1200 GPM ZEOLITE-BASED URANIUM WATER TREATMENT SYSTEM DESIGN REPORT

Prepared For:

Homestake Mining Company of California
Grants Reclamation Project
P. O. Box 98
Grants, New Mexico 87020

Prepared By:

RIMCON, LLC
1430 Haines Avenue, Suite 108-381
Rapid City, South Dakota 57701

And

Hydro Engineering
4685 S. Magnolia Drive
Casper, Wyoming 82604

July 2014

RIMCON, LLC
INDUSTRIAL MINERAL TECHNOLOGIES

Table of Contents

List of Tables

List of Figures

List of Exhibits

INTRODUCTION

Homestake Mining Company (HMC) is in the process of designing a 1200 gallon per minute (gpm) capacity zeolite-based uranium water treatment system at the Grants Reclamation Project site. The proposed 1200 gpm system is designed to supplement the existing 300 gpm pilot treatment system currently being operated at the site and is intended to treat in the impacted plumes wherein uranium is the main constituent of concern (COC). Together, the total treatment capacity of the systems is expected to be able to treat at a rate of up to 1500 gpm. The zeolite-based water treatment systems represent part of HMC's overall water remediation initiatives, which are outlined in the updated and revised Corrective Action Program (CAP). The updated and revised CAP was submitted to the Nuclear Regulatory Commission (NRC) in March 2012. The zeolite-based water treatment systems are further intended to help HMC achieve its water remediation objectives, which are mandated by HMC's Radioactive Materials License (RML) issued by the NRC. Finally, the zeolite-based water treatment systems are also addressed under the proposed DP-200 Discharge Permit issued by the New Mexico Environment Department (NMED), and is expected to become part of the site's total treatment strategy, and when combined with other treatment systems (e.g., Reverse Osmosis (RO)), can be used to account for the requested discharge rate of up to 5500 gpm.

This report is intended to address the requirements of Section 5, Alternate Ground Water Treatment Technologies found in the proposed DP-200 Discharge Permit. Included are descriptions of: system siting, design, and operational plans (5.a.i); system monitoring criteria that allows for an assessment of treatment efficacy and limitations will be provided (5.a.ii); contingency planning to mitigate potential upset conditions will be presented (5.a.iii) along with a description of waste stream quantity and disposition (5.a.iv); ground water quality discharge monitoring frequency and sample analytical suites (5.a.v); and expected rates of treated water discharge rates (5.a.vi).

Pilot test results have been previously supplied to NMED and NRC and are therefore already part of the Administrative Record. Design descriptions of the site 300 gpm zeolite pilot treatment system are included throughout this report merely to explain the context and foundations for the more comprehensive design of the proposed 1200 gpm zeolite water treatment system.

I. SITING, DESIGN AND OPERATIONAL PLANS

SITING

The 300 gpm zeolite-based uranium pilot water treatment system is located atop and near the center of the Large Tailings Pile (LTP) at the Grants Reclamation Project. It is located in an area where construction and operations would not impact the tailings flushing program. Discharge water from these systems is designed to go to the tailings injection system, and the central location of the pilot unit was advantageous to that program.

Technical and programmatic review of the preliminary designs for the proposed 1200 gpm system were performed by HMC site personnel, design engineers, and RIMCON. Based on these reviews, it was determined that the system should be constructed on the southeast corner of the LTP as shown on attached Exhibit 1. The system location is in an area on the LTP where contaminated windblown deposits, (material excavated from areas north and east of the mill site during the mid-1990s) were placed, and in an area where slime mill tailings are not believed to have been deposited.

A geotechnical investigation was conducted on the site during windblown material placement. A stability analysis was conducted on the LTP in 2010 and a review of that analysis and the original geotechnical data from the time of placement indicates that the zeolite cell and water surcharge load (130 – 150 psf per foot of cell height) will not have an adverse effect on the stability of the LTP. Refer to the 2010 NRC and NMED Annual Reports for this analysis.

Locating the system on the LTP also allows for discharge water to flow to the south and north collection well fields for injection via gravity. This is advantageous for several reasons. Firstly, making use of gravity fed systems minimizes the system's reliance on electricity, which therefore reduces the system's carbon footprint, as well as the overall carbon footprint of the Grants site. Secondly, minimizing the need for pumps and other electrical components reduces the opportunities for malfunctions and failures, and therefore increases the system's overall reliability. Thirdly, in the highly unlikely event that a catastrophic failure occurs, locating the system on the LTP provides for added protection of the environment since any discharge would be contained on the LTP (and the LTP is already subject to strict regulatory remediation mandates). Lastly, this location provides for more efficient operation since it is near the 300 gpm pilot system, which is intended to supplement the proposed 1200 gpm system.

BASIS OF DESIGN: 300 GPM SYSTEM DESIGN

Construction of the new 300 gpm zeolite pilot test system for uranium removal began in 2012, on top and in the approximate center of the large tailings pile (LTP). The 300 gpm pilot system was completed in early fall, 2013. The system was designed to have an average treatment capacity of 300 gpm. The pilot system was designed with three treatment cells to add operational flexibility. In addition, a water pump-back system was designed and constructed to allow flexibility in the system's operations (i.e., allowed water from the lowest cell to be pumped back to either of the two higher cells).

The contour view of the three-cell system design is shown on Figure 1 and Figure 2 shows a cross-sectional view of the system. Normally, the operation of the treatment cells involves operating two (2) cells in sequence. Without the pump-back feature, the normal operation of the cells would be as follows:

1) Cell #1 (primary) to Cell #2 (secondary) to discharge,
2) Cell #1 (primary) to Cell #3 (secondary) to discharge, and
3) Cell #2 (primary) to cell #3 (secondary) to discharge.

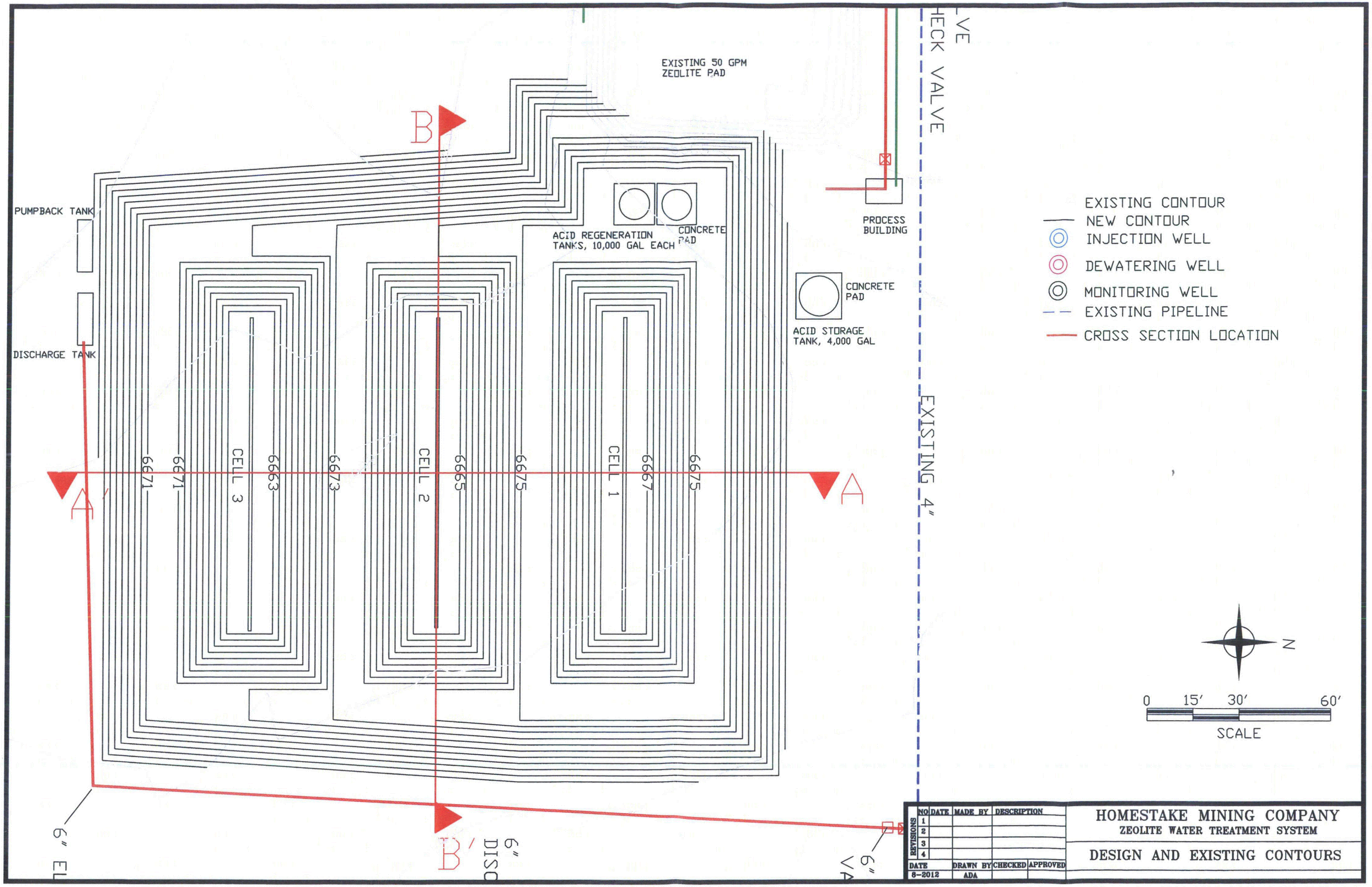
The addition of the pump-back feature allowed for Cell #3 to be the primary treatment cell with secondary treatment occurring in either Cell #1 or Cell #2. It should be noted that the pump-back feature in the 300 gpm pilot system was incorporated to allow for maximum flexibility in testing the effectiveness of the zeolite's uranium recovery capabilities; the pump-back feature is not part of the 1200 gpm full-scale system.

