**AGENDA**
**OURAY CITY COUNCIL**

**Monday, September 25, 2023 - 10:15 AM**

**Ouray Community Center**
**320 6th Ave**
**Ouray, CO 81427**

**VIRTUAL OPTION -** https://zoom.us/j/9349389230
Meeting ID: 934 938 9230 Passcode: 491878 Or dial: 408 638 0968 or 669 900 6833

## Ouray City Council Work Session

- Changes to this agenda can be found on the bulletin board at City Hall
- Electronic copies of the Council Packet are available on the City website at www.cityofouray.com. A hard copy of the Packet is also available at the Administrative Office for interested citizens.
- Notice is hereby given that a majority or quorum of the Planning Commission, Community Economic Development Committee, Beautification Committee, Tourism Advisory Committee, and/or Parks and Recreation Committee may be present at the above noticed City Council meeting to discuss any or all of the matters on the agenda below for Council consideration

1. CALL TO ORDER
2. DISCUSSION ITEM - Ouray Hot Springs Alternative Heat Source and Geothermal Systems Study

# OURAY HOT SPRINGS

## ALTERNATIVE POOL HEAT SOURCE + GEOTHERMAL SYSTEMS STUDY

**September 15, 2023**

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## PROJECT OVERVIEW

The Ouray Hot Springs Pool is one of Ouray's most important tourist attractions and is a vital part of the City's history dating back to the 14th Century when they were first discovered. Located at 1220 Main St., the Pool is bordered by Highway 550 to the east, Fellin Park to the south, the Uncompahgre River to the west, parking lot and Ouray Visitor's Center to the north and helps strengthens the downtown fabric of businesses, parks, trails, restaurants and lodging. Recent struggles with decreased flow rates and legal issues with a neighboring spa have created unexpected challenges for the City in keeping the Pool open to the public 7 days a week and maintaining adequate temperatures year-round. The Pool is a big revenue generator as well and the City does not want the Pool's reputation to be negatively impacted by these recent issues.

The City of Ouray has engaged ME&E Engineering, Major Geothermal and Reynolds Ash + Associates to complete a Pre-Design Study that would provide options for an alternate heat source for the Pool, which would allow the City of Ouray to keep the pools open 7 days a week and maintain ideal temperatures year-round. The Pre-Design Study includes analysis of existing conditions and data, analysis of how various mechanical systems could be integrated to meet the project goals, and finally analysis of new infrastructure and facilities that would be required for each system. A total estimated construction cost is included along with the estimated annual operating cost for each option. The design team's findings will hopefully provide the City of Ouray with a better understanding of the costs, opportunities and constraints of each possible solution.

## EXECUTIVE SUMMARY

Over the course of this project, 7 options have been identified. Of those, the design team and City of Ouray have found 3 options to be the most viable including Option 5, Option 6 and Option 7.1/7.2. Option 7.2 has the most appeal for its ability to be integrated over time with a less expensive cost compared to the other options. Option 7.2 includes a water source heat pump with electric boiler backup. The other options that explore only electric boilers or geothermal borefields are not viable.

Of the 3 sources of hot springs water for the Pools, the OX2 line and the Box Canyon line provide the largest flows and most amount of heat. The Ball Park line is essentially negligible in our calculations. OX2 could be shut down on any given day. However, the City could still augment water from the Box Canyon line every day of the week.

Since the Box Canyon line was recently cleaned, it is performing better and the City anticipates that relying on the Box Canyon line on a daily basis is a safe bet in the short term. The City is doing well for the time being on the Box Canyon line. However, there are still fears that the aquifer will continue to drop and that the Box Canyon line would not be sustainable long term. The design team and City agree that Option 7.2 could be broken up into 3 phase and once fully built out, the Pools could be heated entirely by a supplemental system if necessary.

Phase 1

The water source heat pump, using the spring discharge, should be able to produce some amount of heat and energy on a daily basis and will be the source of supplementary heat in the short term, without any electric boilers. Based on our calculations, it is possible to heat the Pools on Tuesdays with only the water source heat pump and the Box Canyon Line. The water source heat pump piece of Option 7.2 would be the first phase.

Phase 2

As the aquifer changes over time, the first of the electric boilers could be integrated and brought online to then supplement the heat. The single boiler could provide all the heat necessary if Box Canyon decreases significantly and if OX2 is shut off entirely. The first boiler proposed in Option 7.2 could be deferred and be a long term solution.

Phase 3
Finally, the second electric boiler could be integrated and brought online to provide redundancy in the system, providing a backup to the first boiler when needed during periods of maintenance or to fully sustain the desired temps of the Pools.

Implementing this option will require an increase in the amount of electricity brought to the site and a new building to house the new equipment. San Miguel Power Association has provided feedback on costs and potential sites for a new structure have been identified. The design team recommends that the City of Ouray wait until the Ouray Parks Master Plan is completed before a final site location is determined.

## MECHANICAL DESIGN NARRATIVE

*Prepared by ME&E Engineering for Reynolds + Ash.*

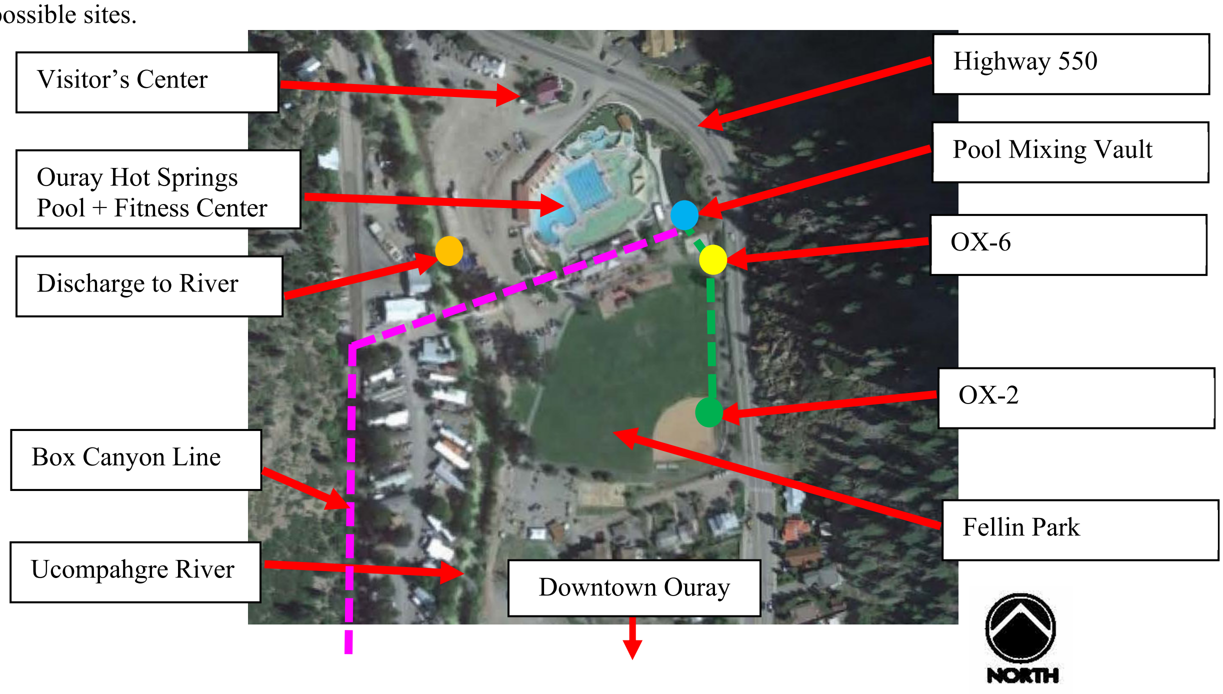
### INTRODUCTION

As reported in a previous report, in late February 2022, Joe Coleman reached out to ME&E Engineering for help finding mechanical options for heating the Ouray Hot Spring Pool. On March 18, 2022, ME&E representatives, Mechanical Engineer and Principal Dustin Sullivan and Technical Writer Nana Naisbitt met with the following city representatives at the Ouray Pool: Public Works Director Joe Coleman, Pool Manager Carmen Brashier, City Manager Silas Clarke, and Filtration Manager Director Joe Cruz. Sullivan and Naisbitt toured the Ouray Hot Spring Pool facility with these city representatives to collect information about current conditions and determine which test results and documents would be needed from the city. All documents requested by ME&E were subsequently provided by the city staff. On June 6, 2022, Sullivan spoke with Trevor Downing and Hayes Lenhart of Wright Water Engineers to better understand existing conditions.

On July 20, 2022, ME&E sent a report to Clarke that outlined four possible mechanical options for heating the pools that included diagrams of the systems and cost estimates. On November 7, 2022, Sullivan and Naisbitt attended a Town Council Meeting in which Sullivan presented the pros and cons of the four options, as well as answered questions. The council voted in favor of proceeding with Option #2, the gas-fired boiler.

However, on March 20, 2023, the City of Ouray held a public work session about the Ouray Pools, with comments from the public. Naisbitt attended the 90-minute meeting for ME&E. City Manager Silas Clarke stated clearly at the top of the meeting that staff wanted direction from City Council. At this meeting, Clarke continued to stress that the Ouray Pool needed “additional heat” and that the pools were “getting a bad rap” for being too cold. He said the work session was about “looking into the options to get artificial heat.” Many locals made public comments, most of which centered around their desire to *not* heat the pools, citing environmental concerns and concerns that the pools would no longer be “natural.” Clarke mentioned that the water table of the hot springs might continue to diminish. His hope was to identify a solution that would continue to provide heat and water for the pools at whatever level the aquifer happened to be – low, high, or diminishing. The City Council seemed to agree with the public that the gas-fired boiler option was no longer in consideration. Council asked for staff to gather more information to create a “global plan” that will serve the city and the needs of the pool for the next 15 to 20 years without natural gas. ME&E was asked to provide additional non-gas-fired options to heat the pools.

On June 30, 2023, Sullivan and Naisbitt met in Ouray with Reynolds Ash + Associates architect Lauren Davis; Ouray Mayor Ethan Funk; and City of Ouray Resource Director, Rick Noll, to review the draft report sent to Clarke on June 29, 2023 by Lauren Davis, including the draft MEP report provided by ME&E. At this meeting, ME&E learned that the Box Canyon line had been jetted and now produces up to 220 GPM (gallons per minute). For purposes of ME&E calculations, Funk and Noll suggested that 180 GPM be used for the flow rate of the Box Canyon line to be on the safe side. Funk asked that ME&E design a system that would act as the supplemental heat source, now that the Box Canyon is flowing well and is entering the pool system at 134°F. He asked that at this time we design a system that could begin as a supplemental heat source, yet can be expanded over time to be the sole source of heat of the pools at the desired temperatures, should the aquifer fail in the future. He also asked that we design a heating plant that is sized to serve as the supplemental heat source of the pools when OX2 is closed on Tuesdays. At those times, the Box Canyon and the Ball Park lines would continue to serve the pools. He asked that we design a heating plant that is sized to serve as the supplemental heat source when Box Canyon is closed for maintenance. At those times, OX2 and the Ball Park lines would continue to serve the pool. It should be noted that due to the low contribution of the Ball Park line, it's failure is of little consequence. Funk also asked that ME&E continue to explore extracting heat, but not the water, from OX2 and into OX6 through a closed loop system. However, the reason this option (Option #1 below) was eliminated in the first round is because this is only a viable option if the aquifer maintains volume, which is uncertain. While Mayor Funk was not enthusiastic about the air-source heat pump (Option #6 below), we feel it is important to include in this report for the record. Funk and Noll also discussed their concern about a ground-source heat pump (Option #7.1 below), as it could pose the danger of collapsing the aquifer and fracturing the sub-strait clay layer in the earth. The group identified that the new building would need to connect to power and to the inflow and outflow of water to the pools. We discussed sizing the building to accommodate all the equipment necessary to heat the pools to the desired temperatures year-round, should the aquifer ultimately fall. With that in mind, we discussed possible locations for the building and walked possible sites.




**ISSUES, AS STATED BY CITY STAFF IN 2022**

- ME&E learned that there are three sources of hot springs water that feed the pools. Collectively they currently provide an average of 210 gallons per minute, according to Joe Cruz and Silas Clarke. The three sources are: 1) Box Canyon Line; 2) OX2 Artesian Well; and 3) The Ball Park Line. The current combined flow rate of 210 gpm is well below the historic flow rate of about 300 gpm, which in the past provided enough flow to heat the pools with no additional mechanical heating.
- During the Step Test conducted by Wright Water Engineers, the natural pressure was measured at 3psi, which is related to flow rate.

- The city must shut down the OX2 line one day per week to be in compliance with an agreement with the Wiesbaden Spa. Currently that closure day is Tuesday. The city and residents would prefer that the pool be open seven days a week.
- Under current natural conditions, ideal temperatures in the pool are difficult to maintain in winter months.
- Historically, the primary source of water for the pools came from the OX2 Artesian Well, however the output of that well has decreased from about 200 gallons per minute to about 110 gallons per minute, and sometimes less. The heat loss of the pools is greater than the heat gain due to the reduced flow, causing uncomfortably cool pool conditions.
- OX6 seems intact according to the Wright Water Engineers and videos. No one is certain what is causing the reduced flow. The well is no longer in service.
- The lap pool is ideally maintained at 80°F. However, under current natural conditions in the winter, the temperature does not get above 76°F, and if the lap pool temperature drops to 72°F, then the pool is closed.
- In the winter months, the shallow pool is shut down with the exception of about a 20% section, which is kept open so children can cool down, even if the temperatures drop to 70°

**City-Determined**
**Ideal Operation**

| Hot Springs | GPM | Inlet Temp. °F | outlet Temp. °F | MBH | KW | Ton |
|---|---|---|---|---|---|---|
| OX2 | 200 | 125 | 80 | 4500 | 1319 | 375 |
| Box Canyon | 70 | 138 | 80 | 2030 | 595 | 169 |
| Ball Park | 20 | 120 | 80 | 400 | 117 | 33 |
| | | | | 6930 | 2031 | 578 |

**GOALS AND PRIORITIES, AS STATED BY CITY STAFF**

- A hot springs flow rate of 300 gallons per minute or more is ideal.
- Get the Overlook Pool up to 106°F, but no cooler than 104°F in the winter months.
- Get the Hot Pool up to 106°F, but no cooler than 100°F in the winter months.
- Get the Shallow Pool up to 98°F, but no cooler than 92°F in the winter months.
- Get the Lap Pool up to 80°-82°F, but no cooler than 78°F in the winter months.
- Open all pools every day all year round at full water levels (except the Activities Pool, which is open seasonally from Memorial Day to Labor Day).
- Heat the pools even on the day of the week when the city shuts off the feed from the OX2 well; in other words, remain open seven days a week.
- Prevent the need to lower water levels in the pools because that causes tiles and plaster to crack.
- Ideally, the OX2 Well would return to its historic output of 200 gallons per minute, however this is unpredictable.

**POSSIBLE SOLUTIONS**

In an effort to be comprehensive, below ME&E lists the four previously eliminated options, plus three new possible mechanical solutions for consideration. Our assumption continues to be that the primary heat source remains the earth's aquifer and flowing natural water for all these systems. However, because of the issues experienced at the Ouray Pools as outlined above, the Ouray staff members have asked ME&E Engineering to suggest mechanical solutions. All the new mechanical systems described below (i.e., Options #5-#7) can supplement or back-up the natural system. All the new mechanical systems described below (i.e., Options #5-#7) are scalable and can be built for maximum capacity over time, as need and budgets allow.

## Options Eliminated Previously by Ouray City Council

### Option #1 Heat Exchanger Only

This option was previously eliminated because it would still require OX2 usage. It should be noted that pumping out of OX2 does not create volume; it only increases pressure. Thus, if the aquifer volume depletes, so will the pumped volume potential. This option would only be useful for OX2's closure on Tuesday and if the aquifer maintains proper volume.

### Option #2 Natural Gas Fired Boiler Plant

This option was eliminated because it uses natural gas.

### Option #3 Heat Exchanger and Back-up Boiler Plant

This option was previously eliminated because it uses natural gas.

### Option #4 Solar Thermal with Back-up Boiler

This option was previously eliminated because it uses natural gas, and solar thermal is ineffective when it is needed the most.

## New Options Proposed by ME&E Engineering

### Option #5 Electric Boiler Plant

One option is adding a new all-electric boiler plant with two boilers to the property to directly heat the pool water. One boiler would be 1,500 kW and a future 800kW. Two boilers are being proposed so that there is redundancy, should one fail. None of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, the boiler could supplement the necessary heat to reach desired levels. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse. (See Exhibit A - Option #5 Diagram for more details.)

**Advantages:**

- The pools can operate at full capacity at any outdoor air temperature.
- Allow the pools to open on Tuesdays.
- Will not disrupt the natural hot springs aquifer.
- Lowest upfront cost.

**Disadvantages:**

- Highest energy costs by a factor of 2-4 times.

### New Option #6 Air Source Heat Pump with Boiler Backup

One option is adding a new all-electric air-source heat-pump plant with an input of 1,500 kW to the property to directly heat the pool water. The boiler option described above would be added to the system to allow heating to occur below 0°F. (see Disadvantages below). None of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, the plant could supplement the necessary heat to reach desired levels if the depletion of the aquifer were to occur. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse.
(See Exhibit B - Option #6 Diagram for more details.)

**Advantages:**

- Will not disrupt the natural hot springs aquifer.
- Lower energy cost than the electric boilers by possibly a factor of 1.5 to 2.3 times.

**Disadvantages:**

- Additional equipment is required, adding to maintenance costs.

### New Option #7.1 Water Source Heat Pump Utilizing the Spring's Rejected Water + a Closed Loop Ground Source

One option is adding a new all-electric water-source heat-pump plant with an input of 2,000 kW to the property to directly heat the pool water. When the heat flow from the natural hot springs is reduced, so is the water source heat pump system's capability. It must be supplemented with a closed-loop borehole system. With the water-source heat pump and closed-loop borehole system in place, none of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, this system could supplement the necessary heat to reach desired levels. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse. Note that the closed loop system would be a vertical ground loop because a horizontal system is not practical.
(See Exhibit C - Option #7 Diagram for more details.)

**Advantages:**

- Will not disrupt the natural hot springs aquifer.
- Lowest energy cost.

**Disadvantages:**

- Highest upfront construction costs.
- Drilling dangers of collapsing the aquifer and fracturing the sub-strait clay, as per Funk/Noll

### New Option #7.2 Water Source Heat Pump Utilizing the Spring's Rejected Water with Boiler Backup.

This is the same as 7.1 above, but a backup electric boiler as described in option# 5 would be part of the system instead of the borefield. These boilers would be roughed in for future water and power connections.

## METHOD FOR ESTIMATION OF INSTALLATION COSTS

Construction estimates are helpful when making decisions about which system to choose. RS Means cost estimating guides are nationally recognized standards for construction cost estimating. The publisher produces a number of specific estimating guides, including *2023 Mechanical Cost Data, 2023 Electrical Cost Data,* and *2023 Plumbing Cost Data.* Construction costs herein are based on 2023 RS Means cost estimating guides. However, it should be highlighted that we are in an inflationary period, with many uncertainties.

**OPINION OF PROBABLE CONSTRUCTION COSTS TABLE**
**SEE ATTACHED EXHIBIT**

San Miguel Power Association provided cost data to ME&E on 08-24-203. Overall costs have been updated accordingly.

**OPINION OF PROBABLE ENERGY COSTS – TUESDAY'S ONLY**
**SEE ATTACHED EXHIBIT**

**OPINION OF PROBABLE ENERGY COSTS-NO PARTICIPTION FROM ANY HOT SPRINGS**
**SEE ATTACHED EXHIBIT**

**EXHIBITS**

- Opinion of Probably Construction Costs
- Opinion of Probable Energy Costs – Tuesday's Only
- Opinion of Probable Energy Costs – Annual Energy Cost if Artificial Heat is the Only Heat Source
- A-Option #5 Diagram
- B-Option #6 Diagram
- C-Option #7.1 Diagram
- Option #7.2 Diagram

## GEOTHERMAL DESIGN NARRATIVE

*Prepared by Major Geothermal for Reynolds + Ash.*

**Abbreviations – GEOTHERMAL DESIGN NARRATIVE**

| | |
|---|---|
| EWT | Entering Water Temperature |
| GHX | Ground Heat Exchanger |
| GPM | Gallons per Minute |
| HDPE | High Density Polyethylene |
| HX | Heat Exchanger |
| LWT | Leaving Water Temperature |
| TC | Thermal Conductivity |
| TDS | Total Dissolved Solids |
| UT | Undisturbed Temperature |

**Executive Summary**

To supplement hot water makeup for the pools, a ground source heat pump system is being considered. Currently eight WaterFurnace TrueClimate 700 nominal 140 ton water-water heat pumps have been selected by ME&E Engineering to meet the demand loads and load side water temperature objectives. These heat pumps are considered extended range heat pumps, ie, they can operate with lower source EWT ranges below 40°F and still generate load side water temperatures of 100°F and higher depending on conditions. To serve these units, two source side assets are considered, a vertically drilled closed loop ground heat exchanger, and scavenging low grade heat from spring water discharge.

A closed loop ground heat exchanger involves drilling boreholes to a certain depth, installing HDPE u-bend circuits, with the holes being completed with a pliable grout mix installed from total depth to surface. This is required not only by state regulations[1] to protect any aquifers but also to assure competent thermal transfer from the host geology.

The second option would be to access the discharge water from the facility and use this warmer water to service the heat pumps.

There is also the possibility to combine both a closed loop GHX and spring water discharge to service the heat pumps. This is described later in this narrative with the concept graphics provided by ME&E Engineering.

Based upon the unavailability of heating load durations and currently unknown thermal conductivity values, the current estimated closed loop GHX calculations to fully drive the water-water heat pump system without other heating assets are likely excessive for both physical installation and first cost considerations.

The spring water discharge option could potentially carry the entire heating load for the water-water heat pump system but may require additional investigation to verify worst case water flow capacity.

A combination of both a closed loop GHX and spring water discharge might also be considered as previously noted.

Should there be any concerns for the reliability of the spring water discharge volume, a backup boiler system should be considered for final stage backup heating.

[1] Colorado Division of Water Resources

**Heating Demand Load to Service Pool Heating**
The current peak load requirements to service the pool heating needs is 13,001 mbh, or 13,001,000 btuh (ME&E Engineering).

**Closed Loop Ground Heat Exchanger Design**
The objective of a closed loop GHX is to provide source water temperatures to heat pumps that the equipment can reliably function with and deliver the heating capacity necessary to meet the project load requirements.

Design requirements include knowing the peak heating loads, the duration of the loads, efficiency parameters of the heat pumps to be serviced, water flow rates required, and the thermal conductivity and undisturbed temperature of the host geology.

**Spring Water Discharge**
The use of the spring water discharge will be dependent upon the available water volume from the pools. Depending on load requirements the heat pumps could require up to 1300 gpm flow rate on the source side. To maintain this the flow rate from existing hot spring or water well sources would have to match this under peak load conditions.

**Water Quality**
For a closed loop GHX, the water within the system between the ground loops and the heat pumps would not require an intermediate heat exchanger as clean potable water with some antifreeze (food grade propylene glycol, 20% to 25%) could be used and is typical for closed loop systems of this type. On the load side this would also use clean potable water but would require an intermediate HX as the spring water to be heated is expected to be high in TDS components. Where intermediate HX units are necessary they should be redundant to allow for routine cleaning and service of one unit while operating the other.

For the spring water discharge source, this will also require redundant intermediate HX units on the source side of the heat pumps.

**Preliminary Closed Loop GHX Calculations**
Based upon the peak loads, interpreted TC values and other parameters two closed loop GHX simulations were generated.

