ANNUAL EVALUATION OF
2015 WATER-LEVEL MONITORING DATA FROM
THE CITY OF LAS CRUCES WATER SUPPLY WELLS,
NEW MEXICO

prepared by

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prepared for

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April 14, 2016
EXECUTIVE SUMMARY

Las Cruces Utilities contracted John Shomaker & Associates, Inc. (JSAI) to assist with the City of Las Cruces water-level monitoring program. Under the monitoring program, groundwater-level data have been collected at the City’s supply wells based on a defined methodology and QA/QC process from mid-2011 to present. Since mid-2011, the monitoring program has used a consistent methodology for collecting hand-measurements of water levels from the majority of the City’s active and inactive supply wells on a monthly basis, and transducers have also recorded water levels on an hourly basis in twelve inactive wells plus the Jornada piezometers. The period of record for the monitoring program is now sufficiently long enough that long-term water-level trends are emerging for the majority of wells included in the program.

Water-level trends may change as more data become available, but as of 2015, long-term water-level declines have occurred at the majority of inactive wells. On the East Mesa, active supply wells showed long-term declining trends for water levels with average rates ranging from 2.2 to 5.4 ft/yr, while the East Mesa observation wells referred to as Jornada Shallow, Middle, and Deep piezometers showed no apparent long-term trend.

Active supply wells in the northern part of the Interstate-25 Corridor generally showed long-term rises ranging from 2.6 to 4.6 ft/yr. Active supply wells and inactive wells in the southern part of the Interstate-25 Corridor showed long-term declines ranging from 0.7 to 1.9 ft/yr. A number of inactive wells in the southern part of the Interstate-25 Corridor showed seasonal fluctuations in water levels influenced by nearby pumping within the Interstate-25 Corridor, as well as nearby pumping to the west in the Valley. In the Griggs and Walnut plume area in the Interstate-25 Corridor, water levels measured at monitoring well GWMW01 (inside liner) showed a slight long-term rise of 0.7 ft/yr in the perched zone from which PCE is recovered by Well 18. This zone is gravity-drained and is not influenced by regional pumping. Water levels measured at monitoring well MW-SF9, in the deeper capture zone for Well 27, showed declines between 2013 and 2015 coinciding with Well 27 pumping.

Active wells in the Valley showed a variety of long-term trends for non-pumping water levels ranging from a decline of 2.6 ft/yr to a rise of 4.5 ft/yr. Inactive wells in the Valley showed long-term declines ranging from 0.9 to 2.3 ft/yr. Water-level trends were variable in supply wells on the West Mesa, and more data are necessary to identify any overall trends for this region.
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(follow text)

Figure 1. Aerial photograph showing locations of City of Las Cruces supply wells and landfill monitoring wells, and City of Las Cruces and USGS-monitored observation wells, used for water-level monitoring program.

Figure 2. Aerial photograph of the Griggs and Walnut plume site showing locations of capture wells and monitoring well network, City of Las Cruces, New Mexico.

Figure 3. Aerial photograph showing December 2015 water-level elevation contours for the City of Las Cruces area.

APPENDICES

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Appendix A. East Mesa hydrographs
Appendix B. Interstate-25 Corridor hydrographs
Appendix C. Valley hydrographs
Appendix D. West Mesa hydrographs
Appendix E. Las Cruces Foothills Landfill hydrographs
Appendix F. Griggs and Walnut Site hydrographs
1.0 INTRODUCTION

Las Cruces Utilities contracted John Shomaker & Associates, Inc. (JSAI) to assist with the City of Las Cruces (City) water-level monitoring program by performing quality assurance and quality control (QA/QC) evaluation of monthly water-level measurements collected by Las Cruces Utilities staff, and preparing an annual report that integrates the City’s water-level data with data from other sources, such as the U.S. Geological Survey (USGS), to define short- and long-term trends.

The City’s supply wells are presented in Table 1 and Figure 1, and can be divided into four regions: East Mesa (Jornada Basin), Interstate-25 Corridor, Valley, and West Mesa. The City’s groundwater wells include active supply wells and inactive wells.

Selected observation wells monitored by the USGS, and located near the City’s supply wells, are also discussed in this report. These wells are presented in Table 2 and Figure 1. Also included in this report are water-level data from Las Cruces Foothills Landfill monitoring wells (Table 3, Fig. 1), located in the transition between the Interstate-25 Corridor and East Mesa. Water-level data have been collected at Las Cruces Foothills Landfill monitoring wells on a monthly to annual basis since 1999 using consistent data collection methods and equipment.

Groundwater-level data collected at the City’s supply wells from mid-2011 to present are included in this report. Water-level measuring attempts prior to 2011 lacked defined methodology and QA/QC process, and would therefore be difficult to use to define water-level trends. Since mid-2011, the City’s water-level monitoring program has used a consistent methodology for collecting hand-measurements from supply wells on a monthly basis, and transducers have also recorded water levels on an hourly basis in twelve wells (in six wells since mid-2012, in three wells since mid-2013, and in three additional wells since early-2014). Las Cruces Utilities has also been monitoring water levels on an hourly basis with transducers in the Jornada Shallow, Middle, and Deep piezometers (CLC Shallow, Middle, and Deep), having taken over this monitoring task from USGS in early 2013.
## Table 1. Summary of wells monitored by City of Las Cruces

<table>
<thead>
<tr>
<th>well</th>
<th>elevation, ft amsl</th>
<th>total depth, ft</th>
<th>screen interval, ft</th>
<th>current status</th>
<th>area</th>
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</thead>
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<td>270 to 370</td>
<td>inactive $^T$</td>
<td>Valley</td>
</tr>
<tr>
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<td>315 to 516</td>
<td>active $^a$</td>
<td>Interstate-25</td>
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<tr>
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<td>612</td>
<td>348 to 363; 373 to 383; 393 to 460; 532 to 540; 564 to 604</td>
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<td>591</td>
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<td>Interstate-25</td>
</tr>
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<td>26</td>
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<td>410 to 510; 600 to 700</td>
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<td>Interstate-25</td>
</tr>
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<td>4,050.00</td>
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<td>4,061.86</td>
<td>751</td>
<td>421 to 447; 455 to 489; 541 to 561; 599 to 617; 619 to 649; 667 to 697; 699 to 738</td>
<td>active</td>
<td>Interstate-25</td>
</tr>
<tr>
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<td>3,893.00</td>
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<td>429 to 629</td>
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<td>Valley</td>
</tr>
<tr>
<td>30</td>
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<td>470</td>
<td>nd</td>
<td>inactive $^T$</td>
<td>Valley</td>
</tr>
<tr>
<td>31</td>
<td>3,896.00</td>
<td>622</td>
<td>465 to 585; 597 to 617</td>
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<td>Valley</td>
</tr>
<tr>
<td>32</td>
<td>3,903.00</td>
<td>697</td>
<td>456 to 556; 592 to 672; 677 to 696</td>
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<td>406 to 606</td>
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<tr>
<td>35</td>
<td>3,885.00</td>
<td>683</td>
<td>325 to 490; 510 to 575; 615 to 680</td>
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<td>Valley</td>
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<tr>
<td>36</td>
<td>nd</td>
<td>1,210</td>
<td>710 to 820; 835 to 890; 970 to 1,020; 1,145 to 1,160; 1,180 to 1,210</td>
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<td>nd</td>
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<td>440 to 640</td>
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<td>Interstate-25</td>
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<td>600</td>
<td>280 to 580</td>
<td>active</td>
<td>Interstate-25</td>
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</tbody>
</table>

