ANNUAL EVALUATION OF 2016 WATER-LEVEL MONITORING DATA FROM THE CITY OF LAS CRUCES WATER SUPPLY WELLS, NEW MEXICO

prepared by
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prepared for
Las Cruces Utilities
City of Las Cruces, New Mexico
May 2017
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.

The water-level elevation data were contoured for the Las Cruces area (Fig. 3); there were not enough data points to develop water-level elevation contour maps for the East or West Mesa areas. Individual drawdown cones at pumping Wells 23, 25, 27, 28, 33, 35, 58, 59, 65, and 67 can be inferred from the December 2016 water-level elevation contours. Outside of the pumping wells the hydraulic gradient is flat as observed between the 3,840 and 3,850 ft contours.

As of December 2016, long-term water-level declines have occurred at the majority of inactive wells. On the East Mesa, active supply wells and inactive wells showed long-term declining trends for water levels with average rates ranging from 2.9 to 5.3 ft/yr.

Active supply wells along the Interstate-25 Corridor showed a variety of long-term trends ranging from decline of 1.4 ft/yr to rise of 3.2 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 in the perched zone near Well 18 are not influenced by regional pumping. Water levels below the perched zone 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 1.6 ft/yr. Inactive wells in the Valley showed long-term declines ranging from 0.6 to 2.0 ft/yr. West Mesa water levels showed declines of 0.5 to 3.0 ft/yr, but more data are necessary to identify overall trends for this region.
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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 2016 water-level elevation contours for the City of Las Cruces area.

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Appendix A. East Mesa hydrographs
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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 groundwater wells include active supply wells and inactive wells. The City’s supply wells are presented in Table 1 and Figure 1, and can be divided into four regions:

1. East Mesa (Jornada Basin)
2. Interstate-25 Corridor
3. Valley, and
4. West Mesa

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 Griggs and Walnut Superfund Site (Fig. 2), and 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 (City of Las Cruces (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>
<tbody>
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<td>10</td>
<td>3,936.00</td>
<td>381</td>
<td>270 to 370</td>
<td>inactive (T)</td>
<td>Valley</td>
</tr>
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<td>18</td>
<td>4,044.00</td>
<td>516</td>
<td>315 to 516</td>
<td>active (a)</td>
<td>Interstate-25</td>
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<tr>
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<td>4,065.51</td>
<td>612</td>
<td>348 to 363; 373 to 383; 393 to 460; 532 to 540; 564 to 604</td>
<td>inactive (T)</td>
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<td>4,072.00</td>
<td>677</td>
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<td>381 to 591</td>
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<td>Interstate-25</td>
</tr>
<tr>
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<td>4,061.43</td>
<td>620</td>
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<td>Interstate-25</td>
</tr>
<tr>
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<td>4,011.00</td>
<td>700</td>
<td>410 to 510; 600 to 700</td>
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<td>430 to 455; 457 to 490; 500 to 524</td>
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<td>751</td>
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<td>active</td>
<td>Interstate-25</td>
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<td>29</td>
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<td>nd</td>
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<td>31</td>
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<td>465 to 585; 597 to 617</td>
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<td>32</td>
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<td>456 to 556; 592 to 672; 677 to 696</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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</tbody>
</table>

\(a\) Griggs and Walnut PCE plume capture well
\(b\) reported to have been “capped off” in 2016; if access is restored for water-level measurements, well may be reclassified from active to inactive
\(T\) transducer installed in well

\(\text{ft amsl} = \text{feet above mean sea level}\)
\(\text{nd} = \text{no data}\)
Table 1. Summary of wells monitored by City of Las Cruces (concluded)

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<th>elevation, ft amsl</th>
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<th>screen interval, ft</th>
<th>current status</th>
<th>area</th>
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<td>nd</td>
<td>1,170</td>
<td>661.3 to 724.1; 775.1 to 940.7; 1,087.4 to 1,150.3</td>
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<td>nd</td>
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<td>43</td>
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<td>46 *</td>
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<td>1,290</td>
<td>603 to 1,254</td>
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<td>68</td>
<td>nd</td>
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<td>nd</td>
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<tr>
<td>CLC Shallow</td>
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<td>485</td>
<td>385 to 485</td>
<td>mwT</td>
<td>Jornada</td>
</tr>
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<td>piezometers; East Mesa</td>
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<td>1,000</td>
<td>960 to 1,000</td>
<td>mwT</td>
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</table>