PROPOSED FULL-SCALE DESIGN: 1200 GPM ZEOLITE TREATMENT SYSTEM

System Design and Treatment Criteria

Selection of the final design of a fully operational treatment system was based on the prior zeolite treatment pilot test results, including treatment efficiencies and operational efficiencies, and on past RIMCON experience with similar and larger systems at other sites. In addition, the design was sized based on the site restoration plans objectives found in the updated and revised CAP, as well as those found in the proposed Discharge Permit DP-200. The zeolite water treatment system is designed to reduce uranium concentration in impacted groundwater to a level such that it meets or exceeds (i.e., is lower than) the agreed upon site standard for uranium in groundwater. The groundwater standard for uranium at the Grants site, as per HMC's NRC License, is 0.16 mg/L (i.e., 0.16 ppm), and this limit is intended to serve as the site control for discharge to injection.

Pilot testing of the 300 gpm pilot system showed that the site standards could be achieved using a primary cell and secondary polishing cell configuration. Previous RIMCON treatment systems at other sites have proven that flow rate and operational sizing of the zeolite system achieves an optimal balance at approximately the 300 to 400 gpm capacity range. Regeneration of the zeolite media tends to be more difficult for larger sized systems. In addition, maintenance issues also tend to be more complicated (i.e., more labor intensive, arduous, and time consuming to resolve). The 300 gpm pilot system testing further verified these predications.



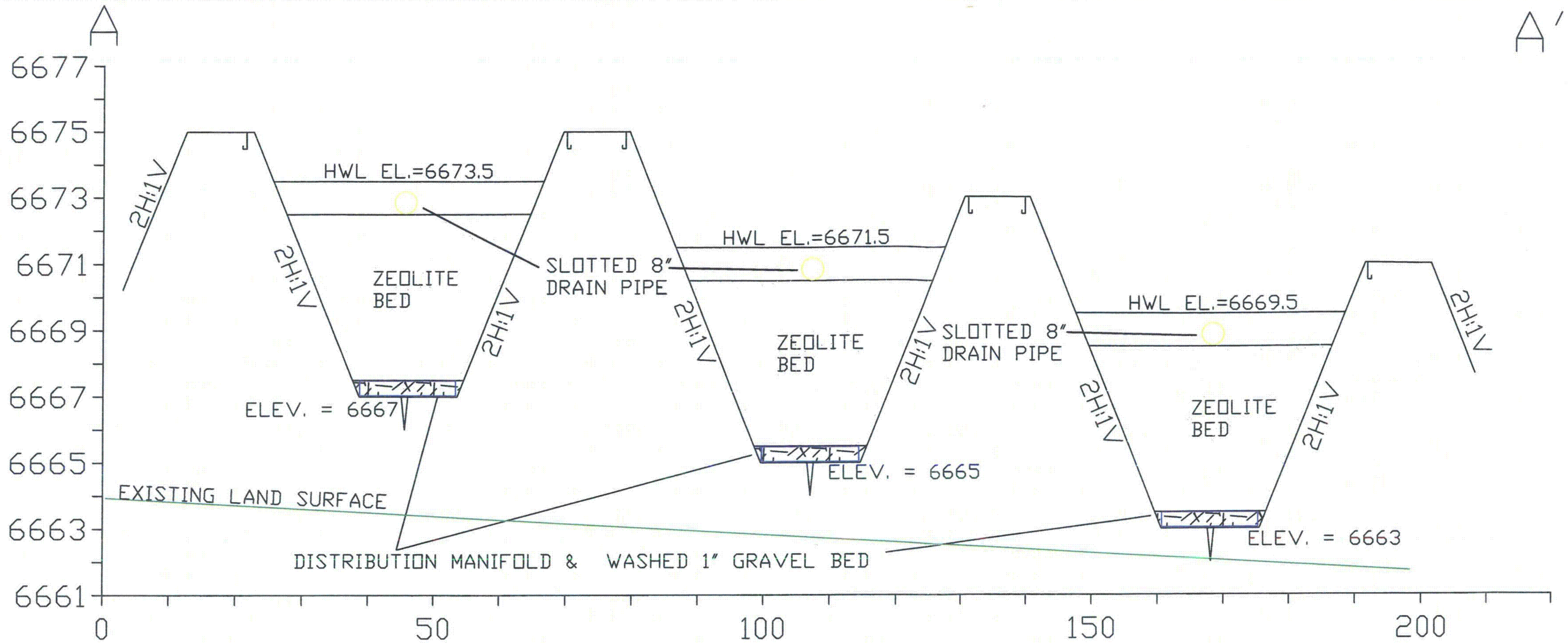
REVISIONS NO	DATE	MADE BY	DESCRIPTION
1			
2			
3			
4			

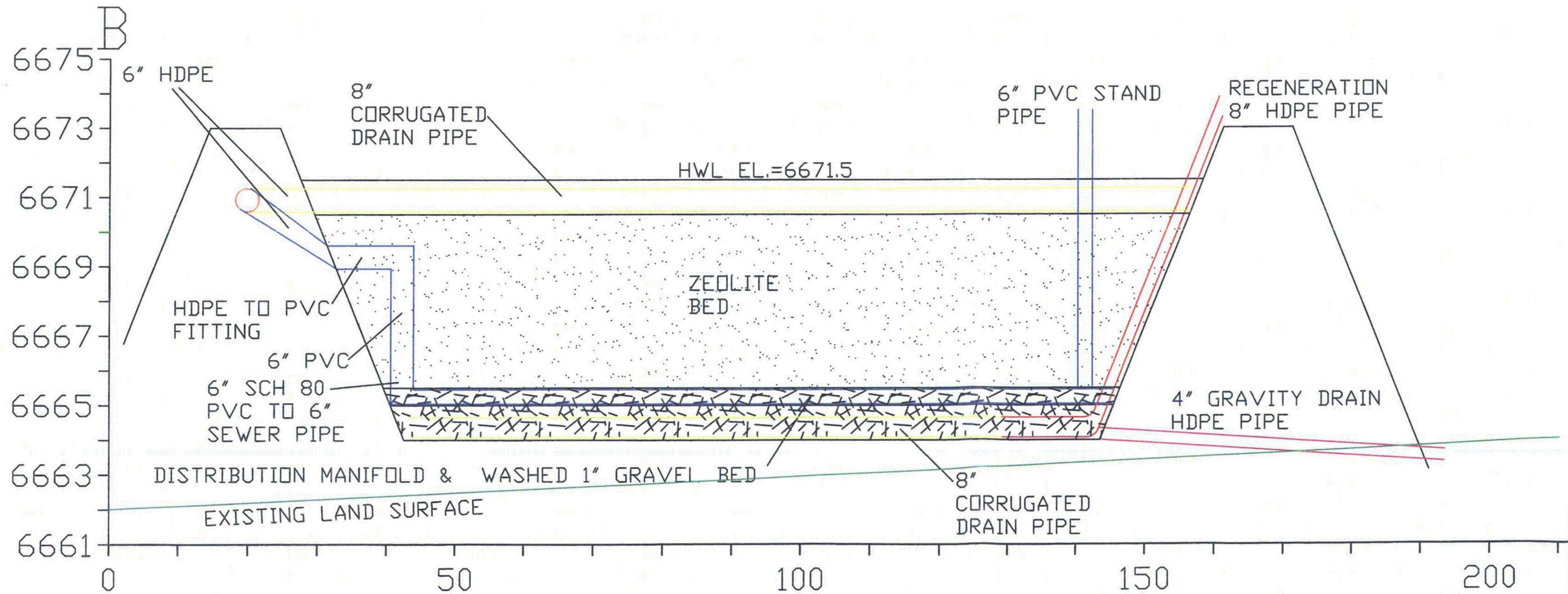
DATE	DRAWN BY	CHECKED	APPROVED
8-2012	ADA		

HOMESTAKE MINING COMPANY

ZEOLITE WATER TREATMENT SYSTEM

DESIGN AND EXISTING CONTOURS





HOMESTAKE MINING COMPANY
ZEOLITE WATER TREATMENT SYSTEM

CROSS SECTIONS A-A' & B-B'

The following block diagram (Figure 3.0) details the normal process steps designed to achieve maximum treatment efficiency.