$^a$ Griggs and Walnut PCE plume recovery well  
$^T$ transducer installed in well  
ft amsl - feet above mean sea level  
nd - no data
<table>
<thead>
<tr>
<th>well</th>
<th>elevation, ft amsl</th>
<th>total depth, ft</th>
<th>screen interval, ft</th>
<th>current status</th>
<th>area</th>
</tr>
</thead>
<tbody>
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<td>nd</td>
<td>1,170</td>
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<td>East Mesa</td>
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<td>980</td>
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<td>42</td>
<td>nd</td>
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<td>700 to 1,150</td>
<td>active</td>
<td>East Mesa</td>
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<td>43</td>
<td>nd</td>
<td>1,150</td>
<td>725 to 1,125</td>
<td>active</td>
<td>East Mesa</td>
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<td>44</td>
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<td>620</td>
<td>400 to 600</td>
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<td>Interstate-25</td>
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<tr>
<td>46</td>
<td>*</td>
<td>1,288</td>
<td>605 to 1,247</td>
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<td>54</td>
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<td>272 to 480</td>
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<tr>
<td>57</td>
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<td>408 to 516</td>
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<td>696</td>
<td>412 to 514; 554 to 676</td>
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<tr>
<td>59</td>
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<td>60</td>
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<td>active</td>
<td>Interstate-25</td>
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<td>1,290</td>
<td>603 to 1,254</td>
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<td>**</td>
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<td>65</td>
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<td>68</td>
<td>nd</td>
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<td>active</td>
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<td>nd</td>
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<td>683</td>
<td>310 to 660</td>
<td>active</td>
<td>Valley</td>
</tr>
<tr>
<td>71</td>
<td>3,900.00</td>
<td>725</td>
<td>305 to 705</td>
<td>active</td>
<td>Valley</td>
</tr>
<tr>
<td><strong>Paz Park</strong></td>
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<td>378</td>
<td>nd</td>
<td>active</td>
<td>Interstate-25</td>
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<tr>
<td><strong>CLC Shallow</strong></td>
<td>4,418.00</td>
<td>485</td>
<td>nd</td>
<td>inactive</td>
<td>Jornada piezometers; East Mesa</td>
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<tr>
<td><strong>CLC Middle</strong></td>
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<td>728</td>
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<tr>
<td><strong>CLC Deep</strong></td>
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<td>1,000</td>
<td>nd</td>
<td>inactive</td>
<td>Valley</td>
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</tbody>
</table>

* Transducer installed in well
** not accessible for water-level measurements
nd - no data

1 ft amsl - feet above mean sea level
* too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels after February 2013
** not accessible for water-level measurements
nd - no data
Table 2. Summary of USGS-monitored wells

<table>
<thead>
<tr>
<th>well</th>
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<th>area</th>
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<td>LC-3C</td>
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<td>490</td>
<td>monitored well ***</td>
<td>East Mesa</td>
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</table>

* *** monitoring by USGS ended in 2012; it appears that no further monitoring has been performed at the well since that time
* USGS - U.S. Geological Survey
* ft amsl - feet above mean sea level

Table 3. Summary of City of Las Cruces Foothills Landfill monitoring wells

<table>
<thead>
<tr>
<th>well</th>
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<th>total depth, ft</th>
<th>screen interval, ft</th>
</tr>
</thead>
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<td>434 to 454</td>
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<td>4,265.36</td>
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<td>395 to 435</td>
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<td>MW-3</td>
<td>4,356.06</td>
<td>340</td>
<td>299.5 to 339.5</td>
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<td>MW-4</td>
<td>4,313.20</td>
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<td>415 to 455</td>
</tr>
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<td>MW-5</td>
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<td>355 to 415</td>
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</table>

* ft amsl - feet above mean sea level
2.0 DATA COLLECTION METHODS

The City’s water-level monitoring program follows specific methodologies for data collection and QA/QC. For an explanation of how the monitoring program methodologies came about, see JSAI (2014).

Water-level collection methods include use of a field notebook and standardized field form, and use of hand tapes in combination with calibrated wireline well sounders to measure water levels. Numbers have been assigned to water-level measurement devices, and the effort is made to consistently use the same device at a given well. Information recorded on the field form includes the date and time of the measurement, the measurement device used, whether the measurement represents a pumping or non-pumping level, explanation for any missing data, and detailed comments such as meter readings, whether pump was operating prior to measurement, instantaneous pumping rate at the time of pumping level measurement, height of measuring point above ground level, description of measuring point, etc. Non-pumping levels are measured to the hundredth of a foot, whereas measurements of pumping levels may be to the nearest foot or tenth of a foot.

After information recorded in the field notebook has been entered into an electronic database, the data entries are reviewed for typographical errors. Water-level measurement devices are calibrated on a quarterly basis, or when stretching of the wire is known to have occurred. Since 2011, the City has been installing transducers in additional wells and addressing access issues at wells that were inaccessible for water-level measurements or had too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels.

3.0 RESULTS

Hydrographs for the City’s supply wells and USGS-monitored observation wells are presented in Appendices A through D, organized according to the four regions: East Mesa (Jornada Basin), Interstate-25 Corridor, Valley, and West Mesa. Hydrographs for Las Cruces Foothills Landfill monitoring wells, located in the transition zone between the Interstate-25 Corridor and East Mesa, are presented in Appendix E. Hydrographs for wells at the Griggs and Walnut Site are presented in Appendix F.
The City’s groundwater wells include active supply wells and inactive wells for which water levels are measured by hand on a monthly basis. Twelve inactive supply wells (Wells 10, 19, 20, 21, 24, 30, 37, 38, 44, 54, 57, and 60) have transducers that measure water levels on an hourly basis. Las Cruces Utilities has measured water levels in Las Cruces Foothills Landfill monitoring wells on at least an annual basis since 1999. Las Cruces Utilities also monitors water levels on an hourly basis with transducers in the Jornada piezometers, having taken over the task from USGS in early 2013. Among the USGS-monitored wells, water levels were measured on a monthly basis in Valley nested observation wells, and semi-annually in Well C on the East Mesa through early 2012; it appears that no further monitoring has been performed at Well C since February 2012.

