CITY OF BOZEMAN
SUNSET HILLS CEMETERY AND LINDLEY PARK
WATER CONSERVATION PROJECT

CITY OF BOZEMAN, MONTANA
20 East Olive Street
Bozeman, Montana
59715

Funding Opportunity: R16FOADO004

WaterSMART: Water and Energy Efficiency Grants for Fiscal Year (FY) 2016

Project Manager: Lain Leoniak
20 East Olive Street
Bozeman, Montana 59715
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Lindley Park Groundwater Well

Lindley Park Well has permitted groundwater rights (Water right number 41H 79578 00, in the NWNESE of section 7 T2S R6E, Gallatin County) for .38 CFS and 37.56 AF to irrigate 25 acres at two (2) sections (in the N2SE of section 7T2S R6E and in the S2SENE of section 7 T2S R6E, Gallatin County), with a priority date of November 4, 1991. The period of use for groundwater right is from April 15 to November 1. Currently the well provides irrigation water to approximately 25 acres of land consisting of approximately 24 acres of irrigated area in the park and a portion of the adjacent cemetery.

Project Update

On November 16, 2015, the Bozeman City Commission contracted to engage the services of Morrison and Maierle Engineering, Inc., in an amount not to exceed $48,392.00 to complete a preliminary engineering report that develops and evaluates various water efficient design alternatives that effectively utilize the Story Ditch surface water right to irrigate Sunset Hills Cemetery and Lindley Park. The preferred alternative, outlined in this proposal, describes the construction of an automated headgate to reduce and control the amount of water diverted and rock ramp infrastructure at the point of diversion to provide fish passage. The report will also identify a second preferred alternative of lining the ditch with half-pipe to eliminate all seepage losses.

Story Ditch

The City of Bozeman has a decreed surface water right for the Story Ditch that diverts from Sourdough Creek (Bozeman Creek)(water right number 41H 99632 00) in the NWSWSE of Section 7 T2S R6E, Gallatin County that is decreed for eight (8) cfs to irrigate eighty-six (86) acres in the E2 of Section 7 T2S R6E, also referred to as Sunset Hills Cemetery and Lindley Park, with a priority date of September 30, 1865. The period of use for the Story Ditch is from April 1-November 1. The water right is also decreed for recreation and flood control.

Story Ditch appears to be initially constructed in 1865 based on water right records. The ditch starts at the diversion structure as a bottomless square concrete culvert which appears to date back to the early 1900's. There is no control on the ditch with the exception of the height of boards installed in the diversion dam. Refer to Appendix B Figure 9. No plans are known to exist for the ditch. The ditch runs east from Bozeman Creek, crosses under the old railroad grade, runs along the east side of the rail road grade to Church Street which it crosses under and then flows through city park land to Main Street. At that point it crosses under Main Street and eventually flows to Rocky Creek. The ditch is not normally maintained and deadfall, debris and sediment in the ditch and phreatophytes along the ditch banks impede flows. Refer to Appendix B Figures 11 and 12.

There are poor soil conditions and heavy vegetation from the ditch to the decreed places of use and as a result, ditch losses are significant. Recent analysis of losses in the ditch indicates that 3.6 cfs is lost in the first 1,100 feet. Refer to Appendix A Figure 5 for soils description and location.

As a result of these structural deficiencies, treated municipal water supplies are used to irrigate most of the subject lands and the use of the diversion structure and ditch is limited. Irrigation of public lands with treated water is an expensive option for COB and annual costs for treated water exceed $25,000.00. This will increase when COB implements plans to expand the cemetery and is therefore is economically unsustainable. Moreover, the use of finite domestic water supplies is physically unsustainable in a rapidly growing headwaters community like Bozeman, located in the Upper Missouri (Gallatin River), a basin closed to new appropriations of surface water.

Additionally, the use of treated water and the inefficient diversion structure and system of conveyance and distribution conflicts with the goals set forth in the City of Bozeman's Integrated Water Resources Plan (IWRP) adopted by the City Commission in 2013 and the Water Conservation Program established July 2014. The Project contributes to the accomplishment of the goals set forth in the IWRP and the Water Conservation Program.

BACKGROUND DATA

Sourdough Creek Diversion

The point of diversion dates back to 1865. The date of construction of the current diversion structure is unknown although it appears to date back to the 1950s and is likely much older. It is probable that no major changes have been made in the diversion since 1956 when the last major use of water (flour mill operation) apparently stopped based on reports in the water right records.

The diversion structure consists of a concrete structure with a throat that is utilized for the insertion of stop logs. No plans are known to exist for the structure. The City of Bozeman has been the primary operator of the diversion structure in recent times. In general the stop logs are placed in the dam across the width of Sourdough Creek in late April-early May and removed in October. Recent water use includes recreation and flood control uses by COB and stock water uses by down-ditch users.

Sourdough Creek, also known as Bozeman Creek, is a mapped floodplain with modeled floodplain elevations. The floodplain is administered by the City of Bozeman.

In order to effect the diversion, substantial quantities of water are required in addition to the decreed amount. This results in the diversion of flows in excess of decreed amounts from Sourdough Creek. The operation of the diversion is also dangerous for City staff to install and remove the stop logs, tarp and sandbags during high flows and when ice is present. This often results in delays in getting water into the ditch and early shut downs in relation to the decreed period of use and interruptions in diversions into the ditch. The current diversion structure does not allow for control of the amount of water diverted.

Photo 1.1-1: Stop Logs Across Sourdough Creek

Photo 1.1-2 Diversion on Sourdough Creek

EXECUTIVE SUMMARY

January 15, 2016

Applicant: City of Bozeman Water Conservation Division
Applicant Town: Bozeman
Applicant County: Gallatin County
Applicant State: Montana

The City of Bozeman (COB) is proposing the Sunset Hills Cemetery and Lindley Park Water Conservation Project (Project) that will conserve water, increase instream flows for fish habitat and downstream water users, reduce safety risks to COB staff associated with the operation of the diversion structure, and increase the availability of domestic water supplies during periods of drought. Refer to Appendix A Figure 1.

Project funds will be used to design and replace the point of diversion that allows for automated control of the amounts of water diverted and a rock ramp to facilitate fish passage in Sourdough Creek. Project funds will also be used to line the ditch to eliminate water losses from seepage, to automate distribution into the irrigation system, replace the irrigation main line and make repairs to known leaks within the irrigation system.

This Project contributes to accomplishing the goals of the FOA in accordance with Section III.B Eligibility Information. Specifically, the applicant is a municipality that operates a water utility with water delivery authority and is located in a Western State identified in the Reclamation Act of June 17, 1902. Additionally, the Project includes a combination of activities described in Tasks A-D as described below.

Applicant COB seeks an award from Funding Group I in the amount of $300,000.00. If awarded, the Project will be completed within two years of award.

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TABLES

PHOTOS

APPENDICES

TABLE OF CONTENTS

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TECHNICAL PROJECT DESCRIPTION

PROJECT IDENTIFICATION

The City of Bozeman (COB) is engaging in a Water Conservation Project (Project). The COB has a decreed surface water right for the Story Ditch that diverts from Sourdough Creek (Bozeman Creek)(water right number 41H 99632 00) in the NWSWSE of Section 7 T2S R6E, Gallatin County that is decreed for eight (8) cfs to irrigate eighty-six (86) acres in the E2 of Section 7 T2S R6E, also referred to as Sunset Hills Cemetery and Lindley Park, with a priority date of September 30, 1865. The period of use for the Story Ditch is from April 1-November 1. The water right is also decreed for recreation and flood control. The Project extents are shown in Appendix A Figure 6.

It is believed that the Story Ditch was constructed in the 1860s with possible repairs to the ditch occurring in the 1950s. It is believed the Ditch remains much the same as it was since that time.

The Project will start at the point of diversion for the Story Ditch and proceed along the length of the canal to the proposed pump station to be located at the approximate location of the Middle Site depicted in Appendix A Figure 2. The Project will include installation of irrigation main lines and repairs to leaking irrigation system components used within Sunset Hills Cemetery and Lindley Park.

The City of Bozeman proposes to replace and improve the point of diversion for the Story Ditch in order to control and reduce the amount of water diverted through an automated headgate and to create fish passage within Sourdough Creek. The Project also proposes to upgrade a section of the ditch from the point of diversion to the location of the proposed pump house by lining it with half-pipe to eliminate all seepage loss along that portion of the ditch. The Project will include hydraulic and structural design, permitting, construction administration and construction activities.

The Project is a construction project to be performed by COB and its contractors. The Project will replace the point of diversion with a rock ramp and a headgate and rehabilitate 1,100 linear feet of unlined ditch. Currently, approximately 30% of the water diverted is lost to seepage in the first 1,100 feet of the ditch. The replacement and upgrades to the point of diversion will not only save water but it will eliminate the safety risks associated with the current diversion structure and make the operation of the diversion safe for COB staff. The lining of the ditch with half-pipe will eliminate all seepage loss along that portion of the ditch, ensuring all water diverted will be placed to beneficial use.

PROJECT DESCRIPTION

Technical Project Description – Evaluation Criterion A - Water Conservation

Diversion dam and Headgate: The proposed rock ramp diversion incorporates the use of rock weirs to create a series of step pools leading to a new rock diversion structure. These step pools would raise the water elevation downstream of the diversion. This facilitates fish passage in two ways; the first is that raising the downstream pool elevation decreases the plunge height which fish must jump, and increases the pool depth which allows fish to jump more easily. Stream simulation design would be incorporated in this alternative so that the step pools would attempt to mimic natural stream conditions. Stream channel measurements of stream slope, pool spacing, depth, length, crest height, dominant rock size, and other geomorphology characteristics would be recorded in a reference reach. These values would be used to design a series of pools downstream of the diversion to allow fish passage while maintaining the function of the diversion itself. Depending on the design and stream measurement values some grouting or armoring of the channel or pool tail crests may be needed. The new automated headgate allows for only the decreed amount of water to be diverted and for the headgate to open and close in coordination with the operation of the pump instead of remaining open 24 hours a day for the duration of the irrigation season. This will result in far less quantities of water diverted into the ditch.

Canal Lining: The half-pipe includes installation of a half pipe and positioning this half pipe along the ditch alignment at a constant grade throughout the project area. Preliminary hydraulic calculations have indicated that a 36 inch diameter smooth wall pipe would be adequate to convey the measured flow rates. This would result in an 18 inch deep cross section. The half pipe would be anchored on either side with a concrete curb with anchor bolts attached to the half pipe and cast into the concrete. The existing ditch would be re-graded and compacted to a consistent slope throughout the project area and imported bedding material brought in to provide a base to lay the half pipe. This type of ditch improvement has been used in other locations in the district and has been successful in eliminating seepage and reducing maintenance efforts.

Pump Station: The main component in using the ditch water source as the main water supply, is developing a diversion system that allows the water flow to continue to flow through downstream to other users down-gradient, while allowing the pump to pull out water that is required for the irrigation system. In order to achieve these objectives, there will be two (2) wet wells installed, approximately 12-15 feet deep using 6" concrete rings stacked. The water will flow through the first wet well, which will act as a sediment separation structure, while the majority of the water to flow through downstream and back into the ditch. This wet well will have a concrete cover with cast iron manhole, to be used for access to clean out the sediment. The second wet well, which will be used to mount a vertical turbine pump station with self-flushing filtration on top, will be installed 90 degrees off the sediment wet well and piped such

that it will maintain the required gallons and ditch water level. The pump station will be a pad mounted assembly using vertical turbine pumps. It will be installed within a pre-fabricated building enclosure to protect and insulate the sound form the adjacent neighborhood. The building will need to engineered and designed architecturally, per COB's requirements. Refer to Appendix F for ditch diversion and wet well/pump assemblies. There will be an opportunity to design the pumping station such that it can be sized for the complete build out, but only two of the three motors/pumps will be installed as a part of this Project. As future development of the cemetery occurs, the third motor/pump can be in installed to supply the extra gallons demand as the system starts to get to its maximum output requirement. In addition to the diversion structure and wet wells / pump assembly, the COB will need to be able to bring a power drop to this location from the power line adjacent to the pump station location. The pump station will be equipped with controls for pump operation, headgate and irrigation control. The irrigation controller will be an ET Based control system with mini weather station on site for adjusting the watering programs daily. The City of Bozeman is currently pursuing a central controller system through another project. If the central controller is in place at the time of this project it will be utilized to allow for Internet Based ET clocks that can be tied to local area weather stations, full two way communications between the central and field units and incorporate flow sensing features, which would allow remote capability of programming and better water management.

Subcriterion No. A.1: Quantifiable Water Savings

Describe the amount of water saved.

What is the applicant's average annual acre-feet of water supply?

The City of Bozeman's water supply for the subject water is 4,348 acre feet.

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

The water that will be conserved is currently lost through a variety of ways:

- seepage in Story Ditch resulting in loss into the ground,
- applied with potable water that is used for irrigation of municipal park and cemetery lands resulting in loss or reduction of stored municipal water
- applied through groundwater used for irrigation of municipal park and cemetery lands resulting in loss of groundwater, *and*
- potable water lost through leaking distribution lines within the cemetery resulting in loss into the ground and reduction of stored municipal water.

The proposed project eliminates the municipal supply use, groundwater use and seepage in the canal.

Where will the conserved water go?

The conserved water will be applied in two locations; instream flows and conserved for use in times of drought:

(1) By eliminating seepage in the ditch, the project reduces necessary diversion flows that will remain in the creek. 1,283 acre feet of water conserved as a result of improvements to the diversion and the elimination of seepage in the ditch will remain in Sourdough Creek for instream flows and for use by downstream water users.
(2) Twenty-five acre feet of groundwater supplies will be conserved and made available for use in times of shortage.
(3) The 34.3 acre feet of water conserved as a result of transitioning from the use of potable water supplies to non-potable frees up potable water supplies to be banked in Hyalite Reservoir for domestic use in times of drought. This will also eliminate the need for COB Parks and Recreation Department to purchase treated water each year, resulting in annual cost savings of $25,618.00.
(4) 8.4 acre feet of potable water is conserved by repairing a leaking distribution pipe in the cemetery.

Please include a specific quantifiable water savings estimate; do not include a range of potential water savings.

Canal Lining:

(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.

Canal Seepage: Flow data within Story Ditch was obtained on October 2, 2015. This date correlates to low flow conditions in Sourdough Creek. Morrison and Maierle staff conducted measurements at three locations in Story Ditch to access the quantity of water flowing in the ditch. Appendix A Figure 2 identifies the three locations. The following describes the location and methods for the three sites.