Simulation *'OurayHtSprgs 2023-06-21 V1'- See Exhibit of Simulation V1*

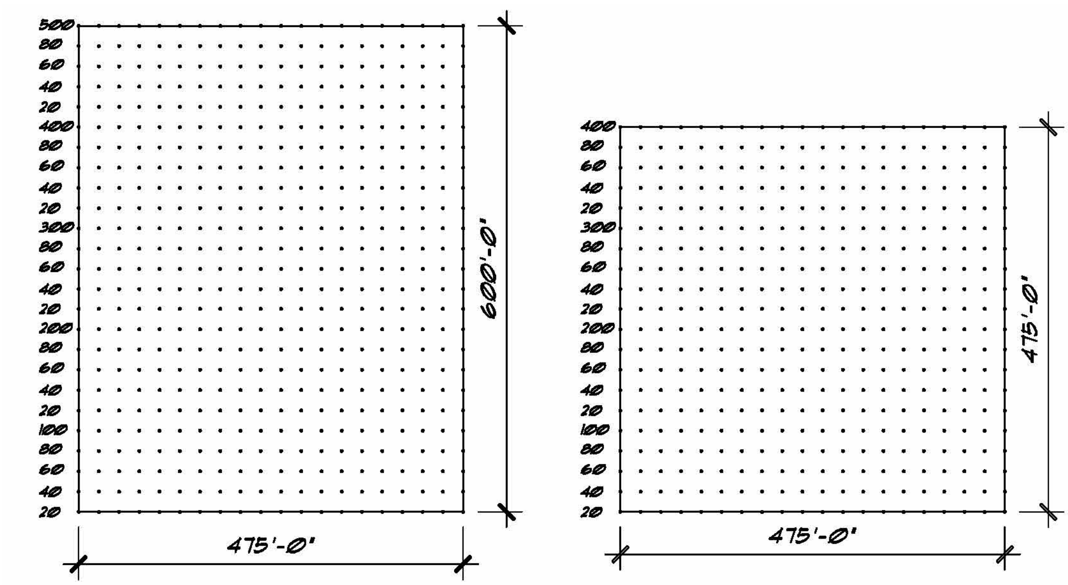
| | |
|---|---|
| Bores | 500 |
| Depth | 550' |
| Spacing | 25' |
| U-bend pipe size | 1.25" DR11 |
| Pipe material | HDPE |
| Est'd TC | 0.95 btuh/ft/°F |
| Est'd UT | 55.0 °F |
| Lowest projected EWT to Heat Pumps | 35.0 °F |

Simulation *'OurayHtSprgs 2023-06-21 V2' See Exhibit of Simulation V2*

| | |
|---|---|
| Bores | 400 |
| Depth | 550' |
| Spacing | 25' |
| U-bend pipe size | 1.25" DR11 |

| | |
|---|---|
| Pipe material | HDPE |
| Est'd TC | 0.95 btuh/ft/°F |
| Est'd UT | 55.0 °F |
| Lowest projected EWT to Heat Pumps | 30.0 °F |

The V1 simulation describes a surface field size of 475' x 600' for a layout of 20 bores x 25 bores x 25' spacing in a conceptual rectangle configuration. The V2 simulation describes a surface field size of 20 bores x 20 bores x 25' spacing, or in a square of 475' x 475'. The smaller field size is determined by lowering the design EWT to the heat pumps from 35°F to 30°F.




The number of bores and depth are based upon the peak loads and TC/UT values interpreted from adjacent well logs (attached), regional experience, required peak flow rates and other variables.

These field ranges are obviously too large for the site to accommodate, but it should also be considered there are still variables to be determined to finalize a GHX design that could serve as a benchmark for servicing the heat pump system without any auxiliary heating capacity.

**Closed Loop GHX Cost**
Cost for a closed loop GHX is expected to be substantial; installed cost inclusive of headering to the mechanical room is estimated to be between $15,000 and $19,000 per borehole.

*'OurayHtSprgs 2023-06-21 V1'*

| | |
|---|---|
| Bores | 500 |
| Cost Range per Borehole, Low | $15,000 |
| Total Low Range | $7,500,000 |
| Cost Range per Borehole, High | $19,000 |
| Total High Range Cost Estimate | $9,500,000 |

*'OurayHtSprgs 2023-06-21 V2'*

| | |
|---|---|
| Bores | 400 |
| Cost Range per Borehole, Low | $15,000 |
| Total Low Range | $6,000,000 |
| Cost Range per Borehole, High | $19,000 |
| Total High Range Cost Estimate | $7,600,000 |

**Closed Loop GHX Design Considerations**
One of the driving factors for the size of the GHX calculations is that the load durations are unknown. Typically for a closed loop GHX hourly loads are calculated for a full year of operation. However, for large outdoor pools, calculating load durations may not be possible.

To put this in perspective, assume a church has a nominal 50 ton (600 kbtuh) heat pump system. Immediately next door, an office building has the exact same nominal 50 ton heat pump system. Both have the same geology and climate. But the office building may require 15x to 20x or more ground loop. The reason being that the office building occupancy and load duration is substantially more then the church, which may only be active for a few hours each week.

The other variables are the unknown thermal conductivity and undisturbed temperature over the average length of the borehole. Typically for commercial and large-scale projects, a GHX is predesigned to establish a field layout and geometry, and adjusted to avoid infrastructure or other conflicts. Once that is completed a test bore location is identified and installed. Then a thermal conductivity test is performed involving a data logger that circulates water through the ground loop for 48 hours with a known amount of heat[2]; the slope of heat input over time is thermal conductivity value, interpreted as how much heat can be exchanged per foot of borehole for every change in °F temperature. Prior to activating heat input, the water in the ground loop is circulated for a given time period to determine the average undisturbed temperature.

The cost to run a TC test, inclusive of drilling and data logging, is estimated to be in the $25,000 to $30,000 range for Ouray location. However, the test bore could later be integrated into the operating field.

There is the potential that if the heating load durations could be accurately calculated and a TC test programmed, the size and scope of the current estimated field parameters could be reduced.

**Closed Loop GHX Maintenance**
As there are no moving parts in the subsurface for a closed loop GHX, there are no maintenance requirements. HDPE piping and fittings are fusion welded so there are no mechanical fittings to degrade or deteriorate. The industry standard warranty for purpose-milled ground loop HDPE pipe is 50 years.

**Spring Water Discharge to Service Heat Pumps**
The design and infrastructure necessary to take advantage of the spring water discharge from the Ouray pools would be substantially less cost than installing a closed loop GHX.

The design and cost of the components and infrastructure to use the spring water discharge has yet to be determined. However a rough estimate of magnitude is described below:

| | |
|---|---|
| Piping | $20,000 |

[2] GHX thermal conductivity testing procedures are determined from ASHRAE RP-1118 and CSA 448 bi-national standards.

| | |
|---|---|
| Fittings, filters and peripheral components | $10,000 |
| Valving | $10,000 |
| Maintenance infrastructure | $15,000 |
| Labor | $80,000 |
| Total Estimated Costs for Spring Water Discharge | $135,000 |

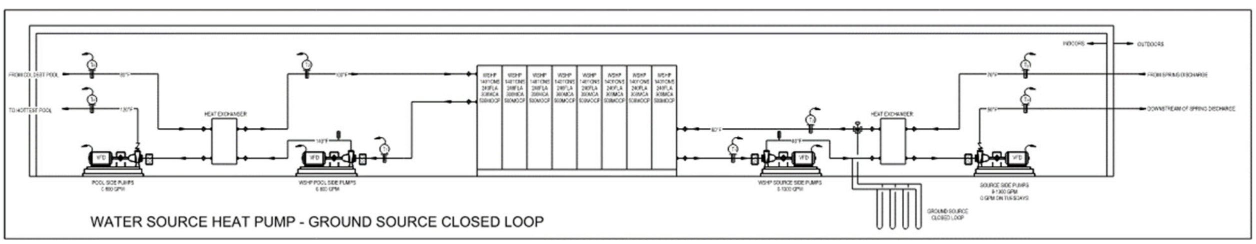
Please note this estimate for tapping the spring water discharge is very rough and may not account for variables yet to be identified.

**Options**

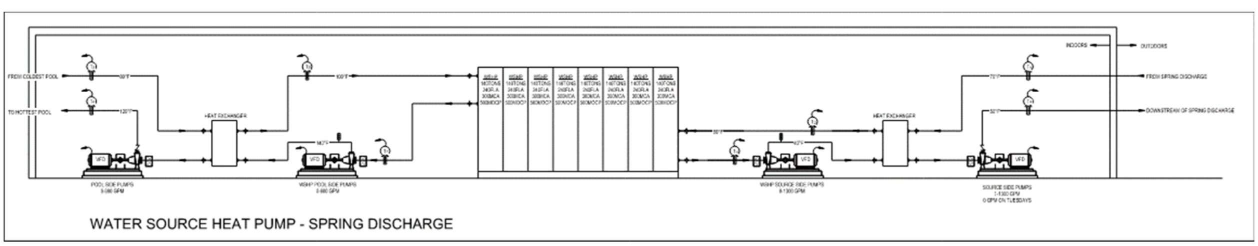
Based upon the variables associated with the design and cost of a closed loop GHX, and the ability to access existing spring discharge water, the following options are proposed for consideration to move forward with servicing a water-water heat pump system.

- Install as much closed GHX capacity that budget and space can accommodate, and integrate with spring water discharge. Use the closed loop GHX capacity as first stage heating as this would have the lowest operating cost. As the capacity of the GHX drops, the spring water discharge would cycle in.
- Omit the closed loop GHX and use the spring water discharge asset to drive the heat pumps system entirely.
- Should the spring water discharge be determined not to be able to service the heat pumps under certain extreme conditions, configure the system to rely on backup boiler capacity as a final heating stage.

**PROJECT GRAPHICS**




Concept drawing of using both a closed loop GHX and spring water discharge to service the heat pumps (ME&E Engineering)




Concept drawing of using only the spring water discharge to service the heat pumps (ME&E Engineering).

**EXHIBITS**

- D-Simulation V1 Site Analysis
- E-Simulation V2 Site Analysis

## SITE ANALYSIS + ARCHITECTURAL DESIGN NARRATIVE

*Prepared by Reynolds Ash + Associates.*

Each of the four options provided by ME&E Engineering and Major Geothermal provide supplemental heat for the Ouray Hot Springs Pool and will require an insulated building to house and protect the various equipment associated with each system including, but not limited to, heat exchangers, boilers, ground source heat pumps, air source heat pumps, and borefield. Locating a new facility on this particular site proves to be very challenging.

RA+A studied the site to help identify the optimal locations for a new structure. RA+A reviewed previous construction drawings for the 2016 renovation, reviewed previous master plans to better understand how the current site was developed and made three site visits to Ouray between May and July of 2023. One site visit took place on June 30, 2023, when Lauren Davis with RA+A met with Mayor Ethan Funk, City of Ouray Resource Director, Rick Noll and ME&E to further review possible site locations. Ultimately, the City of Ouray is currently finalizing the Parks Master Plan. It will be that the location of the new mechanical building be integrated with the Master Plan.

It is also important to note that many aspects of this new building will have impacts to the site. Bringing power to the site will require trenching and potentially some closures to the parking lot may be necessary. Connections to the discharge vault and connections of utility lines to the new building will all take time and require careful sequencing by the General Contractor. If additional projects in this area are planned, there could be opportunities to coordinate work with those projects so that the disruptions to the site are minimized. Instead of having to shut down portions of the parking lot or site on multiple occasions, the City should consider trying to develop multiple projects at the same time such as a new Bathhouse or other Park improvements.

**Site Utilization**

| | |
|---|---|
| Site Area: | 240,000 SF (5.35 acres). |
| Existing Pool + Fish Pond: | 0 .75 surface area acres (32,670 sf). |
| City's Water Rights (per 2016 report): | 0.76 surface area acres (33,106 sf). |
| Existing Pools and outdoor decks: | 32,670 SF |
| Bath House: | 10,000 SF |
| Mechanical Room (upper level): | 2,260 SF |

The 5.35 acre site is maximized in nearly every direction. There are also some incredibly meaningful adjacencies that should be considered in further developing the site. The existing pools/fish pond and support structures make up nearly 80,000 SF of the site. The remaining surface area includes the skate park, children's playground, site storage area and parking lot. Additionally, the infrastructure running below grade for the geothermal systems is significant and includes the snow melt system, which runs below most pedestrian walkways within the Pool. The other infrastructure for standard City utilities such as sewer, power and domestic water, further complicates development on the site. Avoiding utilities, minimizing the impact to the existing parking area and allowing for the build out of the Parks, Recreation and Trail Master Plan will be priorities.

Parking
RA+A has observed that on most weekends during the peak season, the parking lot is full. The Ouray Hot Springs Pool, the Visitor's Center, public restrooms and Fellin Park draw large numbers of people to the site on a daily basis during the peak season and regular basis during the off season. Overflow parking moves to the shoulder of Highway 550 or other adjacent sites, which is not ideal.

The existing parking lot is unpaved and unstriped with gravel only. Cones are used to help maintain turning aisles. The City would like to try and preserve the existing parking capacity if possible. If there is a way to add a structure and rework a similar layout without losing stalls, it would be ideal.

Future Master Plan Buildout
In previous studies of the Parks and Pool, there is a desire to engage more with the River and better connect all of the trails and parks in Ouray. Currently, there is a paved trail that runs along the east side of the Ouray Hot Springs Pool and fish pond. However, there are plans to also connect a path along the west side of the site and have more interconnectivity for pedestrians and bicyclists in the community. Development along the trail and river corridor may be somewhat sacred. Adding a mechanical facility in one of these corridors could have undesirable consequences if not integrated properly. As previously noted, any new building should be in agreement with the approved Parks Master Plan that is currently being developed by the City.

Skate Park
Based on conversations with the City, the skate park may be relocated in the near future, which would allow for this part of the site to be developed.

Children's Playground
Based on conversations with the City, the existing children's playground, which is due south of the Bath House building, may be expanded in the near future.

Restroom Facilities
The current restroom building is getting rebuilt in its current location. The sewer line runs north and south to the restroom facility. The City of Ouray does not want any future building to be located over this sewer line.

Borefield Limitations
As per Major Geothermal's summary, not only is the upfront cost of a large borefield cost prohibitive, but finding the necessary space on this site may not be possible. The number of borings needed is extremely high.

Existing site is 5.35 Acres (approximately 240,000 SF)

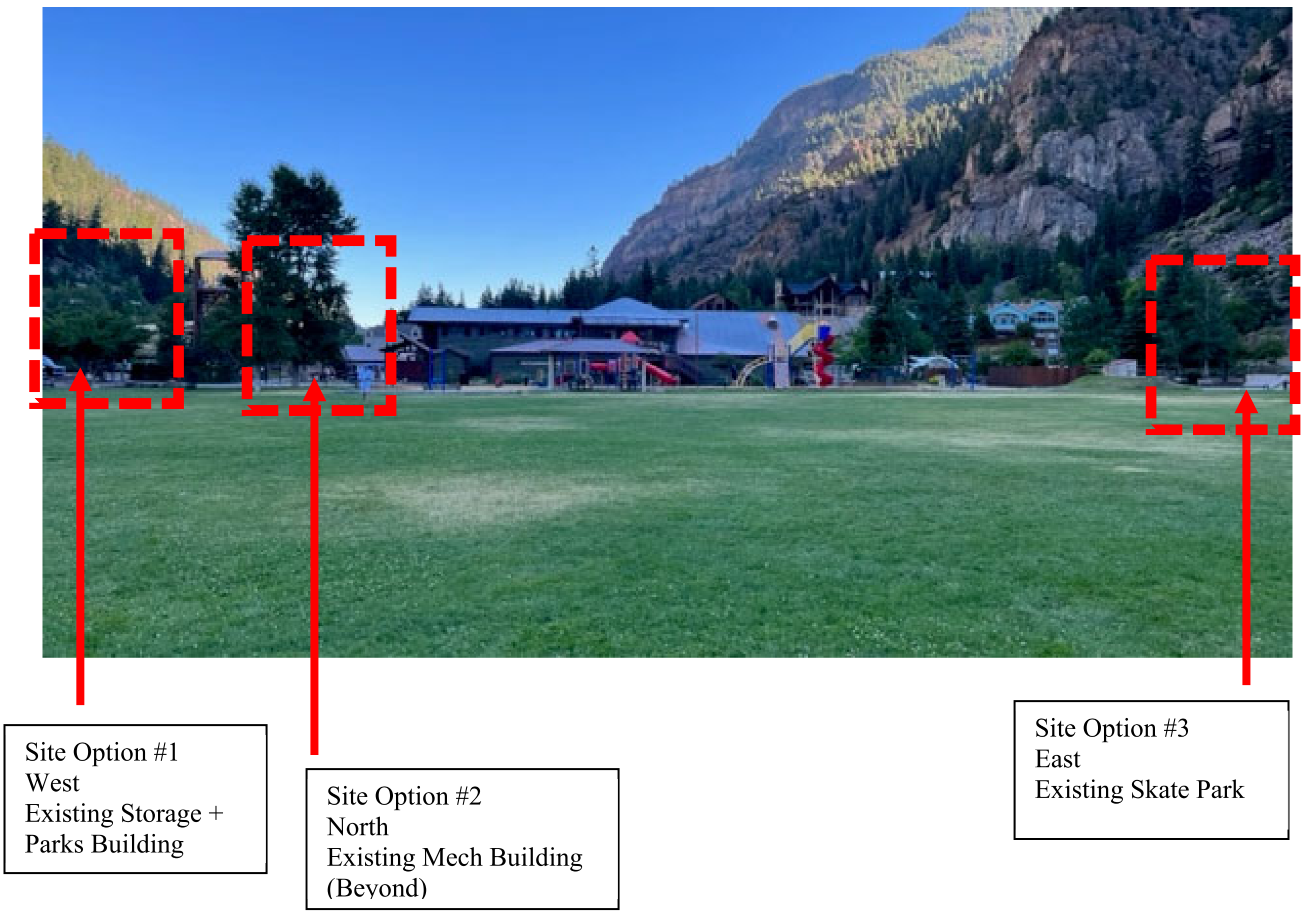
As currently proposed, Major Geothermal's simulations propose the following for bore fields:
Simulation V1 = 500 Bores - 475' x 600' = 285,000 SF (6.5 Acres Needed)
Simulation V2 = 400 Bores - 475' x 475' = 225,625 SF (5.1 Acres Needed)
See Exhibits D + E for size of borefield overlaid on site.

Neither of these options would be possible without utilizing adjacent properties.

The City and County own adjacent parcels and it is unclear if these areas could be additional areas for bore fields if needed. The baseball field to the south is approximately 0.6 Acres

It should be noted that the area within the boundary of the Pool itself and the footprints of existing structures, would not make these viable options and therefore would further reduce the amount of available area for the vertical borings. Snow melt is provided around the entire pool deck area with 2 snow melt zones and nearly the entire site within the fence of the pool is covered with utility lines running underground, which means this area would not be available for the ground source borefield.

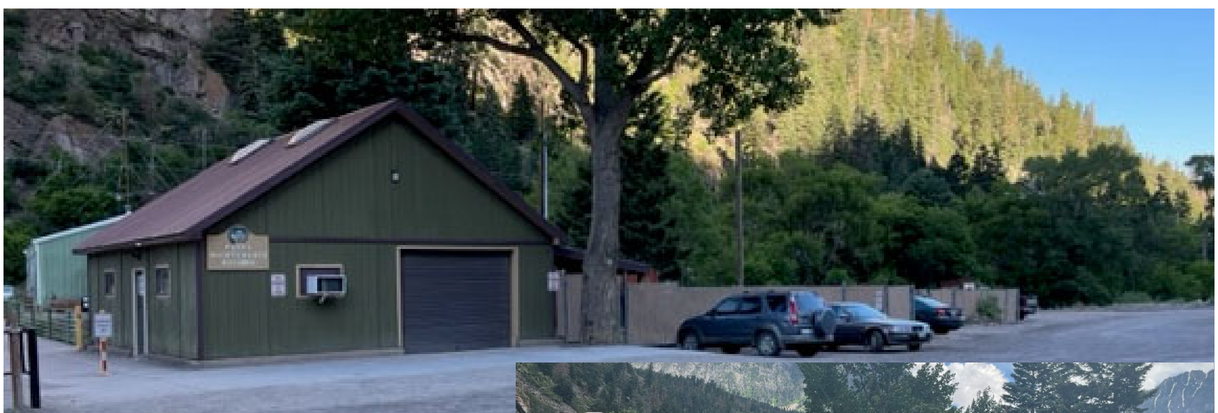
Our team discussed 3 possible locations and discussed the pros and cons of each (See Exhibit F). The 3 locations include the following:

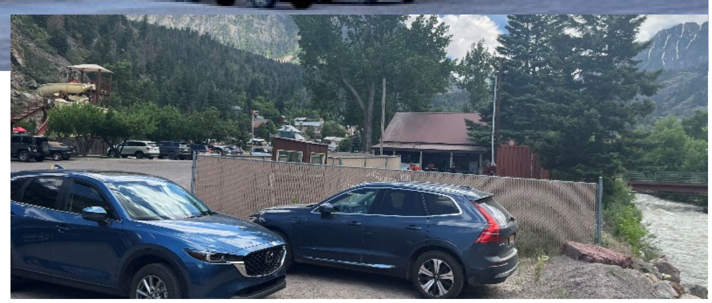


**1. West Side of Property to Replace Existing Storage Area (See Exhibit G)**

The proposed location at the west side of the property would be adjacent to the Uncompahgre River and replace an existing fenced, outdoor storage area. The enclosed storage area is adjacent to a Parks Maintenance and Public Works Building, located adjacent to a pedestrian bridge to the west of the Pool. This location seems to be the most appealing to City staff.

Building out this location will have challenges. There are existing utilities zigzaggin through the parking area between the fenced storage area and the Pool. Among the utilities in this area are communications line, electrical and water The biggest obstacle and constraint will be the existing sewer line that runs from the restroom facility (out of picture frame to the south), in front of the Parks Maintenance building and out into the parking lot to the north. A sewer manhole is located slighlyt north of the discharge vault to the River. The building location will need to be off this line to not create additional costs or changes to the line. The existing discharge vault (within the fenced area of the photo) would remain as well. The new building would need to be located within these two boundaries along with the River.



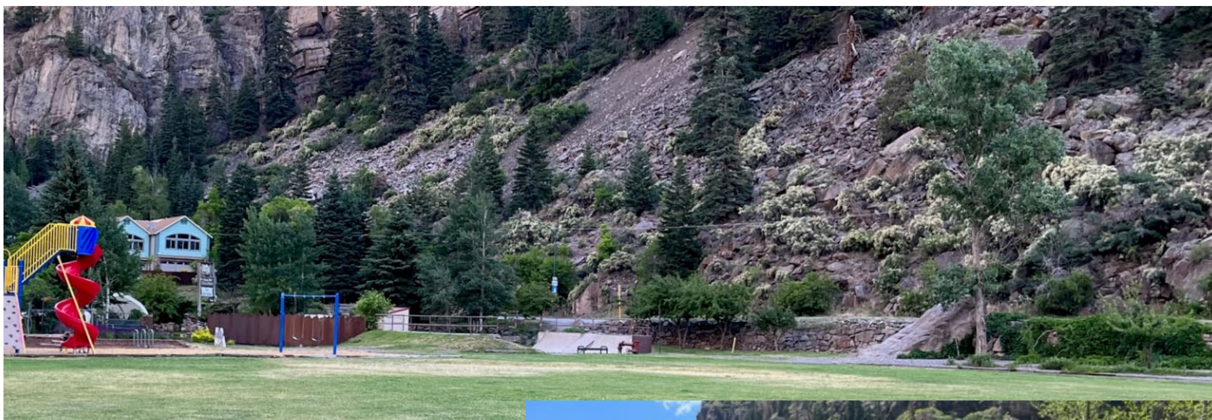


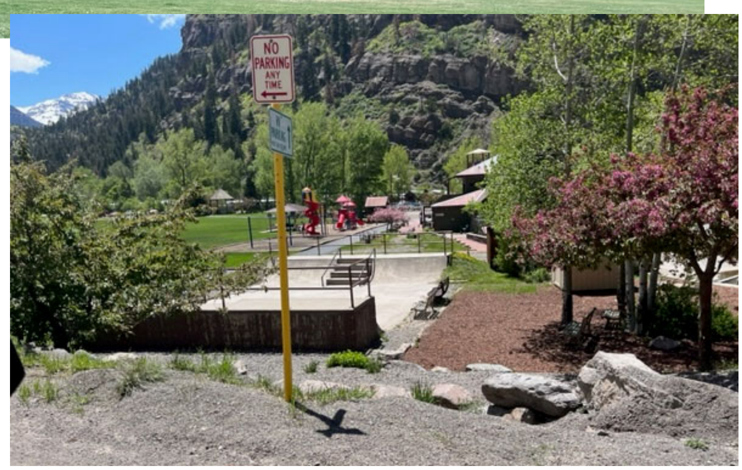
**Advantages:**
- Close to existing discharge vault at Uncompahgre River
- Proximal to mechanical building
- Our of the viewshed of highway 550 and main entry
- Considered back of site
- Could incorporate storage into a building that would be more visually appealing than current storage area
- Could also incorporate new Parks Maintenance and Public Works offices into a single facility that would make use of this park of the site much more efficient.
- Close to power/electrical service

**Disadvantages:**
- Floodplain issues
- Long term master plan goals of connecting with the river may be jeopardized
- Sacred river corridor and viewshed issues
- Farthest from pool mixing vault
- Location is right off the pedestrian path
- Would impact 2 existing large mature trees

**2. East Side of Property adjacent to Highway 550 (See Exhibit H)**
This location seemed to have some support from some City staff knowing that the skate park may be relocated. There could be some savings in locating the facility near the source of water, but ultimately, it would still need to be connected to the existing mechanical building and tie into the discharge vault as well.

