

CITY OF  
TUCSON  
ENVIRONMENTAL  
SERVICES

June 20, 2013

**VIA HAND DELIVERY**

Mr. Marc E. Herman, Project Manager  
Superfund Programs Unit/Southern Regional Office  
Arizona Department of Environmental Quality  
400 W. Congress St., Suite 433  
Tucson, AZ 85701



**Re: Silverbell Landfill Water Quality Assurance Revolving Fund Site  
Remedial Action Plan Implementation  
Pump and Treat System Model Update**

Dear Mr. Herman:

The City of Tucson, Environmental Services (COT-ES) plans to construct a 1000 gallon per minute pump and treat system to remove the maximum mass of contamination from the Silverbell Landfill Water Quality Revolving Fund Site (WQARF). This pump and treat system approach is consistent with the 1994 site Remedial Action Plan and was approved by the Arizona Department of Environmental Quality (ADEQ) in letters dated September 18, 1995 and October 4, 2010. Originally, COT-ES planned to reinject the treated groundwater to the aquifer; however, due to the cost of installing and maintaining injection wells, we have been considering other uses for the treated groundwater. COT-ES retained Clear Creek and Associates to model impacts to the contamination should the water be discharged to the Santa Cruz River instead of reinjected to the aquifer. Attached is the model simulation report, dated June 10, 2013.

The model simulation predicted that the proposed pump and treat system would be slightly more effective if treated groundwater were not reinjected because the plume would not be diluted by the reinjected water. In addition, the model predicts that discharge to the Santa Cruz River may slightly reduce contaminant concentrations north of the main mass of the plume and cause the remaining plume to shift to the west. Overall, the model simulations indicate that the effects of discharge to the Santa Cruz River instead of reinjecting the treated water will be minor but beneficial for the goal of removing the maximum mass of contamination from the aquifer.

COT-ES is currently preparing an Arizona Pollutant Discharge Elimination System (AZDPES) permit application for the proposed pump and treat system. The permit application will be submitted to the ADEQ in early July 2013. Simultaneously, we will submit a Preliminary Jurisdictional Determination to the Army Corps of Engineers to determine the limits of the area regulated under Section 404. When the AZDPES permit is issued late in 2014, we plan to apply for a Section 404 Nationwide Permit (#7) from the Corps of Engineers in order to discharge water to the Santa Cruz River. You will be copied on all permit applications.



Mr. Marc E. Herman

June 20, 2013

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Thank you for your on-going review of the site. Please contact Molly Collins at (520) 837-3703 if you have any questions regarding the model simulation or permitting plans for the proposed Silverbell Pump and Treat System.

Sincerely,



Nancy Petersen  
Deputy Director

NP/MC/nr

Enclosures:

Clear Creek and Associates, *Silverbell Landfill Model Simulation – Elimination of Re-injection wells from Model*, June 10, 2013

cc: William Ellet, Arizona Department of Environmental Quality (letter only)  
Wally Wilson, Tucson Water (Email Link)  
Molly Collins, COT, ES (Email Link)  
Silverbell Landfill Central File

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June 10, 2013

Ms. Molly Collins, R.G.  
Project Coordinator  
City of Tucson Environmental Services  
Price Service Center  
4004 South Park Ave., Bldg. #1  
Tucson, Arizona 85714

**Silverbell Landfill Model Simulation – Elimination of Re-injection Wells from Model**

Dear Molly:

In accordance with our recent discussions, Clear Creek conducted an additional groundwater flow and contaminant transport model simulation for the Silverbell Landfill WQARF site. The purpose of the simulation was to evaluate the effect that eliminating the re-injection wells would have on the effectiveness of the proposed remediation system. In addition, the simulation incorporated updated initial PCE concentration data to more accurately reflect current conditions at the site, and it simulates the revised locations of the future extraction wells (Figure 1). The simulation was limited to PCE and TCE; MTBE and TBA were not included.

Both extraction wells in the model were assigned pumping rates of 500 gpm. The screened intervals were set from 175 feet below land surface to 320 feet below land surface. These depths correspond to the lower part of layer 1, all of layer 2 and all of layer 3 in the model. This is consistent with the recommendation Clear Creek provided in our report on the characterization of the intermediate plume (Clear Creek Associates, 2012).