Table 1 identifies the City’s active and inactive supply wells. For active supply wells, some water-level measurements were collected while the wells were pumping. The pumping water-level data are plotted with a different symbol and color on hydrographs. USGS-monitored observation wells presented in Table 2 have not been pumped. Table 4 presents a summary of the City’s active wells and corresponding nearby observation well(s).

Pumping and non-pumping water-level measurements were collected on a monthly basis at the City’s supply wells since the monitoring program began in 2011, and continued on a monthly basis in 2015. QA/QC review found no apparent major outlier data points in the 2015 dataset. Some variation in hand-measured water levels can be explained by measurements with different wire-line sounders, which may have stretched to varying degrees, or replacement of reel on sounder. Hydrographs have been labeled accordingly in cases where this issue could be identified based on field notes.

Hydrographs show some discrepancies between hand-measured and transducer water-level data (e.g., Figs. B7, B16, B21, and B23). Some of these discrepancies are likely due to shifts in the level at which the transducer is set, or the level used to calculate depth-to-water from transducer data is inaccurate. The level at which the transducer is set can shift slightly during data download or well maintenance or repair events. Nonetheless, transducers record valuable data on short-term changes. Comparison of hand measurements and the transducer dataset in some cases reveals noise in the hand measurement dataset that may be associated with human factors, sounder stretch, or using different sounders, as opposed to natural variability in the water-level data (e.g., Figs. B5, B10, B25, and D3). Despite some discrepancies between hand-measured and transducer water-level data, and although transducer datasets span a shorter period of record, transducer data are in general agreement with trends identified from hand-measured data.
Table 4. Summary of active supply wells and nearby observation wells by region, City of Las Cruces water-level monitoring program

<table>
<thead>
<tr>
<th>region</th>
<th>active well(s)</th>
<th>observation (inactive) well(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Mesa</td>
<td>40, 41, 42, 43</td>
<td>CLC Shallow, Middle, Deep</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td>Well C ***</td>
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<td>Interstate-25 Corridor</td>
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<td>Paz Park</td>
<td>54</td>
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<td>19, 20, 21, 38, 57, GWMW01 (inside liner), MW-SF10, GWMW10 (inside liner), MW-SF9</td>
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<td>59</td>
<td>LC-1(A-C); LC-2(A-C, F)</td>
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<tr>
<td>West Mesa</td>
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<td>36, 37, 64 **</td>
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<td>Las Cruces Foothills Landfill</td>
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<td>MW-5, MW-6, MW-7</td>
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<tr>
<td></td>
<td></td>
<td>MW-8, MW-9</td>
</tr>
</tbody>
</table>

* too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels after February 2013
** not accessible for water-level measurements
*** monitoring by USGS ended in 2012; it appears no further monitoring performed at the well since 2012
When pumping water-level measurements were collected, the instantaneous pumping rates had been noted in the database between 2011 and July 2015; however, the City changed the database format in mid-2015, and instantaneous pumping rates no longer appear to be included in the database. In addition, the sounder ID number no longer appears to be included in the database. These issues are addressed in the Recommendations section at the end of this report.

Short-term water-level trends in 2015, including seasonal trends and overall rises or declines in water levels, are described by region in the following sections. Long-term trends since the beginning of the water-level monitoring program in mid-2011 are also described by region.

3.1 East Mesa

Short-term trends for non-pumping water levels at active supply wells on the East Mesa included water-level rises during the low-demand Winter months (8.2 ft at Well 40, 3.5 ft at Well 41, 5.9 ft at Well 42, and 11.4 ft at Well 43 between late 2014 or January 2015, and April or May 2015 (Figs. A1 through A4)). Non-pumping water levels declined by 6.7 to 11.3 ft between May and June 2015 at Wells 40 through 43 as pumping ramped up in May. Other active East Mesa supply Wells 68 and 69 (Figs. A5 and A6) showed less seasonal fluctuation in 2015; although non-pumping water levels at Wells 68 and 69 showed declines of 3.7 ft and 6.5 ft, respectively, between August and September 2015, following high pumping at Wells 68 and 69 in August. Active supply wells on the East Mesa showed long-term declining trends of 2.2 to 5.4 ft/yr.

Jornada piezometers completed to depths ranging from 485 to 1,000 ft showed rises in water levels on the order of 1 or 2 ft between January and April 2015, with the largest rise in the Shallow piezometer; however, the transducers appeared to malfunction after May 2015 (Fig. A7). Jornada piezometers showed no discernible long-term linear trend. The water-level data from the Jornada piezometers illustrate that drawdown trends are generally not depth specific. When water-level changes in the Jornada piezometers are viewed on the same scale as nearby active supply Wells 68 and 69, it appears that short- and long-term changes in these observation wells have been much smaller than changes in the active supply wells (Figs. A5, A6, and A8).

It would be good to collect hand measurements of water levels in the Jornada piezometers periodically in order to provide a benchmark for the transducer dataset, as is done for the City’s inactive supply wells that are equipped with transducers.
USGS-monitored Well C (USGS No. 322411106422801) showed a decline averaging 4 ft/yr since August 2010, but no data were available for this well for 2013 through 2015, and the USGS has indicated that it will not continue to measure water levels in this privately-owned well (Fig. A9). Water levels at monitoring well MW-3 at Las Cruces Foothills Landfill within the East Mesa area showed no apparent long-term trend (Fig. E3).

3.2 Interstate-25 Corridor

3.2.1 Active Supply Wells

Active supply Wells 23, 25, 28, 39, and 62, in the northern part of the Interstate-25 Corridor, do not have a nearby observation well for comparing water-level trends (Fig. 1). Non-pumping water levels in Well 25 showed a short-term rise of 3.3 ft between November and December 2015 due to recovery from pumping period (Fig. B11). Apparent long-term trends for non-pumping water levels included average rises of 3.2 ft/yr at Well 25, 2.6 ft/yr at Well 28, and 4.6 ft/yr at Well 62 (Figs. B11, B14, and B27). A rise in the pumping level at Well 62 in 2015 was likely related to a decrease in pumping in 2015 compared to 2013 and 2014.

