FLORENCE COPPER

FLORENCE COPPER INC.
1575 W. Hunt Highway, Florence, Arizona 85132 USA
florencecopper.com

September 23, 2021

Ms. Nancy Rumrill
Water Division
U.S. EPA, Region IX (WTR-4-2)
75 Hawthorne Street
San Francisco, California 94105

Re: Response to Request for Additional Information in Support of Underground Injection Control (UIC) Permit Application No. R9UIC-AZ3-FY19-1, May 5, 2020 Southwest Value Partners Aquifer Exemption Petition, Florence Copper Project, Florence Arizona

Dear Ms. Rumrill:

Florence Copper Inc. (Florence Copper) herewith transmits supplemental information in response to a written request received from U.S. Environmental Protection Agency (USEPA) dated September 13, 2021 regarding groundwater modeling results submitted previously in support of capture zone analyses for wells located in the vicinity of the Florence Copper site.

The text of each information request is provided below, followed by our response, which includes references to the attached materials.

Request 1:

As described in FCI's May 20, 2021 response to request #3, please provide a contour map for Q4 2020 groundwater elevations similar to Figure 14A-10, Exhibit A-1, in the 2012 UIC application for the Production Test Facility.

Response 1:

Figure 14A-10 reflects groundwater elevations within the groundwater model domain based on regional water level data available from the Arizona Department of Water Resources (ADWR) Groundwater Site Inventory (GWSI) database in 2010. The frequency of GWSI water level data collection varies and is not strictly collected on a quarterly basis. Water level data are collected from select GWSI wells on an annual basis, others are less frequent. Figure 14A-10 was prepared using water level data collected within the year 2008, the most recent full set of data available at the time.

Haley & Aldrich, Inc. prepared a new groundwater contour map reflecting groundwater elevations within the groundwater model domain area represented in the 2012 Figure 14A-10. The water elevation data used to create the new map were collected in November and December of 2020. Although the reported groundwater elevations have changed since the 2008 data were collected, the groundwater flow direction(s) represented by the 2020 groundwater elevation data are similar to those shown on the earlier map and are consistent with those reflected on Figure 14A-10. The updated groundwater contour map is provided herewith as Figure 1.

Request 2:

Table A-3 in the 2019 groundwater modeling report of the UIC application listed the porosity of the oxide layers as a constant 8 percent while Table 1 in the March 2021 model results lists the oxide porosity as 5-8 percent.

Please clarify the inconsistent porosity of the oxide layers in the 2019 and 2021 modeling reports and provide the basis for the porosity values used in the 2021 modeling results.

Response 2:

Table A-3 of the UIC application lists porosity values determined for the bedrock oxide unit at the Production Test Facility (PTF) based on neutron logging, and these values were applied to the calibrated groundwater flow model during the update conducted in 2019. Table 1 of our March 29, 2021 submittal reflected the range of porosity values used to develop the original model, rather than porosity values developed from neutron logging at the PTF. In response to a request from USEPA, Table 1 was updated to reflect the 8 percent porosity values derived from neutron logging which were applied in the 2019 updated model. The Technical Memorandum with the updated Table 1 were submitted to USEPA on August 9, 2021 and are attached hereto.

Request 3:

Please clarify the illustration of particle tracking for 150 years in Figures 5 and 7 in FCI's May 20, 2021 response and whether results represent the influence of just the three closest Anthem wells or all seven of the Anthem wells located within three miles of the AE boundary, or all wells pumping from the oxide and LBFU aquifers in the model domain for 150 years.

Response 3:

The particle tracking results shown in Figures 5 and 7 of Florence Copper's May 20, 2021 response represent the influence of all pumping wells within the model domain. All of the pumping wells included in the model domain remain pumping throughout all of the model simulations (both 55-year and 150-year), as described in the Technical Memorandum. The active pumping wells within the model domain include all known active municipal and domestic water supply wells and irrigation wells based on the most recent ADWR records available when the model scenarios were run.

Please contact me at 520-316-3710 if you require any additional information.

Sincerely,
Florence Copper Inc.

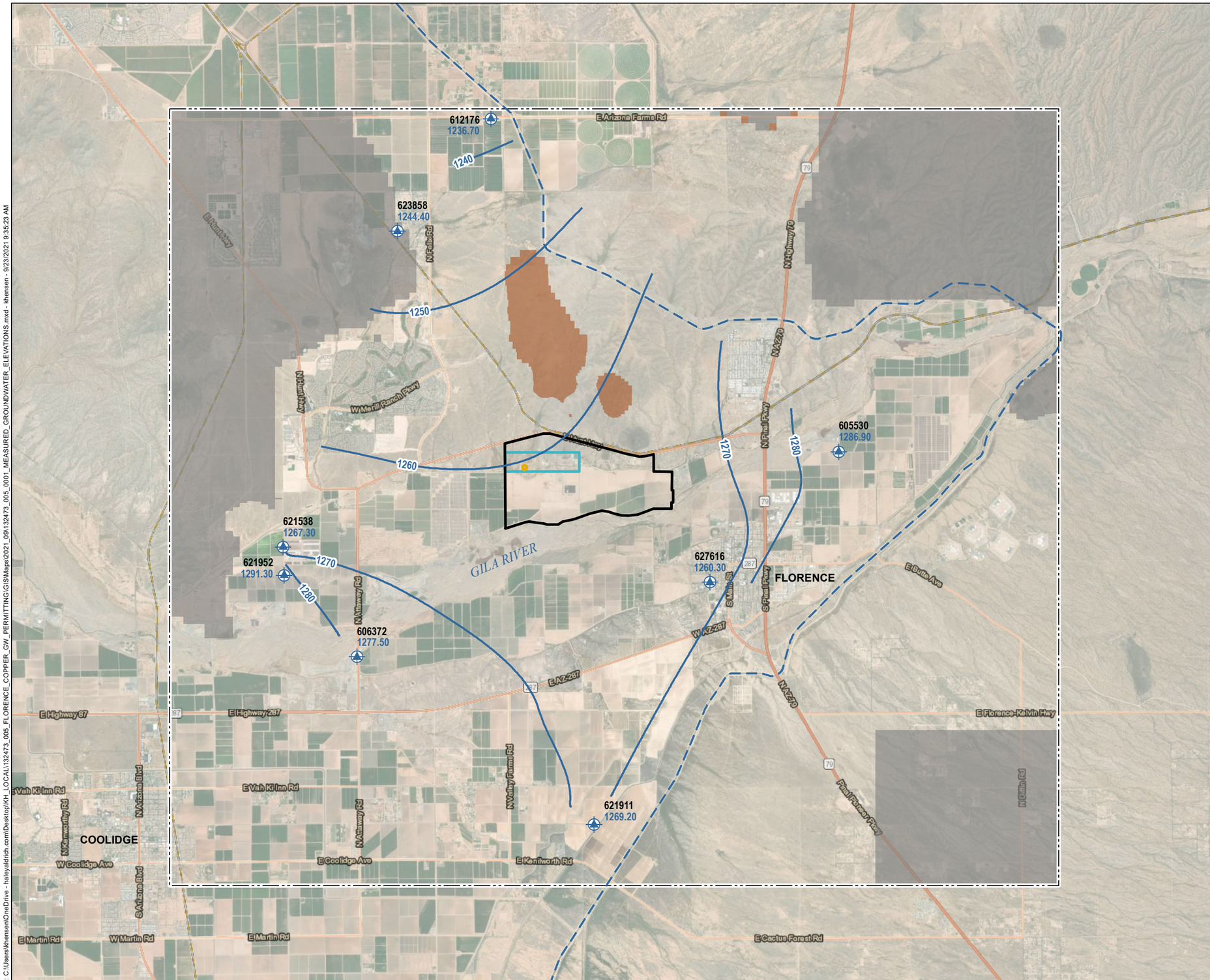
Brent Berg
General Manager

Attachments:

Figure 1 – Measured Groundwater Elevations – November and December 2020
Irrigation Well Groundwater Model Simulations Provided in Support of Florence Copper's October 2019 Application for UIC Permit Technical Memorandum, Dated March 19, 2021

cc: Maribeth Greenslade, Arizona Department of Environmental Quality

ATTACHMENTS



LEGEND

- GROUNDWATER ELEVATION WELL WITH **GROUNDWATER ELEVATION**
- GROUNDWATER ELEVATION CONTOUR, 10-FT INTERVAL
- CENTRAL ARIZONA PROJECT (CAP) CANAL
- DRY CELLS
- NO FLOW CELLS
- PRODUCTION TEST FACILITY (PTF) WELLFIELD
- STATE MINERAL LEASE BOUNDARY
- PROPERTY BOUNDARY
- MODEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GROUNDWATER ELEVATION DATA SOURCE: ARIZONA DEPARTMENT OF WATER RESOURCES (ADWR) GROUNDWATER SITE INVENTORY (GWSI) DATABASE, NOVEMBER AND DECEMBER 2020
3. AERIAL IMAGERY SOURCE: ESRI, 2020

N

0 7,000 14,000
SCALE IN FEET

HALEY ALDRICH

FLORENCE COPPER INC.
FLORENCE, ARIZONA

MEASURED GROUNDWATER ELEVATIONS - NOVEMBER AND DECEMBER 2020

FLORENCE COPPER

SEPTEMBER 2021

FIGURE 1

GIS: C:\Users\khensen\OneDrive - haleyaldrich.com\Desktop\KH_LOCAL\132473_005_FLORENCE_COPPER_GW_PERMITTING\GISMaps\2021_09\132473_005_0001_MEASURED_GROUNDWATER_ELEVATIONS.mxd - khensen - 9/23/2021 9:35:23 AM

HALEY & ALDRICH, INC.
One Arizona Center
400 E. Van Buren St., Suite 545
Phoenix, AZ 85004
602.760.2450

TECHNICAL MEMORANDUM

19 March 2021
Revised: 6 August 2021
File No. 132473-005

TO: Florence Copper Inc.
Brent Berg, General Manager

FROM: Haley & Aldrich, Inc.
Jacob Chu, Ph.D.
Miao Zhang, P.E.
Mark Nicholls, R.G.

SUBJECT: Irrigation Well Groundwater Model Simulations Provided in Support of Florence Copper's October 2019 Application for UIC Permit

At the request of Florence Copper Inc. (Florence Copper), Haley & Aldrich, Inc. (Haley & Aldrich) conducted model simulations to evaluate the effects of pumping at two new irrigation wells, designated N1 and N2. These wells would be operated during and after the in-situ copper recovery (ISCR) operations that are planned to occur under the above-reference underground injection control (UIC) permit (Permit), in lieu of existing irrigation wells BIA-9 and BIA-10B which would be plugged and abandoned in accordance with the terms of the Permit. The well locations are depicted in Figure 1.

Haley & Aldrich's simulations consisted generally of two parts: (1) evaluation of the possible effects of operating the new irrigation wells on migration of ISCR-injected fluids (ISCR Injection Simulations); and (2) evaluation of the possible effects of operating the new irrigation wells on the discharge impact area for a hypothetical period of 30 years following the conclusion of ISCR operations (Discharge Impact Area Simulation). Each simulation was run as a solute transport simulation using the same groundwater model described in Attachment A of the 4 October 2019 application for the UIC permit (Application). Specifically, the ISCR operations, discharge impact area, and other model inputs and configurations were held the same as described in Attachment A of the Application, including Section A.3.2.2 and Exhibit A-2, with the exception of the two new irrigation wells and update of planned facility makeup water production. The simulations and their results are described below.

Updated Model Used to Conduct the Simulations

The original groundwater flow model was developed as part of a hydrogeologic study conducted in support of the UIC permit and aquifer protection permit (APP) applications. The original model had a calibration period extending from 1984 through 2010 and was used by the U.S. Environmental Protection Agency (USEPA) to assess hypothetical, potential discharge impacts resulting from Florence Copper's ISCR production test facility operations.

As described in Attachment A, Exhibit A-2 of the Application, the original model was updated in 2019 in support of the applications for APP and UIC Permit of Florence Copper's planned ISCR commercial operations. The 2019 model update:

- Extended the model to run from 1984 through 2018;
- Incorporated additional regional pumping well and water level data through 2018 (the most recent data available at the time); and
- Was calibrated against additional observed water level data by adjusting the general head and recharge boundary conditions between 2011 and 2018 to reflect variation of water exchange across the model domain.

Model Inputs and Configurations Employed in the Simulations

Hydraulic Properties

All hydraulic properties and boundary conditions used in the 2019 updated model were kept the same for the ISCR Injection Simulations and the Discharge Impact Area Simulation. The hydraulic properties applied at the location of each of the hypothetical injection wells in the ISCR Injection Simulations are listed in Table 1.

General Head Boundaries

The general head boundary (GHB) head value for each GHB cell was set to be the GHB head value for the last stress period in the 2019 updated model, while the GHB conductance remained the same.

Recharge

The recharge distribution was set to be the same as the recharge distribution for the last stress period in the 2019 updated model.

Initial Heads

The simulated head for the last time step of the 2019 updated model was used as the initial head.

Pumping Wells

The pumping conditions for the last stress period of the 2019 updated model (i.e., year 2018) were used. However, added to these conditions was pumping at the additional wells, depicted in Figure 1, each at

its planned capacity with a conservative 100 percent duty cycle. The well names and specified pumping rates are:

- Well N1: 1,030 gallons per minute (gpm)
- Well N2: 1,300 gpm

Wells N1 and N2 were screened in model layers 1 through 5, which is consistent with typical irrigation wells completed in the area.

Note, based on information provided by San Carlos Irrigation Project, the aggregate production capacity of wells BIA-9 and BIA-10B is no more than 2,330 gpm.

Injection Wells

Five injection wells were rendered for the ISCR Injection Simulations. The same five injection wells were considered in the 2019 model runs.

The Sidewinder Fault Injection Well penetrates the fault in model layer 7, just below the exclusion zone in the Bedrock Oxide Unit. The NW Injection Well penetrates the Sidewinder fault in model layer 10, near the base of the Bedrock Oxide Unit. The Bedrock Oxide Unit thins on the eastern edge of the ISCR area and thickens to the west. Where the injection zone thins, the injection rate was reduced below 60 gpm and was set at a value of 0.15 gpm per foot of injection zone. Due to variation in the thickness of the Bedrock Oxide Unit, this adjustment was applied where the injection zone is less than 400 feet thick. Where the injection is thicker than 400 feet, the injection rate was maintained at 60 gpm. The injection zone thickness at the well simulated at the northeastern corner of the ISCR area was approximately 220 feet thick, and consequently, the injection rate at this location was set at 33 gpm. The other four wells were maintained at an injection rate of 60 gpm.

Simulation Period

The simulation periods for the ISCR Injection Simulations were 48 hours and 30 days. The simulation period for the Discharge Impact Area Simulation was 30 years.

Initial Concentrations

In the ISCR Injection Simulations, initial solute concentration was set at 0 milligrams per liter (mg/L) across the entire model domain. In the Discharge Impact Area Simulation, initial solute concentration was set at 0 mg/L across the model domain except for the ISCR wellfield area, which had an initial concentration of 750 mg/L in model layers 7 through 10.

Specified Concentration Boundary

Solute concentrations were set at 10,000 mg/L in the five injection wells in the ISCR Injection Simulations. The concentration of 10,000 mg/L was selected because this concentration reflects a typical ISCR solution composition and is suitable for the fluid migration analyses described in this Technical Memorandum. There is no specified concentration boundary in the Discharge Impact Area Simulation.

Other Transport Parameters and Solver Settings

All other transport parameters and solver settings were kept the same as those used in the 2019 updated model. Longitudinal, transverse, and vertical transverse dispersivity values were 10, 1, and 0.1 feet, respectively. The simulated solute was conservative (with no sorption or reaction).

ISCR Injection Simulations with New Irrigation Wells

Haley & Aldrich used the 2019 updated model to evaluate the potential distance of migration of ISCR injection fluids resulting from ISCR injections at hypothetical injection wells located along the perimeter of the planned ISCR wellfield, with the new irrigation wells pumping. The hypothetical injection wells are the same as those employed in the 2019 model runs. Section A.3.2.2 of the Application explains that the wells' locations were spaced widely apart from one another to allow evaluation of injection zone differences that are reflected in the model construction.

One hypothetical injection well was placed in each corner of the ISCR area and one additional hypothetical injection well was placed in the Sidewinder fault where it crosses the northern boundary of the ISCR wellfield. These wells are identified as NW Injection Well, NE Injection Well, SW Injection Well, SE Injection Well, and Sidewinder Fault Injection Well. The locations of these wells are shown on Figures 2 through 11.

Each of the injection wells was simulated to inject fluids for a period of 48 hours and 30 days, without any extraction pumping or hydraulic control, to evaluate the potential effects of injection under an unrealistic worst-case scenario, as was done for the 2019 model runs.[1]

Figures A-4 through A-13 of the Application depict the results of the 2019 model runs, which were conducted without pumping from the new irrigation wells described in this memo. Those figures are included in Exhibit A-8-1 of this memo.

Figures 2 through 11 of this memo depict the results of the same model runs with the new irrigation wells pumping. The model files for these runs are included in Exhibit A-8-2 of this memo.

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[1] Model scenarios simulating injection without hydraulic control for periods of 48 hours and 30 days were developed based on requests by the USEPA; however, they do not represent planned or realistic ISCR operations. There is no circumstance in which Florence Copper would continue to inject raffinate after a loss of hydraulic control pumping. Based on the applicable contingency plans included in the APP and that would be included in the UIC permit, if hydraulic control is lost, Florence Copper would cease injection and not resume injection until hydraulic control had been reestablished. Moreover, the basic purpose of the pilot-scale ISCR operations, which were conducted under the production test facility (PTF) UIC permit, was to demonstrate that hydraulic control can be maintained to prevent excursions of ISCR solutes beyond the limits of the aquifer exemption. That demonstration was made according to the terms of the PTF UIC permit, using ISCR wells that were constructed and operated in the same manner and at the same depths as the wells that would be constructed and operated for the commercial-scale operations.

The model scenarios and results are discussed below.

NW Injection Well 48 Hours (Figure 2 and Application Figure A-4)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical NW Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 138 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical NW Injection Well for a period of 48 hours without extraction or any type of hydraulic control resulted in up to 125 feet of horizontal migration of injected solution (a difference of 13 feet less migration). The maximum distance of horizontal migration was in model layer 10, where the Sidewinder fault intersects the well.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred 40 feet into model layer 6, which represents the exclusion zone. No migration occurred in the lower basin fill unit (LBFU).
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

NW Injection Well 30 Days (Figure 3 and Application Figure A-5)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical NW Injection Well for a period of 30 days without extraction or any type of hydraulic control resulted in up to 250 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical NW Injection Well for a period of 30 days without extraction or any type of hydraulic control resulted in up to 225 feet of horizontal migration of injected solution (a difference of 25 feet less migration). The maximum distance of horizontal migration was in model layer 10, where the Sidewinder fault intersects the well.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred 40 feet into model layer 6, which represents the exclusion zone. No migration occurred in the LBFU.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

NE Injection Well 48 Hours (Figure 4 and Application Figure A-6)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical NE Injection Well for a period of48 hours without extraction or any type of hydraulic control resulted in up to 66 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical NE Injection Well for a period of 48 hours without extraction or any type of hydraulic control resulted in up to 69 feet of horizontal migration of injected solution (a difference of 3 feet more migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred 30 feet into model layer 5, which represents the lower portion of the LBFU. The full thickness of the LBFU at this well location is approximately 60 feet.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

NE Injection Well 30 Days (Figure 5 and Application Figure A-7)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical NE Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 126 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical NE Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 144 feet of horizontal migration of injected solution (a difference of 18 feet more migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layers, 6, 5, and 4, which represent the exclusion zone and the full thickness (approximately 60 feet at this location) of the LBFU.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

SE Injection Well 48 Hours (Figure 6 and Application Figure A-8)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical SE Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 131 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical SE Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 125 feet of horizontal migration of injected solution (a difference of 6 feet less migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layer 6 (exclusion zone) and 40 feet into model layer 5, which represents the lower portion of the LBFU. The full thickness of the LBFU at this well location is approximately 80 feet.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

SE Injection Well 30 Days (Figure 7 and Application Figure A-9)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical SE Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 189 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical SE Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 175 feet of horizontal migration of injected solution (a difference of 14 feet less migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layers, 6, 5, and 4, which represent the exclusion zone and the full thickness (80 feet at this location) of the LBFU.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

SW Injection Well 48 Hours (Figure 8 and Application Figure A-10)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical SW Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 116 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical SW Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 125 feet of horizontal migration of injected solution (a difference of 9 feet more migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred 40 feet into model layer 6, which represents the exclusion zone. No migration occurred in the LBFU.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

SW Injection Well 30 Days (Figure 9 and Application Figure A-11)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical SW Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 169 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical SW Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 175 feet of horizontal migration of injected solution (a difference of 6 feet more migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layer 6, and 80 feet into model layer 5, which represents the lower portion of the LBFU. The full thickness of the LBFU at this well location is approximately 400 feet.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

Sidewinder Fault Injection Well 48 Hours (Figure 10 and Application Figure A-12)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical Sidewinder Fault Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 82 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical Sidewinder Fault Injection Well for a period of 48 hours, without extraction or any type of hydraulic control, resulted in up to 81 feet of horizontal migration of injected solution (a difference of 1 foot more migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit and the location where the Sidewinder fault intersects the well.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layer 6, and into model layer 5, which represents the lower portion of the LBFU. The full thickness of the LBFU at this well location is approximately 120 feet.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

Sidewinder Fault Injection Well 30 Days (Figure 11 and Application Figure A-13)

Horizontal Migration

- In the 2019 model simulation (without the new irrigation wells pumping), injection at the hypothetical Sidewinder Fault Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 210 feet of horizontal migration of injected solution.
- In the model simulation with the new irrigation wells pumping, injection at the hypothetical Sidewinder Fault Injection Well for a period of 30 days, without extraction or any type of hydraulic control, resulted in up to 181 feet of horizontal migration of injected solution (a difference of 29 feet less migration). The maximum distance of horizontal migration was in model layers 7 and 8, which represent the upper Bedrock Oxide Unit and the location where the Sidewinder fault intersects the well.

Vertical Migration

- In the 2019 model simulation (without the new irrigation wells pumping), the upper limit of vertical migration occurred through model layers, 6, 5, and 4, which represent the exclusion zone and the full thickness of the LBFU. The full thickness of the LBFU at this well location is 120 feet.
- In the model simulation with the new irrigation wells pumping, the vertical migration was the same.

Figure 12 shows a plan view of the maximum distances of migration under the 48-hour and 30-day injection simulations discussed above.

Discharge Impact Area Simulation with New Irrigation Wells Pumping

Attachment A, Exhibit A-2 of the Application describes the 2019 model simulation of solute transport for a period of 30 years after cessation of ISCR operations (including cessation of hydraulic control). Haley & Aldrich reproduced this model simulation with the addition of the new irrigation wells pumping continuously at the rates stated above.

As in the 2019 model run, the extent of migration is defined by the outer 2 mg/L concentration contours for all of the layers. The faults, which were assigned a hydraulic conductivity ten times higher than the surrounding bedrock, slightly enhance migration during the 30-year period.

The solute transport defined by the 2 mg/L concentration contour with the new irrigation wells pumping is shown on Figure 13. For comparison, the solute transport defined by the 2 mg/L concentration contour without the irrigation wells pumping, as reported in Attachment A, Exhibit A-2 of the Application, is also shown on Figure 13.

Please contact Mark Nicholls (602-819-0913) with any questions you may have regarding this memo.

