What Water Levels Tell Us About Aquifer Storage

TUCSON WATER
A proud part of the City of Tucson

CITY OF FOUNDED 1775 TUCSON

February 20, 2020

Introduction

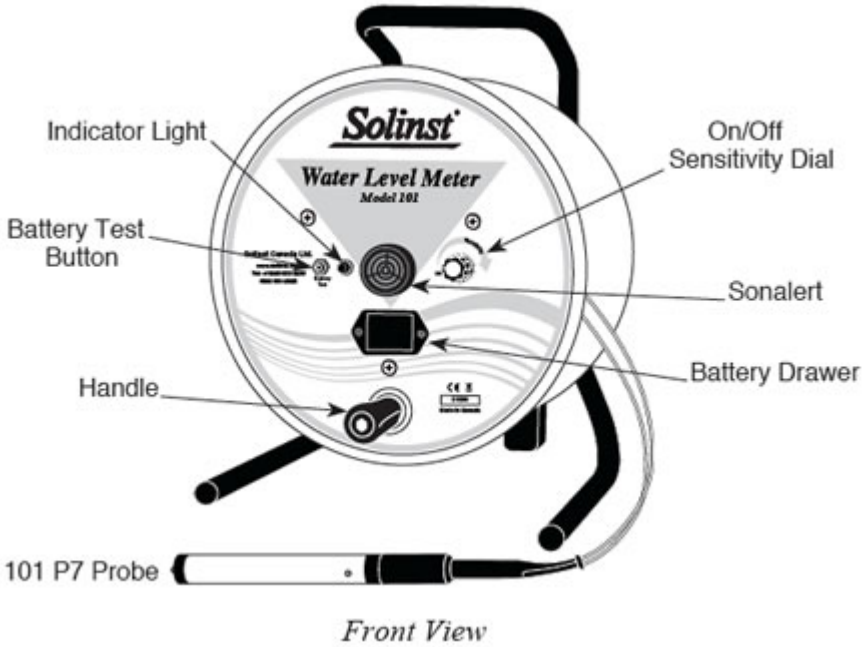
- Tucson Water has been recharging Colorado River water into the regional aquifer for over 20 years and has a current annual allocation of 144,191AF
  - Over 2MAF has been delivered, spread amongst multiple facilities in the Active Management Area
  - TW owns and operates CAVSARP & SAVSARP, and owns 50% of PMRRF
  - TW CAP allocation also goes to multiple GSFs in the AMA
  - TW also recharges storage partner's allocations
    - Water is wheeled to their service areas
    - Or exchanged through credit transfer

Introduction

- Tucson Water uses water levels as one method to closely monitor the regional aquifer
  - The Annual Water Level Round-up happens each winter where a level is taken from every measureable production well
    - Data is used to create maps that show changes over time
  - Water levels are taken by hand, using sounders, or by remote dataloggers installed inside wells
    - Tucson Water has recently digitized hand water level acquisitions

Sounding Wells

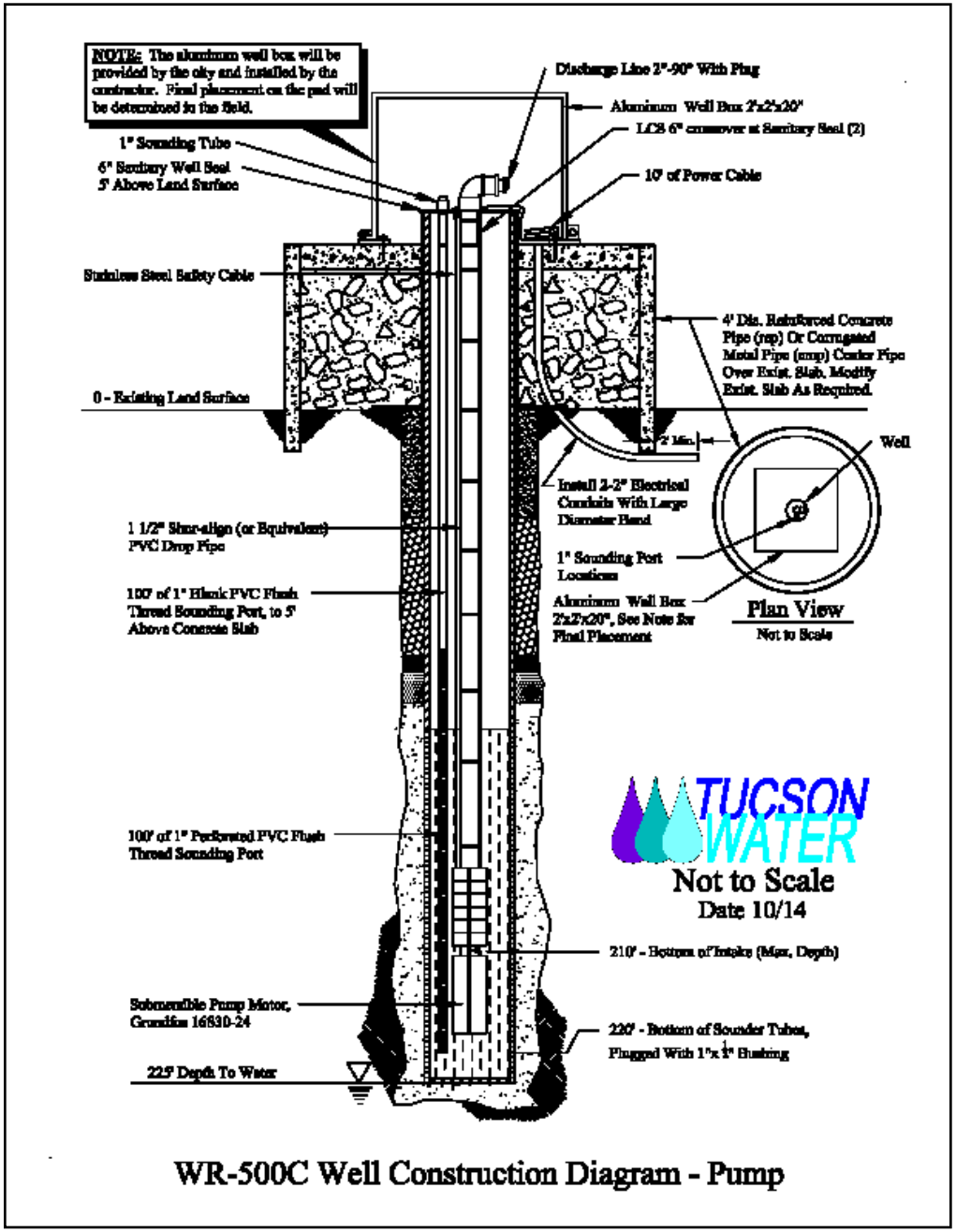
- How does a sounder work?
  - What about TD?