Construction costs for this project would need to include demo of whatever concrete and foundation exists below the skate park. Maintaining adequate clearance from the highway should be considered. In reviewing existing drawings and existing conditions, it appears that the area is generally clear of utilities. The hot springs vault and lines from OX2 and OX6 would be the only infrastructure in the vicinity.





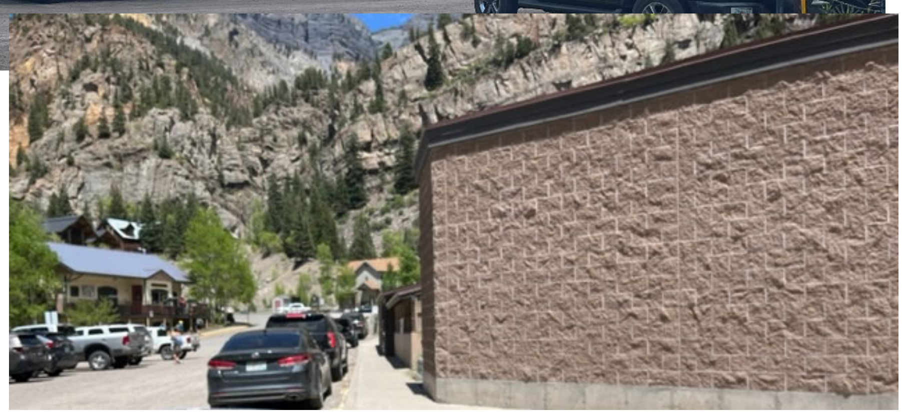

**Advantages:**
- Close to pool mixing vault
- Allows for future development of the river.
- Could potentially buffer the Pool from wind and noise of the highway
- No trees would be lost

**Disadvantages:**
3. Less curb appeal from highway
4. Remote from other mechanical spaces and discharge area
5. Less hidden from view
6. Location is right off a pedestrian path
7. Possible conflict with some existing utilities in this area

**8. Adjacent to Existing Mechanical Building (See Exhibit I)**

Adding a new facility adjacent to the existing building would be a logical fit, but the City will lose parking and will need to make adjustments to drive aisles and parking stalls. Bollards around the building will likely be necessary. Locating the building in the parking area also makes sense from a budget perspective. The existing parking lot is unpaved and has fewer utilities in it than areas within the fenced area of the Pools or near the highway.

Site costs could be minimized at this location since the parking area is unpaved. There are some underground utilities crisscrossing the area of the mechanical building including a line to the discharge vault at the river, sewer connections moving east to west, and an electrical line leaving the existing building headed northwest.

**Advantages:**

- Adjacent to existing pumps, filtration and mechanical buildings ready to enter pools
- Will be aesthetically consistent with existing mechanical buildings and look consistent as large utility building.
- Does not impact trails master plan.
- Does not impact future connection to river or view corridors of river

**Disadvantages:**

9. Impacts parking and will likely reduce 10-20 stalls
10. Would be more visible for guests entering the site

## ARCHITECTURE + ENGINEERING OF NEW STRUCTURES

**Timeline of Construction**
Ouray Hot Springs Pool (OHSP) – 1927
Ouray Hot Springs Pool and Master Plan - 2016

**Existing Occupancy + Construction Type**

| | |
|---|---|
| Existing Building Construction Type – | Type VB |
| Existing Occupancy Classification – | A4 Assembly (Swimming Pools) |
| | S1 Mechanical Building |
| | B Offices and Assembly Rooms with an occupant load of less than 50 |

No change of use anticipated with proposed structures and occupancy.

Existing Mechanical Building
The existing mechanical building is a split face block, fully grouted with standing seam metal roof. Some areas are furred out with 3-5/8" metal studs at 16" o.c. w/ batt insulation. Continuous insulation is also provided. Standard footings and slab on grade is provided. Roof has a 4:12 pitch.
Closed cell spray foam provided at the roof.
Some areas have a sub level area for heat reclamation tank and other infrastructure.
Type VB construction, non-sprinklered.
Constructed under the 2009 IBC, 2009 IEBC and 2009 IECC

Proposed new structures will be evaluated under current IBC for allowable areas and heights on the property. Proposed structures would be of similar style, aesthetic, and construction type of existing mechanical building. The style and construction type of the building will impact costs. The opinion of probably cost is based on this level of design and specifications for the new mechanical building.

Minimal site improvements are anticipated for the proposed options. No parking improvements are anticipated at this time. The new facility would have access per Code and meet floodplain requirements. Costs are based on mechanical building only, not including upgrades or new construction for a Parks Maintenance building.

### Option #5
Electric Boiler
21'-4" X 36'-0" = 768 SF
**Estimated Cost – 768 @ 400/SF** **$307,200**

### Option #6.1
Air Source Heat Pump with Boiler Backup
84'-8" x 40'-0" = 2931 SF
**Estimated Cost – 3,430 @ $400/SF** **$1,372,000**

### Option #7
Water Source Heat Pump with Spring's Rejected Discharge + Ground Source Option or Boiler Option
63'-4" x 21'-4" = 1,351 SF
**Estimated Cost – 1,620 @ $400/SF** **$648,000**

- F-Site Plan – Preferred Site Locations
- G-Site Plan – Option 5 Overlay
- H-Site Plan – Option 6 Overlay
- I-Site Plan – Option 7 Overlay

## OVERALL ESTIMATED COSTS

*PRELIMINARY-ROUGH ORDER OF MAGNITUDE*

**Option #5 - $2,269,952**

**Option #6 - $5,475,809**

**Option #7.1 - $13,312,866**

**Option #7.2 - $4,689,103**

See attached spreadsheet for overall breakdown

**Reference Documents and Information**

Ouray Hot Springs Pool Assessment, Prepared for the City of Ouray – dated July 20, 2022
By ME&E Engineering

Ouray Pool Heat Loss Calculations 2023

Colorado Decision Support Systems CWCB/DWR Log Data - 2023

City of Ouray, Hot Springs Master Plan – dated June 2016
By Wright Water Engineers, Inc.

Ouray Hot Springs Master Plan – Final Draft 2016
By DHM, Anderson Hallas Architects, Cloward H20, DOWL, Russell Planning and Engineering, 360 Engineering, AE Design group

City of Ouray – Ouray Hot Springs – 100% Construction Documents 2016

Drill logs
OX2 Well Permit Document - 1992
OX6 Well Permit Document - 1992
Well Construction + Test Report Information - 2004

Ouray County Assessor and Parcel Information

City of Ouray Work session of Ouray Pools, March 2023

## *ME & E Engineering*
## *Cost Estimate*

Project#: 2202 25-Aug-23
Project: Ouray City Pool
Location: Ouray, CO
Estimator: DS
**Schematic Design Estimate**

| ITEM | | ELECTRIC BOILER **OPTION#5** | ASHP W/ BOILER **OPTION#6** | WSHP W/ BOREFIELD **OPTION#7.1** | WSHP W/ BOILER **OPTION#7.2** |
|---|---|---|---|---|---|
| Architectural | | $307,200 | $1,372,000 | $648,000 | $648,000 |
| Mechanical | | $496,487 | $1,670,254 | $1,400,805 | $1,756,047 |
| Electrical | | $199,904 | $415,042 | $353,293 | $373,653 |
| Controls | | $50,371 | $86,379 | $44,607 | $79,937 |
| TAB contractor | | $3,900 | $9,750 | $3,900 | $6,500 |
| Plumbing | | $33,765 | $9,750 | $43,449 | $43,449 |
| Borefield | | $0 | $0 | $7,600,000 | $0 |
| San Miguel Power Upgrade | | $800,000 | $1,000,000 | $1,000,000 | $1,000,000 |
| Sub-total | | $1,891,627 | $4,563,174 | $11,094,055 | $3,907,586 |
| GC Markup | 10% | $189,163 | $456,317 | $1,109,406 | $390,759 |
| Contingency | 10% | $189,163 | $456,317 | $1,109,406 | $390,759 |
| **Total** | | **$2,269,952** | **$5,475,809** | **$13,312,866** | **$4,689,103** |
| | | | | | |
| Tuesday Annual Energy Use | | $281,573 | $151,542 | $93,858 | $93,858 |
| Tuesday Payback in Years | | 0 | 24.65 | 58.83 | 12.89 |
| | | | | | |
| Annual Energy Use | | $379,734 | $204,372 | $126,578 | $126,578 |
| Simple Payback in Years | | 0 | 18.28 | 43.62 | 12.89 |

# ANNUAL ENERGY COST IF ARTIFICIAL HEAT IS USED ON TUESDAYS

**Electric Boiler**

| Average Air Temp. °F | Pool heat loss kW | COP | | Electrical Rate $/kWh | | Electrical Demand $/kW | | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 1 | $ | 0.070926 | $ | 17.00 | $ | 84.96 | 120 | $10,195 | $25,211 | Jan. |
| 15.4 | 1176.38975 | 1 | $ | 0.070926 | $ | 17.00 | $ | 83.44 | 96 | $8,010 | $25,211 | Feb. |
| 21.6 | 1081.107 | 1 | $ | 0.070926 | $ | 17.00 | $ | 76.68 | 96 | $7,361 | $18,379 | Mar. |
| 26.5 | 1005.84475 | 1 | $ | 0.070926 | $ | 17.00 | $ | 71.34 | 96 | $6,849 | $17,099 | Apr. |
| 36.4 | 853.83725 | 1 | $ | 0.070926 | $ | 17.00 | $ | 60.56 | 120 | $7,267 | $14,515 | May |
| 49.7 | 649.554 | 1 | $ | 0.070926 | $ | 17.00 | $ | 46.07 | 96 | $4,423 | $11,042 | June |
| 54.2 | 580.5945 | 1 | $ | 0.070926 | $ | 17.00 | $ | 41.18 | 96 | $3,953 | $9,870 | July |
| 52.2 | 611.36675 | 1 | $ | 0.070926 | $ | 17.00 | $ | 43.36 | 120 | $5,203 | $10,393 | Aug. |
| 47 | 691.078 | 1 | $ | 0.070926 | $ | 17.00 | $ | 49.02 | 96 | $4,705 | $11,748 | Sept. |
| 35.8 | 863.106 | 1 | $ | 0.070926 | $ | 17.00 | $ | 61.22 | 120 | $7,346 | $14,673 | Oct. |
| 24 | 1044.40275 | 1 | $ | 0.070926 | $ | 17.00 | $ | 74.08 | 96 | $7,111 | $17,755 | Nov. |
| 15.1 | 1180.83875 | 1 | $ | 0.070926 | $ | 17.00 | $ | 83.75 | 96 | $8,040 | $25,211 | Dec. |
| | | | | | | | | | | $80,465 | $201,108 | **$281,573** |
| | | | | | | | | | | | | **Annual Cost** |

**Air Source Heat Pumps**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 1.5 | $0.07 | $17.00 | $56.64 | 120 | $6,797 | $16,807 | Jan. |
| 15.4 | 1176.38975 | 1.5 | $0.07 | $17.00 | $55.62 | 96 | $5,340 | $16,807 | Feb. |
| 21.6 | 1081.107 | 1.5 | $0.07 | $17.00 | $51.12 | 96 | $4,907 | $12,253 | Mar. |
| 26.5 | 1005.84475 | 2 | $0.07 | $17.00 | $35.67 | 96 | $3,424 | $8,550 | Apr. |
| 36.4 | 853.83725 | 2.5 | $0.07 | $17.00 | $24.22 | 120 | $2,907 | $5,806 | May |
| 49.7 | 649.554 | 2.5 | $0.07 | $17.00 | $18.43 | 96 | $1,769 | $4,417 | June |
| 54.2 | 580.5945 | 2.5 | $0.07 | $17.00 | $16.47 | 96 | $1,581 | $3,948 | July |
| 52.2 | 611.36675 | 2.5 | $0.07 | $17.00 | $17.34 | 120 | $2,081 | $4,157 | Aug. |
| 47 | 691.078 | 2.5 | $0.07 | $17.00 | $19.61 | 96 | $1,882 | $4,699 | Sept. |
| 35.8 | 863.106 | 2.5 | $0.07 | $17.00 | $24.49 | 120 | $2,938 | $5,869 | Oct. |
| 24 | 1044.40275 | 2 | $0.07 | $17.00 | $37.04 | 96 | $3,556 | $8,877 | Nov. |
| 15.1 | 1180.83875 | 1.5 | $0.07 | $17.00 | $55.83 | 96 | $5,360 | $16,807 | Dec. |
| | | | | | | | $42,544 | $108,998 | **$151,542** |
| | | | | | | | | | **Annual Cost** |

**Water Source Heat Pumps w/ Closed Loop**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 3 | 0.07 | 17.00 | 28.32 | 120 | $3,398.47 | $8,404 | Jan. |
| 15.4 | 1176.38975 | 3 | 0.07 | 17.00 | 27.81 | 96 | $2,669.97 | $8,404 | Feb. |
| 21.6 | 1081.107 | 3 | 0.07 | 17.00 | 25.56 | 96 | $2,453.72 | $6,126.27 | Mar. |
| 26.5 | 1005.84475 | 3 | 0.07 | 17.00 | 23.78 | 96 | $2,282.90 | $5,699.79 | Apr. |
| 36.4 | 853.83725 | 3 | 0.07 | 17.00 | 20.19 | 120 | $2,422.37 | $4,838.41 | May |
| 49.7 | 649.554 | 3 | 0.07 | 17.00 | 15.36 | 96 | $1,474.25 | $3,680.81 | June |
| 54.2 | 580.5945 | 3 | 0.07 | 17.00 | 13.73 | 96 | $1,317.74 | $3,290.04 | July |
| 52.2 | 611.36675 | 3 | 0.07 | 17.00 | 14.45 | 120 | $1,734.47 | $3,464.41 | Aug. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47 | 691.078 | 3 | 0.07 | 17.00 | 16.34 | 96 | $1,568.49 | $3,916.11 | Sept. |
| 35.8 | 863.106 | 3 | 0.07 | 17.00 | 20.41 | 120 | $2,448.67 | $4,890.93 | Oct. |
| 24 | 1044.40275 | 3 | 0.07 | 17.00 | 24.69 | 96 | $2,370.41 | $5,918.28 | Nov. |
| 15.1 | 1180.83875 | 3 | 0.07 | 17.00 | 27.92 | 96 | $2,680.07 | $8,404 | Dec. |
| | | | | | | | $26,822 | $67,036 | **$93,858** |
| | | | | | | | | | **Annual Cost** |

# ANNUAL ENERGY COST IF ARTIFICIAL HEAT IS THE ONLY HEAT SOURCE

**Electric Boiler**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 1 | $ 0.070926 | $ 17.00 | $ 114.58 | 120 | $13,750 | $34,000 | Jan. |
| 15.4 | 1586.5 | 1 | $ 0.070926 | $ 17.00 | $ 112.52 | 96 | $10,802 | $34,000 | Feb. |
| 21.6 | 1458 | 1 | $ 0.070926 | $ 17.00 | $ 103.41 | 96 | $9,927 | $24,786 | Mar. |
| 26.5 | 1356.5 | 1 | $ 0.070926 | $ 17.00 | $ 96.21 | 96 | $9,236 | $23,061 | Apr. |
| 36.4 | 1151.5 | 1 | $ 0.070926 | $ 17.00 | $ 81.67 | 120 | $9,801 | $19,576 | May |
| 49.7 | 876 | 1 | $ 0.070926 | $ 17.00 | $ 62.13 | 96 | $5,965 | $14,892 | June |
| 54.2 | 783 | 1 | $ 0.070926 | $ 17.00 | $ 55.54 | 96 | $5,331 | $13,311 | July |
| 52.2 | 824.5 | 1 | $ 0.070926 | $ 17.00 | $ 58.48 | 120 | $7,017 | $14,017 | Aug. |
| 47 | 932 | 1 | $ 0.070926 | $ 17.00 | $ 66.10 | 96 | $6,346 | $15,844 | Sept. |
| 35.8 | 1164 | 1 | $ 0.070926 | $ 17.00 | $ 82.56 | 120 | $9,907 | $19,788 | Oct. |
| 24 | 1408.5 | 1 | $ 0.070926 | $ 17.00 | $ 99.90 | 96 | $9,590 | $23,945 | Nov. |
| 15.1 | 1592.5 | 1 | $ 0.070926 | $ 17.00 | $ 112.95 | 96 | $10,843 | $34,000 | Dec. |
| | | | | | | | $108,516 | $271,218 | **$379,734** |
| | | | | | | | | | **Annual Cost** |

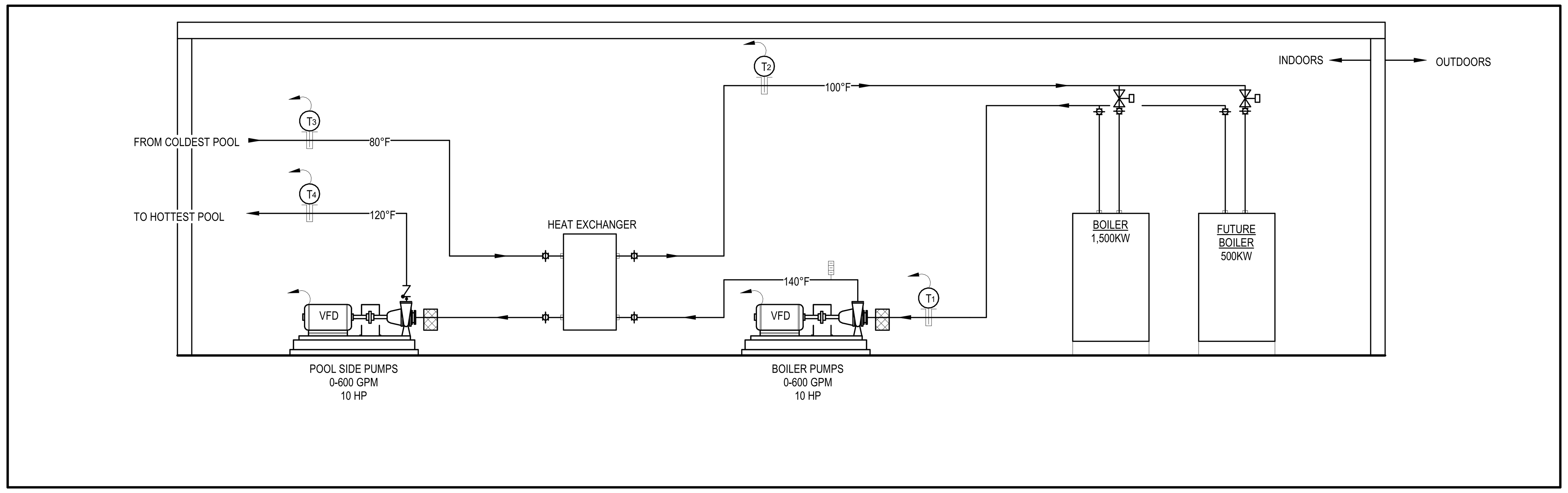
**Air Source Heat Pumps**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 1.5 | $0.07 | $17.00 | $76.39 | 120 | $9,166 | $22,667 | Jan. |
| 15.4 | 1586.5 | 1.5 | $0.07 | $17.00 | $75.02 | 96 | $7,202 | $22,667 | Feb. |
| 21.6 | 1458 | 1.5 | $0.07 | $17.00 | $68.94 | 96 | $6,618 | $16,524 | Mar. |
| 26.5 | 1356.5 | 2 | $0.07 | $17.00 | $48.11 | 96 | $4,618 | $11,530 | Apr. |
| 36.4 | 1151.5 | 2.5 | $0.07 | $17.00 | $32.67 | 120 | $3,920 | $7,830 | May |
| 49.7 | 876 | 2.5 | $0.07 | $17.00 | $24.85 | 96 | $2,386 | $5,957 | June |
| 54.2 | 783 | 2.5 | $0.07 | $17.00 | $22.21 | 96 | $2,133 | $5,324 | July |
| 52.2 | 824.5 | 2.5 | $0.07 | $17.00 | $23.39 | 120 | $2,807 | $5,607 | Aug. |
| 47 | 932 | 2.5 | $0.07 | $17.00 | $26.44 | 96 | $2,538 | $6,338 | Sept. |
| 35.8 | 1164 | 2.5 | $0.07 | $17.00 | $33.02 | 120 | $3,963 | $7,915 | Oct. |
| 24 | 1408.5 | 2 | $0.07 | $17.00 | $49.95 | 96 | $4,795 | $11,972 | Nov. |
| 15.1 | 1592.5 | 1.5 | $0.07 | $17.00 | $75.30 | 96 | $7,229 | $22,667 | Dec. |
| | | | | | | | $57,375 | $146,997 | **$204,372** |
| | | | | | | | | | **Annual Cost** |

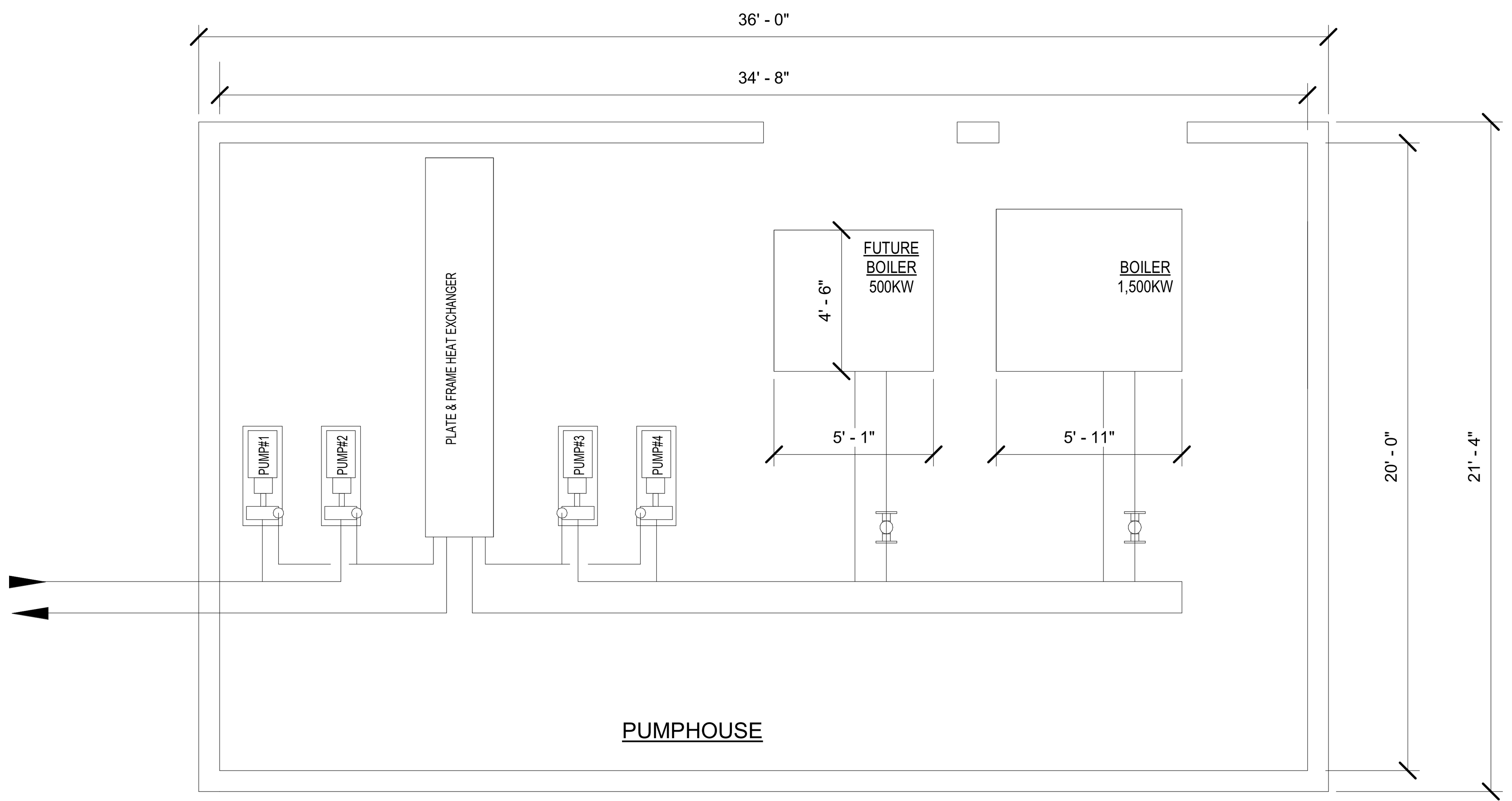
**Water Source Heat Pumps w/ Closed Loop**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 3 | 0.07 | 17.00 | 38.19 | 120 | $4,583.24 | $11,333 | Jan. |
| 15.4 | 1586.5 | 3 | 0.07 | 17.00 | 37.51 | 96 | $3,600.77 | $11,333 | Feb. |
| 21.6 | 1458 | 3 | 0.07 | 17.00 | 34.47 | 96 | $3,309.12 | $8,262.00 | Mar. |
| 26.5 | 1356.5 | 3 | 0.07 | 17.00 | 32.07 | 96 | $3,078.76 | $7,686.83 | Apr. |
| 36.4 | 1151.5 | 3 | 0.07 | 17.00 | 27.22 | 120 | $3,266.85 | $6,525.17 | May |
| 49.7 | 876 | 3 | 0.07 | 17.00 | 20.71 | 96 | $1,988.20 | $4,964.00 | June |
| 54.2 | 783 | 3 | 0.07 | 17.00 | 18.51 | 96 | $1,777.12 | $4,437.00 | July |
| 52.2 | 824.5 | 3 | 0.07 | 17.00 | 19.49 | 120 | $2,339.14 | $4,672.17 | Aug. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47 | 932 | 3 | 0.07 | 17.00 | 22.03 | 96 | $2,115.30 | $5,281.33 | Sept. |
| 35.8 | 1164 | 3 | 0.07 | 17.00 | 27.52 | 120 | $3,302.31 | $6,596.00 | Oct. |
| 24 | 1408.5 | 3 | 0.07 | 17.00 | 33.30 | 96 | $3,196.78 | $7,981.50 | Nov. |
| 15.1 | 1592.5 | 3 | 0.07 | 17.00 | 37.65 | 96 | $3,614.39 | $11,333 | Dec. |
| | | | | | | | $36,172 | $90,406 | **$126,578** |
| | | | | | | | | | **Annual Cost** |




5B OPTION#5 PIPING SCHEMATIC - ELECTRIC BOILER(S)




5A OPTION#5 - ELECTRIC BOILER PLAN

EXHIBIT
A

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+ ASSOCIATES
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ENGINEERING


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PROGRESS SET
NOT FOR CONST.

