Dockum Aquifer Informational Session

December 5, 2019

1. *Call to order*
   a) *Welcome and Introductions*
2. *Public Comment*
3. *Staff presentation regarding 2019 Dockum Aquifer Field Data Collection*
4. *Staff presentation regarding Brackish Groundwater Policy in Texas*
5. *Staff presentation regarding Dockum Aquifer Study and Management*
6. *Closing Remarks*
7. *Adjourn*

HPWD
High Plains Water District
www.hpwd.org

HPWD Dockum Study
Summer 2019 (June-August)

Keith Whitworth

Field Staff Supervisor

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High Plains Water District
www.hpwd.org

HPWD Dockum Study Objectives

Visit Dockum well sites and collect:

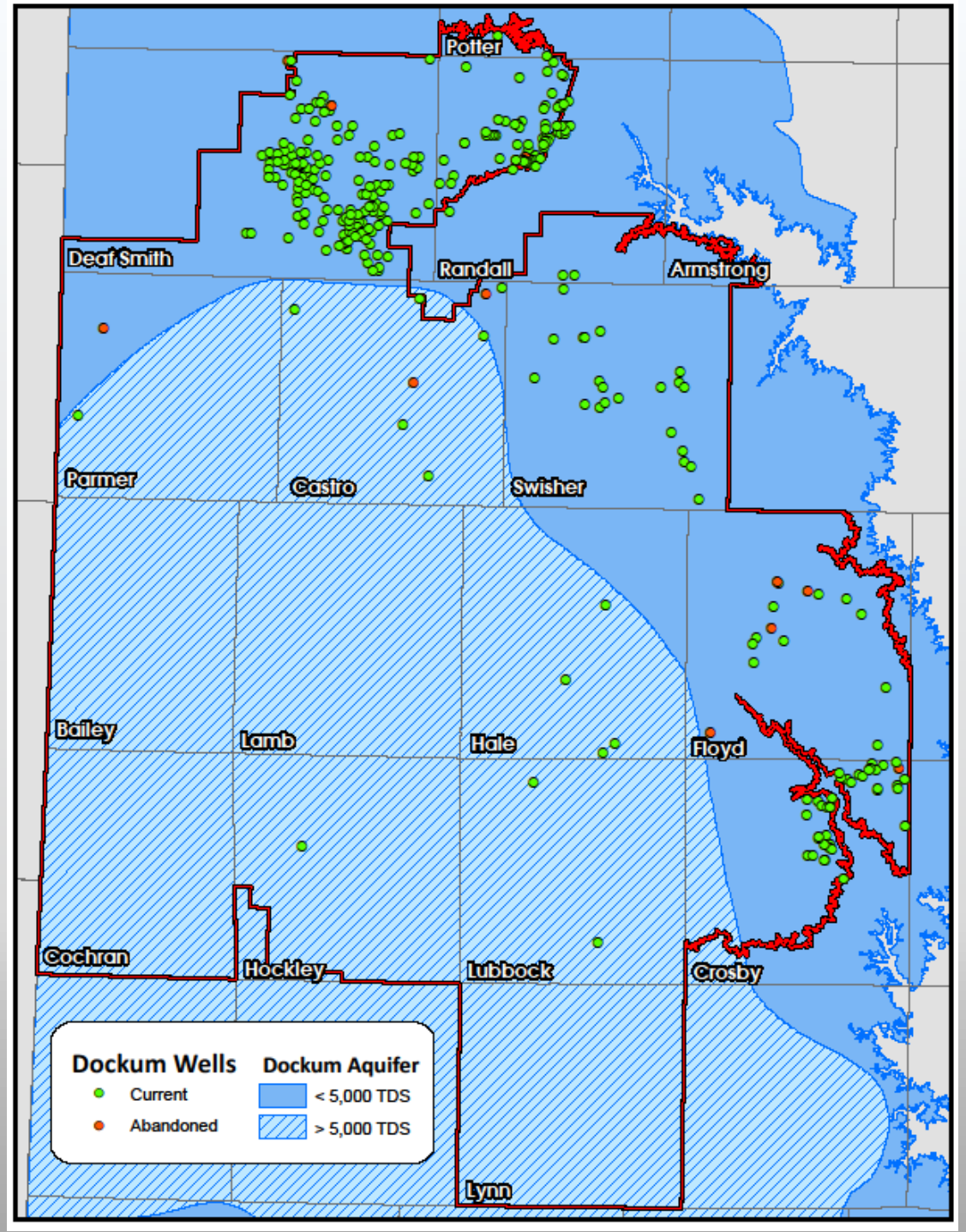
- Water Levels
- Flow Tests
- Aqua Troll Water Quality Logging
- Grab Samples for Water Quality Testing

HPWD Dockum Study 2019 Results

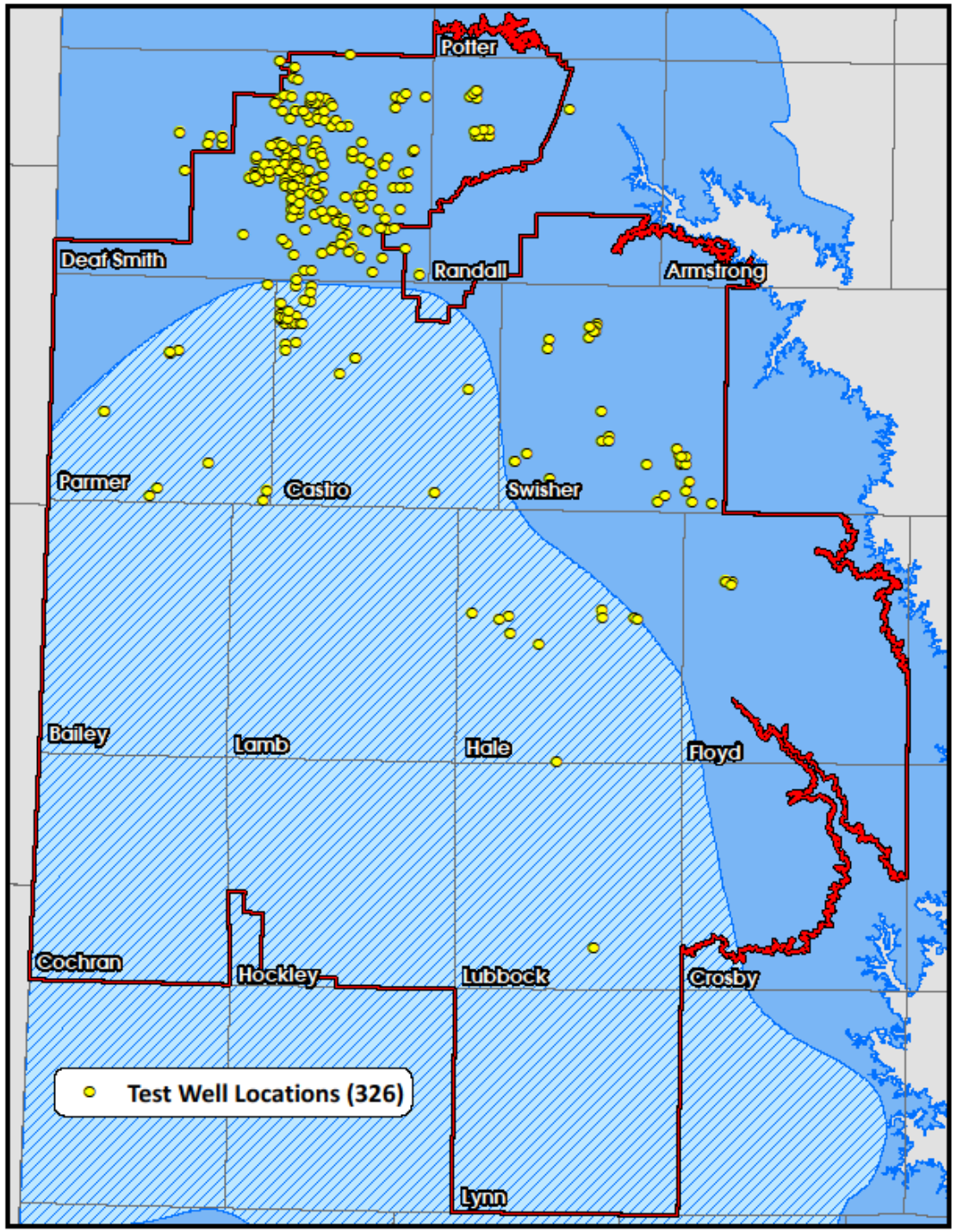
HPWD staff collected:

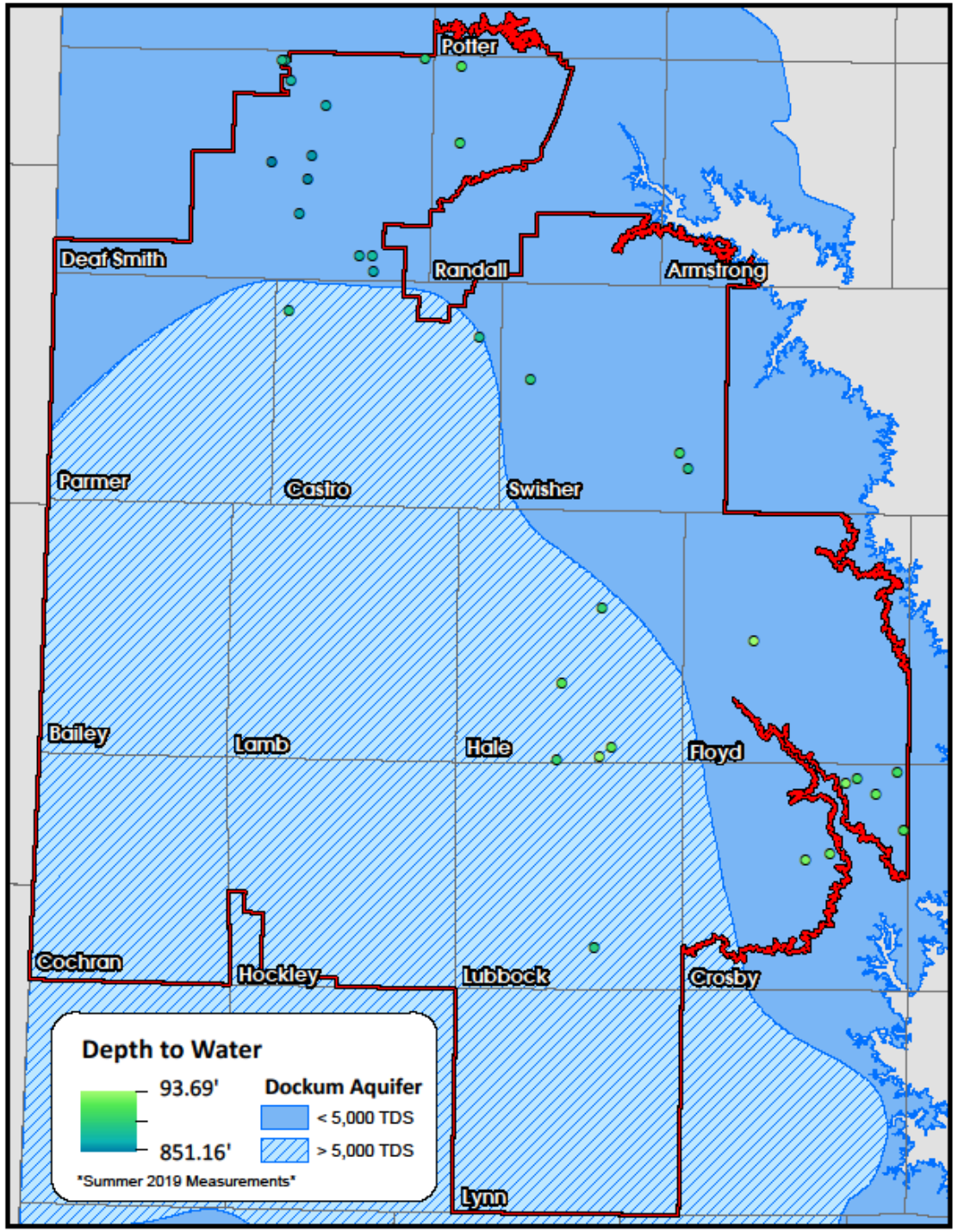
- 33 Water Levels
- 72 Flow Tests
- 24 Aqua Troll Water Quality Logging
- 88 Grab Samples for Water Quality Testing

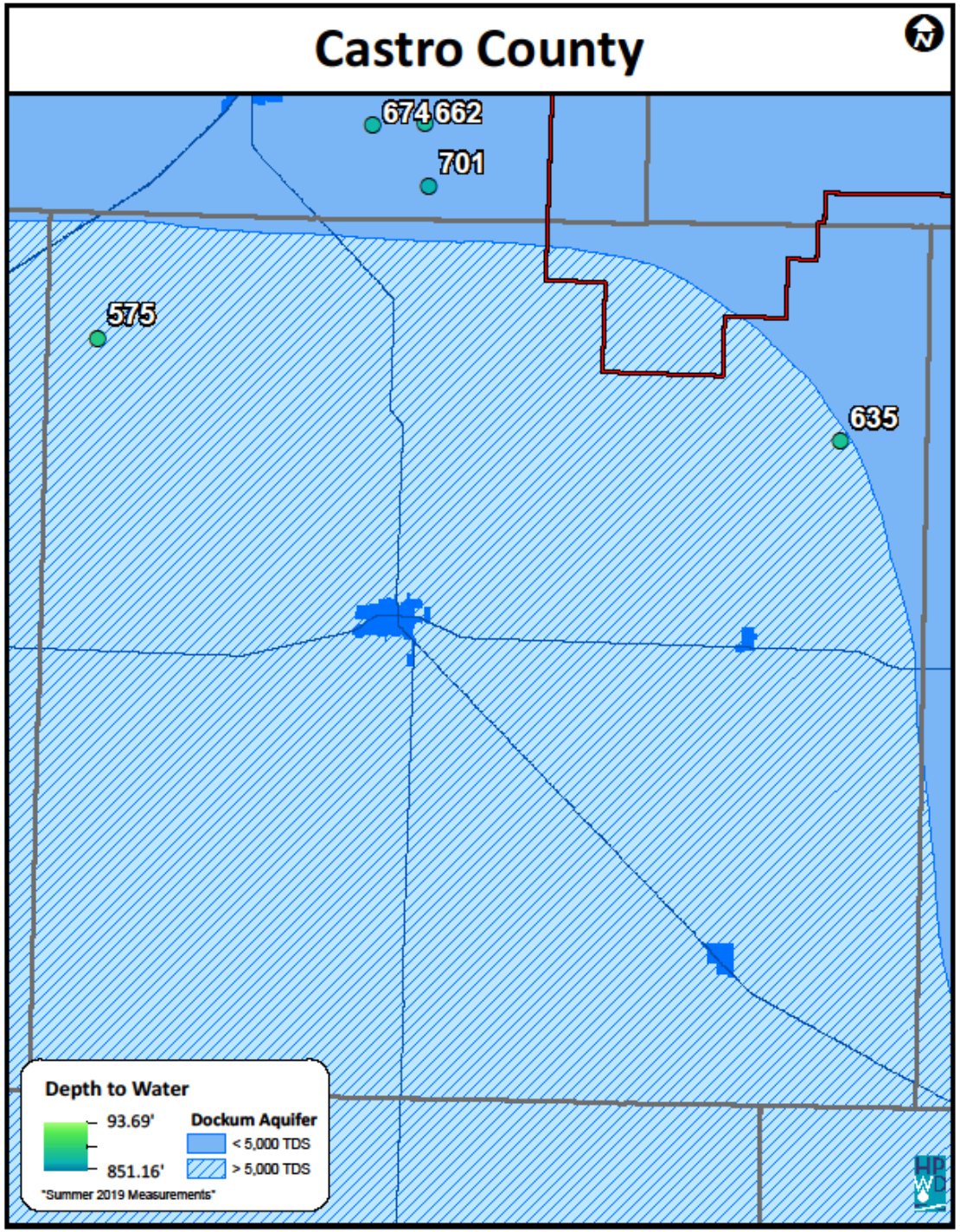
Locations of Dockum Wells



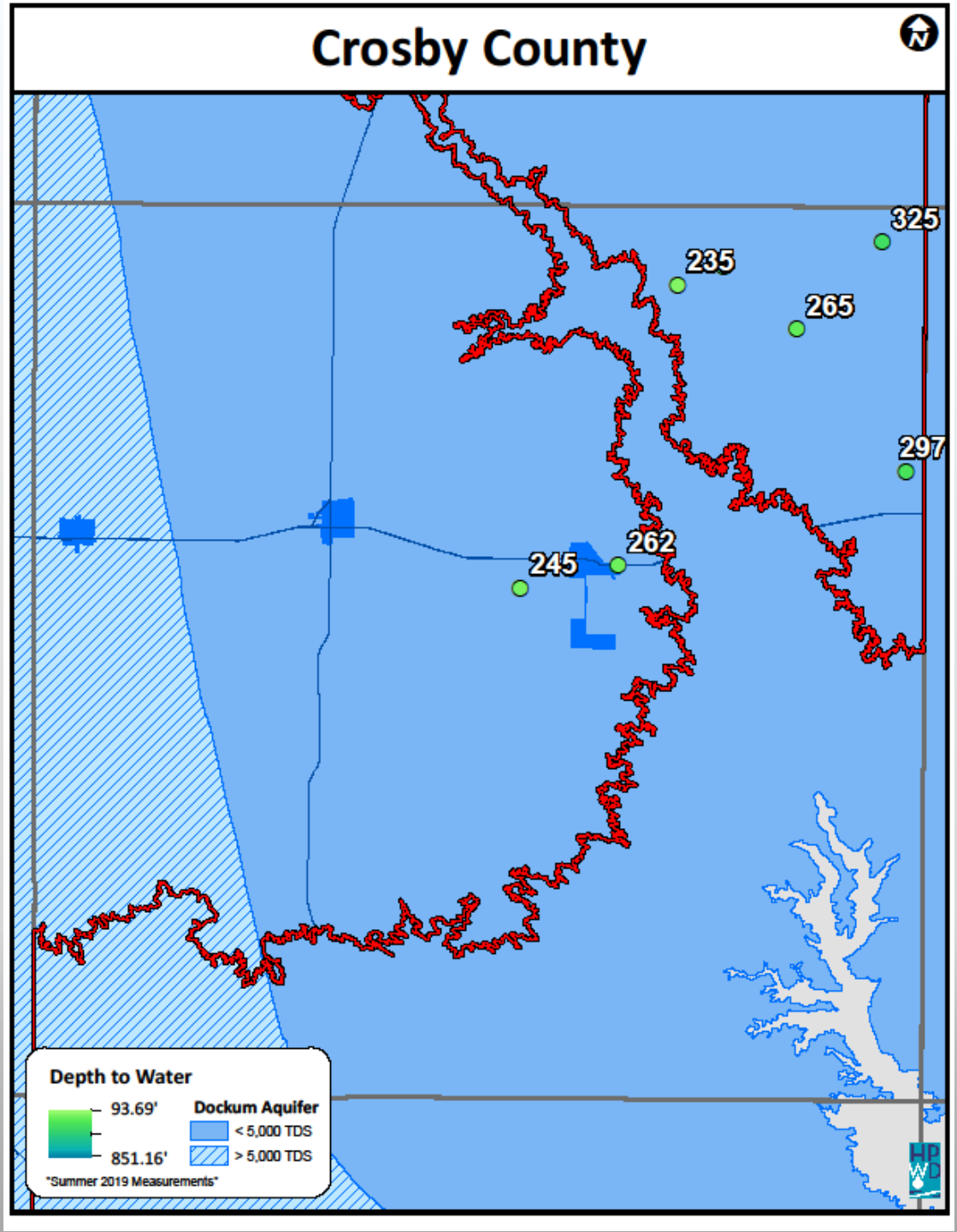
Test well locations typically include a driller's log only.

