

APPENDIX F

Wellfield Closure Strategy

- Caliper
- ABI (Acoustic Borehole Image)
- Cement bond logs (only on wells with steel casing) for Part 2 Mechanical Integrity.
- Directional survey

The temperature logs will meet the Part 2 mechanical integrity requirement for wells constructed with PVC and/or FRP materials. The cement bond log will meet the Part 2 mechanical integrity requirement for wells with steel casing.

Existing core holes or other existing borings/wells used for intermediate monitoring will not be tested. The IMWs will be plugged and abandoned prior to injecting in the block in which they are located.

Additional information regarding Mechanical Integrity testing is provided in Attachment P.

3.2.8 Wellfield Closure Strategy

Closure of the wellfield will include rinsing to remove residual PLS and well abandonment, as discussed in the sections below. The closure strategy consists of the following elements:

- Rinsing
- Well plugging and abandonment
- Report preparation
- Post-closure monitoring

3.2.8.1 Rinsing

A rinsing closure strategy is proposed for the wellfield. After copper recoveries drop below the economic cutoff, ISR in a given production block will be deemed complete and the block will be rinsed using fresh groundwater until applicable water quality standards are met. A flow chart that summarizes the closure strategy is provided as Figure A-18.

Based on geochemical modeling by Duke HydroChem (Attachment H-2), the following 3-step rinsing strategy is proposed:

- Rinse three (3) pore volumes (based on a 3% fracture porosity of the ore body)
- Rest
- Rinse two (2) pore volumes

Step 1 will result in a mix of 5% PLS and 95% groundwater after rinsing with three pore volumes, based on core tray and column testing documented in a rinsing report by Clear Creek (Attachment H-3). The mechanism by which solute is removed during Step 1 is advective flow, i.e. flushing of the fractures.

Step 2 allows the solution to be neutralized as silicate and carbonate minerals are altered. Solute concentrations will be controlled by precipitation of secondary minerals and complexation (sorption) on hydrous ferric oxide surfaces. The resting period will continue until pH of the resident solution is circumneutral and all regulated constituents are at or below AWQs and MCLs. The geochemical model results indicate that these conditions would be attained after a resting period of approximately one year (Attachment H-2).

Step 3 is a final rinse of two pore volumes. This step will facilitate removal of any constituents that might still be present at or near regulatory limits. Similar to Step 1, the solute removal mechanism of Step 3 is flushing.

To get to final closure, the following steps (which are also shown on the flow chart—Figure A-18) will be taken:

- Monitoring of groundwater from the mining block after rinsing will be conducted to evaluate the effectiveness of the rinsing. For mining block 1, all extraction wells will be sampled to characterize post-rinsing groundwater quality after step 3. If the data from mine block 1 indicate that sampling 10%² of recovery wells will adequately characterize post-rinsing groundwater conditions, in subsequent blocks rinse verification samples will be collected from approximately 10% of the recovery wells within the mining block after step 3. This represents approximately one well for every 1.5 acres of the wellfield (Figure A-19). These wells (approximately one well per 1.5 acres) will be designated the “Rinse Verification Wells” (RVWs). The RVWs will remain open and available throughout the mine life to assist with closure verification and post rinse remediation if required. Analyses will be conducted for UIC permit and APP-regulated metals (dissolved), sulfate, TDS, pH, VOCs³ and specific conductance. Excelsior will select these wells based on their spatial, geological, hydrogeological, and geochemical representativeness. Only recovery wells will be sampled, as rinsed injection wells will not be representative of the bedrock groundwater chemistry. If analyses

² In Mine Block 1, 100% of recovery wells will be sampled. Following EPA’s approval of a demonstration that sampling 10% of recovery wells is statistically equivalent to 100%, the sampling frequency will be 10% thereafter.

³ Excelsior proposes to use the full EPA 8260B analyte list for VOC analyses, as listed in the EPA Method.