OURAY HOT SPRINGS

1220 MAIN STREET
OURAY, COLORADO

| | |
|---|---|
| JOB. NO.: | 2202 |
| DATE: | 9/15/2023 |
| DRAWN BY: | DS |

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
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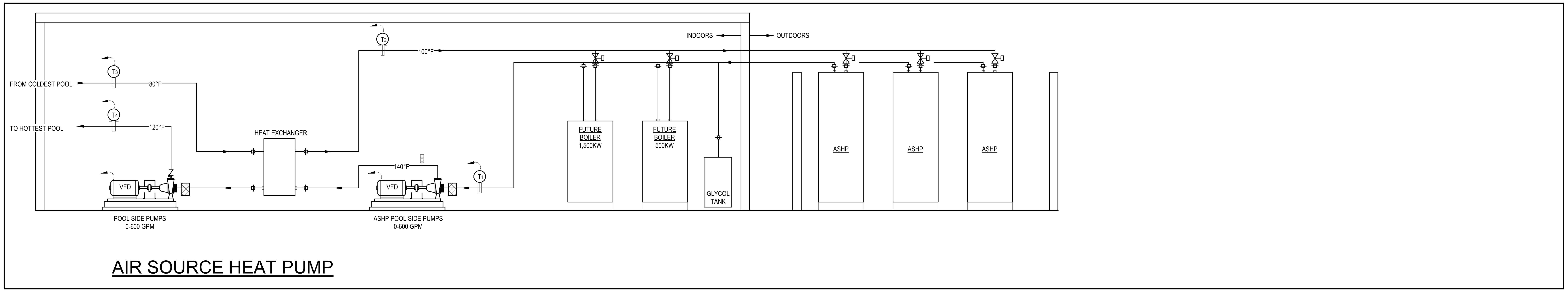
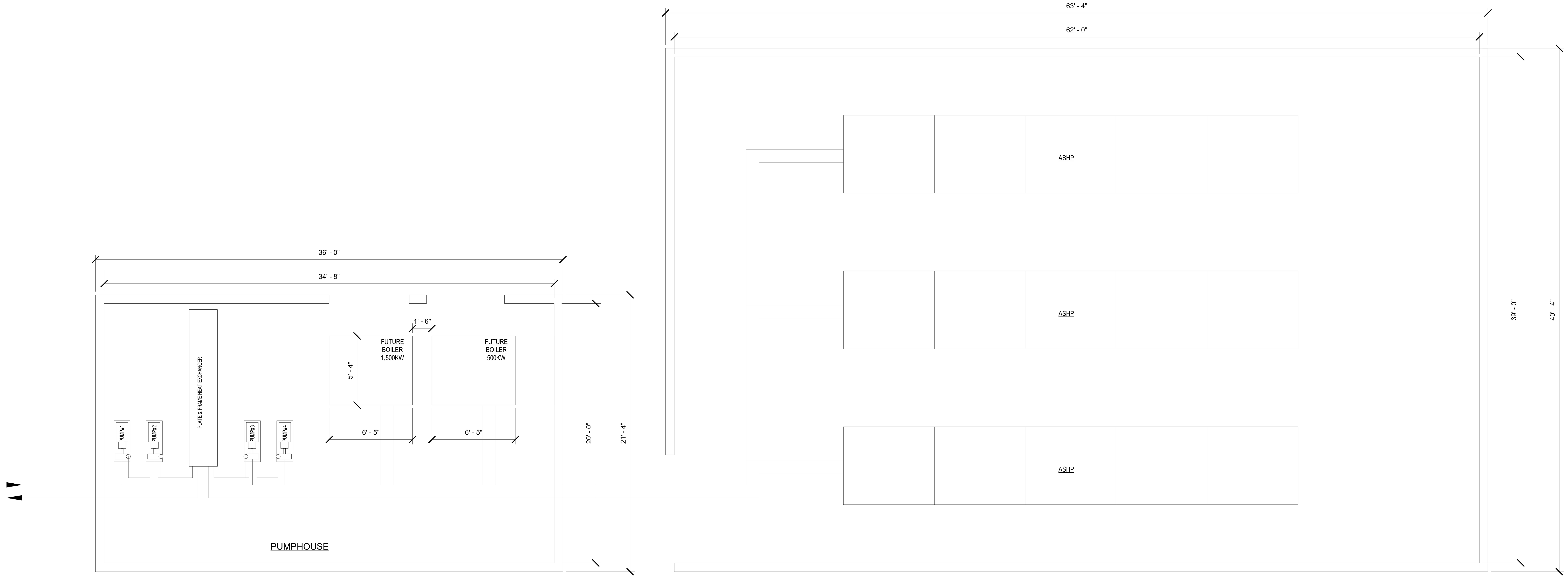
Opt.#5
ELECTRIC BOILER




6B **OPTION#6 PIPING SCHEMATIC - AIR SOURCE HEAT PUMP W/ BOILERS**




6A **OPTION#6 - AIR SOURCE HEAT PUMP W/ BOILERS PLAN**

# EXHIBIT B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PROGRESS SET
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OURAY HOT SPRINGS

1220 MAIN STREET
OURAY, COLORADO

| | |
|---|---|
| JOB. NO.: | 2202 |
| DATE: | 9/15/2023 |
| DRAWN BY: | Author |

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
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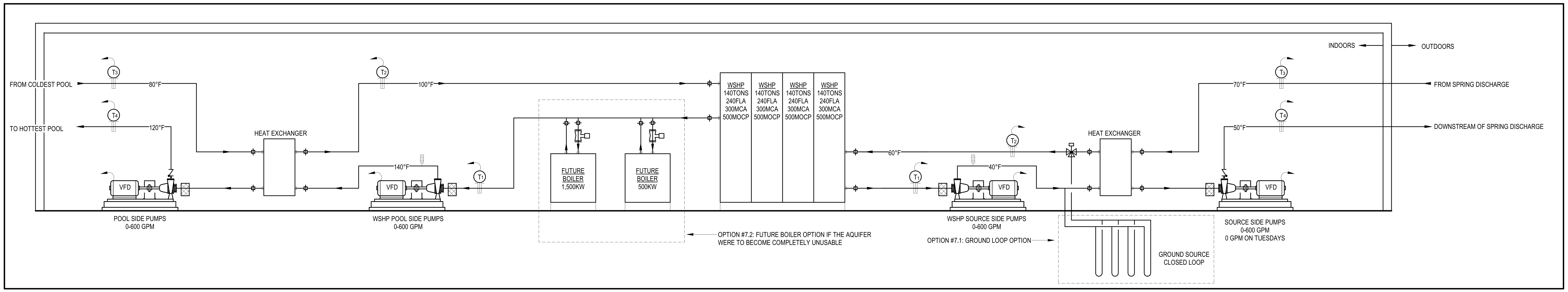
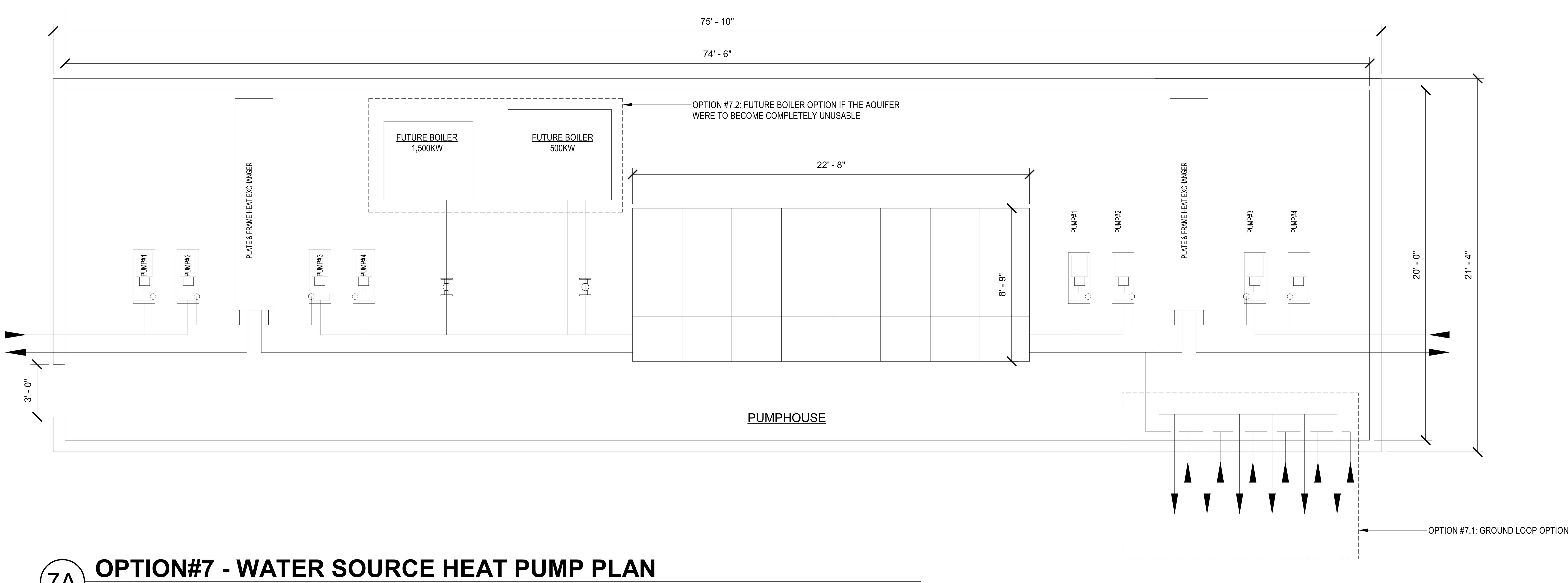
Opt.#6
ASHP W/ BOILERS




7B **OPTION#7 - WATER SOURCE HEAT PUMP W/ CLOSED LOOP PIPING SCHEMATIC**




7A **OPTION#7 - WATER SOURCE HEAT PUMP PLAN**

# EXHIBIT C

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OURAY HOT SPRINGS

1220 MAIN STREET
OURAY, COLORADO

JOB. NO.: 2202
DATE: 9/15/2023
DRAWN BY: DS

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
.

Opt.#7
WSHP


NORTH

# SITE PLAN-SIMULATION V1

SCALE: 1"=200'-0"

| | | | | | | |
|---|---|---|---|---|---|---|
| D<br>SITE PLAN | JOB NO: 23130<br>DATE:<br>DRAWN BY: | OURAY HOT SPRINGS<br>ALTERNATIVE POOL HEAT SOURCE<br><br>1220 Main St.<br>OURAY, COLORADO 81427 | PROGRESS SET<br>NOT FOR CONST. | REYNOLDS ASH + ASSOCIATES, P.C. EXPRESSLY RESERVES THE COMMON LAW COPYRIGHT AND OTHER PROPERTY RIGHTS IN THESE PLANS. THESE PLANS ARE NOT TO BE CHANGED OR COPIED IN ANY FORM OR MANNER WHATSOEVER NOR ARE THEY TO BE ASSIGNED TO ANY THIRD PARTY WITHOUT FIRST OBTAINING WRITTEN PERMISSION AND CONSENT OF THE ARCHITECT OF RECORD.<br>THE USE OF THESE PLANS AND SPECIFICATIONS SHALL BE RESTRICTED TO THE ORIGINAL SITE FOR WHICH THEY WERE PREPARED AND PUBLICATION THEREOF IS EXPRESSLY LIMITED TO SUCH USE. FEDERAL LAW PROHIBITS THE REPRODUCTION, DISPLAY, SALE, OR OTHER DISPOSITION OF THIS DOCUMENT WITHOUT THE EXPRESS WRITTEN CONSENT OF RA+A ARCHITECTS, P.C. | 1140 MAIN AVE., STE. B<br>DURANGO, CO 81301<br>(970) 259 - 7494<br>FAX (970) 259 - 7492<br>262 PAGOSA STREET, STE. 200 / P.O. BOX 96<br>PAGOSA SPRINGS, CO. 81147<br>(970) 264 - 6884<br>FAX (970) 264 - 0997<br>RA-AE.COM | REYNOLDS ASH + ASSOCIATES<br>ARCHITECTURE ENGINEERING |


NORTH

# SITE PLAN-SIMULATION V2

SCALE: 1"=200'-0"

E

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

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ALTERNATIVE POOL HEAT SOURCE

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NORTH

# SITE PLAN-OPTIONS FOR PROPOSED STRUCTURE

SCALE: 1"=200'-0"

F

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

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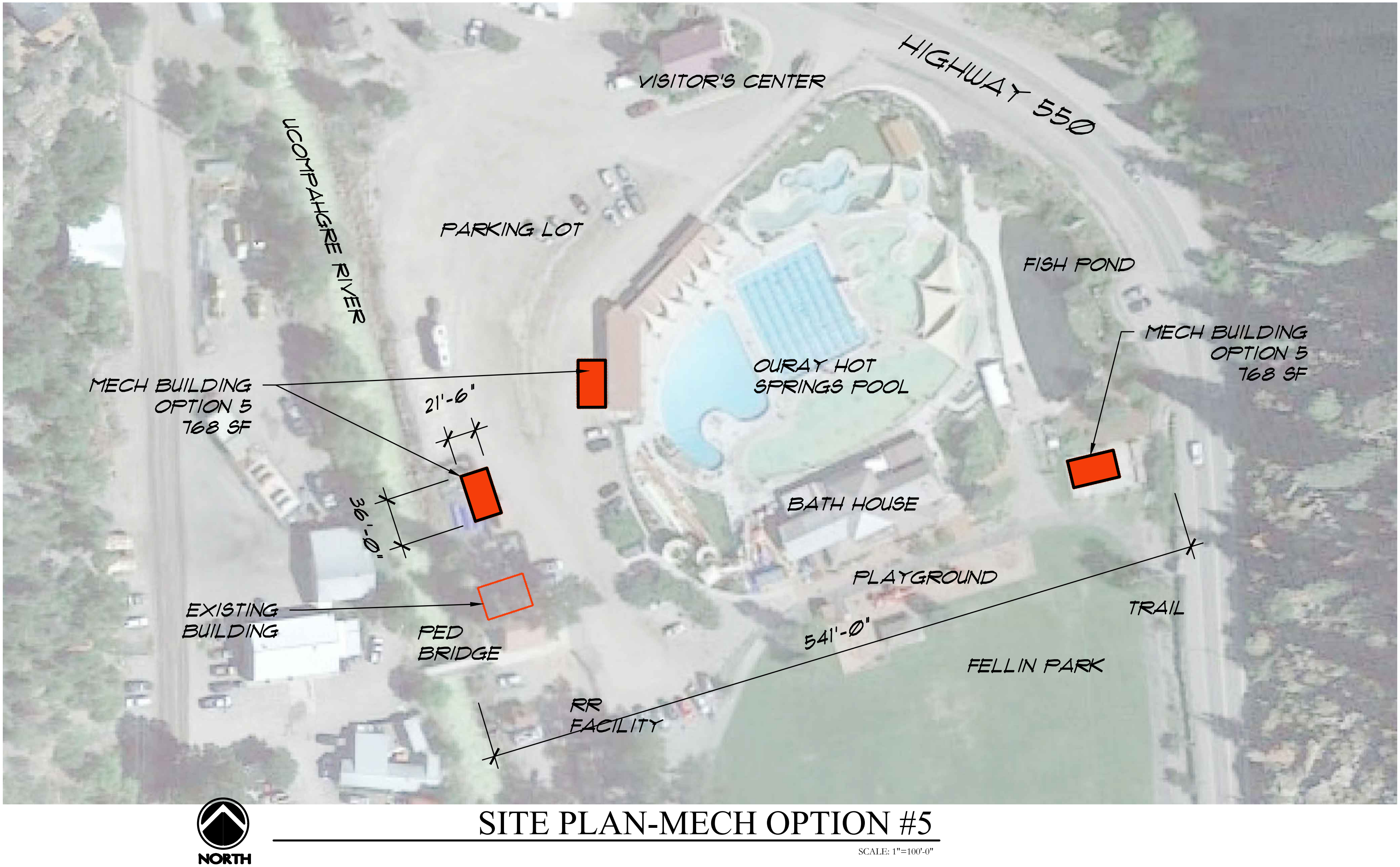


# SITE PLAN-MECH OPTION #5

SCALE: 1"=100'-0"

G

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

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ALTERNATIVE POOL HEAT SOURCE

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# SITE PLAN-MECH OPTION #6

SCALE: 1"=100'-0"

H

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

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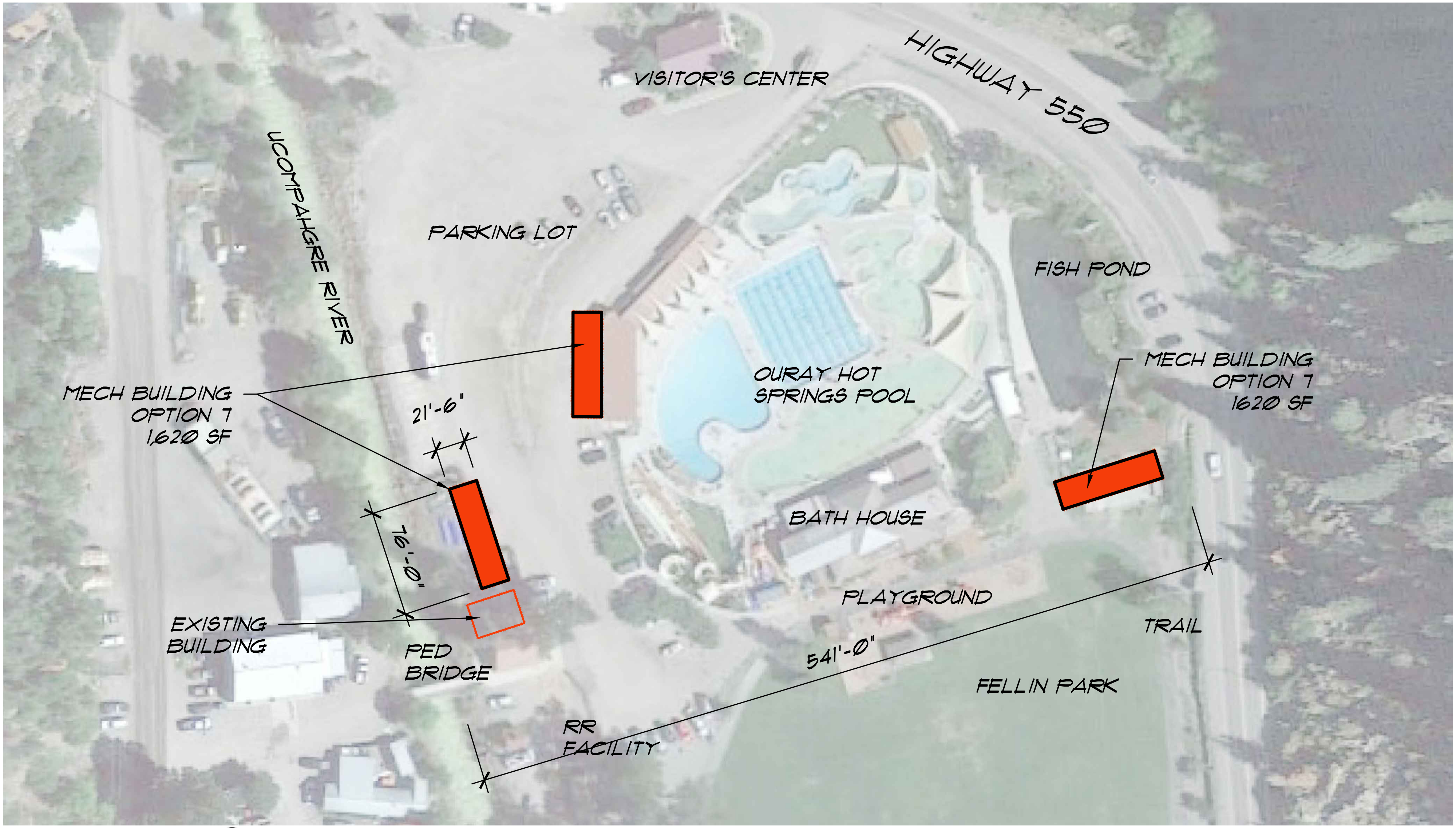


NORTH

# SITE PLAN-MECH OPTION #7

SCALE: 1"=100'-0"

I

SITE PLAN

JOB NO: 23130
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## PROJECT OVERVIEW

The Ouray Hot Springs Pool is one of Ouray's most important tourist attractions and is a vital part of the City's history dating back to the 14th Century when they were first discovered. Located at 1220 Main St., the Pool is bordered by Highway 550 to the east, Fellin Park to the south, the Uncompahgre River to the west, parking lot and Ouray Visitor's Center to the north and helps strengthens the downtown fabric of businesses, parks, trails, restaurants and lodging. Recent struggles with decreased flow rates and legal issues with a neighboring spa have created unexpected challenges for the City in keeping the Pool open to the public 7 days a week and maintaining adequate temperatures year-round. The Pool is a big revenue generator as well and the City does not want the Pool's reputation to be negatively impacted by these recent issues.

The City of Ouray has engaged ME&E Engineering, Major Geothermal and Reynolds Ash + Associates to complete a Pre-Design Study that would provide options for an alternate heat source for the Pool, which would allow the City of Ouray to keep the pools open 7 days a week and maintain ideal temperatures year-round. The Pre-Design Study includes analysis of existing conditions and data, analysis of how various mechanical systems could be integrated to meet the project goals, and finally analysis of new infrastructure and facilities that would be required for each system. A total estimated construction cost is included along with the estimated annual operating cost for each option. The design team's findings will hopefully provide the City of Ouray with a better understanding of the costs, opportunities and constraints of each possible solution.

## EXECUTIVE SUMMARY

Over the course of this project, 7 options have been identified. Of those, the design team and City of Ouray have found 3 options to be the most viable including Option 5, Option 6 and Option 7.1/7.2. Option 7.2 has the most appeal for its ability to be integrated over time with a less expensive cost compared to the other options. Option 7.2 includes a water source heat pump with electric boiler backup. The other options that explore only electric boilers or geothermal borefields are not viable.