Front View

Sounding Wells

- Well construction can help or hinder taking water levels



Sounding Wells

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Data Acquisiti

- Water Level sheets &
  - Cumbersome
  - Errors
  - Fragile
  - Poor maps
  - Room for notes
  - Add pics
  - Easy history
  - Diagrams

FORM WR-2001B
WATER LEVEL MEASUREMENTS

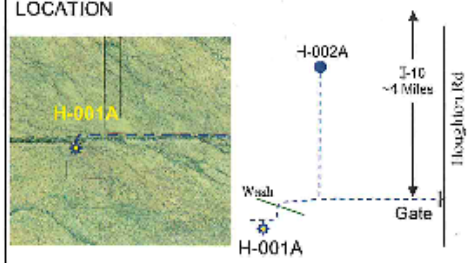
Tucson Water
P.O. Box 27210
Tucson, AZ 85726

WELL NAME H-001A Land surface ☐

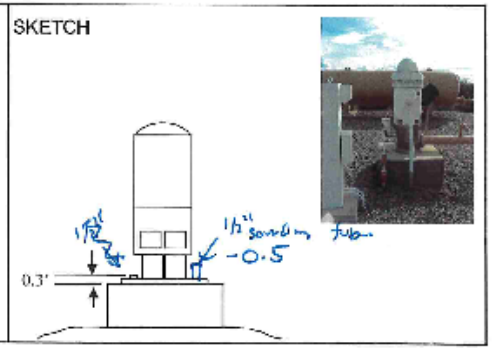
LEGAL DESCRIPTION (D- 16 - 15) 34 AAA ELEV. _____ ft. a.m.s.l. Benchmark ☐

CASING DIA 12 in. TOTAL DEPTH 720 ft

LOCATION



SKETCH



STREET ADDRESS _____

STATUS CODES

A ACTIVE
B BACKFILLED/ABANDONED
C CAPPED CANNOT SOUND
D DRY
E PARTIALLY EQUIP. NOT IN USE
L EQUIPPED WITH DATALOGGER
M S.W.L. MONITORING ONLY
Q DEDICATED SUB. PUM W/O SAMPLING
R CHART RECORDER
S SUBSIDENCE MONITORING
N ACTIVE NOT PART OF DIST. SYS.
O OBSTRUCTIVE CANNOT SOUND

Date (M/D/Y)	Sounder Reading (ft.)	Corr. (ft.)	Corrected Reading (ft.)	Measured by	Status	Comments Method measured, Measuring point Measurement problems, Repairs, Oil
12/21/04	476.27	-0.3	475.97	CF/BZ ✓	A	Tot = 551850 SD#28
2/3/06	479.15	-0.3	477.85	CF/PC ✓	A	Tot = 3140490 SD#21 SD#27
1/30/07	479.33	-0.3	479.03	CF SY	A	Tot= M3950
2/6/08	481.41	-0.3	481.11	CF, BP		Tot 9846470
11/2/09	—	-0.3	✓	CF, JS	A	Unable to get past 250' Tot= 143040592
12/16/09	482.47	-0.3	482.17	CF, TDT	A	SD#35
3/4/11	483.95	-0.3	483.65	CF, JS	A	SD#8
3/2/12	484.05	-0.3	483.75	CF, SH	A	SD#3
2/27/13	483.95	-0.3	483.65	SAK, MM	E	SD#3
2/15/19	495.10	-0.10	495.00	GSH	E	SD 32 Temp Correction
1/30/20	498.0	-0.5		CF/BS	A	SD#15