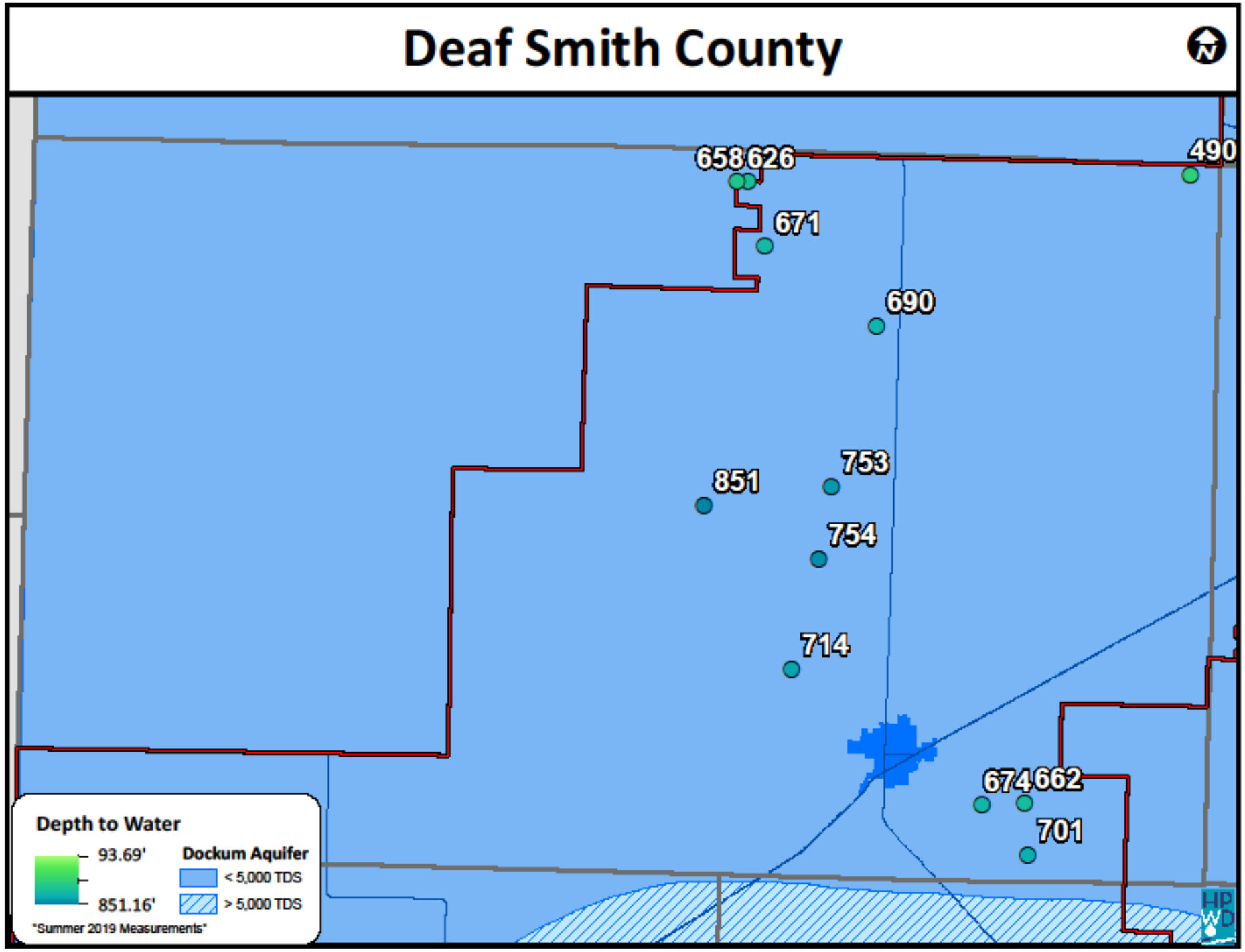



Potter
Deaf Smith
Randall
Armstrong
Parmer
Castro
Swisher
Bailey
Lamb
Hale
Floyd
Cochran
Hockley
Lubbock
Crosby
Lynn
Depth to Water
93.69'
851.16'
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

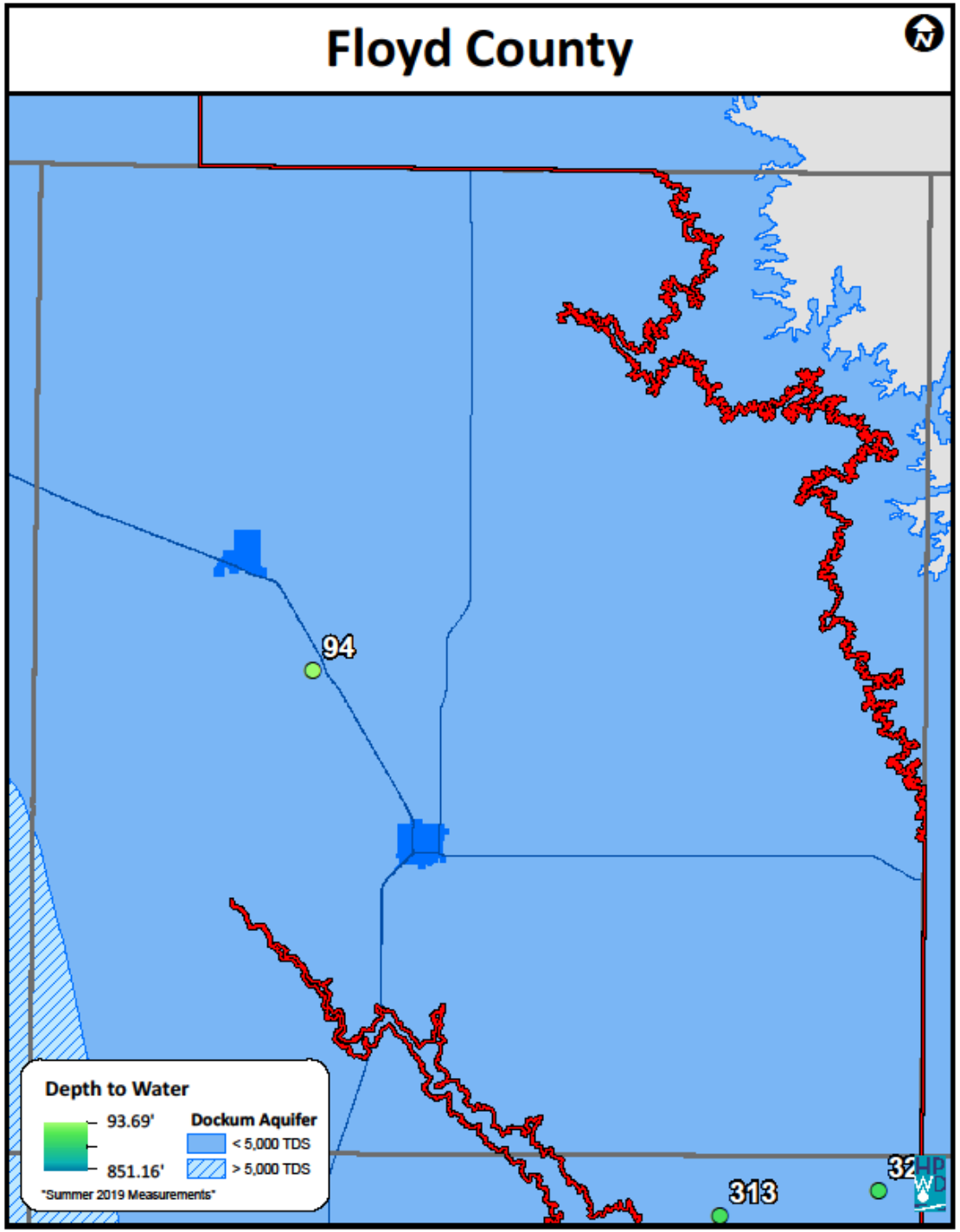

Castro County
674
662
701
575
635
Depth to Water
93.69'
851.16'
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

Most of the wells in this county only partially penetrate the Dockum Aquifer

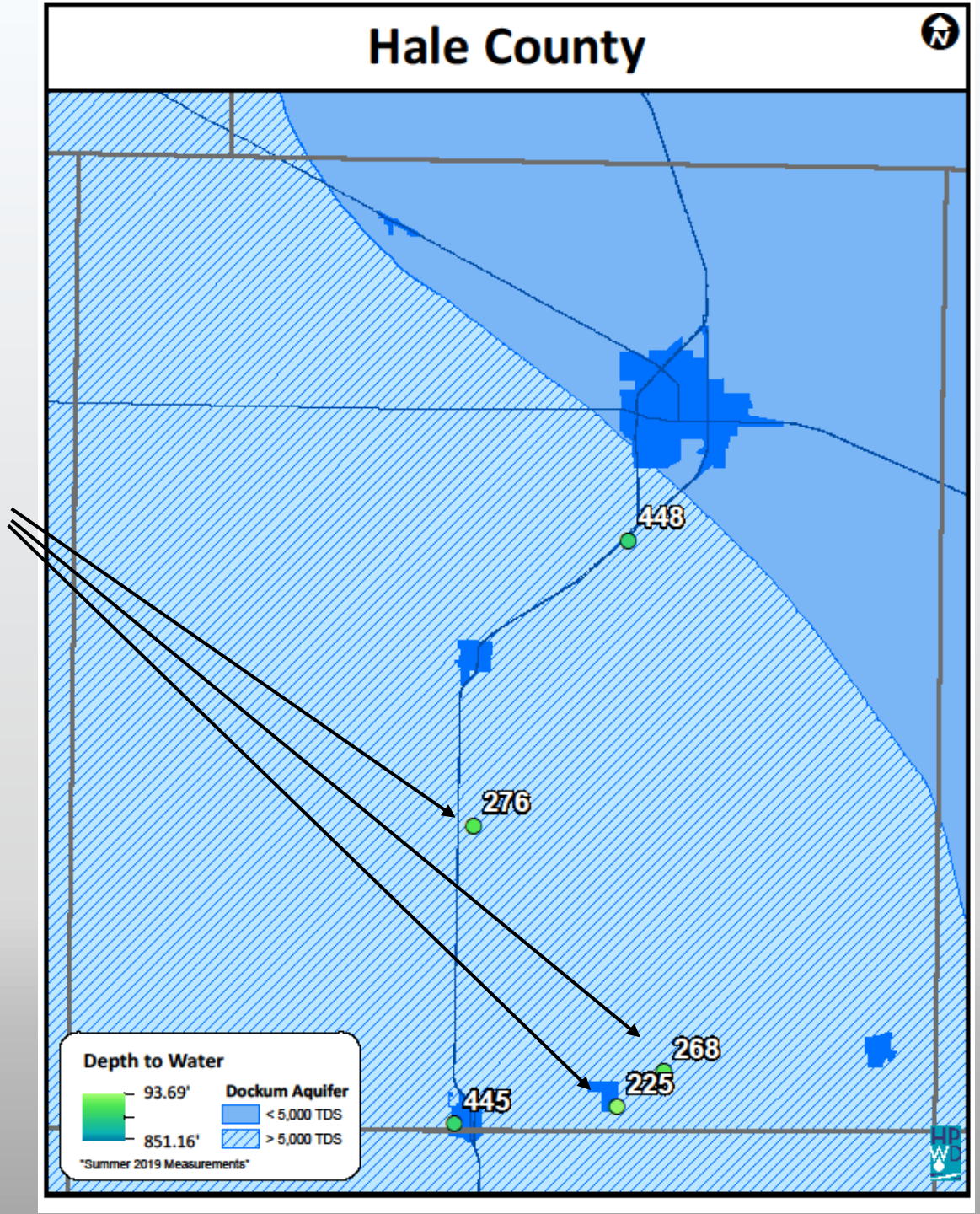


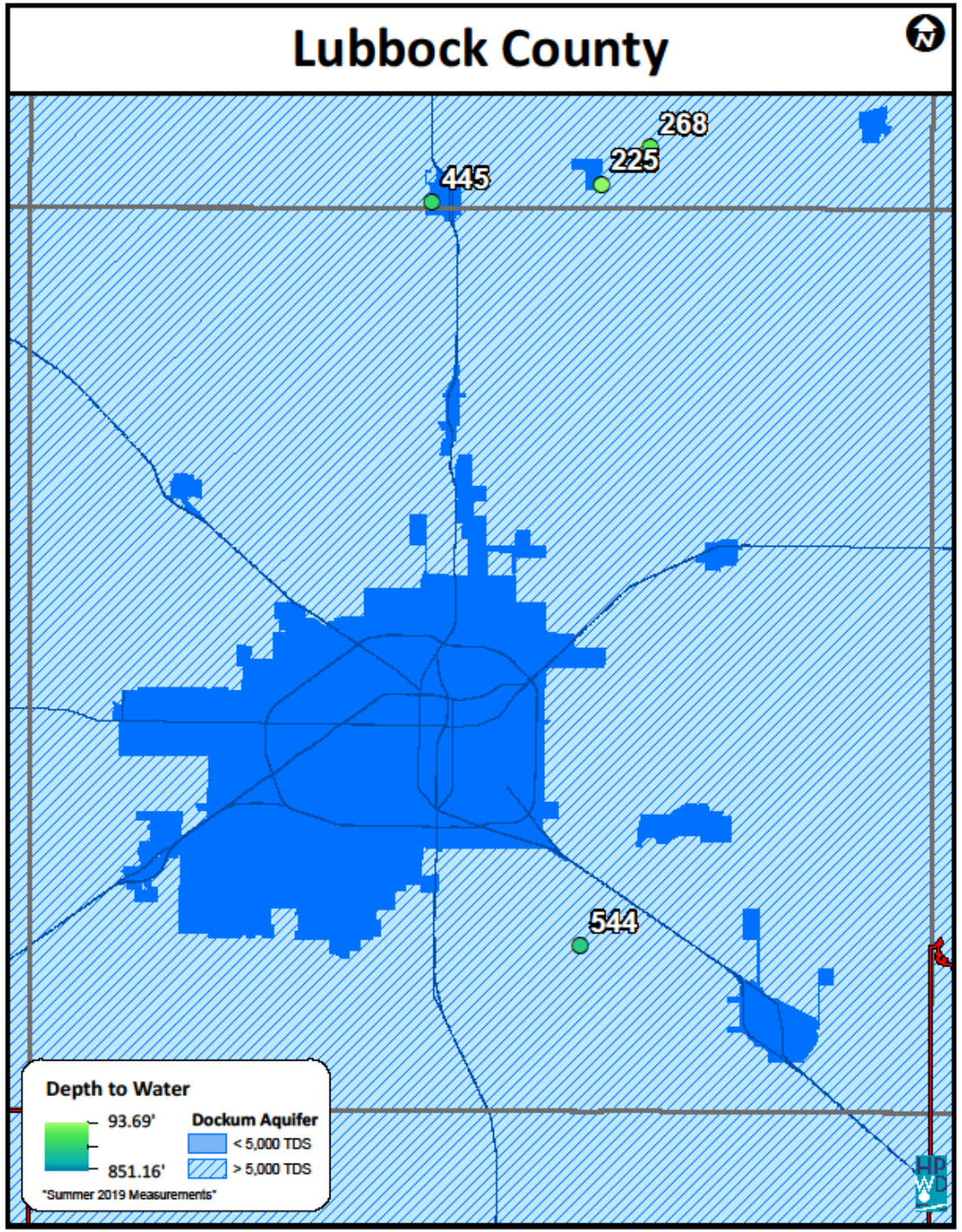

Deaf Smith County
658
626
490
671
690
753
851
754
714
674
662
701
Depth to Water
93.69'
851.16'
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

Floyd County

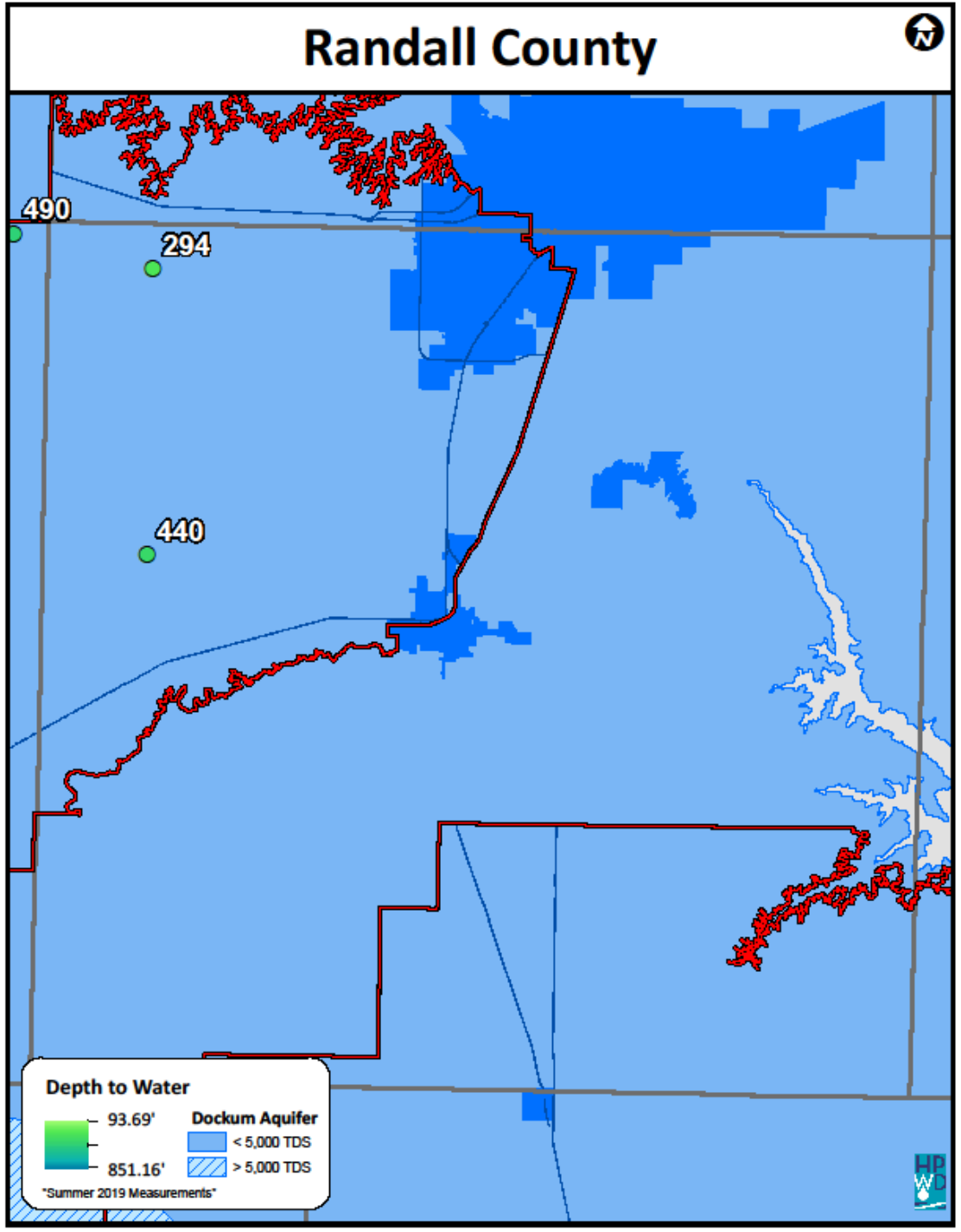


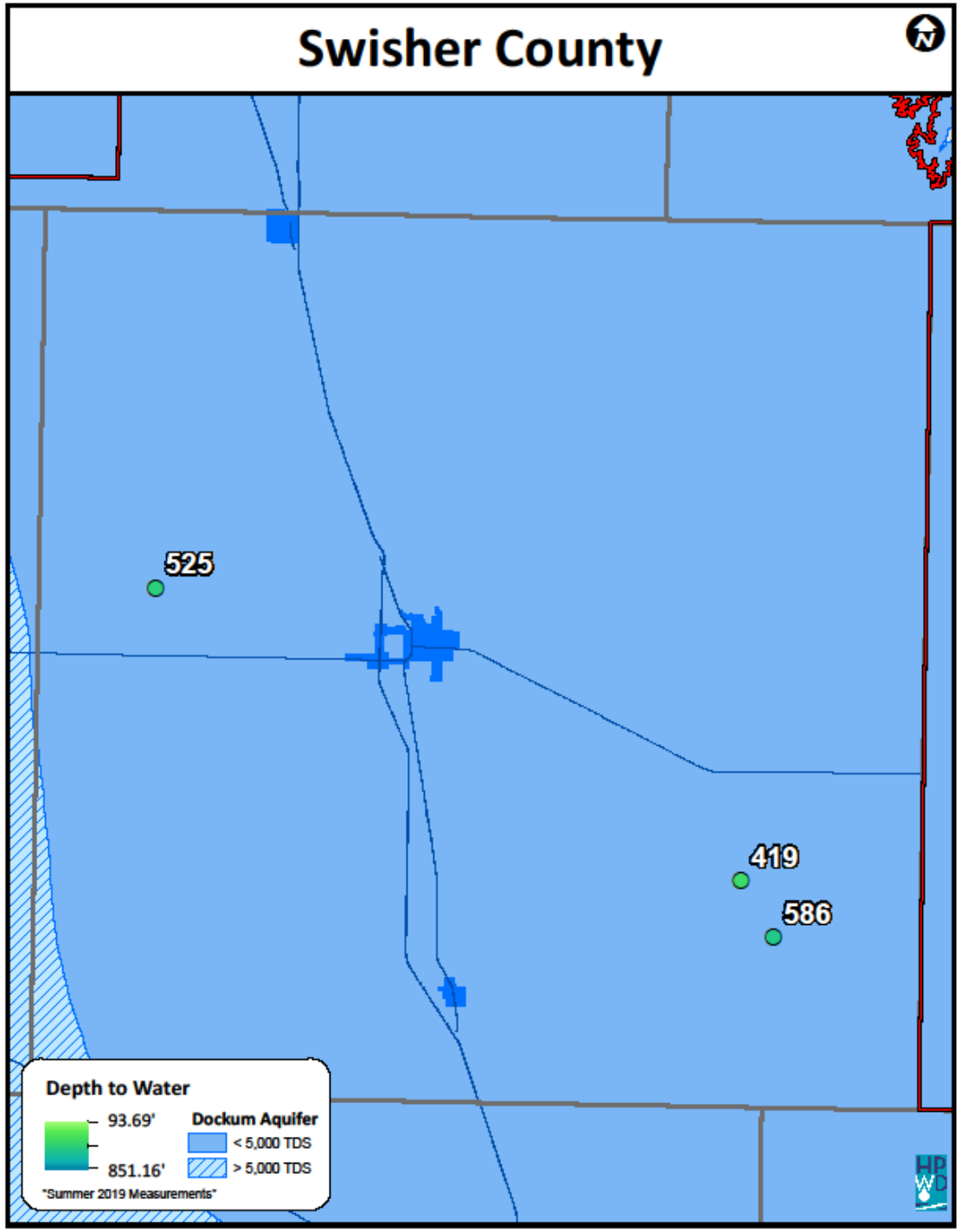
3 of these wells only partially penetrate the Dockum Aquifer