1 transducer installed in well
* 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>
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<tr>
<th>well</th>
<th>USGS No.</th>
<th>elevation, ft amsl</th>
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<th>current status</th>
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<td>nested observation well</td>
<td>Valley</td>
</tr>
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<td>LC-1B</td>
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<td>LC-3B</td>
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<td>LC-3D</td>
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<td>3,890.00</td>
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<td>Well C ***</td>
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<td>490</td>
<td>monitored well ***</td>
<td>East Mesa</td>
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</tbody>
</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>
<th>elevation, ft amsl</th>
<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>MW-2</td>
<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>
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<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>
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<td>MW-5</td>
<td>4,235.55</td>
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<td>390 to 450</td>
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<td>MW-7</td>
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<td>MW-8</td>
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<td>MW-9</td>
<td>4,212.58</td>
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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 2016. QA/QC review found no apparent major outlier data points in the 2016 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. B16, B21, and B23). These discrepancies are likely due to error in water-level measurements rather than transducer error. 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.

Short-term water-level trends in 2016, 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.
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, CLC Shallow, Middle, Deep</td>
<td>CLC Shallow, Middle, Deep</td>
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<tr>
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<td>68</td>
<td>Well C ***</td>
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<td>69</td>
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<tr>
<td>Interstate-25 Corridor</td>
<td>23, 25, 28, 39, 62</td>
<td>18, 27, Paz Park 10, 19, 20, 21, 54, 57, MW-1, MW-SF9</td>
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<td></td>
<td>26, 61</td>
<td>24, 38, 44, 60</td>
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<tr>
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<td>31 b, 33</td>
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<td>65, 71</td>
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<td></td>
<td>59</td>
<td>LC-1(A-C); LC-2(A-C, F)</td>
</tr>
<tr>
<td>West Mesa</td>
<td>46 *, 63</td>
<td>36, 37, 64 **</td>
</tr>
<tr>
<td>Las Cruces Foothills Landfill</td>
<td>Jornada Basin</td>
<td>MW-3</td>
</tr>
<tr>
<td></td>
<td>Jornada Horst</td>
<td>MW-1, MW-2, MW-4, MW-5, MW-6, MW-7, 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
b reported to have been “capped off” in 2016; if access is restored for water-level measurements, well may be reclassified from active to inactive
3.1 East Mesa

In past years, 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; however, this trend was generally not apparent in 2016 as pumping was relatively high in January, February, and March. In 2016, non-pumping water levels were relatively stable in Wells 40 and 69, and declined in Wells 41, 42, 43, and 68, with little seasonal fluctuation (Figs. A1 through A6). Active supply wells on the East Mesa showed long-term declining trends of 2.9 to 5.3 ft/yr.

Jornada piezometers completed to depths ranging from 485 to 1,000 ft showed declines in water levels of about 12 ft between May 2015 and late 2016; the transducers appeared to malfunction in the interim, and it would be good to obtain hand measurements to confirm the current water levels (Fig. A7). Jornada piezometers showed long-term declining trend of 2.8 ft/yr (Fig. A7). The water-level data from the Jornada piezometers illustrate that drawdown trends are generally not depth specific.

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 2016, and the USGS has indicated that it will not continue to measure water levels in this privately-owned well. Water levels at monitoring well MW-3 at Las Cruces Foothills Landfill within the East Mesa area showed a long-term declining trend of 0.2 ft/yr; this well is located within the East Mesa, but close to the western edge of the East Mesa (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 Wells 23, 28, and 62 showed fluctuations of 9.1 ft, 6.9 ft, and 6.9 ft, respectively, in 2016 (Figs. B8, B14, and B27). Apparent long-term trends for non-pumping water levels included average rises of 3.2 ft/yr at Well 25, 2.2 ft/yr at Well 28, and 2.4 ft/yr at Well 62 (Figs. B11, B14, and B27).

Wells 18 and 27 began actively pumping during April 2012 as capture 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 2016, pumping water levels in Well 18 fluctuated seasonally and were deepest in June and September. Pumping water levels in Well 18 remained fairly constant in 2016. Equipping this well with a transducer may provide a better dataset for non-pumping and pumping water-level trends. In 2016, pumping levels in Well 27 showed a declining trend. As with Well 18, equipping Well 27 with a transducer may aid in understanding water-level trends. Paz Park Well, located north of Well 18, had a slight apparent declining trend of 0.5 ft/yr (Fig. B28). Paz Park Well is in the transition between the northern part of the Interstate-25 Corridor, which generally showed long-term rises, and the southern part, which generally showed long-term declines.