Attachments:

- Table 1 – Groundwater Model Results for Specified Injection Scenarios
- Figure 1 – Location of Subject Wells
- Figure 2 – Cross Sections NW Injection Well, 48 Hours Injection with no Extraction
- Figure 3 – Cross Sections NW Injection Well, 30 Days Injection with no Extraction
- Figure 4 – Cross Sections NE Injection Well, 48 Hours Injection with no Extraction
- Figure 5 – Cross Sections NE Injection Well, 30 Days Injection with no Extraction
- Figure 6 – Cross Sections SE Injection Well, 48 Hours Injection with no Extraction
- Figure 7 – Cross Sections SE Injection Well, 30 Days Injection with no Extraction
- Figure 8 – Cross Sections SW Injection Well, 48 Hours Injection with no Extraction
- Figure 9 – Cross Sections SW Injection Well, 30 Days Injection with no Extraction
- Figure 10 – Cross Sections Sidewinder Fault Injection Well, 48 Hours Injection with no Extraction
- Figure 11 – Cross Sections Sidewinder Fault Injection Well, 30 Days Injection with no Extraction
- Figure 12 – Plan View of Maximum Extent of Migration During 48-Hour and 30-Day Injection Scenarios without Hydraulic Control Pumping
- Figure 13 – Discharge Impact Area 30 Years After Closure with New Irrigation Wells Pumping
- Exhibit A-8-1 – Figures A-4 through A-13 from the 4 October 2019 UIC Application
- Exhibit A-8-2 – Model Files

TABLE

TABLE 1
GROUNDWATER MODEL RESULTS
FOR SPECIFIED INJECTION SCENARIOS
FLORENCE COPPER PROJECT
FLORENCE, ARIZONA

	Simulation Period	Injection Rate (gpm)	Porosity of Oxide Layers (%)	Fault Zone Porosity (%)	Fault Zone Hydraulic Conductivity (ft/day)	Maximum Distance of Horizontal Fluid Migration (Feet)	Vertical Distance of Migration in Exclusion Zone (Feet)	Maximum Distance of Vertical Migration in LBFU (Feet)	Approximate Thickness of LBFU at Injection Well Location (Feet)
NW Well	48 hours	60	8	10	6	125	40	0	330
	30 days	60	8	10	6	225	40	0	330
NE Well	48 hours	33	8	10	6	69	40	30	60
	30 days	33	8	10	6	144	40	60	60
SW Well	48 hours	60	8	10	6	125	40	0	400
	30 days	60	8	10	6	175	40	80	400
SE Well	48 hours	60	8	10	6	125	40	40	80
	30 days	60	8	10	6	175	40	80	80
Sidewinder Fault Well	48 hours	60	8	10	6	81	40	60	120
	30 days	60	8	10	6	181	40	120	120

Notes:

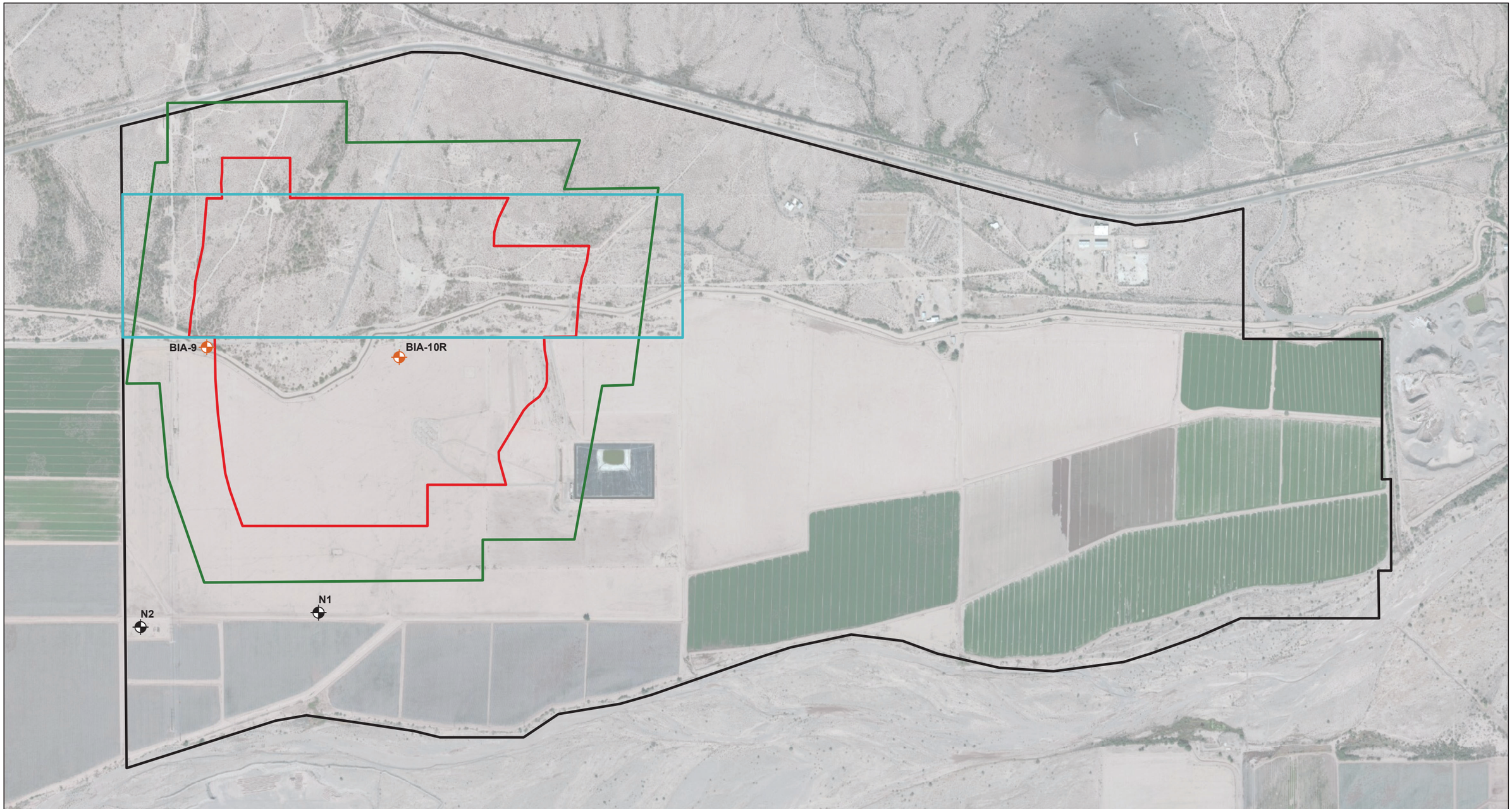
% = percent

ft/day = feet per day

gpm = gallons per minute

LBFU = lower basin fill unit

FIGURES



LEGEND

- NEW IRRIGATION WELL
- EXISTING WELL
- STATE MINERAL LEASE BOUNDARY
- AREA OF REVIEW BOUNDARY
- ISCR WELL FIELD
- FLORENCE COPPER PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

