APPENDIX E:
EVALUATION OF 14 POTENTIAL ADDITIONAL WELL LOCATIONS

TECHNICAL MEMORANDUM #2

TO: Mike Trouchon, Larry Walker Associates

FROM: Jacob Westra, Tulare Lake Basin Water Storage District

DATE: November 16, 2016

RE: Evaluation of 14 Potential Additional Well Locations

Central Valley Regional Water Quality Control Board staff identified 14 potential well locations in addition to the existing potential well sites identified in the Technical and Regulatory Evaluation of MUN and AGR Beneficial Uses in the Tulare Lake Bed area Report (MUN/AGR Report) dated December 4, 2015. Tulare Lake Basin Water Storage District staff conducted additional investigation on these 14 wells (see Attachment 1), some of which were previously identified in the MUN/AGR Report.

Kenneth D. Schmidt and Associates prepared a technical analysis (see Attachment 2) to determine the cone of depression or zone of capture for municipal wells from the various urban communities surrounding the area proposed for de-designation of the MUN beneficial use. The analysis showed that the City of Corcoran municipal well evaluated has a lateral cone of depression of approximately 1,900 feet; therefore, if a city well was located more than 1,900 feet away, it would not be pumping water from the area proposed for de-designation.

Kenneth D. Schmidt and Associates also prepared a technical zone of capture evaluation (see Attachment 3) to determine the cone of depression or zone of capture for a representative domestic well in the Tulare Lake Bed area. The conservative analysis determined that a zone of capture for a representative domestic well was 87.5 feet at a continuous pumping rate of 20 gpm. In an overabundance of caution, a setback distance from the proposed de-designation boundary of 100 feet was used.

The results of the 14 additional sites investigated are as follows:

- Site 1A. Residence is approximately 3,700 feet (0.7 miles) away from de-designation boundary.
- Site 1B. Residence is approximately 3,200 feet (0.6 miles) away from de-designation boundary.
- Site 2A. Residence is approximately 8,100 feet (1.5 miles) away from de-designation boundary.
- Site 2B. Residence is approximately 5,700 feet (1.1 miles) away from de-designation boundary.
- Site 3. Agricultural well is abandoned.
- Site 4. Agricultural well is abandoned and is below Corcoran Clay.
- Site 5. FedEx facility receives water from Kettleman City Community Services District.

- Site 6. No residence was found at this location, however a residence was found ½ mile to the west. It was assumed that this is the residence on the map. This residence is the closest to the proposed de-designation boundary. The domestic well is located approximately 175 feet away from the de-designation boundary.
- Site 7. No Ag well was found at this location, however an Ag well was found ½ mile to the west. It was assumed that this is the Ag well on the map. The Ag well is completed below the Corcoran Clay per discussion with the landowner.
- Site 8. This well was identified in the MUN/AGR report and potable water is served by the City of Corcoran for this residence.
- Site 9. This well was identified in the MUN/AGR report and the well is completed below the Corcoran Clay per personal communication with the landowner. Additionally drinking water is delivered to the residence.
- Site 10. Residence is located approximately 6,300 feet (1.2 miles) away from de-designation boundary.
- Site 11. Per visual inspection, no well was found at this location.
- Site 12A. Residence is located approximately 1,700 feet (0.3 miles) away from de-designation boundary.
- Site 12B. Residence is located more than 1,600 feet (0.3 miles) away from de-designation boundary.
- Site 13. Per personal communication with landowner well is destroyed.
- Site 14. Per personal communication with landowner well is completed below Corcoran Clay. Additionally, the well is approximately 560 feet away from the de-designation boundary.