- indicate that AWQs or MCLs are not achieved in the block, rinsing and/or resting will resume.
- When AWQs and MCLs are achieved in the RVWs, the remaining (non-RVW) wells in the mining block will be plugged and abandoned, leaving only the RVWs which represent approximately one well per 1.5 acres.
 - An appropriate number (a subset) of RVWs will be selected as post-rinse IMWs. These wells will be selected to intersect major flow pathways while providing good geographic coverage. Their purpose is to identify possible migration of mining fluids from adjacent active mining areas back into previously-rinsed mining blocks. These IMWs will be continuously monitored for water elevation and specific conductance. A post-rinse ambient specific conductance level for the RVWs will be set as an AL that is indicative of compliance with AWQs and MCLs, based on empirical data (“post-rinse AL”) gathered during previous monitoring.
 - In the event of increasing specific conductance above the ALs in the IMWs, Excelsior will implement one or more of the following response(s):
 - Continued monitoring to establish neutralization capacity and/or
 - Adjust operations to reverse the trend (pull back solutions) and/or
 - Adjust nearby rinsing operations to reverse the trend
 - When an area is to be closed because it is the end of the mine life or there is no future mining planned adjacent or up-gradient, a subset of the RVWs will be identified (approximately 1 well every 13.5 acres as shown on Figure A-19). These wells will be designated as “Closure Verification Wells” or CVWs. CVWs will remain open through the life of the project, until their abandonment after post-closure monitoring is complete. Samples from these wells will be analyzed by laboratory methods for APP-regulated metals (dissolved), sulfate, TDS, pH, VOCs and specific conductance. When all CVWs in an area meet AWQS or MCLs then applicable hydraulic control wells will be turned off (but not abandoned), and post-closure monitoring will begin.
 - Post-closure monitoring will be conducted to determine if rebound above AWQS or MCLs has occurred. Monitoring of CVWs and outer observation wells will continue once per year until five consecutive years of CVWs and outer observation wells meeting AWQSs and MCLs has occurred. If in any year AWQSs or MCLs are not met in a particular area, appropriate HC wells can be turned back on and additional pumping, rinsing or resting of CVWs and/or adjacent RVWs can occur.
 - When all CVWs and outer observation wells have met AWQSs and MCLs for five consecutive years, monitoring will stop and all wells (RVWs, CVWs, HC, Observation and POC) will be plugged and abandoned.

Hydraulic control will be maintained and monitoring of POC wells will continue, as required under the APP, until closure goals are achieved. Prior to well plugging and abandonment of a mining block, a report will be submitted to ADEQ and EPA documenting the rinsing and monitoring data. The report will include documentation of the volumes of rinse water injected and recovered, results of laboratory analytical analyses after Step 3, and a recommendation will be provided on whether additional rinsing is needed. Well plugging and abandonment will not commence without approval from ADEQ and EPA. As discussed above, approximately one well every 1.5 acres will be designated as Rise Verification Wells (RVWs), a subset of which will become either post-rinse IMWs or later Closure Verification Wells (CVWs) and will not be abandoned until the end of the life of mine, to allow for monitoring as described above.

Well rinsing costs for Stage 1 operations are provided in revised Attachment R-3.

3.2.8.2 *Well Plugging and Abandonment*

Well plugging and Abandonment procedures will be conducted according to the methodology in Attachment Q-1.

After the goals of the rinsing are met, the wells in the wellfield, which are classified as Class III injection wells under the UIC regulations, will be plugged and abandoned, as required under 40 CFR 146.10 and the UIC permit. This requires that wells be abandoned in such a way that fluid will not move into USDWs. In addition to the federal requirements, AAC R12-15-816 contains abandonment requirements and additional guidance is provided in the ADWR Well Abandonment Handbook (ADWR, 2008). The handbook states that the abandonment of a well be accomplished “through filling or sealing the well so as to prevent the well, including the annular outside casing, from being a channel allowing the vertical movement of water.” Class III Well plugging and Abandonment procedures will be conducted according to Attachment Q-1.

Following the plugging and abandonment of Class III injection/recovery wells, reports will be filed with state and federal agencies as described below.

- ADWR: Within 30 days of the completion of plugging and abandonment, the drilling contractor will submit a Well Abandonment Completion Report (Form 55-58) to ADWR. Within 30 days of completion of plugging and abandonment, Excelsior or their designee will submit a Well Owner’s Notification of Abandonment (Form 55-36). The forms are included as Exhibit B.
- USEPA: Excelsior will report plugging and abandonment activities in the quarterly monitoring reports sent to the USEPA Director. The plugging and abandonment will be included in the quarterly report for the quarter in which the

activities were completed. Reporting data will include an updated version of Form 7520-14 and copies of the forms sent to ADWR described above.

