ASR and MAR (AR) in Texas' 2017 State Water Plan

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Underground Injection Control Conference
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ASR defined in TWC

Texas Water Code § 27.151

"…a project involving the injection of water into a geologic formation for the purpose of subsequent recovery and beneficial use by the project operator."

1) ASR injection well - Class V injection well…

2) ASR recovery well - well used for the recovery of water...

3) Native groundwater - groundwater naturally occurring…

4) Project operator - person holding an authorization…to undertake an ASR project.

AR defined in TWC

Texas Water Code § 27.201*

"…a project involving the intentional recharge of an aquifer by means of an injection well authorized under Chapter 27 or other means of infiltration, including actions designed to:

a) reduce declines in the water level…;

b) supplement the quantity of groundwater available;

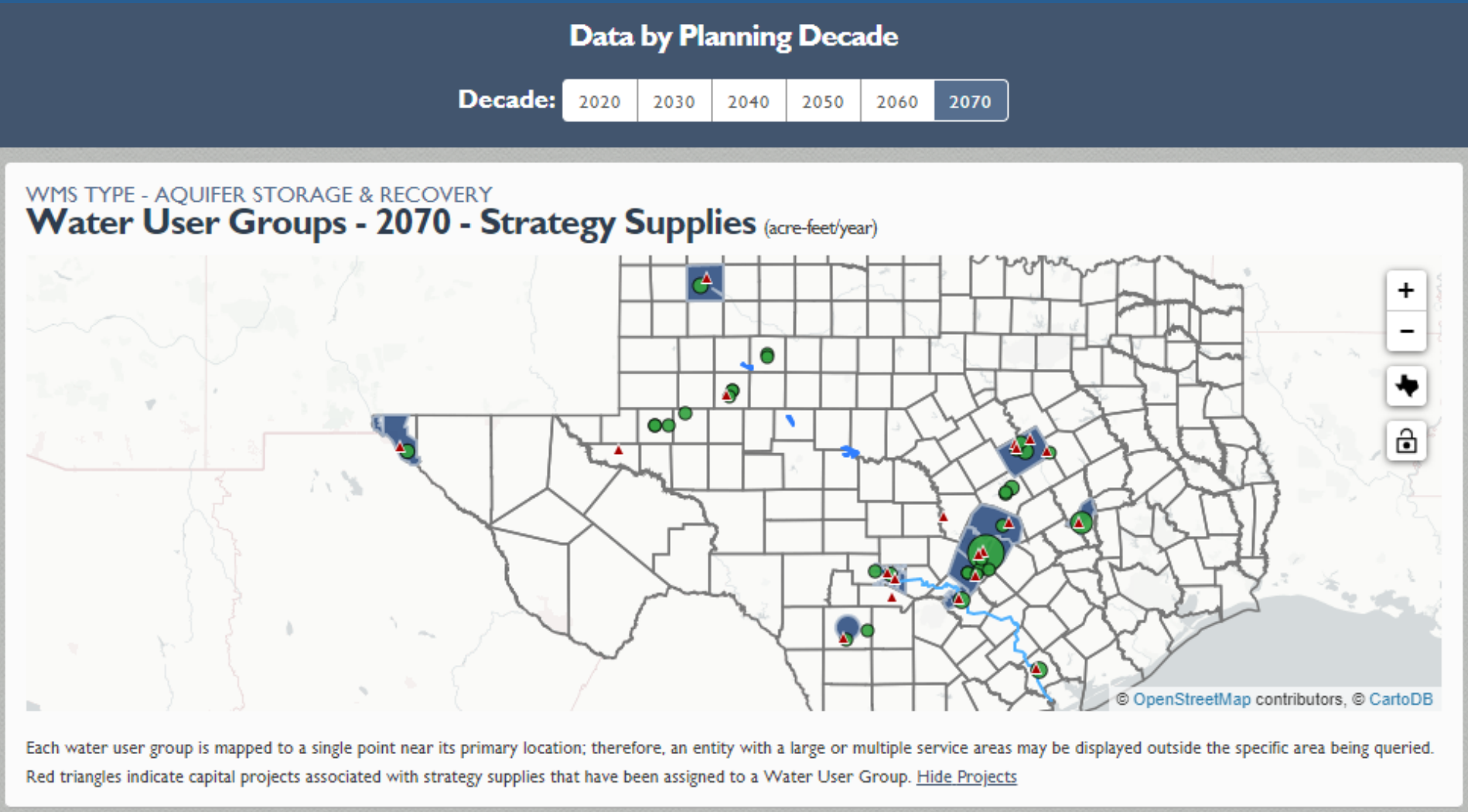
c) improve water quality…;

d) improve spring flows and other interactions between groundwater and surface water; or

e) mitigate subsidence."

State Water Plan 2017

- https://2017.texasstatewaterplan.org/statewide



Recommended ASR and AR WMS

- 25 ASR and 1 AR recommended water management strategies (WMS)