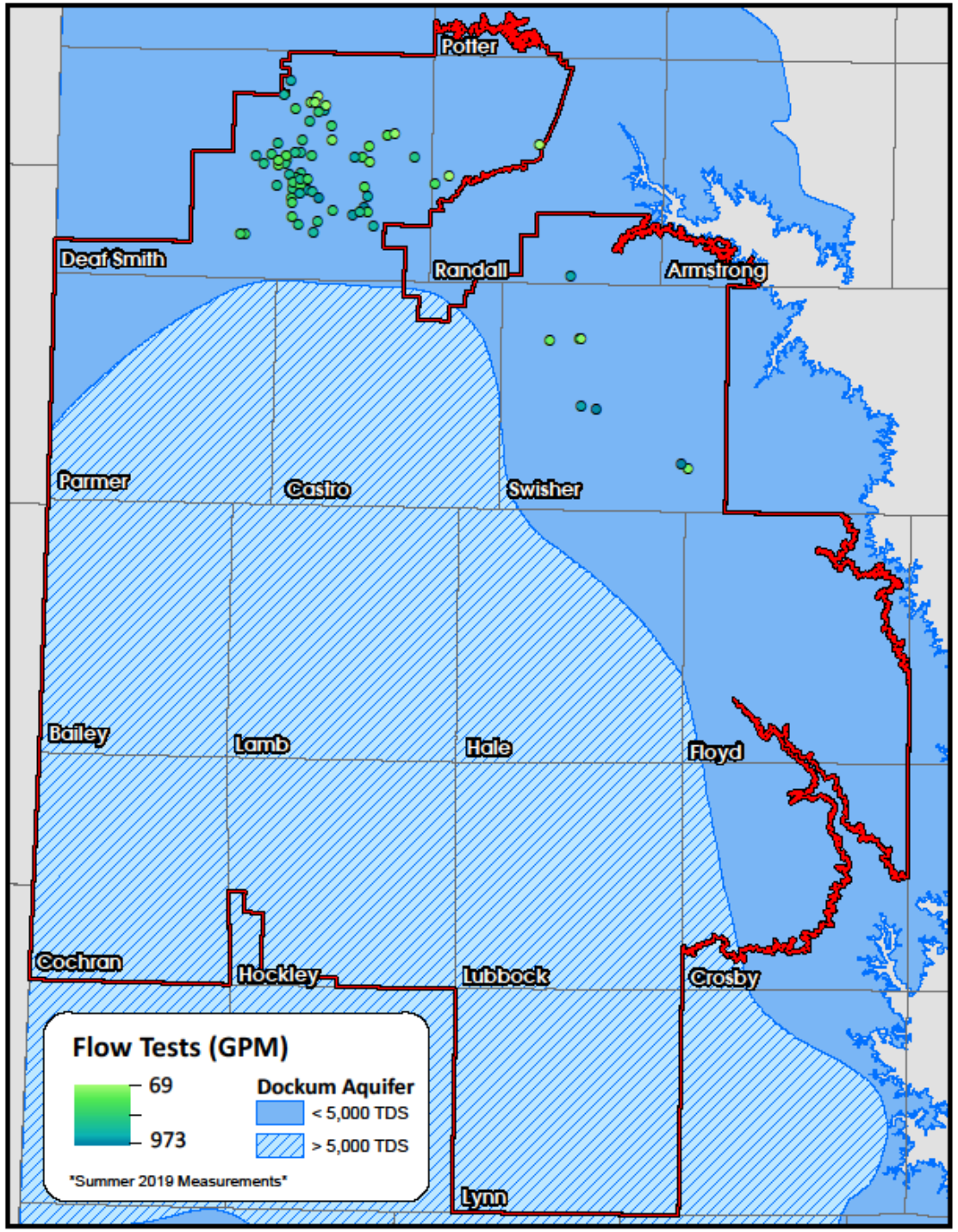


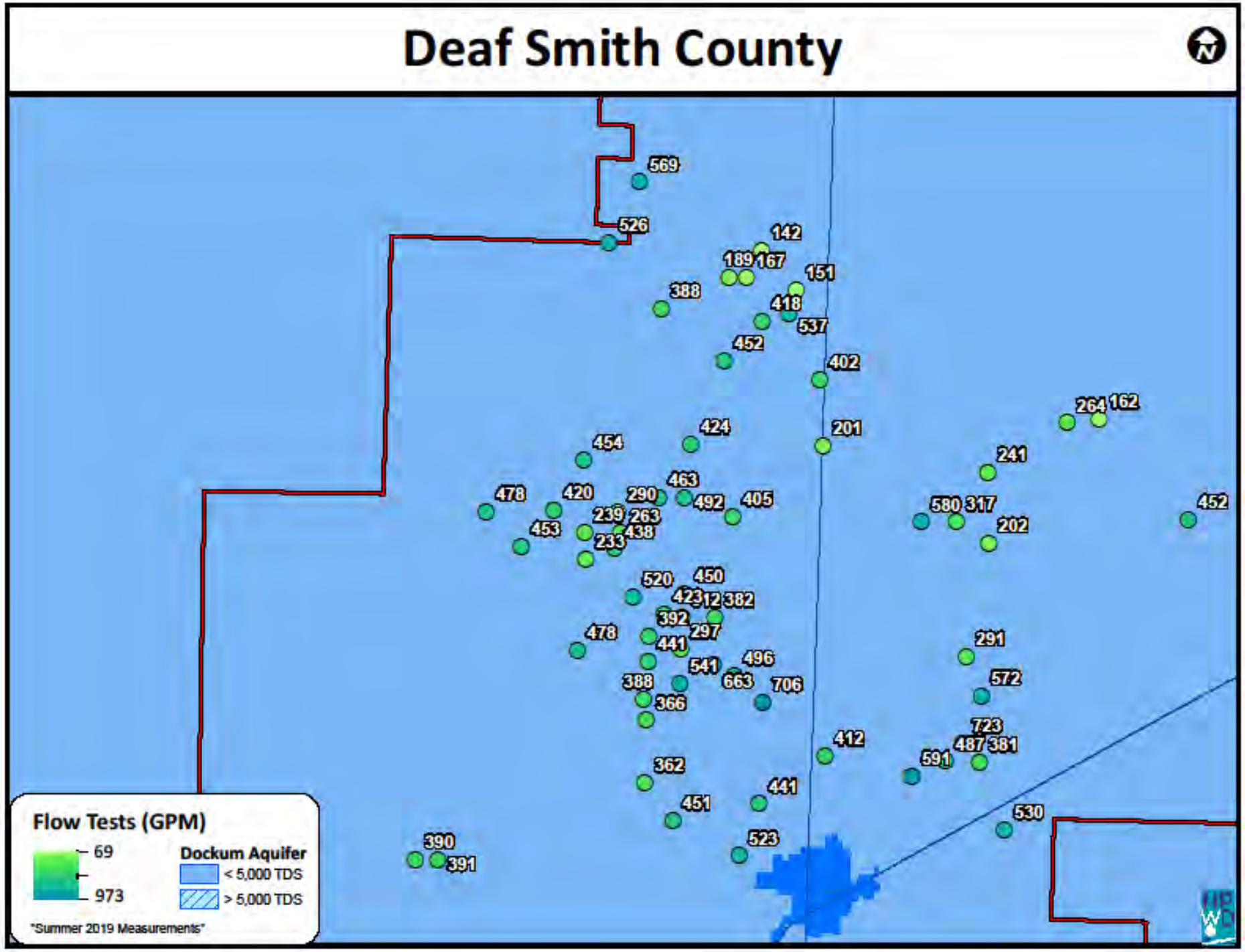

Lubbock County
268
225
445
544
Depth to Water
93.69'
851.16'
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
"Summer 2019 Measurements"

Randall County

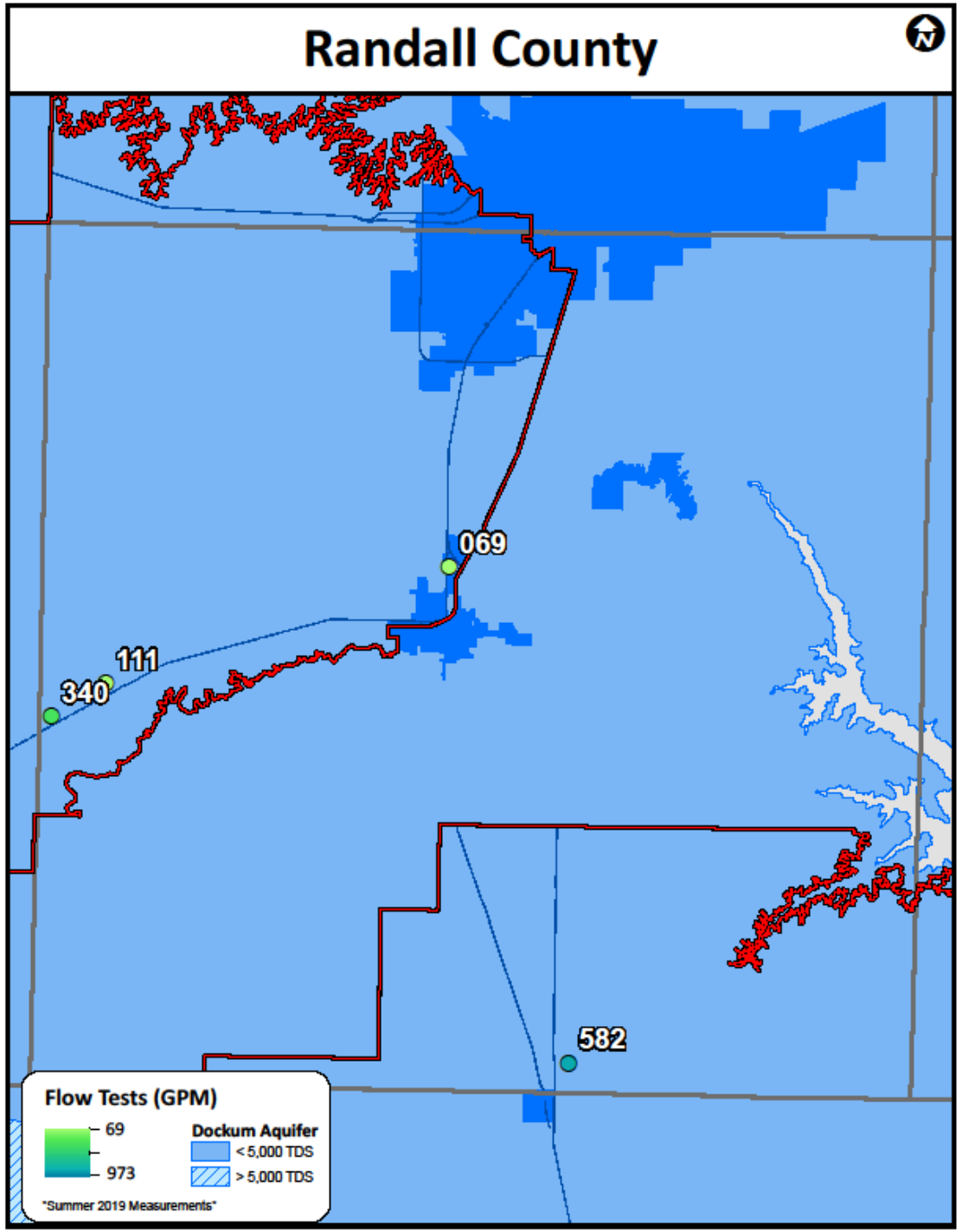


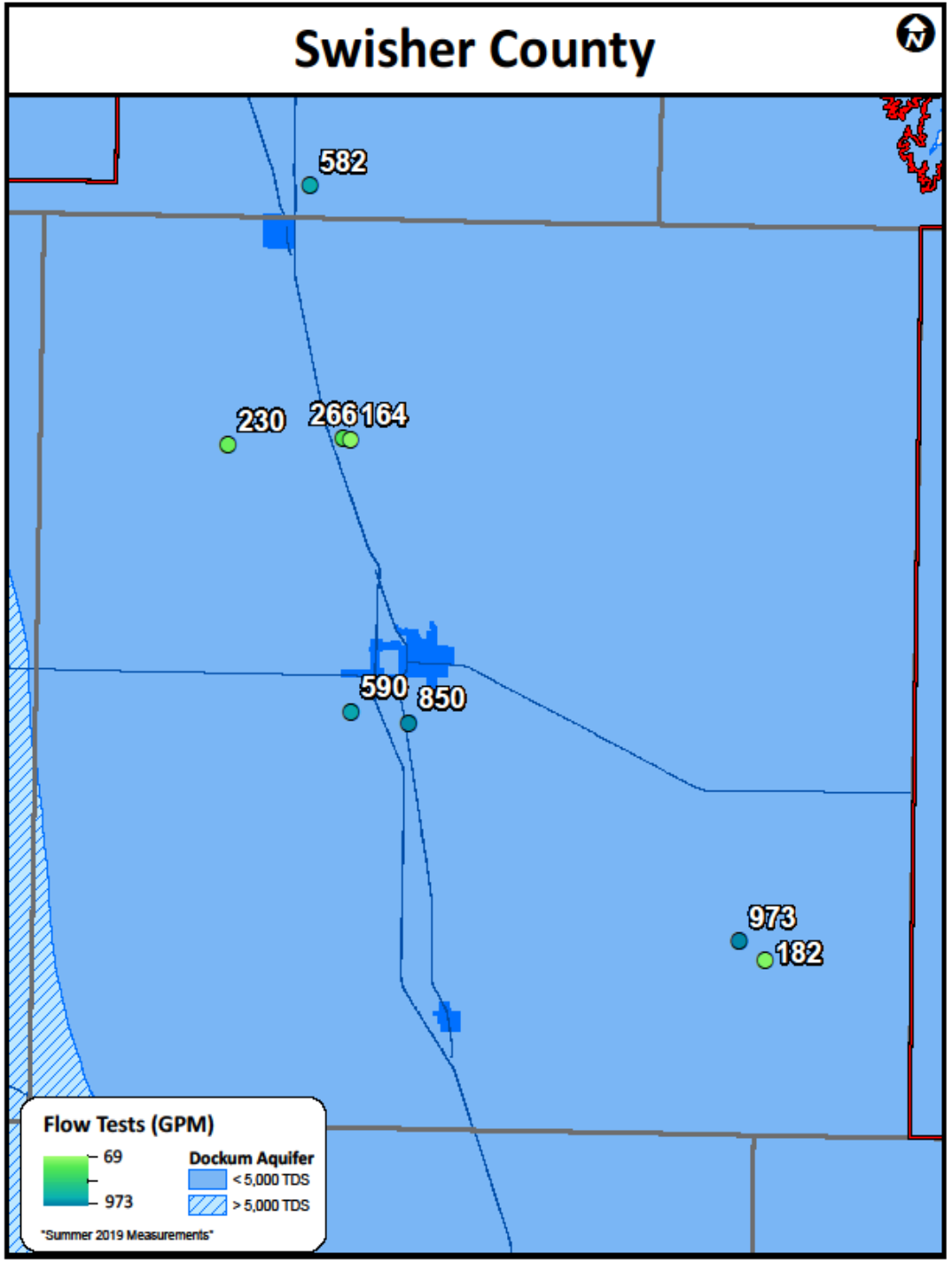

Swisher County
525
419
586
Depth to Water
93.69'
851.16'
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
"Summer 2019 Measurements"


Potter
Deaf Smith
Randall
Armstrong
Parmer
Castro
Swisher
Bailey
Lamb
Hale
Floyd
Cochran
Hockley
Lubbock
Crosby
Lynn
Flow Tests (GPM)
69
973
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

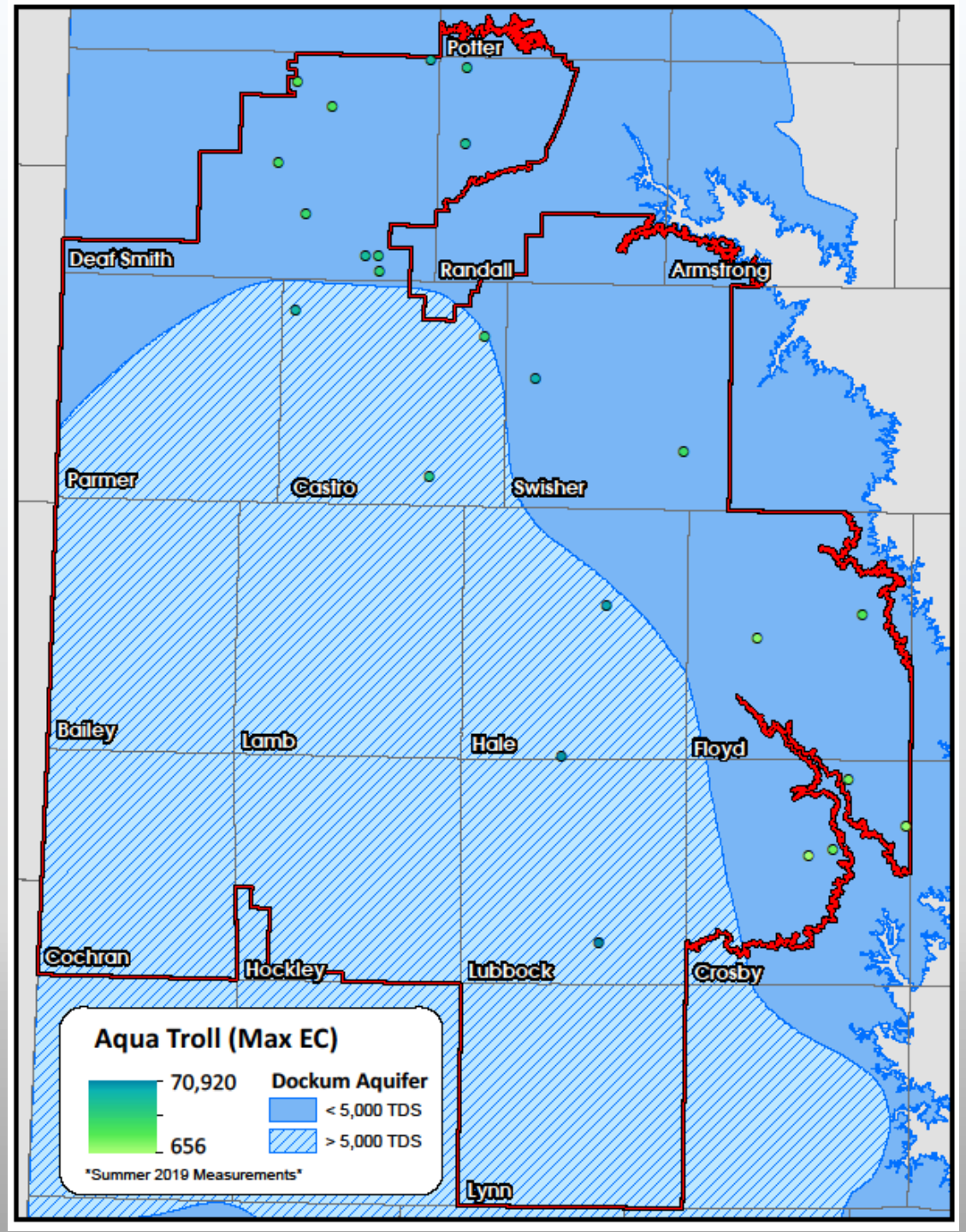

Deaf Smith County
569
526
142
189
167
151
388
418
537
452
402
264
162
424
201
454
241
463
478
420
290
492
405
580
317
452
239
263
202
453
438
233
520
450
423
12
382
392
297
478
441
291
496
541
572
388
663
706
366
723
412
487
381
591
362
441
451
530
523
390
391
Flow Tests (GPM)
69
973
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
"Summer 2019 Measurements"