The starting concentrations used in the model are approximated on Figure 2, which shows model output 90 days into the simulation. The initial concentrations assigned to the model were based on April 2012 and October 2012 sampling results for layers 1 and 3, supplemented by depth-specific sampling data collected for layers 2 and 4 during the July – August 2012 monitor well drilling program. Historical sampling results were also considered in the assignment of initial concentrations. For comparison, the 5- $\mu\text{g/L}$  PCE contour line from October 2012 measured data is also shown on Figure 2. The measured data reflect PCE concentrations at depths corresponding to Layers 1 and 3 of the model.

In accordance with our discussions, this simulation addressed VOC fate and transport west of Interstate-10; no VOCs east of Interstate-10 are simulated, with the exception of the area near SLM-546M.



### Simulation Results

As shown on Figures 3 through 7, the model predicted that implementation of the pump-and-treat system without re-injection would reduce PCE concentrations to levels below the MCL within 25 years at most locations. The simulated future PCE concentrations were lower than the future concentrations predicted in the simulation that included re-injection wells (Clear Creek Associates, 2011). The model predicted that the pump-and-treat system would be slightly more effective without reinjection because the reinjection of treated water would dilute the water withdrawn by the extraction wells and thus reduce overall mass removal. Also, the new simulation, which was based on more recent monitoring data and new monitor wells, included lower initial concentrations compared to the previous simulation.

The low levels of PCE predicted to remain in the deeper intervals of the aquifer at the end of the 25-year simulation (Figure 5, 6 and 7) are north of the area that currently has the highest concentrations of PCE. This is consistent with the locations and depths of the simulated extraction wells, which remove PCE mostly from shallow groundwater intervals in the central part of the site. It also reflects the regional hydraulic gradient, which is oriented southeast to northwest during much of the year, particularly when extraction wells at Sweetwater are operating.

Clear Creek conducted one additional simulation to evaluate the effect that discharging the treated water to the location shown on Figure 8 could have on the effectiveness of the pump-and-treat system. One goal of this run was to evaluate whether the incidental recharge of this water could cause PCE in groundwater at this location to migrate to the east. For this model run, we simulated the incidental recharge of 500 gpm along the watercourse located north of the Silverbell Golf Course maintenance facility. The actual volume of water that will be discharged on-site is not known at this time. The volume assigned in the model assumed that 50% of the treated water will be discharged on site and reach the aquifer as groundwater recharge. The effect on the plume after 25 years was fairly minor. An example of the effect is provided on Figure 8, for Layer 2 of the model. As shown on Figure 8, the model suggests that the incidental recharge will reduce PCE concentrations by the end the simulation period and shift the remaining PCE slightly to the west.

### References

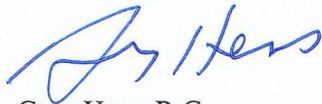
Clear Creek Associates, 2012. Completion Report for the Installation and Testing of Groundwater Monitoring Wells SLM-552, SLM-552M, WR-198M, WR-205M, and WR-433M.

Clear Creek Associates, 2011. Remediation Action Plan Implementation – Updated Modeling Study for Phase I Implementation Alternatives.



Clear Creek appreciates the opportunity to assist City of Tucson Environmental Services with this project. Please call me at 622-3222 if you have any questions.

Sincerely,  
**CLEAR CREEK ASSOCIATES, PLC**



Greg Hess, R.G.  
Senior Hydrogeologist

*Attachments:*  
*Figures 1 through 8*



Cc: Michael Alter, R.G.