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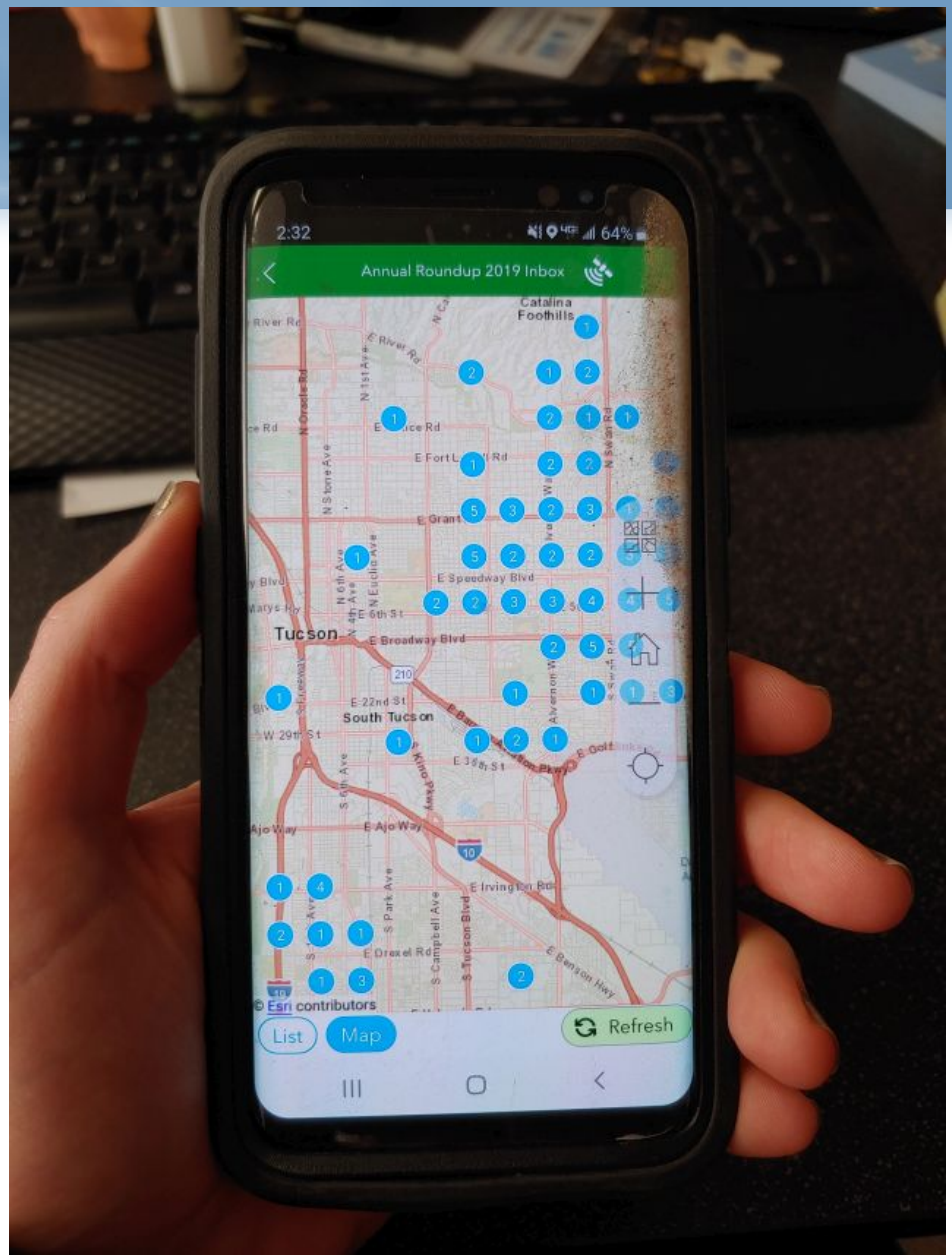
Data Acquisition

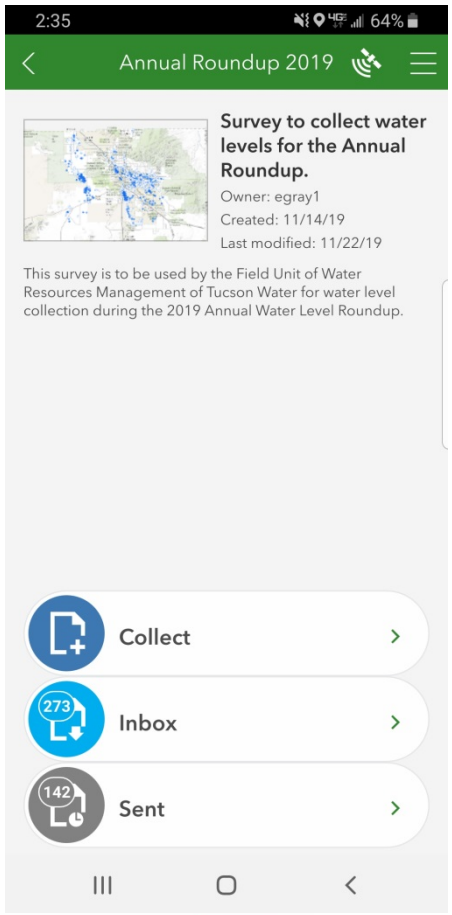
- Water Level App
  - Sweet maps
    - Multiple basemaps
  - No doubles
  - Durable
  - Access to all wells

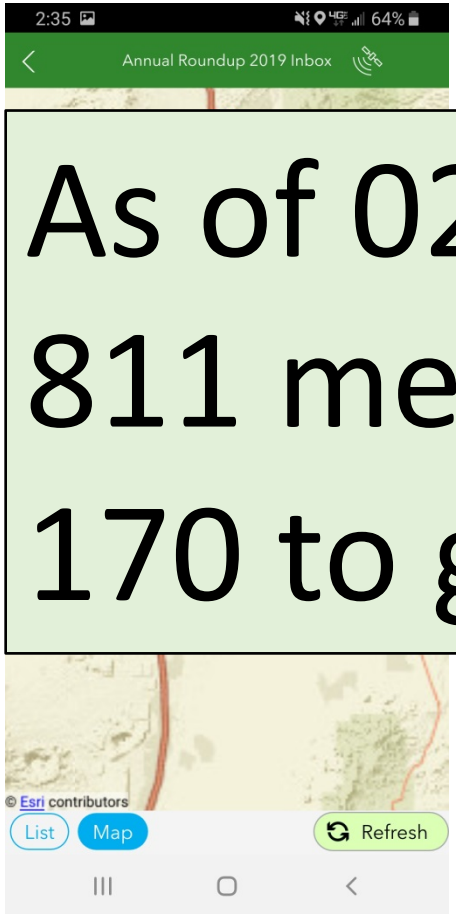
  - Can’t add pics or notes
  - No history