Randall County

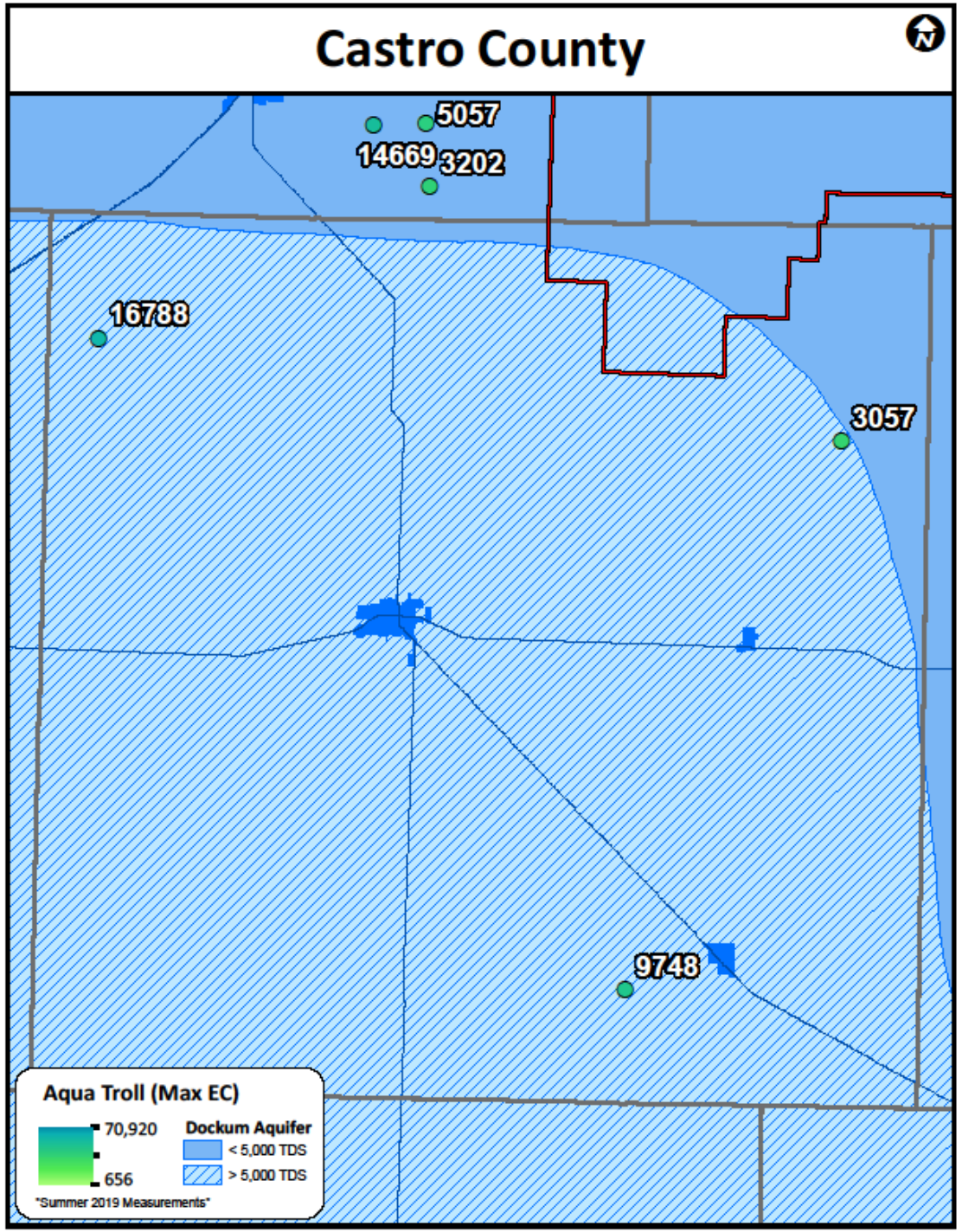



Swisher County
582
230
266
164
590
850
973
182
Flow Tests (GPM)
69
973
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

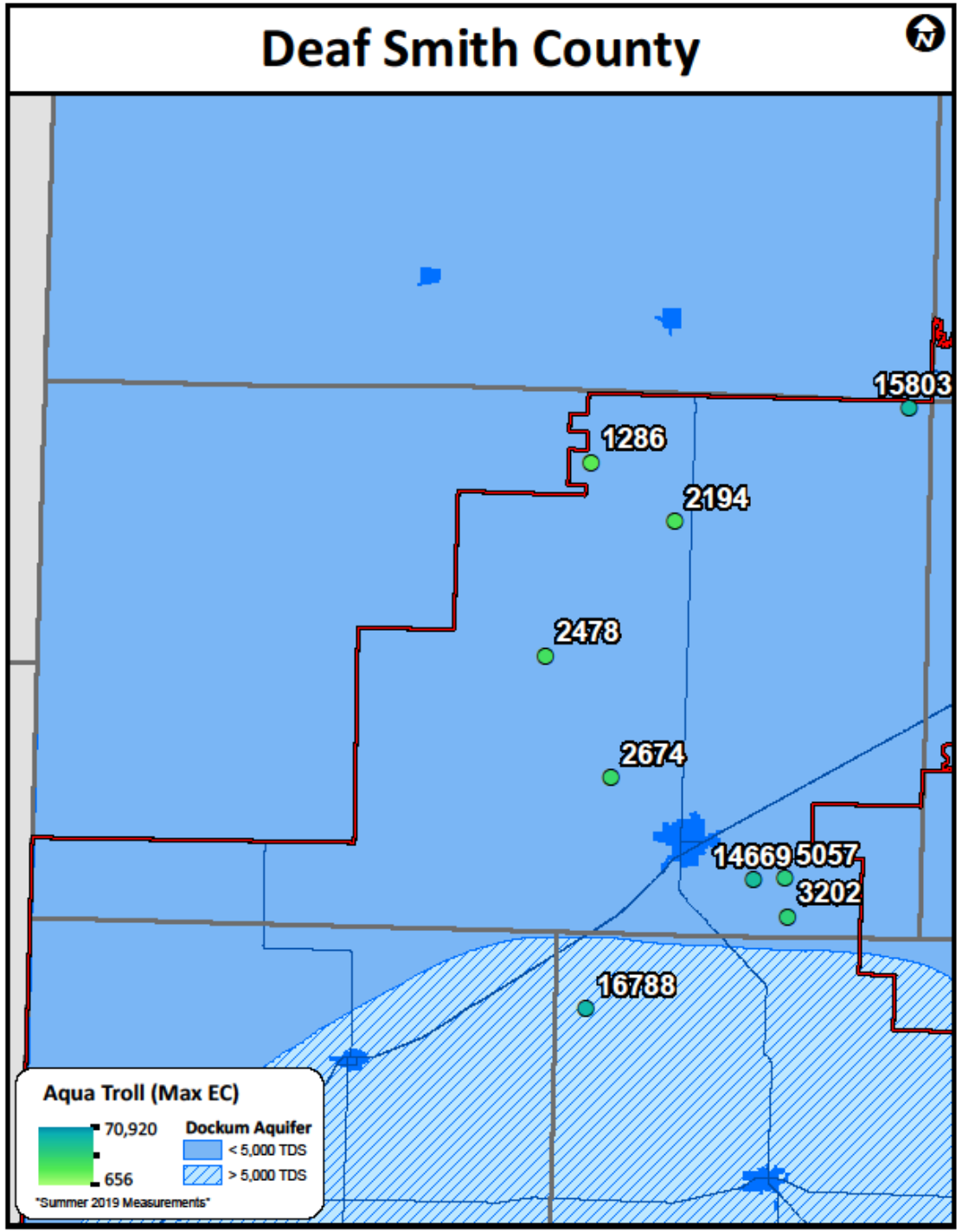
Aqua Troll Logger is typically used when a well is not equipped with a pump.



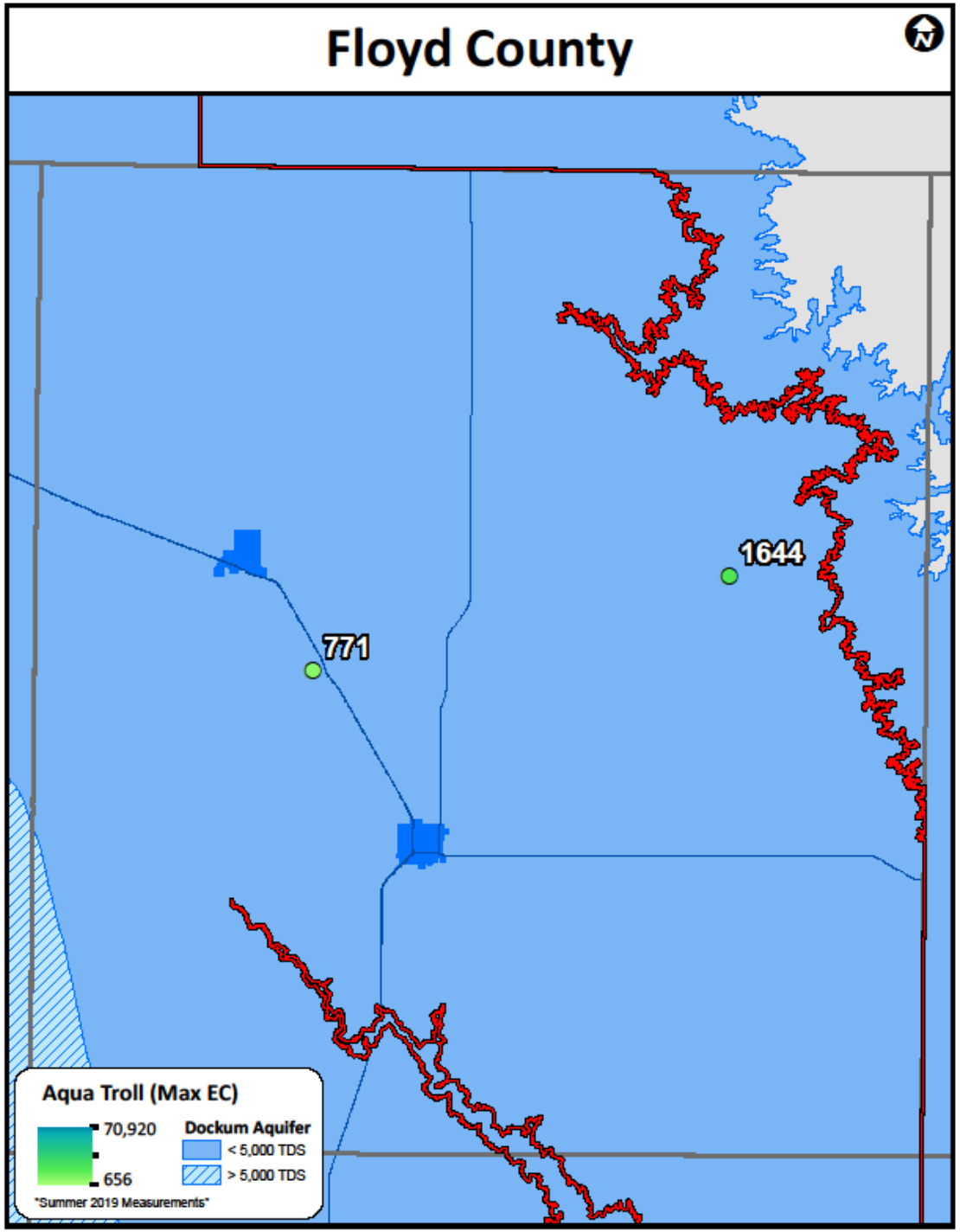

In-Situ Inc.
AQUATROLL


Castro County
5057
14669
3202
16788
3057
9748
Aqua Troll (Max EC)
70,920
656
"Summer 2019 Measurements"
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS

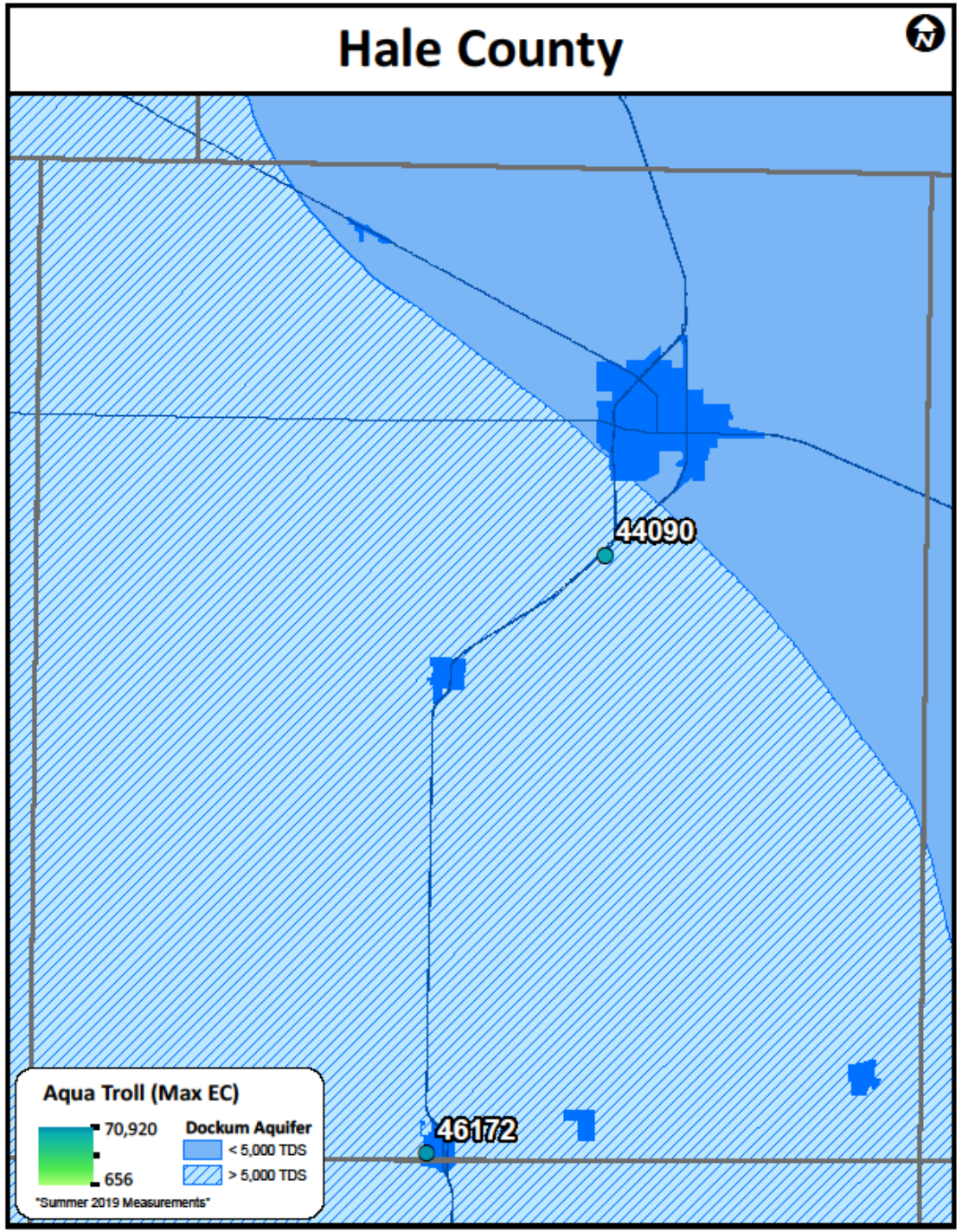

In-Situ Inc.
AQUATROLL


Deaf Smith County
15803
1286
2194
2478
2674
14669
5057
3202
16788
Aqua Troll (Max EC)
70,920
656
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

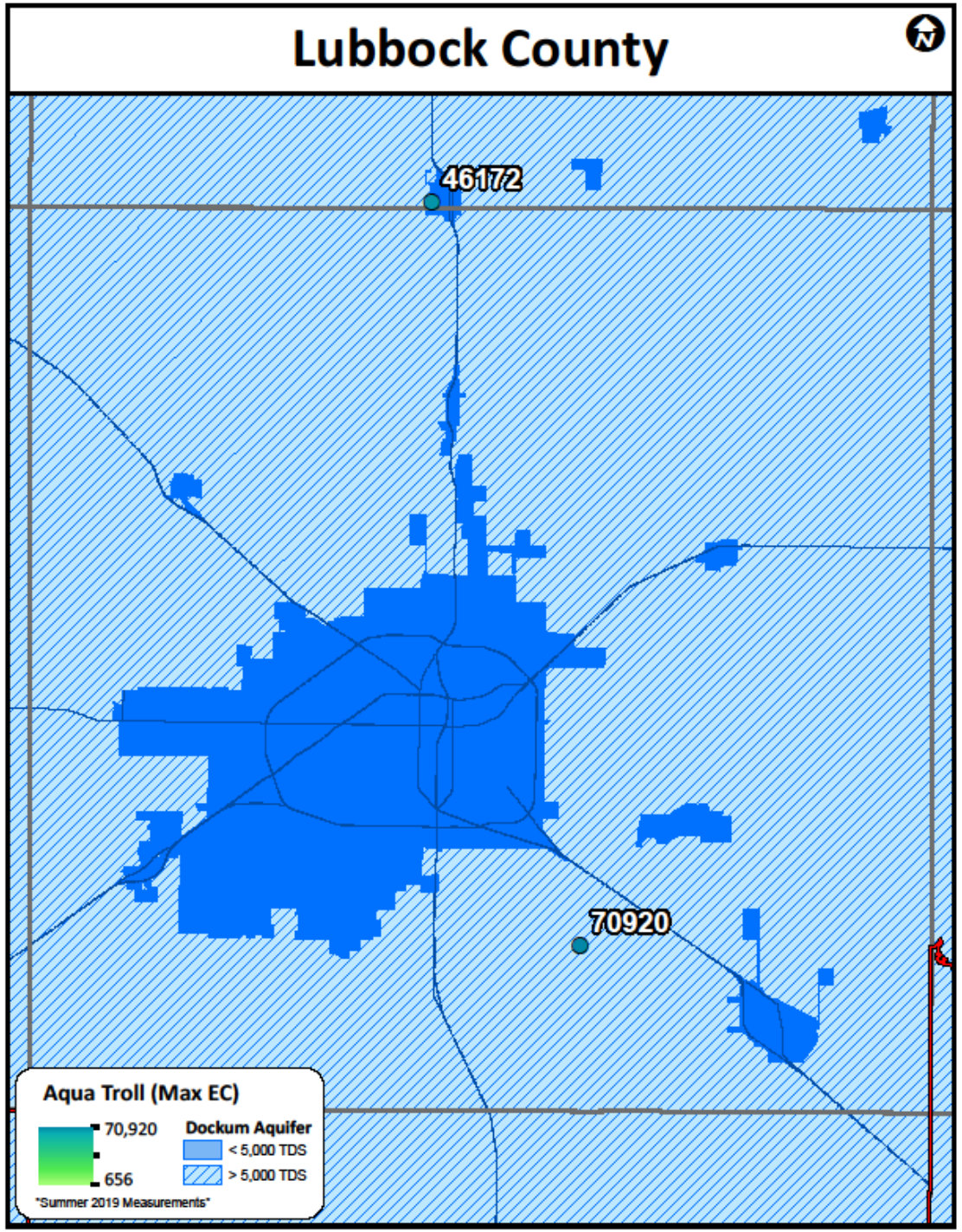
Floyd County




In-Situ Inc.
AQUATROLL


Hale County
44090
46172
Aqua Troll (Max EC)
70,920
656
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements


In-Situ Inc.
AQUATROLL


Lubbock County
46172
70920
Aqua Troll (Max EC)
70,920
656
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

Randall County

15803

6198

11337

Aqua Troll (Max EC)