Wells 18 and 27 began actively pumping during April 2012 as recovery wells for the Griggs and Walnut PCE plume (Figs. B1 and B13). Prior to pumping, water-level rises were observed at Wells 18 and 27. In 2015, pumping water levels in Well 18 fluctuated seasonally and were deepest in August. In 2015, pumping levels steadily declined in Well 27. These short-term trends in pumping water levels at Wells 18 and 27 are despite the fact that monthly pumping rates have been very consistent in these wells. Paz Park Well, located north of Well 18, had a slight apparent declining trend of 0.3 ft/yr (Fig. B28). Paz Park Well is in the transition between the northern part of the Interstate-25 Corridor with apparent long-term rises, and the southern part with apparent long-term declines.

Nearby Well 26 was off-line throughout 2015, and water levels declined by 9.0 ft in the well between February and September 2015, and rose by 8.4 ft between September and December 2015 (Fig. B12). Non-pumping water levels at Well 61 have shown little change over time, with no discernible linear long-term trend (Fig. B26); Well 61 is screened deeper than other wells in the area (Table 1).
3.2.2 Inactive Wells

Well 54 represents the northernmost inactive well in the Interstate-25 Corridor (Fig. 1). Like active supply Paz Park Well, inactive Well 54 is in the transition between the northern part of the Interstate-25 Corridor with apparent long-term rises, and the southern part with apparent long-term declines. Hand measurements and transducer data indicated a long-term slight water-level rise at Well 54 of 0.3 ft/yr (Figs. B20 and B21). Discrepancies between hand-measured and transducer water levels in Well 54 after October 2015 need to be investigated to determine whether the transducer may have shifted, or whether there are problems with hand measurements.

Water-level datasets for inactive supply wells in the southern part of the Interstate-25 Corridor showed declining trends ranging from 0.8 to 1.9 ft/yr. Water levels in a number of wells had seasonal fluctuations. Hand-measurements at Wells 19 and 20 indicated long-term declines of 1.3 and 1.1 ft/yr, respectively, with transducer data showing declines between February and October 2015, and rises between October and December 2015 (Figs. B2 through B5). Nearby pumping ramped up between February and April 2015, and ramped down between October and December 2015. Hand measurements at Well 21 indicated a long-term decline of 0.8 ft/yr (Fig. B6). Transducer data for Well 21 in 2014 and 2015 are difficult to interpret due to instrument malfunctioning, but suggest seasonal fluctuations with rises in Fall and Winter and declines in Spring and Summer (Fig. B7).

Hand-measured water levels at Wells 38 and 57 showed long-term declining trends at average rates of 1.1 ft/yr and 1.4 ft/yr, respectively (Figs. B15, B22, and B23), similar to Wells 19 and 20. Well 38 transducer data showed water levels declining in Spring and Summer 2015, similar to transducer data for Well 19 (see Figs. B3 and B16). Discrepancies between hand-measured and transducer water levels in Wells 38 and 57 after October 2015 need to be investigated to determine whether the transducers may have shifted, or whether there are problems with hand measurements.

Hand-measured water levels at Well 24 showed a long-term declining trend at an average rate of 1.9 ft/yr (Fig. B9). Transducer measurements at Well 24 showed water levels declining between February and October 2015, and rising between October and December 2015 as nearby pumping increased and decreased, respectively (Fig. B10). Wells 44 and 60 showed water-level trends similar to Well 24: long-term declining trends at average rates of 0.7 and 1.6 ft/yr, respectively, and seasonal fluctuations on the order of 10 ft (Figs. B18, B19, B24, and B25).
Seasonal fluctuations in water levels in Wells 19, 20, 21, 24, 44, and 60 occurred in 2014 as well, despite relatively consistent pumping in the Interstate-25 Corridor between September 2013 and November 2014, suggesting that water levels in these inactive wells are also affected by nearby pumping in the Valley (Fig. 1).

3.2.3 Griggs and Walnut Site

As mentioned above, Wells 18 and 27 began actively pumping during April 2012 as recovery wells for the Griggs and Walnut PCE plume (Figs. B1 and B13). Nearby inactive supply Wells 19, 20, 21, and 24 showed seasonal fluctuations in water levels and are influenced by pumping in the Interstate-25 Corridor as well as nearby pumping to the west in the Valley (Fig. F1). These wells all showed long-term declining trends in water levels ranging from 0.8 to 1.9 ft/yr (Figs. B2, B4, B6, and B9).

The Griggs and Walnut site also includes numerous monitoring wells (Fig. 2). Monitoring wells GWMW01, MW-SF1, and MW-SF10, are representative of the perched zone from which PCE is recovered by Well 18. Between 2002 and 2007, water levels were measured for each of the seven ports in GWMW01 as well as inside the liner (Fig. F2). Water levels were also measured inside the liner in 2013 through 2015. Water levels inside the liner are higher than the ports, and showed a long-term rising trend of 0.7 ft/yr. MW-SF10 showed no long-term discernible linear trend. Between 2002 and 2007, water levels in GWMW01 deeper ports differed from the upper Port 1; it would be worthwhile to resume periodic measurement of water levels for individual ports at GWMW01, in addition to the liner, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture.

Monitoring wells GWMW10 and MW-SF9 are representative of the deeper zone from which PCE is recovered by Well 27 at the Griggs and Walnut site. Between 2002 and 2009, water levels were measured for each of the seven ports in GWMW10 as well as inside the liner (Fig. F3). Water levels were also measured inside the liner in 2013 through 2015. Water levels inside the liner are higher than the ports, and showed large fluctuations and no apparent long-term trend. Water levels in MW-SF9 showed no long-term discernible linear trend, but did show a gradual rise between 2002 and 2009, and declines between 2013 and 2015 coinciding with Well 27 pumping. GWMW10 Port 1 showed a similar trend to MW-SF9 through 2009. It would be worthwhile to resume periodic measurement of water levels for individual ports at GWMW10, in addition to the liner, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture.
3.3 Valley

3.3.1 Active Supply Wells

Active supply wells in the Valley region showed a variety of long-term trends for non-pumping water levels ranging from a decline of 2.6 ft/yr at Well 32 (Fig. C7) to rises of 3.2 ft/yr and 4.5 ft/yr at Wells 65 and 71, respectively (Figs. C12 and C15). Pumping water levels generally continued to rise in Well 33 in 2015, as monthly pumping remained below 20 acre-feet (ac-ft) at the well (Fig. C8). Pumping levels continued to fluctuate at Well 35 as monthly pumping ranged from 14 to 111 ac-ft at the well in 2015 (Fig. C9). Pumping levels in Well 65 in 2015 were similar to pumping levels in the well in 2013 (Fig. C12).