but…

- 20 ASR and 1 AR projects

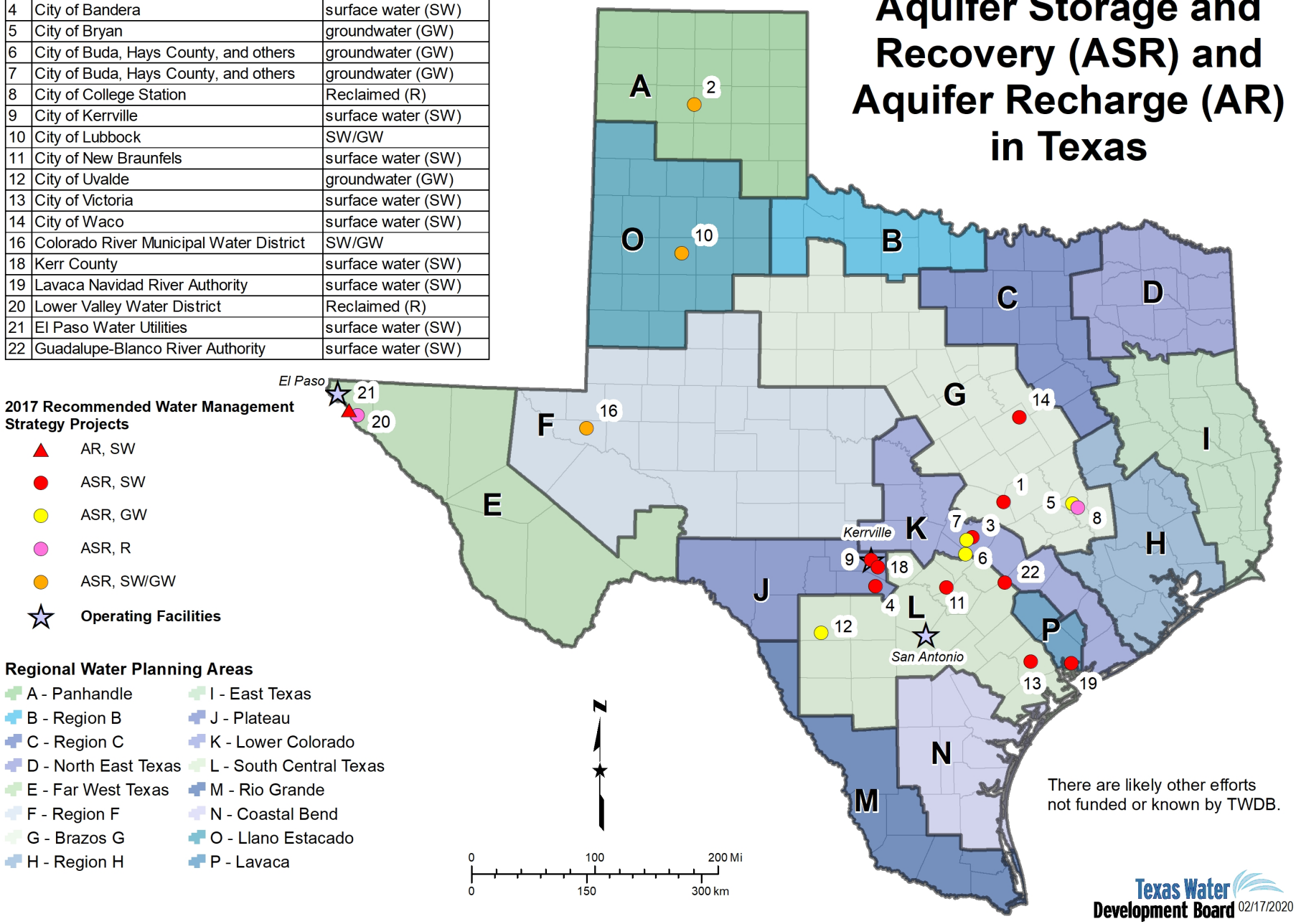
and…

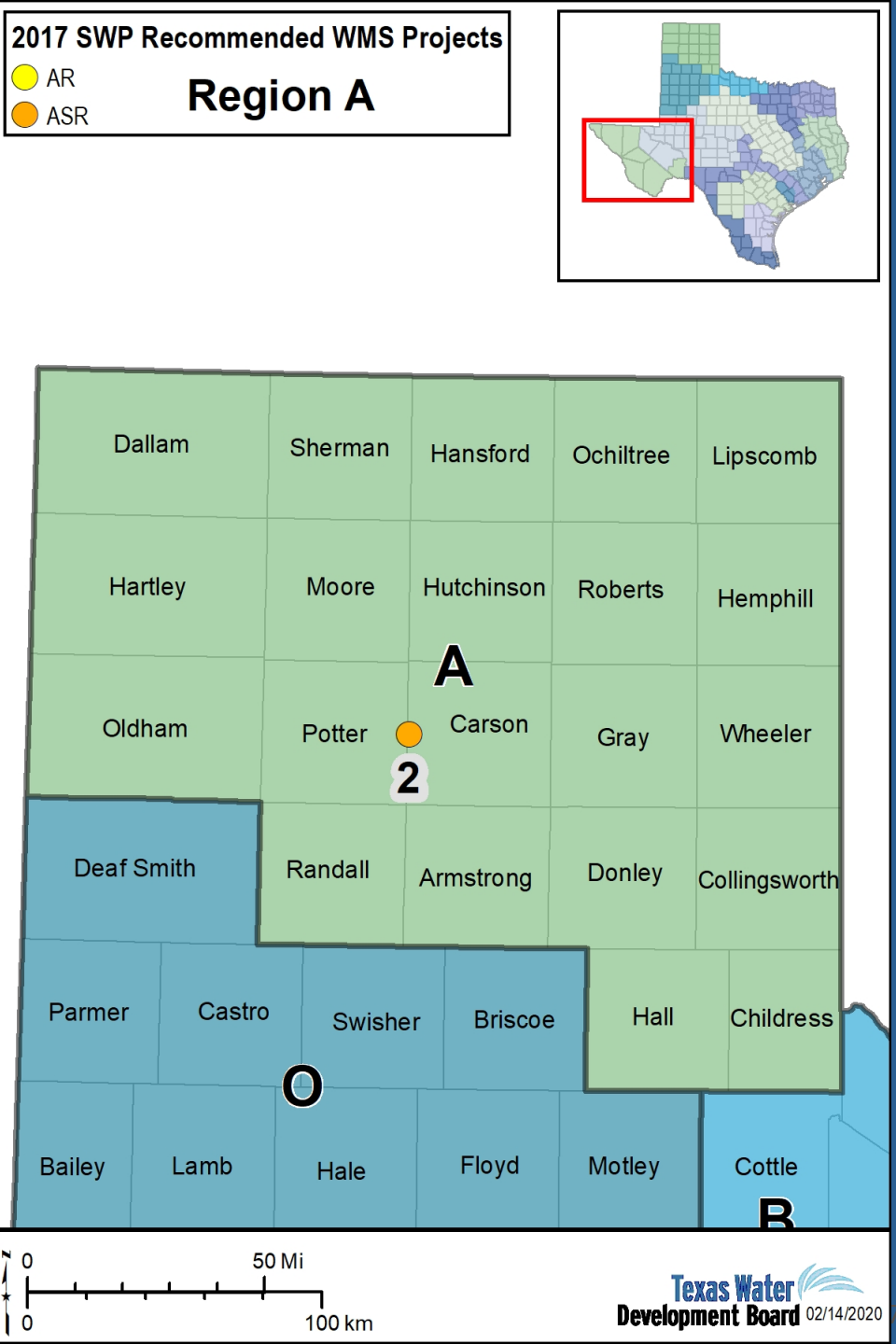
- additional 11 ASR and 1 AR alternative WMS

Confused yet?