Figure 3.0 - Optimum Zeolite-Based Uranium Treatment Block Diagram

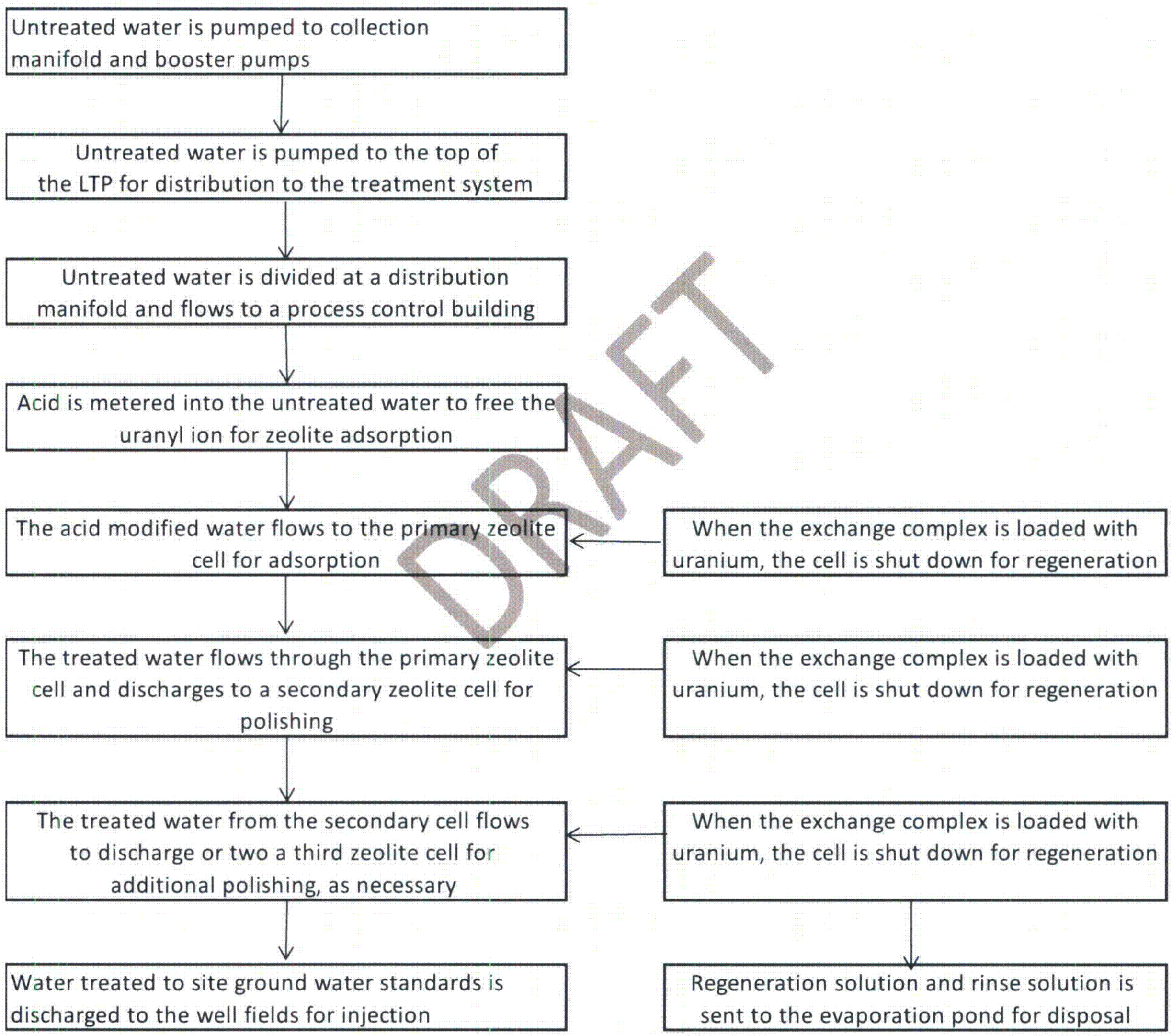
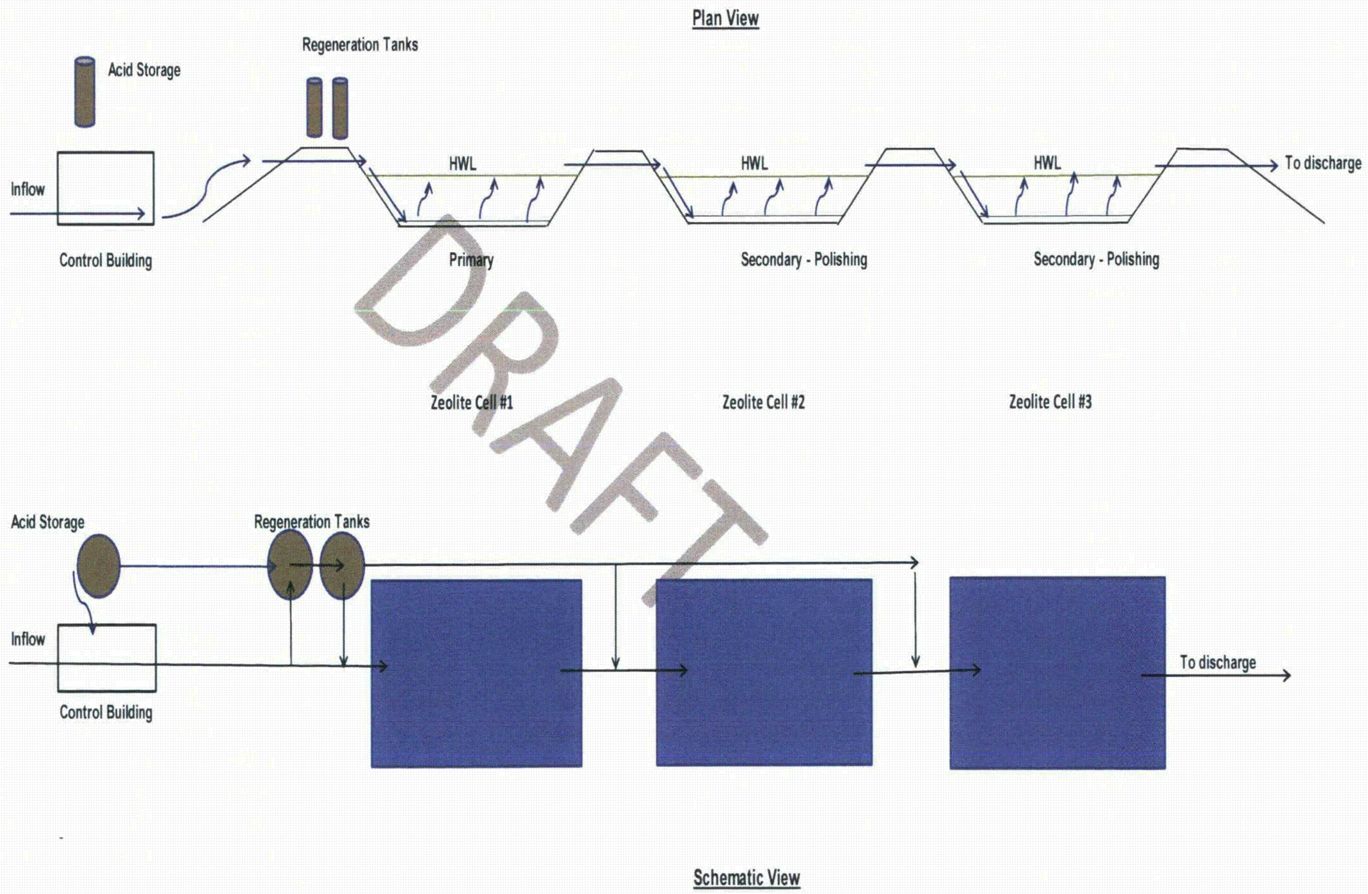


Figure 4.0 is a schematic and plan view diagram providing a view of the preferred zeolite treatment process options.