Nearby Well 26 was off-line throughout 2016, and water levels fluctuated seasonally with an average rise of 1.2 ft/yr (Fig. B12). Non-pumping water levels at Well 61 have shown little change over time, with a slight apparent declining trend of 0.4 ft/yr (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, which generally showed long-term rises, and the southern part, which generally showed long-term declines. Measurements indicated a relatively flat trend at Well 54 (Figs. B20 and B21). This is due to occasional discrepancies between hand-measured and transducer water levels, and more data are needed to verify the apparent declining trend at Well 54.

Water-level datasets for inactive supply wells in the southern part of the Interstate-25 Corridor showed declining trends ranging from 0.6 to 1.6 ft/yr. Water levels in a number of wells had seasonal fluctuations.

Water-level measurements at Wells 19, 20, 21, 38, and 57 indicated long-term declines ranging from 0.5 to 1.1 ft/yr, with declines in Summer, and rises in Fall (Figs. B2 through B6, B15, B16, B22, and B23). These seasonal fluctuations of several feet to 5 ft occurred despite relatively low pumping in the southern part of the Interstate-25 Corridor between March and December 2016, and suggest that these inactive wells are also affected by nearby pumping in the Valley (Fig. 1). Transducer data for Well 21 between 2014 and 2016 are difficult to interpret due to periodic instrument malfunctioning, which should be investigated (Fig. B7). Hand measurement and transducer data for these wells demonstrate the value of the transducer data to identify short-term water-level trends (e.g., Figs. B5, B16, and B23).
Water-level measurements at Wells 24, 44, and 60, in the southwesternmost part of the Interstate-25 Corridor indicated long-term declines ranging from 0.6 to 1.2 ft/yr (Figs. B9, B18, and B24). Similar to the other inactive supply wells in the Interstate-25 Corridor, Wells 24, 44, and 60 showed declines in Summer and rises in Fall, but with higher-magnitude seasonal fluctuations of 5 to 15 ft (Figs. B10, B19, and B25). As mentioned above, these relatively large seasonal fluctuations occurred despite relatively low pumping in the southern part of the Interstate-25 Corridor between March and December 2016, suggesting that these inactive wells are affected by nearby pumping in the Valley.

### 3.2.3 Griggs and Walnut Site

Wells 18 and 27 began actively pumping during April 2012 as capture wells for the Griggs and Walnut PCE plume (Figs. B1 and B13). Inactive supply Wells 10, 19, 20, 21, 54, and 57 surround capture Wells 18 and 27. These inactive wells showed seasonal fluctuations in water levels influenced by regional pumping (Fig. F1). These wells also showed long-term declining trends in water levels ranging from 0.6 to 1.6 ft/yr likely due to pumping Wells 18 and 27.

The Griggs and Walnut site also includes numerous monitoring wells (Fig. 2). Some monitoring wells are representative of a perched zone from which PCE contaminated groundwater drains into Well 18 and is recovered. Other monitoring wells represent the PCE plume in the regional aquifer which is captured by Well 27. The MW-series wells around Well 18 (Fig. 2) represent the perched zone. Since plume capture pumping began in 2012, declining water-level trends have been observed in the MW-series wells (Fig. F2). Monitoring wells MW-SF9 and MW-SF10 represent the regional aquifer pumped by Well 27; these wells also show declining water-level trends since plume capture pumping began in 2012 (Fig. F3).

It is recommended to equip Wells 18, 27, and GWMW16(S,D) with transducers, 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 declines ranging from 1.3 to 2.6 ft/yr at Wells 31, 32, 35, and 59 (Figs. C6, C7, C9, and C11) to rises ranging from 0.5 to 1.6 ft/yr at Wells 29, 65, 67, 70, and 71 (Figs. C3, and C12 through C15). Water levels were not available for Wells 31 and 32 in
2016, as the wells were reported to have been “capped off”; however, it would be good to restore access for water-level measurements at Wells 31 and 32. Although there have been overall declines in non-pumping water levels at Wells 32, 35, and 59, pumping water levels have remained relatively stable at these wells; in fact, pumping water levels generally appear to have remained stable at all active supply wells in the Valley based on available data. Pumping water levels generally continued to rise in Well 33 in 2016, as monthly pumping remained below 20 acre-feet (ac-ft) at the well (Fig. C8). Pumping levels continued to fluctuate by about 20 ft at Well 35 as monthly pumping ranged from 21 to 117 ac-ft at the well in 2016, but were stable over the long-term (Fig. C9).