70,920

656

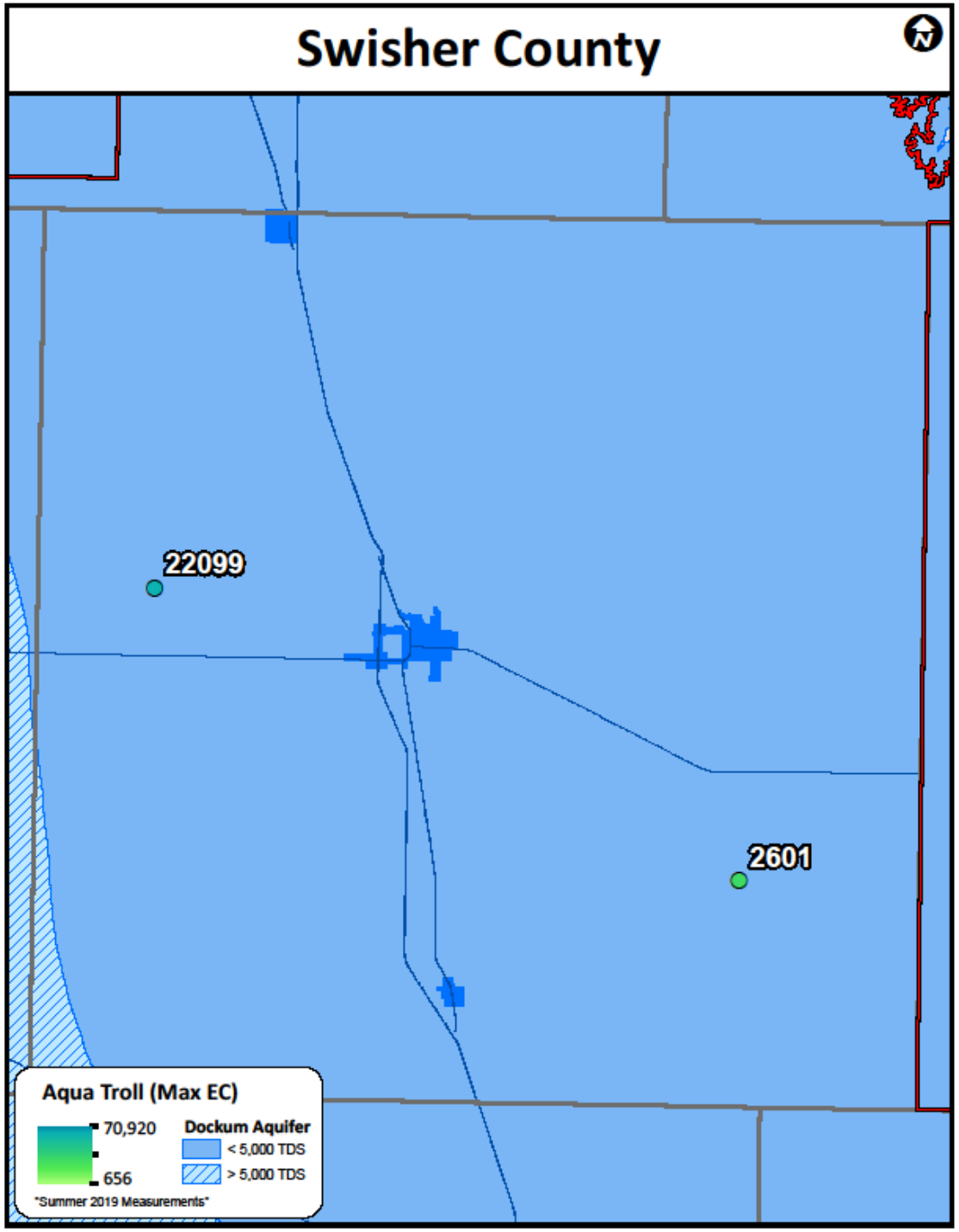
Summer 2019 Measurements

Dockum Aquifer

< 5,000 TDS

> 5,000 TDS

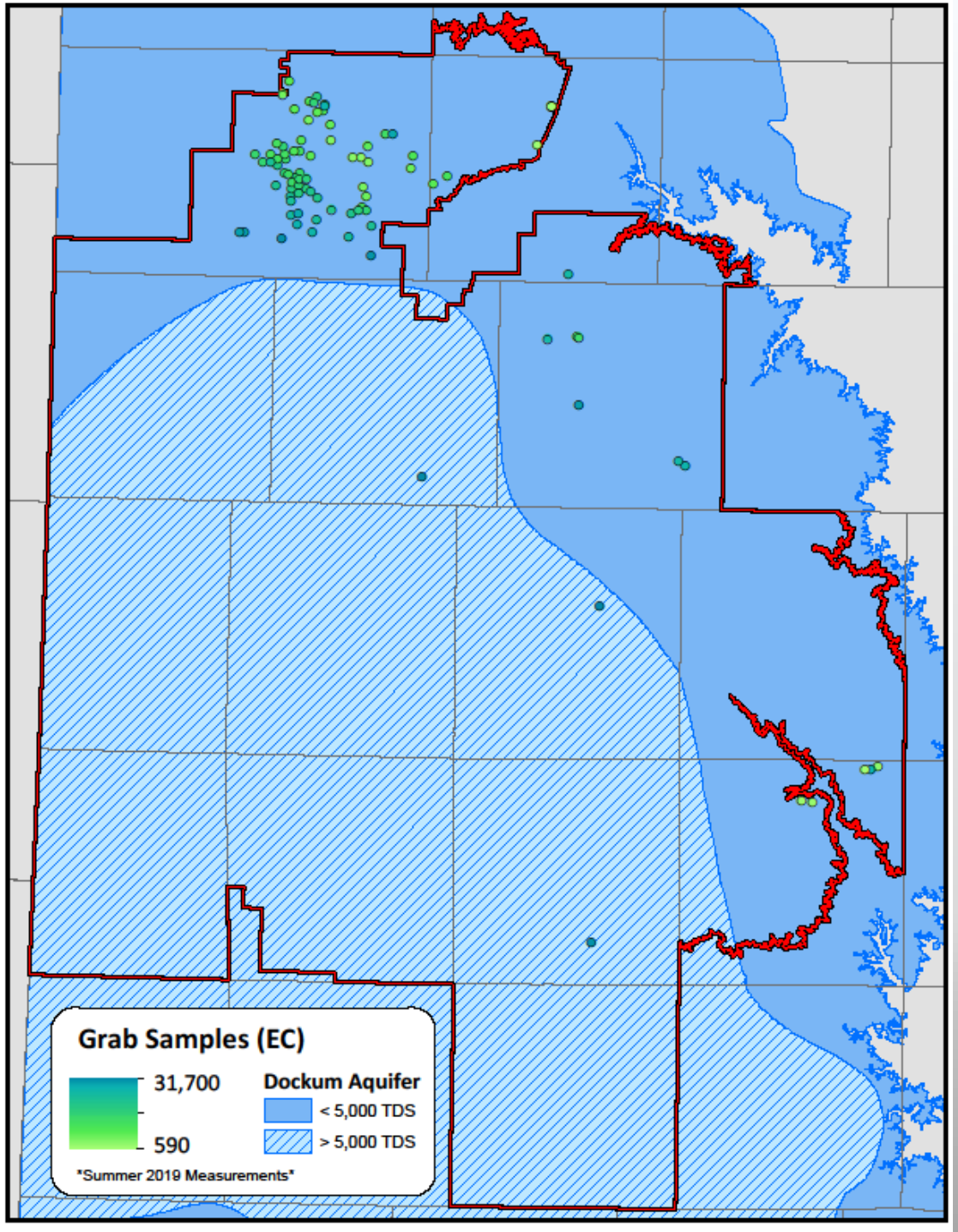

In-Situ Inc.
AQUATROLL


Swisher County
22099
2601
Aqua Troll (Max EC)
70,920
656
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

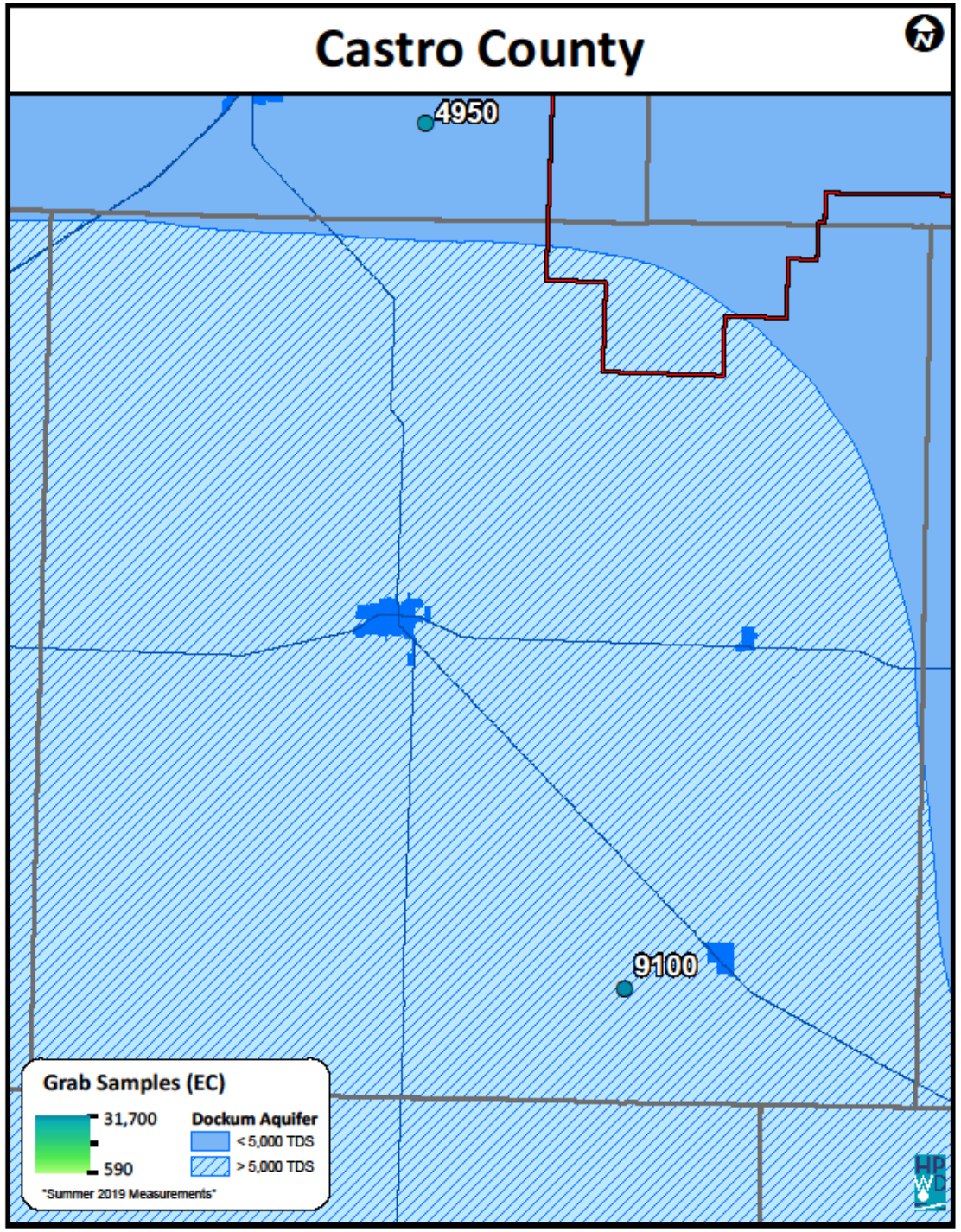
Aqua Troll in Pumping Well

High Plains Water District
www.hpwd.org

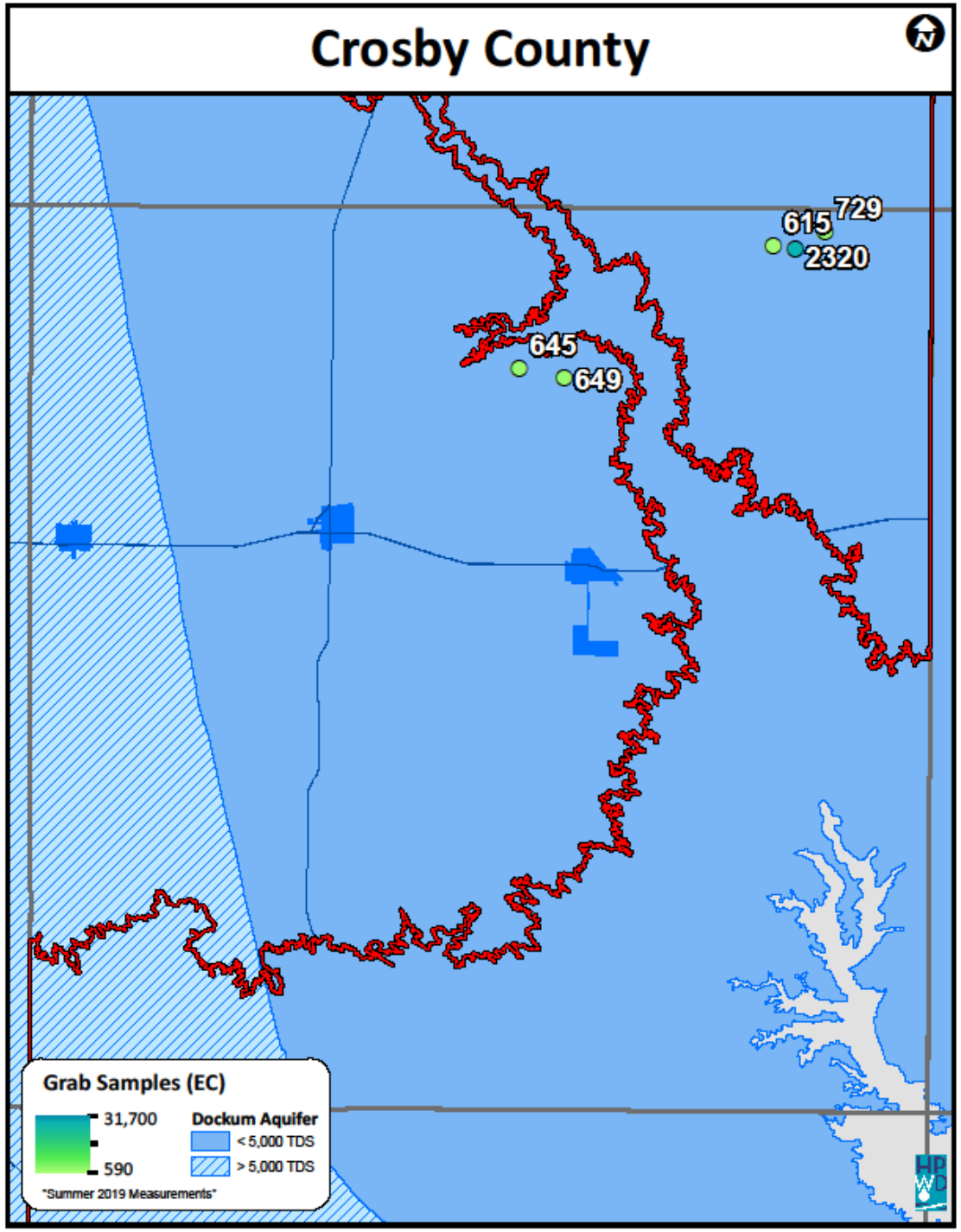
Grab samples are normally obtained from a pumping well and analyzed with a handheld meter.




7.000
pH


Castro County
4950
9100
Grab Samples (EC)
31,700
590
"Summer 2019 Measurements"
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS

Most of the wells in this county only partially penetrate the Dockum Aquifer



Deaf Smith County

1123
1018
1346
1331
1341
2161
1070
1049
1145
999
1031
1286
2560
1129
973
1273
1039
1331
1223
1309
1269
1274
1274
1070
950
1162
1318
1542
1312
971
1284
1028
1289
1348
1313
1346
1476
1387
1340
981
1374
1423
1582
1420
1021
1578
1401
1352
1980
2530
1471
1334
1655
2180
1528
2740
2050
2630
6610
1698
4950

Grab Samples (EC)