South Site

This site is located between the Sourdough Creek diversion and the Gallagator Trail and was the closest location to the diversion available for an accurate measurement . A red triangle on the map indicates the location of the site. The site is located where the remnants of a weir exist. The discharge was measured utilizing a Pygmy meter and utilizing 33 measurements across the cross section.

Middle Site

The middle site is located at the same location as the LWQD's measurement section just downstream of the Peet's Hill culver/bridge crossing. A second red triangle on Appendix A Figure 2 indicates the location of this site. This site is the approximate location of the proposed pump station. The discharge was measured utilizing a Pygmy meter and utilizing 22 measurements across the cross section.

North Site

The north side is located east of the Library. A third red triangle on the map indicates the location of this site. The site is at the discharge point of one of the old ponds in the park and at the time of measurement the weir structure had a board in it to allow for the flow to be computed based on stage.

Table 1 – Story Ditch Flow Measurements

Site	Flow (cfs)
South	12.2
Middle	8.6
North	5.0

The flows are assumed to represent typical flow within Story Ditch. At the flow rates identified, the down-gradient water user is able to obtain their necessary flows.

With the south site representing the diverted flow and the middle site representing the future pump station, we are aware that 3.6 cubic feet per second of flow is lost over the 1,100 feet of canal distance. This flow converts to 1,283 acre-feet considering an irrigation season of 180 days.

The proposed improvements will eliminate seepage resulting in water conservation of 1,283 acre-feet. The water savings will be implemented for beneficial use through the irrigation system at Lindley Park and Sunset Hills Cemetery and turned back to Sourdough Creek. Of the 1,283 acre-feet conserved, 1,082 acre-feet will be returned to Sourdough Creek and 201 acre-feet will be used for the park and cemetery.

(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.

Annual seepage losses have been determined based on the methodology described above. The losses are calculated based on the typical irrigation season, which is defined as 180 days for post-project irrigation. The current loss is based upon water measurement data obtained using an in-stream flow meter at the point of diversion and at the proposed pump house location. Based on flow measurement data, the loss in the canal, which spans 1,100 feet, is 3.6 cubic feet per second. The water measurement data was obtained during low water conditions in the early fall. During higher water conditions, more flow is likely diverted in Story Ditch resulting in the likely event that more seepage occurs during the higher water conditions. The flow measurements obtained represent a conservative seepage value because they are obtained during low flow conditions.

(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)?

It is assumed that post-project seepage/leakage losses will be zero. The proposed solution includes a segment of pipe and a larger section of half-pipe. The half-pipe material will be galvanized steel smooth wall pipe similar to Ultra-flow pipe material. The joints will be sealed and will be water tight. The small piped section will be water tight smooth wall interior HDPE pipe. No losses are anticipated.

(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?

The annual loss due to seepage within Story Ditch for this project is calculated at 1,283 acre-feet. This is for a 1,100 foot section of canal. The loss on a per-mile basis is calculated at 6,168 acre-feet per mile.

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

A flow meter will be installed at the pump station and a flow measurement device using a flume with a stilling well and automation will be installed at the headgate turnout. This equipment will allow for precise flow measurement to verify water savings.

(f) Include a detailed description of the materials being used.

During final design of the project, the specific materials including models numbers, sizing, etc. will be determined. The canal will be lined using a combination of a small

section of pipe and a longer section of half-pipe. The piped section will be smooth wall interior HDPE pipe such as ADS N-12 or similar and the half pipe will be smooth wall galvanized steel pipe such as Ultra flow or similar.

Performance Measures:

Post-project methods for quantifying measurements include assessment of flow measurement data using the installed flume at the turnout, flow meter at the pump station and, if necessary, in-stream flow measurement down-gradient of the pump station to verify data.

Municipal Metering: NA

Irrigation Flow Measurement:

(a) How have average annual water savings estimates been determined? Please provide all relevant calculations, assumptions, and supporting data.

The Project involves canal lining, automation of a pump station/turnout headgate and flow measurement. The current conditions in the canal do not include any of these components. When added to the system, it will result in the ability to measure or manage flow with accuracy combined with significant reductions in seepage.

The proposed improvements will eliminate seepage resulting in water conservation of 1,283 acre-feet. The methodology for this value is demonstrated in the canal lining section above. Of the 1,283 acre-feet conserved from canal lining, 1,082 acre-feet will be returned to Sourdough Creek and 201 acre-feet will be used for the park and cemetery.

By incorporating flow measurement along with controls, COB will be able to avoid diverting nonessential flows to Sourdough Creek and necessary flows to the park/cemetery will be realized. The water savings will be implemented for beneficial use through the irrigation system at Lindley Park and Sunset Hills Cemetery and turned back to Sourdough Creek. Flow measurement will be a critical investment to achieve these goals.

(b) Have current operational losses been determined? If water savings are based on a reduction of spills, please provide support for the amount of water currently being lost to spills.

The existing mechanisms involve a diversion dam with stop logs and a turnout with no headgate. See Appendix B Figure 1, 2, 8 and 9. Upon installation of the stop logs by city staff, minimal adjustments are made to the stop logs to control flow into Story Ditch. Furthermore, no headgate exists at the turnout to control flow. Refer to Appendix B Figures 8 and 9. No flow measurement device exists to control flows to Story Ditch. The only mechanism to guide COB on appropriate diversion of flow into Story Ditch is if the downstream water user notifies COB of low or no flow conditions at the end of Story Ditch. This methodology results in no flow measurement or management of flows into Story Ditch. It is likely that excessive flows are diverted into Story Ditch. As discussed in the response immediately above, the proposed project offers flow control at the turnout via a headgate, flow measurement and controls. It is calculated that 1,082 acre-feet of surface water will be returned to Sourdough Creek.

(c) *Are flows currently measured at proposed sites and if so what is the accuracy of existing devices? How has the existing measurement accuracy been established?*

Flows are not currently being measured in Story Ditch at the diversion or at the proposed pump station. To calculate losses, in-stream flow measurement was obtained using a hand-held device. The hand-held device is typically within 10 percent accuracy.

(d) *Provide detailed descriptions of all proposed flow measurement devices, including accuracy and the basis for the accuracy.*

The proposed project will involve flow measurement devices to control diverted water and pump station flows:

- The flow meter in the pump station will be an in-line flow meter. The accuracy of on in-line flow meter is typically within 5%,
- A flow measurement device at the headgate turnout will be used such as a prefabricated parshall flume or similar. The accuracy associated with a flume is typically within 2%-5%, and
- An automated headgate will be installed at the turnout to Story Ditch. This control will be accomplished using an automated slip gate such as a Rubicon Slipgate or similar. The accuracy associated with a automated slip gate is typically within 5%.

(e) *Will annual farm delivery volumes be reduced by more efficient and timely deliveries? If so, how has this reduction been estimated?*

Annual delivery to irrigated land will be reduced by more efficient and timely deliveries. It is anticipated that the pump station will delivery irrigation water to the cemetery and

park for 8 hours during a 24 hour period. During the 16 hours of no irrigation, the headgate will be automated to reduce diverted flows.

By incorporating control of the turnout and reducing flows for the 16 hour period, 462 acre-feet of water is conserved. The reduction of diverted flows during the 16 hour period is 1.7 CFS. Over 180 days of irrigation, this resulted in 462 acre-feet of conserved water by implemented controls.

(f) How will actual water savings be verified upon completion of the project?

The project will involve a series of controls, which will be continuously calibrated, maintain and operated by qualified COB staff.

Performance Measures: Post-project methods for verify post-project benefits to improved irrigation delivery measurement include comparing post-project water measurement data to pre-project water uses.

SCADA and Automation:

The previous section "irrigation flow measurement" discusses the role of flow measurement and automation with this project.

(a) How have average annual water savings estimates been determined? Please provide all relevant calculations, assumptions, and supporting data.

See previous section – Irrigation Flow Measurement

(b) Have current operational losses been determined? If water savings are based on a reduction of spills, please provide support for the amount of water currently being lost to spills.

See previous section – Irrigation Flow Measurement

(c) Will annual farm delivery volumes be reduced by more efficient and timely deliveries? If so, how has this reduction been estimated?

See previous section – Irrigation Flow Measurement

(d) Will canal seepage be reduced through improved system management? If so, what is the estimated amount and how was it calculated?

See previous section – Irrigation Flow Measurement

(e) How will actual water savings be verified upon completion of the project?

See previous section – Irrigation Flow Measurement

Performance Measures: Post-project benefits of installing a SCADA include the ability to track and record the diversions to water users and compare to pre-project diversions. This would show results of improved management if yearly fluctuations in weather are accounted for.

Groundwater Recharge: NA
Small-scale Water Recycling and Water Reuse: NA
Landscape Irrigation Measure: Yes (?)

(a) Turf Removal: NA
(b) Smart Irrigation Controller:

See previous section – Irrigation Flow Measurement

(i) *What types (manufacturer and model) of devices will be installed and what quantity of each?*

The City of Bozeman is in the process of researching various central controllers from Rainbird, Torro, Baseline and Signature. The City of Bozeman does not irrigate city lands through a CICS at this time. The controller will be an ET Based control system with weather station on site for adjusting the watering programs daily. Features will include Internet Based ET clocks that can be tied to local area weather stations, full two way communications between central and field units and incorporate flow sensing features, which would allow remote capability of programming and better water management.

(ii) *Will the devices be installed through a rebate or direct-install program?*

No.

(iii) *Will site audits be performed before and after installation?*

No audits are planned at this time.

(iv) *How will actual water savings be verified upon completion of the project?*

See previous section – Irrigation Flow Measurement

Performance Measures:

See previous section – Irrigation Flow Measurement

High Efficiency Indoor Appliances and Fixtures: NA
Small-scale Water Recycling and Water Reuse: NA
Other Project Types Not Listed Above: NA

Subcriterion No. A.2: Percentage of Total Supply

The percentage of total supply is calculated below. These values are based on measured streamflow at three locations along the ditch itself identified on the map attached (APPENDIX A Figure 2).

$$\frac{\text{1,082 Acre Feet (Estimated Amount of Water Conserved)}}{\text{4,348 Acre Feet (Average Annual Water Supply)}} = 25\%$$

Technical Project Description – Evaluation Criterion B - Energy Water Nexus

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

No renewable energy components are being proposed on this Project.

Subcriterion B.2: Increasing Energy Efficiency in Water Management:

No increases in energy efficiency are being proposed on the Project.

Technical Project Description – Evaluation Criterion C – Benefits to Endangered Species (Up to 12 points)

Section 7 Endangered Species Act Consultation with US Fish and Wildlife Service (USFWS):

According to the October 2015 list of Endangered, Threatened, Proposed, and Candidate Species for Montana, the following species may occur within Gallatin County:

- Ute Ladies' tresses (*Sprianthes diluvialis*) – Listed threatened
- Canada lynx (*Lynx Canadensis*) – Listed threatened, critical habitat
- Grizzly bear (*Ursus arctos horribilis*) – Listed threatened
- Sprague's pipit (*Anthus spragueii*) – Candidate
- Whitebark pine (*Pinus albicaulis*) – Candidate

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

(i) What is the relationship of the species to water supply?

There are no fish or aquatic species present on this list for Gallatin County. If the presence of federally listed fish or aquatic species was discovered, the proposed project provides significant benefit to aquatic life through the incorporation of aquatic organism passage. Additionally, no habitat characteristics necessary for the presence of these species exist within the proposed project area. Consultation with the USFWS will be triggered through application with the USACE 404 permit and through the use of federal funds on this project.

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

There is likely no chance of impact to any ESA listed species by the proposed Project. Upon award of federal funds, consultation with USFWS will likely occur.

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

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

NA

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

NA

Performance Measures: Consultation with USFWS will include documentation of specific performance measures that will ensure no adverse effects to any endangered, threatened or candidate species. No adverse effects are anticipated.

Technical Project Description – Evaluation Criterion D – Water Marketing
(Up to 12 points)

No development of water markets is being proposed as a component of this project.

Technical Project Description – Evaluation Criterion E – Contributions to Water Supply Sustainability
(Up to 14 points)

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

Although a Missouri River Headwaters Basin Study (Montana) was funded in 2014, no WaterSMART Basin Study has been completed to date in the project area.[1]

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

No expediting of future on-farm irrigation improvements is associated with this project.

Sub criterion E.3: Other Water Supply Sustainability Benefits

(i) Will the project make water available to alleviate water supply shortages resulting from drought?

a. Explain in detail the existing or recent drought conditions in the project area. Describe the impacts that are occurring now or are expected to occur as a result of drought conditions.

While the project area historically experiences periods of drought, over the last two years, the project area has experienced on-going drought conditions of varying severity.[2] This has impacted available supplies in the watershed. During the late summer of 2015, a call on COB water rights was made which resulted in COB having to curtail its diversions for municipal uses in order to meet the call of a downstream senior water user. The consequence was to place COB in a position of being unable to meet demands during the period of curtailment.

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[1] *See e.g.*: http://www.usbr.gov/watersmart/bsp/studies.html; last visited: January 14, 2016.
[2] *See e.g.*:
http://mslapps.mt.gov/Geographic_Information/Maps/watersupply/SurfaceWaterSupplyIndex/Default (July 2013-Ocotber 2015) Last visited: January 14, 2015.

Should 2016 prove to be another dry year, it is expected that that call and possibly others will come on and COB will be forced to curtail water rights that are integral to meeting demands and implement plans to restrict uses by customers.

Should the rapid population growth and changes in land use continue in conjunction with forecasted persistent drought conditions in the project area, COB will face challenges in meeting demands and managing shortages. [3]

b. Describe the severity and duration of drought conditions in the project area.

Drought conditions have been present to varying degrees of severity in the project area for the last two years. Drought forecasts from the US Drought Monitor predict another dry year for the Project area in 2016.

c. Describe how the water source that is the focus of this project (river, aquifer, or other source of supply) is impacted by drought.

Due to the fact that the City of Bozeman is a headwaters community and is wholly reliant on finite surface water supplies including but not limited to Sourdough Creek, the City is particularly susceptible to impacts from drought. In an effort to be proactive and adequately prepare for drought, the City of Bozeman is a partner in the National Drought Resilience Partnership, Upper Missouri River Headwaters Basin Drought Demonstration Project and has contracted for engineering services to assist city staff in the development of a drought management plan in order to prepare for and better manage surface supplies and mitigate effects of drought. Refer to Appendix K.

d. Provide a detailed explanation of how the proposed WaterSMART Grant project will improve the reliability of water supplies during times of drought.