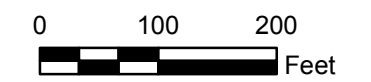


Expires 6/30/16



**Legend**

-  Previous Simulations
-  This Simulation



**Figure 1**  
**Extraction Well Locations**  
**Simulated In Model**

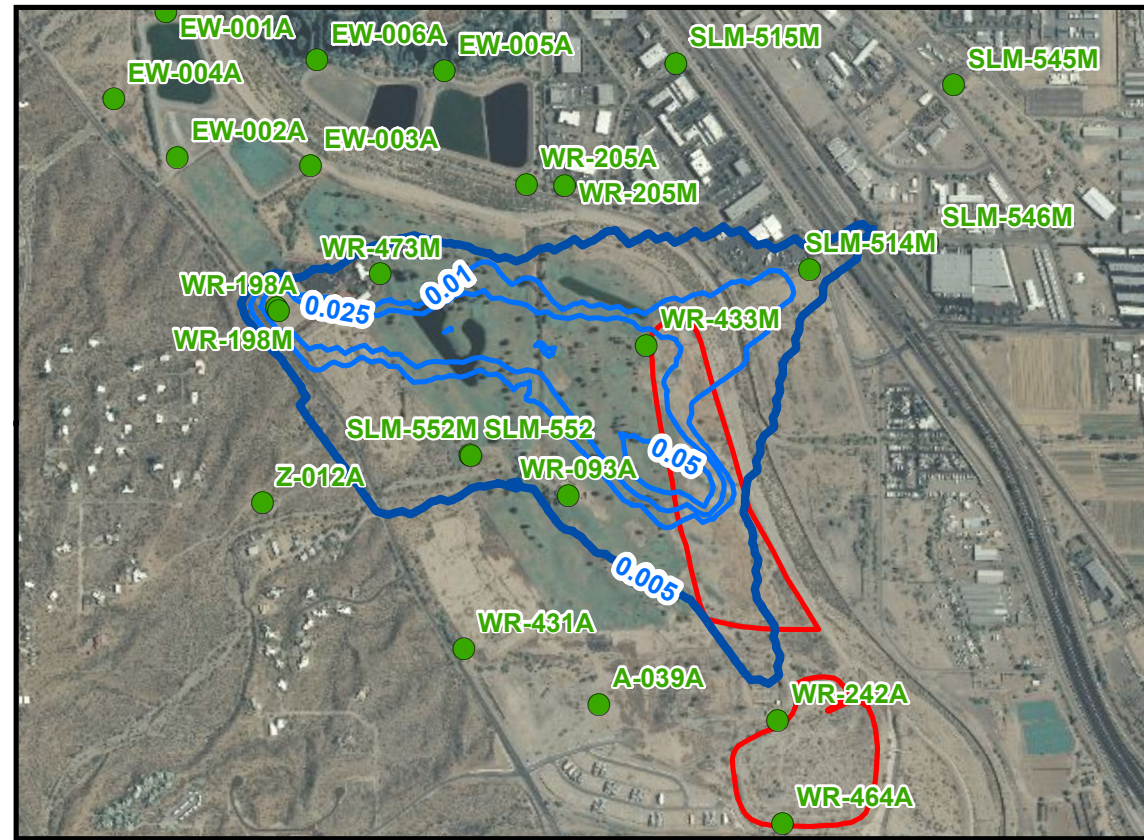
Silverbell Landfill WQARF Site  
CCA Project No. 077046