Attachment 1

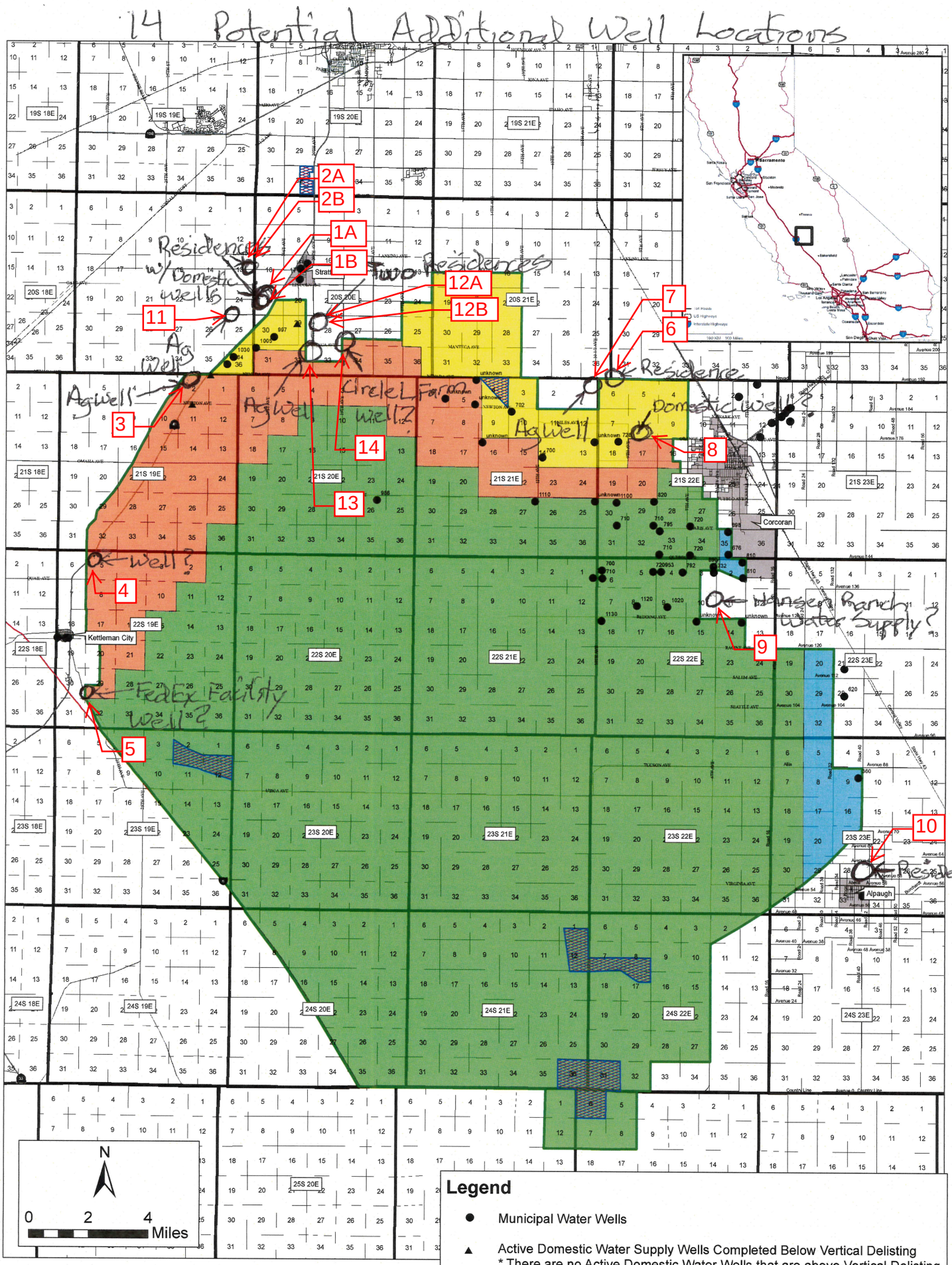

Figure 5 - 1
TULARE LAKE BED AREA
MUN and AGR Beneficial Uses De-designation

- Active Wells

Path: V:\CV Salts\CV salt Annular Seal Intervals for Active Irrigation Wells and other wells.mxd

Attachment 2

KENNETH D. SCHMIDT AND ASSOCIATES
GROUNDWATER QUALITY CONSULTANTS
600 WEST SHAW AVE., SUITE 250
FRESNO, CALIFORNIA 93704
TELEPHONE (559) 224-4412

July 8, 2016

Mr. J.J. Westra
Assistant Manager
Tulare Lake Basin WSD
1001 Chase Avenue
Corcoran, CA 93212

Re: Lakebed De-Designation

Dear J.J.:

Submitted herewith is our enhanced discussion of potential groundwater flow near the urban areas.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist
No. 176

KDS/td

REGISTERED GEOLOGIST
KENNETH D. SCHMIDT
NO. 1578
STATE OF CALIFORNIA

REGISTERED GEOLOGIST
KENNETH D. SCHMIDT
NO. 176
CERTIFIED
HYDROGEOLOGIST
STATE OF CALIFORNIA

TULARE LAKEBED DE-DESIGNATION

DIRECTIONS OF GROUNDWATER FLOW NEAR URBAN AREAS

This section provides a discussion of the direction of groundwater flow at and in the vicinity of the four urban areas surrounding the Project Study Area. In addition, the potential of pumping for these areas to change the direction of groundwater flow near the proposed de-designated area boundaries is evaluated.