The WaterSMART Grant applied for herein to provide support for the Sunset Hills Cemetery and Lindley Park Water Conservation Project will save water which is currently lost due to the inefficient diversion structure and significant ditch losses that occur once the water is diverted.

Through improvements made to the diversion structure and ditch, water in excess of the decreed amount will not be diverted and will be left in the stream. This will directly benefit downstream users including but not limited to bolstering in-stream flow rights held by the Montana Fish, Wildlife and Parks Division of the State of Montana, in key reaches of the East Gallatin and at Logan, Montana, the headwaters confluence of the Upper Missouri River.

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[3] *See:* http://www.cpc.ncep.noaa.gov/products/expert_assessment/mdo_summary.php Last visited: January 14, 2015.

Transitioning irrigation of the subject lands from treated water to the historically decreed surface water supply will increase the amount of treated water available to the city for critical health and sanitation purposes during times of water shortage.

(ii) Will the project make water available to address a specific concern? For example:

a. Will the project directly address a heightened competition for finite water supplies and over-allocation (e.g., population growth)?

Yes. Currently, COB experiences operational constraints due to seasonal impacts that limit the availability of existing water supplies. Changing climate conditions will reduce the estimated annual firm yield of existing supplies. Coupled with the rapid rate of growth occurring in the city and surrounding region, the demands on the finite water supplies are increasing. The Project allows the city to shore up domestic supplies available to city residents during times of drought in order to reduce impacts to the health and socioeconomic well being of the community.

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

Due to the fact that the City of Bozeman is a headwaters community and is wholly reliant on surface water supplies in the form of snowpack, including but not limited to Sourdough Creek, the water source for this project, the City is particularly susceptible to changes in precipitation patterns and increases in temperature. As a result and as part of a long term drought mitigation strategy, the City seeks to conserve and identify all available sources of treated water supplies to set aside in the City's storage reservoir for domestic use during times of water shortage.

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

Yes. A key component of the project is to reconfigure the diversion structure so that it is capable of taking only the decreed amount or some quantity less than the decreed amount in times of shortage to stretch raw water surface supplies as far as possible during times of drought, thereby leaving water in the stream for fish, wildlife and downstream users.

Additionally, as a result of the conversion from treated water supplies to raw surface supplies, the treated water that is not used for irrigation of the subject lands during the summer months can reduce risks of interruption in the municipal supply and be banked for

use during times of shortage to increase the security of domestic supplies for city residents when needed.

(iii) Will the project make additional water available for Indian tribes?

Not at this time.

(iv) Will the project make water available for rural or economically disadvantaged communities?

Yes. The project will make available 3.6 cfs and 1283 acre feet that have been previously lost in the diversion and ditch seepage to farms, ranches and rural communities downstream.

(v) Does the project promote and encourage collaboration among parties?

Yes. See below.

a. Is there widespread support for the project?

Yes. Support for the project exists within many city departments, including the Public Works Department, the City Commission and the Water Conservation, Engineering and Parks and Recreation Divisions. There is widespread support for the project within the environmental and water management communities from Trout Unlimited and two state agencies; the Montana Department of Natural Resources and Conservation and Montana Fish Wildlife and Parks. Refer to Appendix E.

b. What is the significance of the collaboration/support?

Collaboration and support are critical to the project's implementation, completion and on-going success.

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

Yes. In the event the Fish Wildlife and Parks calls for additional water in order to supply needed flows for instream purposes and to receive its full allotment of decreed water, the additional water supplies that are saved and left instream as a result of the aforementioned improvements to the diversion structure and ditch, can go toward keeping that call off. This significantly reduces potential conflicts between COB and Montana Fish Wildlife and Parks.

d. Is there frequently tension or litigation over water in the basin?

There has been growing tension in recent years and currently great efforts are being made in the form of the development of a Gallatin Valley water exchange that includes COB as an interested participant, to address water sharing collaboratively in order to avoid protracted litigation which will be inevitable if collaborative solutions are not achieved.

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

Yes. The improvements made to the diversion structure and ditch will be utilized as an example of best management practices to developers in order to facilitate the non-potable irrigation objective set forth in the city's IWRP and to other ditch users in the Gallatin Watershed and surrounding communities.

(vi) *Will the project increase awareness of water and/or energy conservation and efficiency efforts?*

Yes. The City of Bozeman will measure stream flows, diversions at the headgate and losses to seepage before and after completion of the project, share that data with interested parties and make it available to the public in order to demonstrate water savings that can be obtained through improvements to irrigation infrastructure.

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

Yes. The project will serve as an example of water conservation within the City of Bozeman and for members of neighboring agricultural communities.

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

Not directly, but the Project will serve as a model demonstrating best management irrigation practices and water savings will be readily available to the public and interested parties.

b. *Does the project integrate water and energy components?*

Not at this time.

Technical Project Description – Evaluation Criterion F – Implementation and Results (Up to 10 points)

Subcriterion No. F.1: Project Planning

Does the project have a Water Conservation Plan, System Optimization Review (SOR), and/or district or geographic area drought contingency plans in place? Does the project relate/have a nexus to an adaptation strategy developed as part of a WaterSMART Basin Study)? Please self-certify, or provide copies of these plans where appropriate to verify that such a plan is in place.

Provide the following information regarding 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 Upper Missouri Headwaters is the subject of a 2014 WaterSMART Basin Study. While a final product is pending and it is as yet unknown if there is a nexus between the Project and the WaterSMART Upper Missouri Headwaters Basin Study, it is anticipated that improving water use efficiency would be included as an objective in the Study.

The Project facilitates goals and objectives identified in the following Plans:

(i) Montana State Water Plan: Executive Summary, Including Major Findings and Key Recommendations (2015)(Appendix H)
(ii) The City of Bozeman's Integrated Water Resources Plan (2013)(Appendix I)
(iii) The City of Bozeman's Water Conservation Plan (2014) and Program Update (2015)(Appendix J)
(iv) The City of Bozeman's Drought Management Plan: Professional Services Contract and Scope of Work (Appendix K)

(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).

Montana State Water Plan (2015)

The Sunset Hills Cemetery and Lindley Park Water Conservation Project is within the Upper Missouri River Basin and is part of the Montana State Water Plan's Montana Water Supply Initiative (2015). The Montana State Water Plan: Executive Summary, Including Findings and Key Recommendations, (Appendix H) states that one of its goals is to "improve water use efficiency and conservation." (Appendix H, Executive Summary page 6).

The Montana State Water Plan recognizes that certain irrigation methods can have return flow benefits and that irrigation methods have trade-offs among all water users and recommends "...the development and implementation of water efficiency and water conservation strategies to use water more effectively." (Appendix H page 7)[4]

The water savings from the Sunset Hills Cemetery and Lindley Park Water Conservation Project will be available for use by downstream irrigators, for aquatic habitat and frees up treated water supplies for domestic use in times of shortage. These savings go toward meeting the goals set forth in Montana's State Water Plan.

[4] *See also* Montana State Water Plan available at: http://dnrc.mt.gov/divisions/water/management/docs/state-water-plan/2015_mt_water_plan.pdf page 67, last visited: January 18, 2016.

City of Bozeman Integrated Water Resources Plan

The City of Bozeman's City Commission adopted an Integrated Water Resources Plan (IWRP)(Appendix I) in 2013. The Sunset Hills Cemetery and Lindley Park Water Conservation Project goes toward meeting several objectives set forth in the IWRP. Specifically, the IWRP calls for non-potable irrigation to be utilized where feasible for new developments. In addition to the increase in instream flows to Sourdough Creek that will be made available as a result of improvements made to the point of diversion and ditch described herein, the Project will serve as a model to the development community as to best management practices to capitalize on opportunities to use non-potable water for irrigation versus the use of costly and finite treated water supplies.

City of Bozeman Water Conservation Plan

The IWRP also called for the implementation of a Water Conservation Plan in order to address the anticipated water supply gap. A Water Conservation Plan was adopted by the City Commission in May 2014 and the development and implementation of various demand-side management strategies comprises the largest source of additional water supplies for the city going forward. The Plan and a 2014-2015 Program Update are included in APPENDIX J.

City of Bozeman Drought Management Plan

The City's Integrated Water Resources Plan recommends drought contingency planning as a component of the water conservation program.[5] The IWRP recognizes that water conservation and drought management combine to insure the availability of firm yields to cover indoor water demands during a drought emergency.[6]

On December 28, 2015, the Bozeman City Commission contracted for engineering services to work with city staff to develop a drought management plan in an amount not to exceed $54,035.00. Refer to Appendix K. The scope of work includes the following components:

(1) Vulnerability Assessment
(2) Drought Monitoring
(3) Drought Mitigation
(4) Drought Response
(5) Operational and Administrative Framework
(6) Drought Management Plan Update Process

The City Commission recognized that planning for drought is far more cost effective than emergency response. Taking steps ahead of time to prevent known impacts from a drought

[5] Integrated Water Resources Plan, Appendix B, Technical Memorandum page 38 (Adopted by Bozeman City Commission September 2013); available at:
http://www.bozeman.net/Smarty/media/Public_Works/Water%20Conservation/pdf/IWRP-Bozeman.pdf
[6] *Id.* Page 39.

emergency is far less expensive than measures taken in the midst of a drought. Moreover, post-drought relief is costly and may not reach the right people.[7]

Subcriterion No. F.2: Readiness to Proceed

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 Project Schedule shown below indicates milestones and dates for this project through project completion. Adequate time is shown between finalizing of construction contracts and the beginning of construction to allow for ordering of the materials. Construction is anticipated near the end of the irrigation season when the weather is still reasonably warm to allow for construction. The irrigation season is typically complete by mid-September to early October. This time frame also allows the work to be completed when the creek is at a low flow which minimizes the construction costs associated with dewatering and diverting surface waters in the creek.

Grant Award: September 30, 2016

Preliminary Design: August 2016 – December 2016

Permitting: January 2017 – April 2017

Final Design: May 2017 – June 2017

Bidding: July 2017

Construction: September 2017 – December 2017

Close-out: September 30, 2018

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.

Potential Regulatory Requirements

An initial attempt to identify permitting requirements for each alternative was completed. However, design specifications are necessary to determine the specific regulatory requirements for the proposed project. At this stage of the project, it is assumed that all alternatives would require a similar suite of permits.

[7] National Drought Mitigation Center (NDMC) *available at*: http://drought.unl.edu/Planning/WhyPlanforDrought.aspx

Federal

- Federal Clean Water Act, Section 404 Permit (33 CFR 320-330): This permit is required for any activity that will result in the placement of dredge or fill material into waters of the United States, including wetlands and is administered by the US Army Corps of Engineers (USACE). This permit will be necessary if any dredge or fill materials are placed in Sourdough Creek or stream channel alterations will occur. However, several exemptions to this regulation exist for irrigators. According to 33 CFR 323.4, discharges not requiring permits include the following:

  > "(3) Construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance (but not construction) of drainage ditches. Discharges associated with siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities as are appurtenant and functionally related to irrigation ditches are included in this exemption."

  Therefore, it is not anticipated that a Section 404 permit from the USACE will be required for proposed project activities.

- Section 7 Endangered Species Act Consultation with US Fish and Wildlife Service (USFWS): Section 7 of the Endangered Species Act (ESA) is the mechanism by which Federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. According to the October 2015 list of Endangered, Threatened, Proposed, and Candidate Species for Montana, the following species may occur within Gallatin County:
  - Ute Ladies' tresses (Sprianthes diluvialis) – Listed threatened
  - Canada lynx (Lynx Canadensis) – Listed threatened, critical habitat
  - Grizzly bear (Ursus arctos horribilis) – Listed threatened
  - Sprague's pipit (Anthus spragueii) – Candidate
  - Whitebark pine (Pinus albicaulis) – Candidate

  There are no fish or aquatic species present on this list for Gallatin County. Additionally, no habitat characteristics necessary for the presence of these species exist within the proposed project area. Therefore, there is likely no chance of impact to any ESA listed species by any of the proposed alternatives. The necessity of formal consultation with the USFWS is highly unlikely.

State of Montana

- Montana Stream Protection Act (SPA 124 Permit): This permit is required for any project that may affect the natural existing shape and form of any stream or its banks and tributaries and is administered by the Montana Department of Fish,

Wildlife, and Parks (MFWP). This permit will be necessary if project activities affect Sourdough Creek stream channel or alter current water flow levels within the creek. Any impacts to the stream channel will result in consultation with MFWP and design specifications are necessary to determine need for this permit.

Preliminary consultation with MFWP Region 3 Fisheries Biologist David Moser on December 17, 2015, indicated that fish passage would be an important component to the new or rehabilitated diversion structure. Mr. Moser stated that he does not have specific input at this time, but he would like to be involved in the design process and participate in a site visit.

  - Completion of a Joint Application for Proposed Work in Montana's Streams, Wetlands, Floodplains, and other Water Bodies (Joint Application) will be required for this permit. Refer to Appendix A Figure 3.

- Montana Water Use Act (Water Right Permit and Change Authorization): This permit/authorization is required for any entity intending to acquire new or additional water rights or change an existing water right in Montana and is administered by the Montana Department of Natural Resources and Conservation (MDNRC)-Water Rights Bureau. It is unlikely the Project will require a change of water rights. A recent meeting with Kerri Strasheim, DNRC Water Right Bureau indicated it would be unlikely that the Project will require a change of water rights. However, COB and its contractors will work closely with DNRC to comply with the Montana Water Use Act and all DNRC permitting requirements.
- Short-term Water Quality Standard for Turbidity (318 Authorization): This authorization is required for any entity initiating construction activities that will cause short-term or temporary violations of state surface water quality standards for turbidity and is administered by the Montana Department of Environmental Quality (MDEQ). It is assumed that project activities would cause short-term or temporary violations of state surface water quality standards for turbidity in Sourdough Creek. The 318 Authorization is typically completed concurrently with the SPA 124 permitting process and addressed through the Joint Application process.

City of Bozeman

- Construction Site Stormwater Runoff Management: Construction projects with a total land disturbance of less than 1 acre are required to submit a signed City of Bozeman Stormwater Management Form. The City of Bozeman will review, comment, and enforce all submitted information. Depending on the final scope of the project, site disturbance of more than 1 acre is possible and in that case

construction storm water permitting is required through both the City of Bozeman and the Montana Department of Environmental Quality.

- Montana Floodplain and Floodway Management Act (Floodplain Development Permit): This permit is required for any construction project that will occur within a 100-year floodplain and is administered by the local floodplain administrator, City of Bozeman, through Montana Department of Natural Resources and Conservation. The FEMA Flood Insurance Rate map of Gallatin County, Montana Panel 30031C0816D and 30031C0817D indicates that the proposed project area around Sourdough Creek and Story Ditch occurs in a Flood Hazard Zones defined as 1% Annual Chance of Flood Hazard. Maintaining flood flows as currently modeled will be an important consideration for the project. See Appendix A Figure 4.