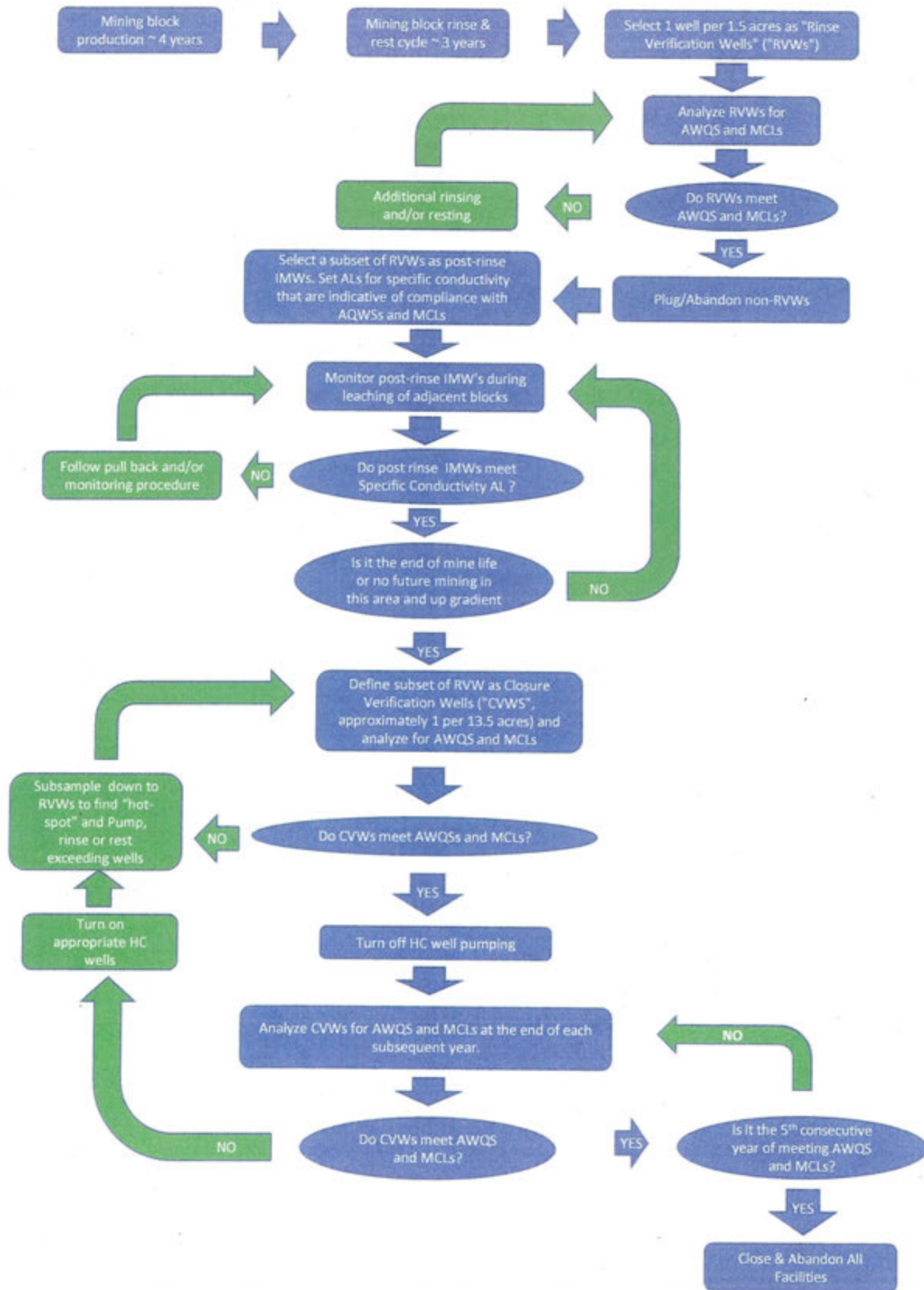
- ADEQ: Will receive copies of all documentation of plugging and abandonment activities that are sent to ADWR and USEPA.