### 3.3.2 Inactive Wells

Wells 10 and 30 have been the only inactive supply wells in the Valley (Fig. 1); however, Wells 31 and 32 were reported to have been “capped off” in 2016, and if access is restored to these wells for water-level measurements, they may be re-classified as inactive supply wells. Well 10 is located along the east margin of the Valley region and showed seasonal fluctuations and a long-term declining trend of 0.6 ft/yr (Fig. C1). Well 30 is the southernmost well in the Valley and showed seasonal fluctuations and a long-term declining trend of 0.9 ft/yr (Fig. C4). Transducer data for Wells 10 and 30 reflected seasonal fluctuations in water levels of 10 to 20 ft corresponding to nearby pumping in the Valley (Figs. C2 and C5).

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 0.6 to 2.0 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. Although this separation appears to have increased slightly over the period of record 2010 to present, the increase in separation is not significant.
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 3.0 ft/yr (Fig. D4); however, there was too much oil to measure water levels at Well 46 between February 2013 and April 2016. More data are needed to verify this trend. Non-pumping water levels in Well 63 showed a long-term decline at an average rate of only 0.5 ft/yr (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 1.3 ft/yr (Figs. D2 and D3). 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 several monitoring wells on the Jornada Horst showed trends influenced by local management of storm water. Prior to completion of Landfill reclamation, storm water ponded and infiltrated, causing water-level rises from 2007 to 2012 in MW-1, MW-2, and MW-4 through MW-8, creating a groundwater mound, (Figs. E1, E2, and E4 through E8). Meanwhile, monitoring well MW-3 in the Jornada Basin to the east showed average declining water-level trend (Fig. E3). Comparing the timing of this water-level mound from infiltrated storm water to monitoring well locations (Figs. E1, E4, and E5) indicates the westward migration and dissipation of the mound.

Water levels at MW-9, between the Jornada Horst and the Interstate-25 Corridor, showed an average decline of 1.1 ft/yr (Fig. E6).
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. These trends may change as more data become available, but as of 2016, 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.

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 and the Jornada piezometers (CLC Shallow, Middle, and Deep) all showed long-term declining trends with average rates ranging from 2.9 to 5.3 ft/yr. No significant vertical hydraulic gradient has been observed in the Jornada piezometers.

Active supply wells in the Interstate-25 Corridor generally showed long-term water-level declines with average rates ranging from 2.9 to 5.3 ft/yr and 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. Overall declining trends in inactive Wells 19, 20, 21, and 24, near Griggs and Walnut PCE plume capture Wells 18 and 27, suggest that plume capture is occurring.

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 1.6 ft/yr. Inactive wells and nested observation wells in the Valley showed long-term water-level declines ranging from 0.6 to 2.0 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. The lowest rates of decline among the nested observation wells in the Valley were in LC-1 (A, B, C), the nested observation wells closest to the river, spanning depths of 41 to 305 ft, and LC-2C, another shallow (40-ft deep) observation well close to the river. The largest rates of decline were in LC-3 (A, B, C), nested observation wells farther from the river, spanning depths of 50 to 332 ft. The rate of decline was somewhat lower in the 640-ft deep LC-3D. A downward vertical hydraulic gradient was observed at LC-1 and LC-2.

Active and inactive wells on the West Mesa showed long-term water-level declines ranging from 0.5 to 3.0 ft/yr. More data are needed to identify any relationship between West Mesa pumping and any short-term trends in inactive wells on the West Mesa.

In general, fluctuations in pumping levels in active supply wells were related to variations in pumping rates at these wells.
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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<td>43</td>
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<td></td>
</tr>
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<td></td>
<td>68</td>
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<td>Well C ***</td>
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<td>69</td>
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<td></td>
<td>MW-9</td>
<td>-1.1</td>
</tr>
</tbody>
</table>

(a) - apparent seasonal fluctuations in water levels
*   too much oil (food-grade lubricating oil for line-shaft turbine pumps) to measure water levels between February 2013 and May 2016
**  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
4.2 Water-Level Elevation Contours

Figure 3 presents a December 2016 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 northwest of the monitoring program area.
- Pumping at Griggs and Walnut PCE plume capture Wells 18 and 27 is containing the PCE plume in the southern part of the Interstate-25 Corridor area.
- Pumping at Interstate-25 Corridor Wells 23, 25, and 26 is creating localized cones of depression in the northern part of the Interstate-25 Corridor area.
- Pumping at numerous Valley wells (Wells 29, 32, 33, 35, 59, 65, and 67) is creating a localized cones of depression.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Continued water-level monitoring will further define local and regional 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 wells on the East Mesa and on the West Mesa, and declining trends for the majority of inactive wells throughout the monitoring program area. Active wells in the Valley and the Interstate-25 Corridor show a variety of long-term trends. A number of inactive wells in the southern part of the Interstate-25 Corridor are influenced by pumping of nearby wells in the Interstate-25 Corridor as well as the Valley.