Subcriterion No. F.3: Performance Measures

Points may be awarded based on the description and development of performance measures to quantify actual project benefits upon completion of the project.

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). For more information calculating performance measure, see Section VIII.A.1. FY2016 WaterSMART Water and Energy Efficiency Grants: Performance Measures.

Specific performance measures are included at the end of each of the components described in the Technical Project Description Section above. In summary, the measures incorporated to identify performance will include updated infrastructure that allows for more accurate operation and maintenance of the system including: automation, flow measurement and controls including but not limited to inflow/outflow testing over multiple years, irrigation metering, installation of a SCADA system, automation of the system, installation of a smart irrigation controller, and a methodology of determining benefits to endangered species and/or critical habitat (if applicable), The control system will result in precise measurements to calculate water savings. See specific performance measures set forth above.

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).

The total project costs are estimated at $875,000 resulting in a net conservation of:

- 1,082 acre-feet returning to Sourdough Creek
- 34.4 acre-feet conserved in the potable water supply
- 25 acre-feet conserved groundwater
- 8.4 acre-feet conserved in the potable water supply due to repair of pipe

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.). Failure to provide this information may result in a reduced score for this section.
The expected life expectancy of the improvements includes the following:

- Diversion structure and turnout: Concrete and rip rap has an industry accepted life expectancy of 75-100 years.
- Canal lining and piping: Galvanized steel and plastic pipe has an industry accepted life expectancy of 40-50 years.
- Pump station and controls: The controls in the pump station has an industry accepted life expectancy of 20 years for pumps and controls

Evaluation Criterion G: Additional Non-Federal Funding
(4 points)

$$\frac{\$575{,}000.00 \text{ (Non-Federal Funding)}}{\$875{,}000.00 \text{ (Total Project Cost)}} = 65.7\%^{8}$$

Evaluation Criterion H: Connection to Reclamation Project Activities
(4 points)

This project is not connected to Reclamation Project Activities.

Environmental and Cultural Resource 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.

[8] Please note: Form SF 424C does not allow for the inclusion of a percentage of 34.3%. The actual funding request is $300,000.00, not $297,500.00 as set forth on line 17b.

Environmental impacts will be identified and mitigated during the regulatory permitting process associated with this project. A host of local, state, and federal permits exist including a storm water pollution discharge permit through the Montana Pollutant Elimination Discharge System. This permit addresses soils, dust, air, and water impacts. The earth-disturbing work associated with this project is limited to the immediate footprint of the Project and is anticipated to be minimal. In addition, consultation with USFWS will likely occur.

(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?*

According to the October 2015 list of Endangered, Threatened, Proposed, and Candidate Species for Montana, the following species may occur within Gallatin County:

- Ute Ladies' tresses (*Sprianthes diluvialis*) – Listed threatened
- Canada lynx (*Lynx Canadensis*) – Listed threatened, critical habitat
- Grizzly bear (*Ursus arctos horribilis*) – Listed threatened
- Sprague's pipit (*Anthus spragueii*) – Candidate
- Whitebark pine (*Pinus albicaulis*) – Candidate

There are no fish or aquatic species present on this list for Gallatin County. Additionally, no habitat characteristics necessary for the presence of these species exist within the proposed project area. The necessity of formal consultation with the USFWS is highly unlikely. To ensure that the proposed project activities do not disturb a candidate for listing, a listed, threatened or critical habitat, Applicant will work closely with the US Fish and Wildlife Service to ensure the project can proceed without harm to the species should the need arise.

(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 proposed project occurs in the headwaters of the Upper Missouri River, specifically on Sourdough Creek, a tributary to the Gallatin River, a tributary to the Missouri River. Section 404(f) of the Clean Water Act provides that activities related to the construction and maintenance of irrigation ditches are exempt from permit requirements.

The proposed project is for the improvement of the existing irrigation diversion and ditch and most construction will occur within the existing footprint. USACE will be consulted to verify that the Section 404(f) exemption is applicable to the proposed project. If the proposed project is exempt, no identification of wetlands will be required. Should the project not be exempt, a wetland delineation of the project area

will be performed to determine the presence and extent of wetlands and any potential impacts as a result of the project. Refer to Riparian and Wetland Map Appendix A Figure 3.

(4) *When was the water delivery system constructed?*

The point of diversion dates back to 1865. The date of construction of the current diversion structure is unknown although it appears to date back to the 1950's and is likely much older. It is probable that no major changes have been made in the diversion since 1956 when the last major use of water (flour mill operation) apparently stopped based on reports in the water right records.

(5) *Will the project result in any modification of or effects to, individual features of an irrigation system (e.g., headgates, 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.*

Yes. The Project intends to alter the point of diversion to improve the efficiency of the diversion and to line the ditch to prevent water loss from seepage. The diversion and ditch were likely constructed in the late 1800s. It is probable that no major changes have been made in the diversion since 1956 when the last major use of water (flour mill operation) apparently stopped based on reports in the water right records.

(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 project area will be inventoried for cultural resources and the results will be submitted to the Montana State Historic Preservation Office (MSHPO) who will be consulted to determine whether the project will impact any historic structures and whether additional measures will be required to comply with the National Historic Preservation Act (NHPA). It is unlikely that any structures or features within the proposed project area will be identified as eligible for listing on the National Register of Historic Places.

(7) Are there any known archeological sites in the proposed project area?

No. There are no known archeological sites in the proposed project area.

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

No. The proposed project will not have any 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?

No. The proposed project will not limit access to nor for the ceremonial use of Indian sacred sites or result in any impacts to tribal lands.

(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. The proposed project will not contribute to the introduction, continued existence or spread of noxious weeds or non-native invasive species known to occur in the project area.

Required Permits or Approvals

The following permits and approvals will be obtained prior to commencing construction activities in the project area.

(1) **SPA 124 Permit (pursuant to the Montana Stream Protection Act)** - To protect and preserve fish and wildlife resources, and to maintain streams and rivers in their natural or existing stage
(2) **City Floodplain Development Permit** – A development permit will be obtained from the City of Bozeman Flood Plain Administrator prior to beginning any work in the project area.
(3) **404 Permit (Federal Clean Water Act)** – Section 404(f) of the Clean Water Act provides that activities related to the construction and maintenance of irrigation ditches are exempt from permit requirements. However, USACE will be notified to determine whether the exemption from Section 404 regulatory requirements applies to the Project.
(4) **318 Authorization (Short-Term Water Quality Standard for Turbidity) (318 Authorization)** - Activities associated with the Project will be carried out in accordance with conditions prescribed by the Department of Environmental Quality.
(5) **Stormwater Discharge Local General Permit** – Obtained from the City of Bozeman's Stormwater Coordinator.
(6) **Other** - Sub-criterion F.2 provides a comprehensive list of local, state and federal permits and approvals.

Official Resolution

PLEASE NOTE: Due to the meeting schedule of the COB Commission and Public Holidays, the Resolution will go before the Commission on **January 25, 2016**. After which time, the Resolution signed by the City Commission will be mailed to the address set forth in the Grant Application Instructions in partial fulfillment of the City of Bozeman's Application for the WaterSMART Grant in accordance with Application and Submission Information, IV.C.1, page 23.

(1) The identity of the official with legal authority to enter into agreement

Chris Kukulski, City Manager, City of Bozeman, Montana

(2) The board of directors, governing body, or appropriate official who has reviewed and supports the application submitted

Bozeman City Commission

(3) The capability of the applicant to provide the amount of funding and/or in-kind contributions specified in the funding plan

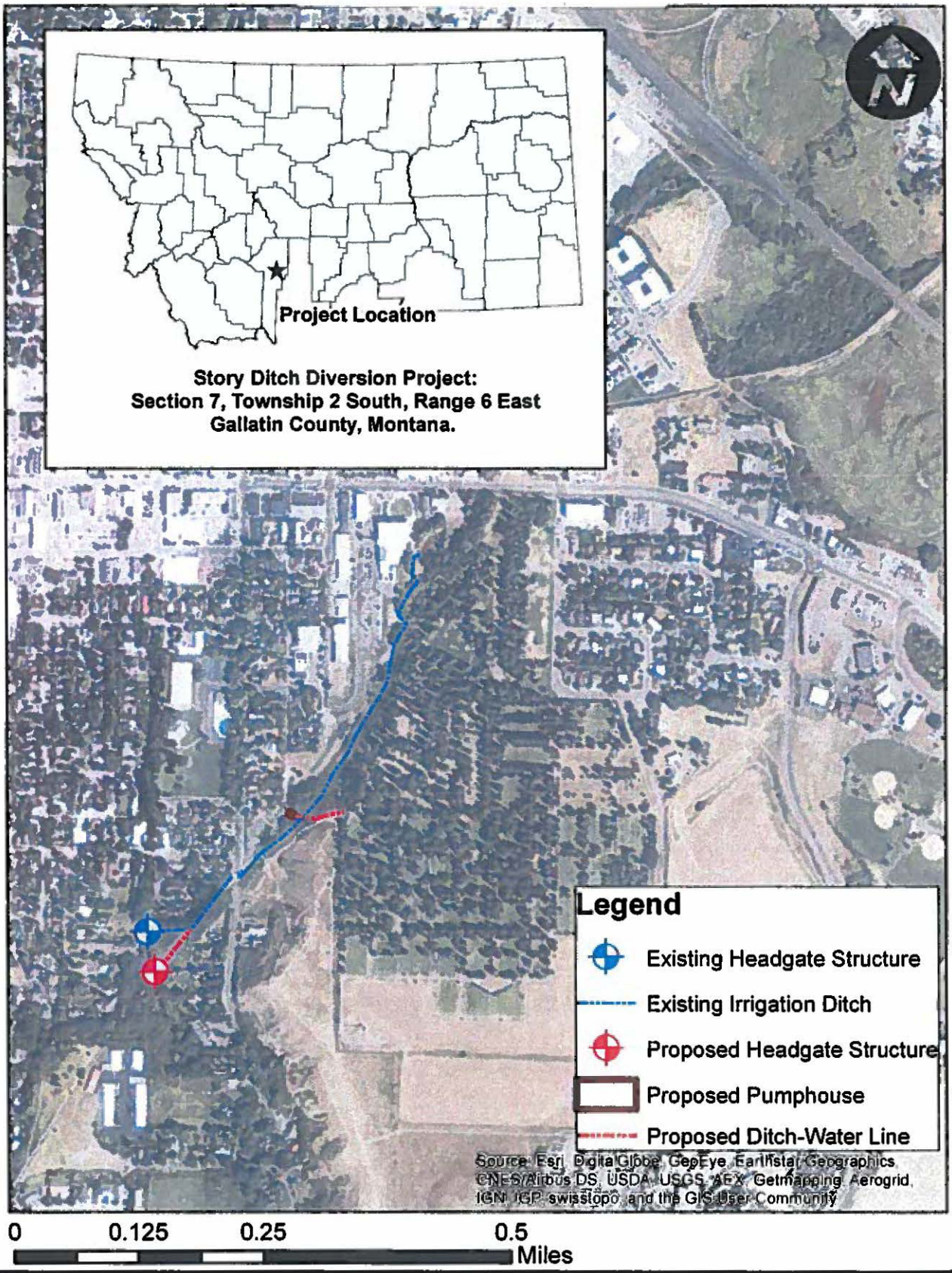
Applicant is able to provide funding as specified in the funding plan set forth herein.

(4) That the applicant will work with Reclamation to meet established deadlines for entering into a cooperative agreement

Applicant will work with Reclamation to meet established deadlines for entering a cooperative agreement.

An official resolution meeting the requirements set forth above is mandatory. *If the applicant is unable to submit the official resolution by the application deadline because of the timing of board meetings or other justifiable reasons, the official resolution may be submitted up to 30 days after the application deadline.*

FIGURE 1



Morrison Maierle
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DRAWN BY: CAP
CHK'D BY: JRN
APPR BY: JRN
DATE: 01/2016