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SCALE IN FEET

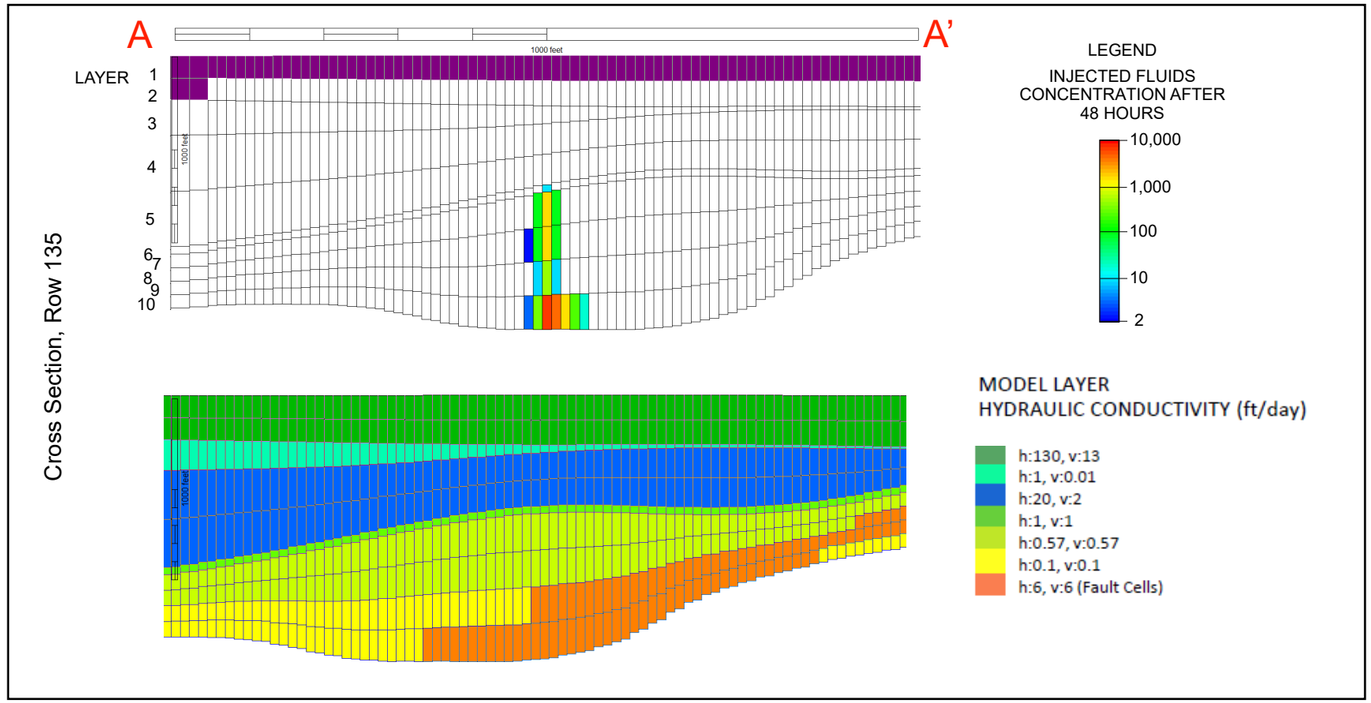
HALEY ALDRICH

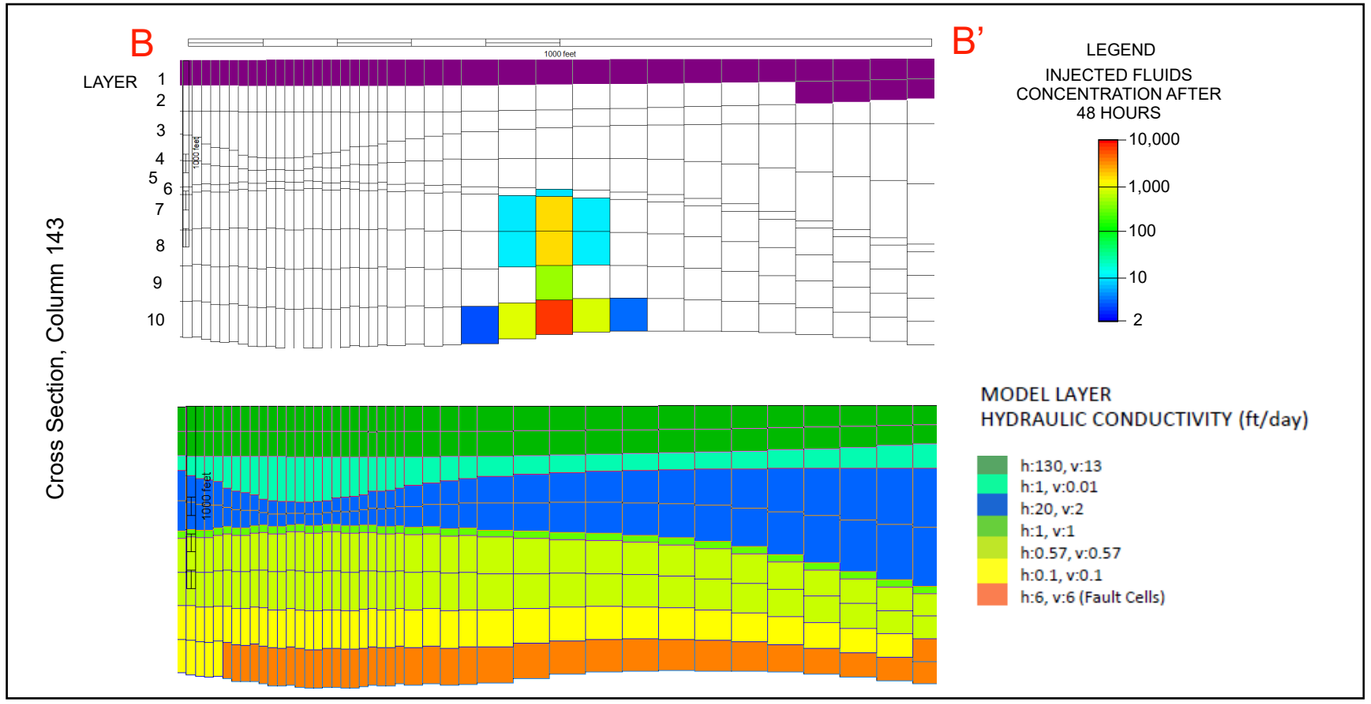
FLORENCE COPPER, INC.
FLORENCE, ARIZONA

LOCATION OF SUBJECT WELLS

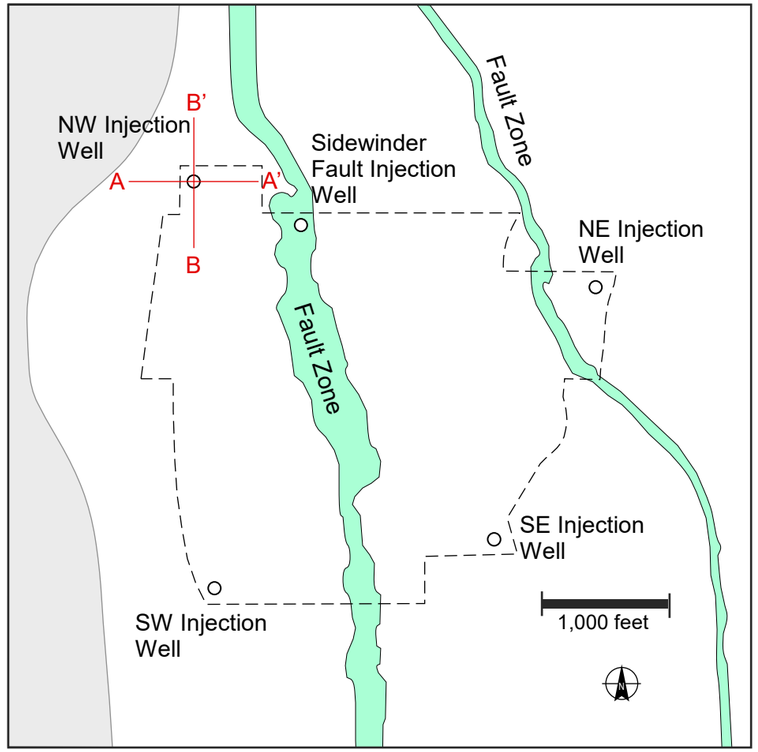
MARCH 2021

FIGURE 1





FAULT LOCATION MAP



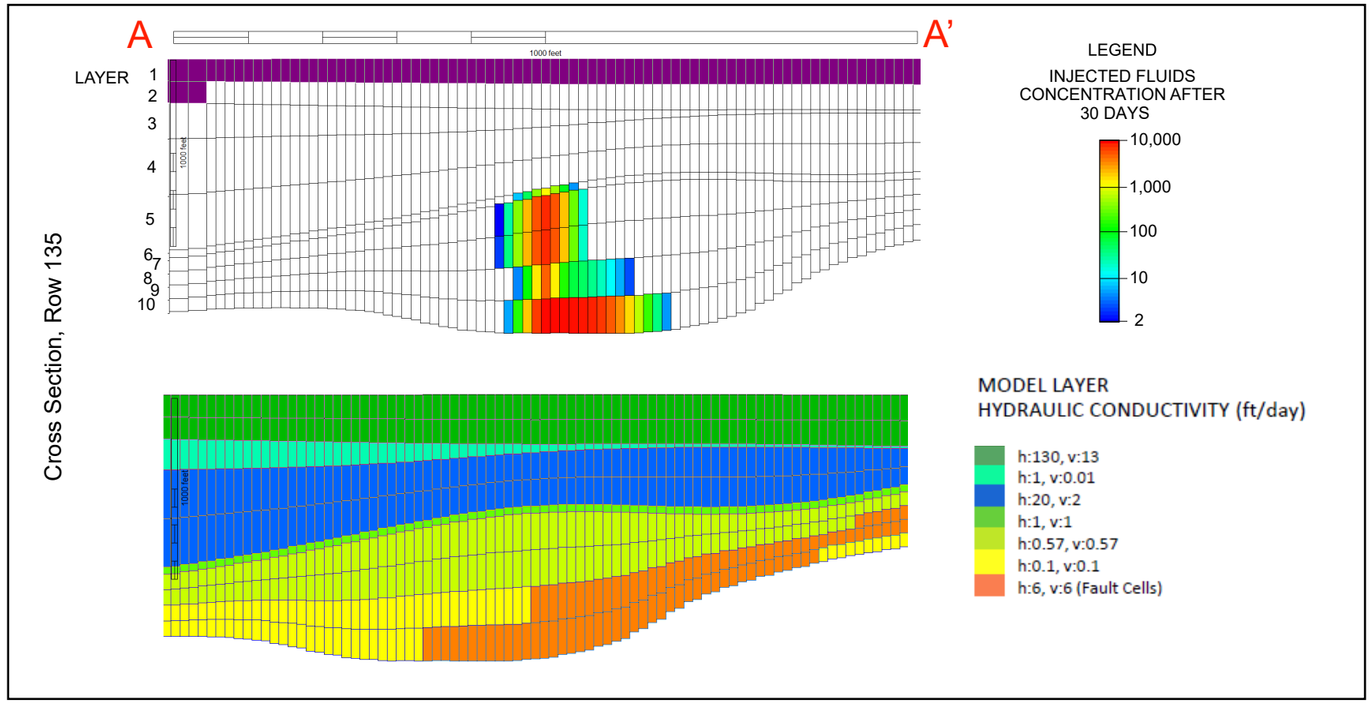
Lorem ipsum

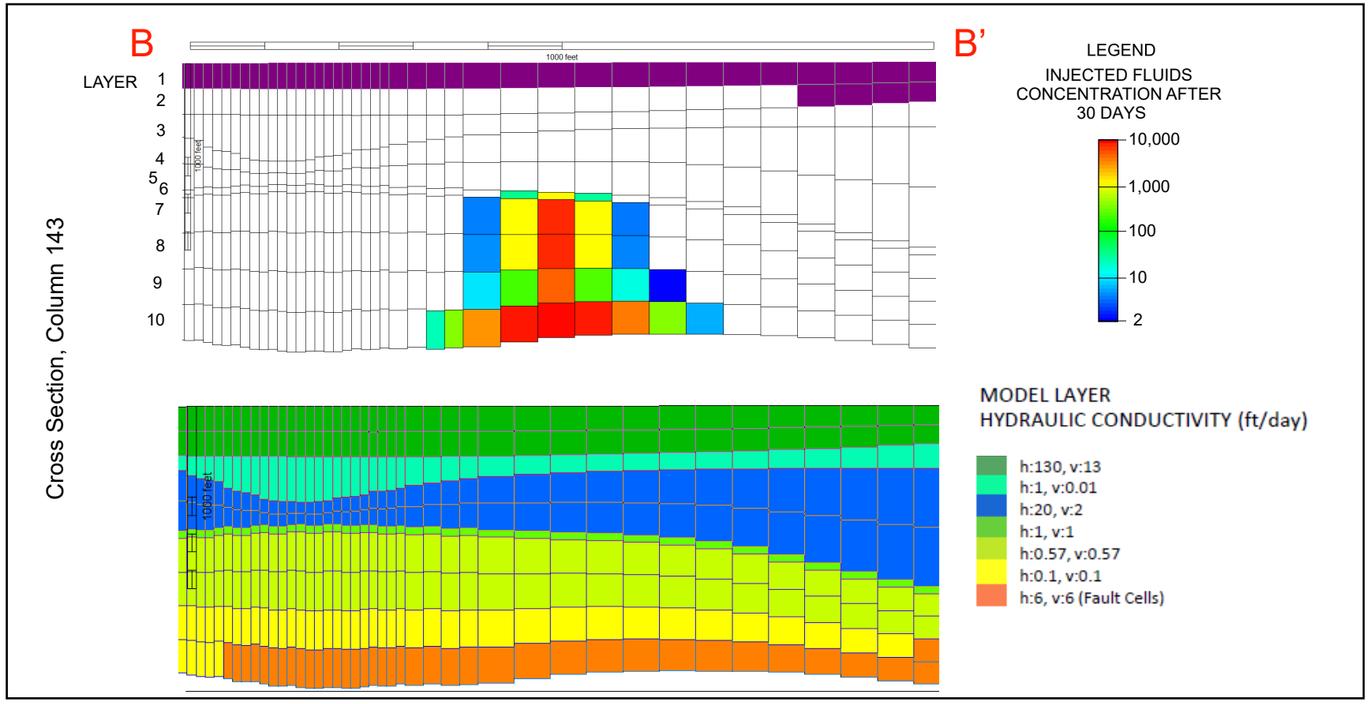
HALEY ALDRICH

CROSS SECTIONS
NW INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

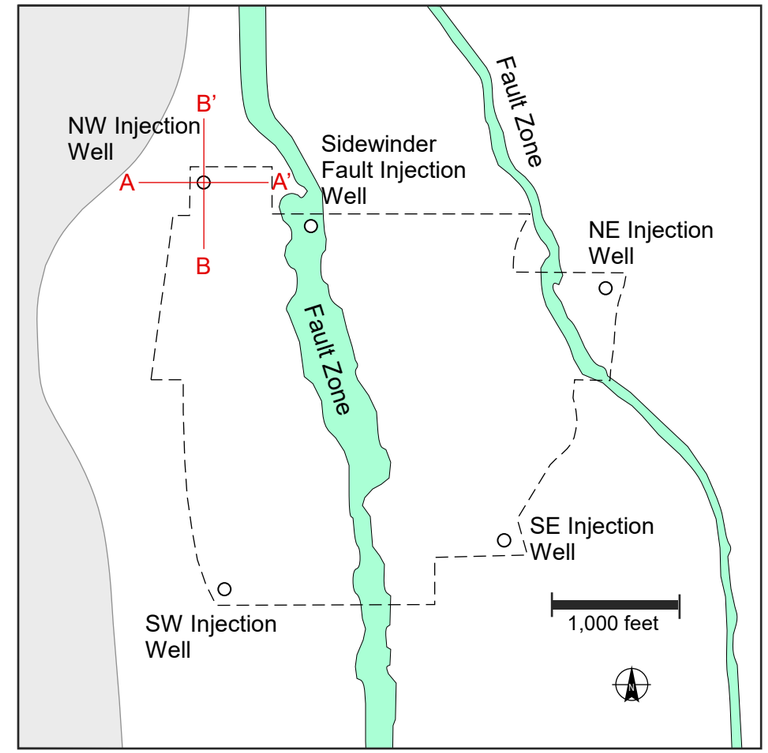
MARCH 2021

FIGURE 2





FAULT LOCATION MAP

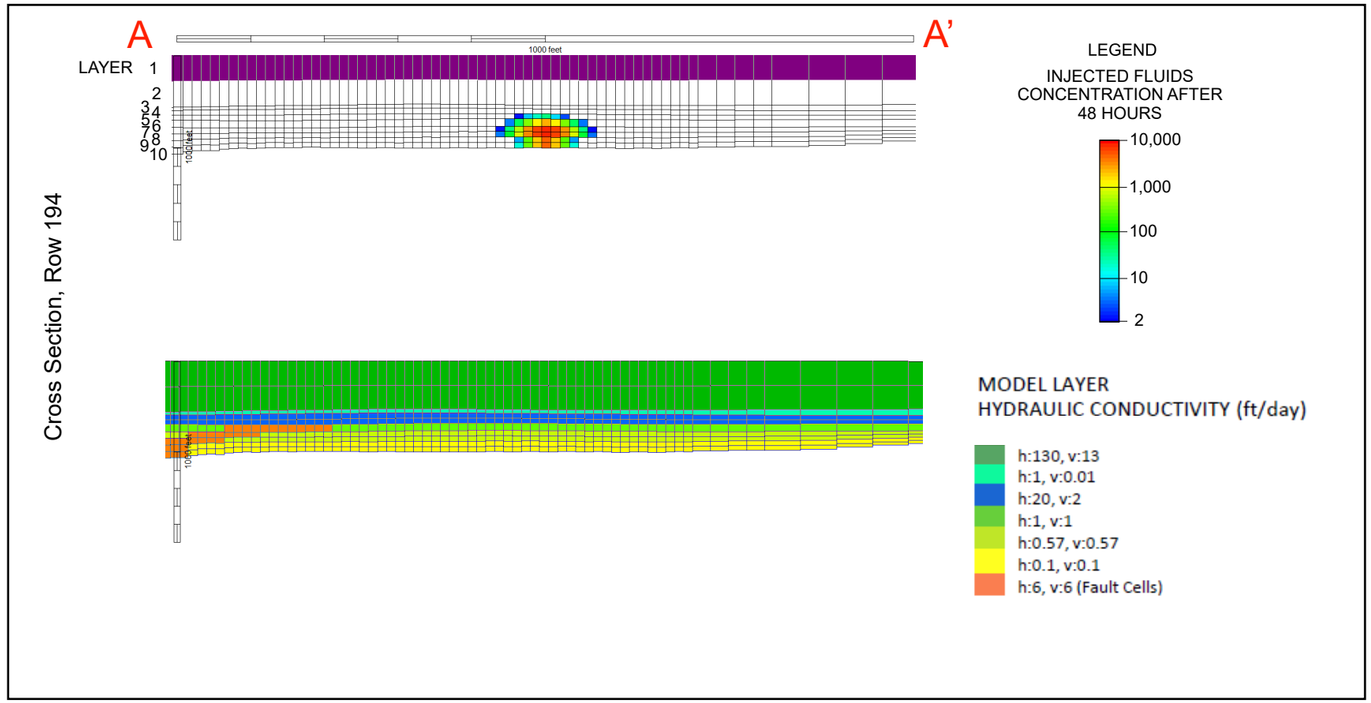


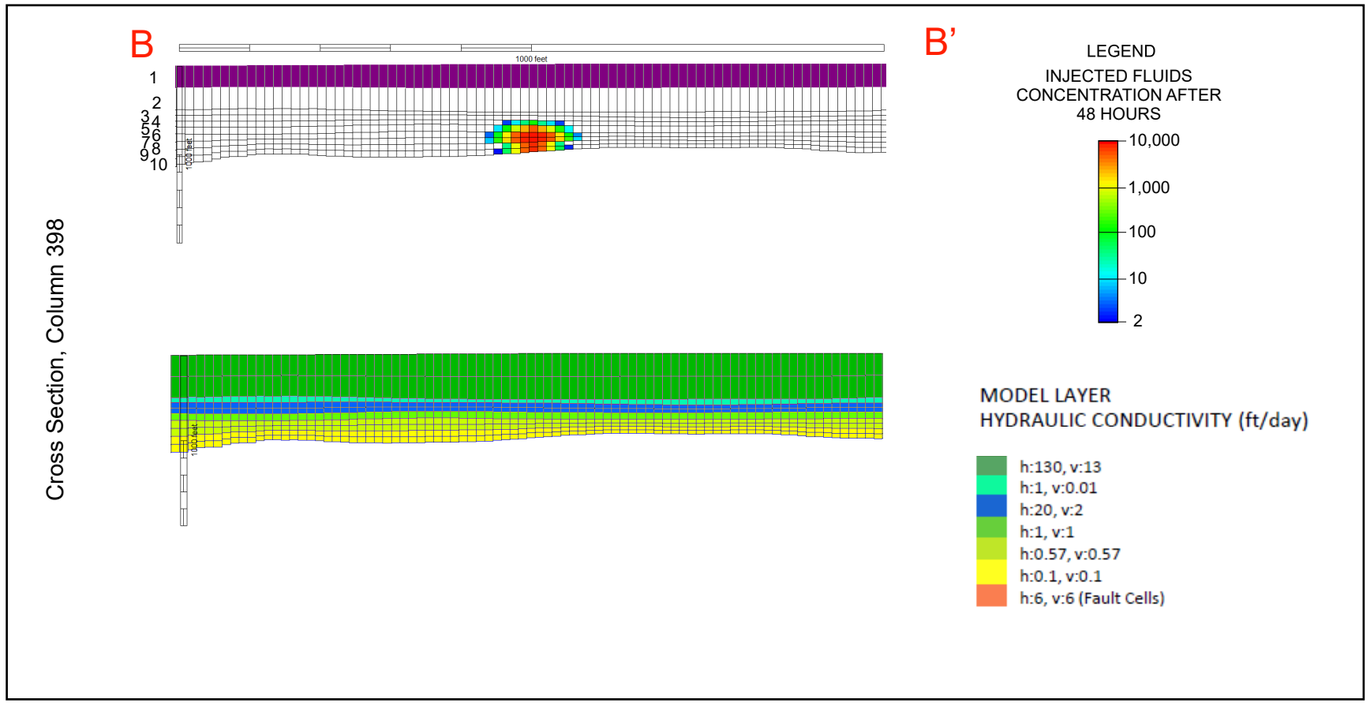
HALEY ALDRICH

CROSS SECTIONS
NW INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

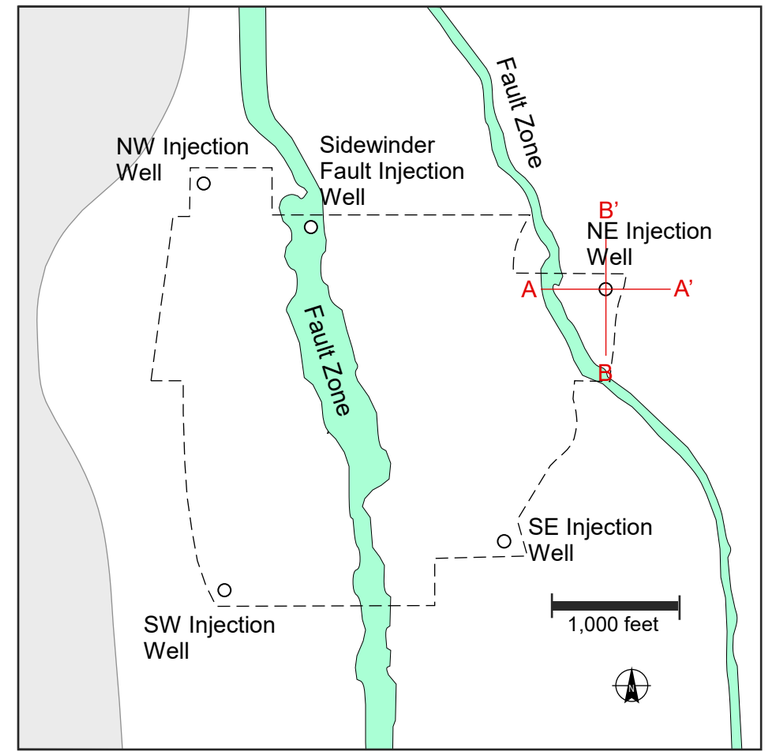
MARCH 2021

FIGURE 3





FAULT LOCATION MAP

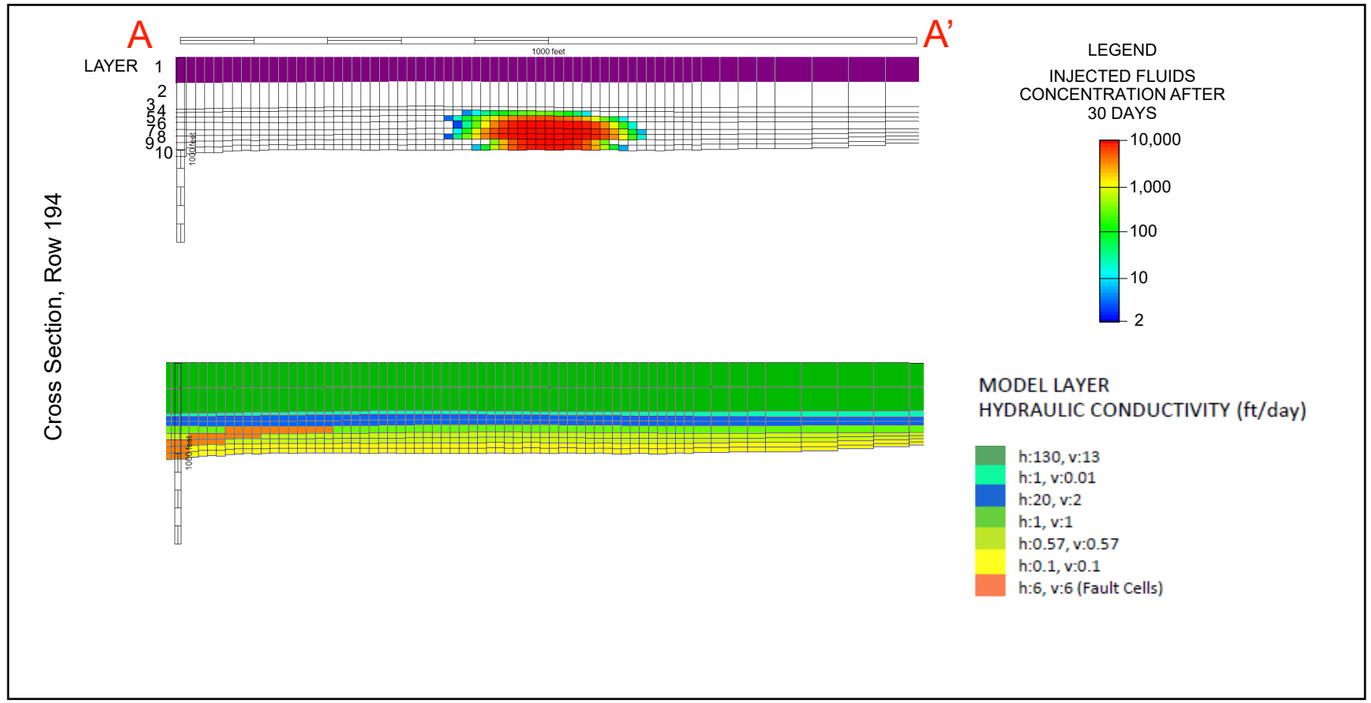


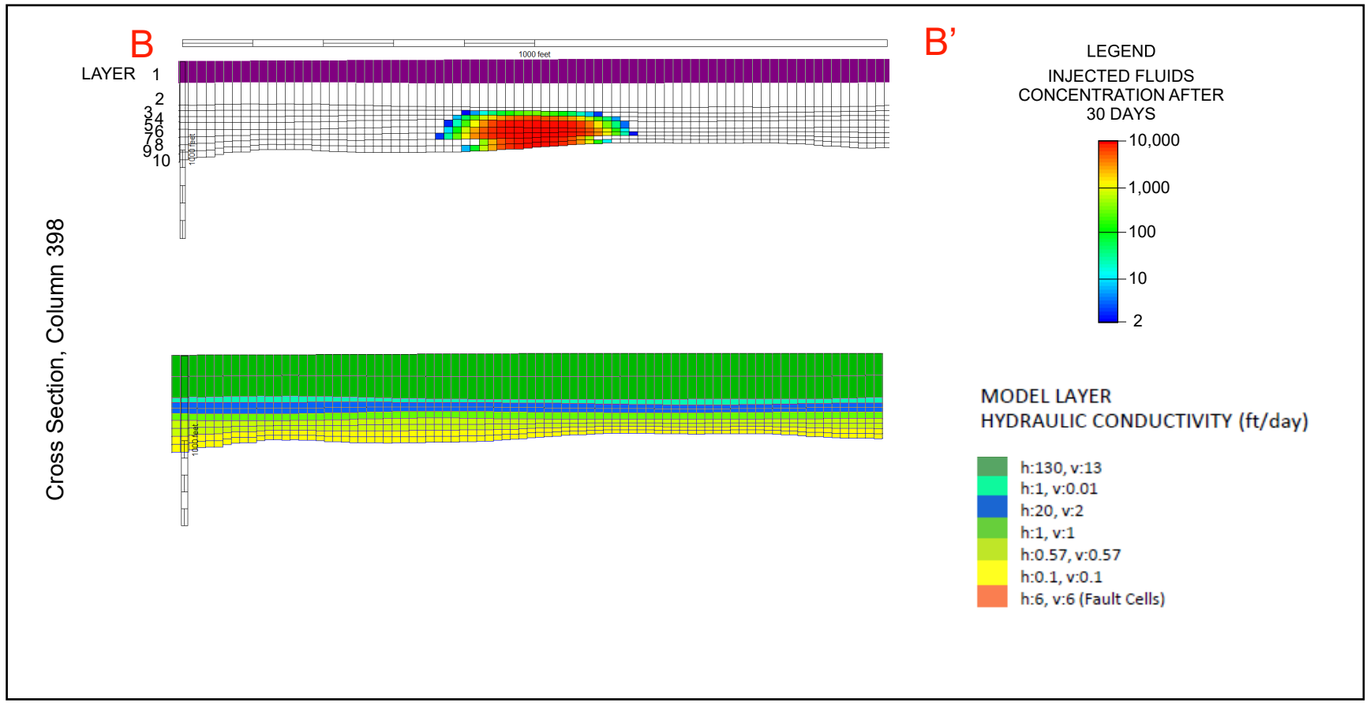
HALEY ALDRICH

CROSS SECTIONS
NE INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

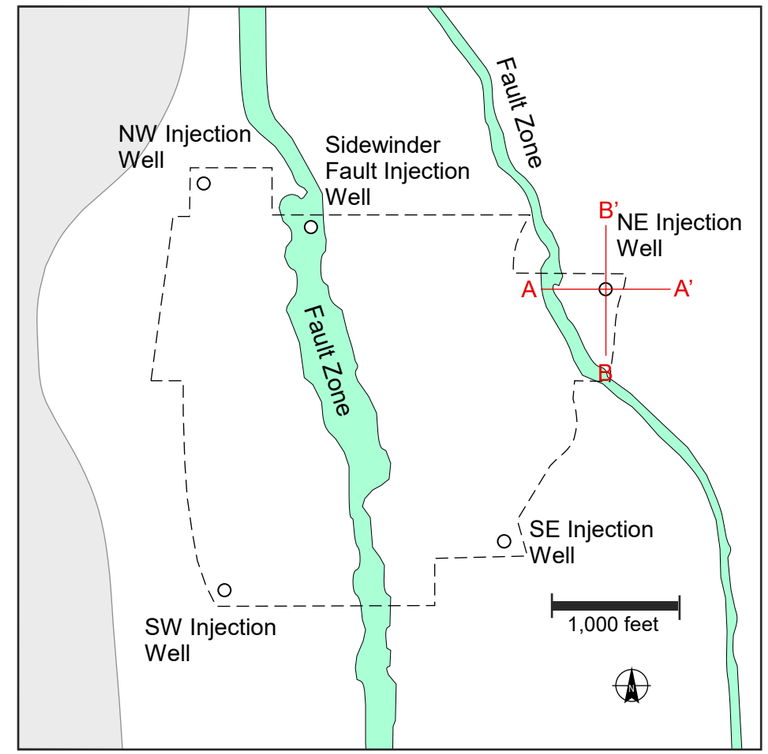
MARCH 2021

FIGURE 4





FAULT LOCATION MAP

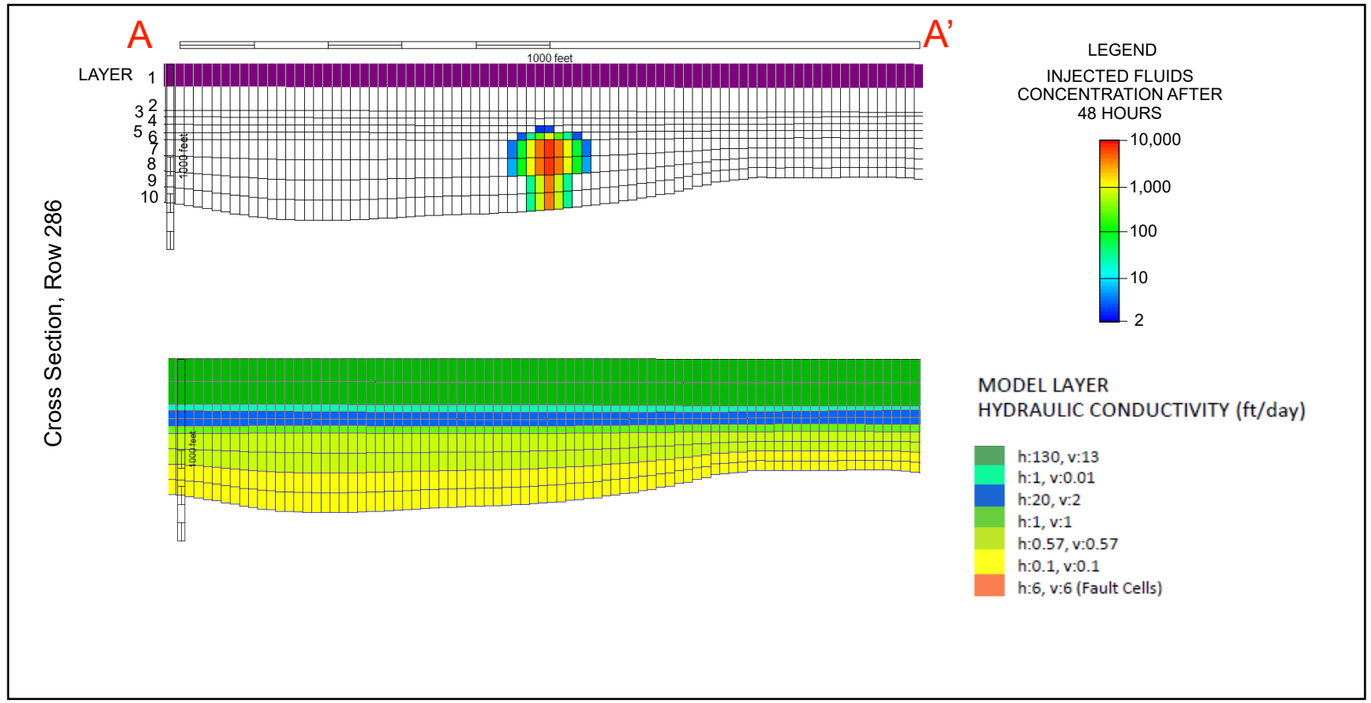


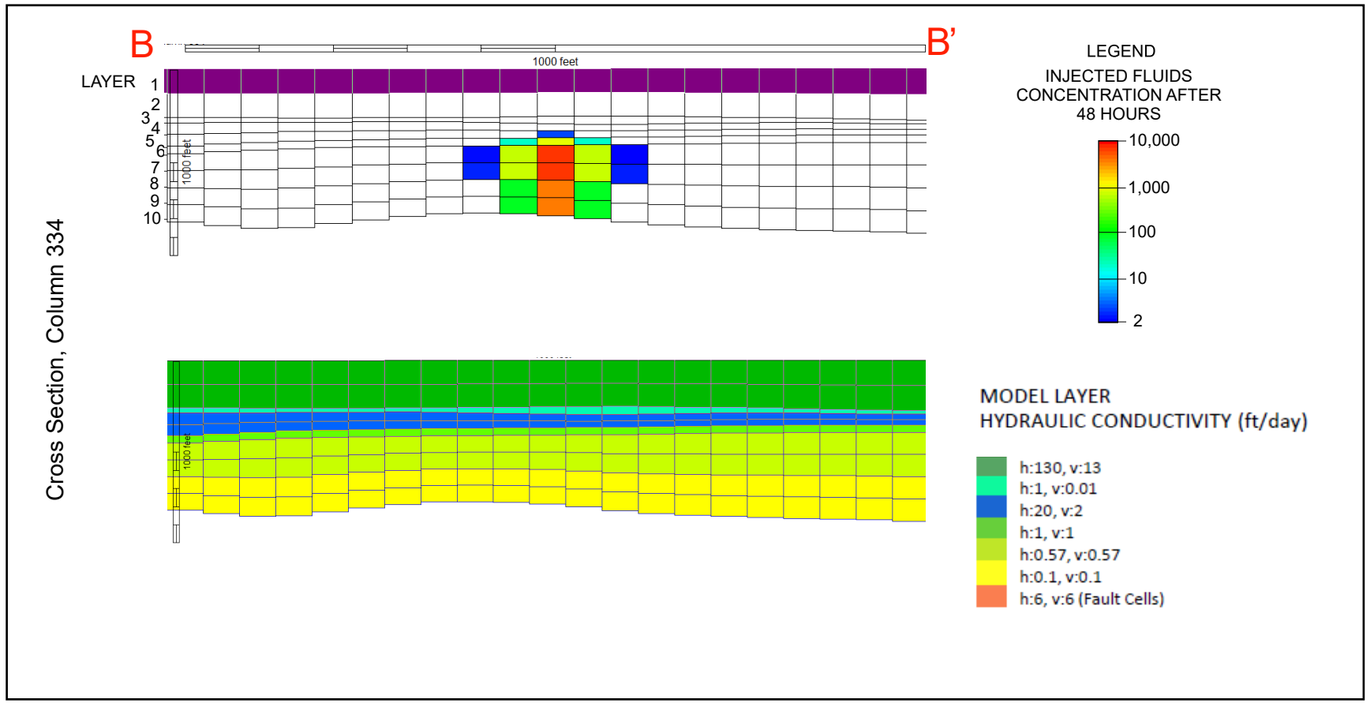
HALEY ALDRICH

CROSS SECTIONS
NE INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

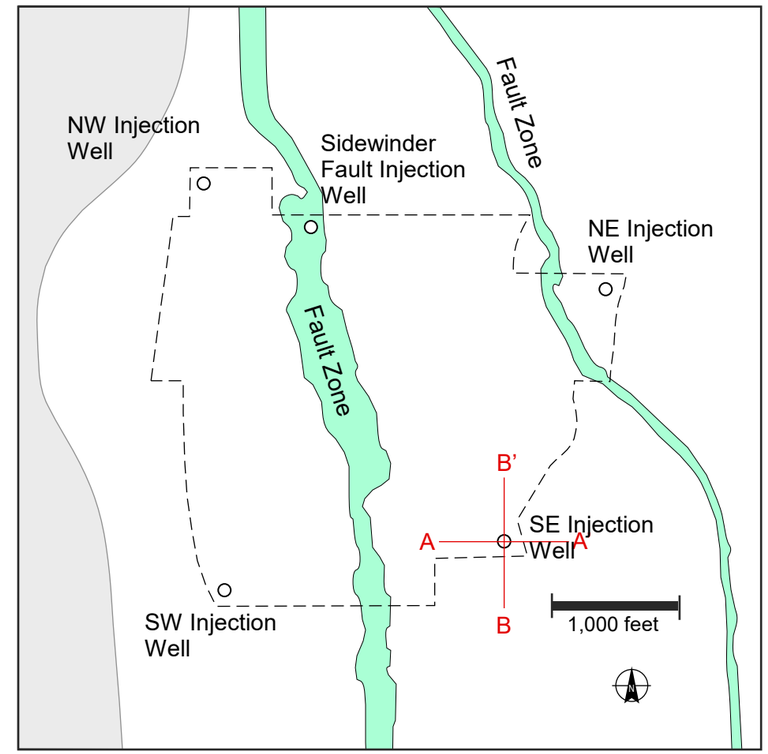
MARCH 2021

FIGURE 5





FAULT LOCATION MAP

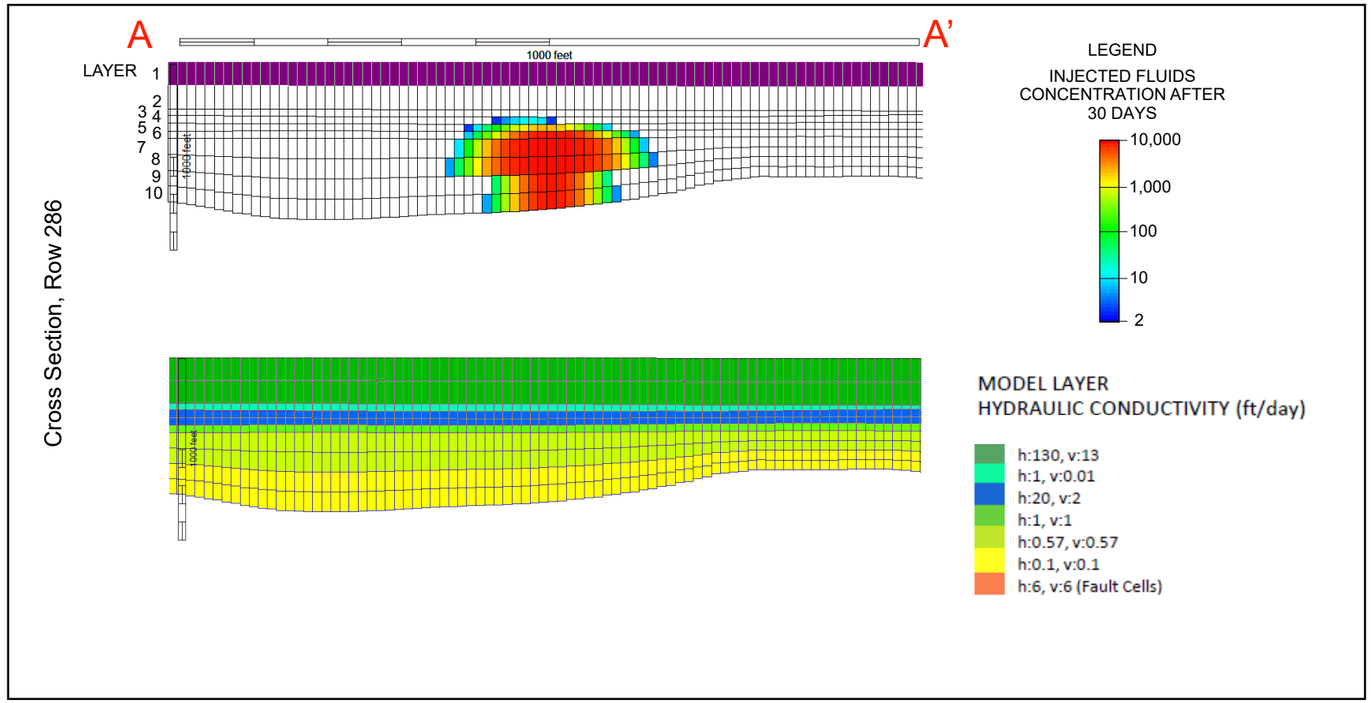


HALEY ALDRICH

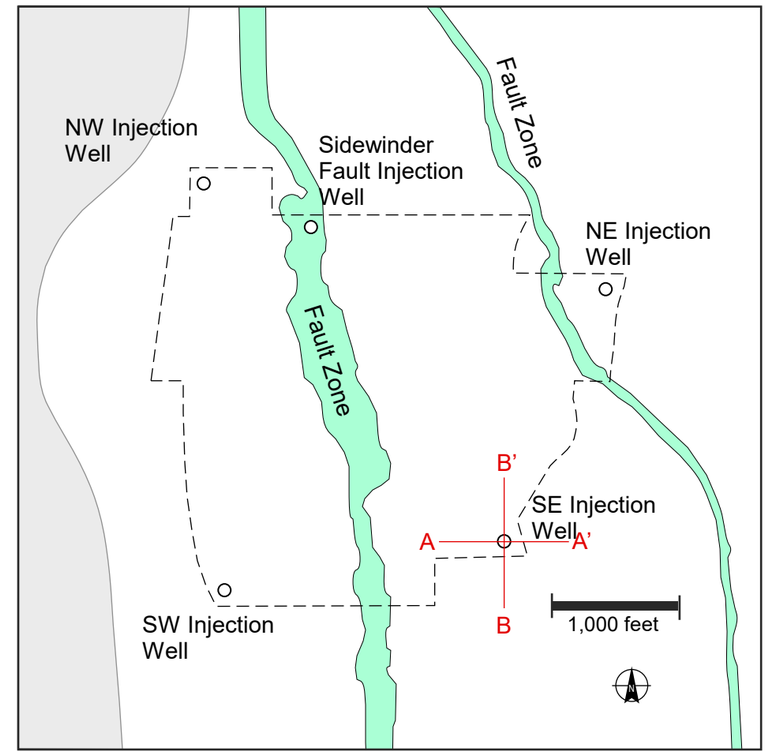
CROSS SECTIONS
SE INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