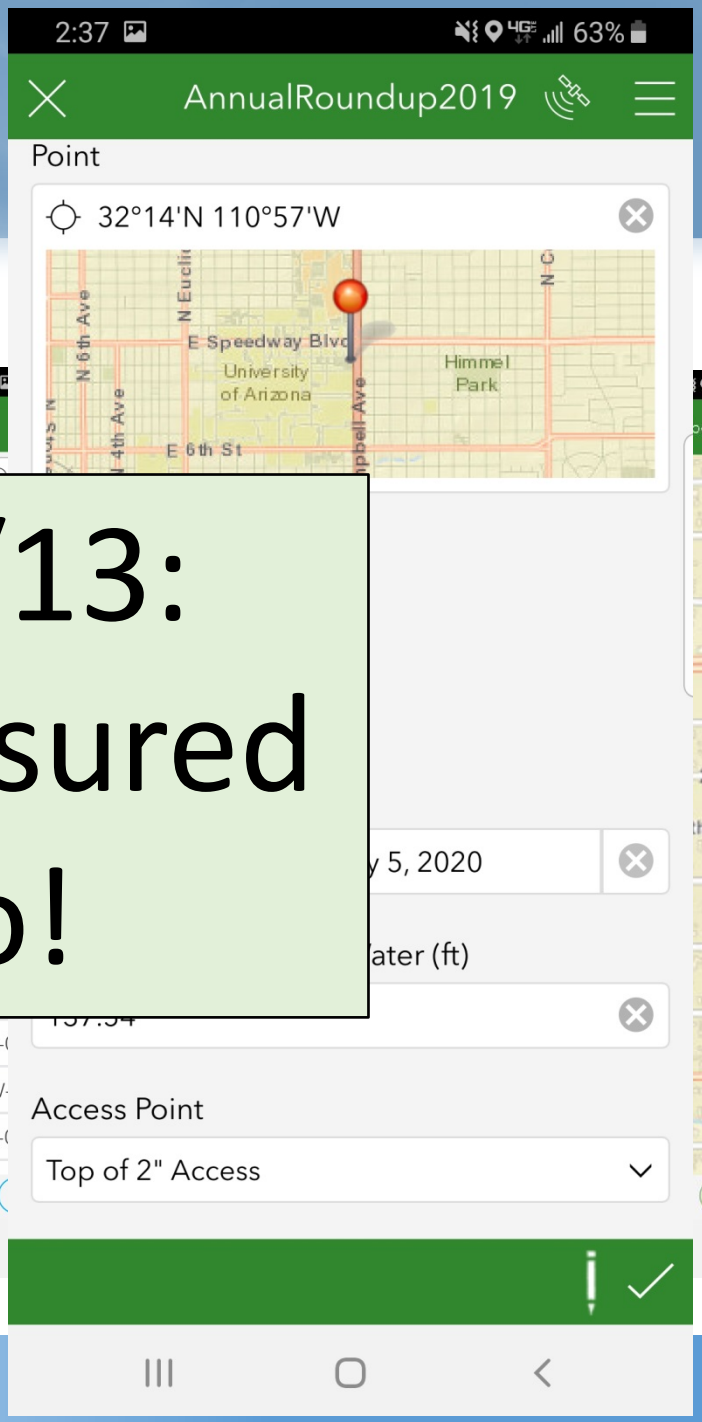


Data Acquisition

- Entering data in the app







As of 02/13:
811 measured
170 to go!