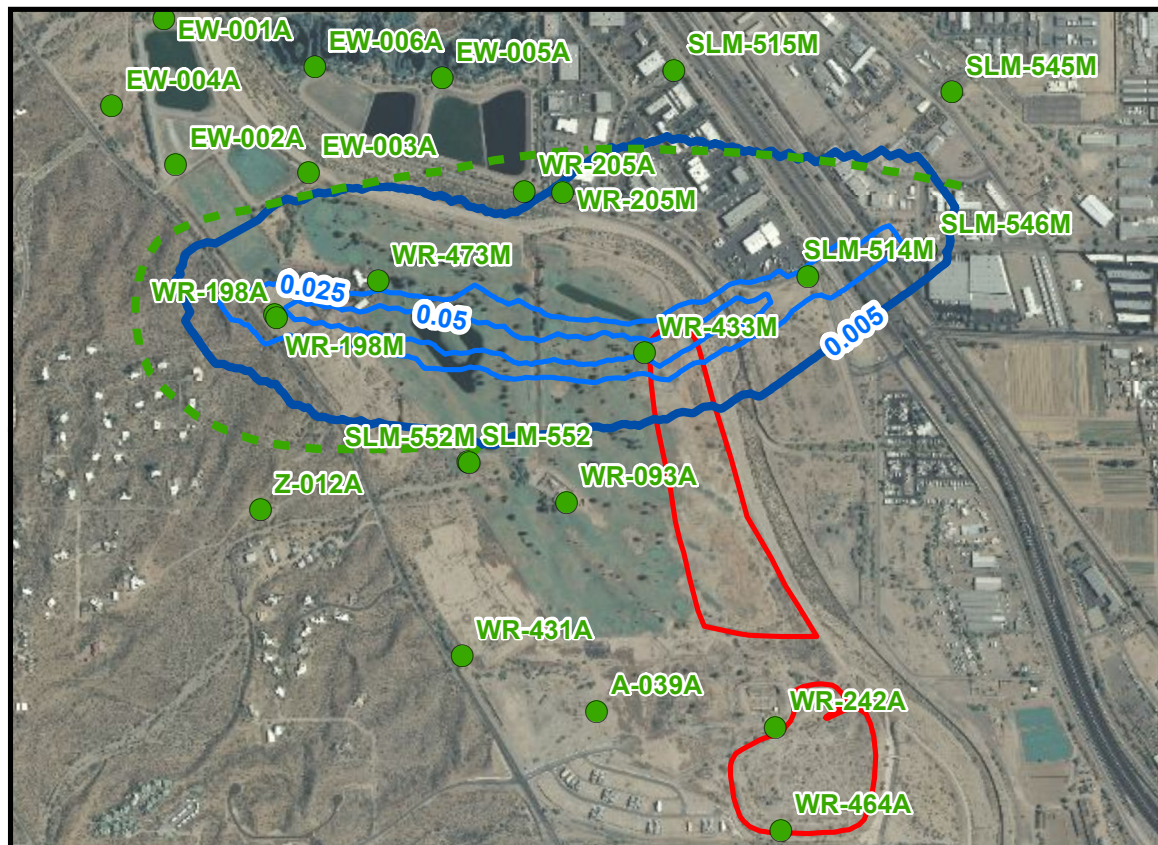




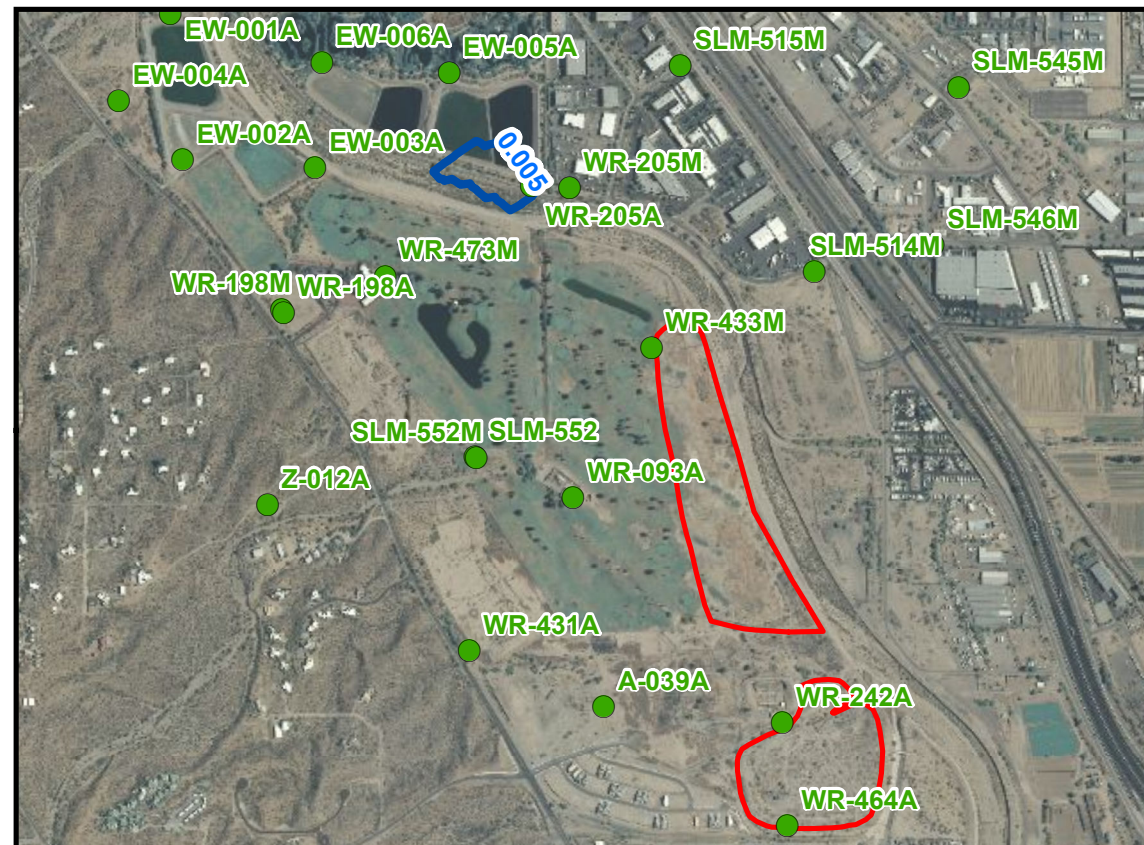
Layer 1



Layer 2



Layer 3



Layer 4

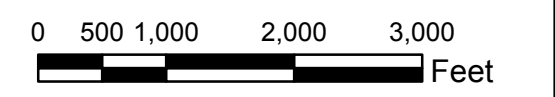
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**Legend**

**Model PCE (mg/L)**

- 0.3
- 0.2
- 0.1
- 0.05
- 0.025