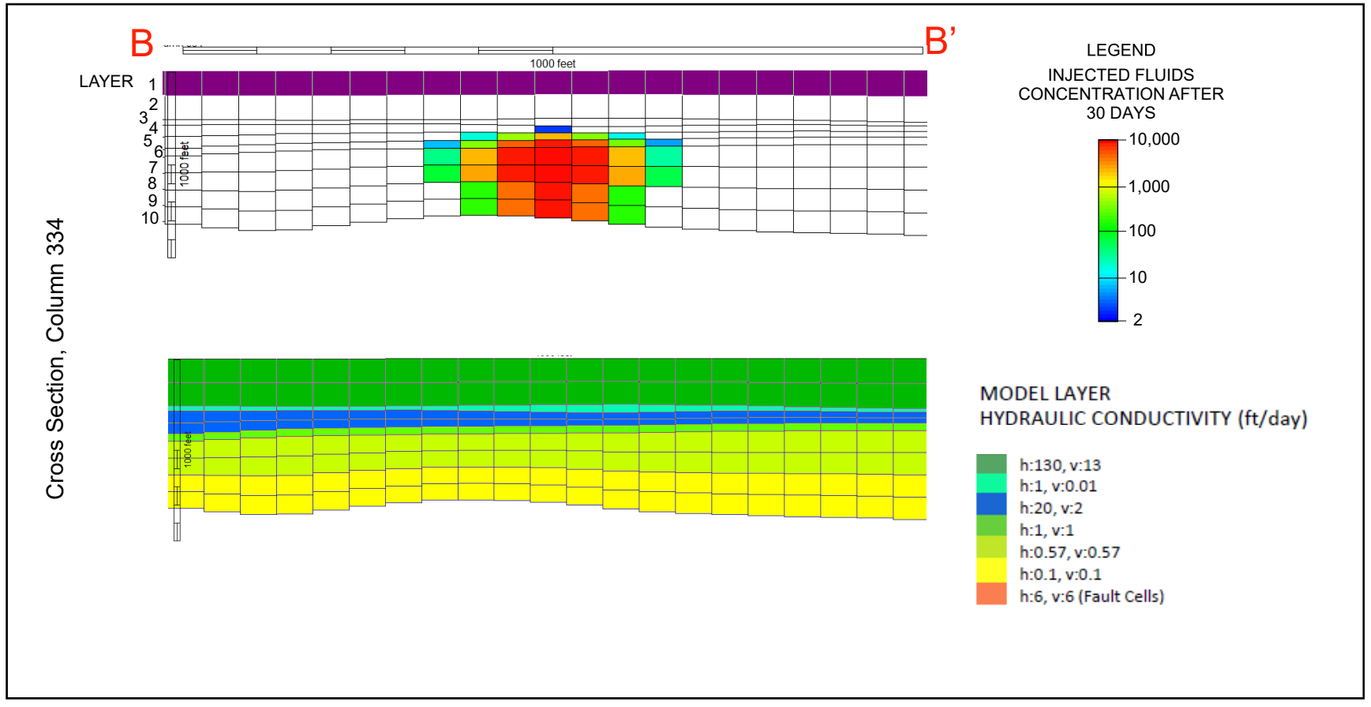
MARCH 2021

FIGURE 6



FAULT LOCATION MAP



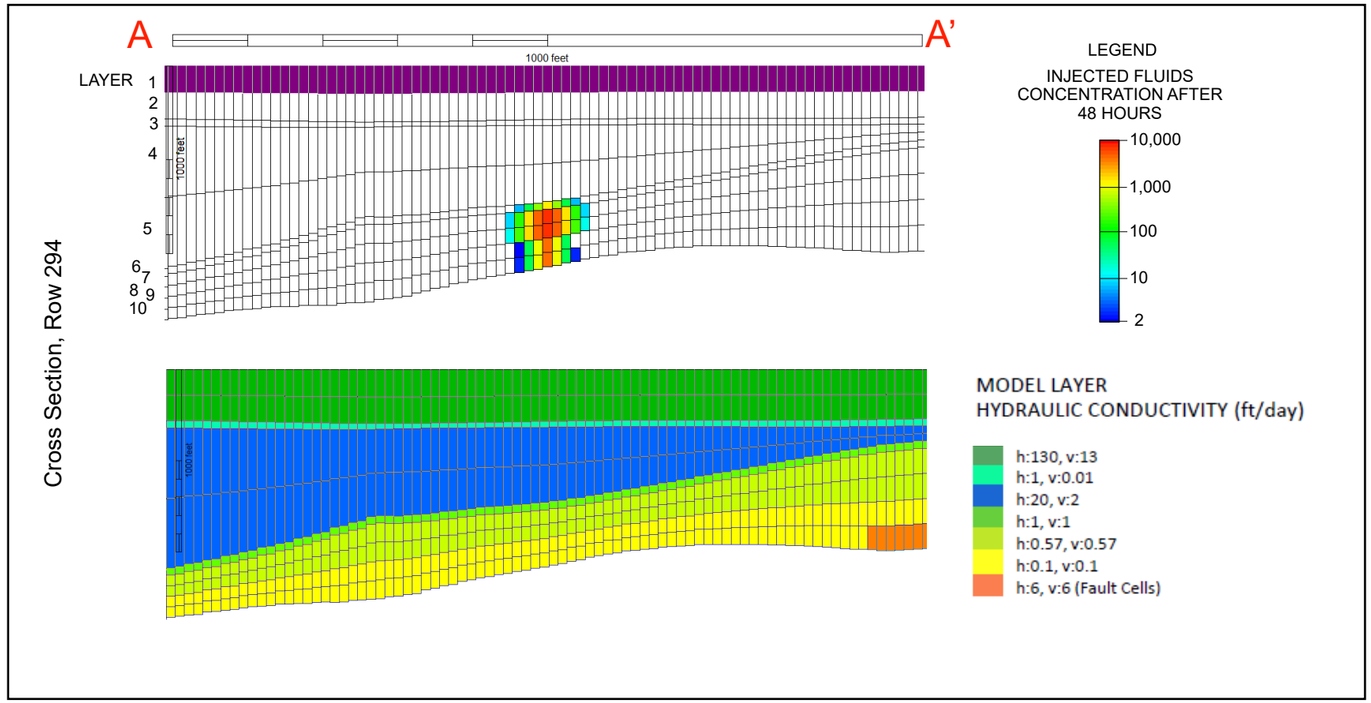


HALEY ALDRICH

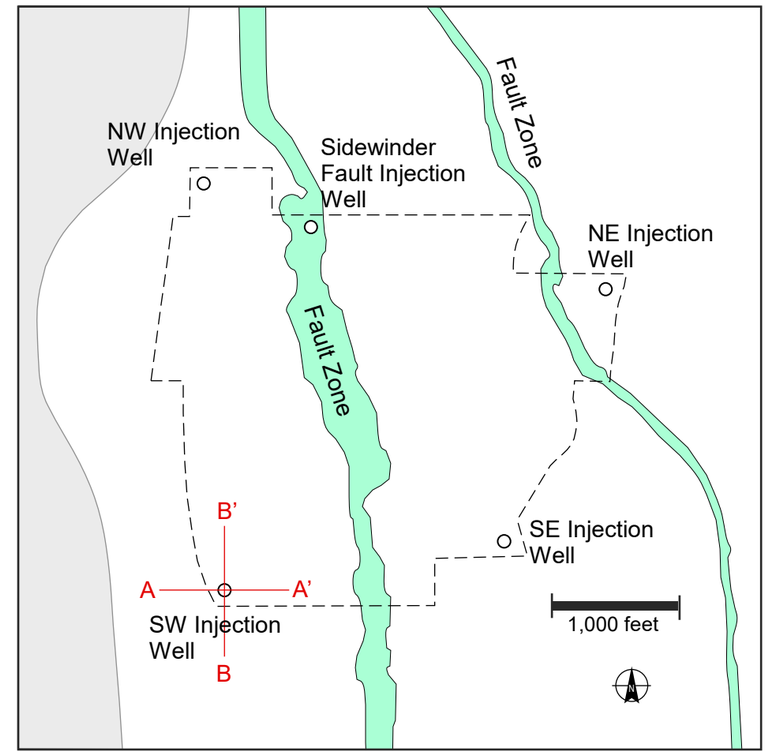
CROSS SECTIONS
SE INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