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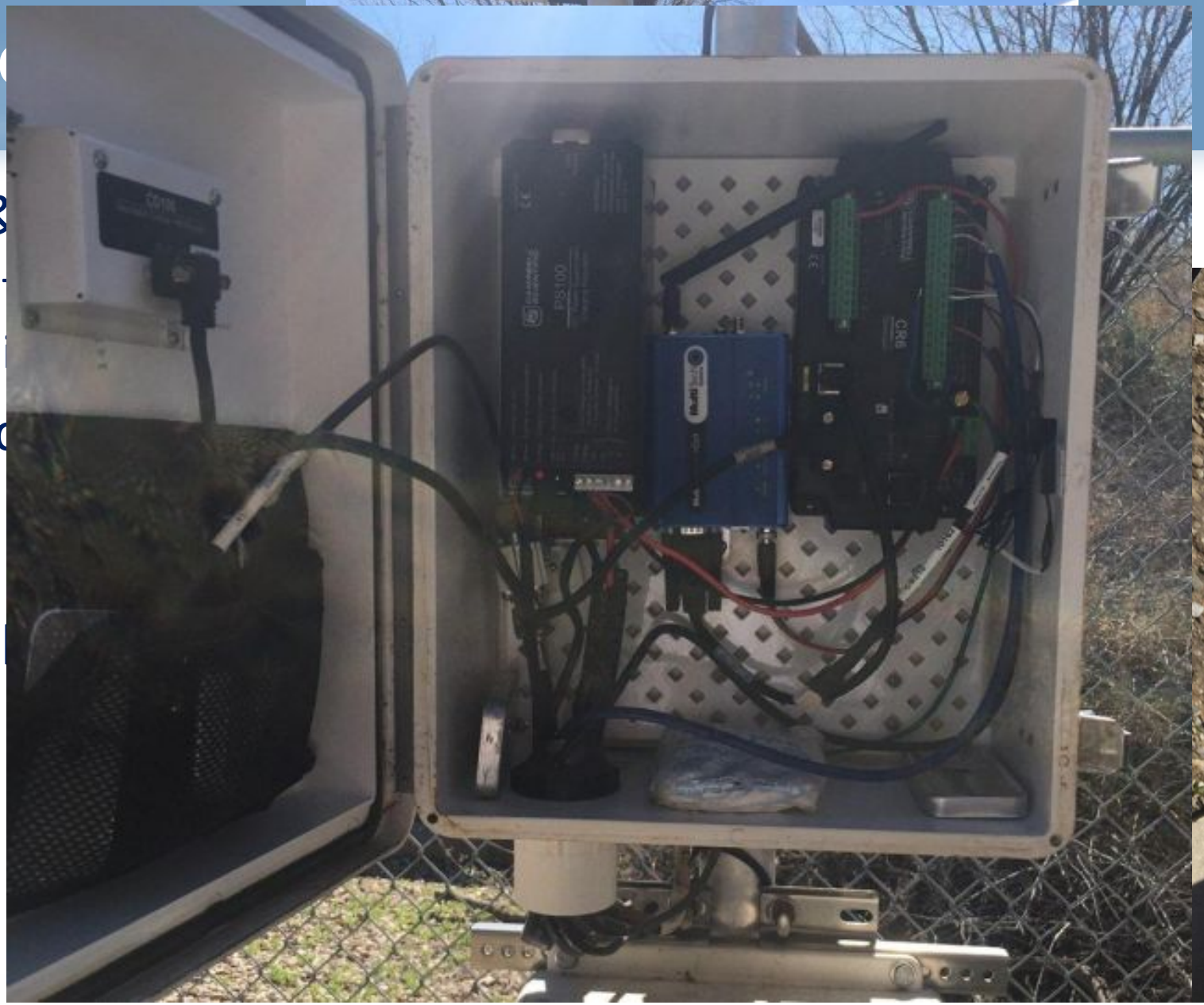
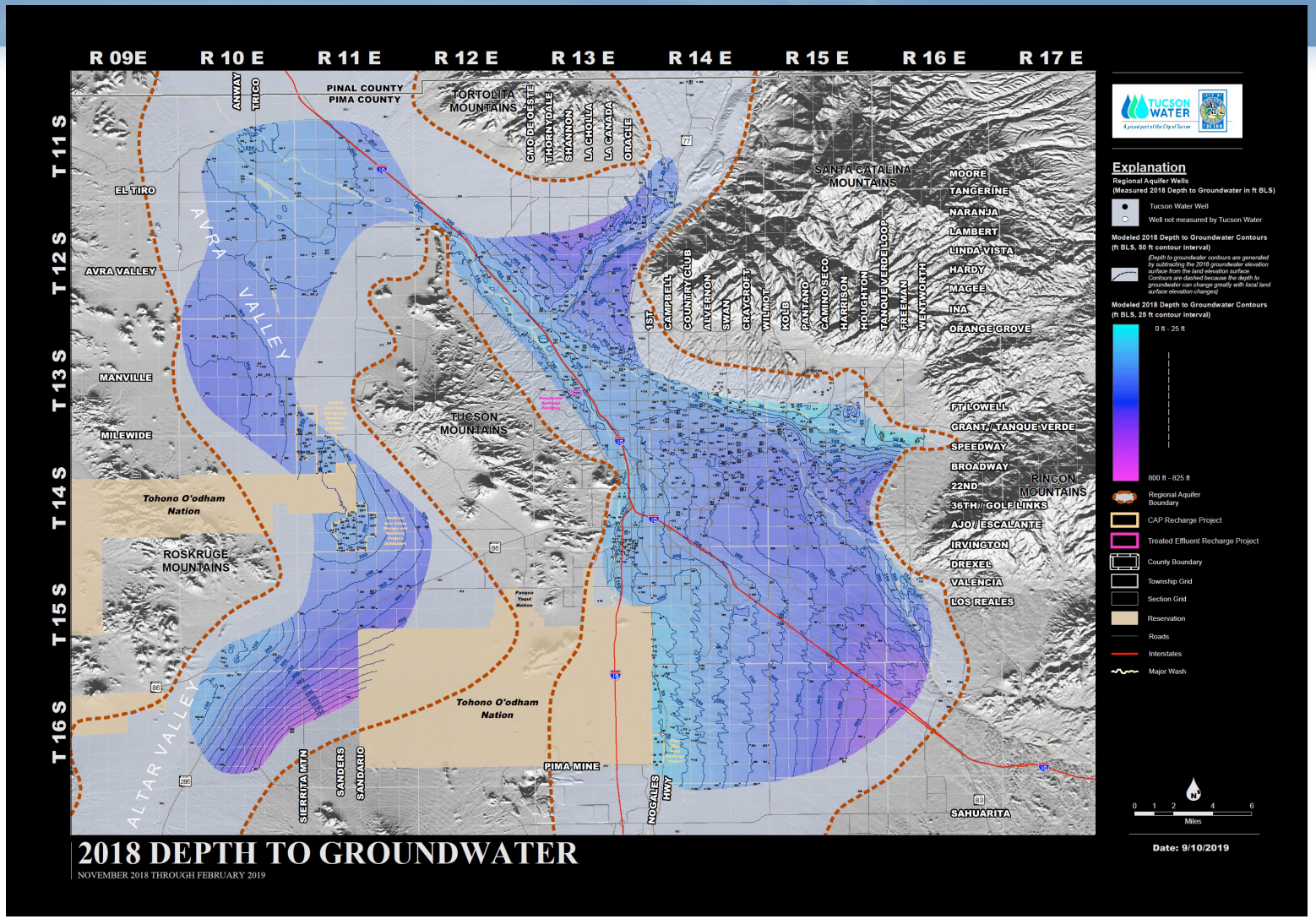
Datal