Stratford

Data for the primary public supply well (Attachment D) in Stratford indicates that it is perforated from 660 to 1,170 feet in depth and taps strata below the Corcoran Clay. The deposits above the Corcoran Clay are sealed off in this well. There are two other wells in Stratford, but they are standby and aren't pumped significantly. The direction of shallow groundwater flow is indicated to be to the south, based primarily on monitoring at the Westlake Farms North Evaporation Basins and on the topography. The proposed de-designation in this area is to a depth of 75 feet. Pumpage from the Stratford supply well would not influence the direction of groundwater flow above the Corcoran Clay because of the intervening clays layers below the base of the de-designated strata and above the top of the perforations and opposite the annular seal nor would these wells draw groundwater from beneath the areas proposed for de-designation. In addition, this well is located more than half a mile from the proposed delisted area.

Alpaugh

The primary supply well in Alpaugh is perforated from 1,025 to 1,210 feet in depth and taps strata below the Corcoran Clay. This well is sealed off opposite all strata above a depth of 900 feet (Attachment D). This well is more than a mile from the nearest boundary of the area proposed for de-designation, and the interval to be de-designated is above a depth of 110 feet. The direction of shallow groundwater flow near Alpaugh is indicated to be to the west, based on topography. The annular seal in this well would preclude any influence on the direction of groundwater flow in shallow strata due to pumping of the well. This is because of the extensive clay layers between 110 feet and 900 feet in depth in the vicinity of the well.

The two Angiola W.D. wells (G-30 and W-18), which could be used for Alpaugh, are perforated from 260 to 500 feet in depth

and tap strata above the Corcoran Clay. These wells have annular seals extending from the surface to at least 220 feet in depth. These wells are located about one mile east of the proposed de-designation boundary. The proposed de-designation in this area is for the interval above 110 feet in depth. The direction of shallow groundwater flow in that area (between Avenues 104 and 112 and Roads 32 and 40) is indicated to be to the west, based on topography. Each of these wells is sealed opposite three clay layers between 115 feet and 220 feet in depth. These clay layers would preclude the pumping of the wells from affecting the direction of groundwater flow in strata above a depth of 100 feet. Additionally, these wells would not draw groundwater from beneath the areas proposed for de-designation.

Kettleman City

There are two active public supply wells in Kettleman City, and they range from about 550 feet to 700 feet deep. A third well (school well) is used only for landscape irrigation due to high arsenic levels (Attachment D). These wells tap strata only above the Corcoran Clay, which is indicated to be below a depth of about 800 feet near Kettleman City. The direction of shallow groundwater flow is indicated to be to the northeast, based primarily on the topography and the direction of groundwater flow at the Westlake Farms South Evaporation Basins. These public supply wells are located outside of the proposed de-designation boundary by 0.6 to 1.0 mile. A zone of capture evaluation was conducted to evaluate the extent that the Kettleman City pumpage could reverse the direction of groundwater flow in strata above the Corcoran Clay. The slope of the land surface between the two wells and the Blakely Canal to the northeast averages about 60 feet per mile. This is the best estimate of the water-level slope for strata above the Corcoran Clay. An aquifer test was conducted on the Kettleman City CSD Maud Street Well in 1995. This well was perforated from 250 to 545 feet in depth. The pumping rate was about 500 gpm and a transmissivity of 9,000 gpd per foot was indicated by the pump test. The measured annual pumping for Kettleman City during 2013-15 ranged from only 27 to 29 acre-feet per year. A zone of capture evaluation was done. The distance between the wells and the stagnation point is the downgradient extent of the cone of depression due to pumping of the wells. The distance to the stagnation point is determined from the following equation from Fetter (1994):

$$Xo = \frac{Q}{2\Pi Kbi}$$

Where X_0 : distance to stagnation point (feet)
Q: pumping rate (ft^3 /day)
K: hydraulic conductivity (ft/day)
b: aquifer initial thickness (ft)
i: hydraulic gradient (unitless).