Figure 4.0 - Zeolite-Based Uranium Treatment System Schematic



The target retention time for optimum uranium adsorption and optimum zeolite size fraction was determined through the testing process. The zeolite tonnage necessary to achieve the target retention time was calculated for each treatment cell. The direction of water flow through each system is preferred to be up-flow, thereby allowing for more efficient water contact time with the zeolite. For the proposed 1200 gpm zeolite water treatment system, the system is designed to consist of four side-by-side individual 300 gpm units (similar to the 300 gpm pilot system). These units are also referred to as "trains."

In addition to the operational and maintenance advantages listed above, this configuration is also expected to allow for other operational flexibility. This additional flexibility would include the ability to operate each treatment train with different quality water from different water sources (i.e., each of the four treatment trains can act independently), the ability to incorporate other treatment parameters into a single treatment train while the others operate independently, and the ability to continue to operate the other treatment trains if operational or maintenance issues arise in a single train. Albeit at a reduced capacity, this essentially maximizes the system's capability to achieve uninterrupted water treatment in the event up to three of the trains need to be taken offline.

The adsorption loading capacity of each zeolite treatment cell is finite. However, the adsorbed uranium can be stripped from the zeolite and piped for disposal to the site's evaporation ponds. This process is referred to as "regeneration," and pilot testing has shown that the zeolite will likely require regeneration approximately every 45 days, or 8 times per year per cell. While the zeolite is not expected to be fully loaded within 45 days of continuous operation, operationally, it is more efficient to strip the uranium from the zeolite exchange complex before full loading occurs. Thus, HMC operators will routinely regenerate the zeolite cells on a periodic basis, when approximately 45 days of continuous operation have elapsed. Note, "continuous" does not imply "consecutive." This means regeneration evolutions may occur several calendar months apart in the event there are interruptions in the system's operation.

Water is designed to flow by gravity from the primary treatment cell to the secondary polishing cell via a piping network. As described, the system will be designed as a tri-cell configuration allowing for the following primary and polishing scenarios:

Flow from Cell #1 to Cell #2;

Flow from Cell #1 to Cell #3;

Flow from Cell #2 to Cell #3; and

Flow from Cell #1 to Cell #2 to Cell #3.

For the agreed upon site standards, it is not likely that the full three-cell configuration will be necessary to achieve the 0.16 mg/L standard for uranium. However, the tri-cell configuration allows for continued operation of the train while any single cell is undergoing regeneration and also has the ability to offer an additional level of confidence in ensuring that the treated water will be able to satisfy the required standards.

System Configuration

The system design requirements and treatment criteria have been outlined previously. RIMCON has significant experience in the design, construction, operation, and maintenance of other zeolite-based water treatment systems at other sites. That experience, along with the testing and pilot system operation at HMC, provides the necessary knowledge foundations to construct a full-scale 1200 gpm system on top of the LTP.

The zeolite system will consist of four, 300 gpm capacity units (i.e., trains) constructed side-by-side, sharing interior berms. Exhibit 2.0 shows the location of the system on the LTP and a general layout of the incoming feed water, distribution through the system, and outgoing discharge water piping. Each 300 gpm unit is comprised of three treatment cells. The four systems, referred to as Trains A, B, C, and D, run parallel to each other from east to west. The three cells within their respective train are designated as A1, A2, A3; B1, B2, and B3; C1, C2, and C3; and, D1, D2, and D3. Exhibit 2.0 shows the plan view details of the 12 cell system.

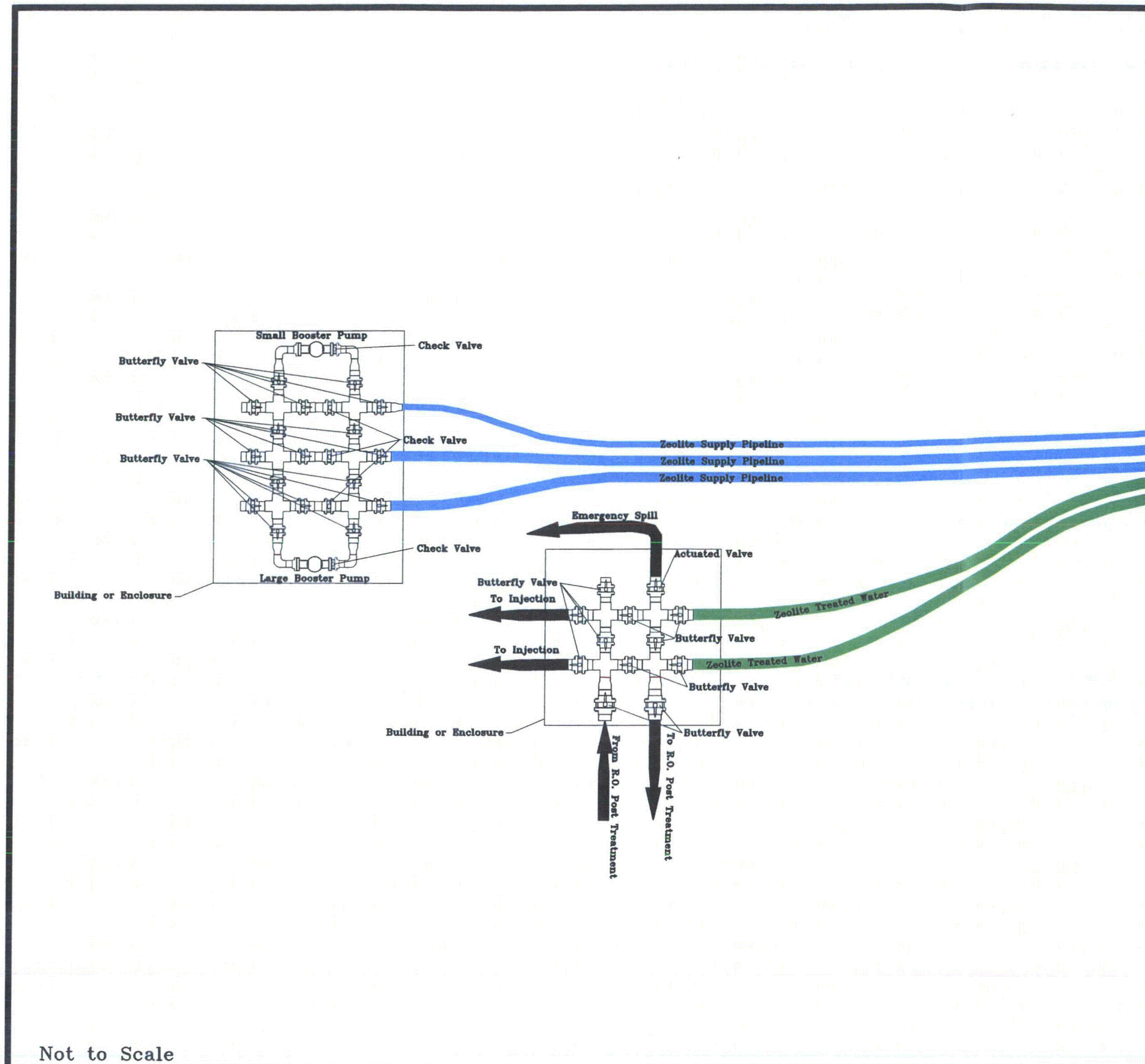
The site is relatively flat with a 2 % slope to the east-southeast. The outer edge of the LTP is a roadway for operational access to wells on the LTP. The road is graded to a series of surface water discharge pipes that drain runoff from storms down off of the LTP. This location on the LTP allows for sufficient room to construct the system without interfering with LTP wells. The east end of the LTP was the placement site for windblown materials collected off site and transported to the LTP for disposal. Few wells are located in this area, because slime uranium tailings were not deposited on the east end of the LTP.