Aquifer Storage and Recovery (ASR) and Aquifer Recharge (AR) in Texas

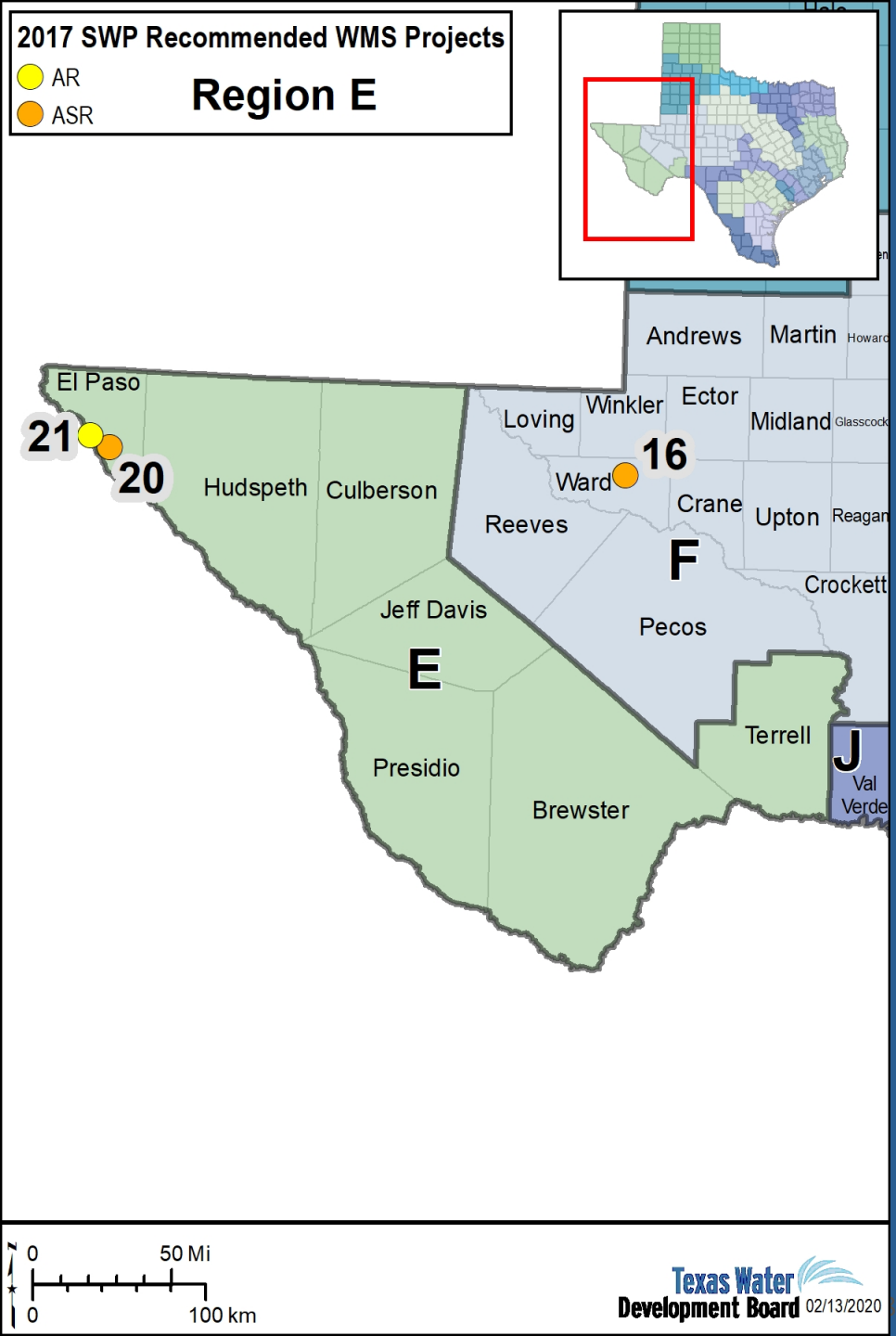
ID	Project sponsor	Source Water Type
1	Brazos River Authority	surface water (SW)
2	Canadian River Municipal Authority	SW/GW
3	City of Austin	surface water (SW)
4	City of Bandera	surface water (SW)
5	City of Bryan	groundwater (GW)
6	City of Buda, Hays County, and others	groundwater (GW)
7	City of Buda, Hays County, and others	groundwater (GW)
8	City of College Station	Reclaimed (R)
9	City of Kerrville	surface water (SW)
10	City of Lubbock	SW/GW
11	City of New Braunfels	surface water (SW)
12	City of Uvalde	groundwater (GW)
13	City of Victoria	surface water (SW)
14	City of Waco	surface water (SW)
16	Colorado River Municipal Water District	SW/GW
18	Kerr County	surface water (SW)
19	Lavaca Navidad River Authority	surface water (SW)
20	Lower Valley Water District	Reclaimed (R)
21	El Paso Water Utilities	surface water (SW)
22	Guadalupe-Blanco River Authority	surface water (SW)





2 - ASR-CRMWA

- Online decade: 2030
- Source water: SW
- Target Aquifer: Ogallala Aquifer
- Volume estimate: 16,400 AF/year
- Cost: $67,649,300
- Other: 11 member cities