- Divers &
  - Vibra
  - Alum
- Divers lo
  internal
- Geokon
  externa



Maps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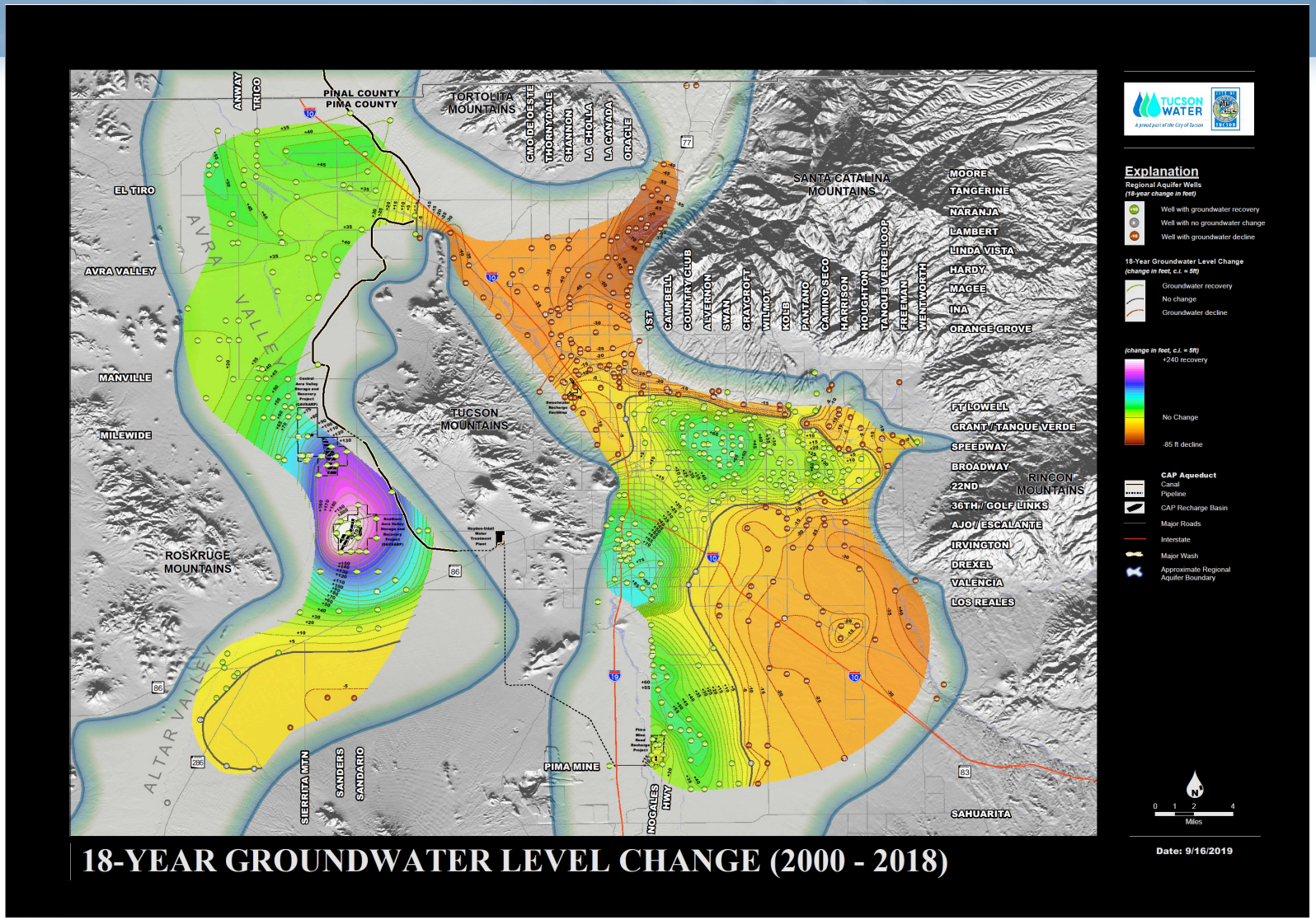
T 11 S
T 12 S
T 13 S
T 14 S
T 15 S
T 16 S
ANWAY
TRICO
PINAL COUNTY
PIMA COUNTY
TORTOLITA MOUNTAINS
CIRO DE OESTE
THORNYDALE
SHANNON
LA CHOLLA
LA CANADA
ORACLE
SANTA CATALINA MOUNTAINS
MOORE
TANGERINE
NARANJA
LAMBERT
LINDA VISTA
HARDY
MAGEE
INA
ORANGE GROVE
1ST
CAMPBELL
COUNTRY CLUB
ALVERNON
SWAN
CRAYCROFT
WILMOT
KOLB
PANTANO
CAMINO SECO
HARRISON
HOUGHTON
TANQUE VERDE LOOP
FREEMAN
WENTWORTH
EL TIRO
AVRA VALLEY
AVRA VALLEY
MANVILLE
MILEWIDE
TUCSON MOUNTAINS
Tohono O'odham Nation
ROSKRUGE MOUNTAINS
Ft LOWELL
GRANT/TANQUE VERDE
SPEEDWAY
BROADWAY
22ND
36TH/GOLF LINKS
AJO/ESCALANTE
IRVINGTON
DREXEL
VALENCIA
LOS REALES
RINCON MOUNTAINS
Pasqua Yaqui Nation
Tohono O'odham Nation
ALTAR VALLEY
SIERRITA MTN
SANDERS
SANDARIO
PIMA MINE
NOGALES HWY
SAHUARITA
Explanation
Regional Aquifer Wells
(Measured 2018 Depth to Groundwater in ft BLS)
Tucson Water Well
Well not measured by Tucson Water
Modeled 2018 Depth to Groundwater Contours
(ft BLS, 50 ft contour interval)
(Depth to groundwater contours are generated by subtracting the 2018 groundwater elevation surface from the land elevation surface. Contours are dashed because the depth to groundwater can change greatly with local land surface elevation changes)
Modeled 2018 Depth to Groundwater Contours
(ft BLS, 25 ft contour interval)
0 ft - 25 ft
800 ft - 825 ft
Regional Aquifer Boundary
CAP Recharge Project
Treated Effluent Recharge Project
County Boundary
Township Grid
Section Grid
Reservation
Roads
Interstates
Major Wash
0 1 2 4 6
Miles
Date: 9/10/2019
2018 DEPTH TO GROUNDWATER
NOVEMBER 2018 THROUGH FEBRUARY 2019