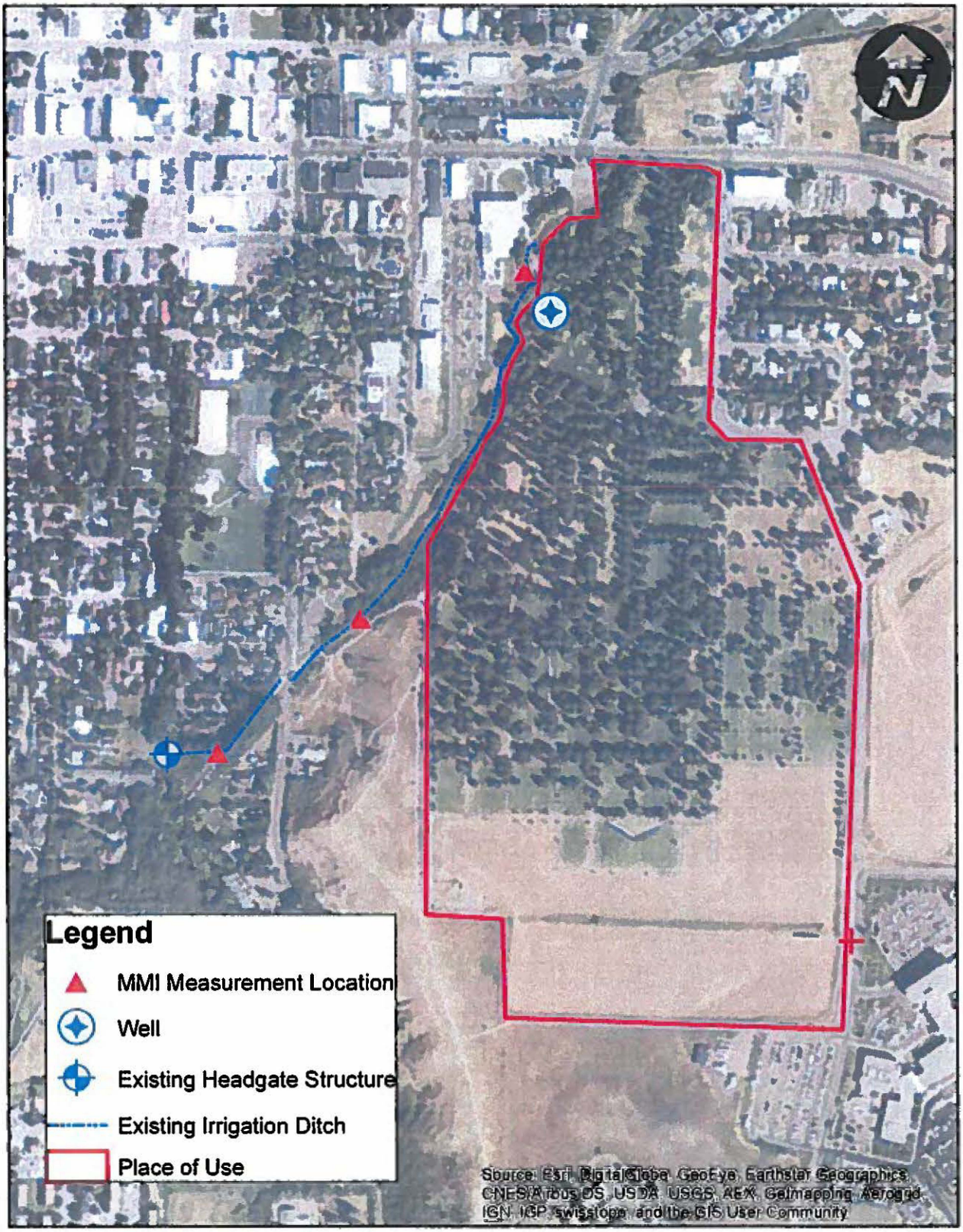
VICINITY MAP
BOZEMAN MT

Story Ditch Diversion Project

PROJECT NO. N:\0417.076

N:\0417\076\ARCGIS\Aerial Map COB Irrigation Study.mxd

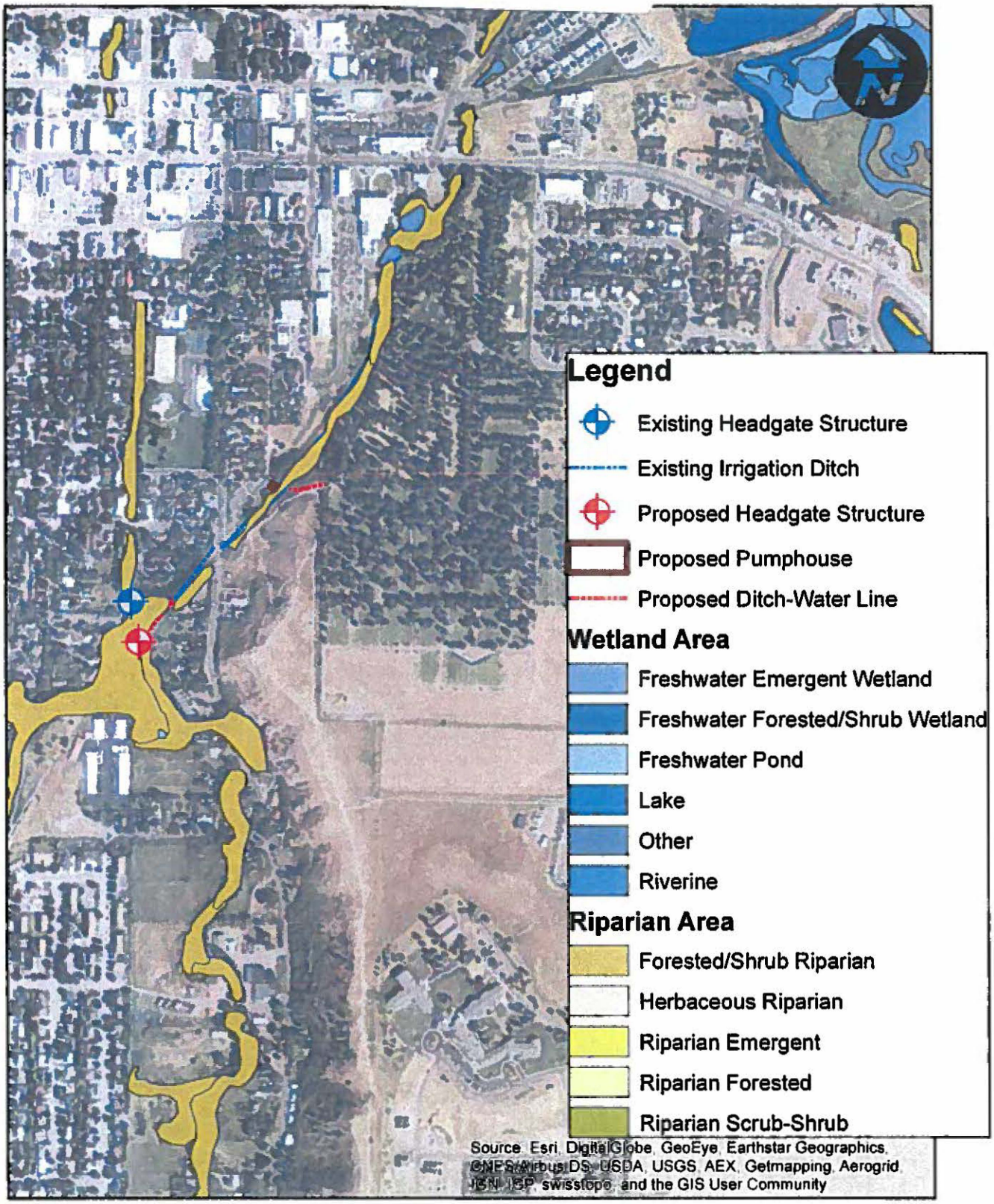
FIGURE 2



Morrison Maierle engineers · surveyors · planners · scientists 2880 Technology Blvd. W. Bozeman, MT 59718 Phone: (406) 587-0721 Fax: (406) 922-6702 	DRAWN BY: CAP CHK'D BY: JRN APPR. BY: JRN DATE 01/2016	FLOW MEASUREMENT MAP BOZEMAN MT Story Ditch Diversion Project	PROJECT NO. N:\0417.076

N:\0417\076\ARCGIS\No Fig x Flow Measurement Map COS Diversion study.mxd

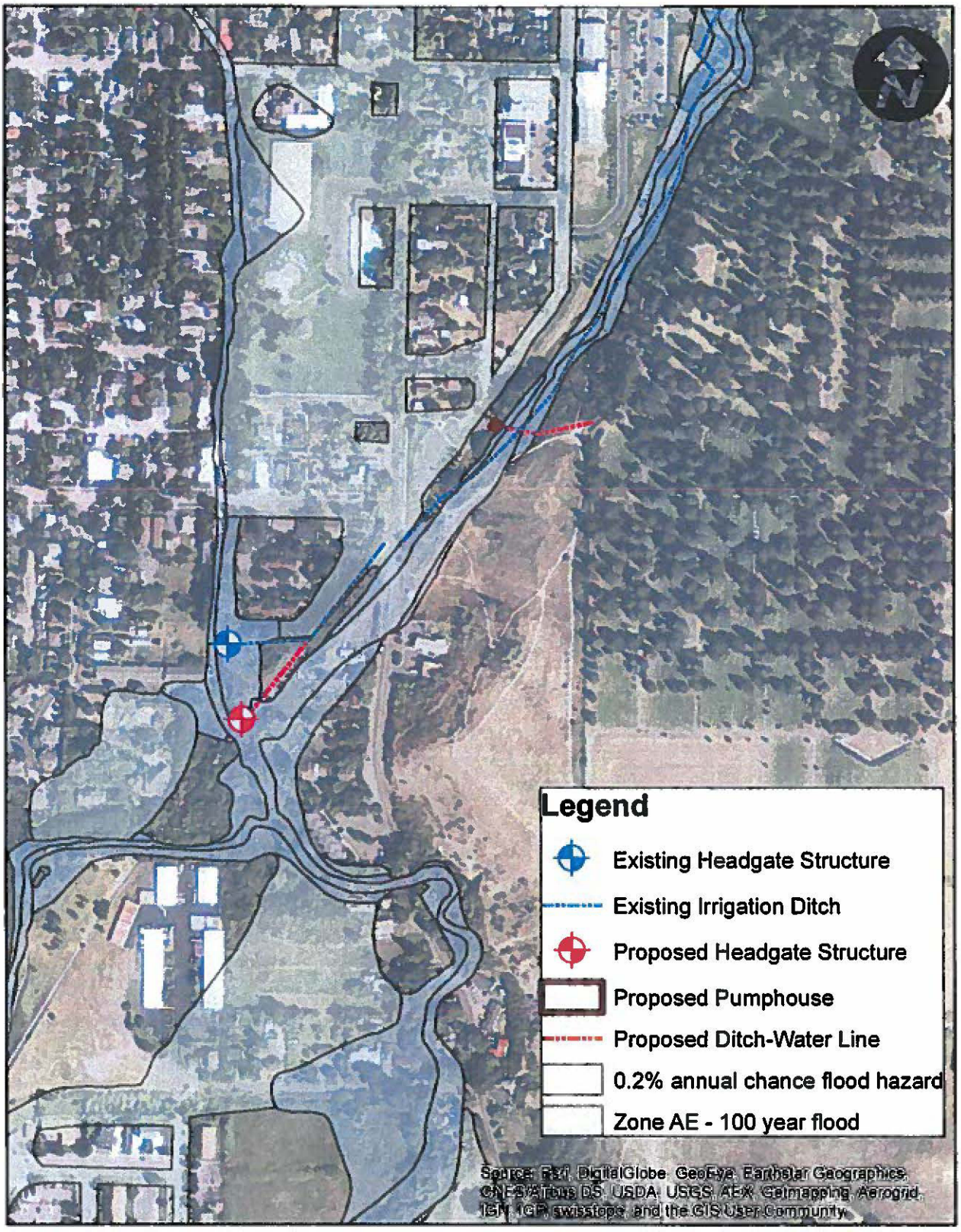
FIGURE 3



Morrison Maierle engineers · surveyors · planners · scientists	2880 Technology Blvd. W. Bozeman, MT 59718 Phone: (406) 587-0721 Fax: (406) 922-6702 	DRAWN BY: CAP CHK'D BY: JRN APPR. BY: JRN DATE: 01/2016	RIPARIAN and WETLAND MAP BOZEMAN MT Story Ditch Diversion Project	PROJECT NO N:\0417.076

N:\0417\076\ARCGIS\Wetland Riparian Map COB Irrigation Study.mxd

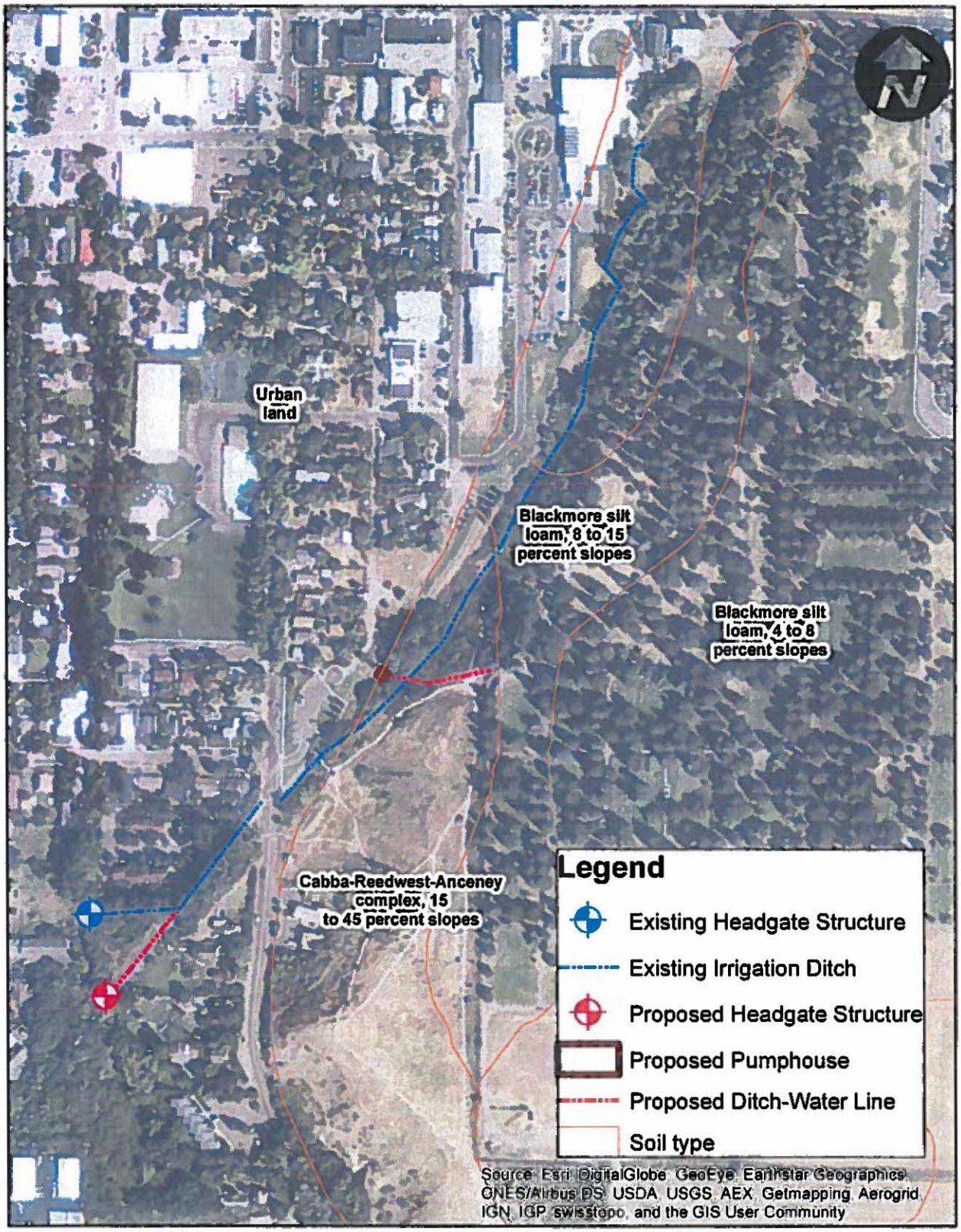
FIGURE 4



Morrison Maierle engineers · surveyors · planners · scientists 2880 Technology Blvd. W. Bozeman, MT 59718 Phone: (406) 587-0721 Fax: (406) 922-6702 	DRAWN BY: CAP CHK'D BY: JRN APPR. BY: JRN DATE: 01/2016	FLOODPLAIN MAP BOZEMAN MT Story Ditch Diversion Project	PROJECT NO. N:\0417.076