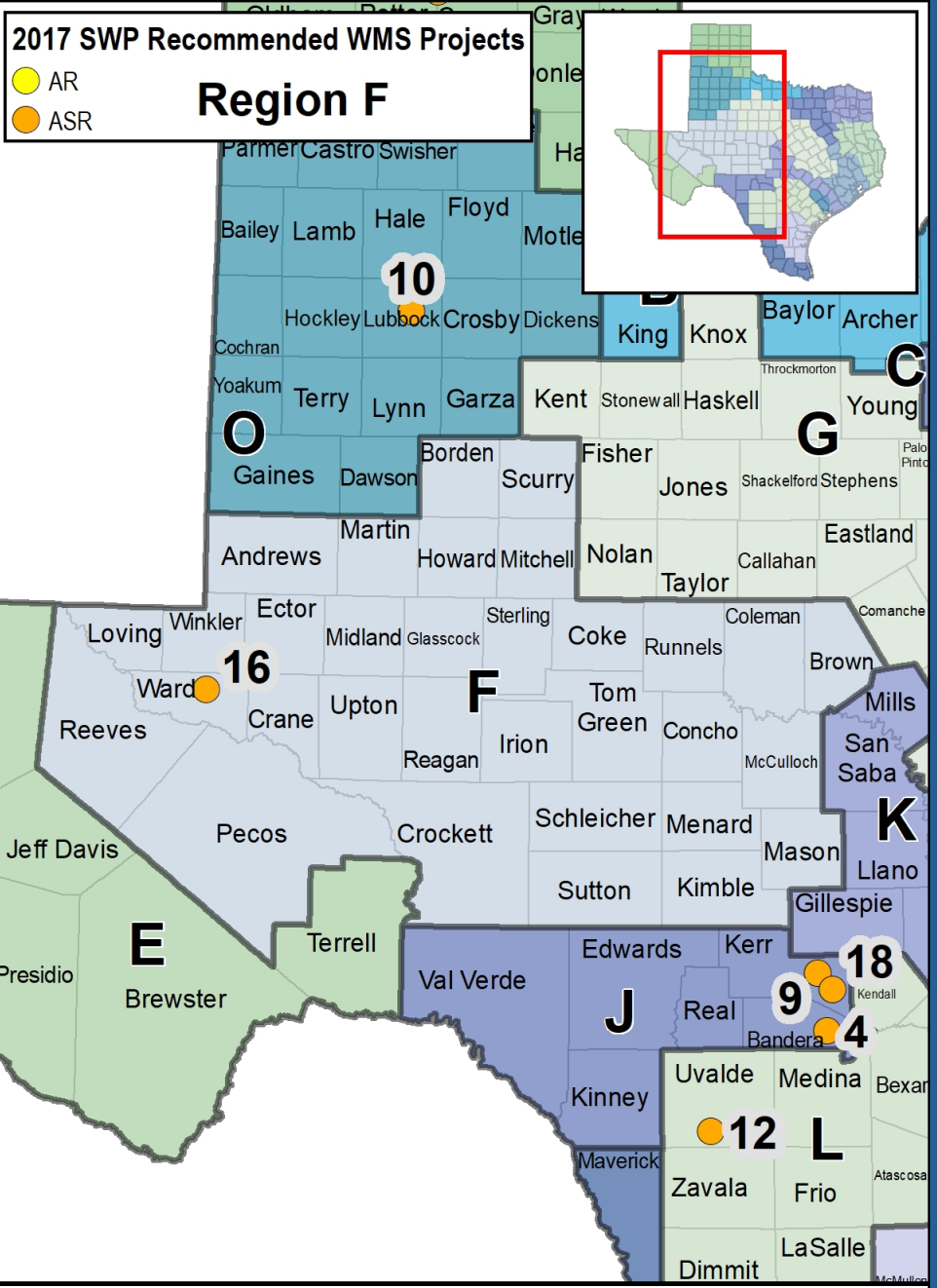


20 - Lower Valley Water District

- Online Decade: 2020
- Source: mixed, SW-R
- Target Aquifer: Hueco Bolson Aquifer
- Volume estimate: 3,808 AF/year
- Cost: $18,108,000
- Other: also considering Rio Grande Alluvium

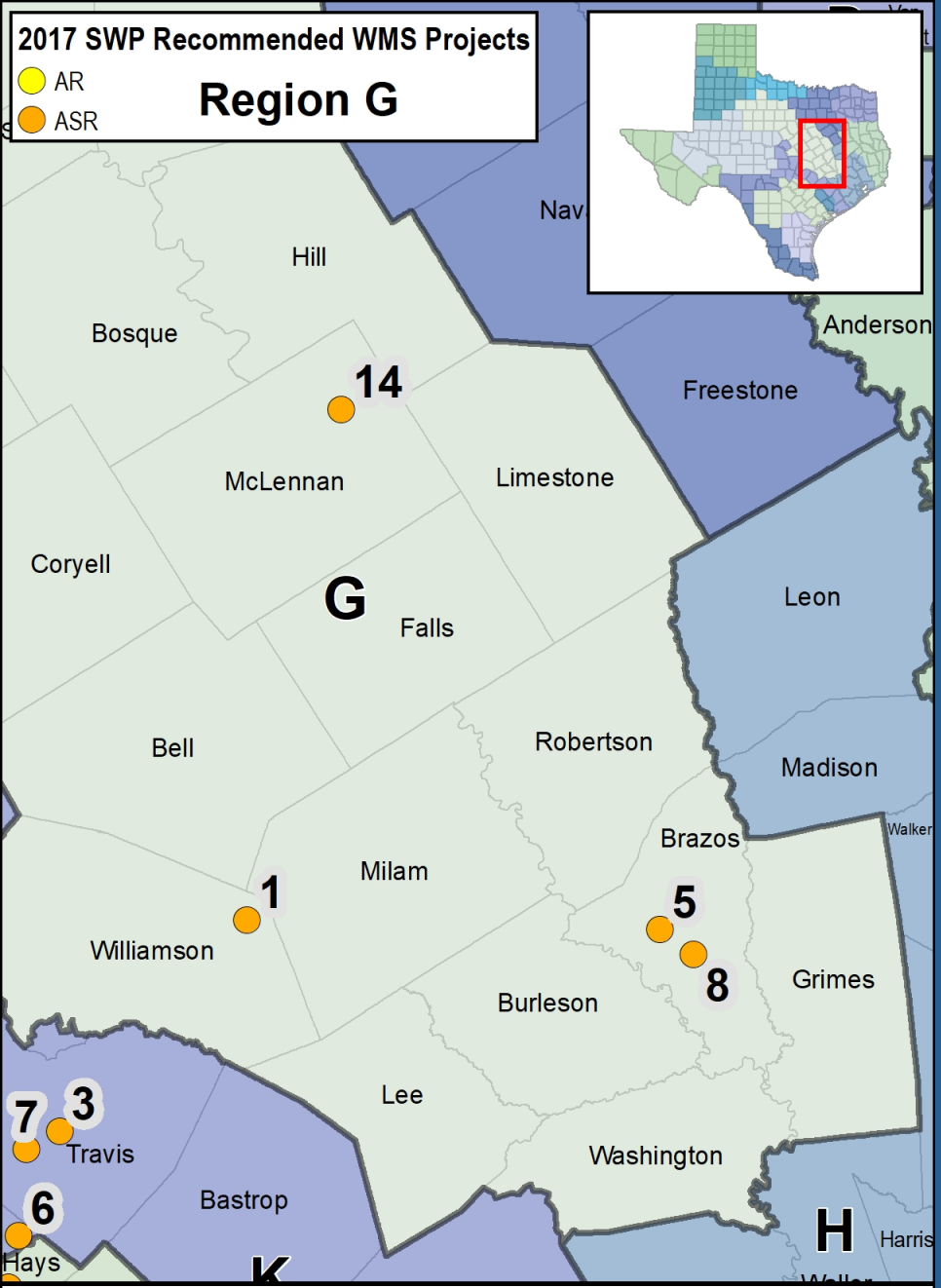
21 - El Paso Water Utilities

- Online decade: 2020
- Source water: SW
- Target Aquifer: Hueco Bolson Aquifer
- Volume estimate: 6,500 AF/year
- Cost: $1,806,000
- Other: 6 new spreader basins



16 - Colorado River Municipal Water District

- Online decade: 2030
- Source water: mixed, SW-GW
- Target Aquifer: Pecos Valley Aquifer
- Volume estimate: 5,000 AF/year
- Cost: $10,184,000
- Other notes: recharge likely done during the winter months



1 - Brazos River Authority

- Online decade: 2020
- Source water: SW
- Target Aquifer: lower Trinity Aquifer
- Volume estimate: 9,677 AF/year
- Cost: $99,820,000
- Other: 5 ASR wells & 10 recovery only wells