3.3.2 Inactive Wells

Wells 10 and 30 are the only inactive supply wells in the Valley (Fig. 1). Well 10 is located along the east margin of the Valley region and showed seasonal trends and a long-term declining trend of 0.9 ft/yr (Fig. C1). Transducer data for Well 10 reflected the seasonal fluctuations in water levels corresponding to nearby pumping in the Valley (Fig. C2). Hand-measurements and transducer measurements were also collected at Well 30 (Figs. C4 and C5). Seasonal fluctuations in water levels on the order of 15 to 20 ft were observed at Well 30 between 2012 and 2015, corresponding to nearby pumping in the Valley. A long-term water decline of 1.8 ft/yr was apparent at Well 30.

Water-level trends at the shallow nested observation Wells LC-1(A, B, and C) and LC-2(A, B, C, and F), close to the Rio Grande, were compared to the water levels and pumping at nearby active supply Well 59 (Figs. C16 and C17). Trends at the shallow nested observation Wells LC-3(A, B, C, and D) were compared to the water levels observed at nearby active supply Well 65 and Valley pumping (Fig. C18). The water levels at the shallower wells close to the river (LC-1(A, B, C), LC-2(B, C)) showed responses to surface-water infiltration from the Rio Grande and associated irrigation ditches, and the deeper wells (LC-2(A, F), LC-3(A, D)) showed water-level responses to nearby pumping. Long-term trends at nested observation wells included declines ranging from 1.1 to 2.3 ft/yr. At LC-1(A, B, and C), LC-2(A, B, C, and F), and LC-3(A, B, C, and D), deeper wells showed deeper water levels than the adjacent shallow wells. The vertical separation in depth to water between shallow and deep wells is a result of regional pumping removing groundwater storage and depressurizing the lower aquifer in relation to the water table.
3.4 West Mesa

3.4.1 Active Supply Wells

Active West Mesa region supply wells include Wells 46 and 63 (Fig. 1). Non-pumping water levels in Well 46 showed a long-term decline at an average rate of 11.8 ft/yr (Fig. D4); however, there was too much oil to measure water levels at Well 46 after February 2013. In contrast to declines at Well 46, there has been a flat linear trend in non-pumping water levels at Well 63 (Fig. D5).

3.4.2 Inactive Wells

Inactive West Mesa region supply wells include Wells 36, 37, and 64 (Fig. 1). Due to a welded cap, there has been no access for collecting water-level measurements from Well 64. Well 36 showed no discernible long-term trend (Fig. D1). Well 37 showed a long-term declining trend of 1.2 ft/yr (Figs. D2 and D3). Both Wells 36 and 37 showed overall water-level declines throughout 2015 despite variations in monthly pumping on the West Mesa. More data are needed to identify any relationship between West Mesa pumping and any short-term trends in inactive Wells 36 and 37, and identify any long-term trends in Well 36.

3.5 Las Cruces Foothill Landfill

With the exception of monitoring wells MW-3 and MW-9, monitoring wells at Las Cruces Foothills Landfill represent a geologic transition between the East Mesa and Interstate-25 Corridor called the Jornada Horst (Fig. 1; MW-1, MW-2, and MW-4 through MW-8). Monitoring well MW-9 is in the area between the Jornada Horst and the Interstate-25 Corridor, and MW-3 is on the East Mesa on the eastern edge of the landfill.

Water levels at monitoring wells on the Jornada Horst generally showed no apparent long-term trends, except for MW-4, which had a declining trend at an average rate of 0.9 ft/yr (Fig. E4), and MW-8, across-gradient and to the south of MW-4, which had a declining trend at an average rate of 1.5 ft/yr (Fig. E8). Water levels at MW-9, between the Jornada Horst and the Interstate-25 Corridor, showed no discernible long-term trend (Fig. E9). Water levels at MW-3, on the East Mesa, showed no discernible long-term trend (Fig. E3).
4.0 DISCUSSION

4.1 Water-Level Trends

A summary of the analysis of long-term average water-level trends is presented as Table 5. The period of record for the water-level monitoring program is now sufficiently long enough that long-term trends are emerging for the majority of wells included in the program. These trends may change as more data become available, but as of 2015, long-term declines have occurred at the majority of inactive wells throughout the monitoring program area. No long-term water-level rises were observed at inactive wells except for a slight rise of 0.3 ft/yr at Well 54 located in the transition between the northern part of the Interstate-25 Corridor with apparent long-term rises in active wells, and the southern part of the Interstate-25 Corridor with apparent long-term declines.

Active supply wells showed a variety of long-term trends in the monitoring program area, and relationships between trends at active and inactive wells also varied. On the East Mesa, active supply wells showed long-term declining trends for water levels with average rates ranging from 2.2 to 5.4 ft/yr, while the Jornada piezometers (CLC Shallow, Middle, and Deep) showed no apparent long-term trend. Short- and long-term changes in the Jornada piezometers have been much smaller than changes in nearby active supply wells.

Active supply wells in the northern part of the Interstate-25 Corridor generally showed long-term water-level rises ranging from 2.6 to 4.6 ft/yr. These wells do not have a nearby observation well for comparing water-level trends. Active Paz Park Well and inactive Well 54, both located in the transition between the northern and southern parts of the Interstate-25 Corridor, showed relatively flat trends (a slight decline of 0.3 ft/yr at Paz Park Well, and a slight rise of 0.3 ft/yr at Well 54).

Active supply wells and inactive wells in the southern part of the Interstate-25 Corridor showed long-term declines ranging from 0.7 to 1.9 ft/yr. Overall declining trends in inactive Wells 19, 20, 21, and 24, near Griggs and Walnut PCE plume recovery Wells 18 and 27, suggest that plume capture is occurring. The inactive wells also showed seasonal fluctuations with water levels rising in Winter and declining in Spring, influenced by nearby pumping within the Interstate-25 Corridor as well as nearby pumping to the west in the Valley.
Table 5. Summary of active supply wells and nearby observation wells by region with long-term average water-level trends, City of Las Cruces water-level monitoring program

<table>
<thead>
<tr>
<th>region</th>
<th>active well</th>
<th>average decline (-) or rise (+), ft/yr</th>
<th>observation (inactive) well</th>
<th>average decline (-) or rise (+), ft/yr</th>
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<tr>
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<td>MW-4</td>
<td>-0.9</td>
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<td>MW-5</td>
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<td>MW-9</td>
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(a) - apparent seasonal fluctuations in water levels
* too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels after February 2013
** not accessible for water-level measurements
*** monitoring by USGS ended in 2012; it appears no further monitoring performed at the well since 2012
na - no apparent average trend
In the Griggs and Walnut plume area, water levels measured inside the liner at GWMW01 showed a long-term rising trend of 0.7 ft/yr in the perched zone from which PCE is recovered by Well 18. This zone is gravity-drained and is not influenced by regional pumping. Water levels measured at MW-SF9, in the deeper zone from which PCE is recovered by Well 27, showed a gradual rise between 2002 and 2009, and declines between 2013 and 2015 coinciding with Well 27 pumping.