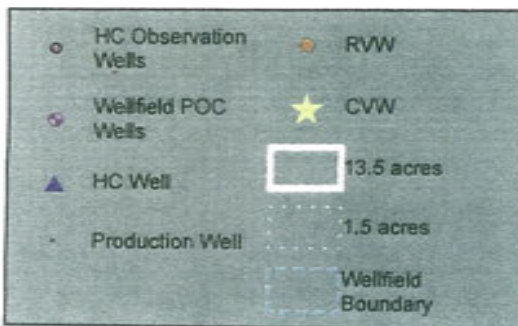
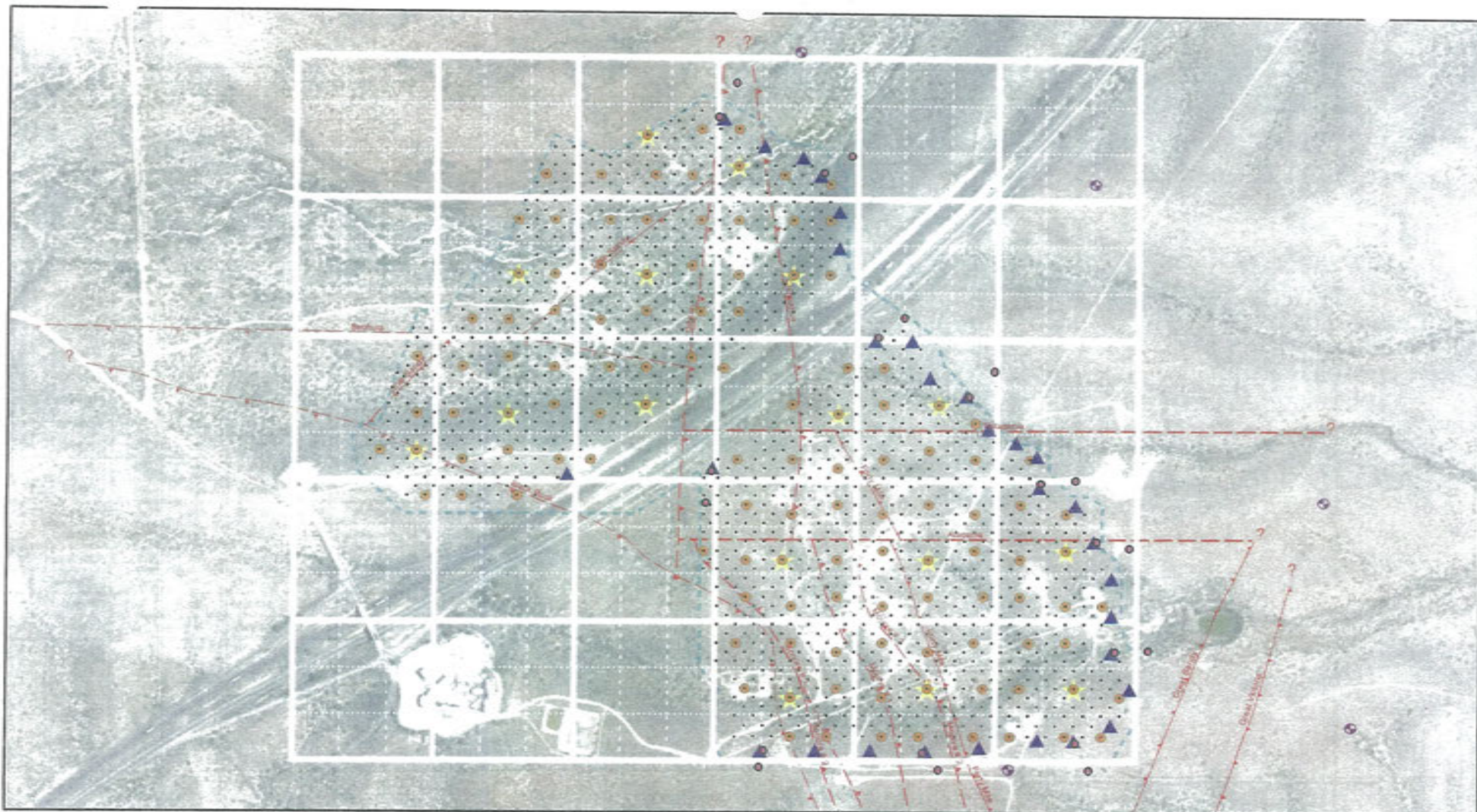
3.2.8.3 *Post-Closure Groundwater Monitoring*

Geochemical modeling (Attachment H.2) has shown that AWQs will be achieved after rinsing. Post closure monitoring will be conducted. Because Excelsior intends to rinse until MCLs and AWQs are achieved within the wellfield, monitoring at the POCs will not be conducted. Rather, post-closure monitoring will be conducted to determine if rebound above AWQs or MCLs has occurred. Monitoring of CVWs and outer observation wells will continue once per year until five consecutive years of CVWs and outer observation wells meeting AWQs and MCLs has occurred. If in any year AWQs or MCLs are not met in a particular area, appropriate HC wells can be turned back on and additional pumping, rinsing or resting of CVWs and/or adjacent RVWs can occur. post-closure monitoring will be conducted at the selected CVWs within the wellfield and outer observation wells for 5 years. The samples will be collected annually, according to the methodology prescribed in the permit.

When all CVWs and outer observation wells have met AWQs and MCLs for five consecutive years, monitoring will stop and all wells (RVWs, CVWs, HC, Observation and POC) will be plugged and abandoned.

FIGURE A-18: Closure Strategy Decision Tree





1,000 500 0 1,000 Feet



Excelsior Mining Arizona Inc.
Gunnison Copper Project
Date Revised: 2/21/2017



Coordinate System: NAD
1983 StatePlane Arizona
East FIPS 0201 Feet

FIGURE A-19 CLOSURE AND POST-CLOSURE MONITORING LOCATIONS