Maps


PINAL COUNTY
PIMA COUNTY
TORTOLITA MOUNTAINS
SANTA CATALINA MOUNTAINS
TUCSON MOUNTAINS
ROSKRUGE MOUNTAINS
RINCON MOUNTAINS
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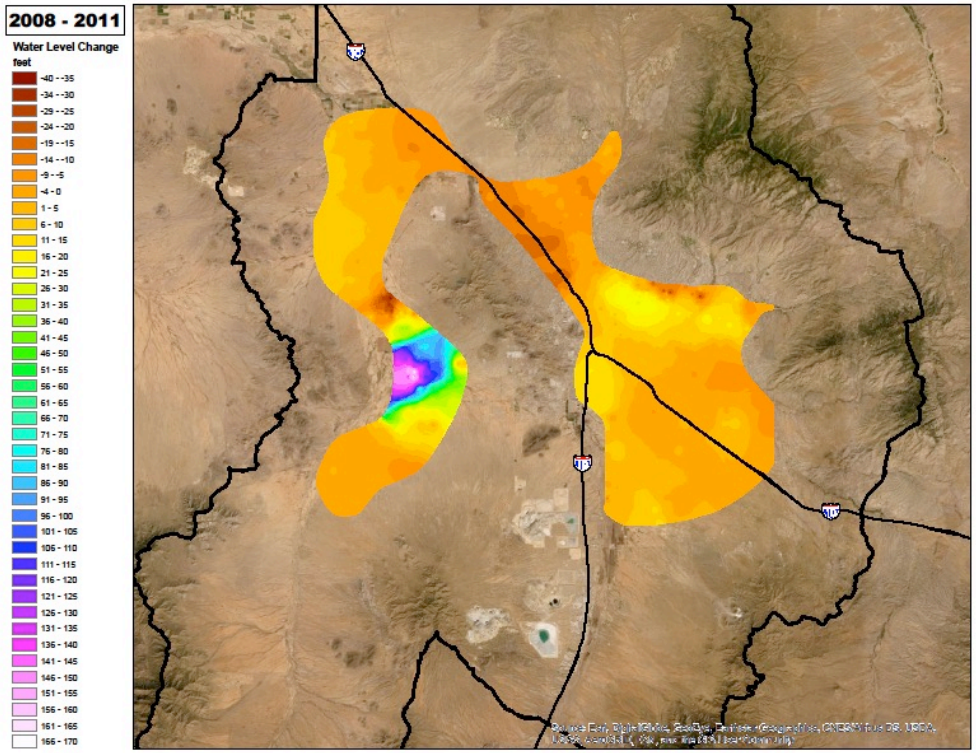
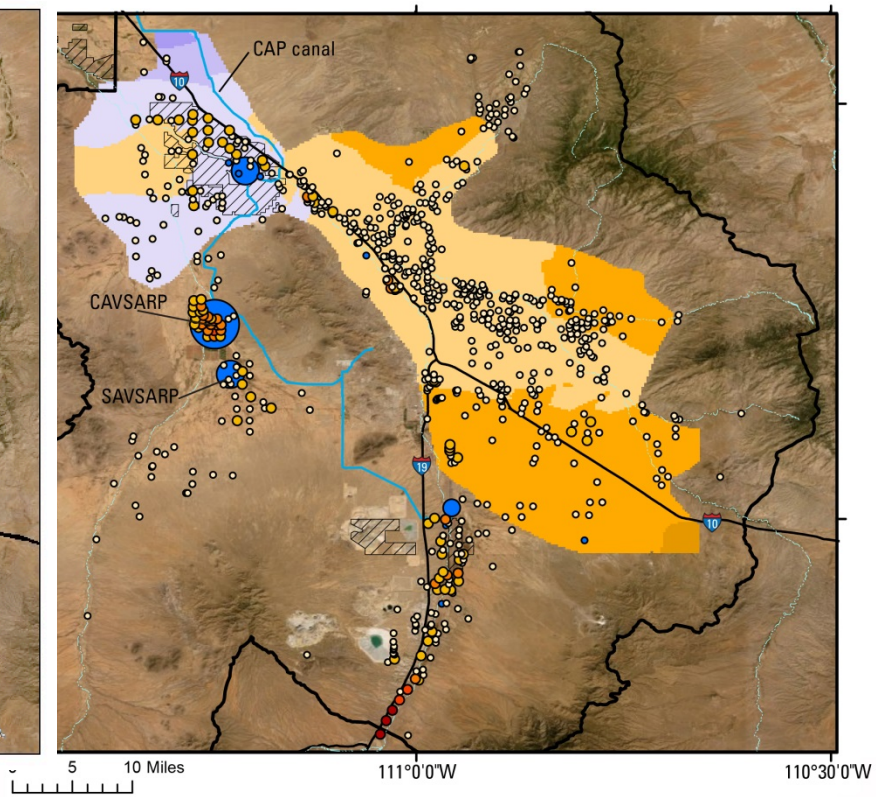
LOS REALES
SAHUARITA
PIMA MINE
SIERRITA MTN
SANDERS
SANDARIO
NOGALES HWY
Explanation
Regional Aquifer Wells
(18-year change in feet)
Well with groundwater recovery
Well with no groundwater change
Well with groundwater decline
18-Year Groundwater Level Change
(change in feet, c.i. = 5ft)
Groundwater recovery
No change
Groundwater decline
(change in feet, c.i. = 5ft)
+240 recovery
No Change
-85 ft decline
CAP Aqueduct
Canal
Pipeline
CAP Recharge Basin
Major Roads
Interstate
Major Wash
Approximate Regional Aquifer Boundary
0 1 2 4
Miles
Date: 9/16/2019
18-YEAR GROUNDWATER LEVEL CHANGE (2000 - 2018)