Active wells in the Valley showed a variety of long-term trends for non-pumping water levels ranging from a decline of 2.6 ft/yr to a rise of 4.5 ft/yr. Inactive Wells 10 and 30 also showed seasonal fluctuations in water levels, with water levels rising in Winter and declining in Spring, clearly in response to nearby pumping in the Valley.

Nested observation wells in the Valley region (LC-1(A-C), LC-2(A, B, C, and F), and LC-3(A-D)) showed long-term water level declines of 1.1 to 2.3 ft/yr. Water-level declines in nested observation wells LC-1(A-C) and LC-2(A, B, C, and F) close to the Rio Grande were relatively consistent at about 1.2 to 1.8 ft/yr despite the range in well depths from 41 to 650 ft. The lowest rate of decline among the nested observation wells in the Valley was in the deepest observation well that is not adjacent to the river (1.1 ft/yr in LC-3D). The largest rate of decline was in the shallowest observation well that is not adjacent to the river (2.3 ft/yr in LC-3C).

Water-level trends were variable in supply wells on the West Mesa, and more data are necessary to identify any overall trends for the region. Active supply Well 46 has shown relatively large drawdowns in non-pumping water levels but has not been measured since February 2013, while nearby active supply Well 63 showed a flat long-term trend. Inactive Well 36 showed no discernible long-term trend and inactive Well 37 showed a long-term declining trend of 1.2 ft/yr. More data are needed to identify any relationship between West Mesa pumping and any short-term trends in inactive Wells 36 and 37, and identify any long-term trends in Well 36. Inactive Well 64 has not been accessible for water-level measurements.

In terms of short-term water-level trends, evaluation of water-level trends in combination with 2015 monthly pumping data showed that short-term trends in inactive wells in the Interstate-25 Corridor were generally related to pumping within the Interstate-25 Corridor as well as in the Valley. Short-term trends in inactive wells in the Valley were related to pumping in the Valley. Fluctuations in pumping levels in active supply wells were typically related to variations in pumping rates at these wells.
4.2 Water-Level Elevation Contours

Figure 3 presents a water-level elevation contour map for the Valley and Interstate-25 Corridor areas. City of Las Cruces supply wells, and USGS-monitored wells completed to similar depths as supply wells, were used to contour water levels and illustrate the directions of groundwater flow. Monitoring program well networks on the East Mesa and West Mesa are too sparse to contour water levels in those areas. Water-level elevation contours for the Valley and Interstate-25 Corridor provide the following information:

- Groundwater continues to flow into the area from the Rio Grande Valley to the northwest of the monitoring program area.
- A cone of depression in the southwestern part of the area is likely due to irrigation pumping to the south of the monitoring program area.
- Pumping at Griggs and Walnut PCE plume recovery Wells 18 and 27 is containing the PCE plume in the Interstate-25 Corridor area.
- Pumping at Valley Wells 32 and 35 is creating a localized cone of depression.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Continued water-level monitoring will further define long-term trends that have emerged for the majority of wells after several years of consistent monitoring. The comparison of water-level trends and monthly pumping will continue to provide a good assessment of the effects of local and regional pumping on water levels. Long-term trends include overall declining trends for active supply wells on the East Mesa, and declining trends for the majority of inactive wells throughout the monitoring program area. Long-term trends within the Interstate-25 Corridor include water-level rises in the northern part and declines in the southern part. A number of inactive wells in the southern part of the Interstate-25 Corridor appear to be influenced by pumping of nearby wells in the Interstate-25 Corridor as well as the Valley. Active supply wells in the Valley show a variety of long-term trends. Water-level trends remain poorly defined on the West Mesa, where one of the two active supply wells has had too much oil to measure water levels since February 2013, one of the three inactive wells is not accessible, and the other two inactive wells have varying trends.
As recommended in the 2012, 2013, and 2014 annual reports, wells for which measuring water levels has been attempted repeatedly without success, such as Wells 46 and 64 on the West Mesa, should be equipped with adequate access or sounding tubes. The problem of too much oil to measure water levels in Well 46 should be addressed so that water-level monitoring can continue at this well, which had shown relatively large declines in non-pumping water levels. Las Cruces Utilities may want to consider gaining access to Well C, the privately-owned well formerly monitored by USGS on the East Mesa, in order to continue measuring water levels at this well. Well C showed an average decline rate of 4.0 ft/yr between 2010 and February 2012. It would also be worthwhile to resume periodic measurement of water levels for individual ports at GWMW01 and GWMW10, in addition to inside the liners, in the vicinity of the Griggs and Walnut site in the Interstate-25 Corridor, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture.

Hydrographs showed some discrepancies between hand-measured and transducer water-level data. It is important to set the transducer back to the same level after removal, and make note if its reference point has changed, so the dataset can be corrected. It is difficult to obtain an accurate measurement of the level at which a transducer is set in a well, and it is recommended that hand measurement(s) be used as a benchmark. It is recommended that hand-measurements be collected periodically at the Jornada piezometers to provide a benchmark and verify transducer data, as is done for the City’s inactive supply wells that are equipped with transducers. The transducers in the Jornada piezometers appeared to malfunction after May 2015, and need to be checked. Discrepancies between hand-measured and transducer water levels in Well 38, Well 54, and Well 57 after October 2015 need to be investigated to determine whether the transducer may have shifted, or whether there are problems with hand measurements.

In terms of database maintenance, the instantaneous pumping rates should be noted in the database for entries that represent pumping water-level measurements. In addition, the sounder ID number should be noted for each water-level measurement entered in the database. This will allow for continued QA/QC of the water-level monitoring dataset.
In summary, specific recommendations based on evaluation of 2015 data are as follows:

- Address problem of too much oil to measure water levels in Well 46 so that water-level monitoring can continue at this active supply well on the West Mesa.

- Address access issues at Well 64 so that water levels can be measured at this inactive supply well on the West Mesa.

- Consider gaining access to Well C, the privately-owned well formerly monitored by USGS on the East Mesa, in order to continue measuring water levels at this well.

- Resume periodic measurement of water levels for individual ports at GWMW01 and GWMW10, in addition to inside the liners of these monitoring wells in the vicinity of the Griggs and Walnut site in the Interstate-25 Corridor.