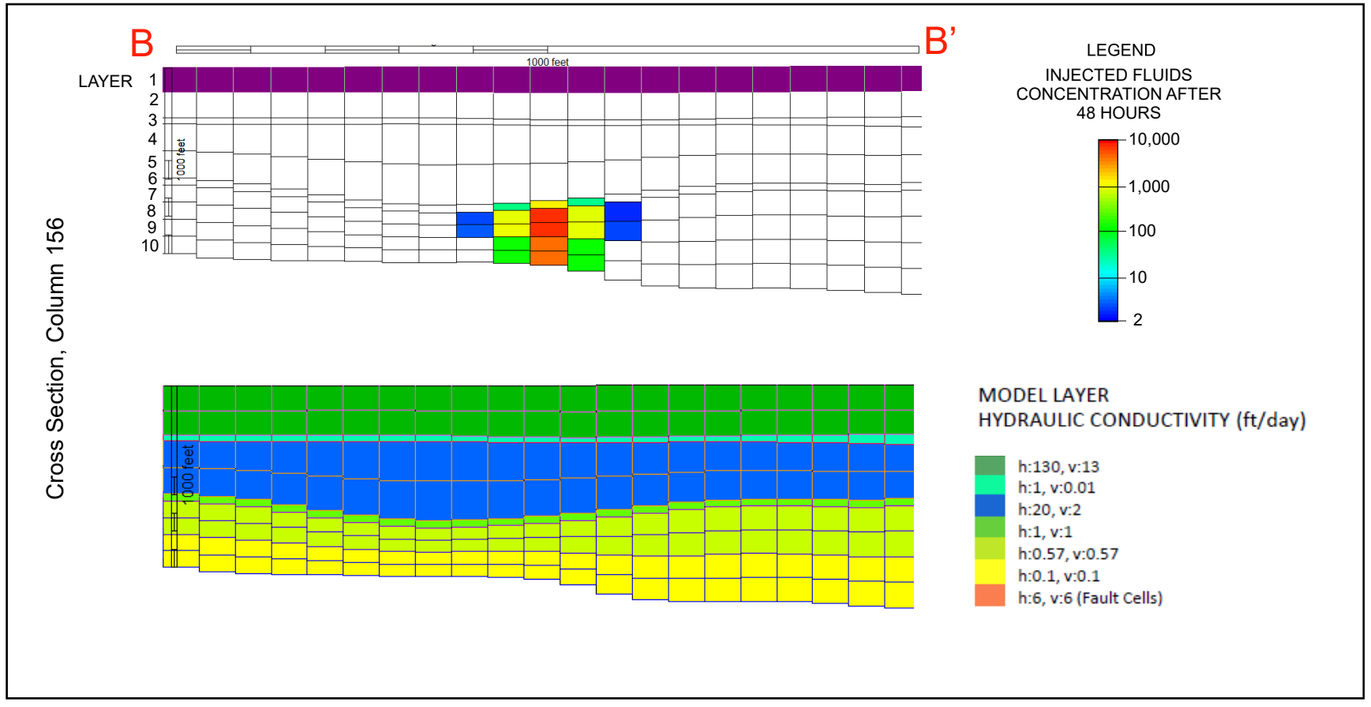
MARCH 2021

FIGURE 7



FAULT LOCATION MAP



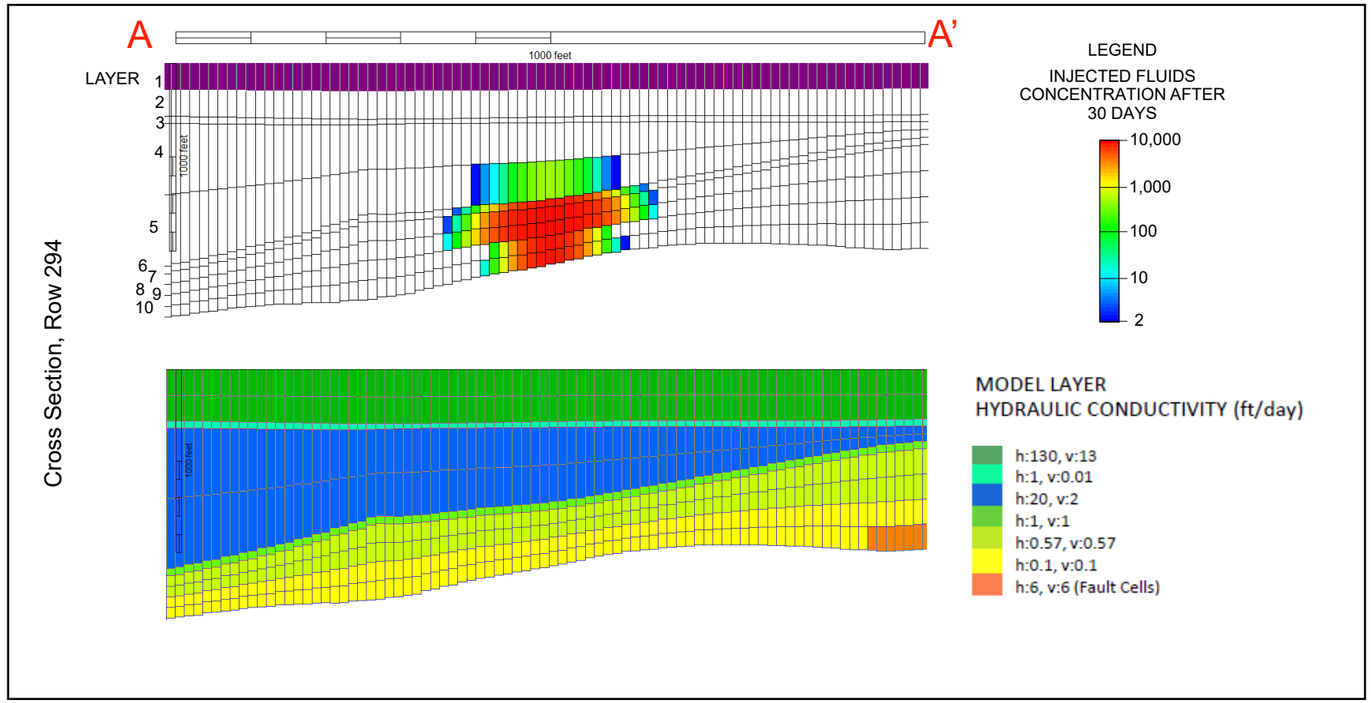


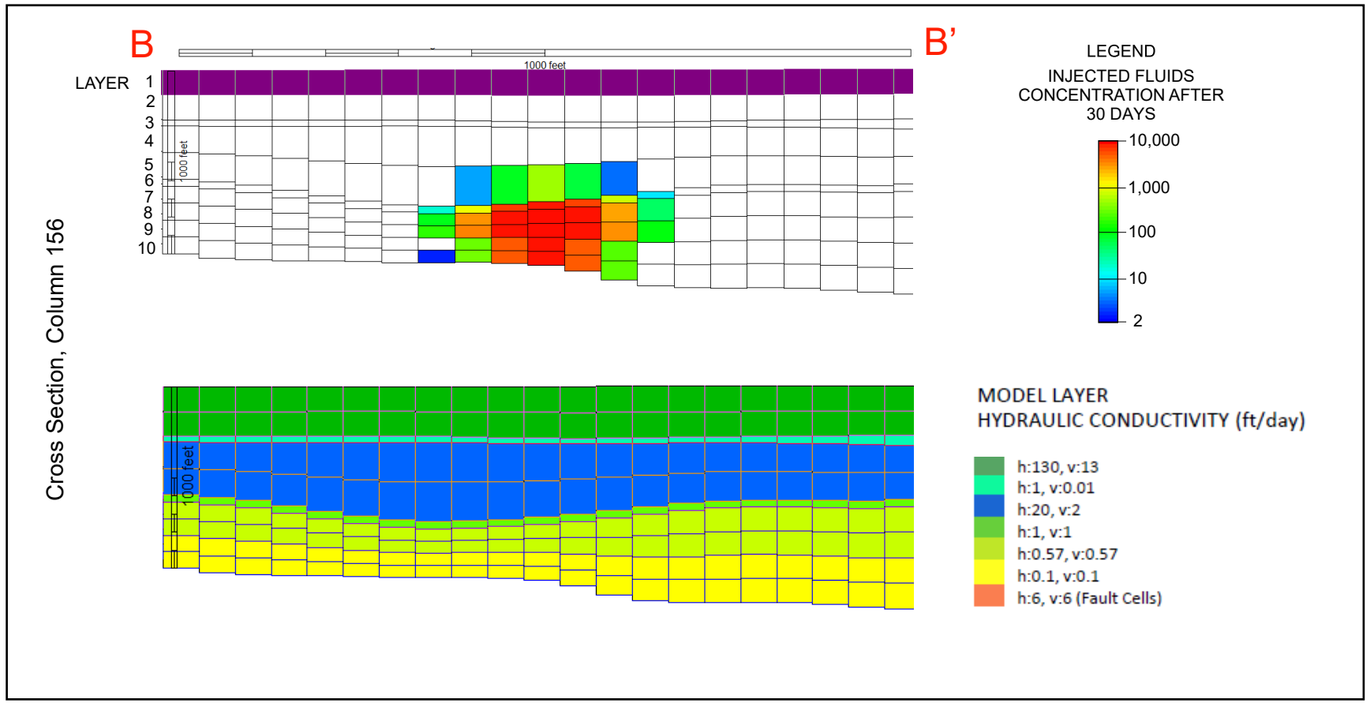
HALEY ALDRICH

CROSS SECTIONS
SW INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

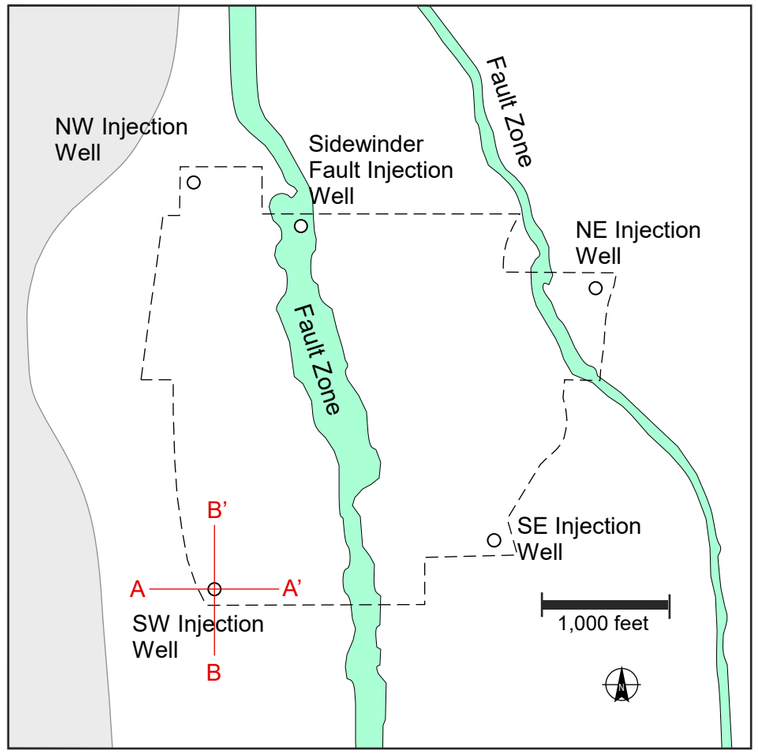
MARCH 2021

FIGURE 8





FAULT LOCATION MAP

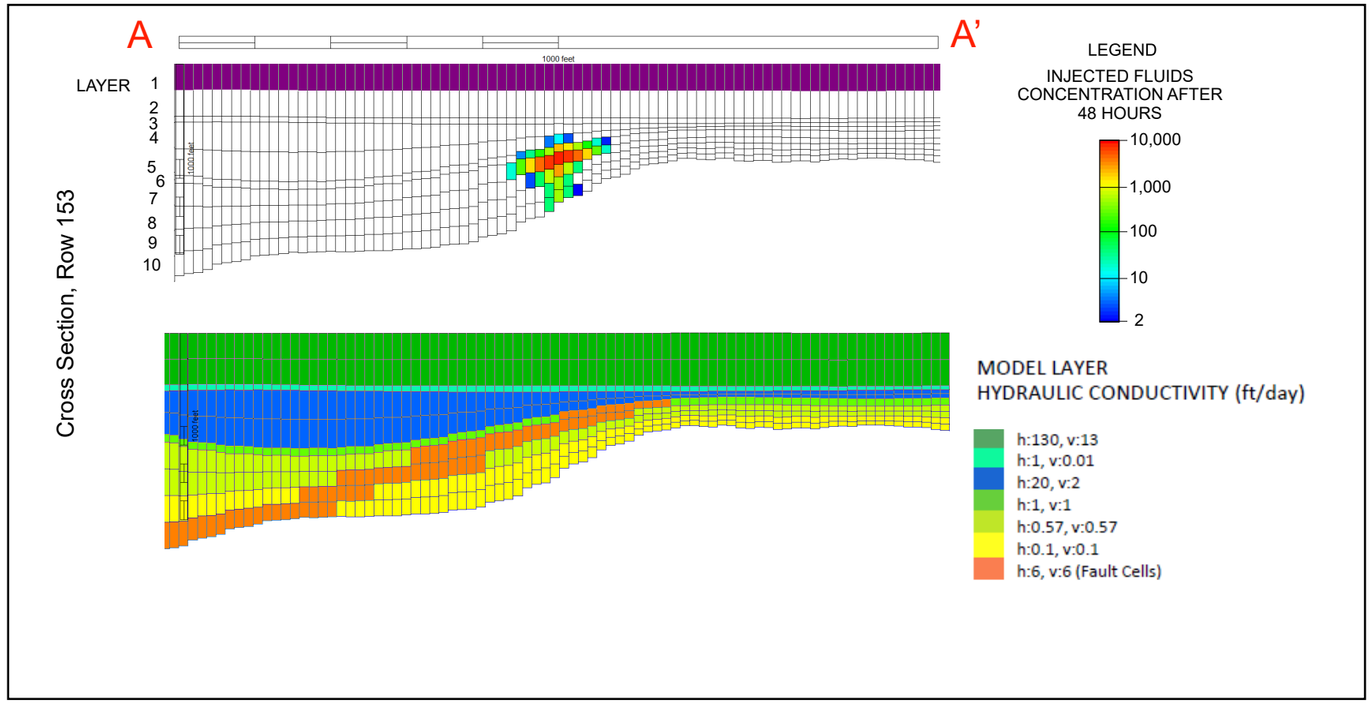


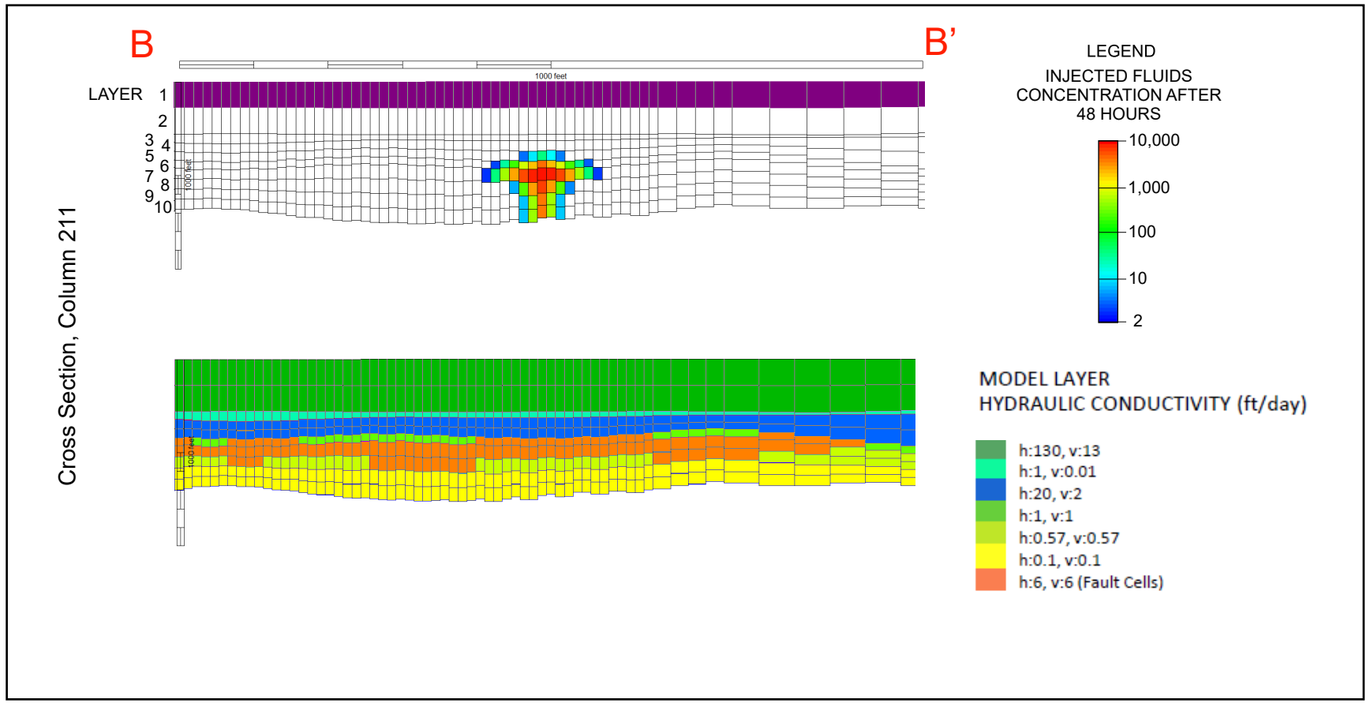
HALEY ALDRICH

CROSS SECTIONS
SW INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

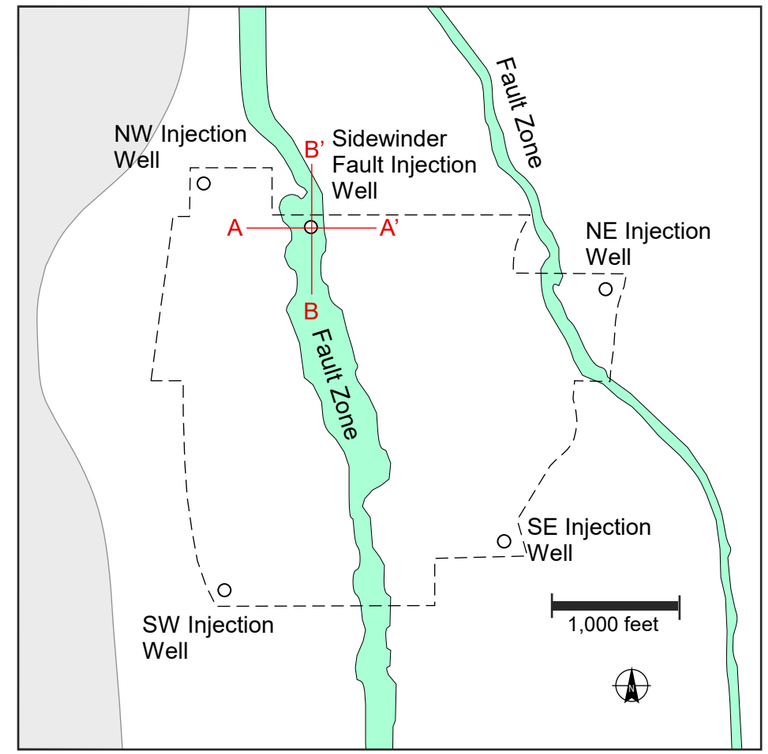
MARCH 2021

FIGURE 9





FAULT LOCATION MAP

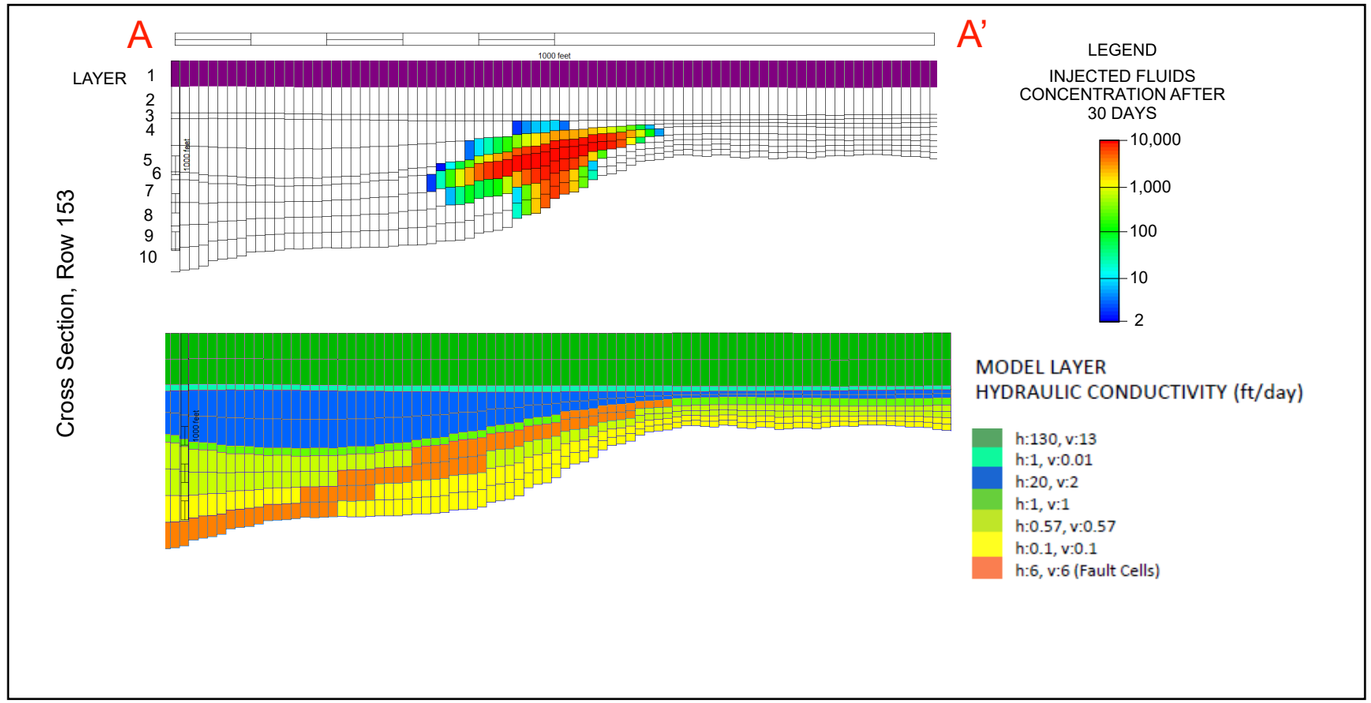


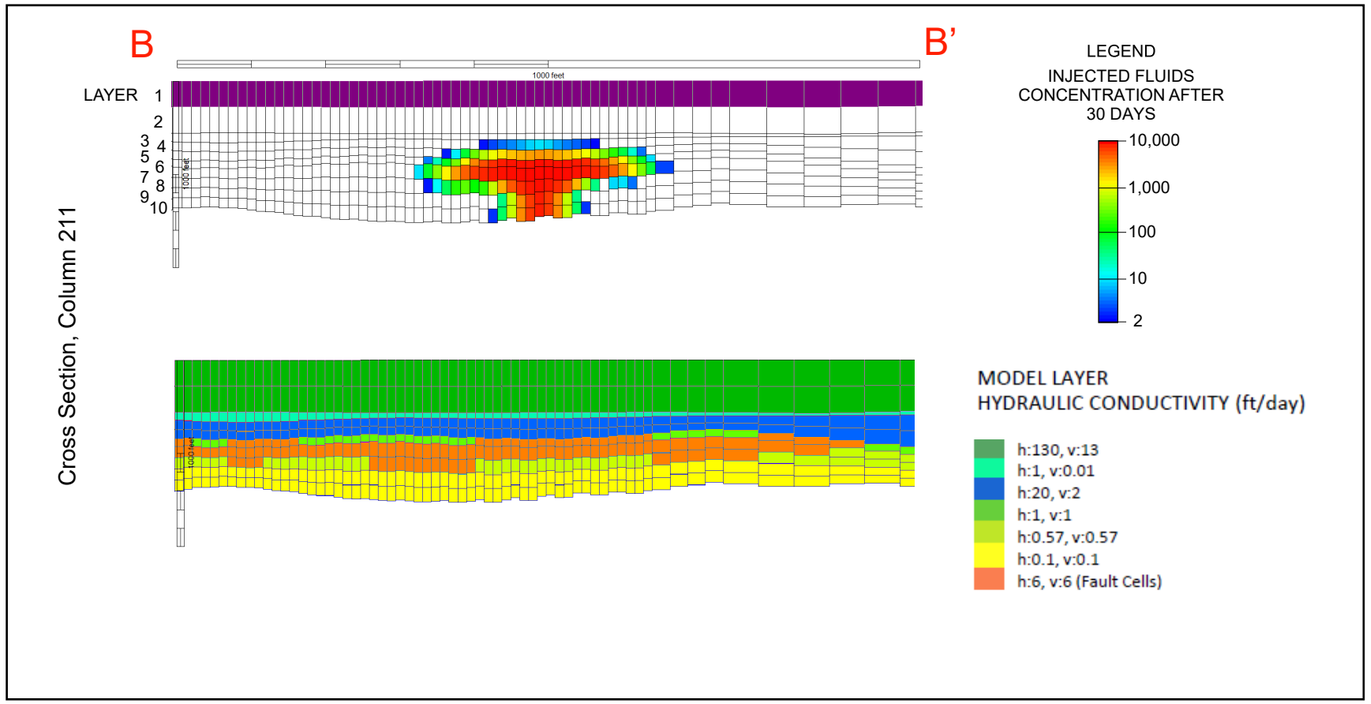
HALEY ALDRICH

CROSS SECTIONS
SIDEWINDER FAULT INJECTION WELL, 48 HOUR INJECTION WITH NO EXTRACTION

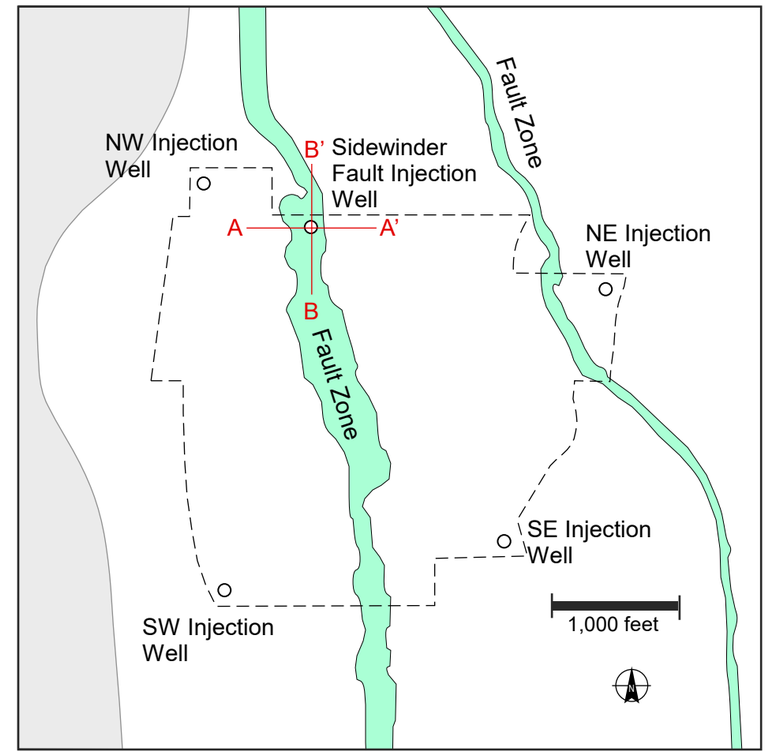
MARCH 2021

FIGURE 10





FAULT LOCATION MAP

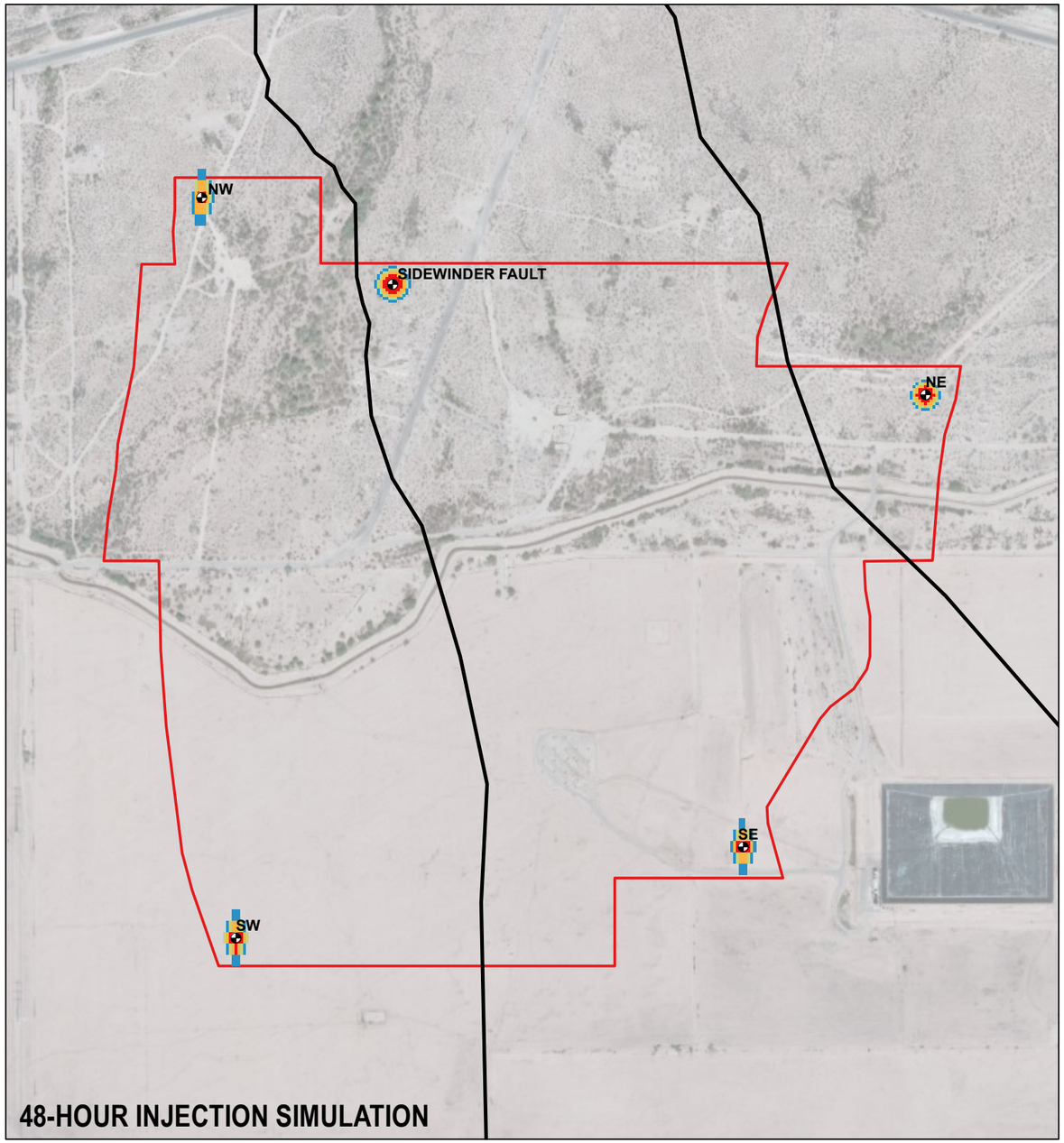


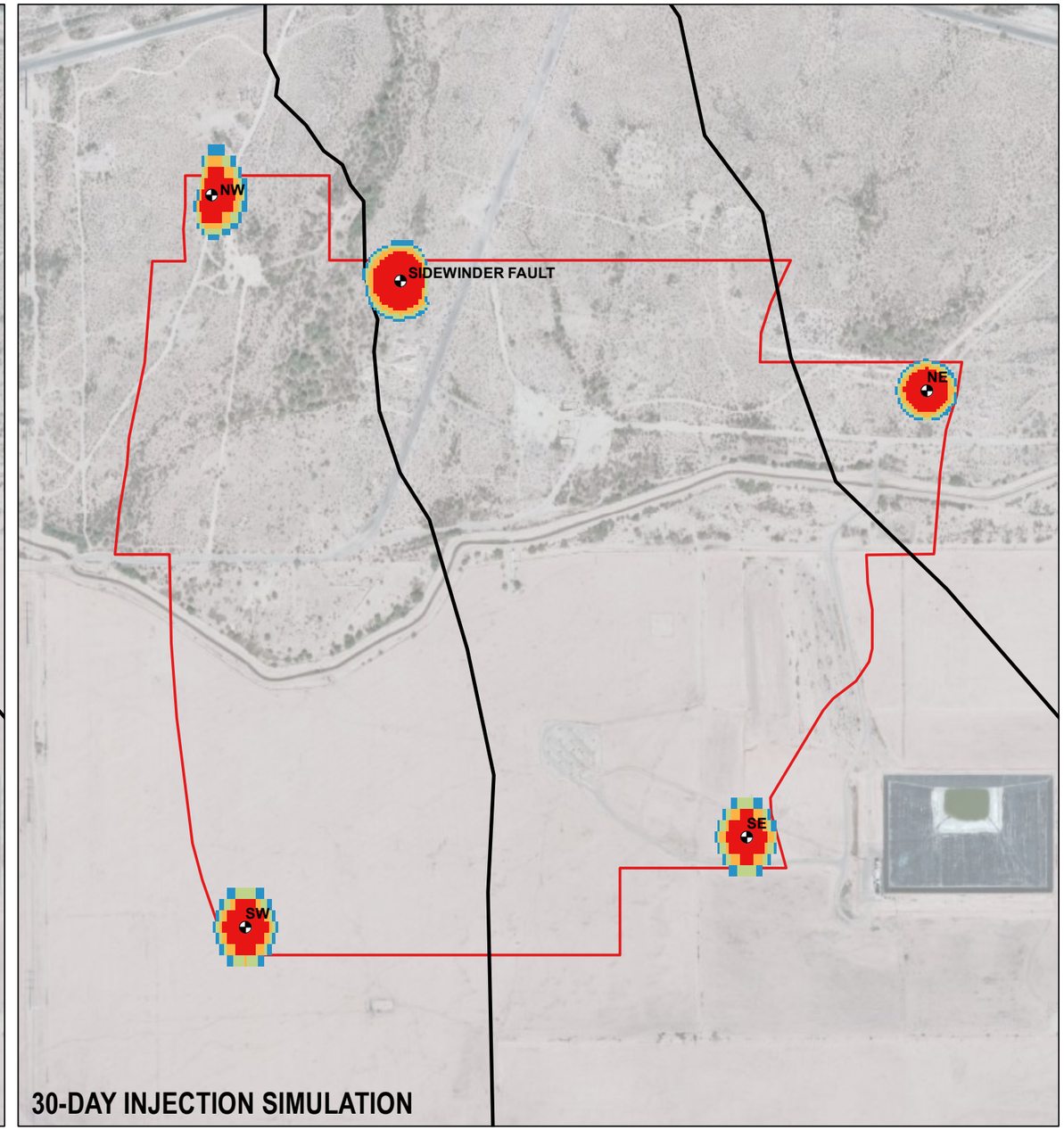
HALEY ALDRICH

CROSS SECTIONS
SIDEWINDER FAULT INJECTION WELL, 30 DAY INJECTION WITH NO EXTRACTION

MARCH 2021

FIGURE 11





LEGEND

- INJECTION WELL
- FAULT
- ISCR WELLFIELD

SOLUTE CONCENTRATION IN MILLIGRAMS PER LITER (mg/L)

- 1 TO 10
- 10 TO 100
- 100 TO 1000
- 1000 TO 10000

NOTES

1. ALL LOCATIONS AND DIMENTIONS ARE APPROXIMATE.
2. SIMULATED SOLUTE CONCENTRATIONS ARE FROM MODEL LAYER 7, EXCEPT THE NW INJECTION WELL WHICH USED MODEL LAYER 10.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 600 1,200

SCALE IN FEET

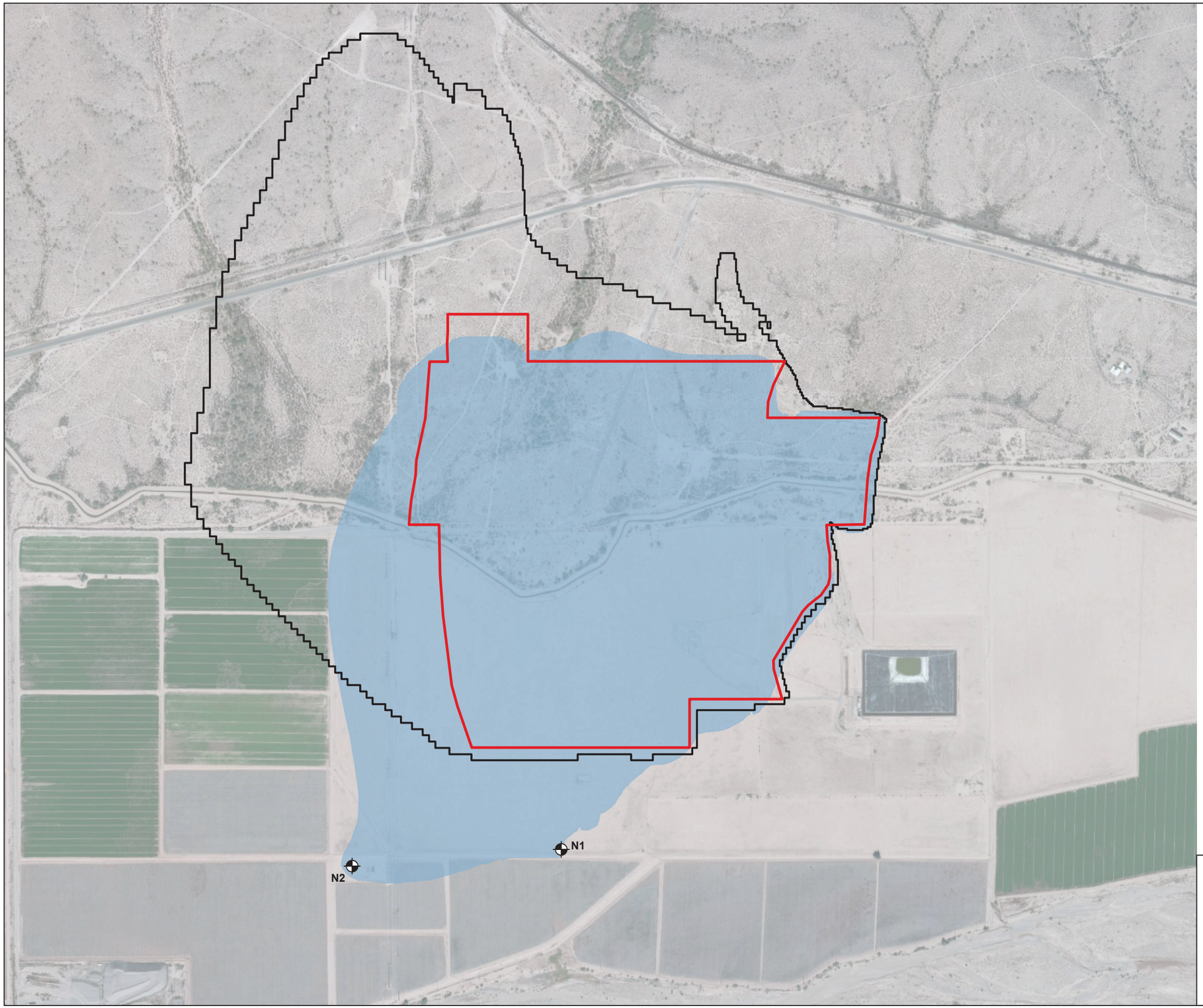
HALEY ALDRICH

FLORENCE COPPPER, INC.
FLORENCE, ARIZONA

PLAN VIEW OF MAXIMUM EXTENT OF MIGRATION DURING 48-HOUR AND 30-DAY INJECTION SCENARIOS WITHOUT HYDRAULIC CONTROL PUMPING

MARCH 2021

FIGURE 12



LEGEND

- NEW IRRIGATION WELL
- EXISTING WELL
- ISCR WELL FIELD
- EXTENT OF SOLUTE MIGRATION WITHOUT WELLS N1, N2, BIA-9R AND WW4 PUMPING
- EXTENT OF SOLUTE MIGRATION WITH WELLS N1, N2, BIA-9R AND WW4 PUMPING