14 – City of Waco

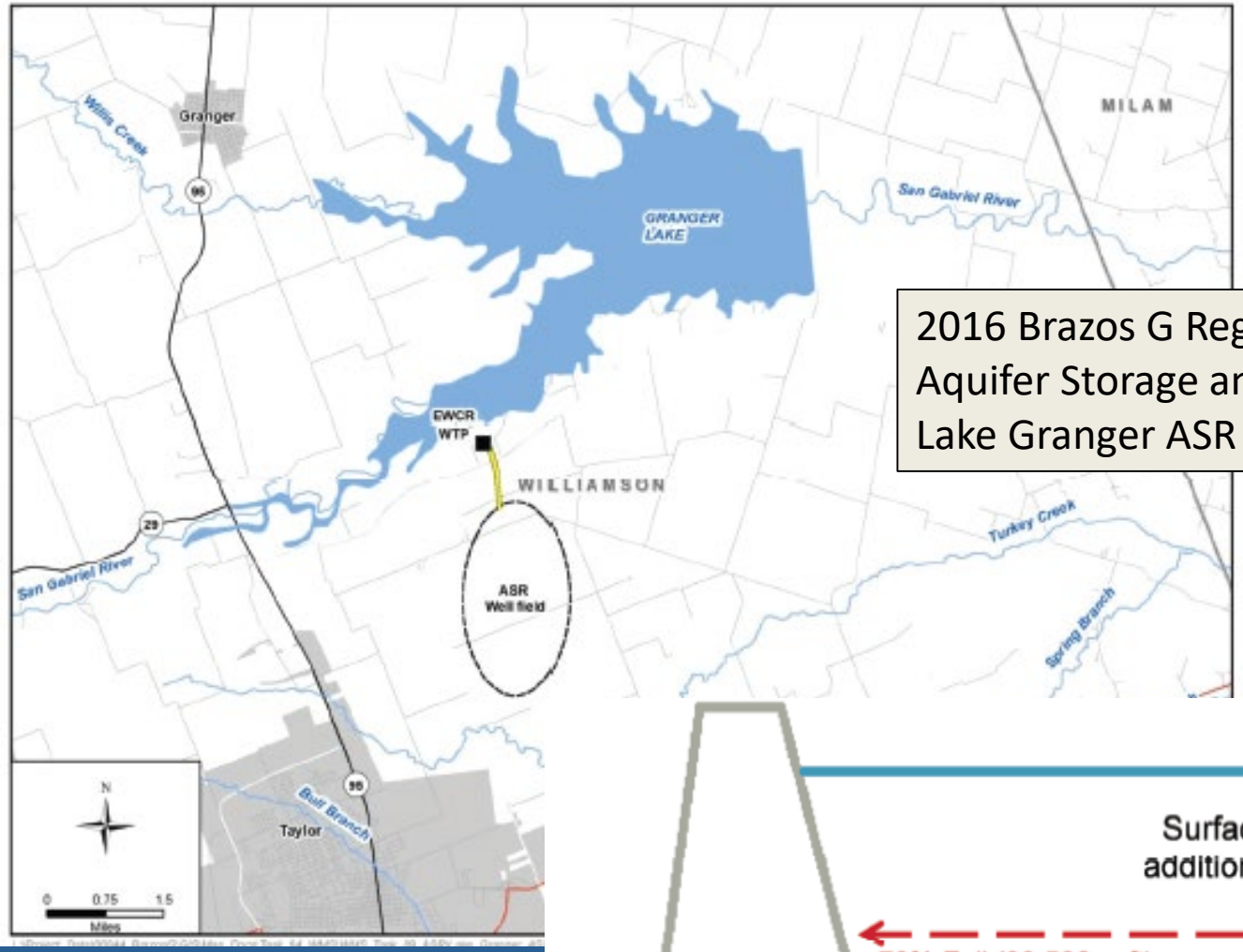
- Online decade: 2020, 2030, 2050
- Source water: SW
- Target Aquifer: Trinity Aquifer
- Volume estimate: 8,000 AF/year
- Cost: $56,542,000
- Other: 4 WMS, central injection with dispersed recovery

5 – City of Bryan

- Online decade: 2020
- Source water: GW
- Target Aquifer: Carrizo-Wilcox Aquifer (115 deg F)
- Volume estimate: 19,839 AF/year
- Cost: $57,328,000
- Other: recovered water will require cooling

8 - City of College Station

- Online decade: 2020
- Source water: R
- Target Aquifer: Queen City - Sparta Aquifer
- Volume estimate: 2,800 AF/year
- Cost: $63,850,000
- Other notes: one of two solely reclaimed water projects