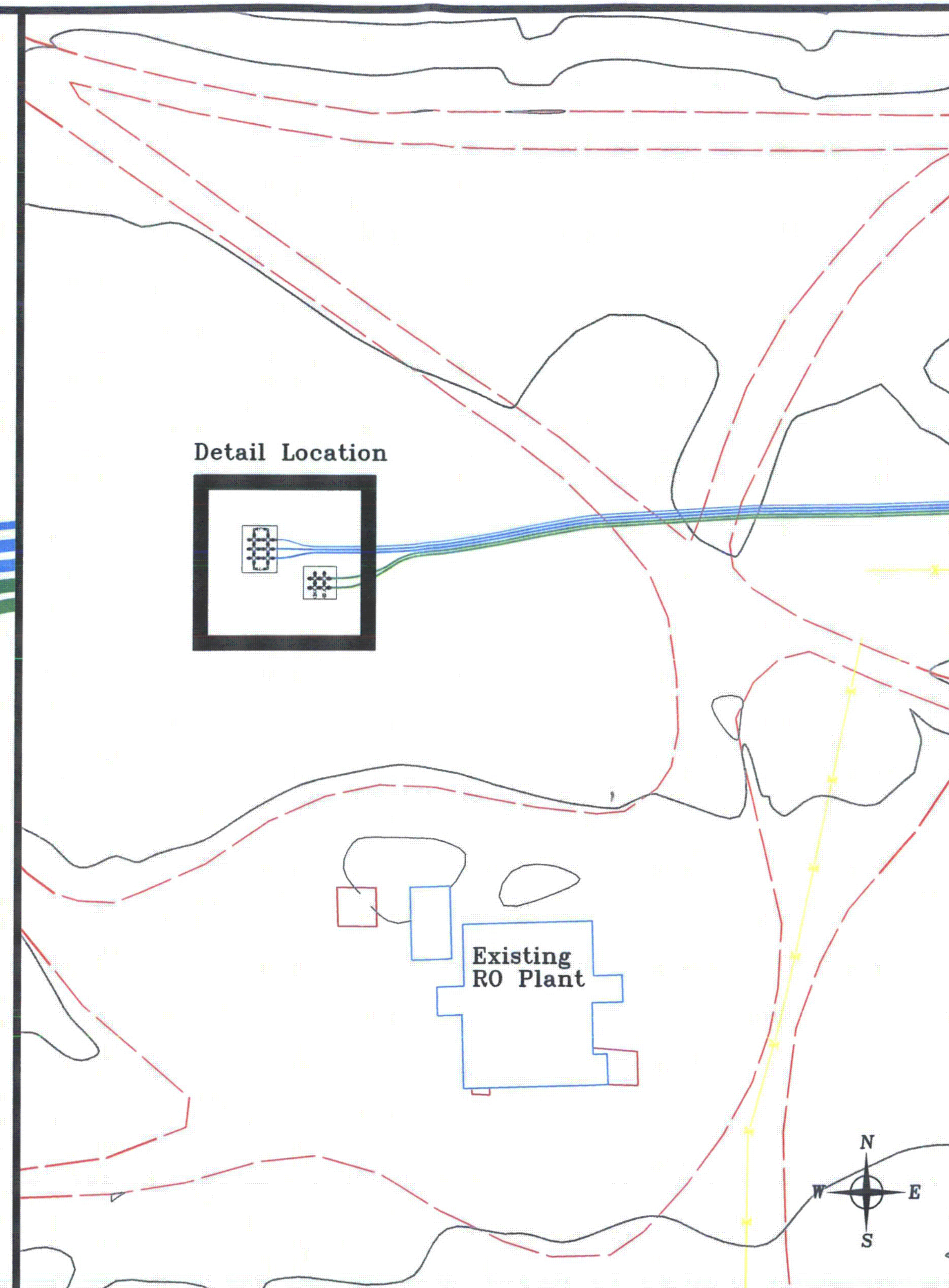
The feed water is designed be piped from the south collection and north collection well fields to a piping manifold which is expected to be located slightly north of the RO plant. The manifold configuration is shown on Figure 5.0. The manifold is designed to allow the collected water to be piped to the system on top of the LTP through either of the two 8 inch poly pipes or a 6 inch poly pipeline.

These three pipes are designed to allow for flexibility in the feed system and allow for separation of water sources, as necessary. A large booster pump, along with a smaller backup booster pump, at the manifold are designed to allow water to be pumped to the system so as to to ensure that the desired flow volumes are maintained. Without the booster pump(s), water would still be expected to flow, merely at a reduced rate.

Cross-sections and Treatment Cell Sizing

Exhibit 3.0, shows a plan view of the general system topography and contours and details the location of earthwork cross-sections. The cross-sections depicted on Exhibit 4.0 detail the configuration of the system berms and interior treatment cells in a west to east direction. Cross-sections E through I, depicted on Exhibit 5.0 show the section of the system in a north to south direction. Note that the bottom elevation of each cell is approximately four feet lower for each train as the system progresses from Cell 1 to Cell 2, to Cell 3. The zeolite surface elevation in each cell is between two and three feet lower (approximately) for each train as the system progresses from Cell 1 to Cell 2 to





REVISIONS No.	DATE	MADE BY	DESCRIPTION
1			
2			
3			
4			

DATE	DRAWN BY	CHECKED	APPROVED
6-2014	TGM		

Homestake Mining Company

Grants, New Mexico

1200 GPM Zeolite System

Manifold and Booster Pump Configuration

Figure 5.0

Cell 3. The drop in elevation is designed to provide sufficient head drop between cells so as to allow water to flow through the cells by gravity.

The crest surface area for Cell 1 in each train is approximately 4480 square feet (ft^2) and the base area of each Cell 1 is approximately 2772 ft^2. The crest surface area for Cell 2 of each train is approximately 3952 ft^2 and the base area is approximately 1972 ft^2. The crest surface area for Cell 3 of each train is approximately 3456 ft^2 and the base surface area is approximately 1300 ft^2. Each of the 12 treatment cells are sized to hold the feed water distribution piping, bedding and required volume of zeolite. Each cell will have at least two feet of freeboard capacity above the zeolite.

Cross-sections A, B, and D show sections through the treatment cells. Cross-section C shows a section between cells where a roadway will be constructed for vehicle access between Trains C and D. A similar roadway will be placed between Trains A and B. A berm is designed to enclose all four treatment trains around the facility area to provide complete containment of solution within the berms for protection against an unlikely system overflow event. This berm is generally in addition to the approximate two feet of freeboard capacity, which is designed into each individual treatment cell.

While no such scenario is envisioned, out of an abundance of caution, this redundant safeguard against a possible overflow was incorporated into the design. The system is designed to operate at full capacity for approximately 20 hours while still providing freeboard within the containment. Exhibit 6.0 shows the location of the perimeter berm and complete containment system.

Cross-section E depicts the topography of the system pad through the area where the water distribution piping, control building, and regeneration tanks are expected to be placed. This area is within the containment berm and is relatively flat. Cross–sections F, G, and I are cut through the treatment cells, again from a north to south direction. Cross-section H shows a cut through the berm between cells and depicts trenches where pipe valves between cells are expected to be placed for access.

Liner System

As described previously, the entire system within the containment berms (see Exhibit 6.0) is designed to be lined with synthetic liner with an approximate thickness of 60 mil. (i.e., 60 thousandths of an inch). A liner anchor trench will be incorporated into the system, and will be designed to be employed around the outside edge of the containment berm. Liner installation, including anchor trench requirements, is shown on Exhibit 7.0. Liner installation will be performed by a commercially certified liner installation contractor.

With the exception of the piping between the berms, all of the piping is designed to be constructed on top of the liner. Pipes between cells will be buried as detailed on the cross-section diagram on Exhibit 9.0 and on the drawings depicted on Exhibit 10.0. These pipes will penetrate the liner on both sides of the berm and will be sealed with poly pipe boots. As with the liner, pipe boot installation will also be performed by a commercially certified liner contractor.

The designs call for earthen roadways and walkways to be built on top of the liner, and are alsoexpected to serve the additional function of anchoring the interior of the liner. Construction of the roadway is also designed to consist of placement of a secondary layer of synthetic material (e.g., a poly "rub" sheet), which will be placed on top of the liner system between Trains A and B and between Trains C and D. Approximately six inches of rock free soil will then be spread on top of the rub sheet and compacted with a roller compactor. Coarse road base material will then be placed on top of the compacted road fill to complete the road system.

Feed Water Distribution

Exhibit 8.0 shows a plan view of the system with placement of the control building, regeneration tanks, acid storage and acid metering tanks, and freshwater wash facility, and the configuration of all of the surface water supply piping. In general, water is designed to arrive at the system via three plastic pipelines from the collection wells. Water is then split into two pipelines northward to Train A and B and two pipelines southward to Train C and D for distribution via a pipe and valve manifold system located between the control buildings. The configuration and location of the distribution manifold is shown on Exhibit 9.0.