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

N

0 800 1,600

SCALE IN FEET

HALEY ALDRICH

FLORENCE COPPER, INC.
FLORENCE, ARIZONA

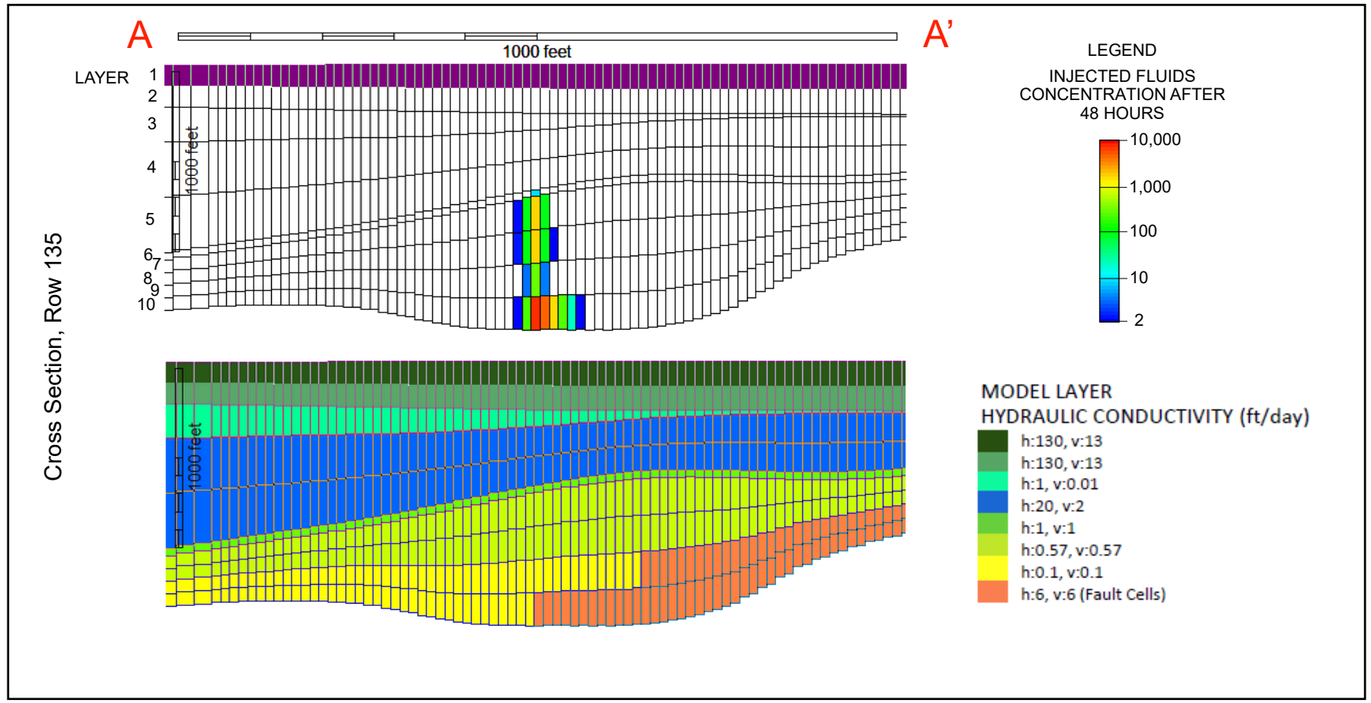
DISCHARGE IMPACT AREA 30 YEARS AFTER CLOSURE WITH NEW IRRIGATION WELLS PUMPING

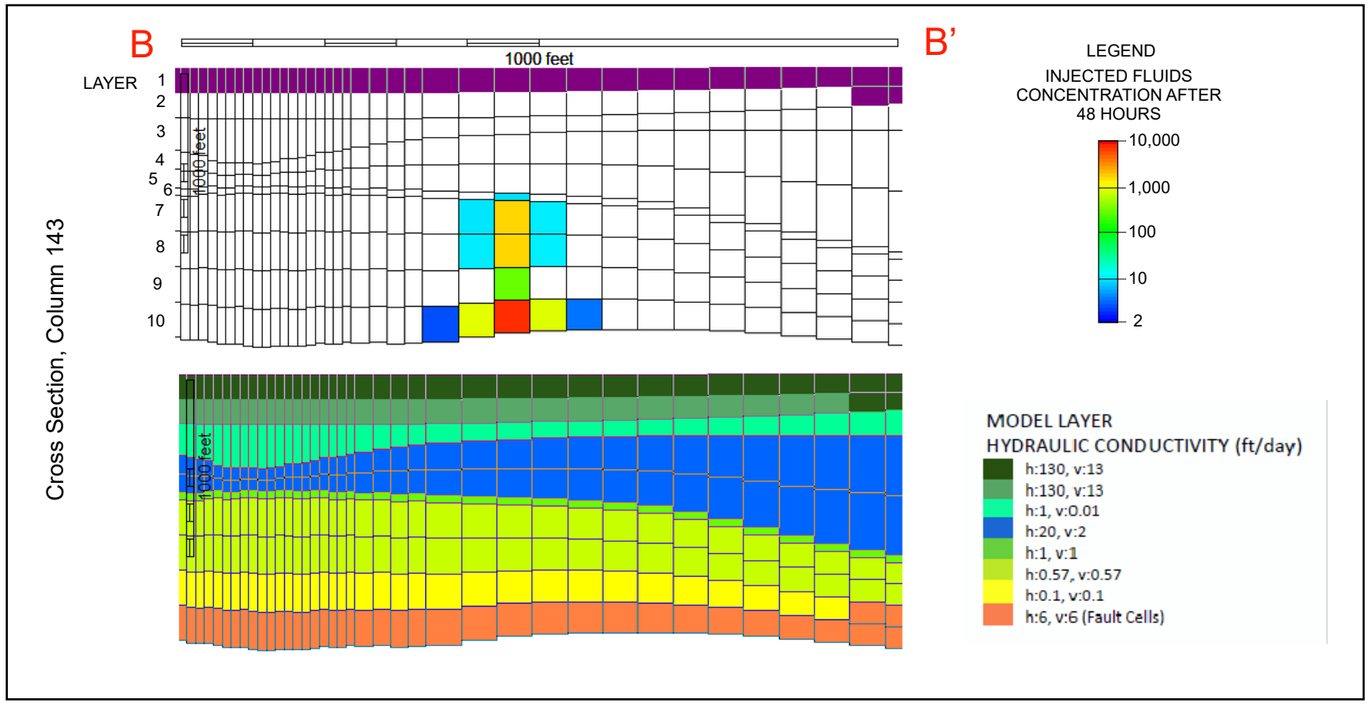
MARCH 2021

FIGURE 13

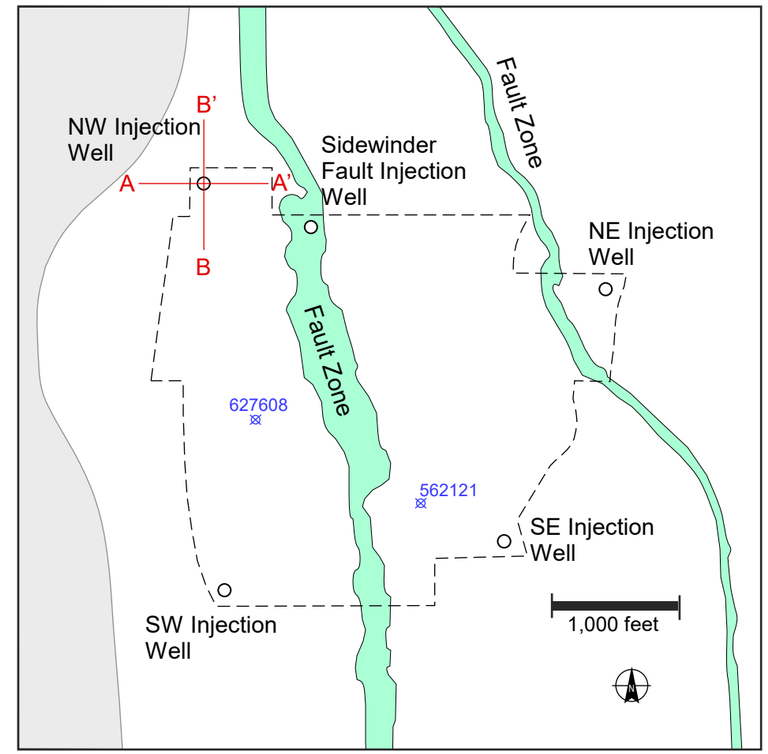
EXHIBIT A-8-1

Figures A-4 through A-13
of the 4 October 2019 UIC Permit Application





FAULT LOCATION MAP

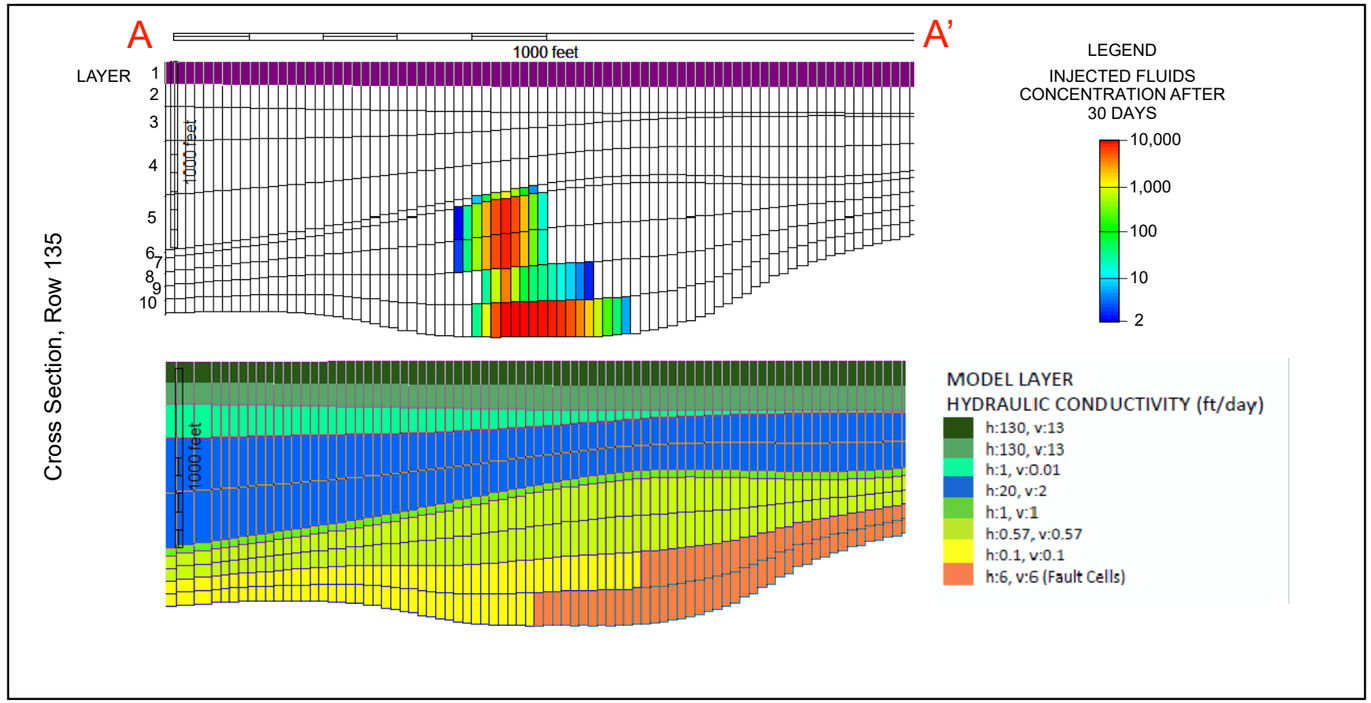


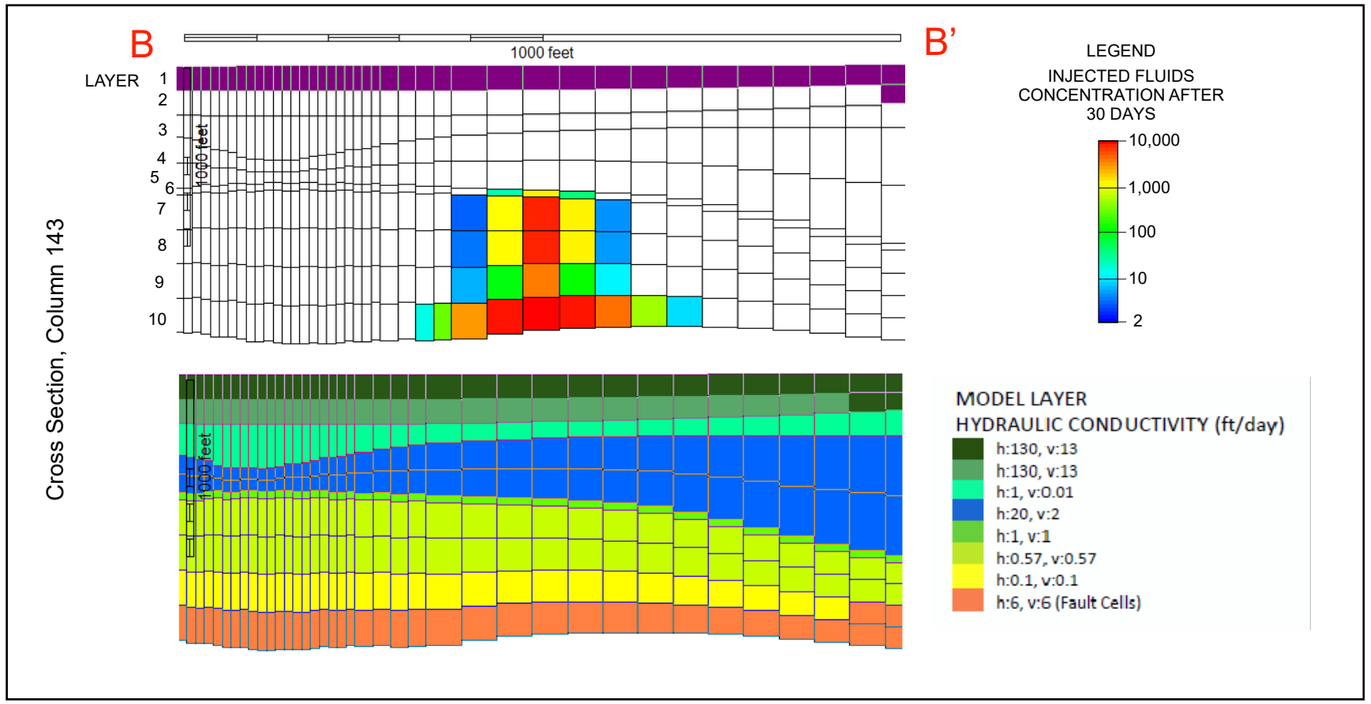
HALEY ALDRICH

CROSS SECTIONS
NW INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

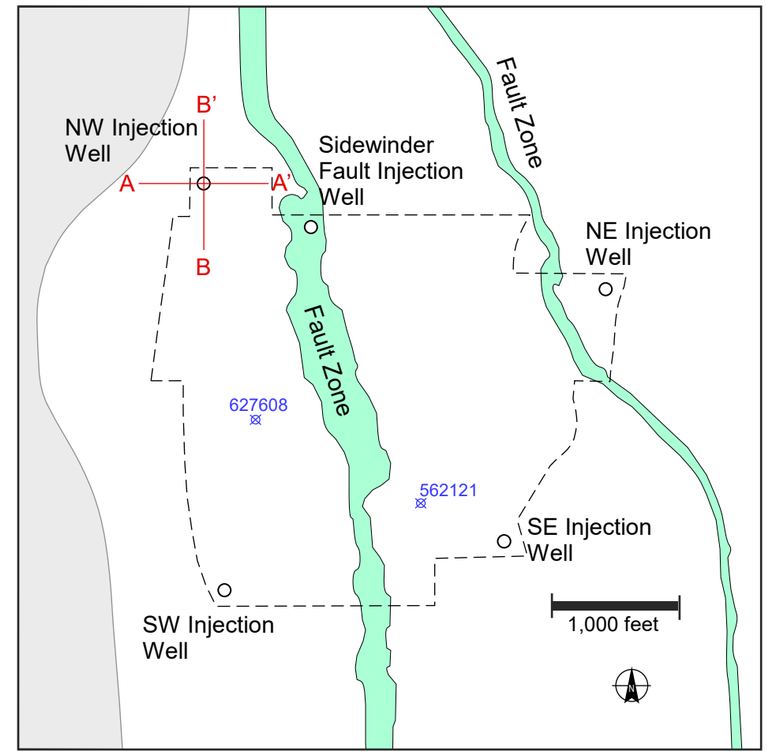
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-4





FAULT LOCATION MAP

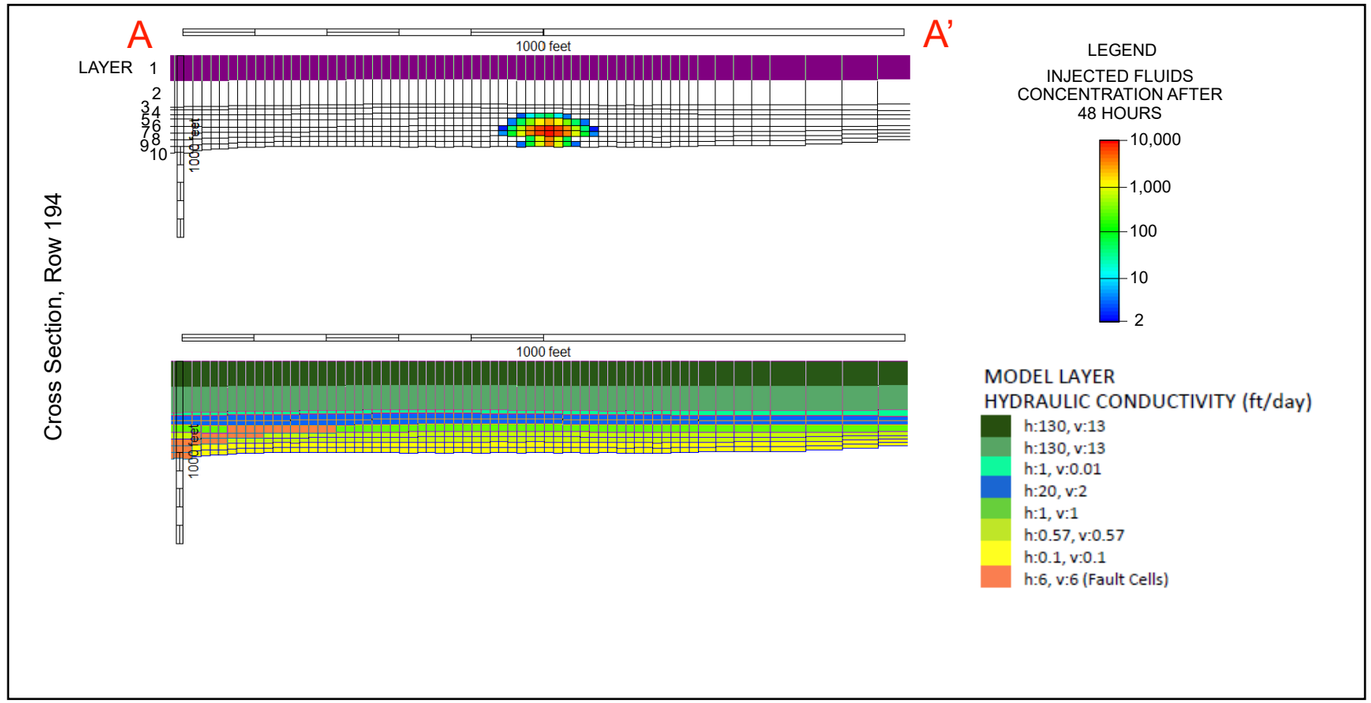


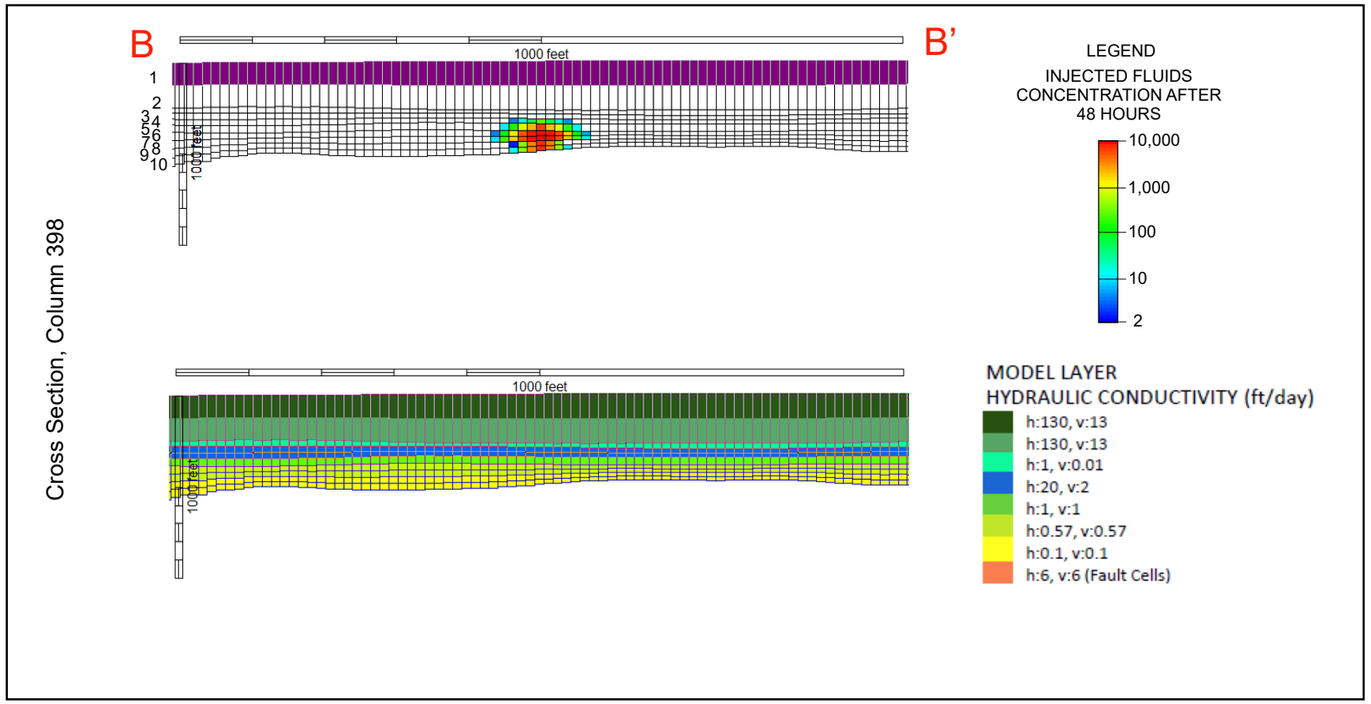
HALEY ALDRICH

CROSS SECTIONS
NW INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

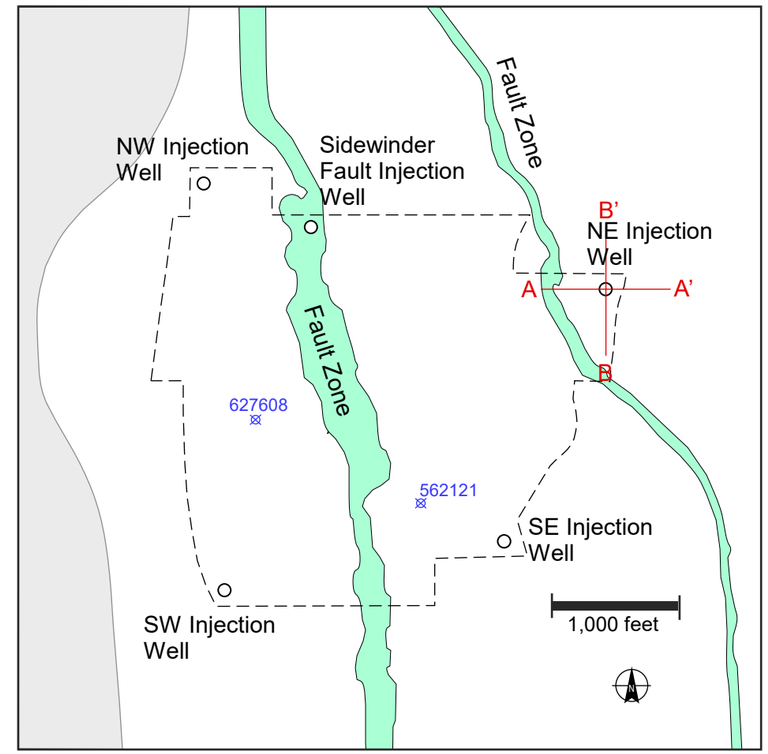
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-5





FAULT LOCATION MAP



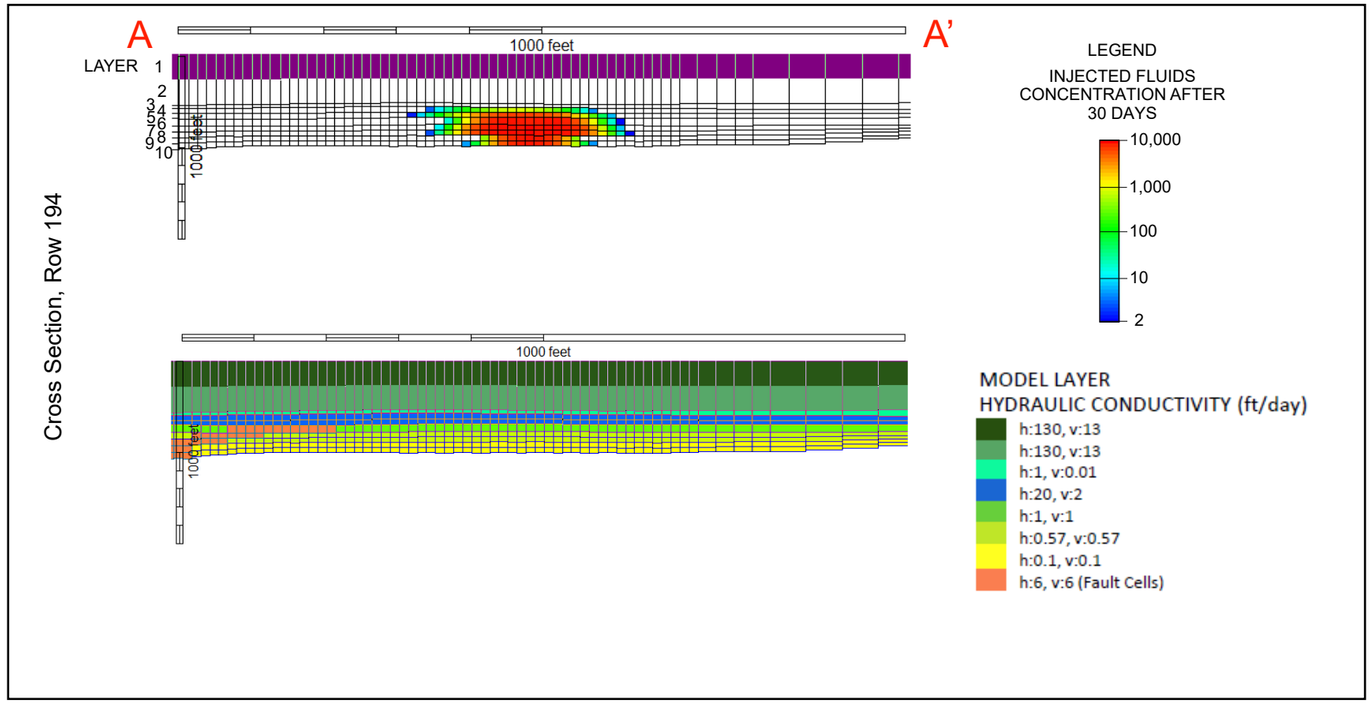
HALEY ALDRICH

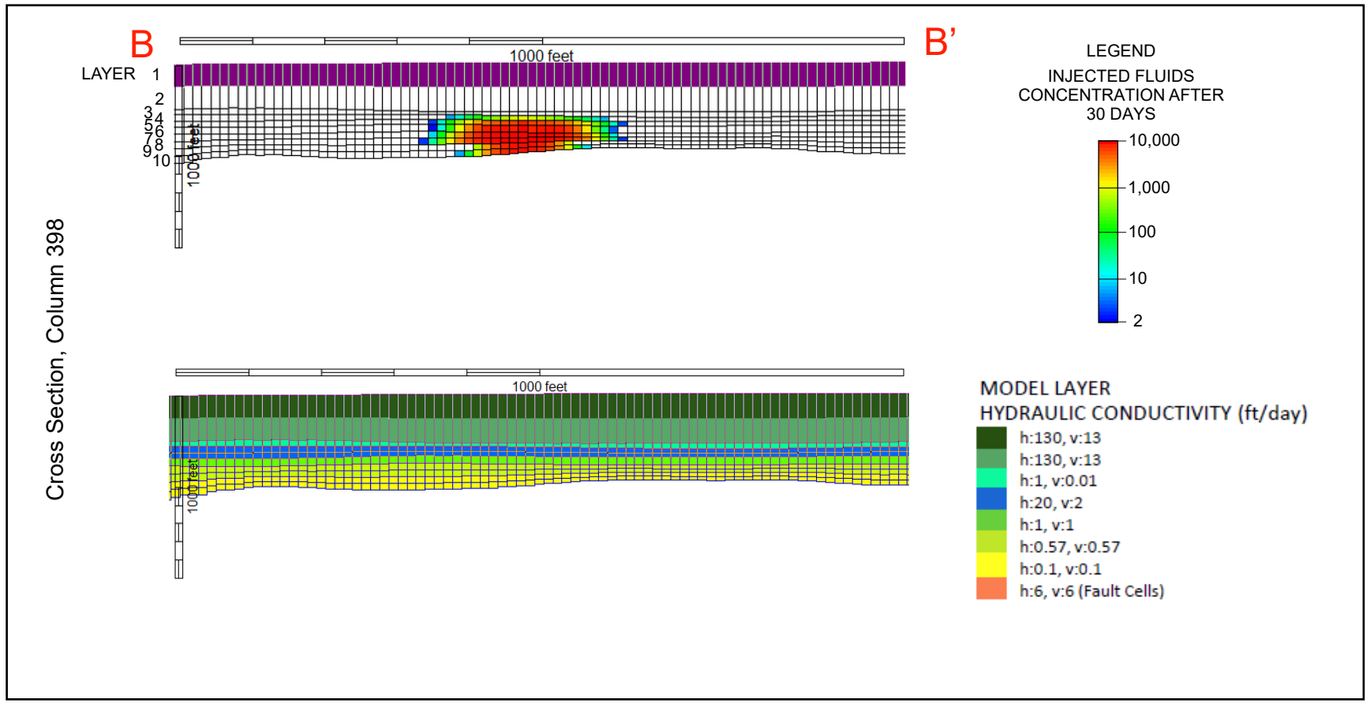
CROSS SECTIONS
NE INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