Q = 0.26 acre-foot per day or 11,230 cubic feet per day
K = 9,000 gpd/ft divided by 335 feet = 27 gpd/ft^2 divided by 7.48 = 3.6 feet per day.
b = 335 feet.

$$I = \frac{60 \text{ feet/mile}}{5{,}280 \text{ feet per mile}} = 0.0144.$$

$$Xo = \frac{11{,}230}{86} = 130 \text{ feet.}$$

This indicates that even if the water-level slope was greater, the cone of depression would only extend less than 200 feet northeast of the well. Both wells are located west of Highway 41 and are more than 0.6 mile upgradient of the proposed de-designation boundary. Thus there would be no impact on the direction of groundwater flow near the de-designation boundary, nor would these wells draw groundwater from beneath the areas proposed for de-designation.

City of Corcoran

Active City of Corcoran public supply wells are located east of 5th Avenue and north of Orange Avenue. All of these wells are located more than two miles outside of the proposed de-designation boundary. None of the active City wells located between Orange and Niles Avenues and 4-1/2 and 5th Avenues is pumped significantly. The City has another well (4-B), which is located farther to the northeast, between 4th and 4 1/2th Avenues. This well is perforated from 235 to 485 feet in depth, and is heavily pumped. Thus most of the upper aquifer City pumpage closest to the de-designation area is from Well No. 4-B, which is located about two and a half miles from the de-designation boundary. The remaining City wells are located either east of 4th Avenue or farther north, much farther distant from the proposed de-designation area.

Water-level maps for the period 1997-2003 were generally based on more measurements near Corcoran, and are thus considered more representative. These maps consistently indicate a southwesterly direction of groundwater flow toward the central part of the lake-

bed. Because the proposed de-designation area southwest of Corcoran extends to the top of the Corcoran Clay, a zone of capture evaluation was done for City Well No. 4B. The annual pumpage from Well 4-B was 1,330 acre-feet in 2015. Aquifer tests were conducted on five upper aquifer City of Corcoran wells in 1993. The hydraulic conductivities averaged about 250 gpd per square foot. The saturated thickness of the upper aquifer tapped by Well No. 4B and is 275 feet. The lateral hydraulic conductivity of 250 gpd per square foot is equal to 33.4 feet per day.

The distance from Well 4-B to the downgradient stagnation point is as follows:

$$Xo = \frac{160{,}700\ ft^3/day}{2\Pi(33.4\ ft/day)(275\ ft)\ 0.00144}$$

$$Xo = \frac{160{,}700\ ft^3/day}{83.07\ ft^2/day}$$

$$Xo = 1{,}934\ feet.$$

The depression cone from pumping this well could extend about 1,900 feet to the southwest of the well, but would still be about two miles from the proposed de-designation boundary. Thus pumping of the City of Corcoran wells wouldn't influence the direction of groundwater flow in the area proposed for de-designation, nor would these wells draw groundwater from beneath the areas proposed for de-designation.

Attachment 3

KENNETH D. SCHMIDT AND ASSOCIATES
GROUNDWATER QUALITY CONSULTANTS
600 WEST SHAW AVE., SUITE 250
FRESNO, CALIFORNIA 93704
TELEPHONE (559) 224-4412

November 8, 2016

Mr. J.J. Westra
Assistant Manager
Tulare Lake Basin WSD
1001 Chase Avenue
Corcoran, CA 93212

Re: Lakebed Delisting

Dear J.J.:

Pursuant to your request, we have prepared a revised zone of capture evaluation for a representative private domestic well on the fringes of the Tulare Lakebed. The pumping rate used was 20 gpm. A lateral hydraulic conductivity of 100 feet per day was used. A relatively flat water level slope of about six feet per mile was used. The distance between the wells and the stagnation point is the downgradient extent of the cone of depression due to pumping of the well. The distance to the stagnation point is determined from the following equation from Fetter (1994):

$$X_0 = \frac{Q}{2\pi Kbi}$$

Where X_0 : *distance to stagnation point*
Q: *pumping rate* (ft^3/day)
K: *hydraulic conductivity* (ft/day)
b: *aquifer initial thickness* (ft)
i: *hydraulic gradient* $(unitless)$

$Q = 20\ gpm\ or\ 3{,}850\ ft^3\ per\ day$
$K = 100\ ft\ per\ day$
$b = 50\ feet$
$i = 6\ feet\ per\ mile/5{,}280\ ft/mile = 0.0014$
$X_0 = 3{,}850/44.0 = 87.5\ feet$

A more permeable sand, with a greater hydraulic conductivity, or a steeper hydraulic gradient, would result in a lower value for this distance. To be conservative a value of 100 feet is used for X_0.

Please call me if you have any questions.

Sincerely yours,

Kenneth D. Schmidt

KDS/cl