Of the 3 sources of hot springs water for the Pools, the OX2 line and the Box Canyon line provide the largest flows and most amount of heat. The Ball Park line is essentially negligible in our calculations. OX2 could be shut down on any given day. However, the City could still augment water from the Box Canyon line every day of the week.

Since the Box Canyon line was recently cleaned, it is performing better and the City anticipates that relying on the Box Canyon line on a daily basis is a safe bet in the short term. The City is doing well for the time being on the Box Canyon line. However, there are still fears that the aquifer will continue to drop and that the Box Canyon line would not be sustainable long term. The design team and City agree that Option 7.2 could be broken up into 3 phases and once fully built out, the Pools could be heated entirely by this supplemental system if necessary.

Phase 1

The water source heat pump, using the spring discharge, should be able to produce some amount of heat and energy on a daily basis and will be the source of supplementary heat in the short term, without any electric boilers. Based on our calculations, it is possible to heat the Pools on Tuesdays with only the water source heat pump and the Box Canyon Line. The water source heat pump piece of Option 7.2 would be the first phase.

Phase 2

As the aquifer changes over time, the first of the electric boilers could be integrated and brought online to then supplement the heat. The single boiler could provide all the heat necessary if Box Canyon decreases significantly and if OX2 is shut off entirely. The first boiler proposed in Option 7.2 could be deferred and be a long term solution.

Phase 3
Finally, the second electric boiler could be integrated and brought online to provide redundancy in the system, providing a backup to the first boiler when needed during periods of maintenance or to fully sustain the desired temps of the Pools.

Implementing this option will require an increase in the amount of electricity brought to the site and a new building to house the new equipment. San Miguel Power Association has provided feedback on costs and potential sites for a new structure have been identified. The design team recommends that the City of Ouray wait until the Ouray Parks Master Plan is completed before a final site location is determined.

## MECHANICAL DESIGN NARRATIVE

*Prepared by ME&E Engineering for Reynolds + Ash.*

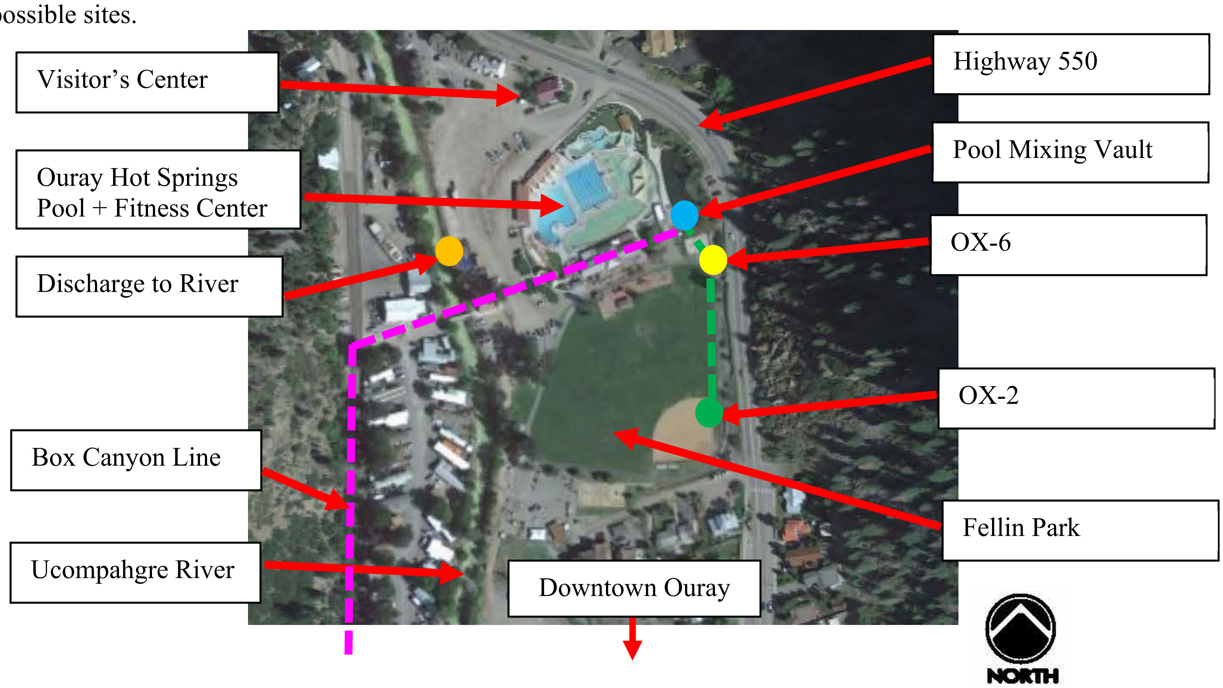
### INTRODUCTION

As reported in a previous report, in late February 2022, Joe Coleman reached out to ME&E Engineering for help finding mechanical options for heating the Ouray Hot Spring Pool. On March 18, 2022, ME&E representatives, Mechanical Engineer and Principal Dustin Sullivan and Technical Writer Nana Naisbitt met with the following city representatives at the Ouray Pool: Public Works Director Joe Coleman, Pool Manager Carmen Brashier, City Manager Silas Clarke, and Filtration Manager Director Joe Cruz. Sullivan and Naisbitt toured the Ouray Hot Spring Pool facility with these city representatives to collect information about current conditions and determine which test results and documents would be needed from the city. All documents requested by ME&E were subsequently provided by the city staff. On June 6, 2022, Sullivan spoke with Trevor Downing and Hayes Lenhart of Wright Water Engineers to better understand existing conditions.

On July 20, 2022, ME&E sent a report to Clarke that outlined four possible mechanical options for heating the pools that included diagrams of the systems and cost estimates. On November 7, 2022, Sullivan and Naisbitt attended a Town Council Meeting in which Sullivan presented the pros and cons of the four options, as well as answered questions. The council voted in favor of proceeding with Option #2, the gas-fired boiler.

However, on March 20, 2023, the City of Ouray held a public work session about the Ouray Pools, with comments from the public. Naisbitt attended the 90-minute meeting for ME&E. City Manager Silas Clarke stated clearly at the top of the meeting that staff wanted direction from City Council. At this meeting, Clarke continued to stress that the Ouray Pool needed “additional heat” and that the pools were “getting a bad rap” for being too cold. He said the work session was about “looking into the options to get artificial heat.” Many locals made public comments, most of which centered around their desire to *not* heat the pools, citing environmental concerns and concerns that the pools would no longer be “natural.” Clarke mentioned that the water table of the hot springs might continue to diminish. His hope was to identify a solution that would continue to provide heat and water for the pools at whatever level the aquifer happened to be – low, high, or diminishing. The City Council seemed to agree with the public that the gas-fired boiler option was no longer in consideration. Council asked for staff to gather more information to create a “global plan” that will serve the city and the needs of the pool for the next 15 to 20 years without natural gas. ME&E was asked to provide additional non-gas-fired options to heat the pools.

On June 30, 2023, Sullivan and Naisbitt met in Ouray with Reynolds Ash + Associates architect Lauren Davis; Ouray Mayor Ethan Funk; and City of Ouray Resource Director, Rick Noll, to review the draft report sent to Clarke on June 29, 2023 by Lauren Davis, including the draft MEP report provided by ME&E. At this meeting, ME&E learned that the Box Canyon line had been jetted and now produces up to 220 GPM (gallons per minute). For purposes of ME&E calculations, Funk and Noll suggested that 180 GPM be used for the flow rate of the Box Canyon line to be on the safe side. Funk asked that ME&E design a system that would act as the supplemental heat source, now that the Box Canyon is flowing well and is entering the pool system at 134°F. He asked that at this time we design a system that could begin as a supplemental heat source, yet can be expanded over time to be the sole source of heat of the pools at the desired temperatures, should the aquifer fail in the future. He also asked that we design a heating plant that is sized to serve as the supplemental heat source of the pools when OX2 is closed on Tuesdays. At those times, the Box Canyon and the Ball Park lines would continue to serve the pools. He asked that we design a heating plant that is sized to serve as the supplemental heat source when Box Canyon is closed for maintenance. At those times, OX2 and the Ball Park lines would continue to serve the pool. It should be noted that due to the low contribution of the Ball Park line, it's failure is of little consequence. Funk also asked that ME&E continue to explore extracting heat, but not the water, from OX2 and into OX6 through a closed loop system. However, the reason this option (Option #1 below) was eliminated in the first round is because this is only a viable option if the aquifer maintains volume, which is uncertain. While Mayor Funk was not enthusiastic about the air-source heat pump (Option #6 below), we feel it is important to include in this report for the record. Funk and Noll also discussed their concern about a ground-source heat pump (Option #7.1 below), as it could pose the danger of collapsing the aquifer and fracturing the sub-strait clay layer in the earth. The group identified that the new building would need to connect to power and to the inflow and outflow of water to the pools. We discussed sizing the building to accommodate all the equipment necessary to heat the pools to the desired temperatures year-round, should the aquifer ultimately fall. With that in mind, we discussed possible locations for the building and walked possible sites.




**ISSUES, AS STATED BY CITY STAFF IN 2022**

- ME&E learned that there are three sources of hot springs water that feed the pools. Collectively they currently provide an average of 210 gallons per minute, according to Joe Cruz and Silas Clarke. The three sources are: 1) Box Canyon Line; 2) OX2 Artesian Well; and 3) The Ball Park Line. The current combined flow rate of 210 gpm is well below the historic flow rate of about 300 gpm, which in the past provided enough flow to heat the pools with no additional mechanical heating.
- During the Step Test conducted by Wright Water Engineers, the natural pressure was measured at 3psi, which is related to flow rate.

- The city must shut down the OX2 line one day per week to be in compliance with an agreement with the Wiesbaden Spa. Currently that closure day is Tuesday. The city and residents would prefer that the pool be open seven days a week.
- Under current natural conditions, ideal temperatures in the pool are difficult to maintain in winter months.
- Historically, the primary source of water for the pools came from the OX2 Artesian Well, however the output of that well has decreased from about 200 gallons per minute to about 110 gallons per minute, and sometimes less. The heat loss of the pools is greater than the heat gain due to the reduced flow, causing uncomfortably cool pool conditions.
- OX6 seems intact according to the Wright Water Engineers and videos. No one is certain what is causing the reduced flow. The well is no longer in service.
- The lap pool is ideally maintained at 80°F. However, under current natural conditions in the winter, the temperature does not get above 76°F, and if the lap pool temperature drops to 72°F, then the pool is closed.
- In the winter months, the shallow pool is shut down with the exception of about a 20% section, which is kept open so children can cool down, even if the temperatures drop to 70°

**City-Determined Ideal Operation**

| Hot Springs | GPM | Inlet Temp. °F | outlet Temp. °F | MBH | KW | Ton |
|---|---|---|---|---|---|---|
| OX2 | 200 | 125 | 80 | 4500 | 1319 | 375 |
| Box Canyon | 70 | 138 | 80 | 2030 | 595 | 169 |
| Ball Park | 20 | 120 | 80 | 400 | 117 | 33 |
| | | | | 6930 | 2031 | 578 |

**GOALS AND PRIORITIES, AS STATED BY CITY STAFF**

- A hot springs flow rate of 300 gallons per minute or more is ideal.
- Get the Overlook Pool up to 106°F, but no cooler than 104°F in the winter months.
- Get the Hot Pool up to 106°F, but no cooler than 100°F in the winter months.
- Get the Shallow Pool up to 98°F, but no cooler than 92°F in the winter months.
- Get the Lap Pool up to 80°-82°F, but no cooler than 78°F in the winter months.
- Open all pools every day all year round at full water levels (except the Activities Pool, which is open seasonally from Memorial Day to Labor Day).
- Heat the pools even on the day of the week when the city shuts off the feed from the OX2 well; in other words, remain open seven days a week.
- Prevent the need to lower water levels in the pools because that causes tiles and plaster to crack.
- Ideally, the OX2 Well would return to its historic output of 200 gallons per minute, however this is unpredictable.

**POSSIBLE SOLUTIONS**

In an effort to be comprehensive, below ME&E lists the four previously eliminated options, plus three new possible mechanical solutions for consideration. Our assumption continues to be that the primary heat source remains the earth's aquifer and flowing natural water for all these systems. However, because of the issues experienced at the Ouray Pools as outlined above, the Ouray staff members have asked ME&E Engineering to suggest mechanical solutions. All the new mechanical systems described below (i.e., Options #5-#7) can supplement or back-up the natural system. All the new mechanical systems described below (i.e., Options #5-#7) are scalable and can be built for maximum capacity over time, as need and budgets allow.

## Options Eliminated Previously by Ouray City Council

### Option #1 Heat Exchanger Only

This option was previously eliminated because it would still require OX2 usage. It should be noted that pumping out of OX2 does not create volume; it only increases pressure. Thus, if the aquifer volume depletes, so will the pumped volume potential. This option would only be useful for OX2's closure on Tuesday and if the aquifer maintains proper volume.

### Option #2 Natural Gas Fired Boiler Plant

This option was eliminated because it uses natural gas.

### Option #3 Heat Exchanger and Back-up Boiler Plant

This option was previously eliminated because it uses natural gas.

### Option #4 Solar Thermal with Back-up Boiler

This option was previously eliminated because it uses natural gas, and solar thermal is ineffective when it is needed the most.

## New Options Proposed by ME&E Engineering

### Option #5 Electric Boiler Plant

One option is adding a new all-electric boiler plant with two boilers to the property to directly heat the pool water. One boiler would be 1,500 kW and a future 800kW. Two boilers are being proposed so that there is redundancy, should one fail. None of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, the boiler could supplement the necessary heat to reach desired levels. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse. (See Exhibit A - Option #5 Diagram for more details.)

**Advantages:**

- The pools can operate at full capacity at any outdoor air temperature.
- Allow the pools to open on Tuesdays.
- Will not disrupt the natural hot springs aquifer.
- Lowest upfront cost.

**Disadvantages:**

- Highest energy costs by a factor of 2-4 times.

### New Option #6 Air Source Heat Pump with Boiler Backup

One option is adding a new all-electric air-source heat-pump plant with an input of 1,500 kW to the property to directly heat the pool water. The boiler option described above would be added to the system to allow heating to occur below 0°F. (see Disadvantages below). None of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, the plant could supplement the necessary heat to reach desired levels if the depletion of the aquifer were to occur. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse.
(See Exhibit B - Option #6 Diagram for more details.)

**Advantages:**

- Will not disrupt the natural hot springs aquifer.
- Lower energy cost than the electric boilers by possibly a factor of 1.5 to 2.3 times.

**Disadvantages:**

- Additional equipment is required, adding to maintenance costs.

### New Option #7.1 Water Source Heat Pump Utilizing the Spring's Rejected Water + a Closed Loop Ground Source

One option is adding a new all-electric water-source heat-pump plant with an input of 2,000 kW to the property to directly heat the pool water. When the heat flow from the natural hot springs is reduced, so is the water source heat pump system's capability. It must be supplemented with a closed-loop borehole system. With the water-source heat pump and closed-loop borehole system in place, none of the natural hot springs water would be necessary to operate the Hot Springs, thus it could remain open on Tuesdays. On the other days of the week, this system could supplement the necessary heat to reach desired levels. All current chlorination and filtration systems would remain. All the equipment would be housed in a new insulated pumphouse. Note that the closed loop system would be a vertical ground loop because a horizontal system is not practical.
(See Exhibit C - Option #7 Diagram for more details.)

**Advantages:**

- Will not disrupt the natural hot springs aquifer.
- Lowest energy cost.

**Disadvantages:**

- Highest upfront construction costs.
- Drilling dangers of collapsing the aquifer and fracturing the sub-strait clay, as per Funk/Noll

### New Option #7.2 Water Source Heat Pump Utilizing the Spring's Rejected Water with Boiler Backup.

This is the same as 7.1 above, but a backup electric boiler as described in option# 5 would be part of the system instead of the borefield. These boilers would be roughed in for future water and power connections.

## METHOD FOR ESTIMATION OF INSTALLATION COSTS

Construction estimates are helpful when making decisions about which system to choose. RS Means cost estimating guides are nationally recognized standards for construction cost estimating. The publisher produces a number of specific estimating guides, including *2023 Mechanical Cost Data, 2023 Electrical Cost Data,* and *2023 Plumbing Cost Data.* Construction costs herein are based on 2023 RS Means cost estimating guides. However, it should be highlighted that we are in an inflationary period, with many uncertainties.

**OPINION OF PROBABLE CONSTRUCTION COSTS TABLE**
**SEE ATTACHED EXHIBIT**

San Miguel Power Association provided cost data to ME&E on 08-24-203. Overall costs have been updated accordingly.

**OPINION OF PROBABLE ENERGY COSTS – TUESDAY'S ONLY**
**SEE ATTACHED EXHIBIT**

**OPINION OF PROBABLE ENERGY COSTS-NO PARTICIPTION FROM ANY HOT SPRINGS**
**SEE ATTACHED EXHIBIT**

**EXHIBITS**

- Opinion of Probably Construction Costs
- Opinion of Probable Energy Costs – Tuesday's Only
- Opinion of Probable Energy Costs – Annual Energy Cost if Artificial Heat is the Only Heat Source
- A-Option #5 Diagram
- B-Option #6 Diagram
- C-Option #7.1 Diagram
- Option #7.2 Diagram

## GEOTHERMAL DESIGN NARRATIVE

*Prepared by Major Geothermal for Reynolds + Ash.*

**Abbreviations – GEOTHERMAL DESIGN NARRATIVE**

| | |
|---|---|
| EWT | Entering Water Temperature |
| GHX | Ground Heat Exchanger |
| GPM | Gallons per Minute |
| HDPE | High Density Polyethylene |
| HX | Heat Exchanger |
| LWT | Leaving Water Temperature |
| TC | Thermal Conductivity |
| TDS | Total Dissolved Solids |
| UT | Undisturbed Temperature |

**Executive Summary**

To supplement hot water makeup for the pools, a ground source heat pump system is being considered. Currently eight WaterFurnace TrueClimate 700 nominal 140 ton water-water heat pumps have been selected by ME&E Engineering to meet the demand loads and load side water temperature objectives. These heat pumps are considered extended range heat pumps, ie, they can operate with lower source EWT ranges below 40°F and still generate load side water temperatures of 100°F and higher depending on conditions. To serve these units, two source side assets are considered, a vertically drilled closed loop ground heat exchanger, and scavenging low grade heat from spring water discharge.

A closed loop ground heat exchanger involves drilling boreholes to a certain depth, installing HDPE u-bend circuits, with the holes being completed with a pliable grout mix installed from total depth to surface. This is required not only by state regulations[1] to protect any aquifers but also to assure competent thermal transfer from the host geology.

The second option would be to access the discharge water from the facility and use this warmer water to service the heat pumps.

There is also the possibility to combine both a closed loop GHX and spring water discharge to service the heat pumps. This is described later in this narrative with the concept graphics provided by ME&E Engineering.

Based upon the unavailability of heating load durations and currently unknown thermal conductivity values, the current estimated closed loop GHX calculations to fully drive the water-water heat pump system without other heating assets are likely excessive for both physical installation and first cost considerations.

The spring water discharge option could potentially carry the entire heating load for the water-water heat pump system but may require additional investigation to verify worst case water flow capacity.

A combination of both a closed loop GHX and spring water discharge might also be considered as previously noted.

Should there be any concerns for the reliability of the spring water discharge volume, a backup boiler system should be considered for final stage backup heating.

[1] Colorado Division of Water Resources

**Heating Demand Load to Service Pool Heating**
The current peak load requirements to service the pool heating needs is 13,001 mbh, or 13,001,000 btuh (ME&E Engineering).

**Closed Loop Ground Heat Exchanger Design**
The objective of a closed loop GHX is to provide source water temperatures to heat pumps that the equipment can reliably function with and deliver the heating capacity necessary to meet the project load requirements.

Design requirements include knowing the peak heating loads, the duration of the loads, efficiency parameters of the heat pumps to be serviced, water flow rates required, and the thermal conductivity and undisturbed temperature of the host geology.

**Spring Water Discharge**
The use of the spring water discharge will be dependent upon the available water volume from the pools. Depending on load requirements the heat pumps could require up to 1300 gpm flow rate on the source side. To maintain this the flow rate from existing hot spring or water well sources would have to match this under peak load conditions.

**Water Quality**
For a closed loop GHX, the water within the system between the ground loops and the heat pumps would not require an intermediate heat exchanger as clean potable water with some antifreeze (food grade propylene glycol, 20% to 25%) could be used and is typical for closed loop systems of this type. On the load side this would also use clean potable water but would require an intermediate HX as the spring water to be heated is expected to be high in TDS components. Where intermediate HX units are necessary they should be redundant to allow for routine cleaning and service of one unit while operating the other.

For the spring water discharge source, this will also require redundant intermediate HX units on the source side of the heat pumps.

**Preliminary Closed Loop GHX Calculations**
Based upon the peak loads, interpreted TC values and other parameters two closed loop GHX simulations were generated.

Simulation *'OurayHtSprgs 2023-06-21 V1'- See Exhibit of Simulation V1*

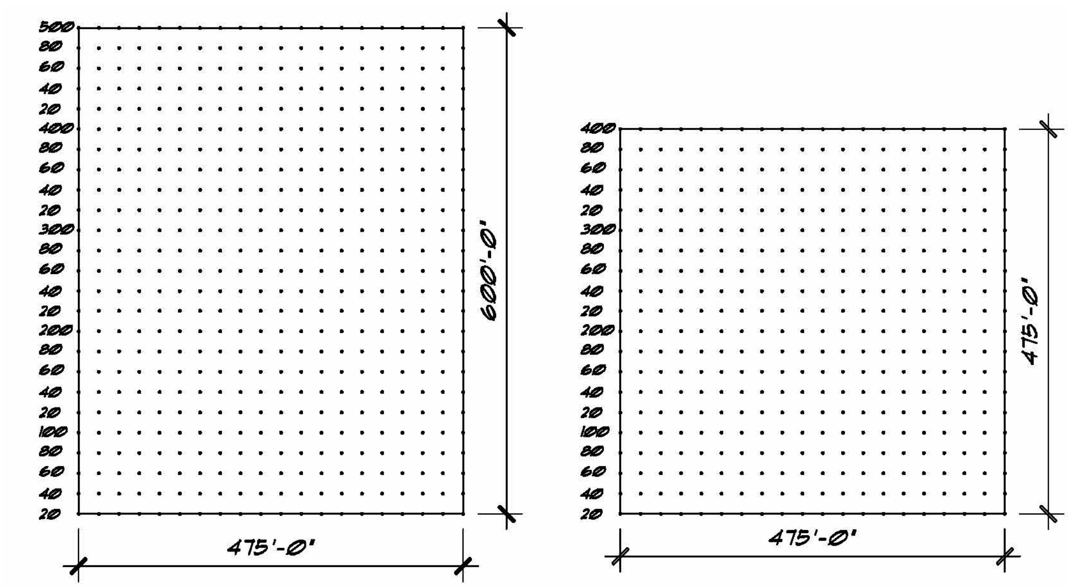
| | |
|---|---|
| Bores | 500 |
| Depth | 550' |
| Spacing | 25' |
| U-bend pipe size | 1.25" DR11 |
| Pipe material | HDPE |
| Est'd TC | 0.95 btuh/ft/°F |
| Est'd UT | 55.0 °F |
| Lowest projected EWT to Heat Pumps | 35.0 °F |

Simulation *'OurayHtSprgs 2023-06-21 V2' See Exhibit of Simulation V2*

| | |
|---|---|
| Bores | 400 |
| Depth | 550' |
| Spacing | 25' |
| U-bend pipe size | 1.25" DR11 |

| | |
|---|---|
| Pipe material | HDPE |
| Est'd TC | 0.95 btuh/ft/°F |
| Est'd UT | 55.0 °F |
| Lowest projected EWT to Heat Pumps | 30.0 °F |

The V1 simulation describes a surface field size of 475' x 600' for a layout of 20 bores x 25 bores x 25' spacing in a conceptual rectangle configuration. The V2 simulation describes a surface field size of 20 bores x 20 bores x 25' spacing, or in a square of 475' x 475'. The smaller field size is determined by lowering the design EWT to the heat pumps from 35°F to 30°F.




The number of bores and depth are based upon the peak loads and TC/UT values interpreted from adjacent well logs (attached), regional experience, required peak flow rates and other variables.

These field ranges are obviously too large for the site to accommodate, but it should also be considered there are still variables to be determined to finalize a GHX design that could serve as a benchmark for servicing the heat pump system without any auxiliary heating capacity.