The following are recommended:

1. Make sure well work for water-level access issues at Wells 46 and 64 on the West Mesa is conducted in July 2017 as scheduled.

2. Access for water-level measurements at Well 32 in the Valley should be restored (reported to have been “capped off” in 2016).
3. Make note of replacement wells in the water-level monitoring database, such as Well 31.

4. It has been noted to be worthwhile to equip Wells 18 and 27, and GWMW16(S,D) with transducers, as part of the water-level monitoring program and to aid in understanding Griggs and Walnut plume capture. The best time to incorporate water-level transducers on the two plume capture wells is when normal well maintenance occurs so there is no undue lapse in groundwater cleanup.

5. 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. Some transducer equipment requires periodic factory re-calibration to prevent instrument drift; Las Cruces Utilities may want to check information regarding the transducer equipment to see if re-calibration may be necessary. 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.

6. The transducer at Well 21 should be checked, as it appears to be periodically malfunctioning.

7. Begin monitoring water levels at Well 72 on the East Mesa. This well is not yet pumping and would provide valuable data as an inactive supply well on the East Mesa.
6.0 REFERENCE

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 2016 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 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.

**Non-pumping water level**

**Pumping water level**

**Wells 40-43 monthly pumping**

**Linear (Non-pumping water level)**

average decline 4.0 ft/yr

TD 1,170 ft
screen 700-1,150 ft
pump set at 665 ft

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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.

average decline 5.0 ft/yr

TD 1,150 ft
screen 725-1,125 ft
pump set at 690 ft

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

- Average decline: 2.9 ft/yr
- TD 815 ft
- Screen 485-785 ft
- Pump setting unknown
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.
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.

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

- **average decline 1.7 ft/yr**
- **TD 516 ft screen 315-516 ft pump set at 300 ft**
- **pumping for plume capture started in 2012**

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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 hand-measured and transducer 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 hand-measured and transducer 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.

average decline 1.0 ft/yr

TD 592 ft
screen 452-592 ft
pump setting unknown

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

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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 hand-measured and transducer 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.

Griggs and Walnut Plume Capture Well

average decline 1.1 ft/yr

TD 524 ft
screen 430-524 ft
pump setting unknown

Non-pumping water level
Pumping water level
Monthly pumping
Linear (Non-pumping water level)
Figure B14. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Well 28.

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

Average rise: 2.2 ft/yr

TD 751 ft
screen 421-738 ft
pump set at 380 ft
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 hand-measured and transducer 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 hand-measured and transducer 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 hand-measured and transducer 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 hand-measured and transducer 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.
Average decline 0.5 ft/yr

Figure B28. Graph of water-level data and monthly pumping data collected by the City of Las Cruces for Paz Park Well.
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-C, 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.
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.

Average decline 1.6 ft/yr

TD 622 ft
screen 465-585; 597-617 ft
pump set at 200 ft

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

Average decline: 2.6 ft/yr

TD 697 ft
Screen 456-696 ft (multiple intervals)
Pump set at 300 ft
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.

average decline
2.4 ft/yr

TD 683 ft
screen 325-680 ft (multiple intervals)
pump setting unknown
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**

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.

average rise 1.6 ft/yr

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

TD 765 ft
screen 455-745 ft
pump setting unknown

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

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

Average rise: 1.2 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.
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.

Average decline 0.8 ft/yr
Figure C17. Graph of water-level data for nested observation Well LC-2 (A-C, 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.
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

(no discernible linear trend)
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.

Note: too much oil to measure water levels

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.

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

average decline 0.5 ft/yr

TD 1,290 ft
screen 603-1,254 ft
pump set at 520 ft

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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.
Figure E3. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-3.

average decline
0.2 ft/yr
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.

average decline
0.4 ft/yr
Figure E8. Graph of water-level data for Las Cruces Foothills Landfill monitoring well MW-8.

average decline
1.4 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.
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 Griggs and Walnut site MW-1 through MW-5 observed water levels, City of Las Cruces, New Mexico.

Figure F3. Graph of Griggs and Walnut site MW-SF1 through MW-SF10 observed water levels, City of Las Cruces, 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 Griggs and Walnut site MW-1 through MW-5 observed water levels, City of Las Cruces, New Mexico.
Figure F3. Graph of Griggs and Walnut site MW-SF1 through MW-SF10 observed water levels, City of Las Cruces, New Mexico.