N:\0417\078\ARCGIS\Floodplains Map COB Irrigation Study.mxd

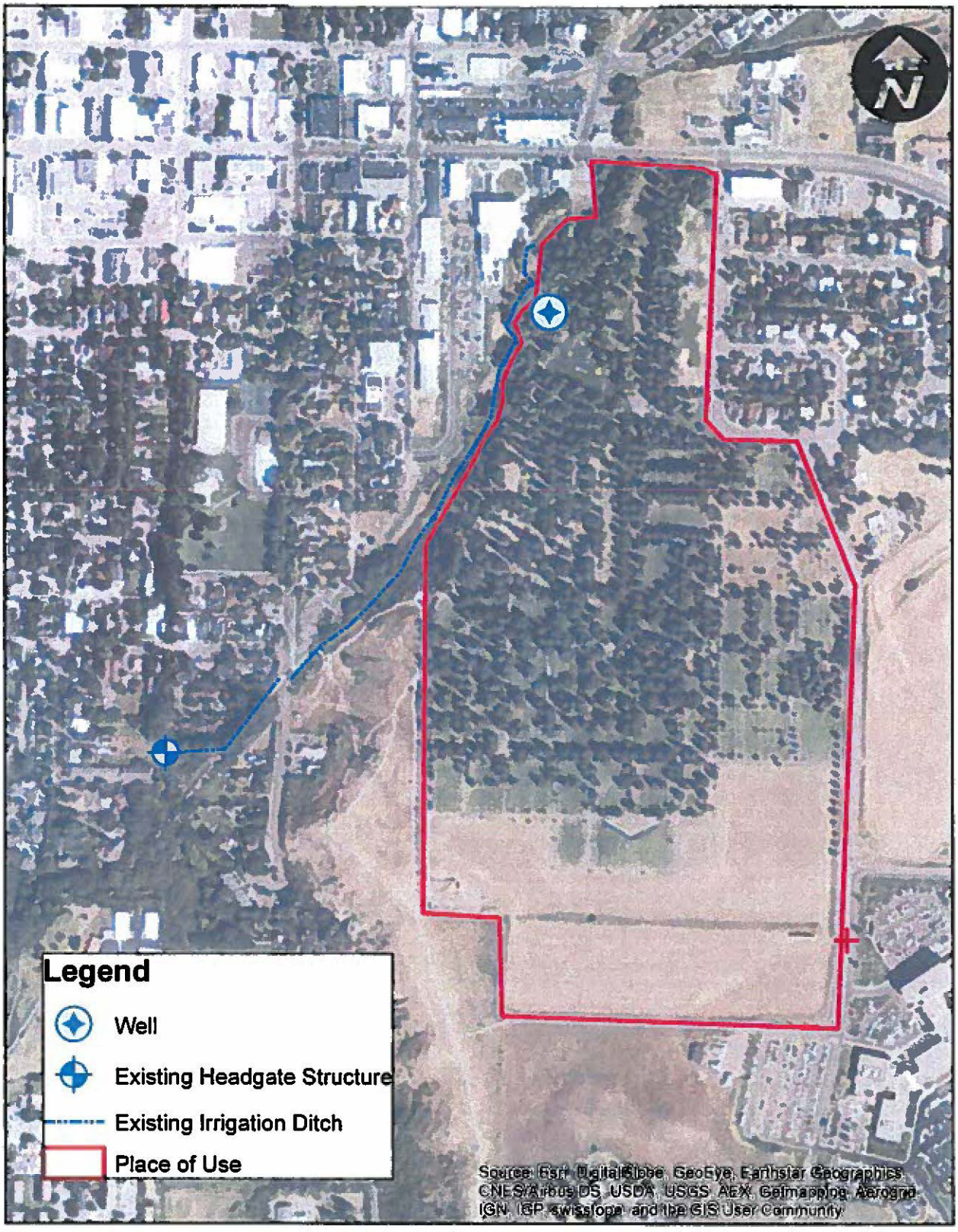
FIGURE 5



Morrison Maierle engineers · surveyors · planners · scientists 2880 Technology Blvd. W. Bozeman, MT 59718 Phone: (406) 587-0721 Fax: (406) 922-6702 	DRAWN BY: CAP CHK'D BY: JRN APPR. BY: JRN DATE: 01/2016	SOIL MAP BOZEMAN MT Story Ditch Diversion Project	PROJECT NO. N:\0417.076

N:\0417\076\ARCGIS\Soils Map COB Irrigation Study.mxd

FIGURE 6



Morrison Maierle engineers · surveyors · planners · scientists 2880 Technology Blvd. W. Bozeman, MT 59718 Phone: (406) 587-0721 Fax: (406) 922-6702 	DRAWN BY: CAP CHK'D BY: JRN APPR. BY: JRN DATE: 01/2016	PROJECT MAP BOZEMAN MT Story Ditch Diversion Project

PROJECT NO. N:\0417.076

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APPENDIX B

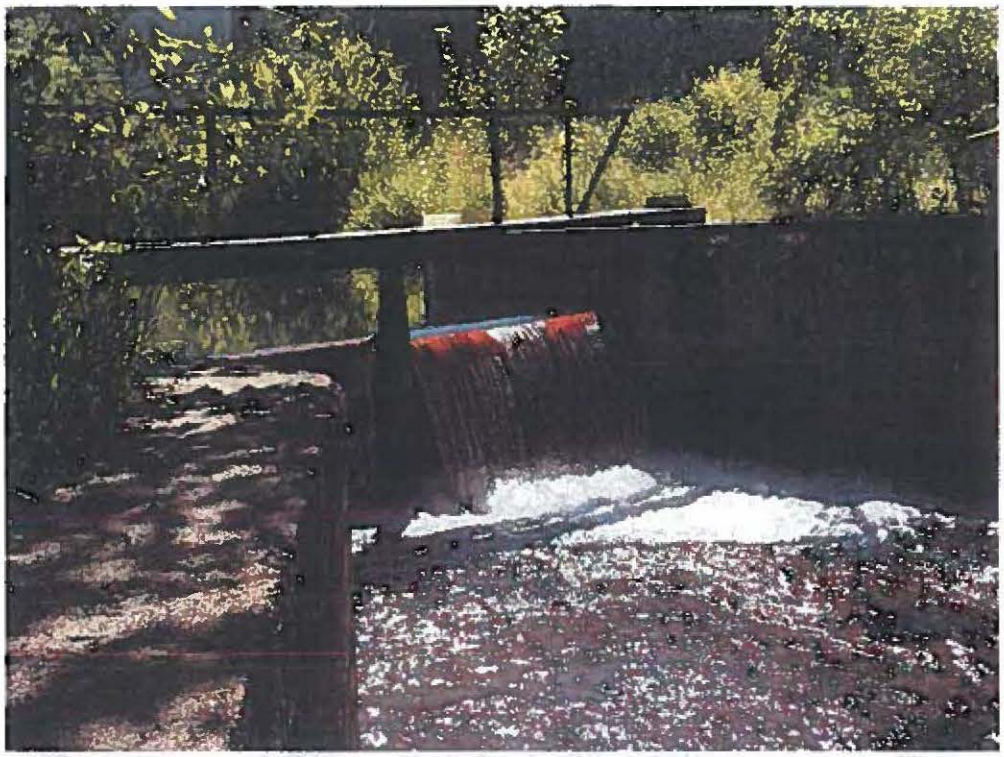

Figure 1 – Existing stop log diversion dam on Sourdough (Bozeman) Creek

Figure 2 – Existing stop log diversion dam on Sourdough (Bozeman) Creek

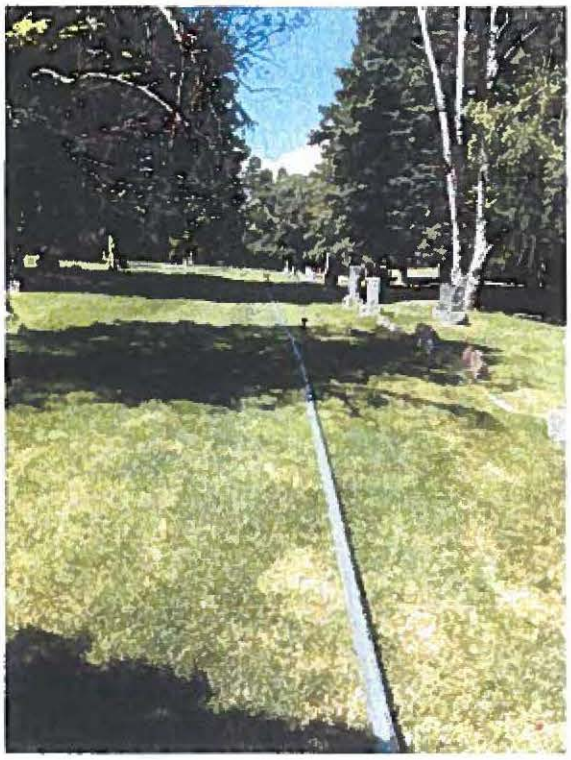

Figure 5 – Existing irrigation distribution line

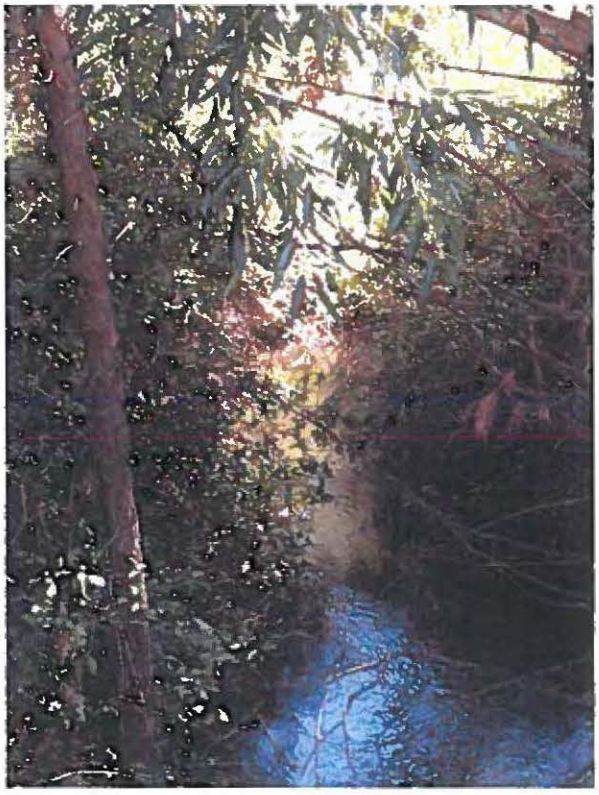

Figure 6 – Story Ditch with significant vegetation

Figure 9 – Existing turnout to Story Ditch

Figure 10 – Existing Diversion Dam at Sourdough (Bozeman) Creek. Notice deteriorating stop log brackets.

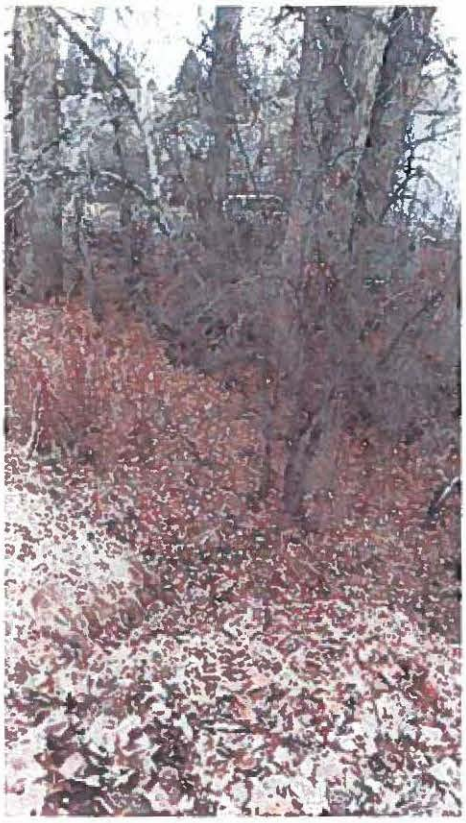

Figure 11 – Story Ditch with heavy vegetation.

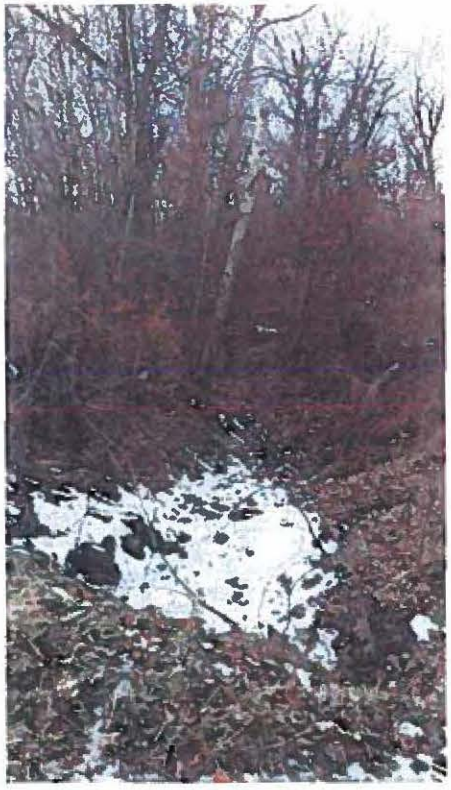

Figure 12 – Story Ditch with heavy vegetation

APPENDIX C

Conservation Summary Table

Use	Pre-project			Post-Project			Net Effect
	CFS	Acre-feet	Quantification	CFS	Acre-feet	Quantification	Acre-feet
Diversion – Sourdough Creek	Diversion at Sourdough Creek - estimated as 12.2 cubic feet per second	Estimated as – 4,348 acre-feet	Flow measurement obtained from flow meter in Story Ditch	8.6 (16 hours) - 10.3 (8 hours) cubic feet per second	3,266 acre-feet	Calculated project demands	Reduction (conservation) of 1,082 acre-feet not withdrawn from Sourdough Creek
Potable Water Supply	-	34.3 acre-feet	Water meter data	0 cubic feet per second	0 acre-feet	Source not needed	Reduction (conservation) of 34.3 acre-feet not used from potable water supply; Development of 34.3 acre-feet of water stored in Hyalite Reservoir
Groundwater Well	-	25.0 acre-feet	Well power data	-	0 acre-feet	Source not needed	Reduction (conservation) of 25.0 acre-feet from groundwater well.
Story Ditch	Net loss of 3.6 cubic feet per second over 1,100 feet	1,283 acre-feet lost during irrigation season	Flow measurement	0 cfs loss	0 acre-feet	No seepage	Reduction of 1,283 acre-feet water loss from seepage; 201 acre feet used in the park and cemetery and 1,082 acre-feet returned to Sourdough Creek
Land application Infrastructure – Leaking line	Loss of 16 gpm	8.4 acre-feet	Water meter data and well power data	Loss of 0 gpm	0 acre feet	Estimate based on water leak repairs	Reduction (conservation) of 8.4 acre-feet.