31,700

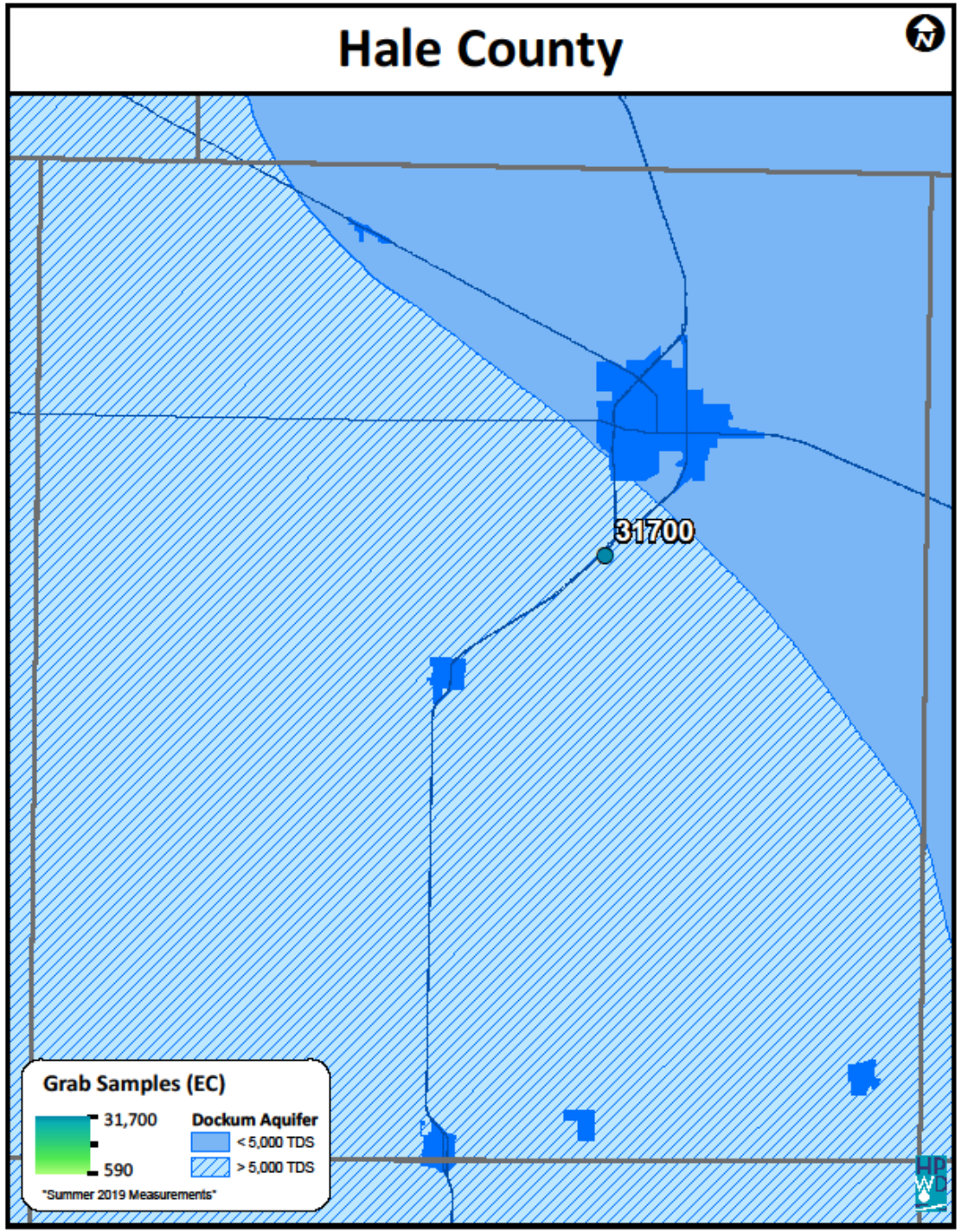
590

Dockum Aquifer

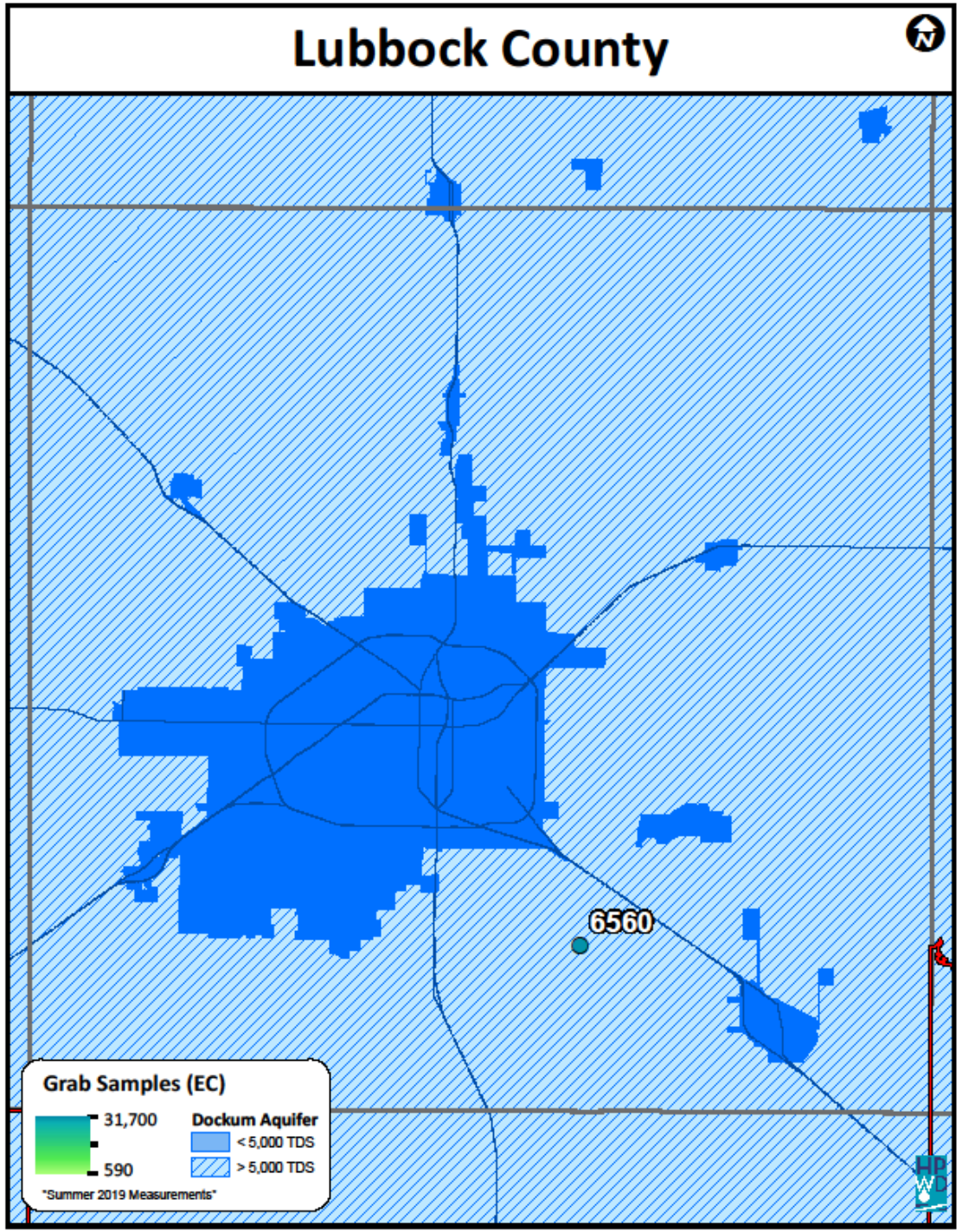
< 5,000 TDS

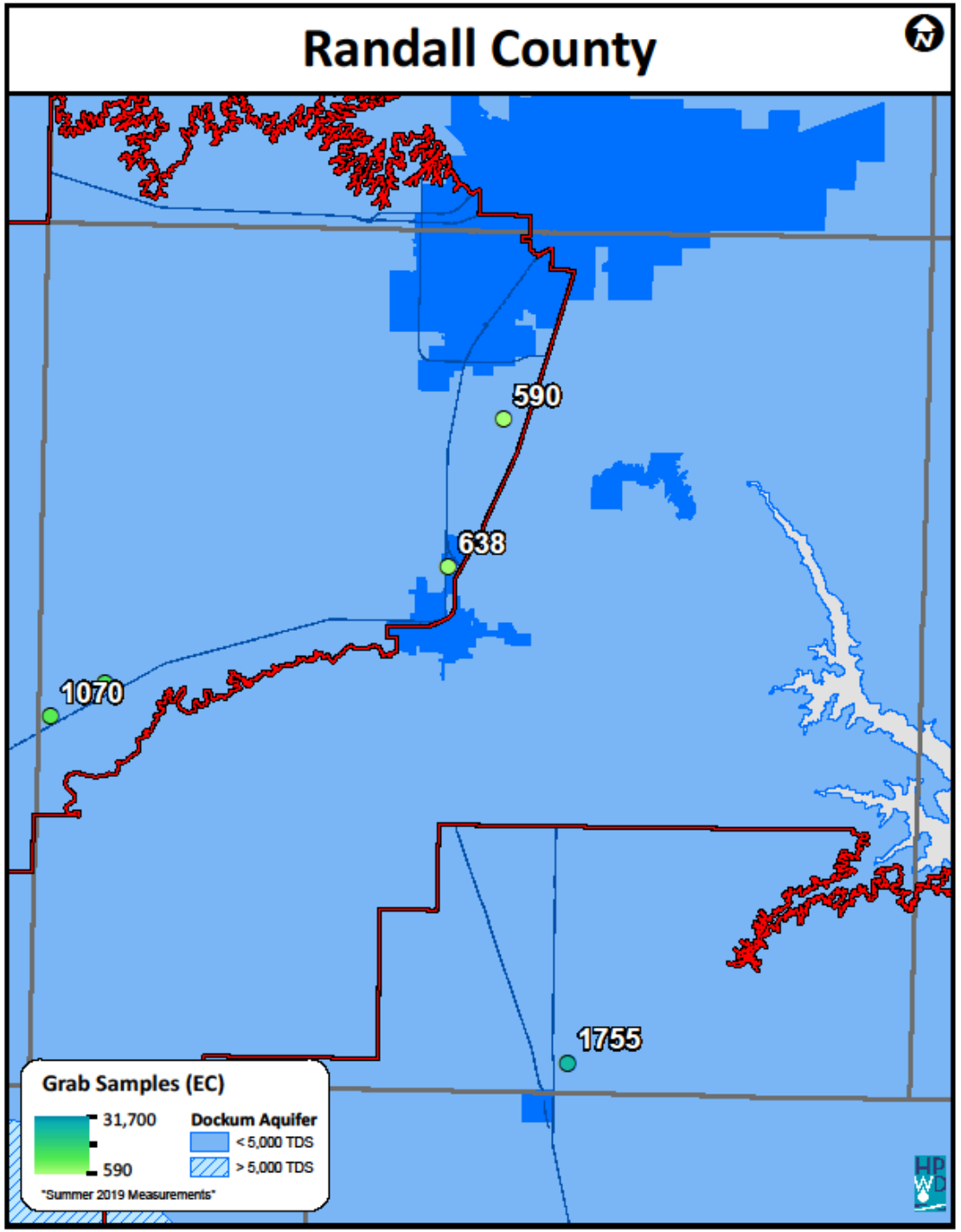
> 5,000 TDS

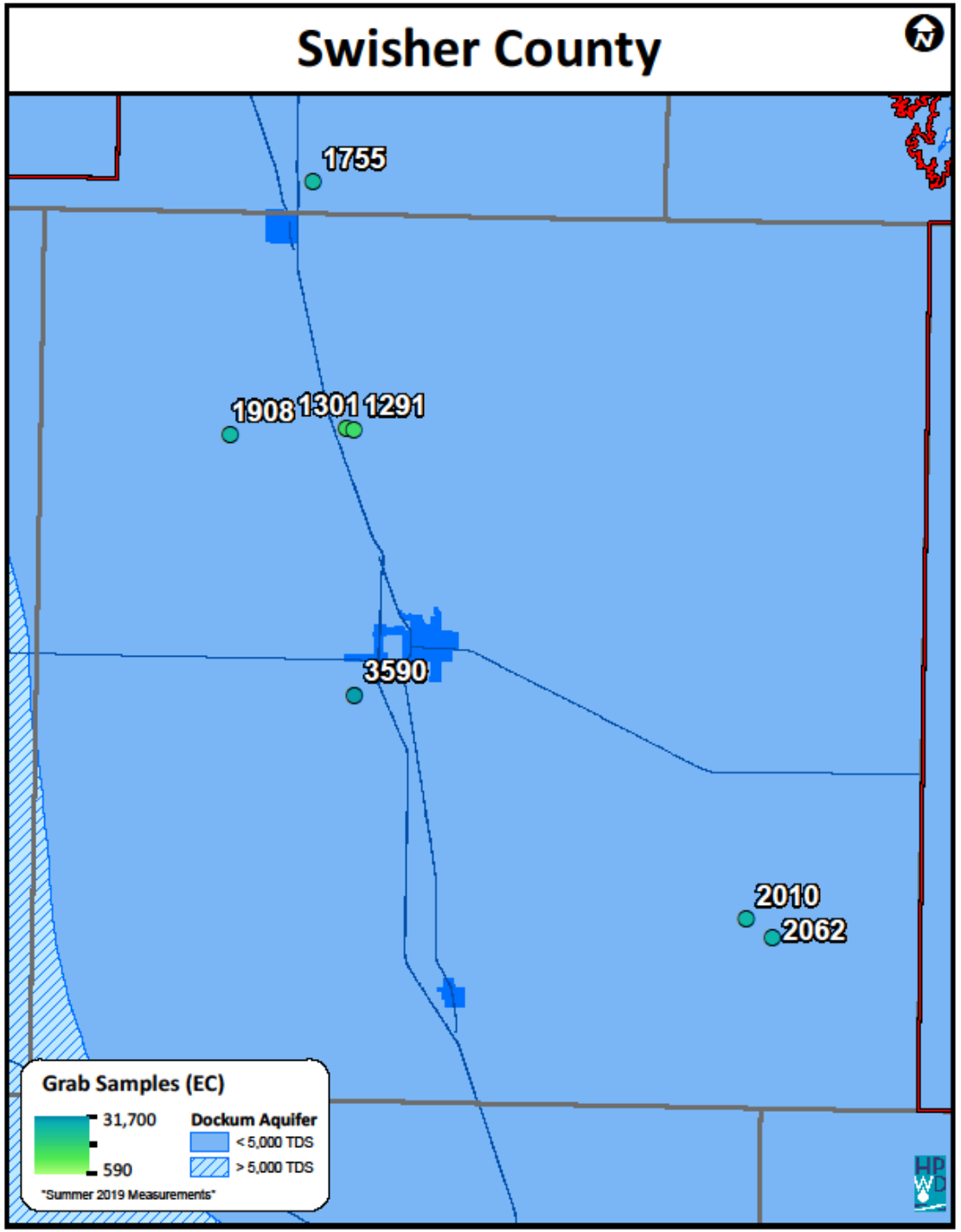
"Summer 2019 Measurements"


Hale County
31700
Grab Samples (EC)
31,700
590
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements


ion156
7.000
pH


Lubbock County
6560
Grab Samples (EC)
31,700
590
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
"Summer 2019 Measurements"


Randall County
590
638
1070
1755
Grab Samples (EC)
31,700
590
Summer 2019 Measurements
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS

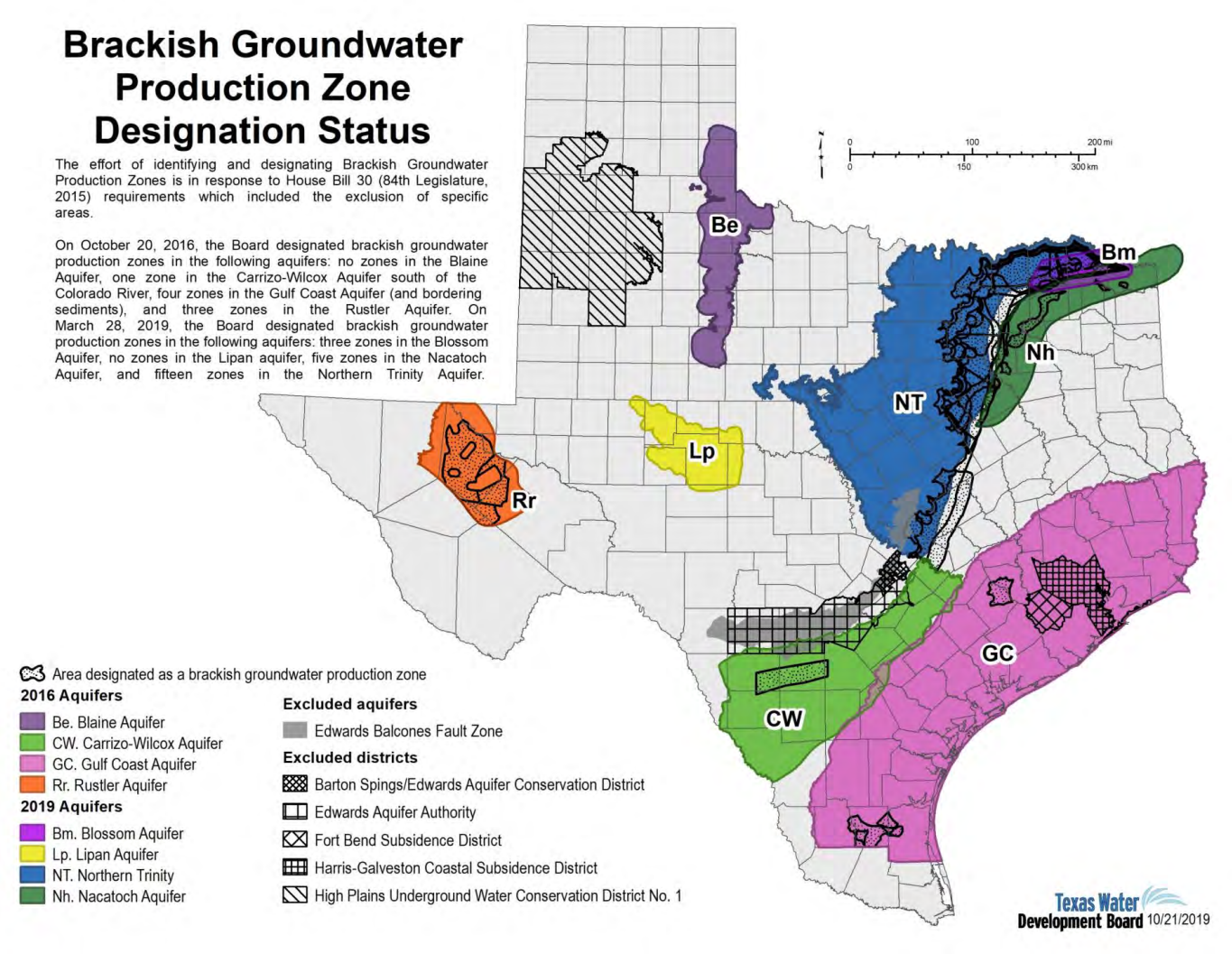

Swisher County
1755
1908
1301
1291
3590
2010
2062
Grab Samples (EC)
31,700
590
Dockum Aquifer
< 5,000 TDS
> 5,000 TDS
Summer 2019 Measurements

Results of Grab Samples

Count of Wells	Percent of Total Samples	Conductivity Range
12	13.6%	<1000
60	68.2%	1000-2000
10	11.4%	2001-3000
2	2.3%	3001-5000
3	3.4%	5001-10000
1	1.1%	>10000


4X4

Groundwater Law & Policy
"Brackish" Groundwater Regulations



Victoria Whitehead

General Counsel

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Victoria.whitehead@hpwd.org

@Victoriarosetx

Groundwater Law & Policy
"Brackish" Groundwater Regulations

What's on tap?

1. Groundwater Ownership Review
2. Development & Implementation of Brackish Groundwater Production Zones (BGPZs)
3. Brackish Permitting

Groundwater Ownership

- **Groundwater** is a form of real property that goes with the surface estate unless otherwise severed or reserved. *Edwards Aquifer Auth. v. Day*, 369 S.W.3d 814, 832 (Tex. 2012).
  - **What is "groundwater"?-**The Legislature defines groundwater as "water percolating below the surface of the earth" Tex. Water Code Ann. § 36.001
  - **What is "percolating"?-**Underground water capable of being obtained via a well. *Texas Co. v. Burkett*

Groundwater Ownership

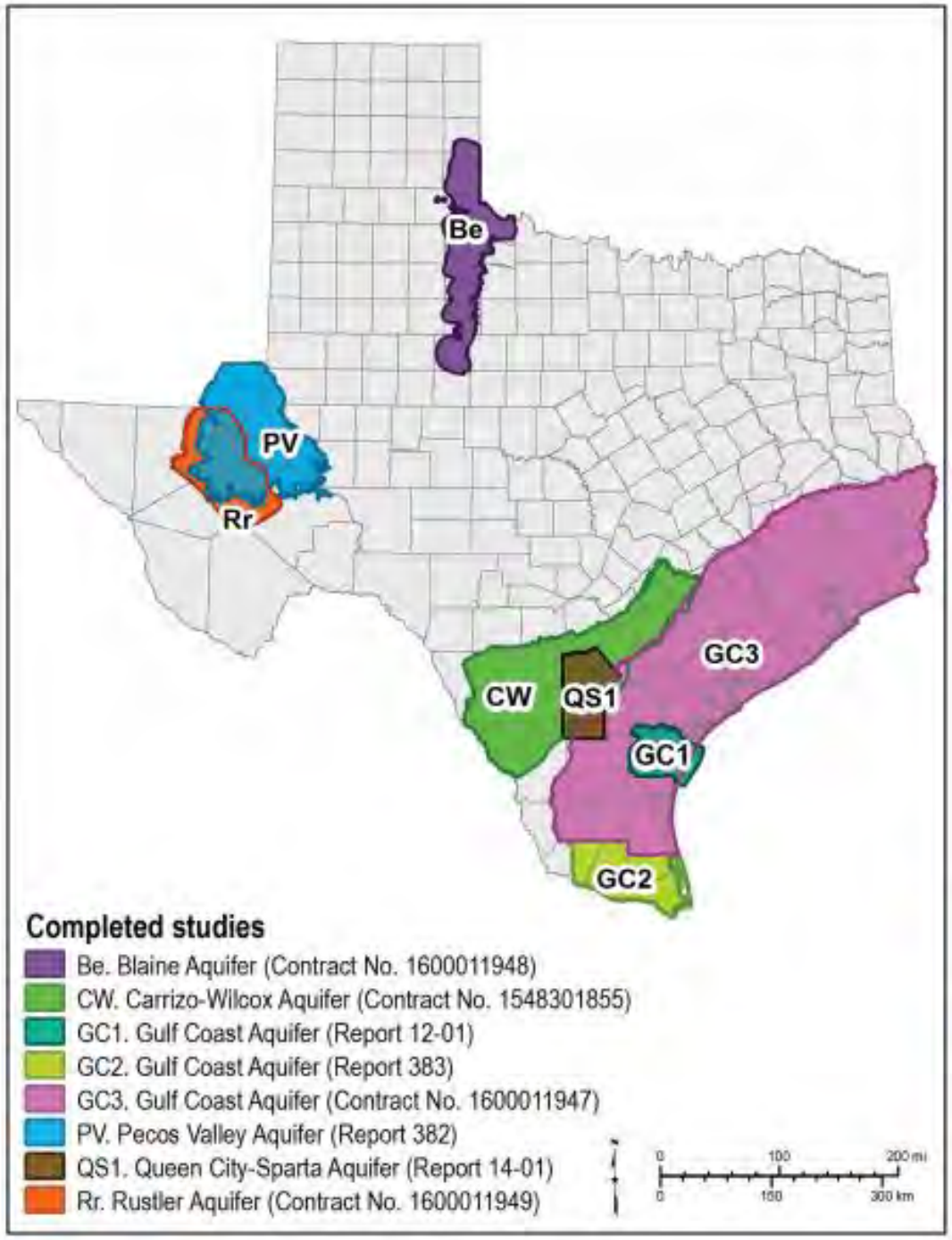
- Does the law treat groundwater ownership differently based water quality?
  - No: Texas Supreme Court Case: Salinity bore "no consequence upon ownership." *Robinson v. Robbins Petroleum Corp., Inc.*, 501 S.W.2d 865, 867 (Tex. 1973)
- "Brackish" generally defined as: "water containing total dissolved solid (TDS) concentrations of between 1,000 and 10,000 milligrams per liter (mg/l)." (Ashworth and Hopkins, 1995)