- 0.005
- - - Oct 2012 PCE 5 ug/L Contour\*
- Silverbell Landfill (approx)
- Well

\* From City of Tucson Environmental Services ("Shallow Zone" = Layer 1, "Intermediate Zone" = Layer 3)



Note: Only selected wells are shown for reference; additional wells exist but are not shown.

**Figure 2**  
**Model PCE Concentrations in Groundwater**  
**First Year of Simulation**

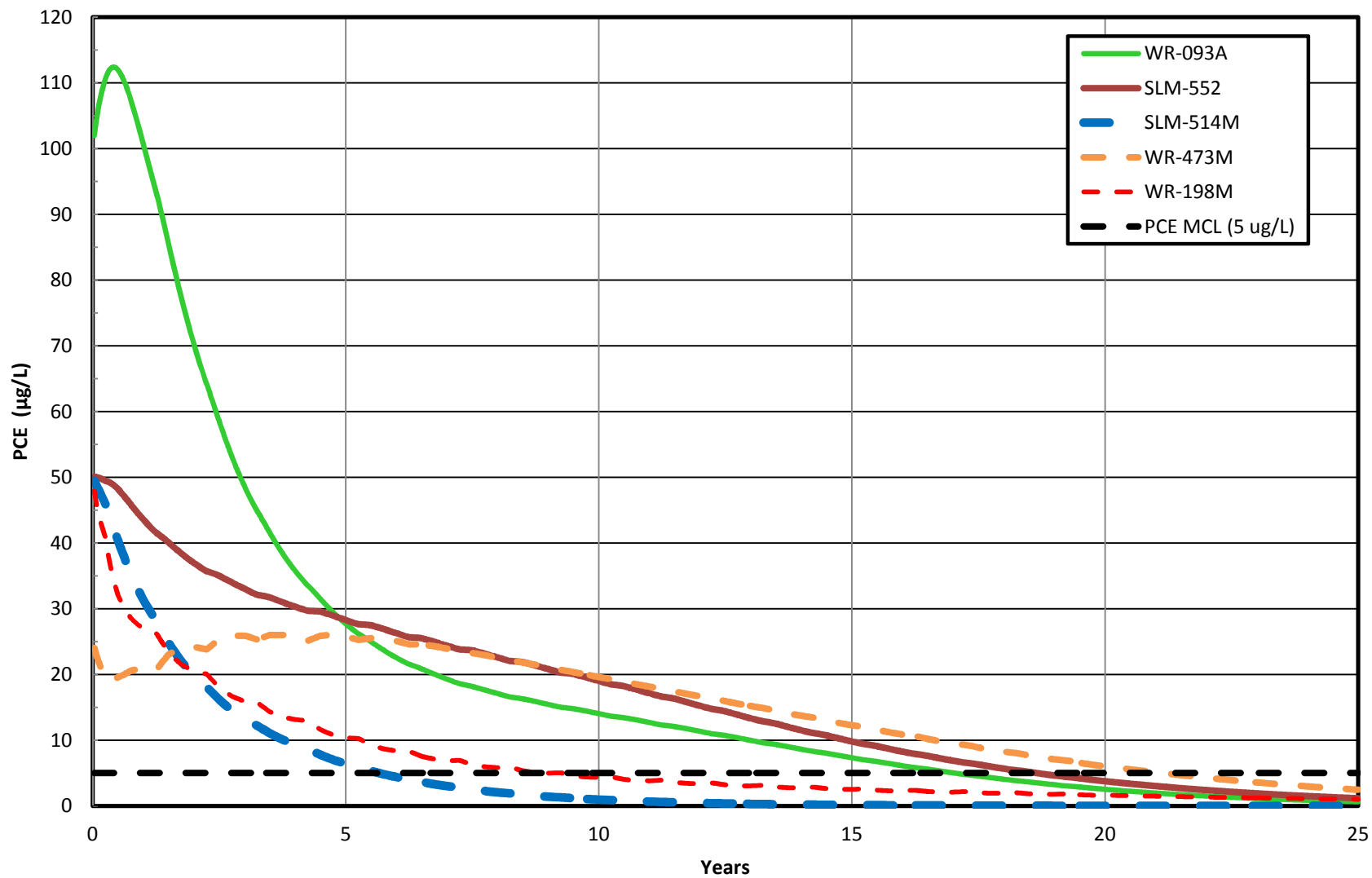
Silverbell Landfill WQARF Site  
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### Figure 3. Predicted PCE Concentrations in Selected Monitor Wells