Exhibit 8.0 shows schematic plans of the feed water supply system into Cell 1, and then through Cell 2, and into Cell 3 for all four trains. Note that the piping configuration for Trains C and D are essentially a mirror image of Trains A and B. The feed water is designed to be split at Cell 1 three ways by plastic pipes and butterfly valves. The center feed line enters Cell 1 and drops to the bottom of the cell for distribution up through the zeolite. The second pipe system is designed to allow for water to bypass Cell 1 to flow to Cell 2, Cell 3, or to be discharged from the system. The third pipeline is designed to allow for distribution of zeolite regeneration solution to all three cells and to allow for treatment to continue in any of the cells not being regenerated at that time.

Note that the bypass pipeline and the regeneration pipeline are laid on top of the zeolite in each cell and are not buried. The feed water moves upward through the zeolite cell to the surface of the zeolite. A discharge pipe with drain openings is placed on top of the zeolite and allows the treated water from one cell to flow by gravity to the next cell. The three pipes placed on top of the zeolite are combined at the end of Cell 3, where a single pipe is designed to discharge the treated effluent water to the well fields for injection.

As described previously, the system is designed to allow for the feed water to flow upward through the zeolite to maximize contact time. Vertical standpipes are also plumbed into the distribution system. These pipes extend above the treatment cells and are designed to allow for pumping of regeneration solution.

Process Control Building(s) and Safety Building(s)

The process control for the systems is designed to occur in two buildings, one for Train A and B and one for Trains C and D as shown on Exhibit 8.0. These features are expected to be located on containment above the liner system. Two feed water lines, one for each train, will enter and exit each building. The process requires that acid be metered into the feed water. This will be done using two acid metering pumps inside the building, one for each train. Acid from a storage tank, located outside the building, is designed to be piped to the metering pumps. The metered acid is designed to be fed to the feed water using flexible acid transfer tubing. The pumps are designed to be adjusted manually or electronically via computer. The acid modified water can then flow through a mixing tube that will ensure the acid is thoroughly combined with the feed water. A pH electrode installed at the end of each pipe just before the pipes exit the building, is designed to monitor feed water pH.

To ensure operator safety, the acid metering system will be separated from other process control operations inside the building by constructing an interior wall. The wall is designed to be fitted with an access door and a viewing window. By instruction, operators will not be allowed to enter the acid metering room without proper safety attire. The process building will be equipped with an eyewash station, wash basin, and shower equipment. Acid neutralization chemicals (e.g., baking soda), are expected to be kept in abundance inside each building.

After the two pipes enter the building, an electronic readout flowmeter will be installed to measure flow volumes. Two electronic readout panels are expected to be installed in the building. The panel is designed to be used to monitor feed water flow rates, the pH electrode in the building, and pH electrodes installed in the discharge lines of each treatment cell. Additional design considerations call for these panels to be monitored remotely. The acid metering pump, using a 4 to 20 mA circuit, is also designed to be controlled and monitored remotely.

Storage shelves for safety attire, acid neutralization substances, cleaning supplies, maintenance equipment, and other sundries may be present in each building along with necessary operating manuals.

A safety building housing a safety shower is designed to be placed near the control buildings as shown on Exhibit 9.0. The building is designed to be heated and will include a fresh water storage tank, shower pressure pump, and other safety supplies.

Acid, Regeneration, and Water Storage Tankage

As shown on the Exhibit 8.0, the system requires the use of several tanks. Two 8700 gallon double-walled polyethylene acid storage tanks are expected to be placed on the west side of the system as shown. This location is expected to allow for safe transport and off-loading of acid at the system. The designs call for the tanks to be located on top of a concrete slab, anchored with cables, and tightened with turnbuckles. The acid tanks are designed to be accessible for delivery of acid by semi-load. The level of the acid in each tank may be visually monitored by a float, electronic readout meter, and remotely via computer. The design calls for acid to be pumped using a commercial acid pump through a plastic pipeline equipped with carbon steel acid-safe valves. The acid delivery line is designed to pump directly to the regeneration tanks or to two 1000 gallon acid metering storage tanks, as shown on the Exhibit. Acid tank construction details are shown on Exhibit 11.0.

Two 10,000 gallon polyethylene tanks are required for each of the north treatment trains and for the south treatment trains to mix zeolite regeneration solution and to supply the regeneration solution to the zeolite. The location of the tanks is shown on Exhibit 8.0. The acid solution consists of mixing of acid and water to form a weak acid solution. The tanks are designed to feed the zeolite cells by gravity flow.

Exhibit 11.0 details the construction and anchoring requirements for the regeneration tank system. As shown, the tanks are designed to be located on containment above the liner system.

Electrical

The electrical supply system for the zeolite treatment system will be installed under the supervision of a licensed electrician. Electricity will be required to feed the process control instrumentation, lights, pH electrodes, acid metering pumps, acid transfer pump, regeneration discharge pumps, safety shower pump, ultrasonic acid tank level indicators, ultrasonic zeolite cell water level indicators, building heaters, and other miscellaneous equipment.

OPERATION PLANS

HMC personnel are expected to be assigned as operators for the system and the operations will become a routine part of their daily tasks. Operators will be required to routinely check the system, visually observing flow rates and water levels in all active cells. They will also be required to routinely examine the electronic readouts in the process control building for feed water flow rates, and pH levels.

If pH levels travel outside of the desired range, operators will adjust the acid feed rate. Operators will be required to ensure that pH, flow conditions, and adjustments made to acid metering pumps are properly recorded. The control point for the system will be the agreed upon site standard of 0.16 mg/L (for uranium).

Operators will also be charged with observing the acid storage volumes and assessing the need to effect delivery of more acid to the site. They will have the ability to transfer acid from the storage facility to the metering tanks near the process control building approximately on a weekly basis. On approximately a daily basis, operators will be required to note the position of all valves and record the valve line-ups on a designated HMC Valve Line-up Verification Form. Any manipulation of valve status will be recorded on these forms. In addition, operators will be required to file Field Level Risk Assessment (FLRA) forms for activities that are not routine to the system operations.

Operators will also be responsible for taking samples to check treatment efficiency and to satisfy regulatory sampling and reporting requirements. Operators will be required to be trained how to use the site's uranium Kinetic Phosphorescence Analyzer (KPA) and will use the analyzer for routine uranium monitoring. While the KPA is expected to serve the additional function of an early warning detection system, it should be duly noted that the KPA is only an operational tool, and is only designed to be used as a guide to zeolite system's efficiency; it is not intended to ensure any sort of regulatory compliance.

The pH electrode output will be required to be continually monitored. Operators will be required to take routine feed and discharge water samples and tested for pH using a calibrated field pH meter. In-line pH electrodes will be required to be calibrated, at a minimum, during each regeneration cycle using factory specified procedures. If field pH testing indicates a problem with a pH reading, the electrode will be required to be re-calibrated, or replaced, as deemed appropriate. Operations samples will be required to be routinely collected to verify field pH and uranium levels at a certified laboratory. All samples collected will be required to be sent to a certified laboratory with proper labeling and chain of custody restrictions implemented.

Operators will also be responsible for conducting zeolite cell regeneration tasks. They will be responsible for mixing the diluted-acid regeneration solution, transfering that solution to the cells, pumping the solution from the cells to the evaporation pond(s), and rinsing the cells. Once the cells have been regenerated, operators will be able to return the system to full operation. Volumes of regeneration solution will be required to be recorded from a totalizing flow meter.

II. MONITORING PLANS AND DISCHARGE WATER QUALITY

Operational Monitoring

As described previously, operators will be required to routinely monitor the system for operating efficiency and to detect potential operational problems with the system efficiency. The system is designed such that it will require pH to be routinely monitored so as to maintain treatment efficiency. pH electrodes are designed to be installed in each feed water pipeline after acid addition to ensure the acid feed water is at the desired pH range, thereby ensuring bicarbonate dissolution. In addition, pH electrodes are designed to be installed at the discharge end of each treatment cell to monitor the pH range throughout the system.

The system design is such that the electrodes may be monitored at the system or remotely from onsite or offsite computers. While in-line pH electrodes can be used for monitoring, routine (e.g., daily) field samples will be required to ensure the electrodes are calibrated and operating correctly. On-site field pH equipment will be required to be available for this task. All field test equipment will be required to be calibrated routinely according to factory calibration methods. Samples may be taken and submitted to a certified laboratory for analysis and compared to the field results.

Uranium samples will be required to be taken routinely to monitor the treatment efficiency and to evaluate zeolite loading. Samples will be required to be analyzed on-site with a KPA. As with all sophisticated laboratory equipment, the analyzer will be routinely calibrated according to its manufacturer's recommendations.