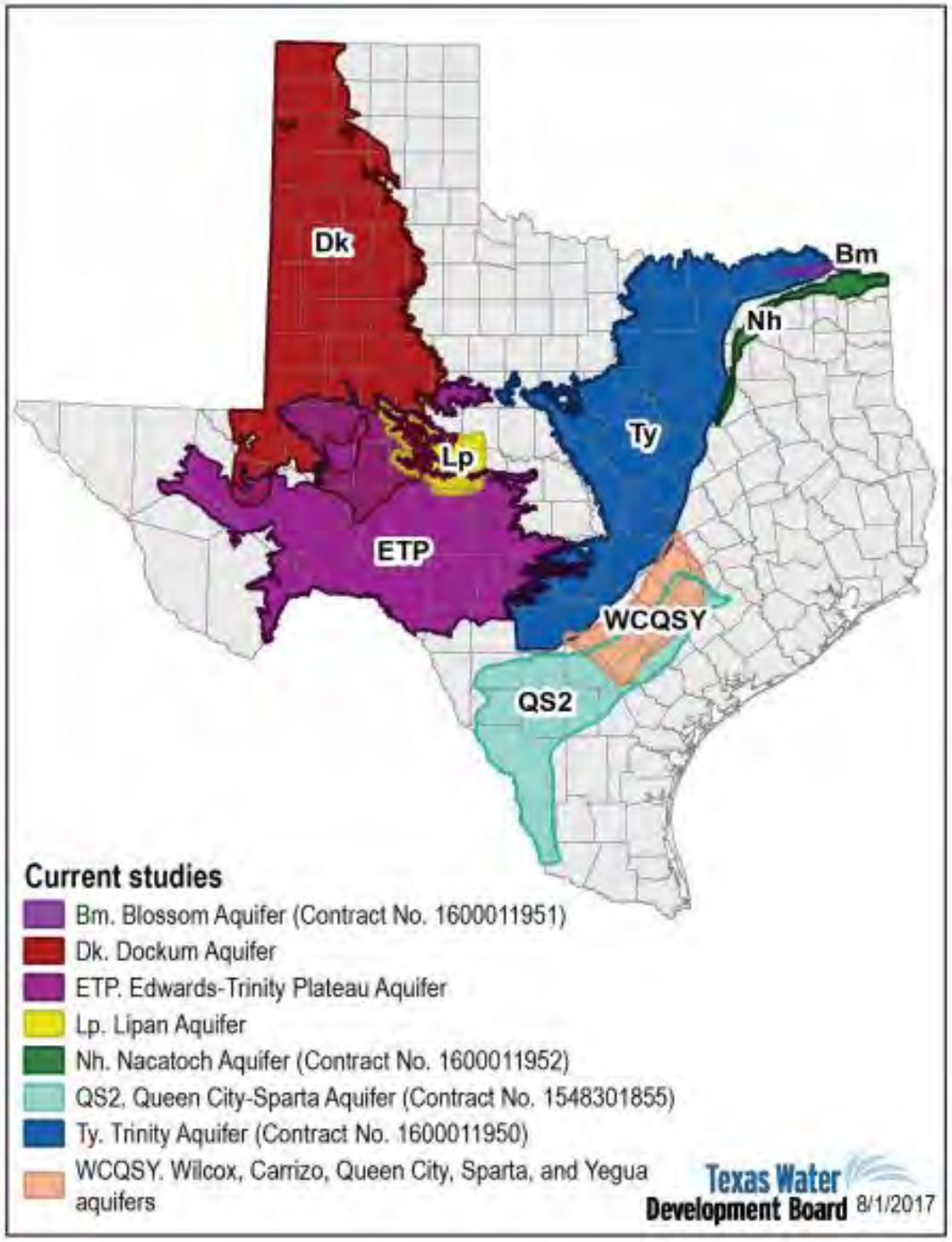
HB 30 and Brackish Groundwater Production Zones- TWDB Charge

- Define brackish groundwater production zones.
- Estimate productivity over 30 and 50 year periods.
- Recommend groundwater monitoring programs.
- Work with stakeholders and groundwater conservation districts.
- Complete four aquifers by December 2016.
- Complete all aquifers by December ~~2022~~ 2032 (updated 2019).

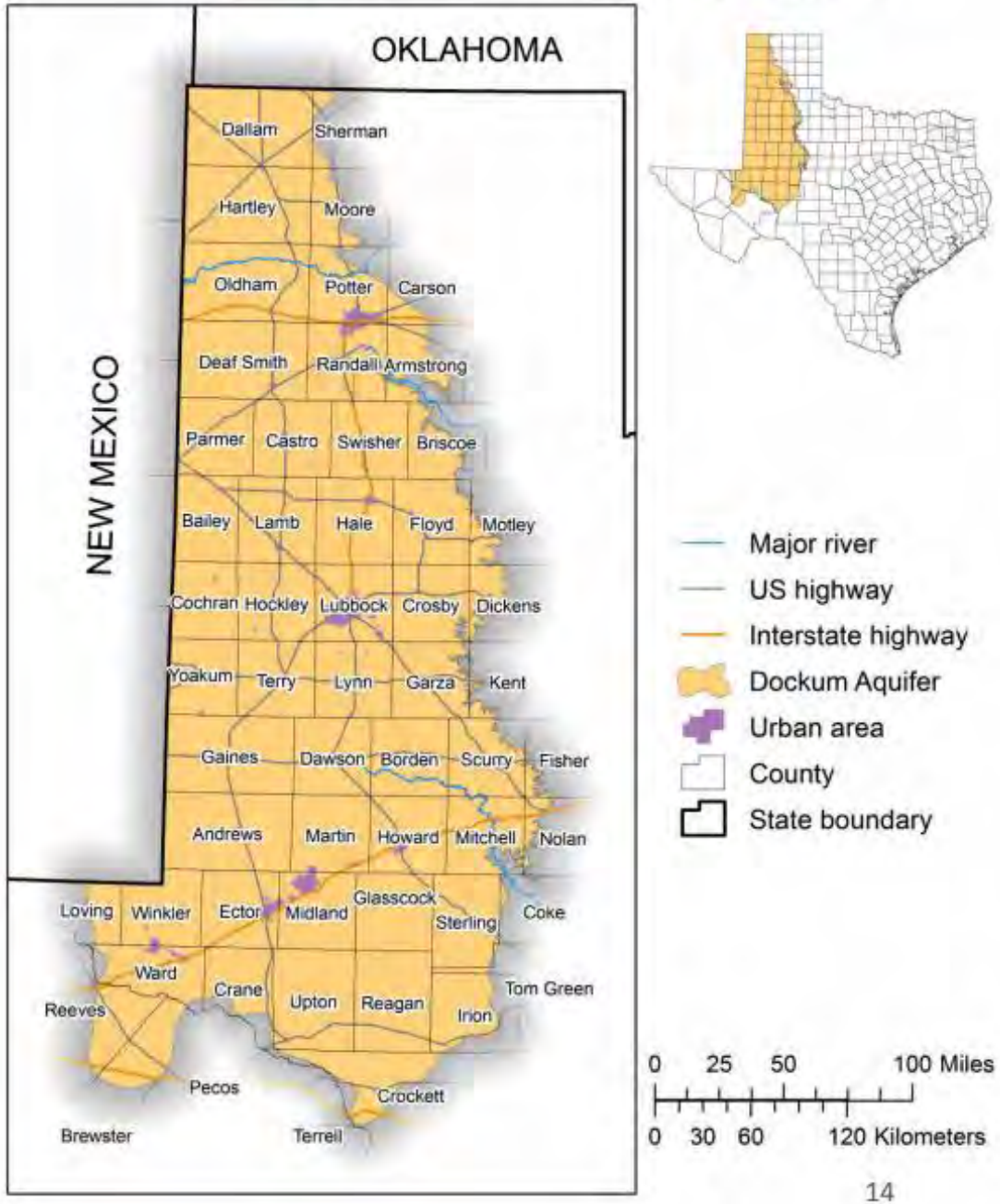
TWDB Criteria for BGPZs

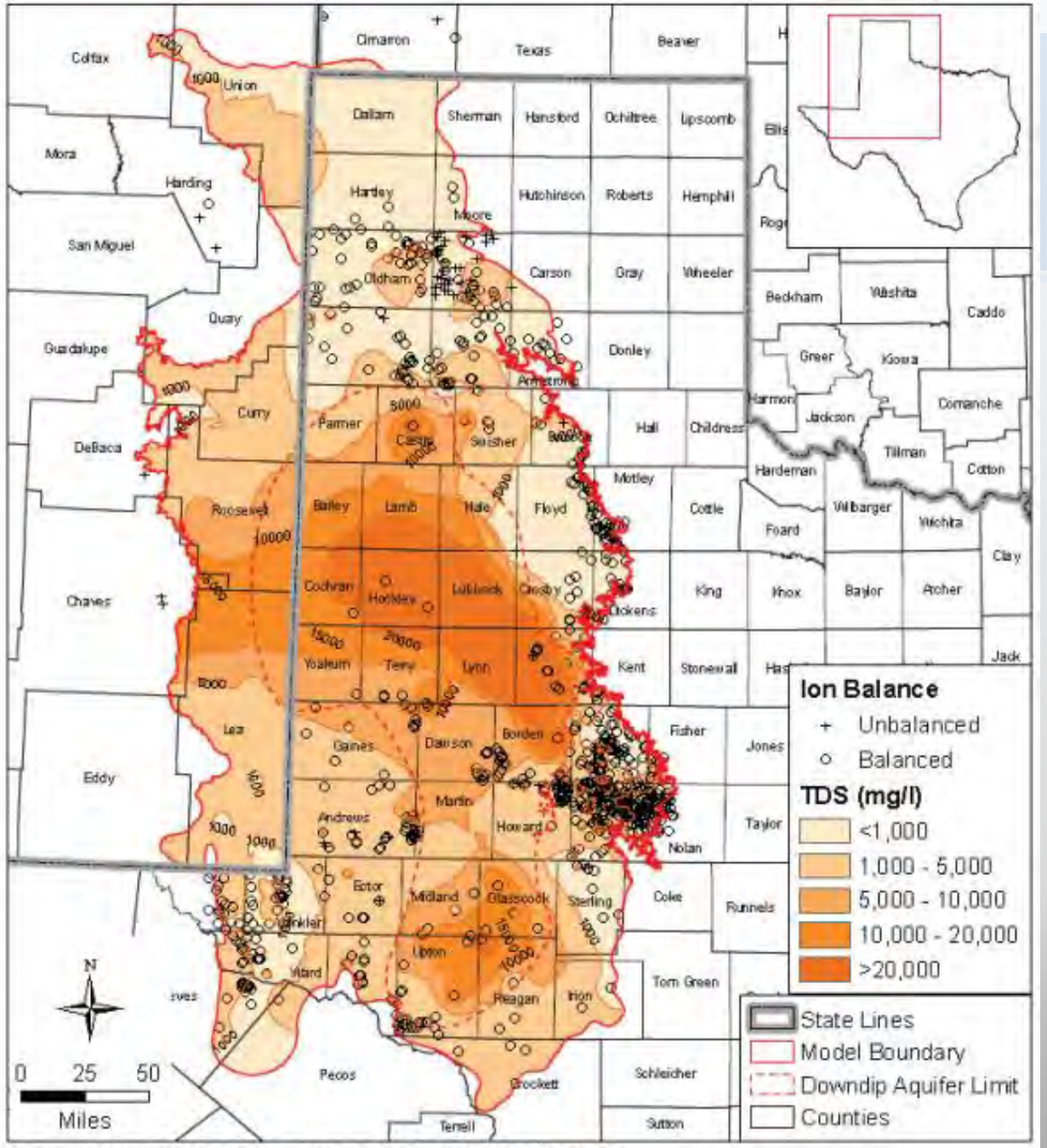
- Must have brackish water:
  - In areas of the state with moderate to high availability and productivity.
- Must have hydrogeologic barriers;
  - Sufficient to prevent significant impacts to fresh water availability or quality.
- Cannot be within these boundaries:
  - EAA, Harris-Galveston Subsidence District, or Fort Bend Subsidence District
- Cannot be already in use:
  - Brackish water already serving as a significant source of water supply for municipal, domestic, or agricultural.
- Cannot be used for wastewater injection:
  - Permits under Chapter 27, Texas Water Code


Be
PV
Rr
GC3
CW
QS1
GC1
GC2
Completed studies
Be. Blaine Aquifer (Contract No. 1600011948)
CW. Carrizo-Wilcox Aquifer (Contract No. 1548301855)
GC1. Gulf Coast Aquifer (Report 12-01)
GC2. Gulf Coast Aquifer (Report 383)
GC3. Gulf Coast Aquifer (Contract No. 1600011947)
PV. Pecos Valley Aquifer (Report 382)
QS1. Queen City-Sparta Aquifer (Report 14-01)
Rr. Rustler Aquifer (Contract No. 1600011949)
0 100 200 mi
0 150 300 km


Dk
Bm
Nh
Ty
Lp
ETP
WCQSY
QS2
Current studies
Bm. Blossom Aquifer (Contract No. 1600011951)
Dk. Dockum Aquifer
ETP. Edwards-Trinity Plateau Aquifer
Lp. Lipan Aquifer
Nh. Nacatoch Aquifer (Contract No. 1600011952)
QS2. Queen City-Sparta Aquifer (Contract No. 1548301855)
Ty. Trinity Aquifer (Contract No. 1600011950)
WCQSY. Wilcox, Carrizo, Queen City, Sparta, and Yegua aquifers
Texas Water Development Board 8/1/2017

Dockum Aquifer BRACS Study Extent



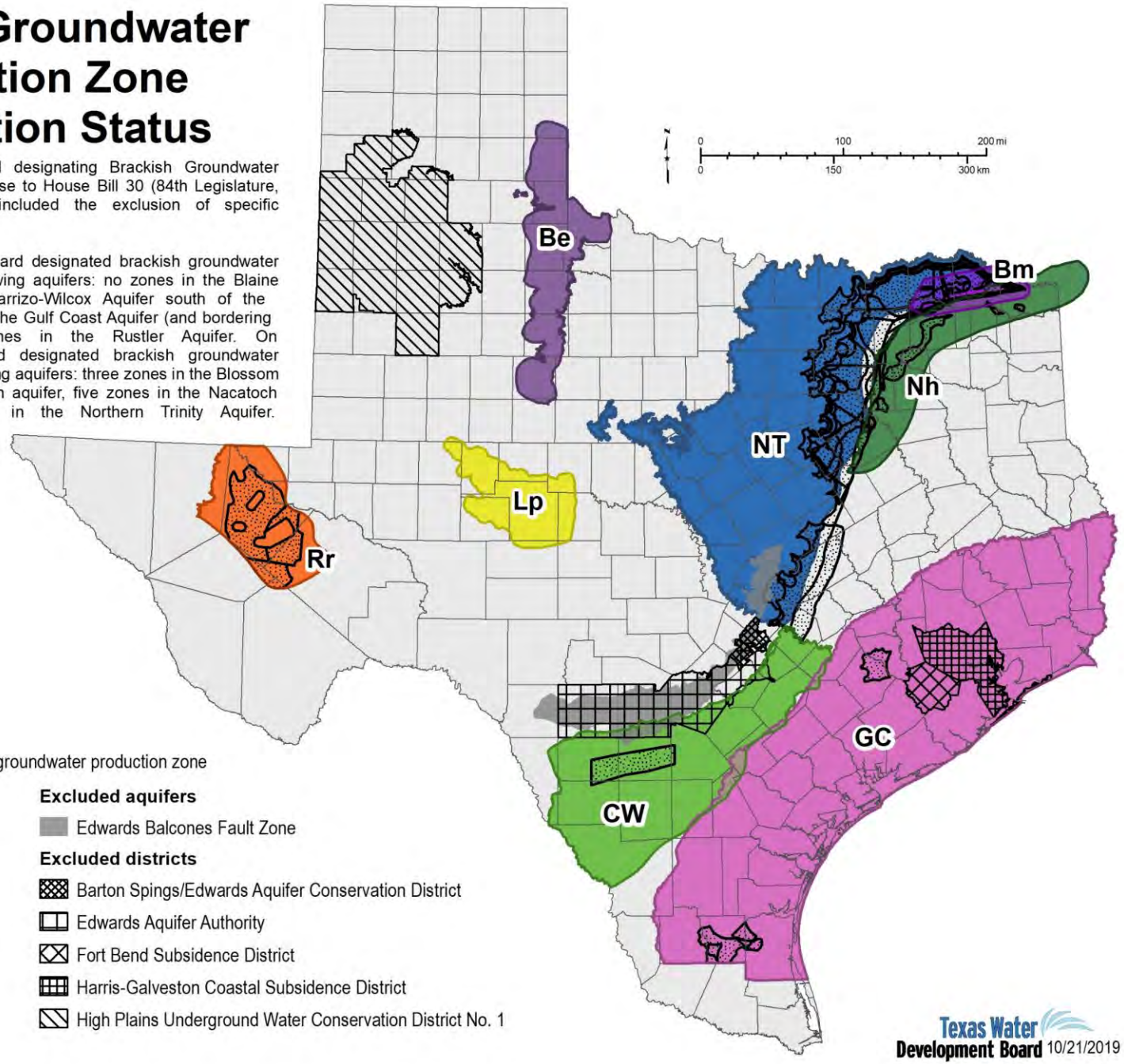


Source: TWDB, Panhandle GCD; USGS/New Mexico; Hart and others (1976)

Brackish Groundwater Production Zone Designation Status

The effort of identifying and designating Brackish Groundwater Production Zones is in response to House Bill 30 (84th Legislature, 2015) requirements which included the exclusion of specific areas.

On October 20, 2016, the Board designated brackish groundwater production zones in the following aquifers: no zones in the Blaine Aquifer, one zone in the Carrizo-Wilcox Aquifer south of the Colorado River, four zones in the Gulf Coast Aquifer (and bordering sediments), and three zones in the Rustler Aquifer. On March 28, 2019, the Board designated brackish groundwater production zones in the following aquifers: three zones in the Blossom Aquifer, no zones in the Lipan aquifer, five zones in the Nacatoch Aquifer, and fifteen zones in the Northern Trinity Aquifer.



TWDB Dockum Timeline

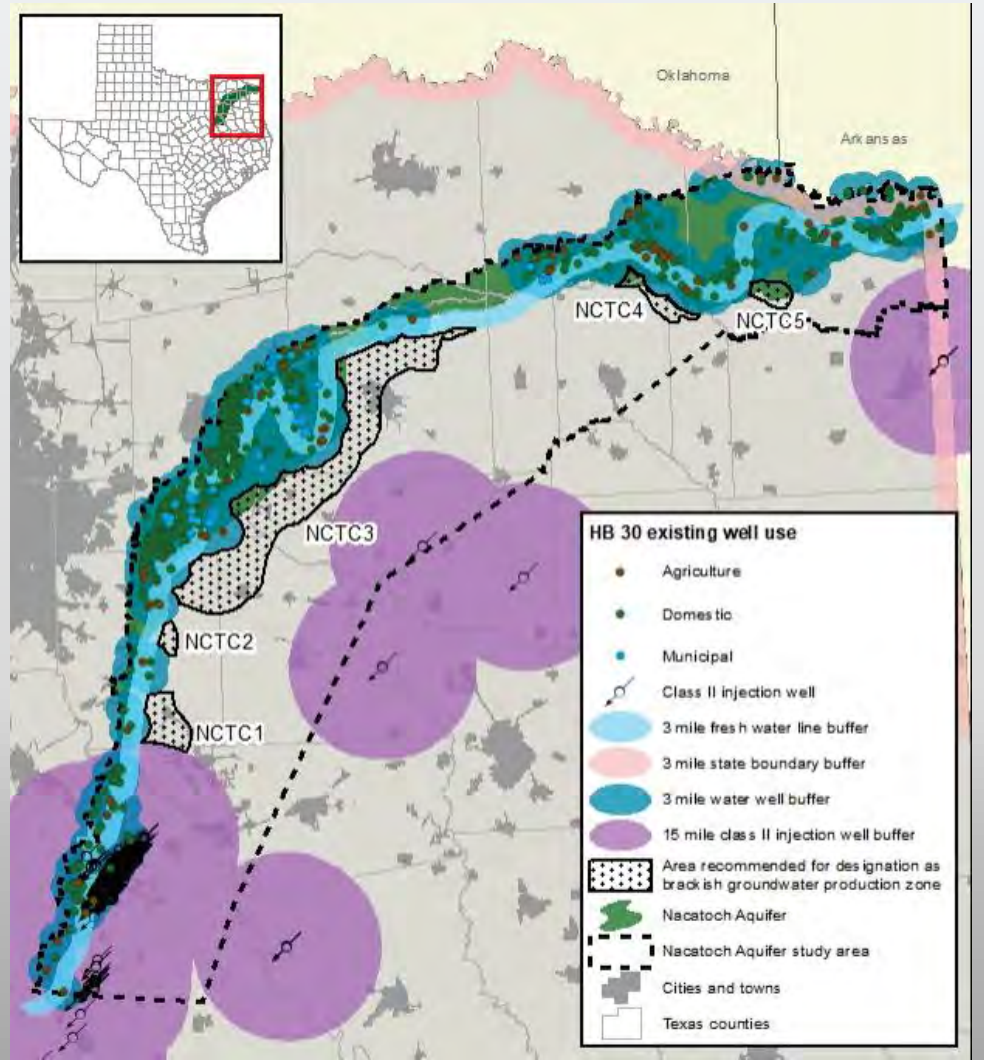
- ~~First Stakeholder meeting in Midland (2017)~~
- Additional kickoff stakeholder meeting (Lubbock)
- Map stratigraphy, lithology, measured water quality, calculated water quality, aquifer properties, and existing use.
- Calculate the volume of fresh, slightly saline, moderately saline, and very saline groundwater.
- Proposed production area (PPA) analysis stakeholder meeting.
- PPA impact analysis (modeling).
- Final report(s), study completion meeting, and stakeholder comment solicitation.
- Board possibly designates brackish groundwater production zone.