**Closed Loop GHX Cost**
Cost for a closed loop GHX is expected to be substantial; installed cost inclusive of headering to the mechanical room is estimated to be between $15,000 and $19,000 per borehole.

*'OurayHtSprgs 2023-06-21 V1'*

| | |
|---|---|
| Bores | 500 |
| Cost Range per Borehole, Low | $15,000 |
| Total Low Range | $7,500,000 |
| Cost Range per Borehole, High | $19,000 |
| Total High Range Cost Estimate | $9,500,000 |

*'OurayHtSprgs 2023-06-21 V2'*

| | |
|---|---|
| Bores | 400 |
| Cost Range per Borehole, Low | $15,000 |
| Total Low Range | $6,000,000 |
| Cost Range per Borehole, High | $19,000 |
| Total High Range Cost Estimate | $7,600,000 |

**Closed Loop GHX Design Considerations**
One of the driving factors for the size of the GHX calculations is that the load durations are unknown. Typically for a closed loop GHX hourly loads are calculated for a full year of operation. However, for large outdoor pools, calculating load durations may not be possible.

To put this in perspective, assume a church has a nominal 50 ton (600 kbtuh) heat pump system. Immediately next door, an office building has the exact same nominal 50 ton heat pump system. Both have the same geology and climate. But the office building may require 15x to 20x or more ground loop. The reason being that the office building occupancy and load duration is substantially more then the church, which may only be active for a few hours each week.

The other variables are the unknown thermal conductivity and undisturbed temperature over the average length of the borehole. Typically for commercial and large-scale projects, a GHX is predesigned to establish a field layout and geometry, and adjusted to avoid infrastructure or other conflicts. Once that is completed a test bore location is identified and installed. Then a thermal conductivity test is performed involving a data logger that circulates water through the ground loop for 48 hours with a known amount of heat[2]; the slope of heat input over time is thermal conductivity value, interpreted as how much heat can be exchanged per foot of borehole for every change in °F temperature. Prior to activating heat input, the water in the ground loop is circulated for a given time period to determine the average undisturbed temperature.

The cost to run a TC test, inclusive of drilling and data logging, is estimated to be in the $25,000 to $30,000 range for Ouray location. However, the test bore could later be integrated into the operating field.

There is the potential that if the heating load durations could be accurately calculated and a TC test programmed, the size and scope of the current estimated field parameters could be reduced.

**Closed Loop GHX Maintenance**
As there are no moving parts in the subsurface for a closed loop GHX, there are no maintenance requirements. HDPE piping and fittings are fusion welded so there are no mechanical fittings to degrade or deteriorate. The industry standard warranty for purpose-milled ground loop HDPE pipe is 50 years.

**Spring Water Discharge to Service Heat Pumps**
The design and infrastructure necessary to take advantage of the spring water discharge from the Ouray pools would be substantially less cost than installing a closed loop GHX.

The design and cost of the components and infrastructure to use the spring water discharge has yet to be determined. However a rough estimate of magnitude is described below:

| | |
|---|---|
| Piping | $20,000 |

[2] GHX thermal conductivity testing procedures are determined from ASHRAE RP-1118 and CSA 448 bi-national standards.

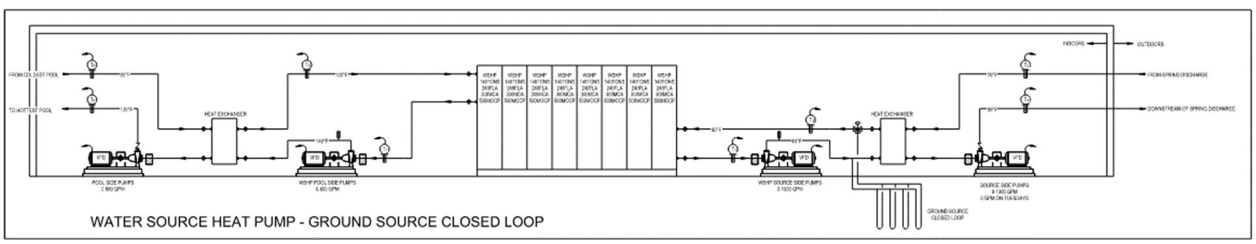
| | |
|---|---|
| Fittings, filters and peripheral components | $10,000 |
| Valving | $10,000 |
| Maintenance infrastructure | $15,000 |
| Labor | $80,000 |
| Total Estimated Costs for Spring Water Discharge | $135,000 |

Please note this estimate for tapping the spring water discharge is very rough and may not account for variables yet to be identified.

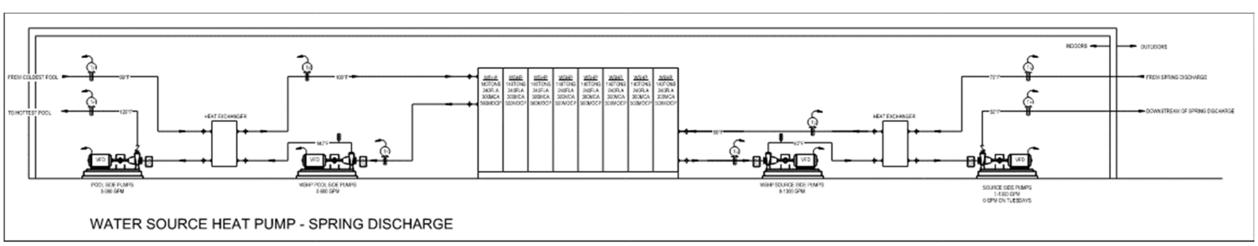
**Options**
Based upon the variables associated with the design and cost of a closed loop GHX, and the ability to access existing spring discharge water, the following options are proposed for consideration to move forward with servicing a water-water heat pump system.

- Install as much closed GHX capacity that budget and space can accommodate, and integrate with spring water discharge. Use the closed loop GHX capacity as first stage heating as this would have the lowest operating cost. As the capacity of the GHX drops, the spring water discharge would cycle in.
- Omit the closed loop GHX and use the spring water discharge asset to drive the heat pumps system entirely.
- Should the spring water discharge be determined not to be able to service the heat pumps under certain extreme conditions, configure the system to rely on backup boiler capacity as a final heating stage.

**PROJECT GRAPHICS**




Concept drawing of using both a closed loop GHX and spring water discharge to service the heat pumps (ME&E Engineering)




Concept drawing of using only the spring water discharge to service the heat pumps (ME&E Engineering).

**EXHIBITS**
- D-Simulation V1 Site Analysis
- E-Simulation V2 Site Analysis

## SITE ANALYSIS + ARCHITECTURAL DESIGN NARRATIVE

*Prepared by Reynolds Ash + Associates.*

Each of the four options provided by ME&E Engineering and Major Geothermal provide supplemental heat for the Ouray Hot Springs Pool and will require an insulated building to house and protect the various equipment associated with each system including, but not limited to, heat exchangers, boilers, ground source heat pumps, air source heat pumps, and borefield. Locating a new facility on this particular site proves to be very challenging.

RA+A studied the site to help identify the optimal locations for a new structure. RA+A reviewed previous construction drawings for the 2016 renovation, reviewed previous master plans to better understand how the current site was developed and made three site visits to Ouray between May and July of 2023. One site visit took place on June 30, 2023, when Lauren Davis with RA+A met with Mayor Ethan Funk, City of Ouray Resource Director, Rick Noll and ME&E to further review possible site locations. Ultimately, the City of Ouray is currently finalizing the Parks Master Plan. It will be that the location of the new mechanical building be integrated with the Master Plan.

It is also important to note that many aspects of this new building will have impacts to the site. Bringing power to the site will require trenching and potentially some closures to the parking lot may be necessary. Connections to the discharge vault and connections of utility lines to the new building will all take time and require careful sequencing by the General Contractor. If additional projects in this area are planned, there could be opportunities to coordinate work with those projects so that the disruptions to the site are minimized. Instead of having to shut down portions of the parking lot or site on multiple occasions, the City should consider trying to develop multiple projects at the same time such as a new Bathhouse or other Park improvements.

**<u>Site Utilization</u>**

| | |
|---|---|
| Site Area: | 240,000 SF (5.35 acres). |
| Existing Pool + Fish Pond: | 0 .75 surface area acres (32,670 sf). |
| City's Water Rights (per 2016 report): | 0.76 surface area acres (33,106 sf). |
| Existing Pools and outdoor decks: | 32,670 SF |
| Bath House: | 10,000 SF |
| Mechanical Room (upper level): | 2,260 SF |

The 5.35 acre site is maximized in nearly every direction. There are also some incredibly meaningful adjacencies that should be considered in further developing the site. The existing pools/fish pond and support structures make up nearly 80,000 SF of the site. The remaining surface area includes the skate park, children's playground, site storage area and parking lot. Additionally, the infrastructure running below grade for the geothermal systems is significant and includes the snow melt system, which runs below most pedestrian walkways within the Pool. The other infrastructure for standard City utilities such as sewer, power and domestic water, further complicates development on the site. Avoiding utilities, minimizing the impact to the existing parking area and allowing for the build out of the Parks, Recreation and Trail Master Plan will be priorities.

<u>Parking</u>
RA+A has observed that on most weekends during the peak season, the parking lot is full. The Ouray Hot Springs Pool, the Visitor's Center, public restrooms and Fellin Park draw large numbers of people to the site on a daily basis during the peak season and regular basis during the off season. Overflow parking moves to the shoulder of Highway 550 or other adjacent sites, which is not ideal.

The existing parking lot is unpaved and unstriped with gravel only. Cones are used to help maintain turning aisles. The City would like to try and preserve the existing parking capacity if possible. If there is a way to add a structure and rework a similar layout without losing stalls, it would be ideal.

Future Master Plan Buildout
In previous studies of the Parks and Pool, there is a desire to engage more with the River and better connect all of the trails and parks in Ouray. Currently, there is a paved trail that runs along the east side of the Ouray Hot Springs Pool and fish pond. However, there are plans to also connect a path along the west side of the site and have more interconnectivity for pedestrians and bicyclists in the community. Development along the trail and river corridor may be somewhat sacred. Adding a mechanical facility in one of these corridors could have undesirable consequences if not integrated properly. As previously noted, any new building should be in agreement with the approved Parks Master Plan that is currently being developed by the City.

Skate Park
Based on conversations with the City, the skate park may be relocated in the near future, which would allow for this part of the site to be developed.

Children's Playground
Based on conversations with the City, the existing children's playground, which is due south of the Bath House building, may be expanded in the near future.

Restroom Facilities
The current restroom building is getting rebuilt in its current location. The sewer line runs north and south to the restroom facility. The City of Ouray does not want any future building to be located over this sewer line.

Borefield Limitations
As per Major Geothermal's summary, not only is the upfront cost of a large borefield cost prohibitive, but finding the necessary space on this site may not be possible. The number of borings needed is extremely high.

Existing site is 5.35 Acres (approximately 240,000 SF)

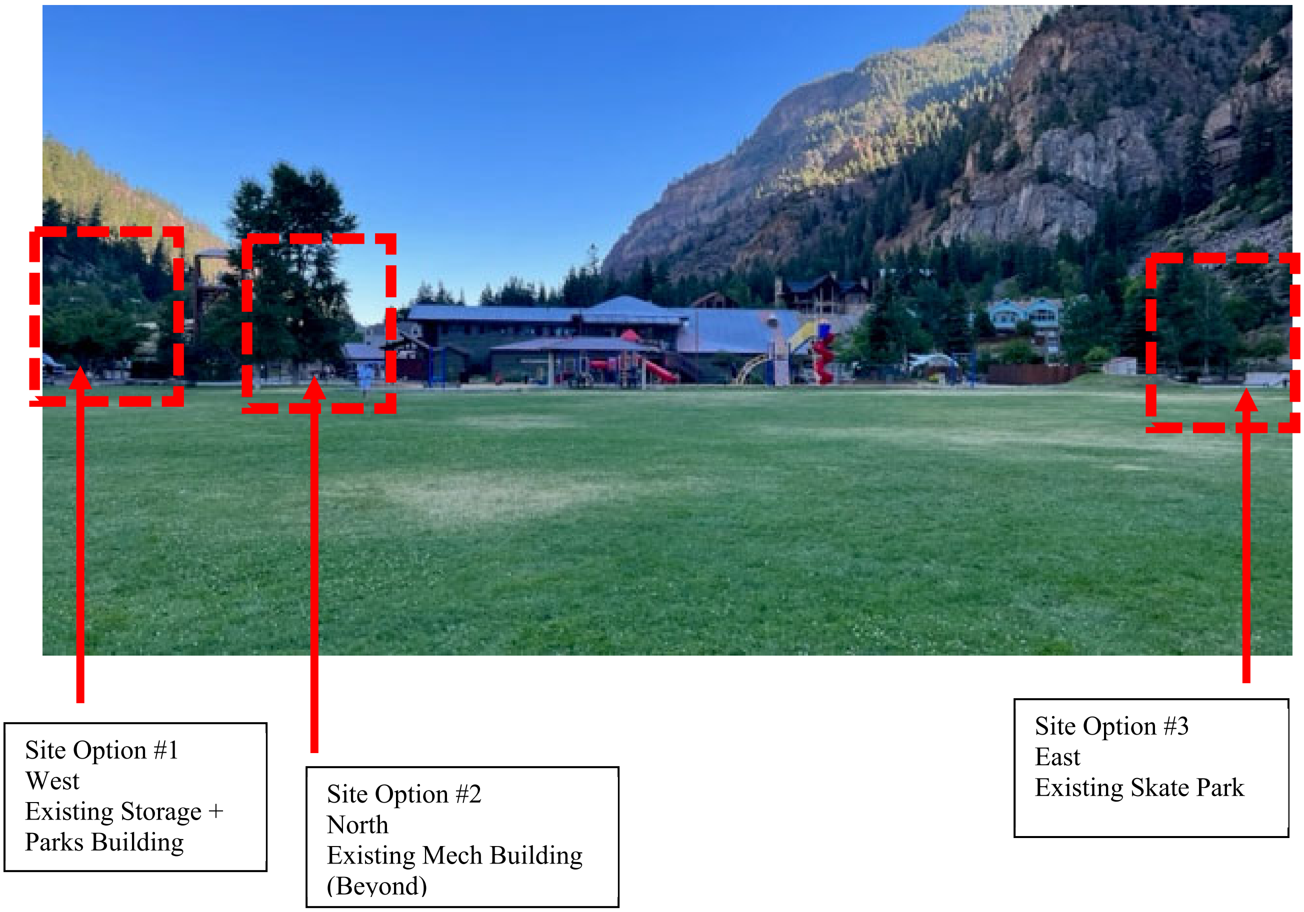
As currently proposed, Major Geothermal's simulations propose the following for bore fields:
Simulation V1 = 500 Bores - 475' x 600' = 285,000 SF (6.5 Acres Needed)
Simulation V2 = 400 Bores - 475' x 475' = 225,625 SF (5.1 Acres Needed)
See Exhibits D + E for size of borefield overlaid on site.

Neither of these options would be possible without utilizing adjacent properties.

The City and County own adjacent parcels and it is unclear if these areas could be additional areas for bore fields if needed. The baseball field to the south is approximately 0.6 Acres

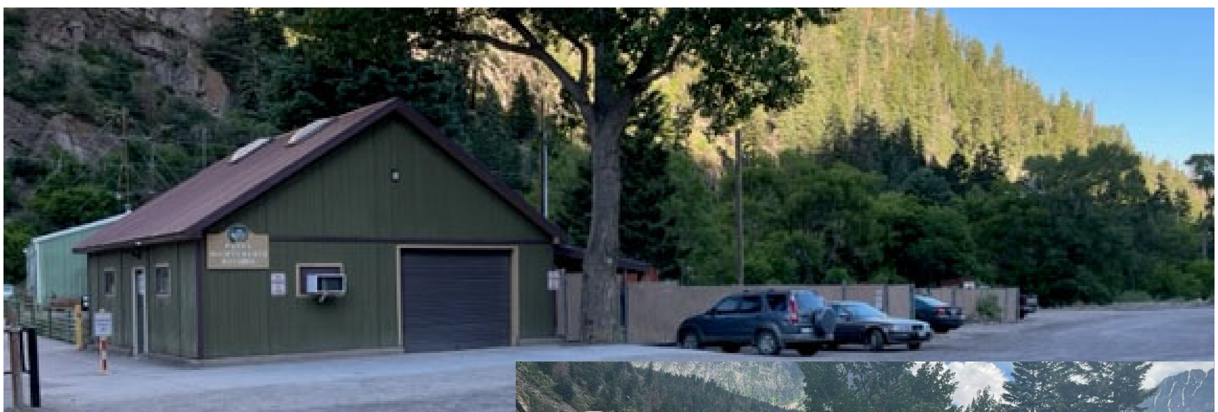
It should be noted that the area within the boundary of the Pool itself and the footprints of existing structures, would not make these viable options and therefore would further reduce the amount of available area for the vertical borings. Snow melt is provided around the entire pool deck area with 2 snow melt zones and nearly the entire site within the fence of the pool is covered with utility lines running underground, which means this area would not be available for the ground source borefield.

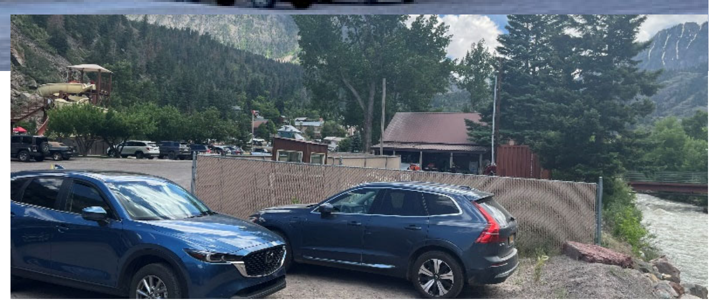
Our team discussed 3 possible locations and discussed the pros and cons of each (See Exhibit F). The 3 locations include the following:



**1. West Side of Property to Replace Existing Storage Area (See Exhibit G)**
The proposed location at the west side of the property would be adjacent to the Uncompahgre River and replace an existing fenced, outdoor storage area. The enclosed storage area is adjacent to a Parks Maintenance and Public Works Building, located adjacent to a pedestrian bridge to the west of the Pool. This location seems to be the most appealing to City staff.

Building out this location will have challenges. There are existing utilities zigzaggin through the parking area between the fenced storage area and the Pool. Among the utilities in this area are communications line, electrical and water The biggest obstacle and constraint will be the existing sewer line that runs from the restroom facility (out of picture frame to the south), in front of the Parks Maintenance building and out into the parking lot to the north. A sewer manhole is located slighlyt north of the discharge vault to the River. The building location will need to be off this line to not create additional costs or changes to the line. The existing discharge vault (within the fenced area of the photo) would remain as well. The new building would need to be located within these two boundaries along with the River.



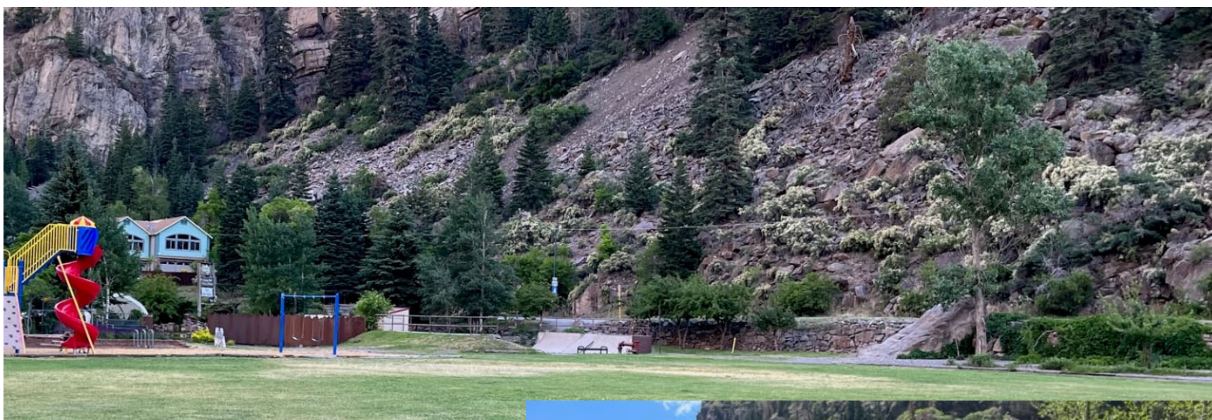


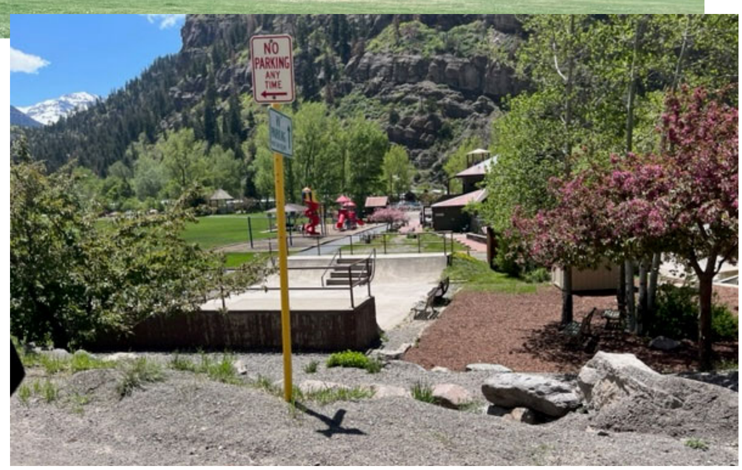
**Advantages:**
- Close to existing discharge vault at Uncompahgre River
- Proximal to mechanical building
- Our of the viewshed of highway 550 and main entry
- Considered back of site
- Could incorporate storage into a building that would be more visually appealing than current storage area
- Could also incorporate new Parks Maintenance and Public Works offices into a single facility that would make use of this park of the site much more efficient.
- Close to power/electrical service

**Disadvantages:**
- Floodplain issues
- Long term master plan goals of connecting with the river may be jeopardized
- Sacred river corridor and viewshed issues
- Farthest from pool mixing vault
- Location is right off the pedestrian path
- Would impact 2 existing large mature trees

**2. East Side of Property adjacent to Highway 550 (See Exhibit H)**
This location seemed to have some support from some City staff knowing that the skate park may be relocated. There could be some savings in locating the facility near the source of water, but ultimately, it would still need to be connected to the existing mechanical building and tie into the discharge vault as well.

Construction costs for this project would need to include demo of whatever concrete and foundation exists below the skate park. Maintaining adequate clearance from the highway should be considered. In reviewing existing drawings and existing conditions, it appears that the area is generally clear of utilities. The hot springs vault and lines from OX2 and OX6 would be the only infrastructure in the vicinity.






**Advantages:**

- Close to pool mixing vault
- Allows for future development of the river.
- Could potentially buffer the Pool from wind and noise of the highway
- No trees would be lost

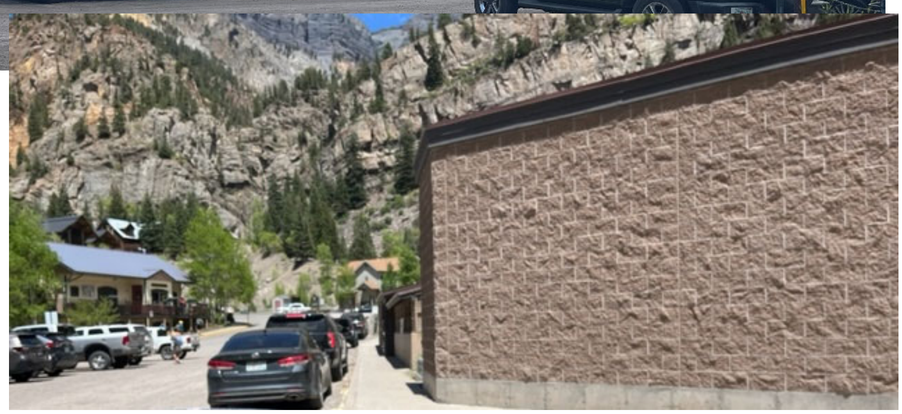
**Disadvantages:**

3. Less curb appeal from highway
4. Remote from other mechanical spaces and discharge area
5. Less hidden from view
6. Location is right off a pedestrian path
7. Possible conflict with some existing utilities in this area

**8. Adjacent to Existing Mechanical Building (See Exhibit I)**

Adding a new facility adjacent to the existing building would be a logical fit, but the City will lose parking and will need to make adjustments to drive aisles and parking stalls. Bollards around the building will likely be necessary. Locating the building in the parking area also makes sense from a budget perspective. The existing parking lot is unpaved and has fewer utilities in it than areas within the fenced area of the Pools or near the highway.