Remediation Scenario: Two Extraction wells (500 gpm each), and No ReInjection







**Legend**

- Model PCE (mg/L)**
- 0.0025
  - 0.001
  - Silverbell Landfill (approx)
  - Well

(All model PCE < 0.005 mg/L)

*Note: Only selected wells are shown for reference; additional wells exist but are not shown.*



**Figure 4**  
**Model Simulated PCE**  
**Concentration in Groundwater**  
**Layer 1, Year 25**

Silverbell Landfill WQARF Site  
 CCA Project No. 077046







**Legend**

**Model PCE (mg/L)**

- 0.005
- 0.0025
- 0.001
- Silverbell Landfill (approx)
- Well

*Note: Only selected wells are shown for reference; additional wells exist but are not shown.*

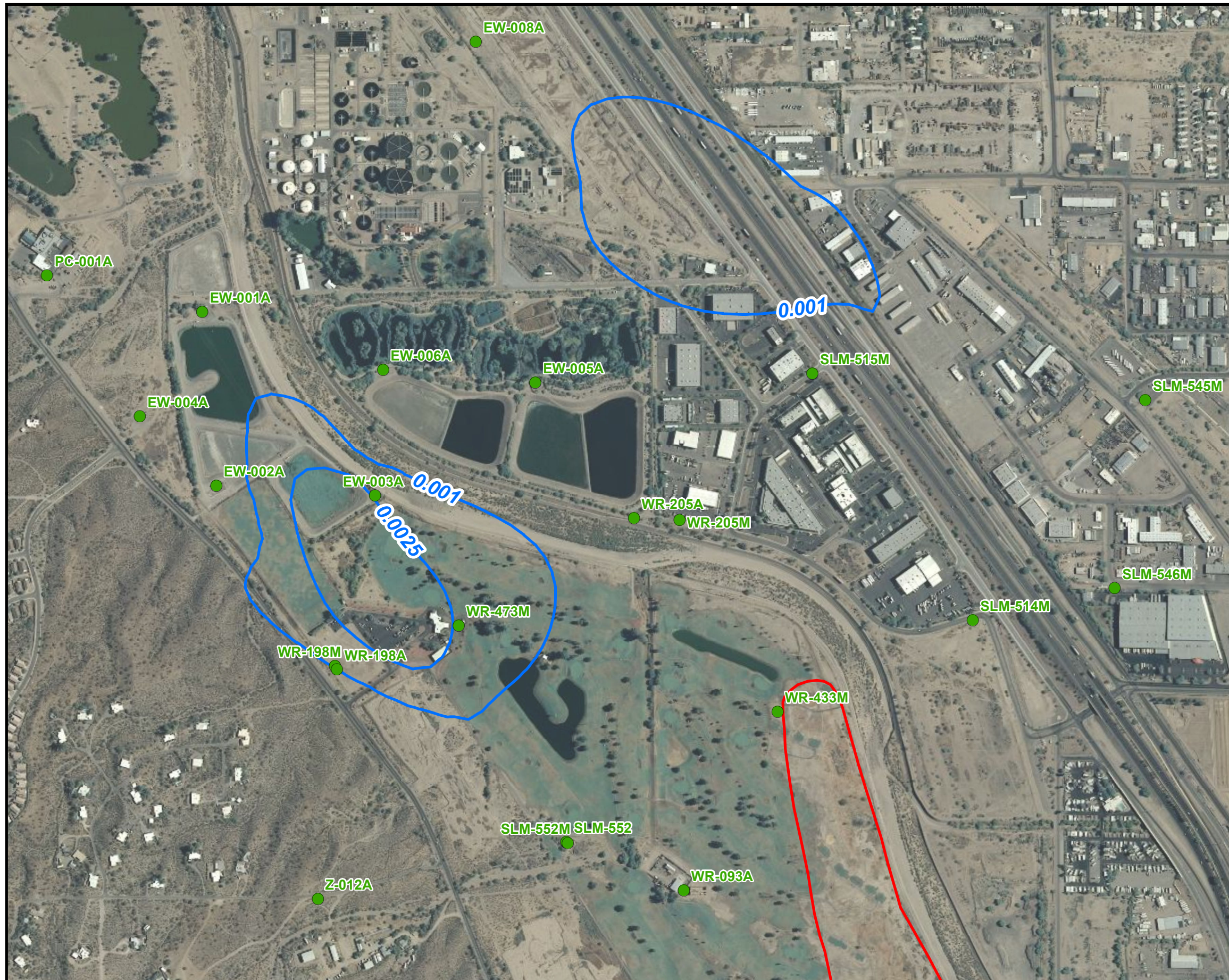


**Figure 5**  
**Model Simulated PCE**  
**Concentration in Groundwater**  
**Layer 2, Year 25**

Silverbell Landfill WQARF Site  
 CCA Project No. 077046







**Legend**

**Model PCE (mg/L)**

— 0.0025

— 0.001

▭ Silverbell Landfill (approx)

● Well

(All model PCE < 0.005 mg/L)

*Note: Only selected wells are shown for reference; additional wells exist but are not shown.*



**Figure 6**  
**Model Simulated PCE**  
**Concentration in Groundwater**  
**Layer 3, Year 25**

Silverbell Landfill WQARF Site  
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**Legend**

**Model PCE (mg/L)**

— 0.0025

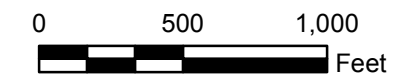
— 0.001

▭ Silverbell Landfill (approx)

● Well

(All Model PCE < 0.005 mg/L)

*Note: Only selected wells are shown for reference; additional wells exist but are not shown.*