- Collect hand-measurements periodically at the Jornada piezometers to provide a benchmark and verification for transducer data.

- Check transducers in Jornada piezometers, which appear to have malfunctioned after May 2015.

- Check transducers and review hand-measurement methods at Well 38, Well 54, and Well 57, where discrepancies between hand-measured and transducer water levels occurred after October 2015.

- For database maintenance, instantaneous pumping rates should be noted in the database for entries that represent pumping water-level measurements, and sounder ID number should be noted for each water-level measurement entered in the database.
6.0 REFERENCE

ILLUSTRATIONS
Figure 1. Aerial photograph showing locations of City of Las Cruces supply wells and landfill monitoring wells, and City of Las Cruces and USGS-monitored observation wells, used for water-level monitoring program.
Figure 2. Aerial photograph of the Griggs and Walnut plume site showing locations of capture wells and monitoring well network, City of Las Cruces, New Mexico.
Figure 3. Aerial photograph showing December 2015 water-level elevation contours for the City of Las Cruces area.
APPENDICES
Appendix A.

East Mesa hydrographs
Appendix A.

East Mesa hydrographs

Figure A1. Graph of water-level data collected by the City of Las Cruces for Well 40, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A2. Graph of water-level data collected by the City of Las Cruces for Well 41, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A3. Graph of water-level data collected by the City of Las Cruces for Well 42, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A4. Graph of water-level data collected by the City of Las Cruces for Well 43, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

Figure A5. Graph of water-level data collected by the City of Las Cruces for Well 68, and monthly pumping at Wells 68 and 69.

Figure A6. Graph of water-level data collected by the City of Las Cruces for Well 69, and monthly pumping at Wells 68 and 69.

Figure A7. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43.

Figure A8. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43 (with same scale as Figs A5 and A6).

Figure A9. Graph of water-level data for Well C (USGS 322411106422801).
Figure A1. Graph of water-level data collected by the City of Las Cruces for Well 40, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

- **Non-pumping water level**
- **Pumping water level**
- **Wells 40-43 monthly pumping**
- **Linear (Non-pumping water level)**

**Average decline**: 2.5 ft/yr

**TD 1,170 ft**
**Screen 661-1,150 ft (multiple intervals)**
**Pump set at 650 ft**

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Figure A2. Graph of water-level data collected by the City of Las Cruces for Well 41, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

average decline 3.3 ft/yr

TD 980 ft
screen 649-960 ft
pump set at 640 ft
Figure A3. Graph of water-level data collected by the City of Las Cruces for Well 42, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.

average decline 3.7 ft/yr

used different sounder

new reel on sounder

Non-pumping water level

Pumping water level

Wells 40-43 monthly pumping

Linear (Non-pumping water level)

TD 1,170 ft
screen 700-1,150 ft
pump set at 665 ft
Figure A4. Graph of water-level data collected by the City of Las Cruces for Well 43, and monthly pumping at Wells 40, 41, 42, and 43, on the East Mesa.
Figure A5. Graph of water-level data collected by the City of Las Cruces for Well 68, and monthly pumping at Wells 68 and 69.
Figure A6. Graph of water-level data collected by the City of Las Cruces for Well 69, and monthly pumping at Wells 68 and 69.
Figure A7. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43.
Figure A8. Graph of water-level data for Jornada piezometers (CLC Shallow, Middle, and Deep), and monthly pumping at nearby active supply Wells 40, 41, 42, and 43.
Figure A9. Graph of water-level data for Well C (USGS 322411106422801).

JOHN SHOMAKER & ASSOCIATES, INC.
Appendix B.

Interstate-25 Corridor hydrographs
Appendix B.

Interstate-25 Corridor hydrographs

Figure B1. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 18.

Figure B2. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B3. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B4. Graph of water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B5. Graph of hand-measured and transducer water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B6. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B7. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 23.

Figure B9. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B10. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 25.

Figure B12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 26.

Figure B13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 27.

Figure B14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 28.
Appendix B.

Interstate-25 Corridor hydrographs

Figure B15. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B16. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B17. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 39.

Figure B18. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B19. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B20. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B21. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B22. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B23. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B24. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B25. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

Figure B26. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 61.

Figure B27. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 62.

Figure B28. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Paz Park Well.
Figure B1. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 18.
Figure B2. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B3. Graph of water-level data collected by the City of Las Cruces for Well 19, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B4. Graph of water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B5. Graph of water-level data collected by the City of Las Cruces for Well 20, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
average decline 0.8 ft/yr

Figure B6. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B7. Graph of water-level data collected by the City of Las Cruces for Well 21, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 23.

(NO DISCERNIBLE LINEAR TREND)
Figure B9. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B10. Graph of water-level data collected by the City of Las Cruces for Well 24, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 25.

average rise
3.2 ft/yr

TD 620 ft
screen 392-438; 460-620 ft
pump set at 360 ft
Figure B12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 26.

TD 700 ft
screen 410-510; 600-700 ft
pump set at 310 ft
Figure B13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 27.
Figure B14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 28.
Figure B15. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

average decline 1.1 ft/yr

TD 800 ft screen 320-400; 480-780 ft pump set at 440 ft
Figure B16. Graph of water-level data collected by the City of Las Cruces for Well 38, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B17. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 39.

(no discernible linear trend)

TD 600 ft screen 280-580 ft pump set at 370 ft
Figure B18. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B19. Graph of water-level data collected by the City of Las Cruces for Well 44, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B20. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B21. Graph of water-level data collected by the City of Las Cruces for Well 54, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B22. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B23. Graph of water-level data collected by the City of Las Cruces for Well 57, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).

TD 532 ft
screen 408-516 ft
Figure B24. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B25. Graph of water-level data collected by the City of Las Cruces for Well 60, and monthly pumping in the southern part of the I-25 Corridor (Wells 18, 27, 26, 61, and Paz Park).
Figure B26. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 61.

- Non-pumping water level
- Pumping water level
- Monthly pumping

(No discernible linear trend)

TD 1,070 ft
Screen 600-1,050 ft pump set at 580 ft
Figure B27. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 62.

Average rise: 4.6 ft/yr

TD 640 ft screen 400-620 ft pump set at 365 ft
Figure B28. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Paz Park Well.

- **Average decline**: 0.3 ft/yr
- **Well decommissioned and temporarily welded shut**
- **TD 378 ft**
- **Screen interval unknown**
- **Pump setting unknown**

**Legend**:
- Blue line: Non-pumping water level
- Black squares: Monthly pumping
- Black dashed line: Linear (Non-pumping water level)
Appendix C.