FEBRUARY 2019
REVISED FEBRUARY 2020

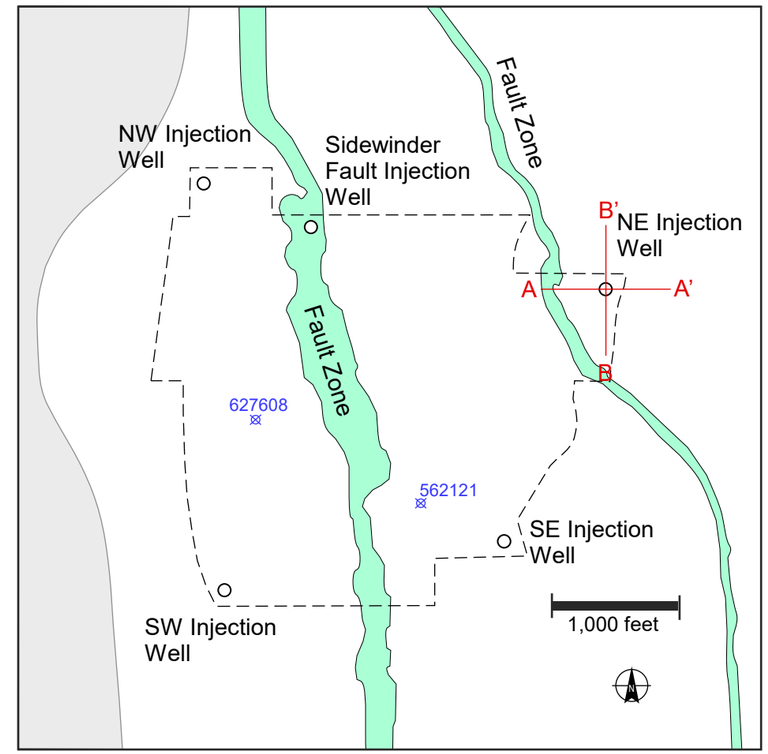
FIGURE A-6

DRAFT





FAULT LOCATION MAP

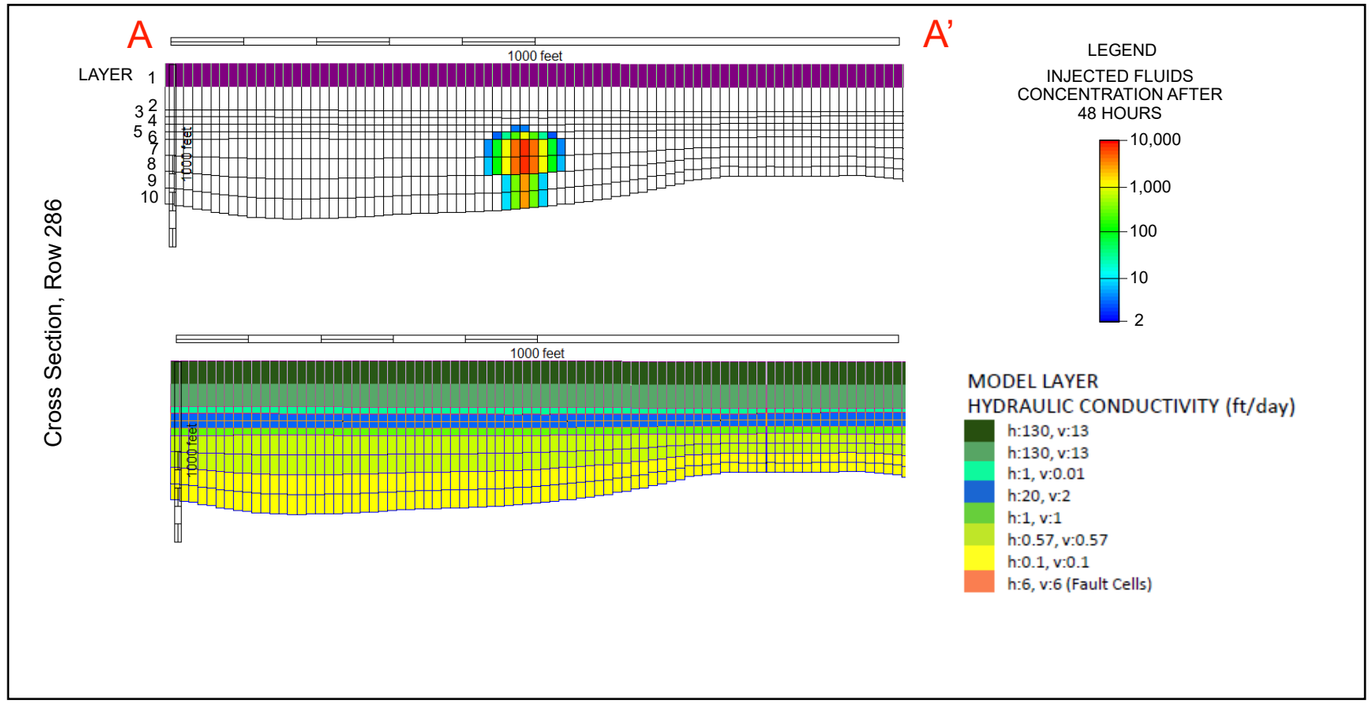


HALEY ALDRICH

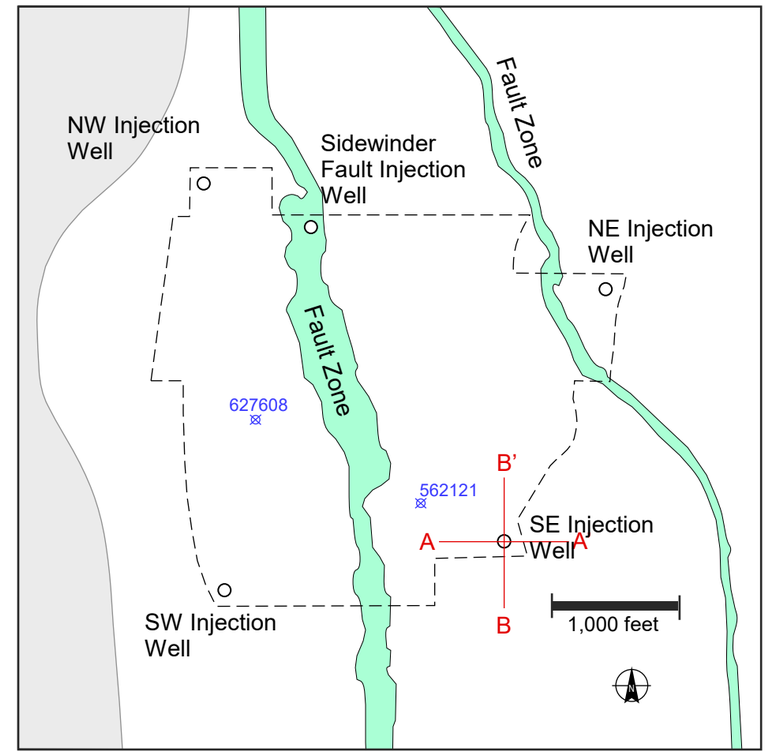
CROSS SECTIONS
NE INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

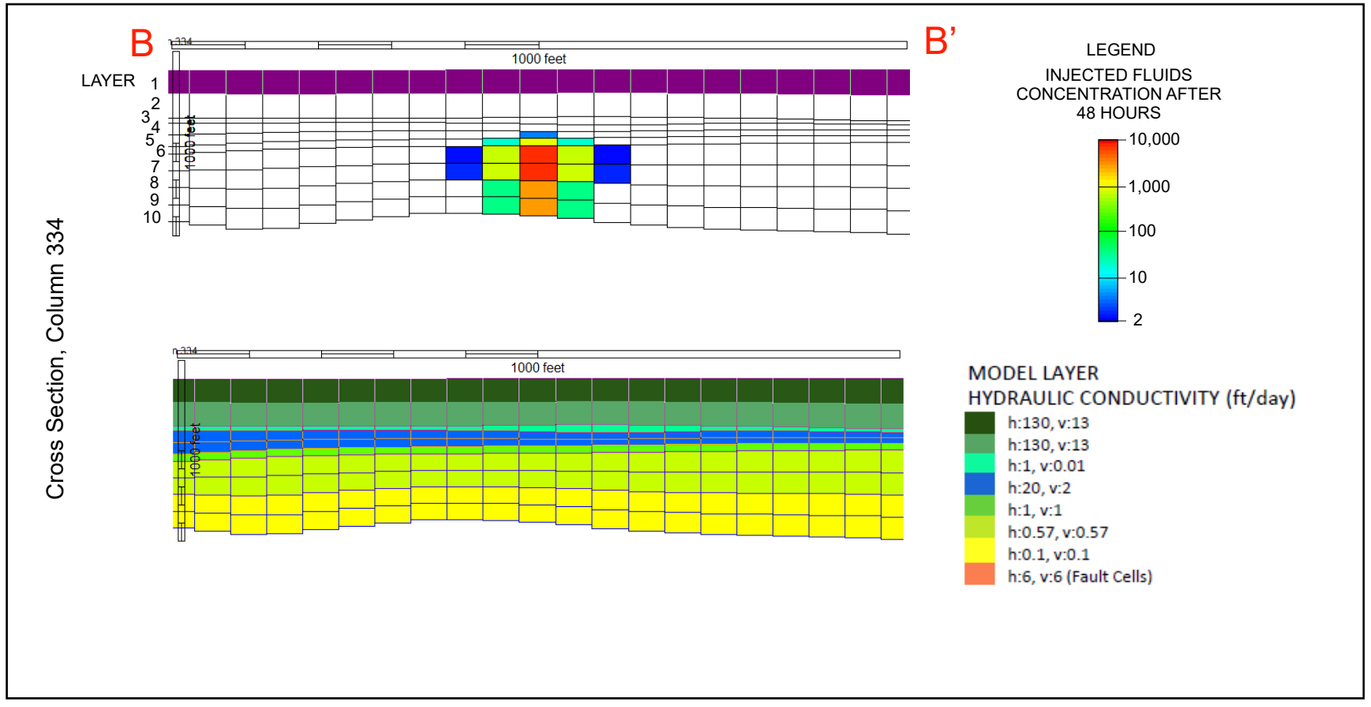
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-7



FAULT LOCATION MAP



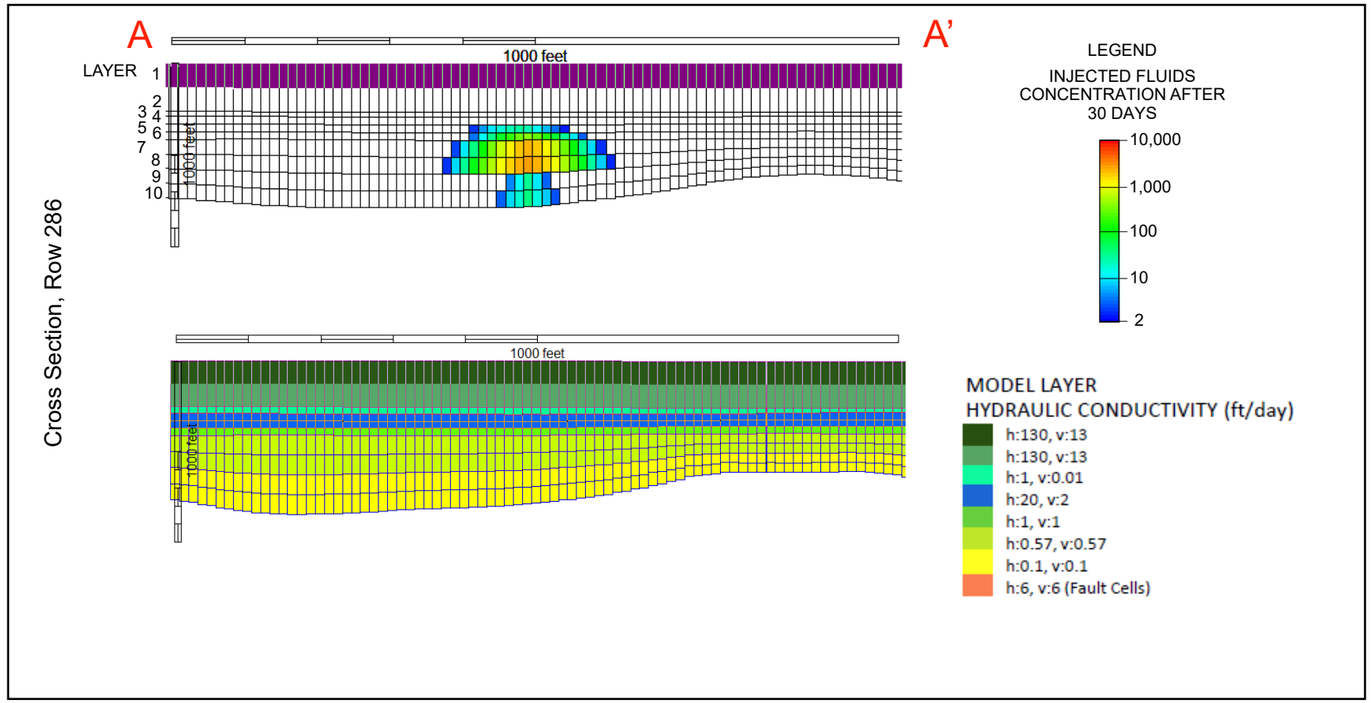


HALEY ALDRICH

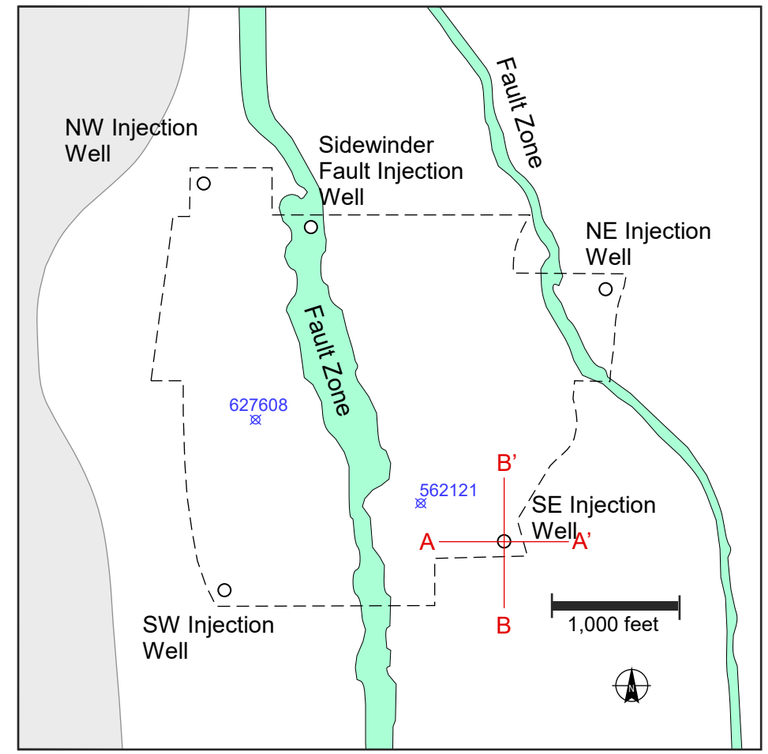
CROSS SECTIONS
SE INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

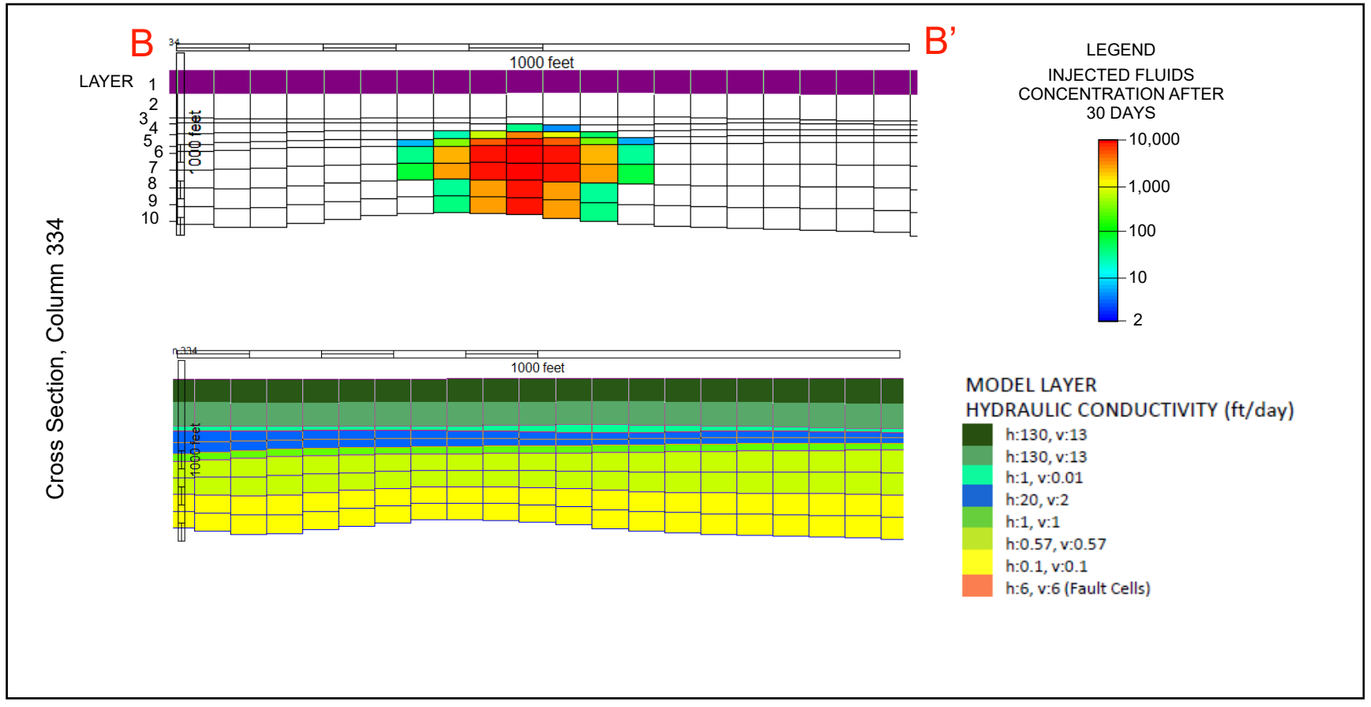
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-8



FAULT LOCATION MAP



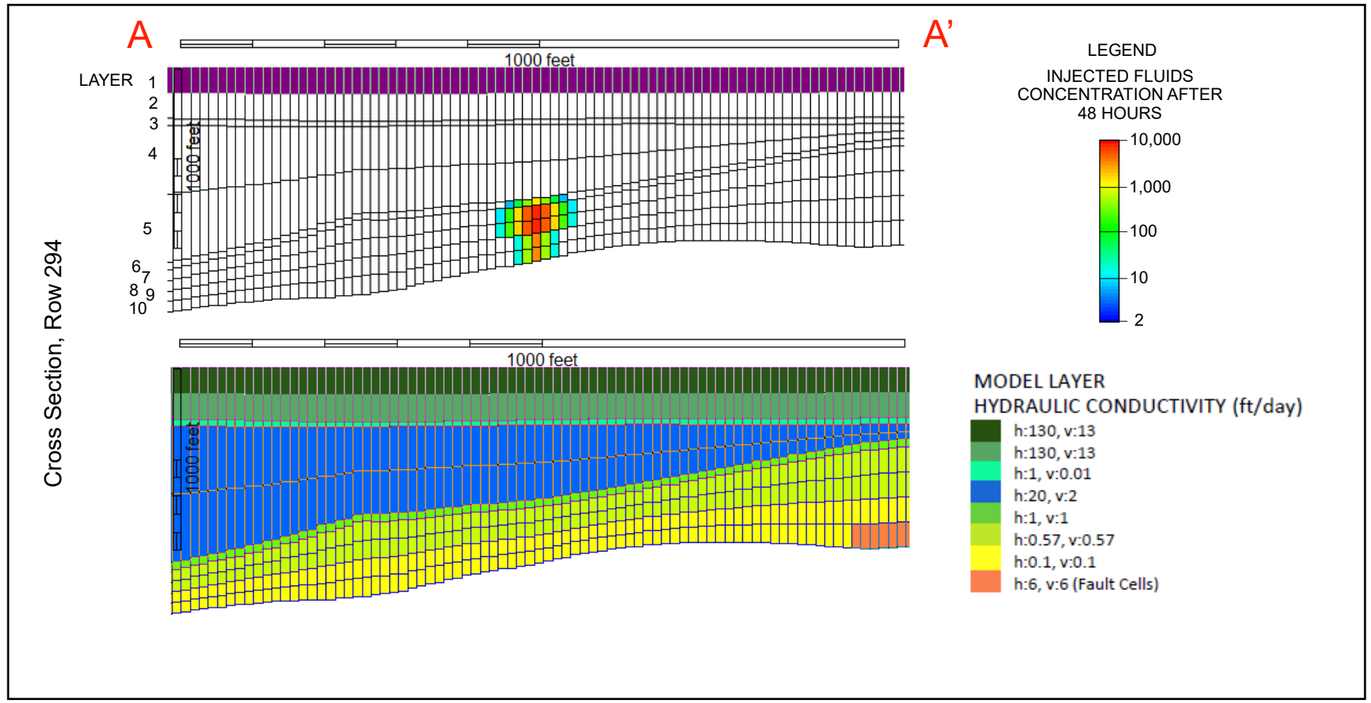


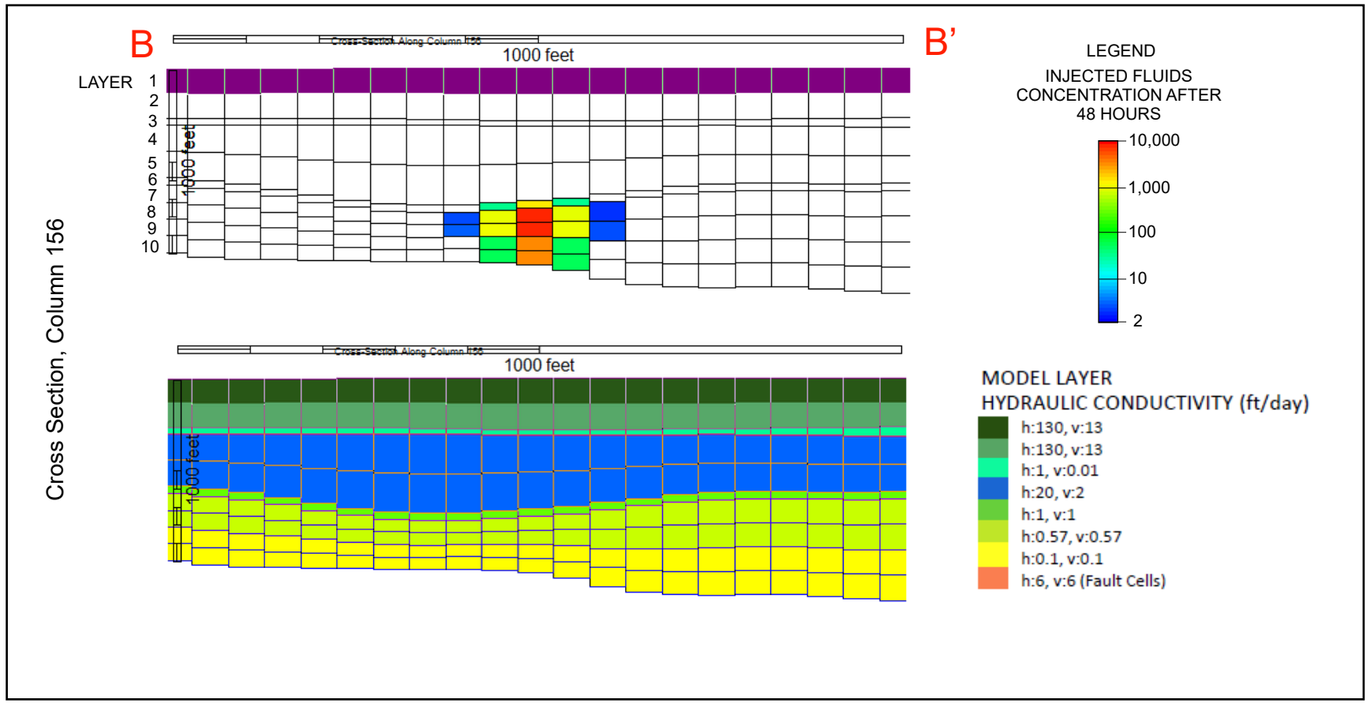
HALEY ALDRICH

CROSS SECTIONS
SE INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

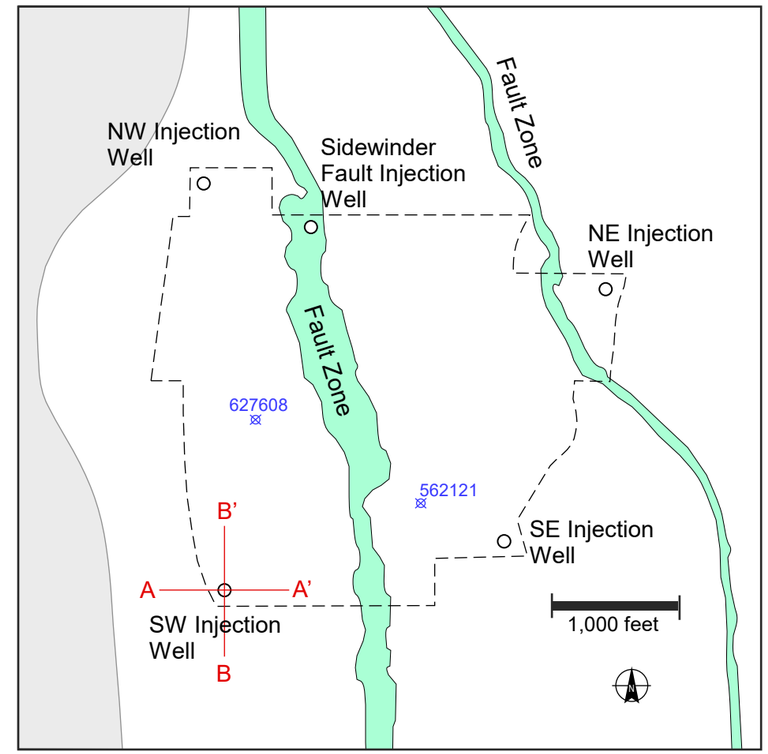
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-9