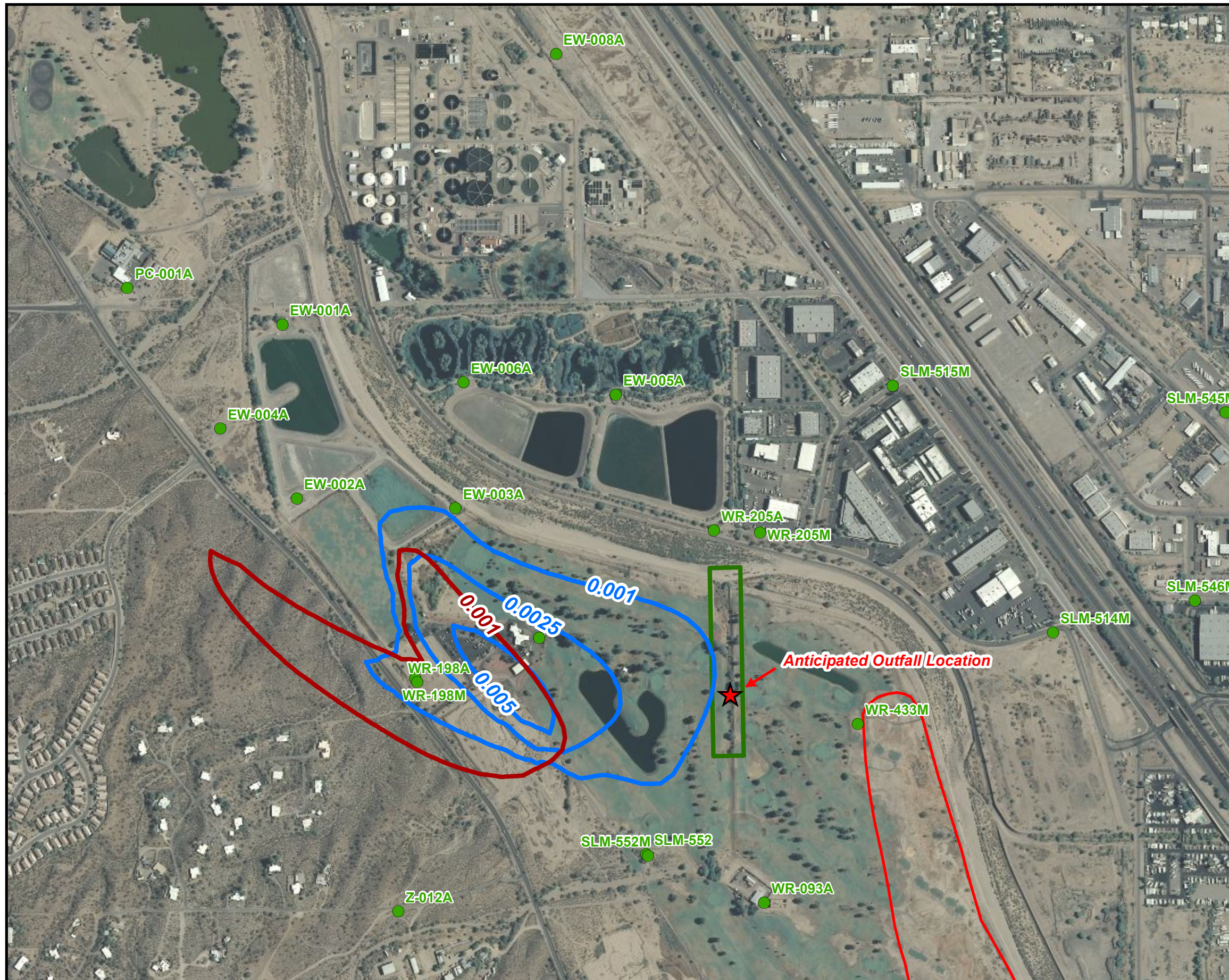


**Figure 7**  
**Model Simulated PCE**  
**Concentration in Groundwater**  
**Layer 4, Year 25**

Silverbell Landfill WQARF Site  
 CCA Project No. 077046





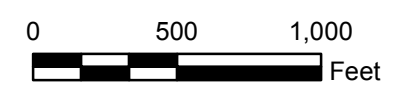


**Legend**

- Model PCE (mg/L) with discharge
- Model PCE (mg/L) no discharge
- Simulated Recharge (500 gpm)
- Silverbell Landfill (approx)
- Well

(All model PCE < 0.0025 mg/L for simulation with discharge)

*Note: Only selected wells are shown for reference; additional wells exist but are not shown.*



**Figure 8**  
**Effect of Including Incidental Recharge of Treated Water (Layer 2, Year 25)**

Silverbell Landfill WQARF Site  
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