coiled Pipe	**HDPE** pipe is available in coil form upto 200mmtrs in single length in sizes 20mm Ø to 110mm Ø . It leads to significant saving in installation / welding costs.
11. Corrosion Resistance	Corrosion resistant. Does not rust, rot, or corrode.
12. Leak Proof	Leak tight. Heat-fused joints create a homogenous, monolithic system. The fusion joint is as strong or stronger than the **HDPE** pipe itself.
13. Jointing	Polyethylene pipe is normally joined by heat fusion. Butt, socket, create a joint that is as strong or stronger than the pipe itself, and is virtually leak free. This unique joining method produces significant cost reductions compared to other materials.