FAULT LOCATION MAP

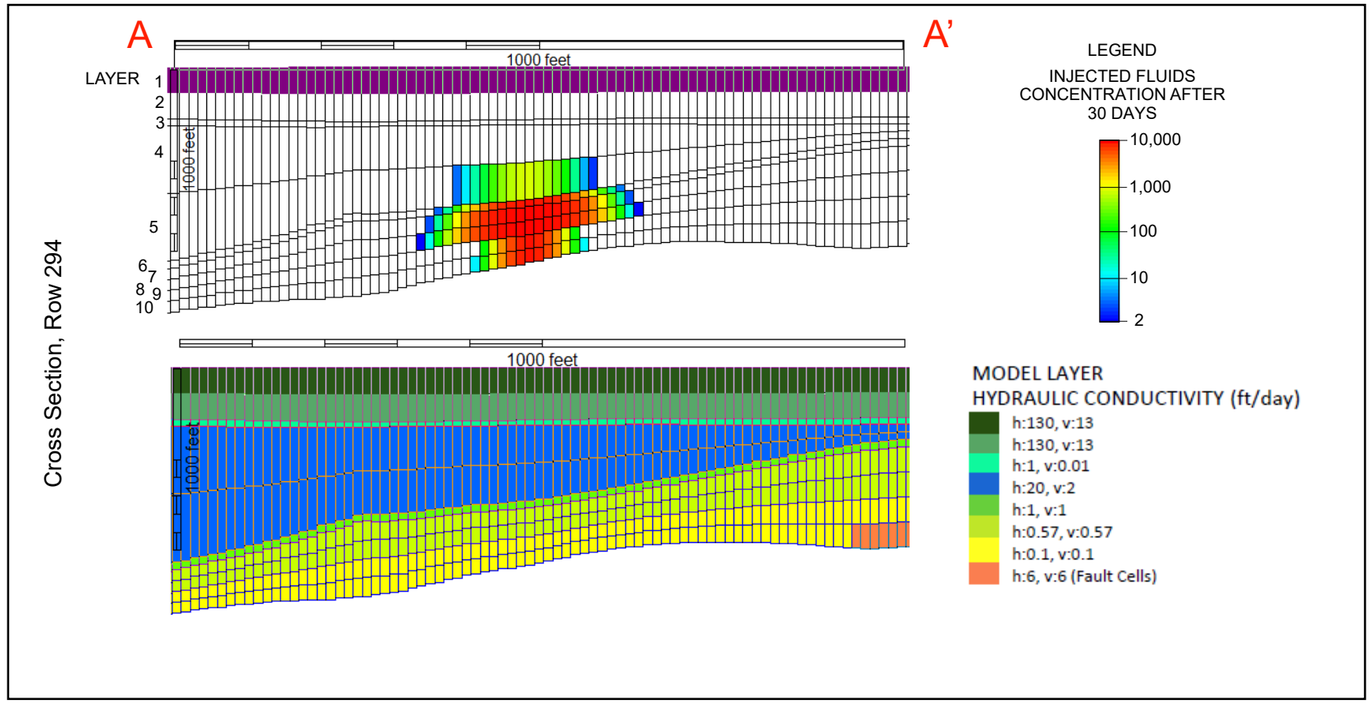


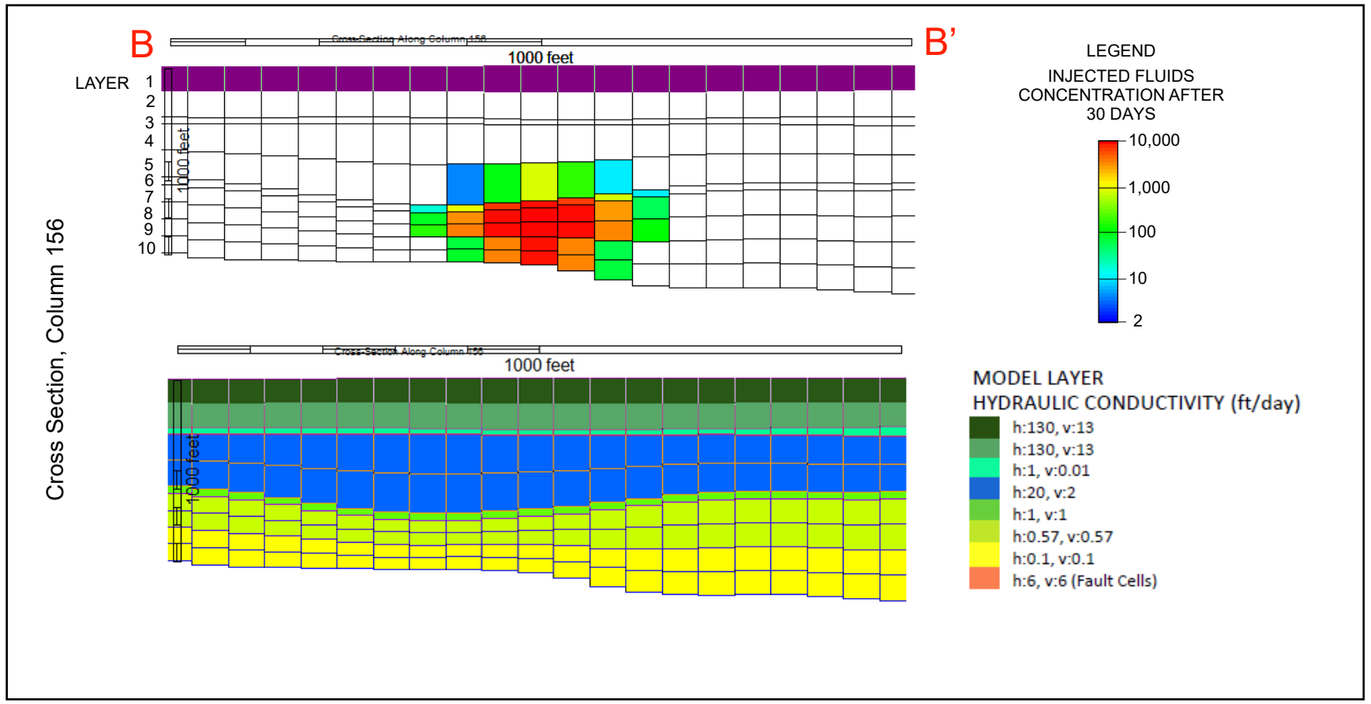
HALEY ALDRICH

CROSS SECTIONS
SW INJECTION WELL, 48 HOURS
INJECTION WITH NO EXTRACTION

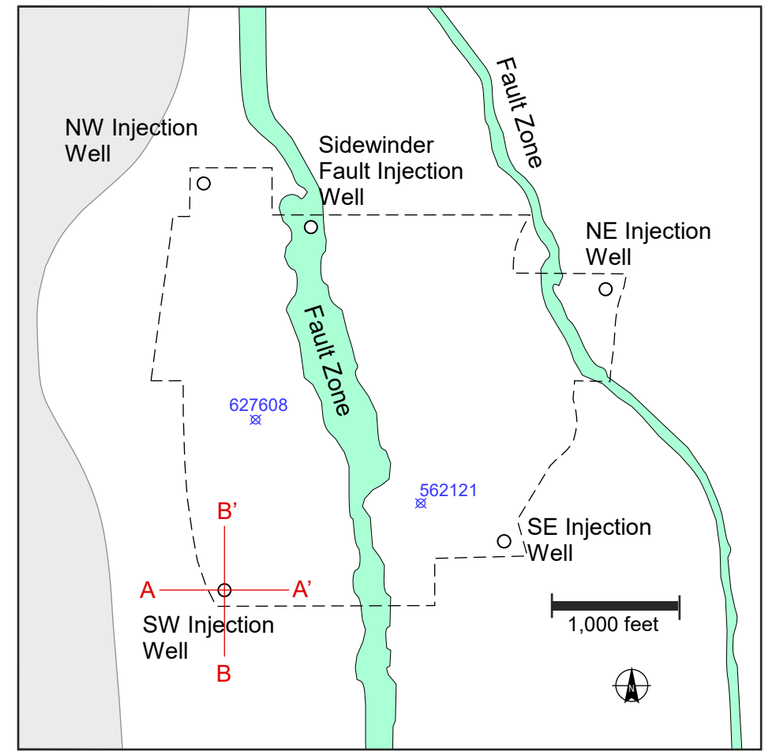
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-10





FAULT LOCATION MAP

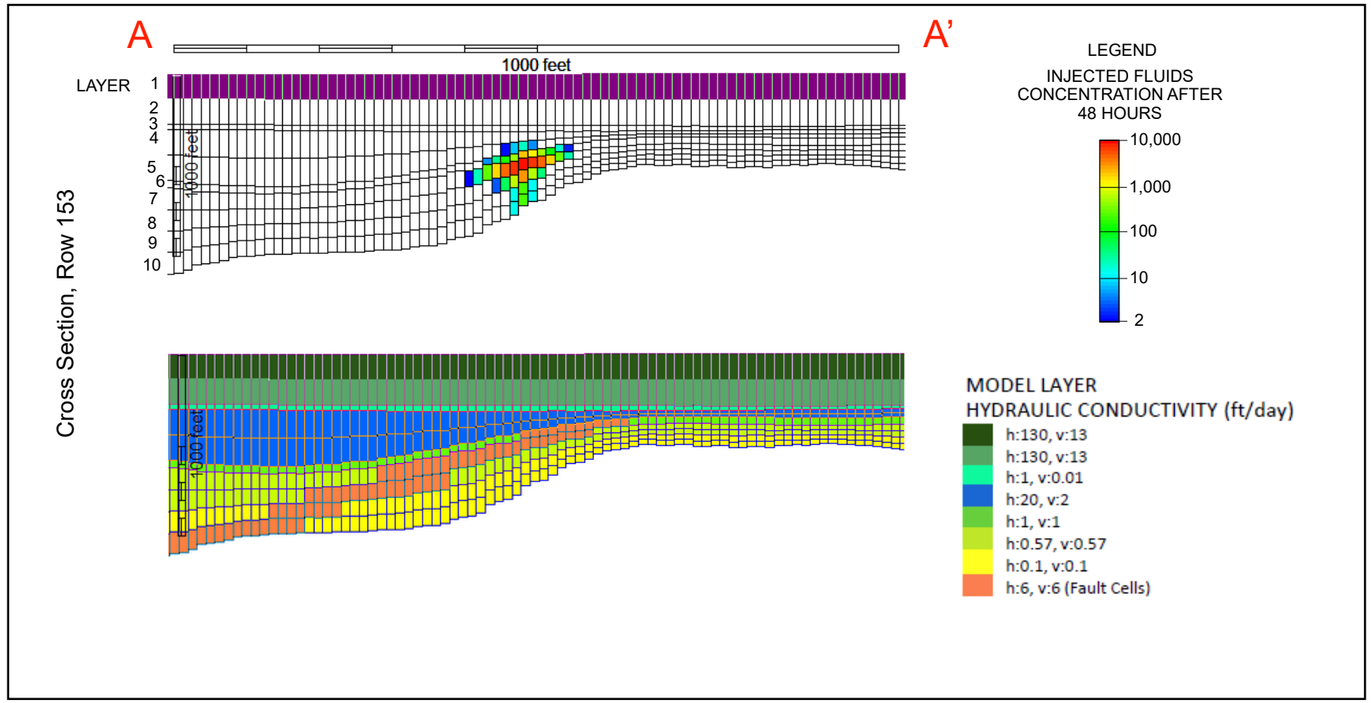


HALEY ALDRICH

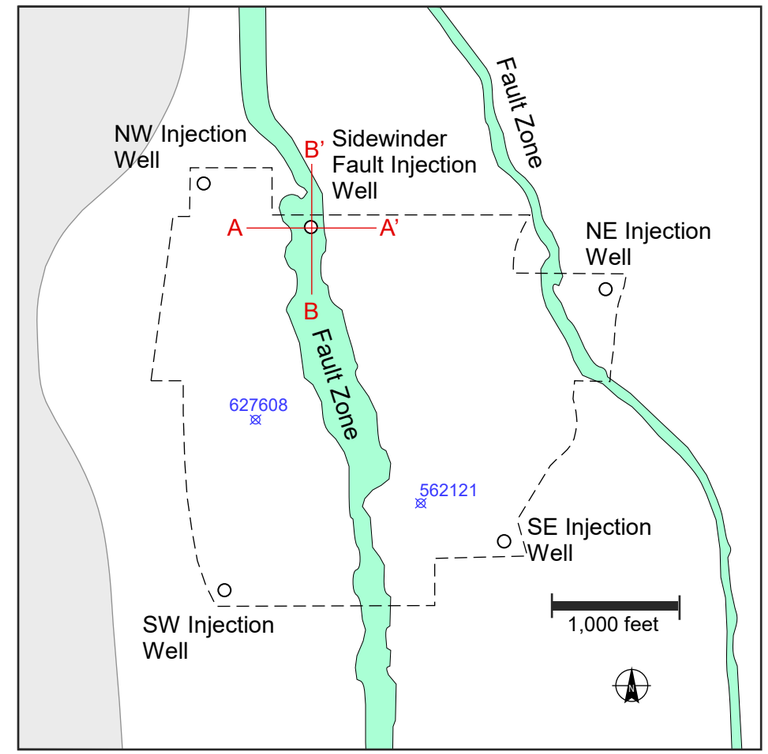
CROSS SECTIONS
SW INJECTION WELL, 30 DAYS
INJECTION WITH NO EXTRACTION

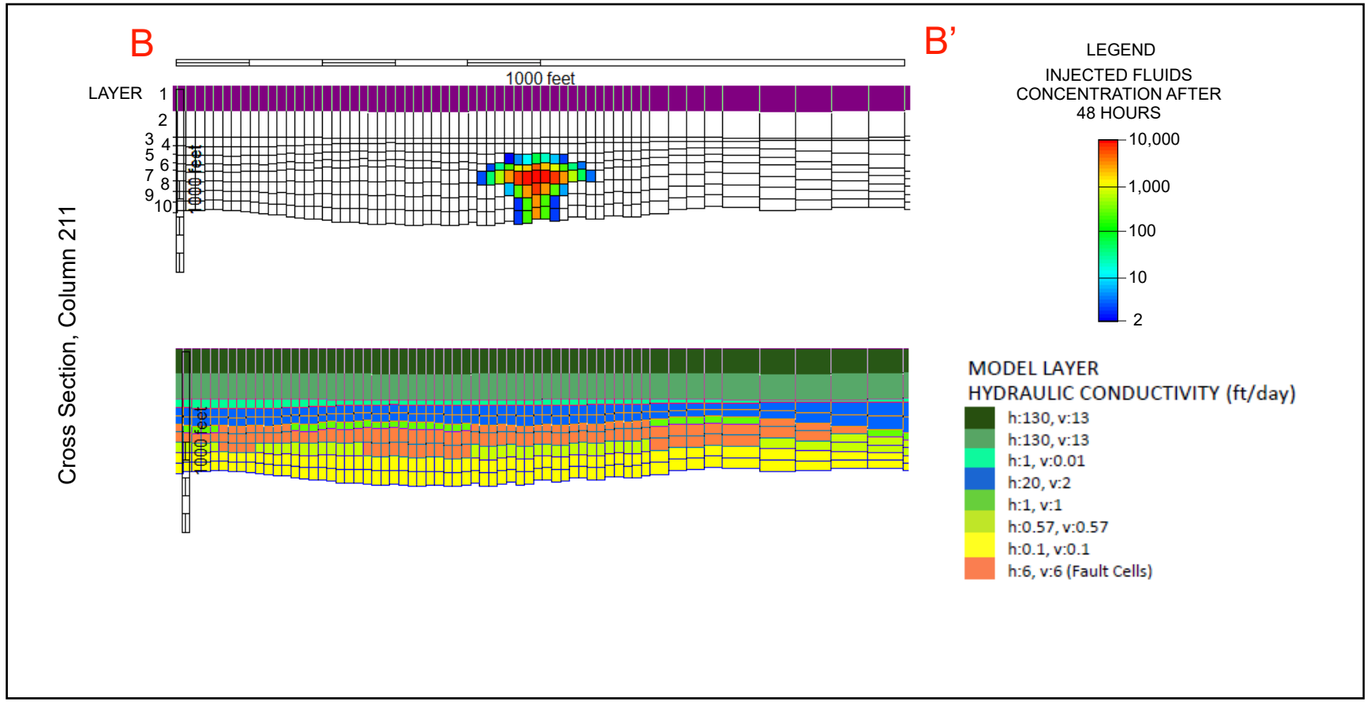
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-11



FAULT LOCATION MAP



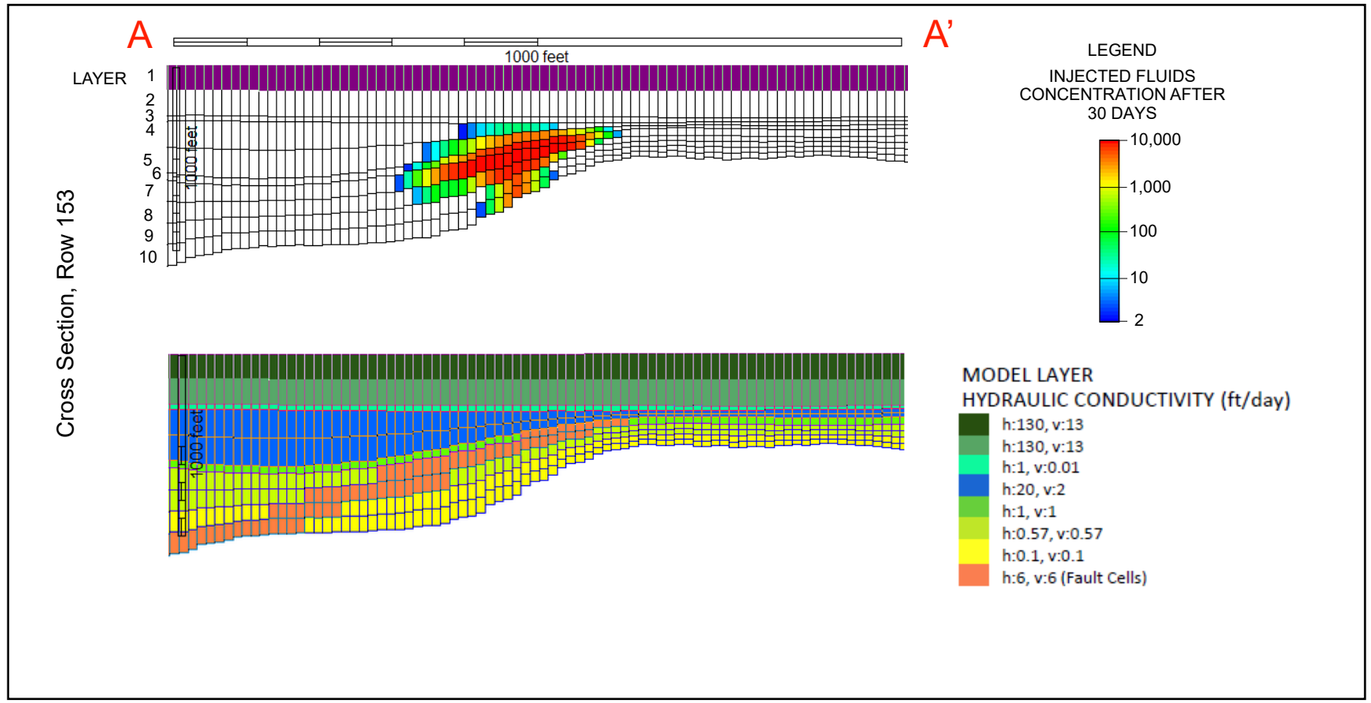


HALEY ALDRICH

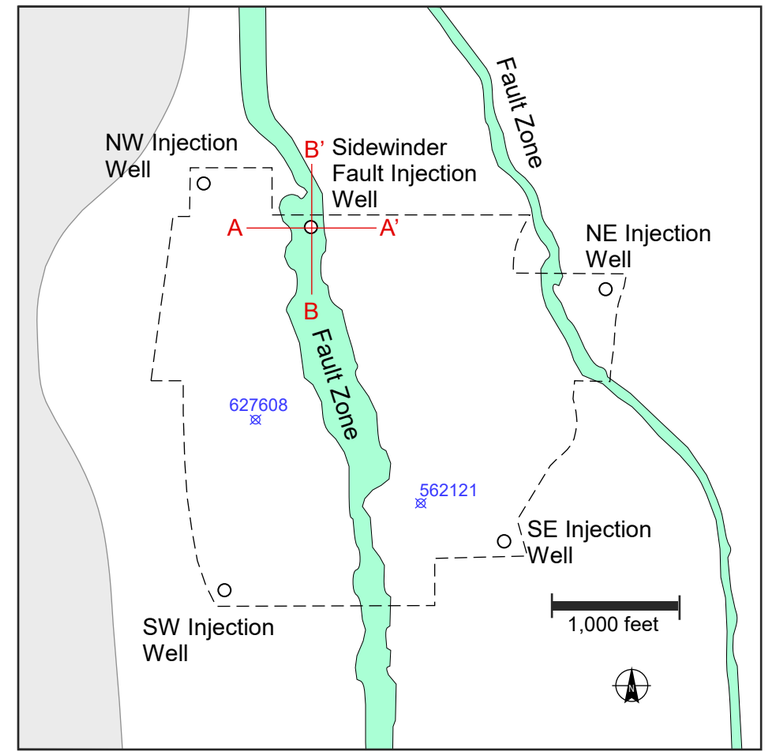
CROSS SECTIONS
SIDEWINDER FAULT INJECTION WELL, 48 HOUR INJECTION WITH NO EXTRACTION

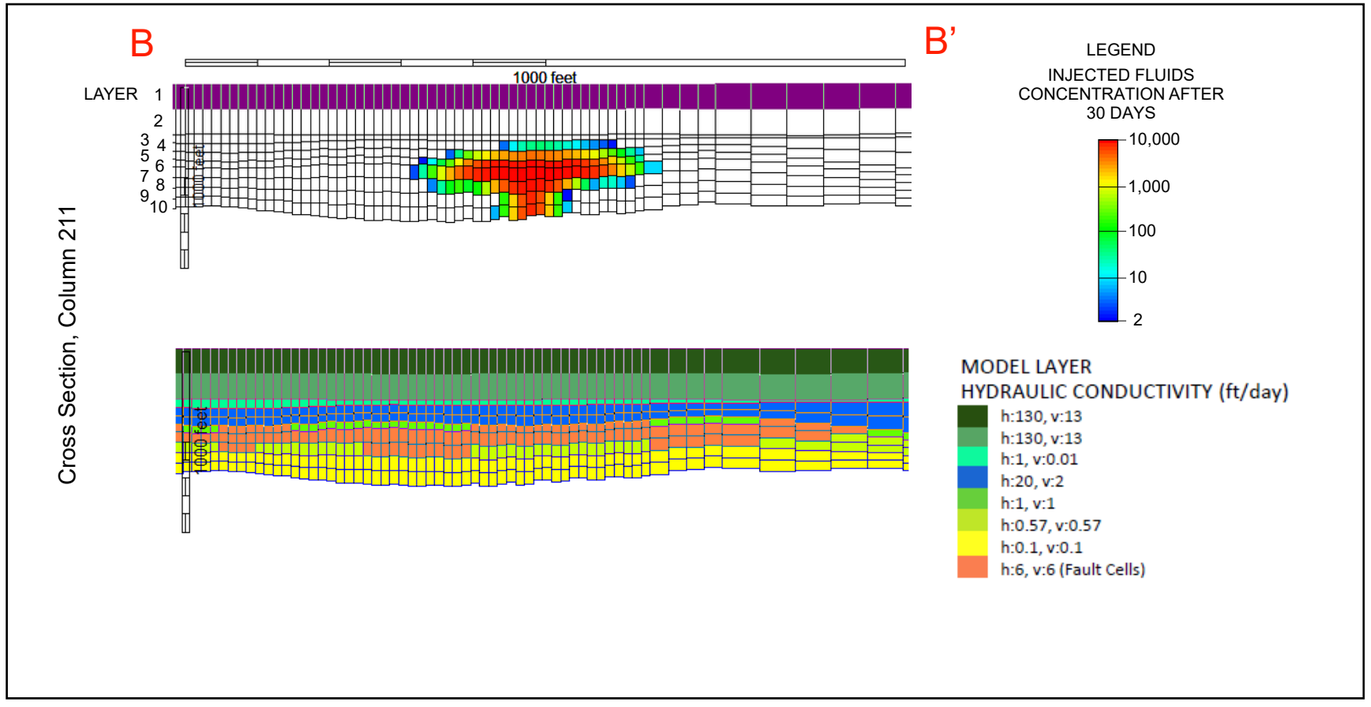
FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-12



FAULT LOCATION MAP





HALEY ALDRICH

CROSS SECTIONS
SIDEWINDER FAULT INJECTION WELL, 30 DAY INJECTION WITH NO EXTRACTION

FEBRUARY 2019
REVISED FEBRUARY 2020

FIGURE A-13

EXHIBIT A-8-2

Model Files