Valley hydrographs
Appendix C.

Valley hydrographs

Figure C1. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

Figure C2. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

Figure C3. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 29.

Figure C4. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

Figure C5. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

Figure C6. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 31.

Figure C7. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 32.

Figure C8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 33.

Figure C9. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 35.

Figure C10. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 58.

Figure C11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 59.

Figure C12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 65.

Figure C13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 67.

Figure C14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 70.

Figure C15. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 71.

Figure C16. Graph of water-level data for nested observation Well LC-1 (A-C) and City of Las Cruces Well 59, and monthly pumping at Well 59.

Figure C17. Graph of water-level data for nested observation Well LC-2 (A-D, and -F) and City of Las Cruces Well 59, and monthly pumping at Well 59.

Figure C18. Graph of water-level data for nested observation Well LC-3 (A-D) and City of Las Cruces Well 65, and monthly pumping in the Valley.
Figure C1. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.

average decline 0.9 ft/yr

TD 381 ft
screen 270-370 ft
pump was set at 260 ft, but may have been removed
Figure C2. Graph of water-level data collected by the City of Las Cruces for Well 10, and monthly pumping in the Valley.
Figure C3. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 29.
Figure C4. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.

average decline
1.8 ft/yr

Average decline of 1.8 feet per year.

TD 470 ft
Screen interval unknown
Pump setting unknown

Non-pumping water level
Valley monthly pumping
Linear (Non-pumping water level)
Figure C5. Graph of water-level data collected by the City of Las Cruces for Well 30, and monthly pumping in the Valley.
Figure C6. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 31.
average decline 
2.6 ft/yr

TD 697 ft 
screen 456-696 ft (multiple intervals) 
pump set at 300 ft

Figure C7. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 32.
Figure C8. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 33.
average decline 1.7 ft/yr

Figure C9. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 35.
Figure C10. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 58.
Figure C11. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 59.

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)

average decline
1.3 ft/yr

used different sounder

TD 772 ft
screen 575-757 ft
pump set at 250 ft
Figure C12. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 65.

- Non-pumping water level
- Pumping water level
- Monthly pumping
- Linear (Non-pumping water level)

Average rise 3.2 ft/yr

TD 765 ft
Screen 455-745 ft
Pump setting unknown
Figure C13. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 67.

average rise
1.1 ft/yr

TD 648 ft
screen 308-448; 478-628 ft
pump setting unknown
Figure C14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 70.

average decline
0.9 ft/yr

TD 683 ft
screen 310-660 ft
pump setting unknown

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)
Figure C15. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 71.

average rise
4.5 ft/yr

TD 725 ft
screen 305-705 ft
pump setting unknown
Figure C16. Graph of water-level data for nested observation Well LC-1(A-C) and City of Las Cruces Well 59, and monthly pumping at Well 59.

average decline
1.2 ft/yr
Figure C17. Graph of water-level data for nested observation Well LC-2 (A-D, and -F) and City of Las Cruces Well 59, and monthly pumping at Well 59.
Figure C18. Graph of water-level data for nested observation Well LC-3 (A-D) and City of Las Cruces Well 65, and monthly pumping in the Valley.

average decline 2.1 ft/yr
Appendix D.

West Mesa hydrographs
Appendix D.

West Mesa hydrographs

Figure D1. Graph of water-level data collected by the City of Las Cruces for Well 36, and monthly pumping on the West Mesa.

Figure D2. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.

Figure D3. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.

Figure D4. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 46.

Figure D5. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 63.
Figure D1. Graph of water-level data collected by the City of Las Cruces for Well 36, and monthly pumping on the West Mesa.

- **Non-pumping water level**
- **West Mesa monthly pumping**

*TD 1,210 ft screen 710-1,210 ft (multiple intervals) pump set at 500 ft*

*JOHN SHOMAKER & ASSOCIATES, INC.*
Figure D2. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.

- Non-pumping water level
- West Mesa monthly pumping
- Linear (Non-pumping water level)

- Average decline: 1.2 ft/yr
- TD 640 ft
- Screen 440-640 ft
- Not currently equipped
- Used different sounders
Figure D3. Graph of water-level data collected by the City of Las Cruces for Well 37, and monthly pumping on the West Mesa.
Figure D4. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 46.

**average decline 11.8 ft/yr**

**note:** too much oil to measure water levels after February 2013

**TD 1,288 ft**

**screen 605-1,247 ft**

**pump set at 500 ft**
Figure D5. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 63.
Appendix E.

Las Cruces Foothills Landfill hydrographs
Appendix E.

Las Cruces Foothills Landfill hydrographs

Figure E1. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-1.
Figure E2. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-2.
Figure E3. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-3.
Figure E4. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-4.
Figure E5. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-5.
Figure E6. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-6.
Figure E7. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-7.
Figure E8. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-8.
Figure E9. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-9, and monthly pumping in the I-25 Corridor.
Figure E1. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-1.
Figure E2. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-2.

(no discernible linear trend)
Figure E3. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-3. (no discernible linear trend)
Figure E4. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-4.

average decline
0.9 ft/yr
Figure E5. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-5.

(no discernible linear trend)
Figure E6. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-6.

(no discernible linear trend)
Figure E7. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-7.

(no discernible linear trend)
Figure E8. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-8.

average decline
1.5 ft/yr
Figure E9. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-9, and monthly pumping in the I-25 Corridor.

(no discernible linear trend)
Appendix F.

Griggs and Walnut Site hydrographs
Appendix F.

Griggs and Walnut Site hydrographs

Figure F1. Graph of water-level elevations for City of Las Cruces Wells 19, 20, 21, and 24, in the vicinity of the Griggs and Walnut site, New Mexico.

Figure F2. Graph of water-level elevations for monitoring wells GWMW01 (Ports 1 through 7, and inside liner), MW-SF1, and MW-SF10, Griggs and Walnut site, New Mexico.

Figure F3. Graph of water-level elevations for monitoring wells GWMW10 (Ports 1 through 7, and inside liner) and MW-SF9, Griggs and Walnut site, New Mexico.
Figure F1. Graph of water-level elevations for City of Las Cruces Wells 19, 20, 21, and 24, in the vicinity of the Griggs and Walnut site, New Mexico.
Figure F2. Graph of water-level elevations for monitoring wells GWMW01 (Ports 1 through 7, and inside liner), MW-SF1, and MW-SF10, Griggs and Walnut site, New Mexico.
Figure F3. Graph of water-level elevations for monitoring wells GWMW10 (Ports 1 through 7, and inside liner) and MW-SF9, Griggs and Walnut site, New Mexico.