Site costs could be minimized at this location since the parking area is unpaved. There are some underground utilities crisscrossing the area of the mechanical building including a line to the discharge vault at the river, sewer connections moving east to west, and an electrical line leaving the existing building headed northwest.

**Advantages:**

- Adjacent to existing pumps, filtration and mechanical buildings ready to enter pools
- Will be aesthetically consistent with existing mechanical buildings and look consistent as large utility building.
- Does not impact trails master plan.
- Does not impact future connection to river or view corridors of river

**Disadvantages:**

9. Impacts parking and will likely reduce 10-20 stalls
10. Would be more visible for guests entering the site

## ARCHITECTURE + ENGINEERING OF NEW STRUCTURES

**Timeline of Construction**
Ouray Hot Springs Pool (OHSP) – 1927
Ouray Hot Springs Pool and Master Plan - 2016

**Existing Occupancy + Construction Type**

| | |
|---|---|
| Existing Building Construction Type – | Type VB |
| Existing Occupancy Classification – | A4 Assembly (Swimming Pools) |
| | S1 Mechanical Building |
| | B Offices and Assembly Rooms with an occupant load of less than 50 |

No change of use anticipated with proposed structures and occupancy.

Existing Mechanical Building
The existing mechanical building is a split face block, fully grouted with standing seam metal roof. Some areas are furred out with 3-5/8" metal studs at 16" o.c. w/ batt insulation. Continuous insulation is also provided. Standard footings and slab on grade is provided. Roof has a 4:12 pitch.
Closed cell spray foam provided at the roof.
Some areas have a sub level area for heat reclamation tank and other infrastructure.
Type VB construction, non-sprinklered.
Constructed under the 2009 IBC, 2009 IEBC and 2009 IECC

Proposed new structures will be evaluated under current IBC for allowable areas and heights on the property. Proposed structures would be of similar style, aesthetic, and construction type of existing mechanical building. The style and construction type of the building will impact costs. The opinion of probably cost is based on this level of design and specifications for the new mechanical building.

Minimal site improvements are anticipated for the proposed options. No parking improvements are anticipated at this time. The new facility would have access per Code and meet floodplain requirements. Costs are based on mechanical building only, not including upgrades or new construction for a Parks Maintenance building.

### Option #5
Electric Boiler
21'-4" X 36'-0" = 768 SF
**Estimated Cost – 768 @ 400/SF** **$307,200**

### Option #6.1
Air Source Heat Pump with Boiler Backup
84'-8" x 40'-0" = 2931 SF
**Estimated Cost – 3,430 @ $400/SF** **$1,372,000**

### Option #7
Water Source Heat Pump with Spring's Rejected Discharge + Ground Source Option or Boiler Option
63'-4" x 21'-4" = 1,351 SF
**Estimated Cost – 1,620 @ $400/SF** **$648,000**

- F-Site Plan – Preferred Site Locations
- G-Site Plan – Option 5 Overlay
- H-Site Plan – Option 6 Overlay
- I-Site Plan – Option 7 Overlay

## OVERALL ESTIMATED COSTS

*PRELIMINARY-ROUGH ORDER OF MAGNITUDE*

**Option #5 - $2,269,952**

**Option #6 - $5,475,809**

**Option #7.1 - $13,312,866**

**Option #7.2 - $4,689,103**

See attached spreadsheet for overall breakdown
Note! The design team recommends the City of Ouray have additional Owner contingency on top of the estimated costs.

**Reference Documents and Information**

Ouray Hot Springs Pool Assessment, Prepared for the City of Ouray – dated July 20, 2022
By ME&E Engineering

Ouray Pool Heat Loss Calculations 2023

Colorado Decision Support Systems CWCB/DWR Log Data - 2023

City of Ouray, Hot Springs Master Plan – dated June 2016
By Wright Water Engineers, Inc.

Ouray Hot Springs Master Plan – Final Draft 2016
By DHM, Anderson Hallas Architects, Cloward H20, DOWL, Russell Planning and Engineering, 360 Engineering, AE Design group

City of Ouray – Ouray Hot Springs – 100% Construction Documents 2016

Drill logs
OX2 Well Permit Document - 1992
OX6 Well Permit Document - 1992
Well Construction + Test Report Information - 2004

Ouray County Assessor and Parcel Information

City of Ouray Work session of Ouray Pools, March 2023

## *ME & E Engineering*
## *Cost Estimate*

Project#: 2202 — 25-Aug-23

Project: Ouray City Pool

Location: Ouray, CO

Estimator: DS

**Schematic Design Estimate**

| ITEM | | ELECTRIC BOILER **OPTION#5** | ASHP W/ BOILER **OPTION#6** | WSHP W/ BOREFIELD **OPTION#7.1** | WSHP W/ BOILER **OPTION#7.2** |
|---|---|---|---|---|---|
| Architectural | | $307,200 | $1,372,000 | $648,000 | $648,000 |
| Mechanical | | $496,487 | $1,670,254 | $1,400,805 | $1,756,047 |
| Electrical | | $199,904 | $415,042 | $353,293 | $373,653 |
| Controls | | $50,371 | $86,379 | $44,607 | $79,937 |
| TAB contractor | | $3,900 | $9,750 | $3,900 | $6,500 |
| Plumbing | | $33,765 | $9,750 | $43,449 | $43,449 |
| Borefield | | $0 | $0 | $7,600,000 | $0 |
| San Miguel Power Upgrade | | $800,000 | $1,000,000 | $1,000,000 | $1,000,000 |
| Sub-total | | $1,891,627 | $4,563,174 | $11,094,055 | $3,907,586 |
| GC Markup | 10% | $189,163 | $456,317 | $1,109,406 | $390,759 |
| Contingency | 10% | $189,163 | $456,317 | $1,109,406 | $390,759 |
| **Total** | | **$2,269,952** | **$5,475,809** | **$13,312,866** | **$4,689,103** |
| | | | | | |
| Tuesday Annual Energy Use | | $281,573 | $151,542 | $93,858 | $93,858 |
| Tuesday Payback in Years | | 0 | 24.65 | 58.83 | 12.89 |
| | | | | | |
| Annual Energy Use | | $379,734 | $204,372 | $126,578 | $126,578 |
| Simple Payback in Years | | 0 | 18.28 | 43.62 | 12.89 |

# ANNUAL ENERGY COST IF ARTIFICIAL HEAT IS USED ON TUESDAYS

**Electric Boiler**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 1 | $ 0.070926 | $ 17.00 | $ 84.96 | 120 | $10,195 | $25,211 | Jan. |
| 15.4 | 1176.38975 | 1 | $ 0.070926 | $ 17.00 | $ 83.44 | 96 | $8,010 | $25,211 | Feb. |
| 21.6 | 1081.107 | 1 | $ 0.070926 | $ 17.00 | $ 76.68 | 96 | $7,361 | $18,379 | Mar. |
| 26.5 | 1005.84475 | 1 | $ 0.070926 | $ 17.00 | $ 71.34 | 96 | $6,849 | $17,099 | Apr. |
| 36.4 | 853.83725 | 1 | $ 0.070926 | $ 17.00 | $ 60.56 | 120 | $7,267 | $14,515 | May |
| 49.7 | 649.554 | 1 | $ 0.070926 | $ 17.00 | $ 46.07 | 96 | $4,423 | $11,042 | June |
| 54.2 | 580.5945 | 1 | $ 0.070926 | $ 17.00 | $ 41.18 | 96 | $3,953 | $9,870 | July |
| 52.2 | 611.36675 | 1 | $ 0.070926 | $ 17.00 | $ 43.36 | 120 | $5,203 | $10,393 | Aug. |
| 47 | 691.078 | 1 | $ 0.070926 | $ 17.00 | $ 49.02 | 96 | $4,705 | $11,748 | Sept. |
| 35.8 | 863.106 | 1 | $ 0.070926 | $ 17.00 | $ 61.22 | 120 | $7,346 | $14,673 | Oct. |
| 24 | 1044.40275 | 1 | $ 0.070926 | $ 17.00 | $ 74.08 | 96 | $7,111 | $17,755 | Nov. |
| 15.1 | 1180.83875 | 1 | $ 0.070926 | $ 17.00 | $ 83.75 | 96 | $8,040 | $25,211 | Dec. |
| | | | | | | | $80,465 | $201,108 | **$281,573** |
| | | | | | | | | | **Annual Cost** |

**Air Source Heat Pumps**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 1.5 | $0.07 | $17.00 | $56.64 | 120 | $6,797 | $16,807 | Jan. |
| 15.4 | 1176.38975 | 1.5 | $0.07 | $17.00 | $55.62 | 96 | $5,340 | $16,807 | Feb. |
| 21.6 | 1081.107 | 1.5 | $0.07 | $17.00 | $51.12 | 96 | $4,907 | $12,253 | Mar. |
| 26.5 | 1005.84475 | 2 | $0.07 | $17.00 | $35.67 | 96 | $3,424 | $8,550 | Apr. |
| 36.4 | 853.83725 | 2.5 | $0.07 | $17.00 | $24.22 | 120 | $2,907 | $5,806 | May |
| 49.7 | 649.554 | 2.5 | $0.07 | $17.00 | $18.43 | 96 | $1,769 | $4,417 | June |
| 54.2 | 580.5945 | 2.5 | $0.07 | $17.00 | $16.47 | 96 | $1,581 | $3,948 | July |
| 52.2 | 611.36675 | 2.5 | $0.07 | $17.00 | $17.34 | 120 | $2,081 | $4,157 | Aug. |
| 47 | 691.078 | 2.5 | $0.07 | $17.00 | $19.61 | 96 | $1,882 | $4,699 | Sept. |
| 35.8 | 863.106 | 2.5 | $0.07 | $17.00 | $24.49 | 120 | $2,938 | $5,869 | Oct. |
| 24 | 1044.40275 | 2 | $0.07 | $17.00 | $37.04 | 96 | $3,556 | $8,877 | Nov. |
| 15.1 | 1180.83875 | 1.5 | $0.07 | $17.00 | $55.83 | 96 | $5,360 | $16,807 | Dec. |
| | | | | | | | $42,544 | $108,998 | **$151,542** |
| | | | | | | | | | **Annual Cost** |

**Water Source Heat Pumps w/ Closed Loop**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1197.89325 | 3 | 0.07 | 17.00 | 28.32 | 120 | $3,398.47 | $8,404 | Jan. |
| 15.4 | 1176.38975 | 3 | 0.07 | 17.00 | 27.81 | 96 | $2,669.97 | $8,404 | Feb. |
| 21.6 | 1081.107 | 3 | 0.07 | 17.00 | 25.56 | 96 | $2,453.72 | $6,126.27 | Mar. |
| 26.5 | 1005.84475 | 3 | 0.07 | 17.00 | 23.78 | 96 | $2,282.90 | $5,699.79 | Apr. |
| 36.4 | 853.83725 | 3 | 0.07 | 17.00 | 20.19 | 120 | $2,422.37 | $4,838.41 | May |
| 49.7 | 649.554 | 3 | 0.07 | 17.00 | 15.36 | 96 | $1,474.25 | $3,680.81 | June |
| 54.2 | 580.5945 | 3 | 0.07 | 17.00 | 13.73 | 96 | $1,317.74 | $3,290.04 | July |
| 52.2 | 611.36675 | 3 | 0.07 | 17.00 | 14.45 | 120 | $1,734.47 | $3,464.41 | Aug. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47 | 691.078 | 3 | 0.07 | 17.00 | 16.34 | 96 | $1,568.49 | $3,916.11 | Sept. |
| 35.8 | 863.106 | 3 | 0.07 | 17.00 | 20.41 | 120 | $2,448.67 | $4,890.93 | Oct. |
| 24 | 1044.40275 | 3 | 0.07 | 17.00 | 24.69 | 96 | $2,370.41 | $5,918.28 | Nov. |
| 15.1 | 1180.83875 | 3 | 0.07 | 17.00 | 27.92 | 96 | $2,680.07 | $8,404 | Dec. |
| | | | | | | | $26,822 | $67,036 | **$93,858** |
| | | | | | | | | | **Annual Cost** |

# ANNUAL ENERGY COST IF ARTIFICIAL HEAT IS THE ONLY HEAT SOURCE

**Electric Boiler**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 1 | $ 0.070926 | $ 17.00 | $ 114.58 | 120 | $13,750 | $34,000 | Jan. |
| 15.4 | 1586.5 | 1 | $ 0.070926 | $ 17.00 | $ 112.52 | 96 | $10,802 | $34,000 | Feb. |
| 21.6 | 1458 | 1 | $ 0.070926 | $ 17.00 | $ 103.41 | 96 | $9,927 | $24,786 | Mar. |
| 26.5 | 1356.5 | 1 | $ 0.070926 | $ 17.00 | $ 96.21 | 96 | $9,236 | $23,061 | Apr. |
| 36.4 | 1151.5 | 1 | $ 0.070926 | $ 17.00 | $ 81.67 | 120 | $9,801 | $19,576 | May |
| 49.7 | 876 | 1 | $ 0.070926 | $ 17.00 | $ 62.13 | 96 | $5,965 | $14,892 | June |
| 54.2 | 783 | 1 | $ 0.070926 | $ 17.00 | $ 55.54 | 96 | $5,331 | $13,311 | July |
| 52.2 | 824.5 | 1 | $ 0.070926 | $ 17.00 | $ 58.48 | 120 | $7,017 | $14,017 | Aug. |
| 47 | 932 | 1 | $ 0.070926 | $ 17.00 | $ 66.10 | 96 | $6,346 | $15,844 | Sept. |
| 35.8 | 1164 | 1 | $ 0.070926 | $ 17.00 | $ 82.56 | 120 | $9,907 | $19,788 | Oct. |
| 24 | 1408.5 | 1 | $ 0.070926 | $ 17.00 | $ 99.90 | 96 | $9,590 | $23,945 | Nov. |
| 15.1 | 1592.5 | 1 | $ 0.070926 | $ 17.00 | $ 112.95 | 96 | $10,843 | $34,000 | Dec. |
| | | | | | | | $108,516 | $271,218 | **$379,734** |
| | | | | | | | | | **Annual Cost** |

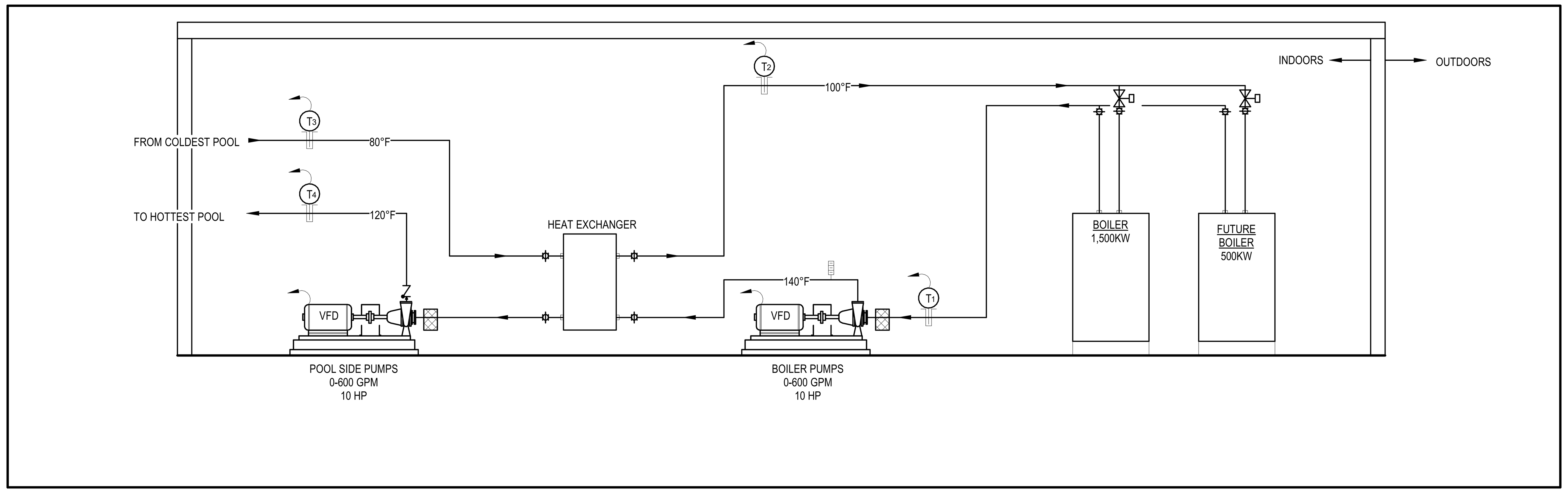
**Air Source Heat Pumps**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 1.5 | $0.07 | $17.00 | $76.39 | 120 | $9,166 | $22,667 | Jan. |
| 15.4 | 1586.5 | 1.5 | $0.07 | $17.00 | $75.02 | 96 | $7,202 | $22,667 | Feb. |
| 21.6 | 1458 | 1.5 | $0.07 | $17.00 | $68.94 | 96 | $6,618 | $16,524 | Mar. |
| 26.5 | 1356.5 | 2 | $0.07 | $17.00 | $48.11 | 96 | $4,618 | $11,530 | Apr. |
| 36.4 | 1151.5 | 2.5 | $0.07 | $17.00 | $32.67 | 120 | $3,920 | $7,830 | May |
| 49.7 | 876 | 2.5 | $0.07 | $17.00 | $24.85 | 96 | $2,386 | $5,957 | June |
| 54.2 | 783 | 2.5 | $0.07 | $17.00 | $22.21 | 96 | $2,133 | $5,324 | July |
| 52.2 | 824.5 | 2.5 | $0.07 | $17.00 | $23.39 | 120 | $2,807 | $5,607 | Aug. |
| 47 | 932 | 2.5 | $0.07 | $17.00 | $26.44 | 96 | $2,538 | $6,338 | Sept. |
| 35.8 | 1164 | 2.5 | $0.07 | $17.00 | $33.02 | 120 | $3,963 | $7,915 | Oct. |
| 24 | 1408.5 | 2 | $0.07 | $17.00 | $49.95 | 96 | $4,795 | $11,972 | Nov. |
| 15.1 | 1592.5 | 1.5 | $0.07 | $17.00 | $75.30 | 96 | $7,229 | $22,667 | Dec. |
| | | | | | | | $57,375 | $146,997 | **$204,372** |
| | | | | | | | | | **Annual Cost** |

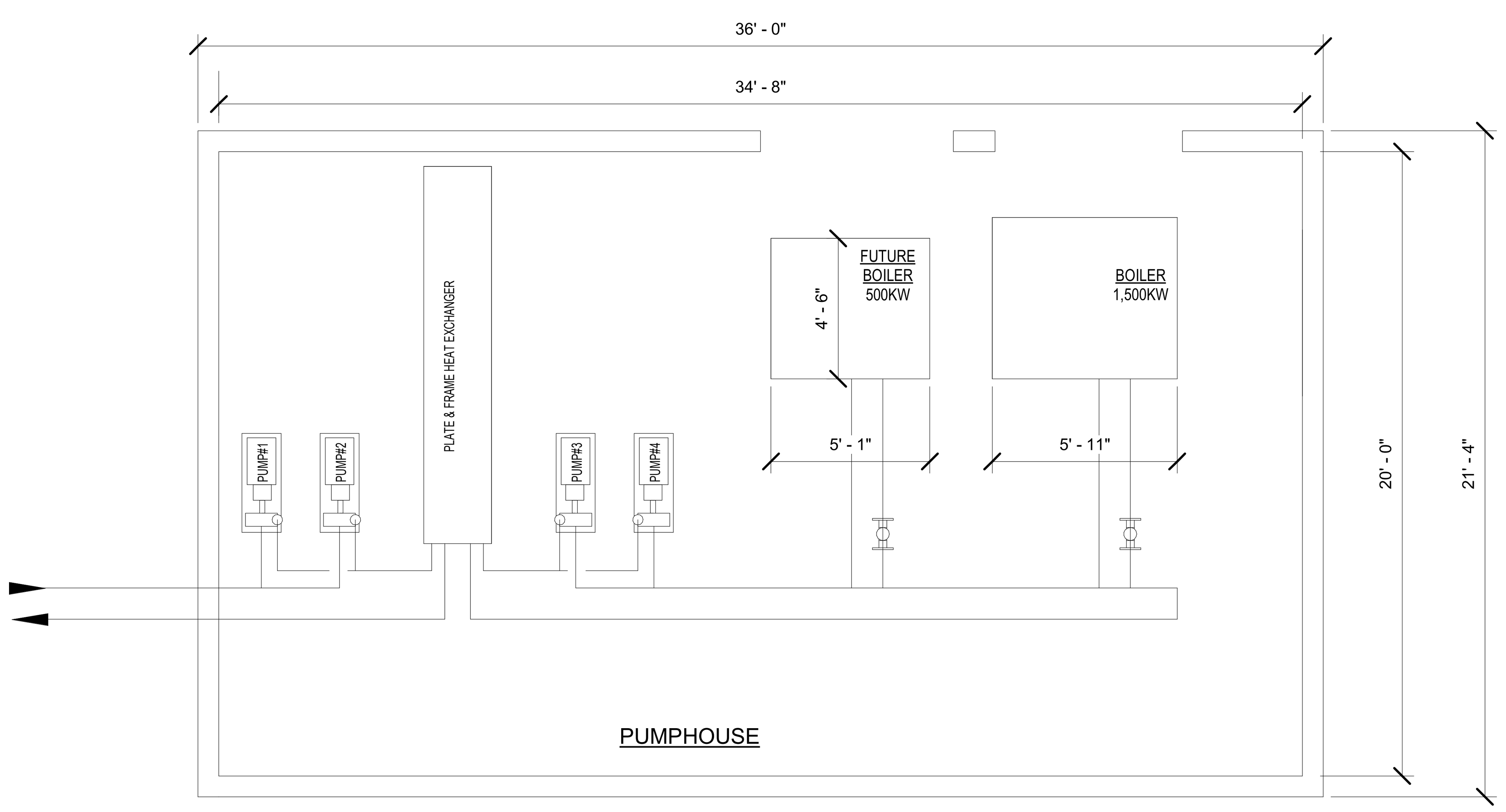
**Water Source Heat Pumps w/ Closed Loop**

| Average Air Temp. °F | Pool heat loss kW | COP | Electrical Rate $/kWh | Electrical Demand $/kW | hourly rate $/hour | Hours in the month | monthly rate $/month | monthly demand rate | |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 1615.5 | 3 | 0.07 | 17.00 | 38.19 | 120 | $4,583.24 | $11,333 | Jan. |
| 15.4 | 1586.5 | 3 | 0.07 | 17.00 | 37.51 | 96 | $3,600.77 | $11,333 | Feb. |
| 21.6 | 1458 | 3 | 0.07 | 17.00 | 34.47 | 96 | $3,309.12 | $8,262.00 | Mar. |
| 26.5 | 1356.5 | 3 | 0.07 | 17.00 | 32.07 | 96 | $3,078.76 | $7,686.83 | Apr. |
| 36.4 | 1151.5 | 3 | 0.07 | 17.00 | 27.22 | 120 | $3,266.85 | $6,525.17 | May |
| 49.7 | 876 | 3 | 0.07 | 17.00 | 20.71 | 96 | $1,988.20 | $4,964.00 | June |
| 54.2 | 783 | 3 | 0.07 | 17.00 | 18.51 | 96 | $1,777.12 | $4,437.00 | July |
| 52.2 | 824.5 | 3 | 0.07 | 17.00 | 19.49 | 120 | $2,339.14 | $4,672.17 | Aug. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47 | 932 | 3 | 0.07 | 17.00 | 22.03 | 96 | $2,115.30 | $5,281.33 | Sept. |
| 35.8 | 1164 | 3 | 0.07 | 17.00 | 27.52 | 120 | $3,302.31 | $6,596.00 | Oct. |
| 24 | 1408.5 | 3 | 0.07 | 17.00 | 33.30 | 96 | $3,196.78 | $7,981.50 | Nov. |
| 15.1 | 1592.5 | 3 | 0.07 | 17.00 | 37.65 | 96 | $3,614.39 | $11,333 | Dec. |
| | | | | | | | $36,172 | $90,406 | **$126,578** |
| | | | | | | | | | **Annual Cost** |




5B OPTION#5 PIPING SCHEMATIC - ELECTRIC BOILER(S)




5A OPTION#5 - ELECTRIC BOILER PLAN

EXHIBIT
A

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+ ASSOCIATES
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ENGINEERING

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P.O. BOX 96
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PROGRESS SET
NOT FOR CONST.