HB 722 by Larson 86R

HB 722 by Larson

- Provides the rules for permits within a BGPZ.
- A district located over a BGPZ may adopt rules to govern the issuance of permits for these zones, but shall adopt rules if petitioned.
- Rules shall be in accordance with this legislation.

Passed in the 85th, but was vetoed by Governor Abbott: *The bill's permitting rules are unduly prescriptive and would create a separate and complex bureaucratic process for the permitting of brackish wells. While the development of brackish water resources as a potential means of meeting our state's future water needs is important, House Bill 2377 went about it the wrong way. The next Legislature should consider a simpler and less bureaucratic way to provide greater access to brackish water.*



HB 722 by Larson

- Requires GCDs to process permits in a similar manner as freshwater permits.
- Allows withdrawals and rates of withdraws not to exceed amounts identified by TWDB in BGPZ designation.
- Provides for a minimum term of 30 years.
- Requires the implementation of a monitoring system as recommended by TWDB to monitor water levels and water quality.
- Requires the holder of the permit to complete annual reporting that must include:
  - The amount of brackish groundwater withdrawn;
  - The average monthly water quality of the brackish groundwater and monitoring wells;
  - Aquifer levels in both the designated zone and adjacent monitoring wells

HB 722 by Larson

- The rules must:
  - Provide greater access to brackish groundwater by simplifying procedure, avoiding delay in permitting, saving expense for the permit seeker, and providing flexibility to permit applicants and the district;
  - Be consistent with and not impair property rights described by Sections 36.002(a) and (b); and
  - Specify all additional information that must be included in an application.

The district shall submit the application to TWDB and the board shall conduct a technical review of the application.

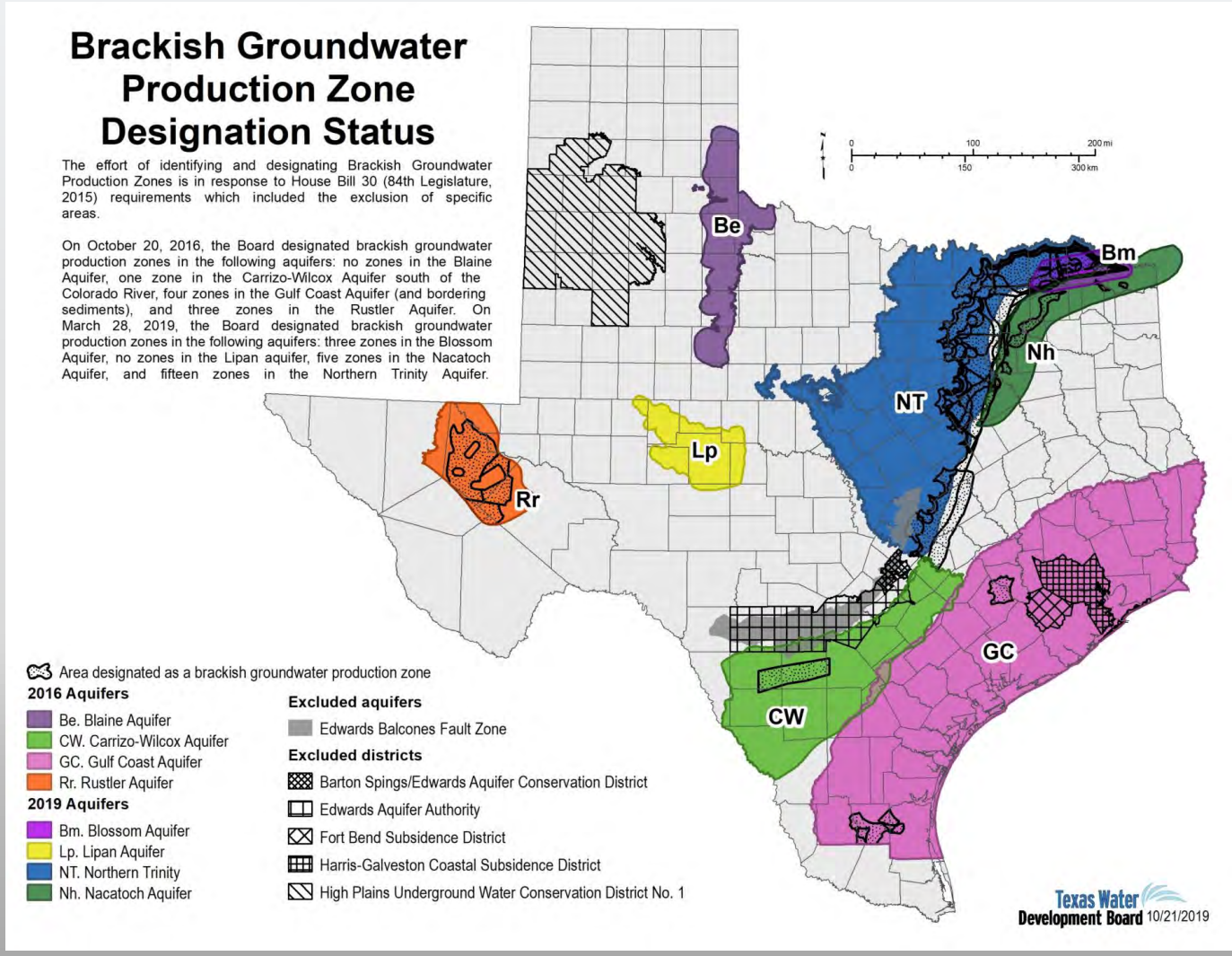
The development board shall submit a report of the review of the application that includes finding of compatibility and recommendations for monitoring systems.

HB 722 Testimony

Results of the 86th Tx Lege

HB 722 by Larson: Excludes "a district that overlies the Dockum aquifer and includes wholly or partly 10 or more counties."

HB1 (Texas Budget): House directs TWDB to use appropriations for contract costs for studies related to designating priority zones for the production of brackish groundwater and for administrative costs in implementing the studies, excluding the Dockum Aquifer.



Dockum Aquifer Management & Permitting

Jason Coleman, P.E.

Manager

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Dockum Aquifer Management & Permitting

Source: TWDB GAM Run 19-002

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation	Dockum Aquifer	31 ac-ft/year
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams and rivers	Dockum Aquifer	124 ac-ft/year
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	4,439 ac-ft/year
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	14,851 ac-ft/year

Dockum Aquifer Management & Permitting

Source: TWDB GAM Run 19-002

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated net annual volume of flow between each aquifer in the district	From Dockum brackish portion to Dockum Aquifer	828 ac-ft/year
Estimated net annual volume of flow between each aquifer in the district	From Ogallala Aquifer to Dockum Aquifer	2,273 ac-ft/year
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (High Plains) Aquifer to Dockum Aquifer	331 ac-ft/year

Dockum Aquifer Management & Permitting

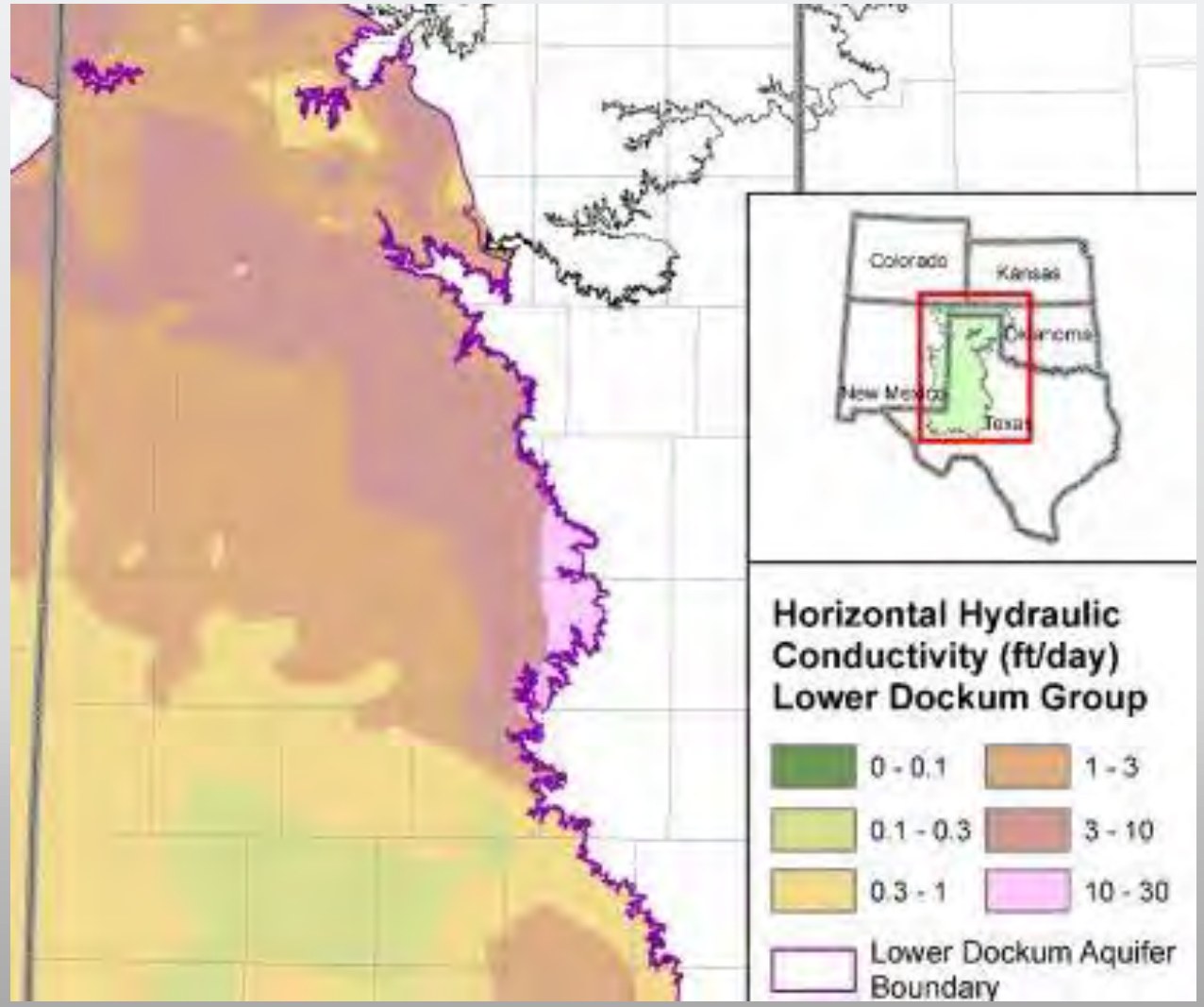
Source: TWDB GAM Run 13-026

County	Total Storage (ac-ft)	25% of Total Storage (ac-ft)	75% of Total Storage (ac-ft)
Deaf Smith	77,000,000	19,250,000	57,750,000
Potter	2,700,000	675,000	2,025,000
Randall	25,000,000	6,250,000	18,750,000
Swisher	66,000,000	16,500,000	49,500,000

Dockum Aquifer Management & Permitting

Hydraulic conductivity is the ease with which a fluid can move through the pore spaces of aquifer sediments.

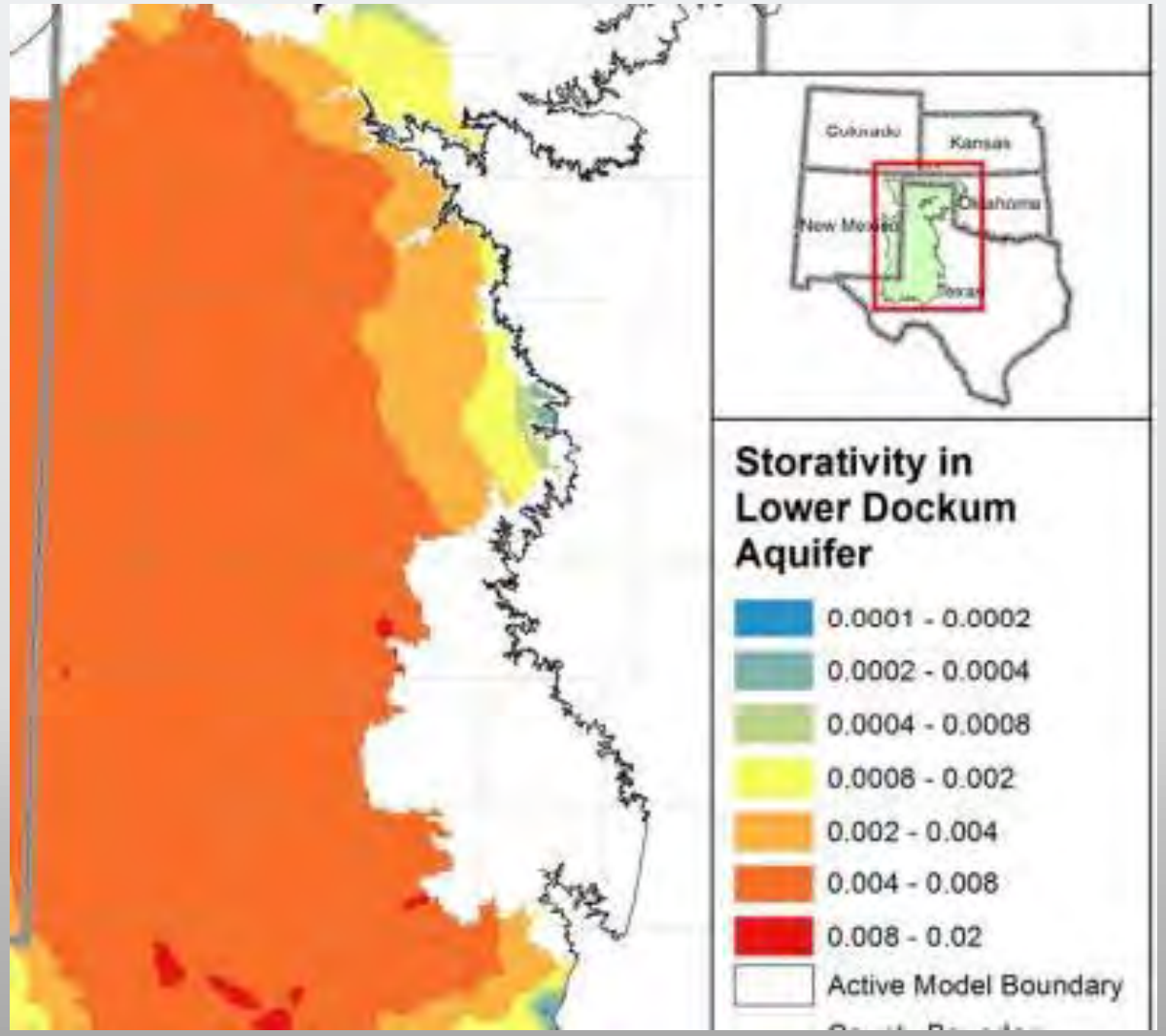
- **Hydraulic Conductivity 0.01-6 feet per day in Upper Dockum**
- **Hydraulic Conductivity 0.09-22 feet per day in Lower Dockum**



Dockum Aquifer Management & Permitting

Storativity (or storage coefficient) is the volume of water released from storage per unit decline in hydraulic head, per unit area of the aquifer.

- **Storativity in Lower Dockum 0.004-0.008**
- **Specific yield in Ogallala is about 0.15**



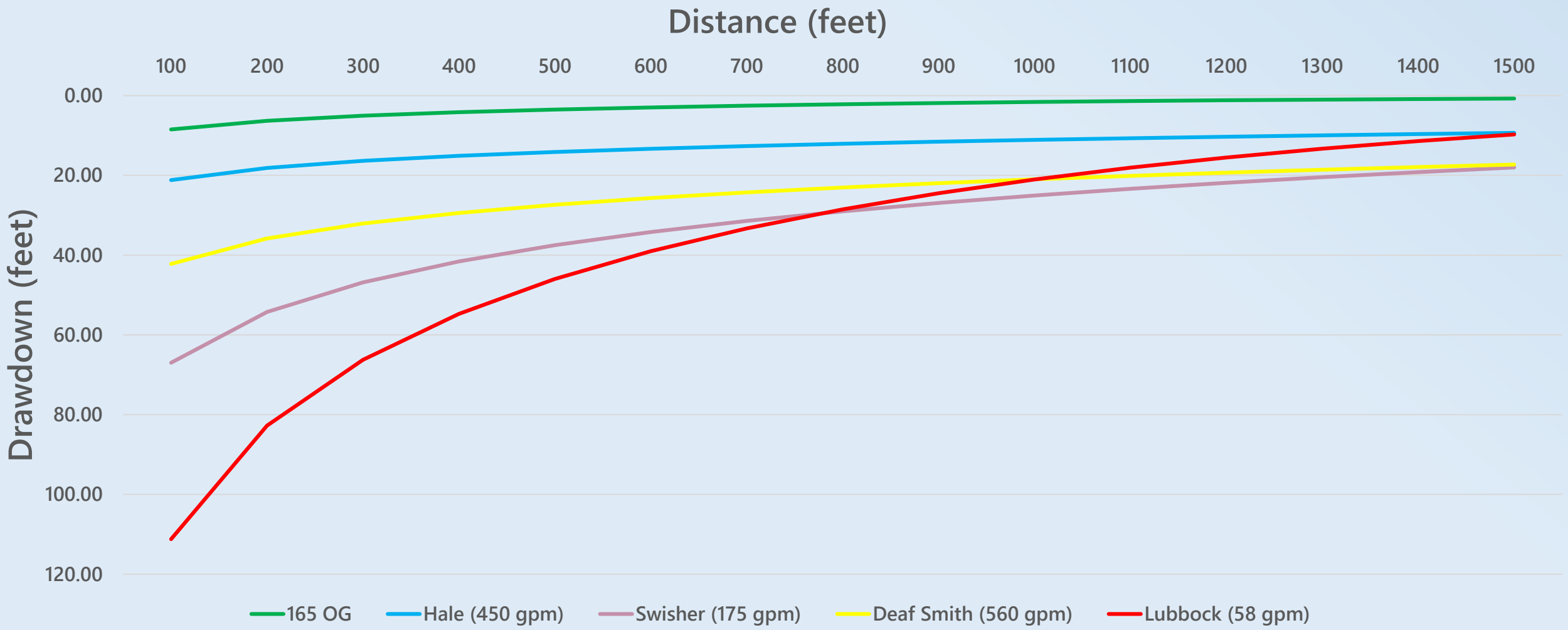
Dockum Aquifer Management & Permitting

Current HPWD Well Spacing Rules for Ogallala (blue) and Dockum (green)

Maximum GPM	Well Spacing (yards)	Property Line Spacing (yards)	Influence Past Property Lines (yards)	Maximum GPM	Well Spacing (yards)	Property Line Spacing (yards)	Influence Past Property Lines (yards)
70	100	25	75	70	100	25	75
165	200	50	150	165	200	50	150
265	300	75	225	265	300	75	225
390	350	87.5	262.5	500	880	100	780
560	400	100	300	>500	1760	135	1625
1000	500	125	375				
>1000	540	135	405				

Dockum Aquifer Management & Permitting

Source: HPWD at Time=90 days of Pumping



Dockum Aquifer Management & Permitting

1. Wells that partially penetrate Dockum Aquifer are common.
   - Can be hard to discern units between aquifers
2. Do current HPWD spacing rules prohibit an owner from accessing the water they own?
3. Is there any information we need that is not being obtained?
4. Test wells support/funding in areas where there is no data.
   - HPWD Board is considering an expanded policy on cost share.
5. Legislature emphasizes use of data for developing rules.

Questions About Today's Presentations?

HPWD Dockum Study
Summer 2019
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Groundwater Law & Policy: Brackish Groundwater Regulations
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HPWD Groundwater Management & Permitting
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HPWD Funded Research: hpwd.org/research

- Tarleton State University: Plant Based Polymers Used for TDS and Arsenic Removal
- Texas A&M AgriLife Research and Extension, Amarillo: Evaluation of the depth and water quality of the Dockum Aquifer in Southwest Potter County
- Texas Tech University, Dept. of Civil, Environmental & Construction Engineering: Brackish groundwater quality monitoring in the Dockum Aquifer
- City of Abernathy: Dockum Aquifer depth and salinity study
- Texas Tech University, Dept. of Agricultural and Applied Economics: Economic analysis to determine the feasibility of groundwater supplementation from the Dockum Aquifer
- City of Lubbock: Dockum Aquifer depth and salinity partnership