Key site personnel will be required to be trained to operate the analyzer. On a routine basis consistent with the requirements prescribed in Discharge Permit DP-200, samples will also be required to be submitted to a certified laboratory. The KPA can be calibrated based on the correlation between the lab results and the intermediate results produced by the KPA. As stated above, the KPA will be used as a field indicator of uranium concentrations. It is not intended to ensure any sort of regulatory compliance. The agreed upon site standard for uranium (0.16 mg/L), as stipulated in HMC's RML, will be used as the control indicator for discharge.

Regulatory Monitoring

Discharge Permit DP-200 outlines the regulatory monitoring requirements for the zeolite water treatment system. The treated effluent will be sampled and monitored in accordance with the periodicities stipulated in Discharge Permit DP-200 (e.g., on a weekly basis for a period of at least three months when the treated effluent is used as injectate). For this period, treated effluent will be required to be sampled for analysis of uranium (mg/L), selenium (mg/L), sulfate (mg/L), chloride (mg/L), TDS (mg/L), and nitrate (mg/L).

Zeolite treated water may be blended with effluent water from the RO plant in a specially designated post treatment tank and used as injectate. The regulatory compliance location for sampling purposes is expected to be downstream of the confluence of the RO and zeolite effluents.

Following three months of sampling, HMC may request that frequency of sampling and the number of sample parameters be reduced so long as the data indicates that compliance issues will not exist with a less frequent sampling pattern and sample parameter list.

III. CONTINGENCY PLANS

HMC personnel, RIMCON, and design engineers conducted a risk assessment to identify, define, and assess the potential for upset conditions to occur as a result of the design, construction, and operation of the zeolite water treatment system. As a result of these assessments, numerous design features were developed to mitigate the potential for an upset event to occur.

Discussions related to spills and unexpected operational shutdown(s) of the system resulted in the system being designed to allow for a 20-hour retention of all water at a 1200 gpm flow rate. This feature incorporates berms around the perimeter of all 12 cells and around the process facilities (See Exhibit 6.0). The entire area within the berm is planned to be lined with synthetic liner with an approximate thickness of 60 mil. for extended containment.

Without any controls in place, handling of acid also presents a risk to operators and potentially to the environment if a spill were to occur. By instruction protocols, as well as by design of the acid systems, risk control features have been incorporated into the design (e.g., safety showers, personal protective equipment, keyed acid nipples, dosed acid injection features, and eyewash stations). All operators and acid haulers will be required to wear safety attire including rubber or Tyvek clothing, eye shields, hardhats, and rubber gloves when working with the acid supply and storage equipment. The design of the process control building includes separation of acid metering equipment from the rest of the control building operations. In addition to all of the aforementioned, wherever practical and necessary, physical components and fittings capable of handling acid have been selected.

As shown on Exhibit 11.0, the system is designed such that acid storage will occur in double walled (double containment) acid tanks. The tanks are designed to be placed on a concrete pad and anchored with cables. The location of the acid storage tanks is expected to be to the west side of the constructed system and is designed to allow for easy and safe access to the tank by acid haulers.

As described above, the acid offload site will be designed with a safety shower. In the unlikely event of a spill, locating the treatment system and the acid tanks on the LTP provides containment of any spilled solution.

The system is designed such that feed water flow may be continually monitored at the system by totalizing flow meters. The meters can be read manually at the control buildings or remotely by computer. The system is designed such that any change in system flow rates may be detected prior to those flow variations having any significant effect on the system operation. In addition, the third cell of each treatment train is designed to be equipped with an ultrasonic water level indicator that can be read at the control building or by remote computer. The level indicator will be programed to read when the water level in the cells exceeds the operational water level range. Early detection of the rising water is designed to prevent an upset condition from occurring.

Flow from the system is designed to occur via gravity from the LTP to the north and south well fields. The system is designed such that treated water will still be allowed to flow (unless manually stopped by operators) to the injection wells even if electrical outages occur. In addition, the discharge manifold is equipped with an actuated valve that is designed to open to an emergency overflow if a problem exists in the pipelines downstream from the manifold. All pipelines and fittings to and from the treatment system are expected to be buried, insulated, or covered to prevent freezing of lines during extreme cold conditions.

IV. WASTE STREAM QUANTITY AND DISPOSITION

The only waste stream expected to be produced by the zeolite process is from the regeneration solution (diluted acid containing high concentrations of uranium and other COCs). Regeneration of the zeolite is accomplished with a diluted acid solution rinse of each zeolite cell. Each acid rinse will normally be followed with two water rinses. The volume of diluted acid solution needed for each cell regeneration cycle is approximately

18,000 gallons. The gravel field under the zeolite will hold approximately 9,000 gallons of solution, so the combined regeneration solution volume needed for each cell is approximately 27,000 gallons. Likewise, each water rinse requires approximately 27,000 gallons of water to rinse each cell. Acid storage tanks and proper secondary containment are required for the sulfuric acid systems. The zeolite media itself is expected to last the duration of the restoration process (i.e., at least six years); that is to say, the zeolite media itself is not expected to need replacement, it can be regenerated hundreds of dozens of times and still effectively recover uranium from impacted groundwater.

The volume of waste generated from the zeolite water treatment system can be calculated as follows:

<u>Maximum Flow Volume:</u>

1500 gpm X 60 min/hr X 24 hrs/day X 360 days = 788,400,000 gallons per year

<u>Regeneration Volume:</u>

27,000 gal/rinse X 3 rinses/cell X 15 cells X 8 regeneration cycles = 9,720,000 gallons

<u>Total Annual Treatment Capacity Volume:</u>

788,400,000 gallons – 9,720,000 gallons = **691,200,000 gallons**

The regeneration volume (concentrate) represents approximately **1.25%** of the total treated annual water volume and is significantly lower than other treatment options. The above numbers are nominal values based upon extrapolations from the pilot studies. Since the figures used in the calculation above are nominal, figures from actual operations under steady-state conditions are expected to result in a lower annual consumption of acid, and therefore, a lesser volume of waste; that is to say, the waste stream calculation above is believed to be sufficiently conservative.

In addition to the quantity of treated water and quantity of regeneration solution, it is also important to understand the quality of the regeneration solution that may be allowed to go to the evaporation pond. Data was collected from regeneration solution over the course of the pilot testing period. Information is provided in Table 1.0 for TDS, uranium, sulfate, chloride, and pH per the acid rinse and two water rinse cycle.

Table 1.0 - Expected Regeneration Solution Quality

Parameter	Acid Solution	Water Rinse #1	Water Rinse #2
TDS – mg/L	30,000 to 35,000	9,000 to 12,000	2,000 to 3,000
Uranium – mg/L	25 to 40	5 to 15	0.5 to 1.0
Sulfate – mg/L	3,000 to 4,500	2,000 to 3,000	1,000 to 1,500
Chloride – mg/L	200 to 400	200 to 400	200 to 400
pH – std. units	0.5 to 1.5	3.0 to 4.0	5.0 to 6.0

V. ASSOCIATED GROUND WATER QUALITY MONITORING, FREQUENCY, AND ANALYTICAL SUITES

Compliance sampling of groundwater for the zeolite water treatment system is expected to take place at the confluence of the north and south well field influent pipeline, prior to the water reporting to the zeolite water treatment system. The proposed operation plan calls for routine samples to be collected to analyze for uranium using the KPA analyzer described in Section II above. For the first three months of operation, the influent will be sampled approximately weekly at the same time the discharge effluent sampling occurs (See Section II). These samples will be analyzed to ensure the agreed upon site standards for selenium, uranium, molybdenum, sulfate, chloride, TDS, nitrate, vanadium, thorium 230, and radium 226 + 228 are being satisfied. After the three month period, it is anticipated that the sampling frequency will be reduced for the treatment effluent and the sampling frequency for the influent will be reduced accordingly.

As part of the pilot test procedures, laboratory samples were taken to ascertain the effectiveness of the treatment process on the constituents of the alluvial aquifer site standards. Table 2.0 summarizes the results of the site standard testing.

Table 2.0 Alluvial Aquifer Site Standards: Before and After Zeolite Treatment

Constituent	Unit	Site Std.	Well field Average	Zeolite Discharge Average	Comment
Selenium	mg/L	0.32	0.41	0.42	No change
Uranium	mg/L	0.16	0.40	0.058	Reduced
Molybdenum	mg/L	0.10	0.022	0.030	No change
Sulfate	mg/L	1500	737	1115	Slight increase
Chloride	mg/L	250	188	181	No change
TDS	mg/L	2734	1720	1895	Slight increase
Nitrate	mg/L	12	2.50	2.43	No change
Vanadium	mg/L	0.02	Non-detect	Non-detect	No change
Thorium 230	piC/L	0.30	Non-detect	Non-detect	No change
Radium 226+228	piC/L	5.0	Non-detect	Non-detect	No-change

As shown in the table, sulfate concentrations increased approximately 50% over the well field average after zeolite treatment but are well below the site standard. Sulfuric acid is used in the process and results in an increase of sulfate concentration. The TDS concentration increased slightly over the south collection well concentration, again due to the use of sulfuric acid during operation. No significant changes in concentrations were observed after treatment for selenium, molybdenum, chloride, nitrate, vanadium, thorium 230, and radium 226 + 228.