APPENDIX E

Irrigation Feasibility Study for the Sunset Hills Cemetery: Bozeman, Montana

Prepared for:

City of Bozeman

Prepared by:

Morrison-Maierle Inc.
901 Technology Blvd.
Bozeman, Mt.
(406) 587-0721

April 17, 2002

1.0 Introduction

Morrison-Maierle Inc. was retained by the City of Bozeman to conduct an investigation into ways to eliminate the use of expensive, treated water for the irrigation of Sunset Hills cemetery. The city is currently utilizing treated public water supply water to irrigate portions of the cemetery. Adjacent to the cemetery, a well is currently used to irrigate all of Lindley Park. The same well (Lindley Park well), is used to irrigate approximately eleven acres in the cemetery.

There are several irrigation water supply sources available to the city. The city can expand the use of groundwater; utilize surface irrigation water from the Story-Mill ditch diversion off Bozeman Creek or a combination of both. All of these options can eliminate the cemetery's dependency on treated water, but the use of surface water appears to be the more viable solution. Existing wells were researched to find the viability of using a groundwater source for irrigation and different surface water scenarios were researched. The analysis was done to see which choice would be the most feasible, both practically and economically.

2.0 Executive Summary

The Sunset Hills cemetery covers approximately 140 acres with 40 acres presently developed. Except for eleven acres, the cemetery is irrigated with treated city water. This is a large yearly expense to the cemetery that could be lowered through the use of surface or ground water for irrigation. Switching from treated city water to surface or groundwater for irrigation would allow treated water to be reserved for residential customers.

Local geology and existing wells reveal a fairly low-yield aquifer material underlying the cemetery. The Tertiary gravels and sands underlying the cemetery are typically very clayey and produce small amounts of water. The high lateral variability of the Tertiary materials makes it problematic to locate a test well site that will provide a high yield of water. With the present irrigation system demanding approximately 400 gallons per minute (gpm) and the highest yielding well in the area producing 165gpm (Lindley Park), it would appear that a minimum of two new wells would be needed. Two eight-inch wells drilled and completed at 300 feet would cost approximately $80,000. The yearly power cost would be approximately $5000.

The City of Bozeman currently holds water rights on Sourdough Creek (also known as Bozeman Creek). The water would be diverted from the creek through existing headgates and ditches located west of the cemetery. From where the irrigation water reaches the cemetery, the surface water could be withdrawn using various options. The most feasible option for a surface water intake would be to install a sump in the Story-Mill ditch coming from Bozeman Creek. Out of the different types of sumps, the "standard" sump is the least expensive option, and also requires the least maintenance. Liability concerns are the least using the standard sump. The standard sump, pump, controls, supply line and

wire could be installed at an approximate cost of $35,000. A yearly cost of approximately $3000 could be expected for providing power to the pump.

Surface water should be first priority in phasing out the use of treated city water for irrigation of present and future acreage at the Sunset Hills cemetery. A standard sump is the most viable option for a surface intake off the Story-Mill ditch, although a rotating screen may be a better option due to the amount of debris that may be found in the Story-Mill ditch.

Prior to settling on the use of surface water as the best option, a number of other concerns should be examined. Investigation of the historical flow of Sourdough Creek should be evaluated to see how often the diversion works might be out of service due to drought conditions. A staff gage or similar device should be installed and calibrated to be able to measure flow throughout the spring, summer and fall of 2002. The weir at the headgate is likely a good place to measure flow. A quick survey of the ditch should be completed to see if there would be any overflow or flooding problems from running the ditch. The headgate on Sourdough creek should be inspected to estimate repair costs to return the headgate structure to an operating condition.

Water use by appropriators (water rights owners) with senior priority dates should be investigated. A cost assessment should be done on the amount of time it will take city employees to operate and maintain the diversion works, pump, screen, control of headgate and Story-Mill Ditch. Easements for access to the ditch should be investigated and current landowners of property of which the Story-Mill ditch crosses should be identified then contacted before ditch work is started. Possible lining of the ditch from the headgate to the location of the intake structure should be considered. Lining of the ditch would prevent the loss of water through the ditch bottom and could prevent trash, leaves and twigs from entering the ditch before the intake structure.

3.0 Irrigable Acreage and Existing System

As noted earlier, The Sunset Hills cemetery property covers approximately 140 acres, of which 40 acres is presently developed, roughly 100 acres are reserved for future expansion. The cemetery presently utilizes city water to irrigate roughly 30 acres. Approximately 11 acres is currently irrigated using the Lindley Park well.

To replace the amount of city water needed to irrigate 30 acres approximately 120 gpm is needed. This will provide 1.5" of water per week to the 30 acres of cemetery ground now irrigated by city water. Assuming a total of 100 acres of future irrigation at full build out, an additional 400 gpm is needed. These rates all assume 24 hours of pumping and are calculated as follows:

IRRIGATION CALCULATION, (Current Need)

$$\frac{1.5 \text{ inches}}{\text{week}} \times \frac{\text{foot}}{12 \text{ inches}} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{7.481 \text{ gal}}{\text{feet}^2} \times \frac{\text{week}}{7 \text{ days}} = \textbf{5820 gpd/acre}$$

$$\frac{5820 \text{ gpd}}{\text{acre}} \times 30 \text{ acres} = \textbf{174600 gallons}$$

$$\frac{174600 \text{ gallons}}{24 \text{ hours}} = \textbf{121 gpm} \qquad \frac{174600 \text{ gallons}}{10 \text{ hours}} = \textbf{291 gpm}$$

IRRIGATION CALCULATION, (Future Need)

$$\frac{1.5 \text{ inches}}{\text{week}} \times \frac{\text{foot}}{12 \text{ inches}} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{7.481 \text{ gal}}{\text{feet}^2} \times \frac{\text{week}}{7 \text{ days}} = \textbf{5820 gpd/acre}$$

$$\frac{5820 \text{ gpd}}{\text{acre}} \times 100 \text{ acres} = \textbf{582000 gallons}$$

$$\frac{582000 \text{ gallons}}{24 \text{ hours}} = \textbf{404 gpm} \qquad \frac{582000 \text{ gallons}}{10 \text{ hours}} = \textbf{970 gpm}$$

Two inch to six inch water mains presently distribute water to various locations in the cemetery. Handlines are used to connect to the water mains with 2" quick-connect couplers in most areas of the cemetery. A few zones are irrigated using hoses and sprinklers or by underground sprinklers. Rainbird impact heads with approximately a 3/16" nozzle are used on the handlines. Approximately 50 heads are run at one time. Rainbird specifications show that each head delivers approximately eight gallons a minute, for a total of 400gpm for each zone. If 400gpm is provided, the current zones could be run without storage requirements.

4.0 Groundwater Investigation

An investigation of groundwater resources identified possible drilling depths and yields of wells in the area. Local geology and existing wells were studied to determine subsurface conditions and possible well construction.

4.1 Local Geology

Hackett and others (1960) identified the underlying geology as being Tertiary aged material (Unit 2) that is highly variable in composition that consists mainly of

conglomerates, sandstones, and claystones that range from unconsolidated to partly cemented. A Tertiary aged material (Unit 1) underlies Unit 2 and has been interpreted as being a lacustrine (lake) deposit. Unit 1 consists mainly of volcanic ash, tuffaceous siltstones and sandstones, with a few minor beds of limestone. Hackett and others (1960) identify both units as having relatively low transmissivity values and concluded that wells completed in Tertiary strata would be able to yield water for domestic use, but would most likely not yield water of sufficient quantity to provide for high-volume irrigation, such as would be needed to be reasonably efficient to irrigate the cemetery.

4.2 Existing Wells

Using well log information, locations, total depths and yields of neighboring wells were identified and examined to determine possible drilling depth and yields for test wells in the cemetery area. Existing wells were located and identified on a USGS topographic map. A transect (labeled A-A') was drawn from north to south, from Kagy to Main Street, bisecting the cemetery. Wells along the transect were inventoried and a cross section was constructed (See Appendix D). This cross section identifies topographic relief, water table, yield, depth of screens (water-bearing materials), and total depth. The water table closely mimics the average topographic relief, yet water-bearing materials are found at different depths and with varying yields.

The cemetery area seems to be a zone of low transmissivity or low yield materials. Note that Well #7 (2nd cementery well) is open to 200 feet of material, but only yields 35 gpm. This works out to a specific yield of 0.18gpm/foot. A screened or open area for the first cemetery well was not reported; however the well explored to a depth of 320 feet and only yielded 14 gpm. The wells at the hospital have produced decent yields of water (75gpm) along with the Lindley Park well (165gpm), yet all wells drilled in and around the cemetery area have produced low yields (14-35gpm) at varying depths (320'-460'). West of the Deaconess Hospital the Hillcrest wells also produced low yields of water (15-25gpm) and were completed at fairly deep depths (300-330 feet).

Two exploratory holes have recently been drilled on the cemetery property. Red Tiger Drilling of Manhattan, Montana drilled both exploratory wells. The first test hole was drilled in the southwest corner of the cemetery. This well was drilled to 320 feet and produced 14 gpm. The second test hole was drilled just south of the cemetery shop. This well was drilled to 460 feet and produced 35 gpm. The well log for the second test well reports a maximum airlift of 35gpm however, Duane Hauser of Red Tiger Drilling believes that the well may make as much as 60gpm when pumped.

There have been reports that there was a 150-gpm well that was abandoned in the latest addition to the cemetery. JTL Inc. was reported to have been the company who did the abandonment work on the old well. However, follow-up conversations with local drillers failed to provide any information on this well.

The Lindley Park well was completed to a depth of 230 feet, was screened in multiple zones (five) and was completed with a gravel pack. A 13 ¾" Borehole was drilled,

Screens were set in multiple zones and gravel was used to fill the annular space (space between the borehole wall and the casing) as a filter pack. This well reportedly yielded 165 gpm. This type of well construction is fairly common, fairly expensive, and is only done after an exploratory hole has been drilled and only if the formation warrants this type of construction. A gravel pack is usually installed in a formation that doesn't have much variance in grain size, such as sand that is all of one size.

4.3 Possible Groundwater Exploration

An exploratory hole drilled in the cemetery area should explore for water to depths of a minimum of 300 feet, and 500 feet should be considered for a maximum depth of exploration. Drilling should be ceased if the Tertiary Unit 1 is encountered. Probability of producing a high yield of water out of Unit 1 is very low. The exact location of the well is not critical due to the heterogeneity inherent with Tertiary materials. Location of a test well should be based on distance to power and connection to the existing system. The test well should be constructed as an eight-inch well so a pump-sizing constraint won't limit well yield. A yield greater than 25gpm should not be expected, but may be possible.

4.4 Summary of Groundwater Investigation

Investigation into the groundwater resources available at the cemetery revealed a low probability of discovering groundwater of sufficient yield to satisfy current and future irrigation demands at the cemetery utilizing at single source. Multiple wells would almost certainly have to be completed to supply the volume of water needed for irrigation. Existing wells have indicated deep drilling depths and an aquifer material that yields small volumes of water per foot of material. Previous studies have identified the subsurface geology as a Tertiary aged alluvial formation that will yield water in sufficient volume for domestic use, but found it highly unlikely to find a sufficient yield for irrigation use. If groundwater is to be explored for use in irrigation of the cemetery, drilling multiple wells to depths of 300 to 500 feet should be expected. All things considered, it would appear that the relatively high yield of the Lindley park well is a one-time aberration and that it is unlikely that high yield wells, at reasonable depths, can be found on the cemetery.

5.0 Surface Water Investigation

An investigation into surface water for use in irrigating the cemetery identified existing surface water rights on Sourdough (Bozeman) Creek and the Story-Mill ditch, types of intake structures, and advantages and disadvantages to different systems.

5.1 Existing Water Rights

Investigation into using surface water for irrigation began with an investigation of existing water rights. The City of Bozeman currently has an existing water right (water right number 41H-W-099632-00) on Sourdough Creek(Appendix B). The city can legally irrigate 86 acres in the cemetery and Lindley Park and can draw up to 8 cubic feet per

second (cfs). In time, more than 80 acres may need irrigating. However, given the rate of development, it will be a long time before the issue will need consideration.

Stipulations on this water right are that the Place of Use and the Point of Diversion cannot be changed and that the water shall only be used from April 1 through November 1. Applying for a change in any of these stipulations would result in the loss of the water right. The right may also be challenged and possibly lost if it is not put to a beneficial use. Discussion with the DNRC revealed that unused water rights could legally be challenged after ten years of non-use. (In some cases they have been challenged after only seven years of non-use) The priority date for this right is September 30, 1865 and is subordinate in priority to ten other existing rights.

5.2 Historical Flow of Sourdough Creek

Investigation into the historical flow of Sourdough creek failed to find data of practical use. The USGS had a gauging station on Bozeman Creek from May 1951 through September 1953. The Water Facility Plan for Bozeman, Montana (MSE-HKM, 1997) identifies the U.S. Forest Service and the USGS as recording flow measurements for approximately 10 years on Bozeman Creek. An estimated average annual yield of 17,900ac-ft for Bozeman Creek was reported in the Water Facility Plan for Bozeman, Montana (MSE-HKM, 1997). Unfortunately, all this data was collected close to the current intake structure for city water supply south of Bozeman. This data cannot be dependably used to determine the reliability of the Story-Mill Ditch water right for irrigation of the Sunset Hills cemetery due to multiple variables downstream from the gauging station. With 2002 being suggested as being a drought year, it would be in the best interests of the project to locate areas suitable for gauging sites during the spring, and then record flow through the next year as a minimum. Various agencies such as DEQ and Fish, Wildlife and Parks may have programs to help start/fund a permanent gauging station.

5.3 Types of Intake Structures

Three types of intake structure could be utilized to withdraw water from Story-Mill Ditch for irrigation. A rotating screen, a self-cleaning suction screen, and a standard sump could be used. Each type of intake structure has its advantages and disadvantages. Examples of each intake structure are located in Appendix F.