OURAY HOT SPRINGS

1220 MAIN STREET
OURAY, COLORADO

| | |
|---|---|
| JOB. NO.: | 2202 |
| DATE: | 9/15/2023 |
| DRAWN BY: | DS |

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
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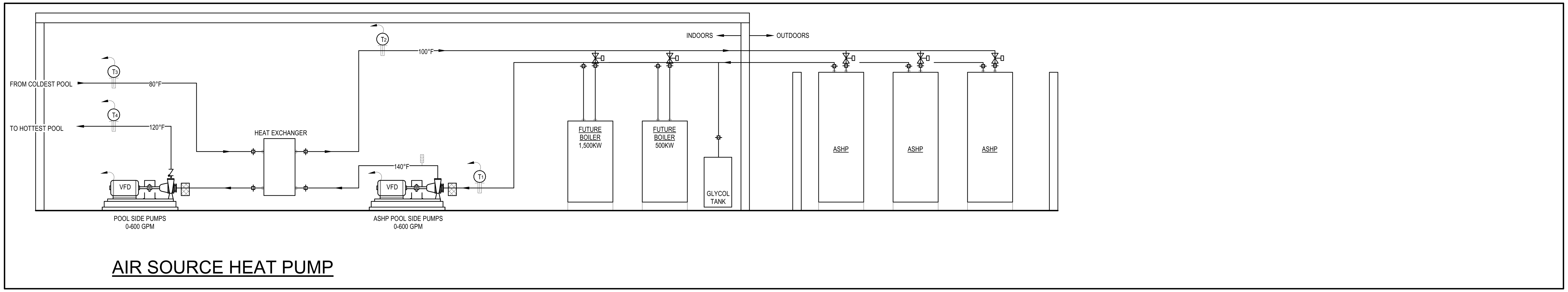
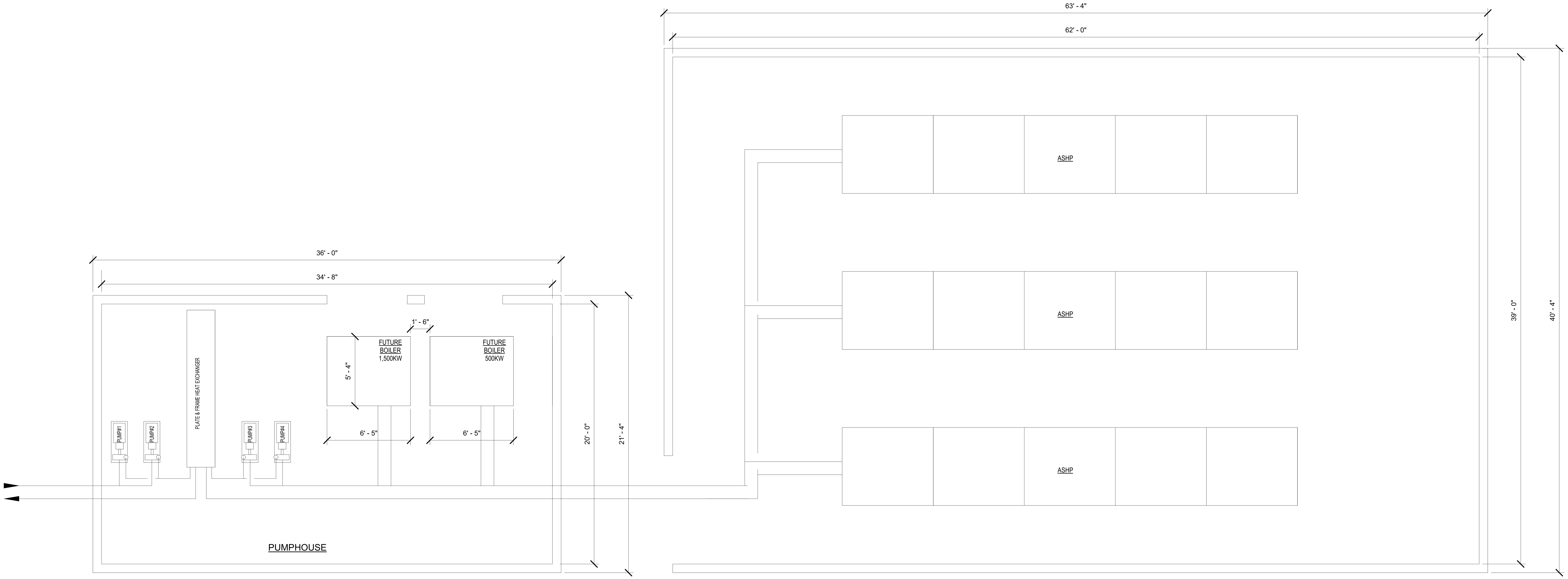
Opt.#5
ELECTRIC BOILER




6B **OPTION#6 PIPING SCHEMATIC - AIR SOURCE HEAT PUMP W/ BOILERS**




6A **OPTION#6 - AIR SOURCE HEAT PUMP W/ BOILERS PLAN**

# EXHIBIT B

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ARCHITECTURE ENGINEERING

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OURAY HOT SPRINGS
1220 MAIN STREET
OURAY, COLORADO

| | |
|---|---|
| JOB. NO.: | 2202 |
| DATE: | 9/15/2023 |
| DRAWN BY: | Author |

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
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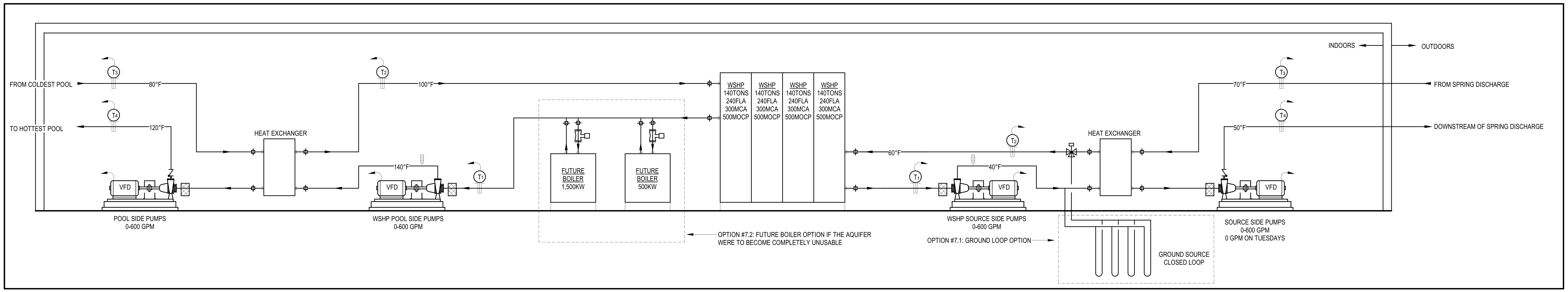
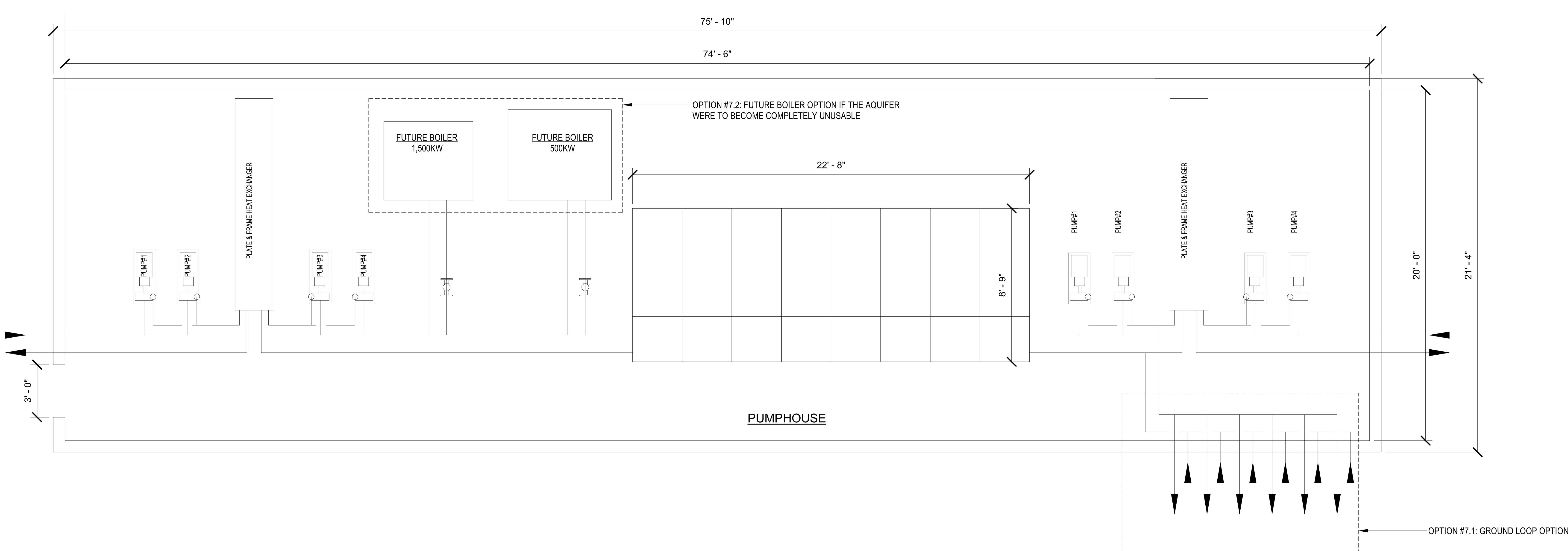
Opt.#6
ASHP W/ BOILERS




7B **OPTION#7 - WATER SOURCE HEAT PUMP W/ CLOSED LOOP PIPING SCHEMATIC**




7A **OPTION#7 - WATER SOURCE HEAT PUMP PLAN**

# EXHIBIT C

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OURAY HOT SPRINGS
1220 MAIN STREET
OURAY, COLORADO

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| JOB. NO.: | 2202 |
| DATE: | 9/15/2023 |
| DRAWN BY: | DS |

ISSUE RECORD:
1ST DRAFT 06-28-23

REVISIONS:
.

Opt.#7
WSHP


NORTH

# SITE PLAN-SIMULATION V1

SCALE: 1"=200'-0"

| | | | | | | |
|---|---|---|---|---|---|---|
| D<br>SITE PLAN | JOB NO: 23130<br>DATE:<br>DRAWN BY: | OURAY HOT SPRINGS<br>ALTERNATIVE POOL HEAT SOURCE<br><br>1220 Main St.<br>OURAY, COLORADO 81427 | PROGRESS SET<br>NOT FOR CONST. | REYNOLDS ASH + ASSOCIATES, P.C. EXPRESSLY RESERVES THE COMMON LAW COPYRIGHT AND OTHER PROPERTY RIGHTS IN THESE PLANS. THESE PLANS ARE NOT TO BE CHANGED OR COPIED IN ANY FORM OR MANNER WHATSOEVER NOR ARE THEY TO BE ASSIGNED TO ANY THIRD PARTY WITHOUT FIRST OBTAINING WRITTEN PERMISSION AND CONSENT OF THE ARCHITECT OF RECORD.<br>THE USE OF THESE PLANS AND SPECIFICATIONS SHALL BE RESTRICTED TO THE ORIGINAL SITE FOR WHICH THEY WERE PREPARED AND PUBLICATION THEREOF IS EXPRESSLY LIMITED TO SUCH USE. FEDERAL LAW PROHIBITS THE REPRODUCTION, DISPLAY, SALE, OR OTHER DISPOSITION OF THIS DOCUMENT WITHOUT THE EXPRESS WRITTEN CONSENT OF RA+A ARCHITECTS, P.C. | 1140 MAIN AVE., STE. B<br>DURANGO, CO 81301<br>(970) 259 - 7494<br>FAX (970) 259 - 7492<br>262 PAGOSA STREET, STE. 200 / P.O. BOX 96<br>PAGOSA SPRINGS, CO. 81147<br>(970) 264 - 6884<br>FAX (970) 264 - 0997<br>RA-AE.COM | REYNOLDS ASH + ASSOCIATES<br>ARCHITECTURE ENGINEERING |


# SITE PLAN-SIMULATION V2

NORTH

SCALE: 1"=200'-0"

E

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

OURAY HOT SPRINGS
ALTERNATIVE POOL HEAT SOURCE

1220 Main St.
OURAY, COLORADO 81427

PROGRESS SET
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# SITE PLAN-OPTIONS FOR PROPOSED STRUCTURE

SCALE: 1"=200'-0"

F

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

OURAY HOT SPRINGS
ALTERNATIVE POOL HEAT SOURCE

1220 Main St.
OURAY, COLORADO 81427

PROGRESS SET
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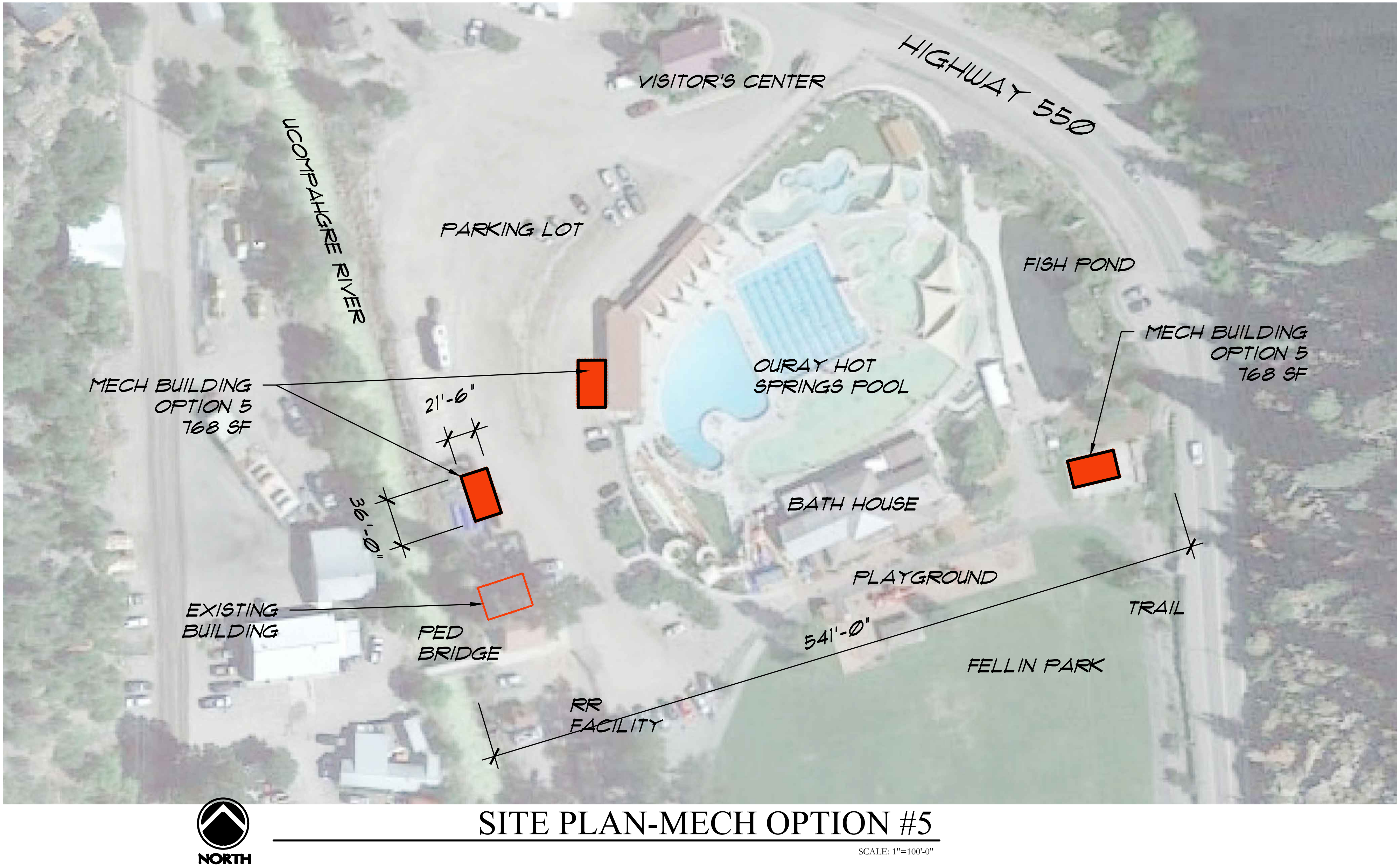


# SITE PLAN-MECH OPTION #5

SCALE: 1"=100'-0"

G

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

OURAY HOT SPRINGS
ALTERNATIVE POOL HEAT SOURCE

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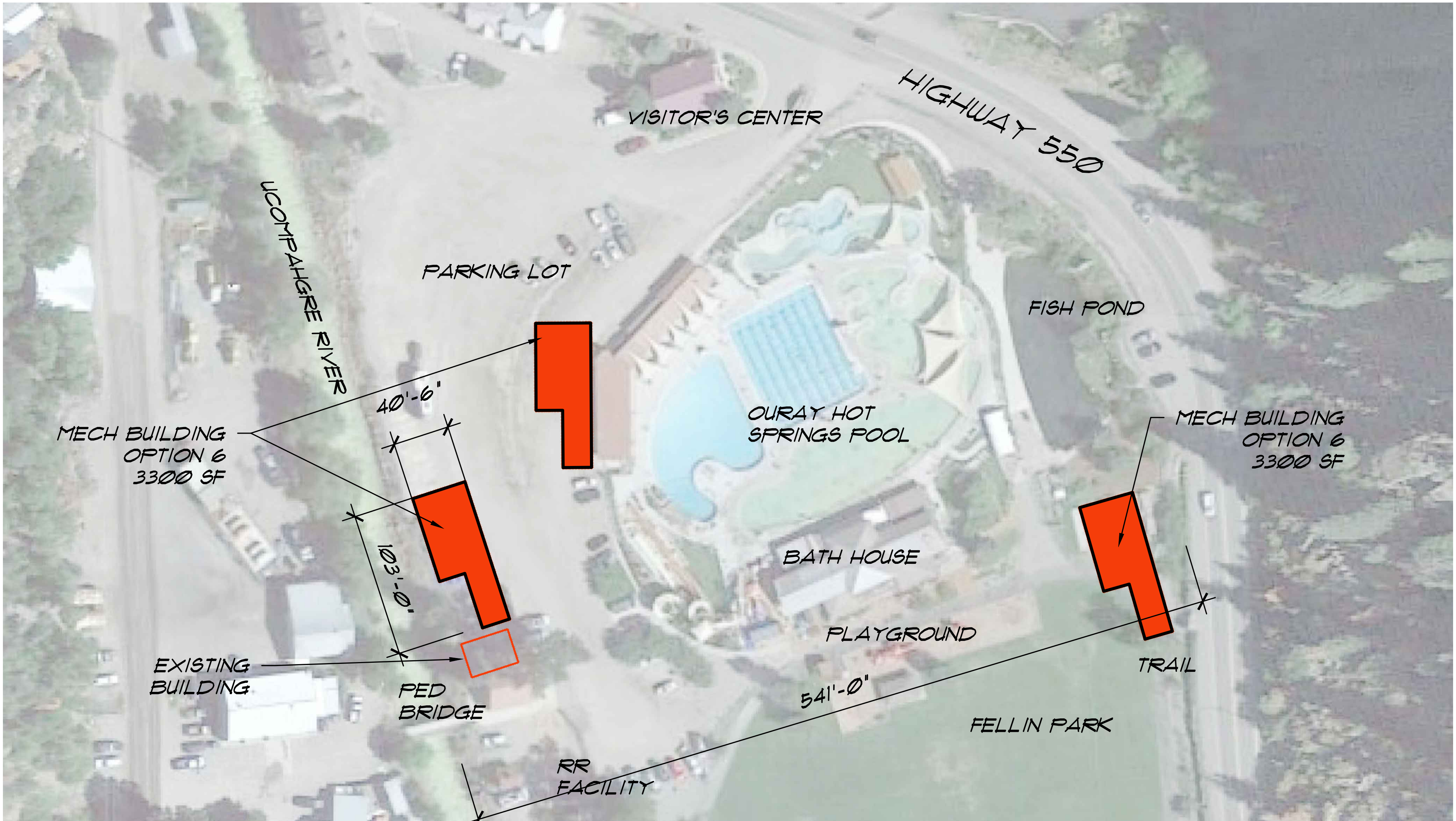


NORTH

# SITE PLAN-MECH OPTION #6

SCALE: 1"=100'-0"

H

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

OURAY HOT SPRINGS
ALTERNATIVE POOL HEAT SOURCE

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PROGRESS SET
NOT FOR CONST.




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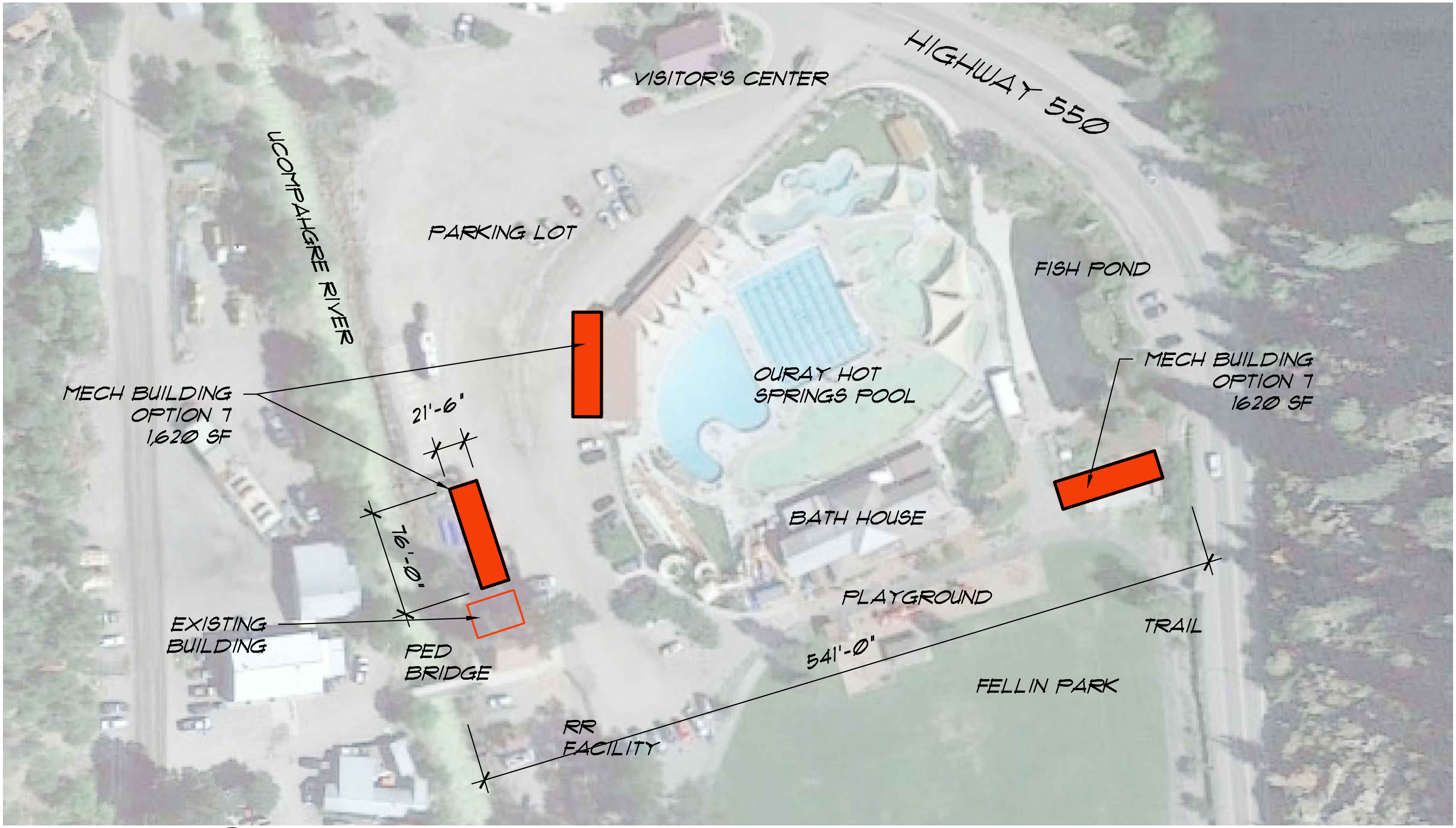


NORTH

# SITE PLAN-MECH OPTION #7

SCALE: 1"=100'-0"

I

SITE PLAN

JOB NO: 23130
DATE:
DRAWN BY:

OURAY HOT SPRINGS
ALTERNATIVE POOL HEAT SOURCE

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