VI. TREATED WATER DISCHARGE RATES

At 1500 gpm design capacity, the proposed zeolite-based water treatment system is designed to treat 788,400,000 gallons of water annually and discharge a maximum of approximately 691,200,000 gallons of water annually (subtracting for waste streams).

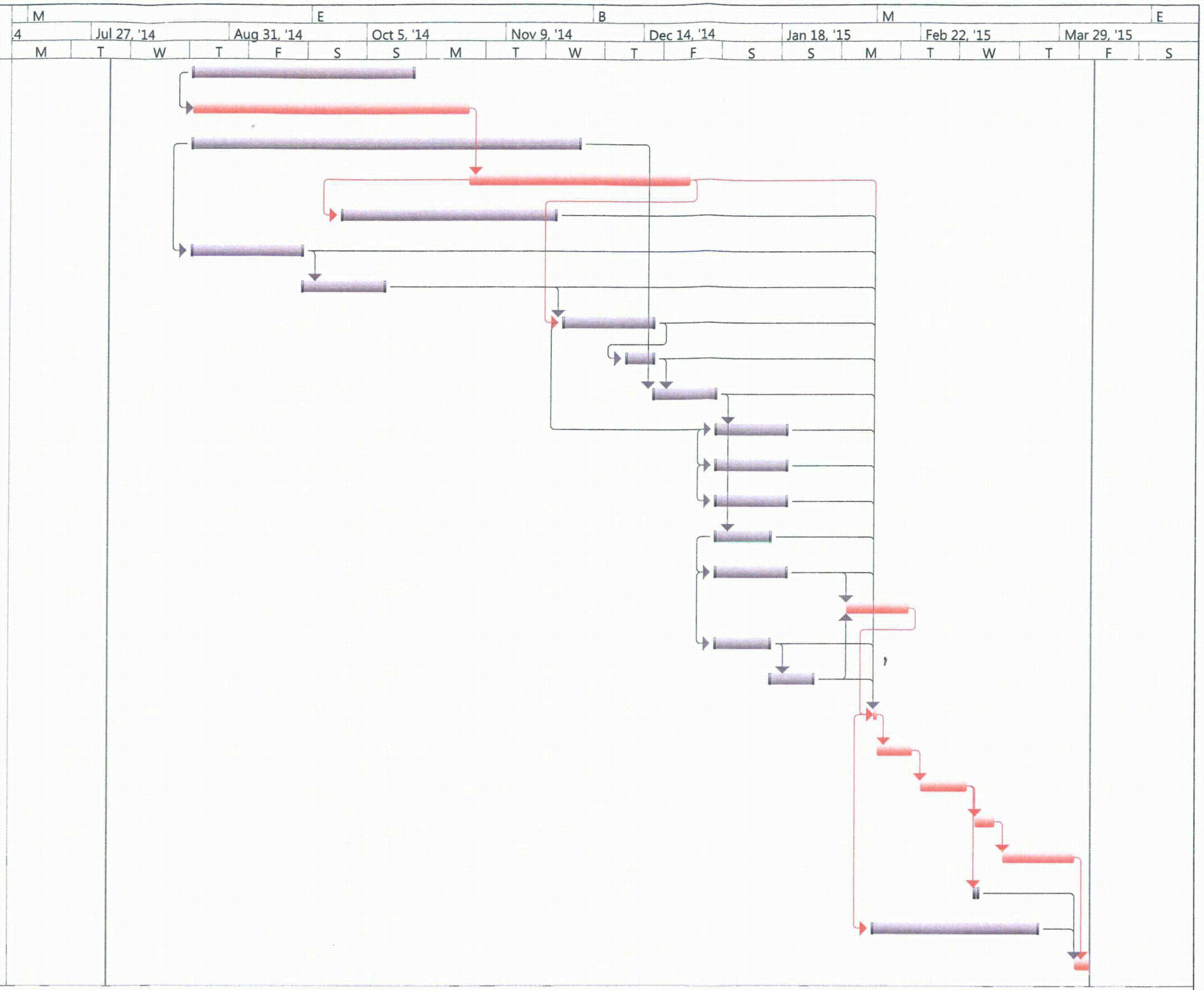
As these figures represent nominal, maximum design values, actual steady state operation, are expected to result in somewhat lower discharge rates. During regeneration cycles, the incoming feed water is consumed by the regeneration process. Even though the design has factored in several operational safeguards, it is assumed that there will be unexpected periods of downtime and other interruptions to operation due to extenuating circumstances (e.g., inclement weather, power outages, etc.).

It is expected that the steady state effluent discharge quantity will be approximately 740,000,000 to 775,000,000 gallons, which represents a steady-state treatment capacity of approximately 1400 to 1475 gpm for the combined 1200 gpm and 300 gpm systems when operational and regeneration losses are included.

SCHEDULE

The construction of the 1200 gpm zeolite-based uranium water treatment system is expected to take four to six months to complete. The following chart (Table 3.0) depicts the current planned construction activities. Note that while the expected timeline will remain similar, the dates of startup and completion will slide as permitting tasks are completed.

ID		Task Name	Duration	Start	Finish
1		Borrow Soil Excavation & Hauling	40 days	Fri 8/22/14	Thu 10/16/14
2		Pad Construction & Compaction	50 days	Fri 8/22/14	Thu 10/30/14
3		Zeolite Purchase and Delivery	70 days	Fri 8/22/14	Thu 11/27/14
4		Water Supply Pipe & Fititngs Install	40 days	Fri 10/31/14	Thu 12/25/14
5		Discharge Pipe & Fittings Install	40 days	Mon 9/29/14	Fri 11/21/14
6		Liner Purchase and Delivery	20 days	Fri 8/22/14	Thu 9/18/14
7		Liner and Pipe Boot Installation	15 days	Fri 9/19/14	Thu 10/9/14
8		Zeolite Distribution Manifold	17 days	Mon 11/24/14	Tue 12/16/14
9		Washed Gravel Placement	5 days	Wed 12/10/14	Tue 12/16/14
10		Zeolite Placement	12 days	Wed 12/17/14	Thu 1/1/15
11		Regeneration Pipeline Install	12 days	Fri 1/2/15	Mon 1/19/15
12		Regen, Acid Feed, and Water Tanks	12 days	Fri 1/2/15	Mon 1/19/15
13		Acid Tank Installation	12 days	Fri 1/2/15	Mon 1/19/15
14		System Feed Piping Installation	10 days	Fri 1/2/15	Thu 1/15/15
15		Process Control Building Install	12 days	Fri 1/2/15	Mon 1/19/15
16		Instrumentation	12 days	Wed 2/4/15	Thu 2/19/15
17		Regen Pump Install	10 days	Fri 1/2/15	Thu 1/15/15
18		Electrical Supply	7 days	Fri 1/16/15	Mon 1/26/15
19		Begin Start Up Testing	1 day	Wed 2/11/15	Wed 2/11/15
20		Pipeline & System Pressure Testing	7 days	Thu 2/12/15	Fri 2/20/15
21		Zeolite Preparation	10 days	Mon 2/23/15	Fri 3/6/15
22		System Flow Calibration	5 days	Mon 3/9/15	Fri 3/13/15
23		System Adjustements	14 days	Mon 3/16/15	Thu 4/2/15
24		Hexa Armour Install	1 day	Mon 3/9/15	Mon 3/9/15
25		Operator Training	30 days	Wed 2/11/15	Tue 3/24/15
26		Commissioning	2 days	Fri 4/3/15	Mon 4/6/15



Project: Zeolite Construction Sc
Date: Mon 7/7/14

Task	Inactive Task	Manual Summary Rollup	External Milestone	Manual Progress
Split	Inactive Milestone	Manual Summary	Deadline	
Milestone	Inactive Summary	Start-only	Critical	
Summary	Manual Task	Finish-only	Critical Split	
Project Summary	Duration-only	External Tasks	Progress	

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

**HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO
1200 GPM ZEOLITE SYSTEM**

**WITHIN THIS PACKAGE... OR,
BY SEARCHING USING THE
DOCUMENT/REPORT
DRAWING NO. :**

EXHIBITS 1 THROUGH 11

D-01 THROUGH D-11