2016 Brazos G Regional Water Plan, Volume II
Aquifer Storage and Recovery (ASR)
Lake Granger ASR

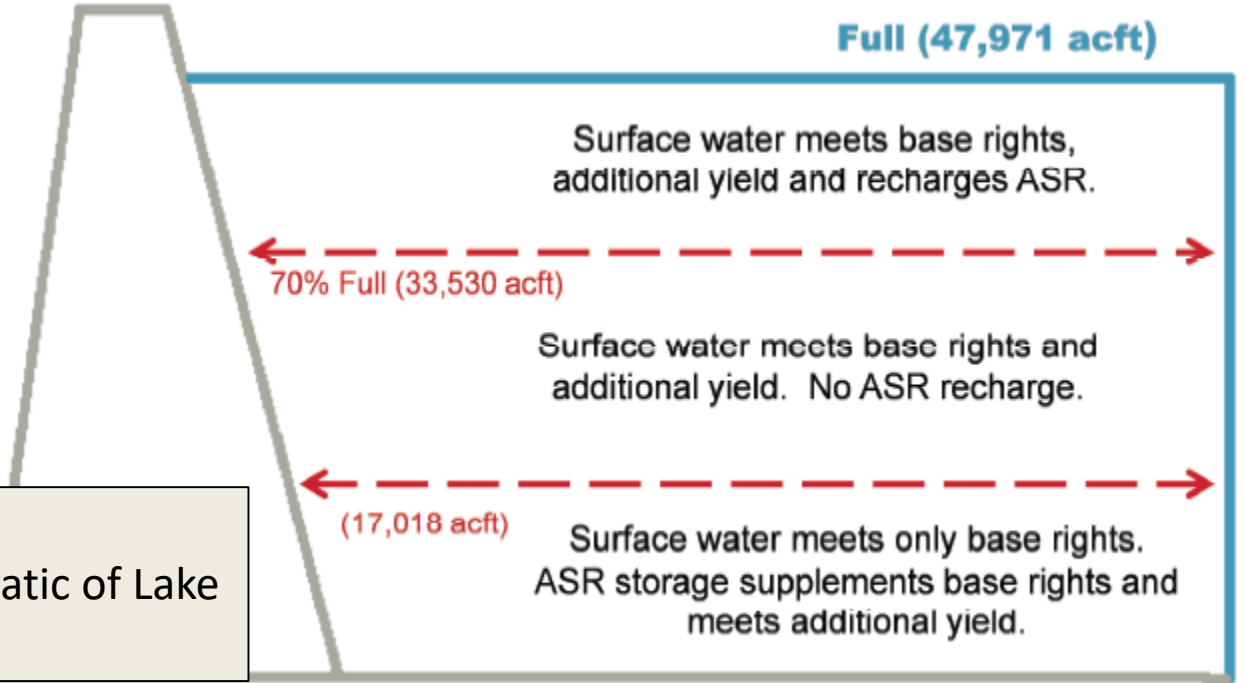
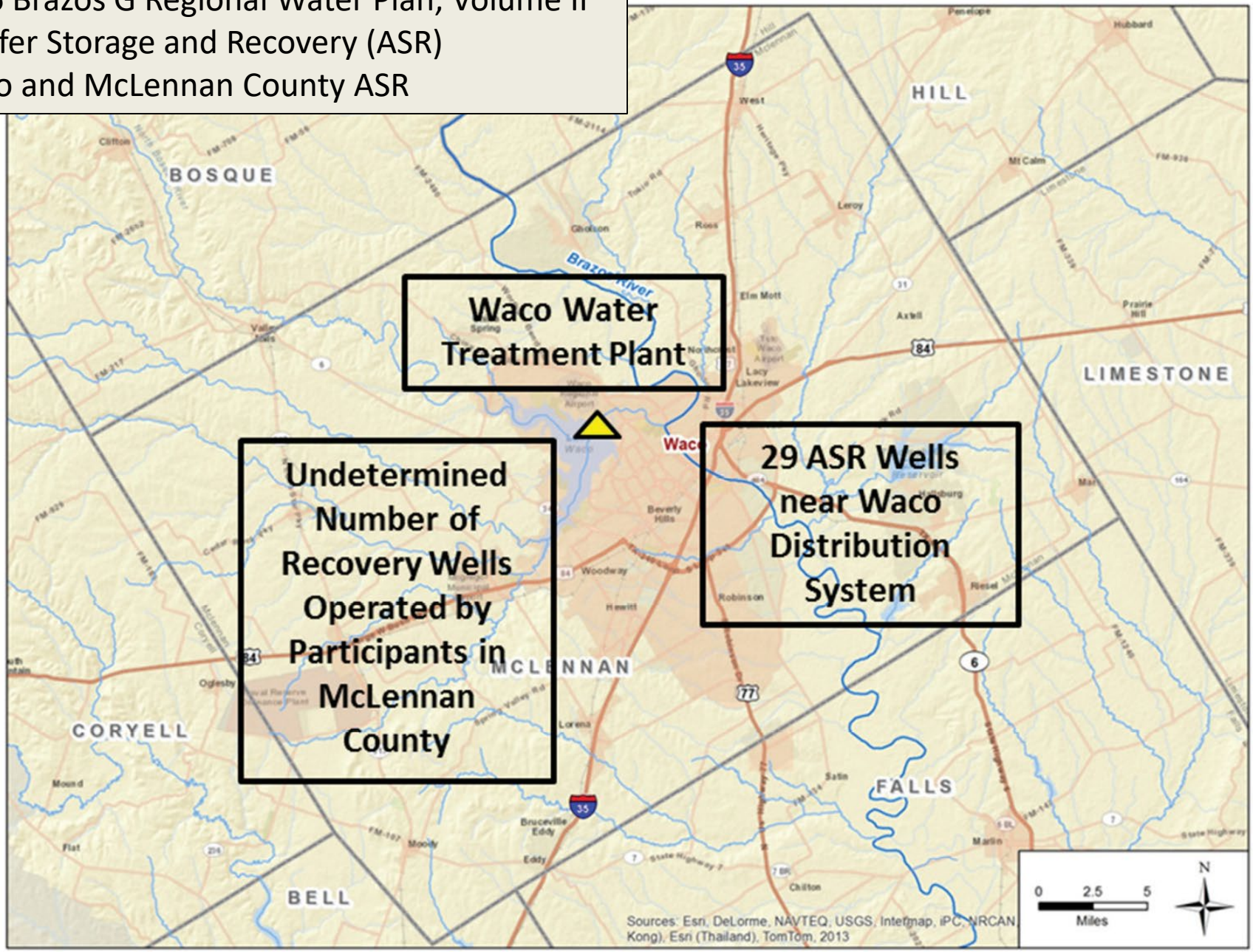


Figure 10.4-1. Project Location
Figure 10.4-2. Operational Schematic of Lake Granger and ASR Project