5.4 Rotating Screen

The first type is a rotating screen. This type of intake structure is constructed in the channel of the ditch. It consists of a cylindrical stainless steel screen, which rotates slowly in the ditch. The screen is cleaned by water movement past the screen along with sprinklers located within the screen. Maintenance is low due to the self-cleaning nature of screen. Since the screen is suspended above the floor of the ditch, silting is not a problem as can be with other screen types. Annual maintenance must be performed once a year before winter. This consists of greasing two bearings and changing the gear oil in the

drive motor. The belt that rotates the screen and the bearings would have to be replaced every five to seven years. The rotating screen can be easily removed with a backhoe and stored inside for the winter. Boards placed underneath of the structure are used to raise or lower the structure in the creek or ditch.

5.5 Self-Cleaning Suction Screen

A self-cleaning suction screen rests on the floor of the ditch and must be submerged to operate. They are constructed using stainless steel and also have internal sprinklers to clean the screen of debris. This type of screen is prone to "silting" in. The only maintenance required would be to occasionally dig out the structure.

5.6 Standard Sump

A standard sump is constructed in the stream bottom. A two-foot piece of corrugated metal pipe is installed from a couple inches above the floor of the ditch to two feet below the ditch floor. A stainless steel screen is then installed that intercepts the flow of the ditch. The standard sump also incorporates an internal sprinkler system to clean the screen of any debris. The sump bottom may fill with silt after a few years, but it is easily removed using a trash pump.

5.7 Advantages and Disadvantages to Different Types of Screens

Each screen type has its advantages and disadvantages. The rotating screen requires the least amount of cleaning due to rotation of the screen and elevation above the bottom of the ditch. The rotating screen will not require "digging" out at any time from being silted in. The rotating screen can be fully removed from the ditch during the winter to eliminate seasonal damage (ice buildup). The rotating screen does require annual maintenance and five year maintenance to the rotational parts of the screen.

The self-cleaning suction screen requires no annual maintenance due to moving parts, however the screen can be partially buried by silt and may have a clogging problem if there are abundant trees in the area. Since the drum does not rotate, twigs and leaves can accumulate and partially plug the screen. The suction screen also has to be fully submerged at all times to operate properly. This could be a limitation during drought years.

The standard sump is also self-cleaning through the use of internal sprinklers, although the screen may have to be cleaned occasionally during the summer months. The standard sump is supposed to work excellent in mossy/leafy streams. The standard sump may also require that the sump be cleaned every few years due do silting in of the sump. Removal of silt from the sump can be done with a trash pump. The standard sump is the least expensive option; examples operate all over the Gallatin valley.

All types of self-cleaning screens use an internal sprinkler to clean the screen. These internal sprinklers may require occasional replacement every 5 to 10 years, depending on the amount of sand pumped through them.

5.8 Pump and Pump Controls

The Story-Mill ditch lies below the cemetery and water would need to pumped from the ditch to the cemetery. To do this a short-coupled vertical turbine shaft pump is recommended to pull water from a surface water intake. The pump is water-cooled instead of oil cooled, self-priming, and requires less maintenance than other comparable pumps. This type of pump would be mounted in an 8-foot deep sump next to the ditch. This would consist of a lined sump that could only be accessed by authorized personnel, which would limit liability to the city.

A remote start unit, typically a push-button unit, can be placed at the waterline connection location to the existing system. A low-pressure shut-off switch should be used as a fail-safe device in case the screen plugs to prevent pump failure.

5.9 Sand Separator

A sand separator installed between the screen and the pump could prolong the life of the pump and internal sprinklers of the screen. A sand separator would prohibit sand from entering the irrigation system. This could save on nozzle replacement and pipe infilling of sand. Sand separators are fairly inexpensive and can be made to be manual or self-purging.

A sand separator may not be necessary for the Story-Mill ditch application. Sourdough creek is probably not a very high-energy stream in the vicinity of the headgate. A board with holes placed at the bottom of the headgate structure can be used to flush sand down stream, through the headgate structure. Water from the top half of the water column would be diverted down the storymill ditch. This system would be a preliminary sand separator. A small reduction of the velocity of the water in the Story-Mill ditch near the diversion works would also cause any sand being transported by the water in the ditch to drop out of the water column. Silt in the water column is not seen as a problem since it will be flushed through the system with little to no effect on the operation of the system.

5.10 Summary of Surface Water Investigation

The City of Bozeman currently holds the right to use up to 8 cfs on 86 acres in the cemetery and Lindley Park. Current irrigation demand would be roughly 1 cfs, leaving 7 cfs to flow past the intake structure. Three different types of intake structures could be used to divert water to the cemetery. A sump and pump would be needed to lift water from the ditch to the cemetery. The standard sump is the least expensive option, with the fewest liability concerns. The rotating screen may be a preferable option since it is designed to easily handle debris in the ditch. It would appear that the Story-Mill ditch will have a high amount of branch and leaf fall from the abundant cottonwoods and other

vegetations. Surface water lifted to the cemetery from the ditch could easily be hooked directly to the existing pipe system in the cemetery.

6.0 Cost Analysis of Surface Water vs. Groundwater for Irrigation Use

A cost analysis of well exploration was done assuming the completion of two eight-inch exploratory wells into production wells. Two wells were assumed as a minimum, using the demand for irrigation (approximately 400gpm) and the yield of the Lindley Park well at 165gpm. This also assumed that only two eight-inch exploratory holes were needed to find and produce the desired yield for irrigation. If more than two wells are required in the event of low yields, the cost quickly becomes prohibitive. Completion cost of two eight inch wells was estimated at $80,000. An itemized cost assessment can be found in appendix D.

A cost analysis of using surface water for irrigation of the cemetery was completed for three different surface intake options. A standard sump could be installed for approximately $35,000, a suction screen could be installed for approximately $37,000 and a rotating screen could be installed for approximately $40,000. These cost assements include the intake structure, pump and waterline to hook into the existing system. A complete itemized cost analysis can be found in appendix D. Aquatech Inc. of Bozeman helped to provide cost estimates for purchase and installation of all three options. The cost of installation could be lowered if the City of Bozeman wishes to install the surface intake structure.

A yearly operating cost for all options was included for power usage only. Yearly maintenance was not estimated.

6.1 Cost of Exploration for High Yield Groundwater Wells

There are two basic exploration options to locate high yield water wells in Tertiary materials. The first option is to drill multiple small diameter (six inch) exploration wells to locate possible water-bearing materials. After locating promising water-bearing zones it is then necessary to design and drill a large diameter well that will not limit yield due to pump size. The second option is to drill a large diameter (eight inch) exploratory well, then later turn this well into an operational well.

Small exploratory holes are less expensive than drilling a larger sized exploratory hole, therefore more areas can be explored for the same cost as drilling fewer large diameter holes. However, well yield may be constrained to what size pump can be installed in the well.

Eight inch exploratory holes are more expensive to drill initially, but they can be immediately finished as a production well after drilling if a high yield of water is encountered.

APPENDIX F

Montana Department
of
Fish, Wildlife & Parks

Region 3 Headquarters | 1400 S 9th | Bozeman, MT 59718

January 13, 2016

Christine Pearcy
Environmental Scientist
Morrison - Maierle
2880 Technology Blvd W
Bozeman MT 59718

Re: Story Creek Diversion - Bozeman/Sourdough Creek

Dear Ms. Pearcy,

Bozeman/Sourdough Creek is a vital waterway that is at the heart of the Bozeman community. Bozeman/Sourdough creek supports numerous species of trout and coolwater fishes. Functioning and well maintained diversions are critical for water users to obtain the quantity of water at the correct time of year. Montana Fish, Wildlife & Parks is a strong proponent of diversions that allow passage of all life stages of fish and other aquatic species throughout the year. Montana Fish, Wildlife & Parks wholeheartedly supports development of aquatic passage friendly diversions; and if necessary and reasonable, diversions that don't allow escapement of fish into ditches that cannot support aquatic life. Please feel free to use this letter in support of grants to construct an ecologically friendly weir/diversion that fulfills the needs of water users. If you require further assistance please contact me any time (406) 994-6938.

Sincerely,

David C Moser
Fisheries Biologist

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

STEVE BULLOCK, GOVERNOR

1625 ELEVENTH AVENUE

STATE OF MONTANA

DIRECTOR'S OFFICE: (406) 444-2074
FAX: (406) 444-2684

PO BOX 201601
HELENA, MONTANA 59620-1601

Bureau of Reclamation Financial Assistance Management Branch
Attn: Ms. Janeen Koza
P.O. Box 25007
Denver, CO 80225

January 15, 2016

Re: WaterSMART City of Bozeman Water Conservation Project

Ms Koza,

The Water Resources Division of MT DNRC supports the conservation, development, utilization and sustainability of the state's water resources while protecting existing uses and planning for future needs. Montana DNRC completed an update to our State Water Plan in 2015, and this project aligns directly with several of the recommended goals identified in the Plan, namely '*Support the implementation of water conservation incentives and measures that are adaptable to the needs of the local conditions, individual watersheds and municipalities*". The project also demonstrates innovative strategies to help communities become more resilient to drought and water shortages, as part of the National Drought Resiliency Partnership Montana Demonstration Project.

Bozeman and the Gallatin Valley are facing a water crisis. The area is one of the fastest growing regions in the state and that growth is straining municipal water supplies. Through the recently completed Integrated Water Conservation Planning process, growth projections indicate that the City will not be able to adequately meet all of the municipal needs at the current rate of expansion. Bozeman is also located in the Missouri Headwaters Basin, which is over allocated and administratively closed to new water appropriations. Thus the City recognizes the need for multiple water conservation strategies and improved water delivery systems to reduce the demand side of the equation.

We are excited that Bozeman, a *Water Smart Community*, is the first municipality in the state to hire a full time water conservation specialist to build community awareness and implement water conservation projects. This project proposal would install the infrastructure to accurately measure and reduce diverted water, decrease the use of valuable treated potable water and improve the conveyance systems, each important pieces for increased water conservation.

I urge you to give full consideration and funding for this extremely worthy project application.

Sincerely,

Ann C Schwend

Ann Schwend
DNRC Upper Missouri Basin Water Planner

Laura Ziemer
Senior Counsel and Water Policy Advisor

January 18, 2016

Bureau of Reclamation
Acquisition Operations Group
Attn: Michelle Maher
Mail Code: 84-27810
P.O. Box 25004
Denver, CO 80225

Re: Trout Unlimited's Support for Sunset Hills Cemetery and Lindley Park Water Conservation Project by the City of Bozeman Water Conservation Division.

Dear Ms. Maher,

Trout Unlimited (TU) has over 4,000 members in Montana, and our Madison-Gallatin Chapter based in Bozeman, Montana is the largest TU Chapter in the state. Reflecting the values of the Madison-Gallatin TU Chapter to conserve, protect, and restore trout streams within the Gallatin River watershed, TU was an active member of the City of Bozeman's Advisory Council during the preparation of--and study of issues surrounding—the City's Integrated Water Resources Plan, adopted in 2013. TU has been very supportive of the City's Water Conservation Program, established in 2014 as one of the first steps in implementing the Integrated Water Resources Plan.

TU supports the City of Bozeman's proposed WaterSMART project to end the use of treated water to irrigate park and cemetery land, and upgrade the diversion structure for Story Ditch from Sourdough Creek—tributary to the East Gallatin River—to increase water efficiency and facilitate fish passage in Sourdough Creek. Not only is this proposed project another step to implement the recommendations of the City of Bozeman's Integrated Water Resources Plan, but the diversion structure upgrade and plan to line and pipe segments of the ditch to reduce ditch losses will improve instream flows and fish passage in Sourdough Creek.

Please don't hesitate to contact me at lziemer@tu.org or (406) 522-7695 if you would like any additional information about TU's support for this project.

Yours truly,

Laura Ziemer

Cc: Lain Leoniak, City of Bozeman Water Conservation Specialist

BOZEMAN MT
Parks, Recreation,
Forestry & Cemetery

Bureau of Reclamation
Financial Assistance Branch
Mail Code: 84-27852
P.O. Box 25007
Denver, Colorado 80225

Dear Ms. Koza:

I would like to offer my support for the WaterSMART grant application put forth by our water conservation specialist, Lain Leoniak. Being the Park and Cemetery Superintendent, I can see the City of Bozeman benefitting from the Cemetery/Lindley park irrigation project, in many ways. Initially, by utilizing the water rights to the Story Mill ditch, we can start efficiently irrigating our cemetery and Lindley Park, while transitioning these areas off of treated water meant for our customers.

Secondly, with the re-design of a head gate diversion, out employees will be safer, as the need to physically enter the creek will be eliminated.

The overall project is a "flagship" endeavor that will set a precedence here in Bozeman in regards to water conservation and smart use of our most precious resources. Being the manager of the cemetery and over 400 acres of parkland, I am acutely aware of the need to manage our water in the most efficient and effective ways. This project, I believe, starts our city down that path. Do not hesitate to contact me with any additional questions.

Thom White
City of Bozeman
Park/Cemetery Superintendent
(406) 582-3224
twhite@bozeman.net

BOZEMAN MT
City Commission

January 12, 2016

Ms. Janeen Koza
Bureau of Reclamation
Financial Assistance Management Branch
Mail Code 84-27852
P.O. Box 25007
Denver, Colorado 80225

Re: FY 2016 WaterSMART Water and Energy Efficiency Grant
City of Bozeman Water Conservation Division
City of Bozeman Sunset Hills Cemetery and Lindley Park Water Conservation Project

Dear Ms. Koza:

This letter is presented on behalf of the City of Bozeman, Montana in support of the Water Conservation Division's grant application to the Bureau of Reclamation's WaterSMART Water and Energy Efficiency Grant for the City of Bozeman Sunset Hills Cemetery and Lindley Park Water Conservation Project. This project will provide numerous lasting benefits to the community and its residents for decades to come.

The City of Bozeman's Water Conservation Division is proceeding with a plan to rehabilitate the point of diversion, conveyance and distribution system for one of the City's most senior water rights in order to reduce water consumption, to make the distribution system safe for city staff to operate, and to reduce annual costs. The Sunset Hills Cemetery and Lindley Park Water Conservation Project will contribute to the goals of the Water Conservation Program, reduce the amount of water diverted at the headgate and lost to seepage in the ditch, thereby leaving more water in-stream. It will serve as a model for the community of best management practices for outdoor irrigation efficiencies.

The City of Bozeman intends to contribute to the project in the form of cost share and leveraged resources. Specifically, $450,000.00 is allocated in the City's Capital Improvement Plan for FY 16-18 for the Project. The City is also seeking funding from the Renewable Resource Grant and Loan Program (RRGL) through the State of Montana's Department of Natural Resources and Conservation in the amount of $125,000.00. Additionally, the City of Bozeman will contribute FTE to ensure the project's completion and continued success as an example of outdoor water conservation techniques.