USGS vs. Tucson Water 2008-2011





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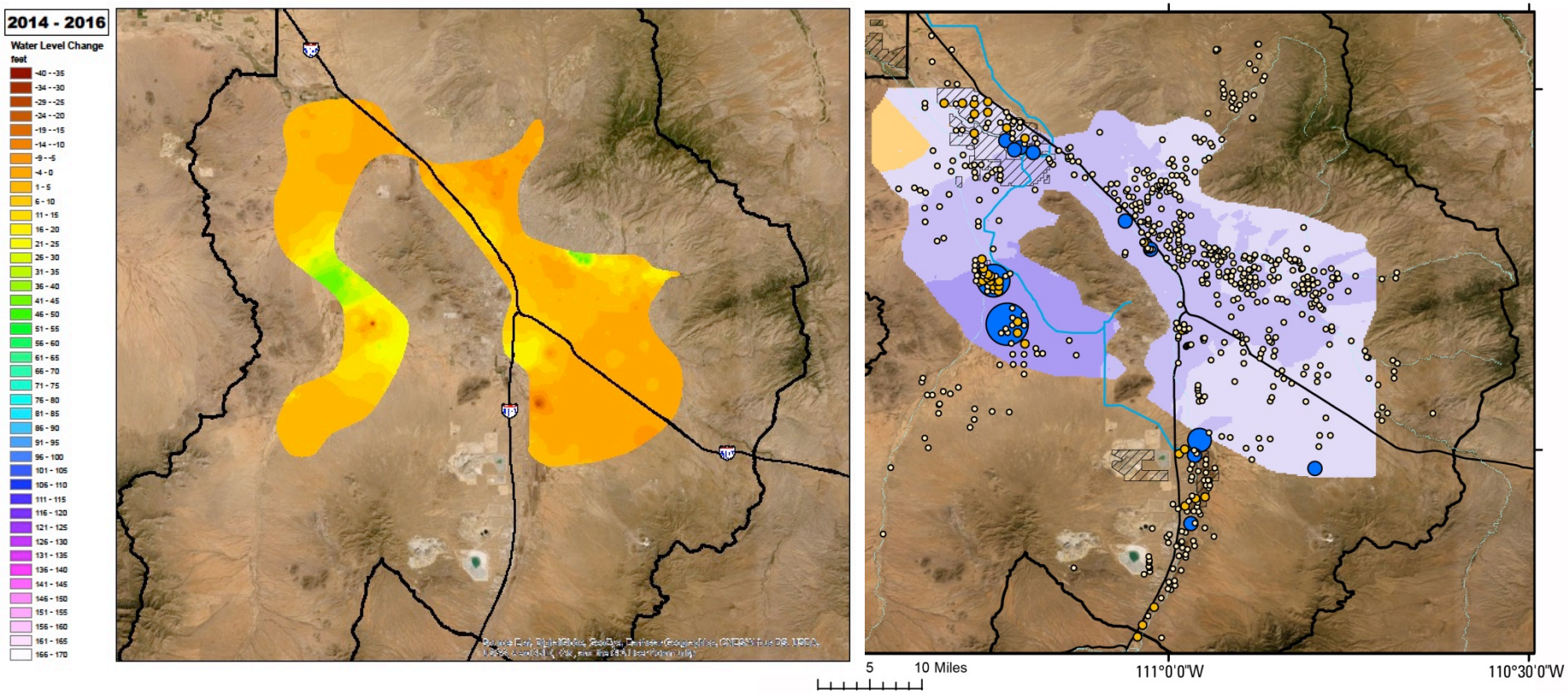
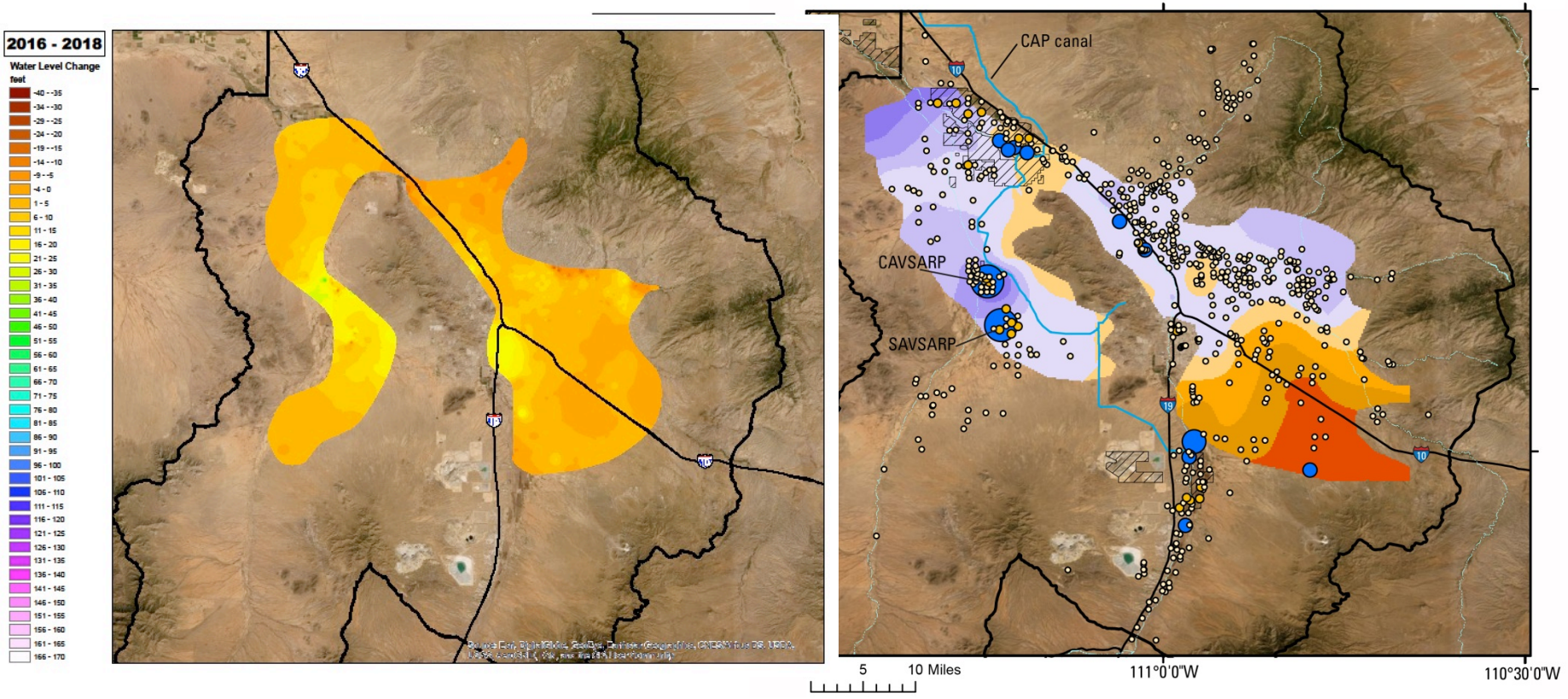
USGS vs. Tucson Water 2014-2016



USGS vs. Tucson Water 2016-2018



Takeaways

- USGS gravimetrics “see” much more water below surface than water levels do during short intervals
  - Water levels only capture the saturated zone – below the water table
  - Gravity measurements are able to account for water in the vadose zone
- Water level measurements show dramatic change over longer periods


Questions?
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