2016 Brazos G Regional Water Plan, Volume II
Aquifer Storage and Recovery (ASR)
Waco and McLennan County ASR



Document Path: W:\000044\2016_Plan\GIS\map_docs\arcmap\Mclennan_Basemap.mxd

Figure 10.5-1. Location of Waco and McLennan County ASR Project

2016 Brazos G Regional Water Plan, Volume II
Aquifer Storage and Recovery (ASR)
City of Bryan ASR

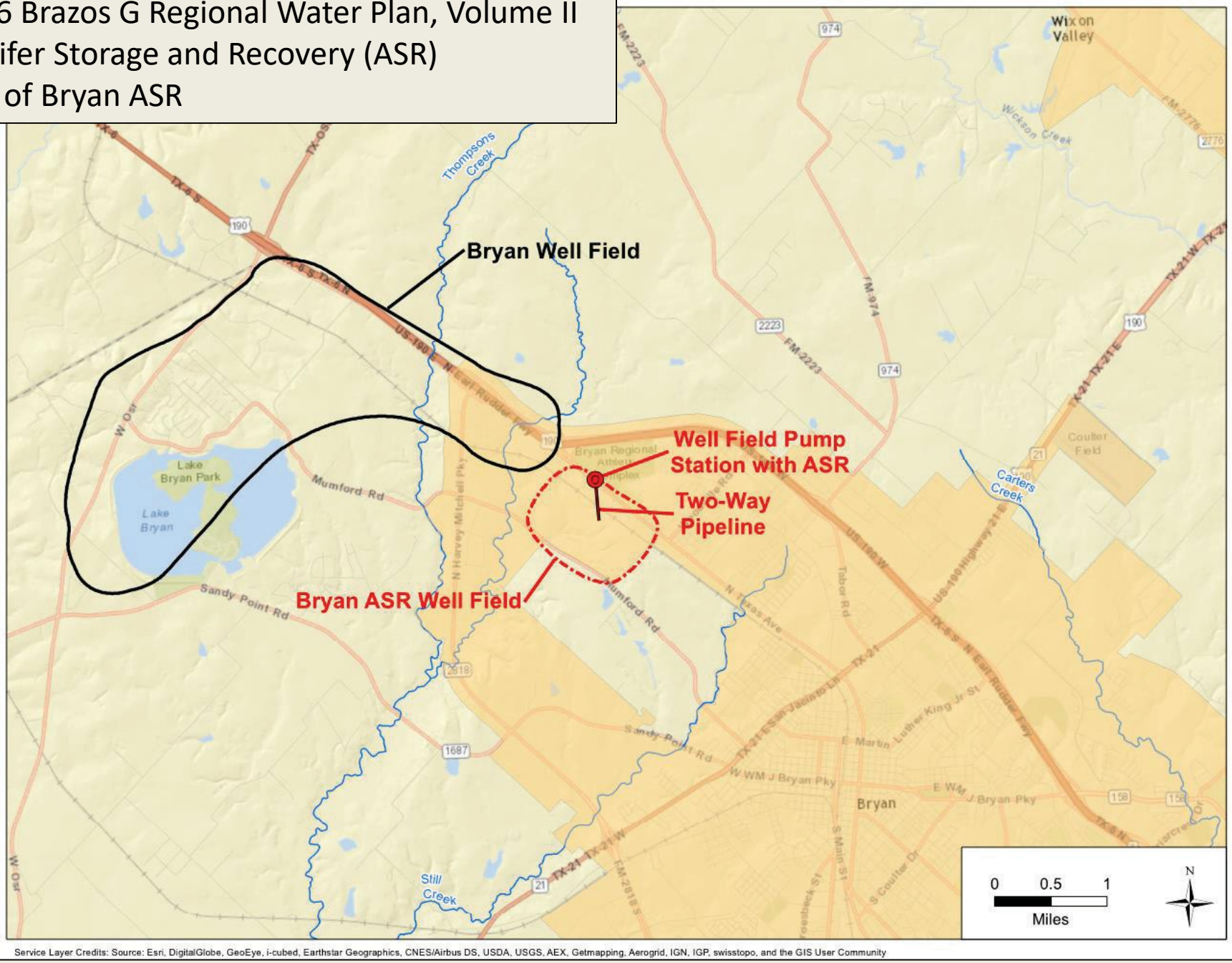


Figure 10.1-1. Bryan's Existing Well Field and Proposed ASR Well Field

2016 Brazos G Regional Water Plan, Volume II
Aquifer Storage and Recovery (ASR)
City of College Station ASR

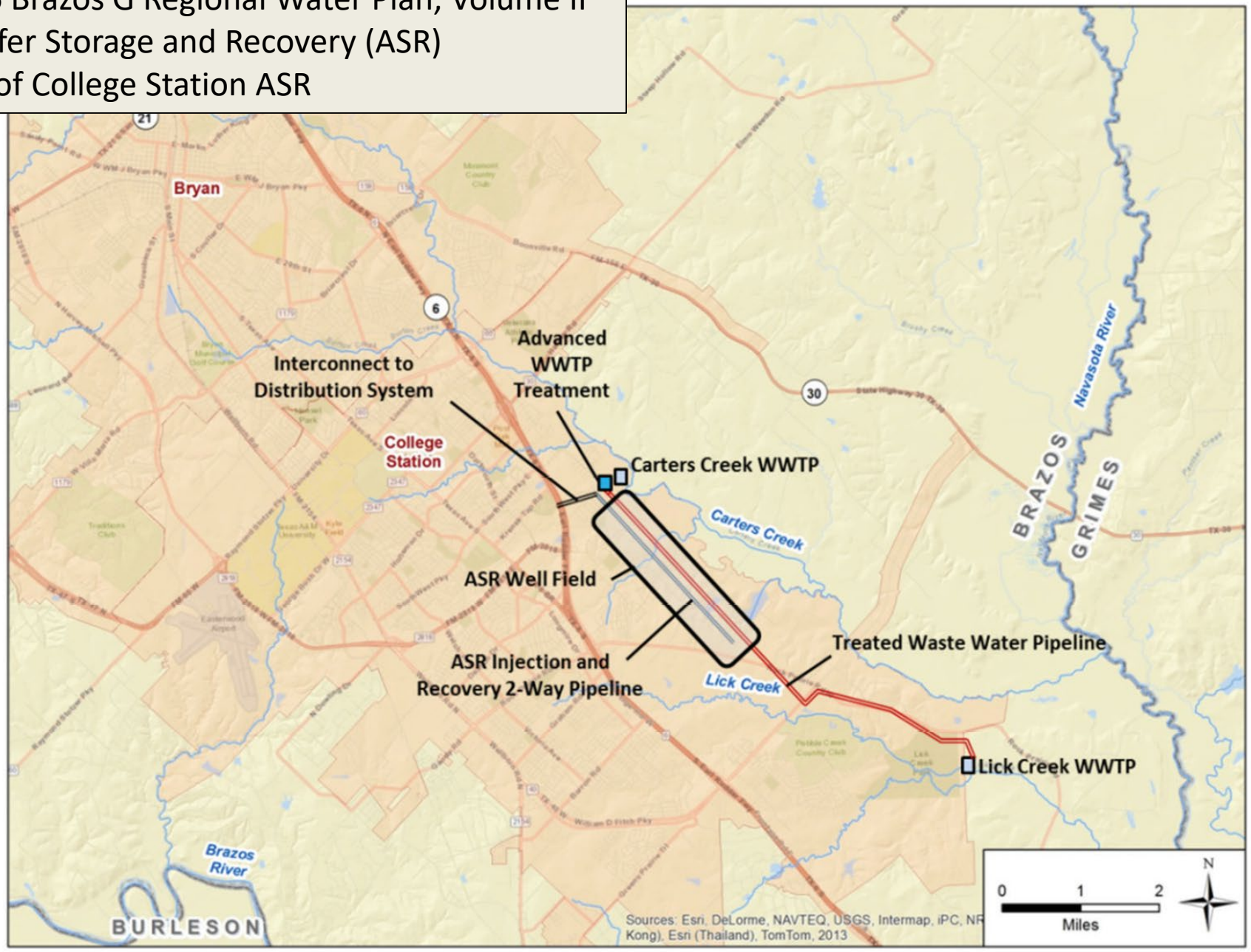
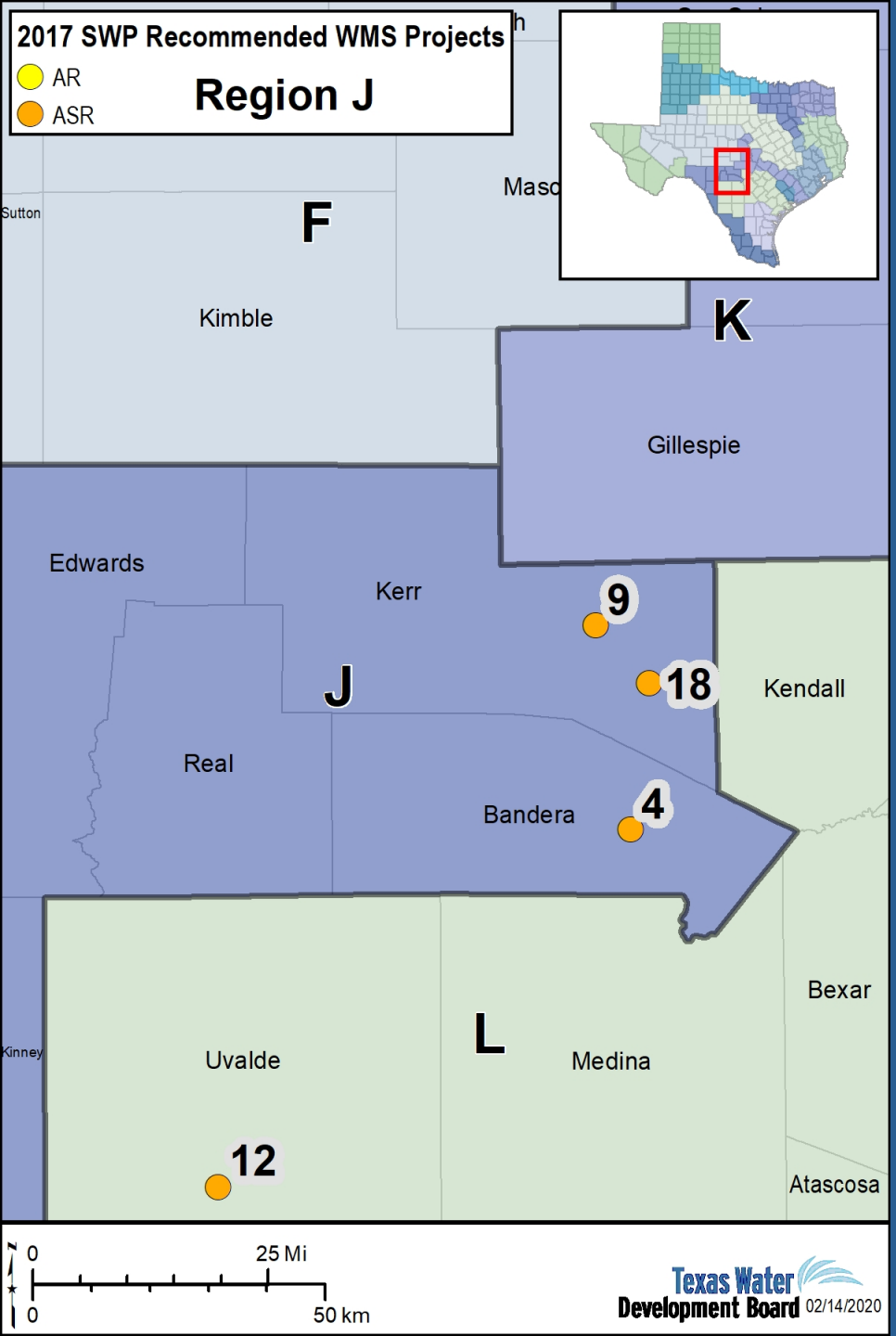


Figure 10.2-1. Location of College Station's ASR Project



4 - City of Bandera

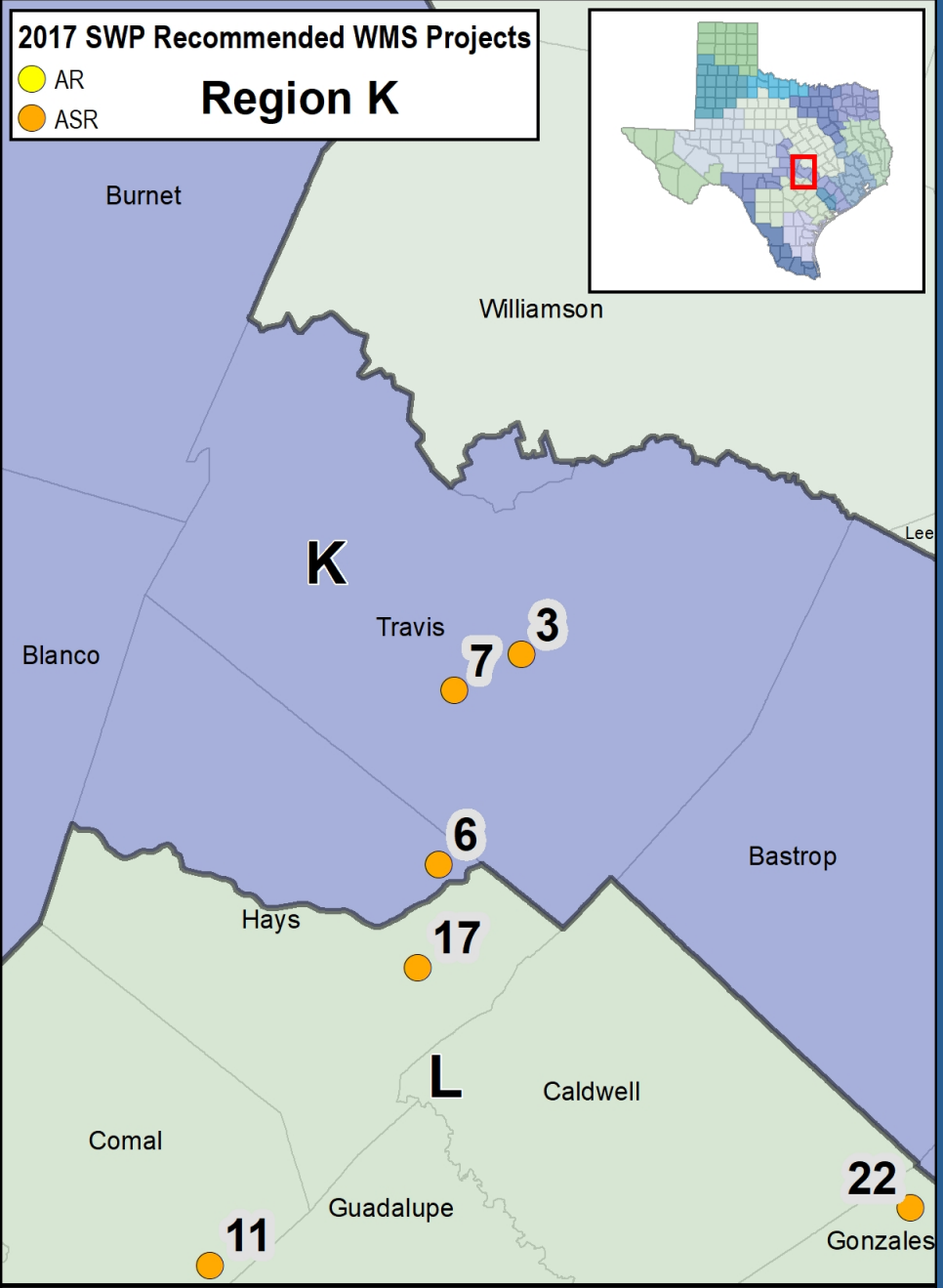
- Online decade: 2040
- Source water: SW
- Target Aquifer: lower Trinity Aquifer
- Volume estimate: 500-1,500 AF/year
- Cost: $29,450,000
- Other: 2 ASR wells

9 – City of Kerrville

- Online decade: 2020
- Source water: SW
- Target Aquifer: lower Trinity Aquifer
- Volume estimate: 3,360 AF/year
- Cost: $11,543,000
- Other: expansion +2 ASR wells for a total of 4

18 – Kerr County

- Online decade: 2020
- Source water: SW
- Target Aquifer: lower Trinity Aquifer
- Volume estimate: 1,124 AF/year
- Cost: $1,258,000
- Other notes: 2 WMS, paired with a new WTP (+$25,581,000)



3 – City of Austin

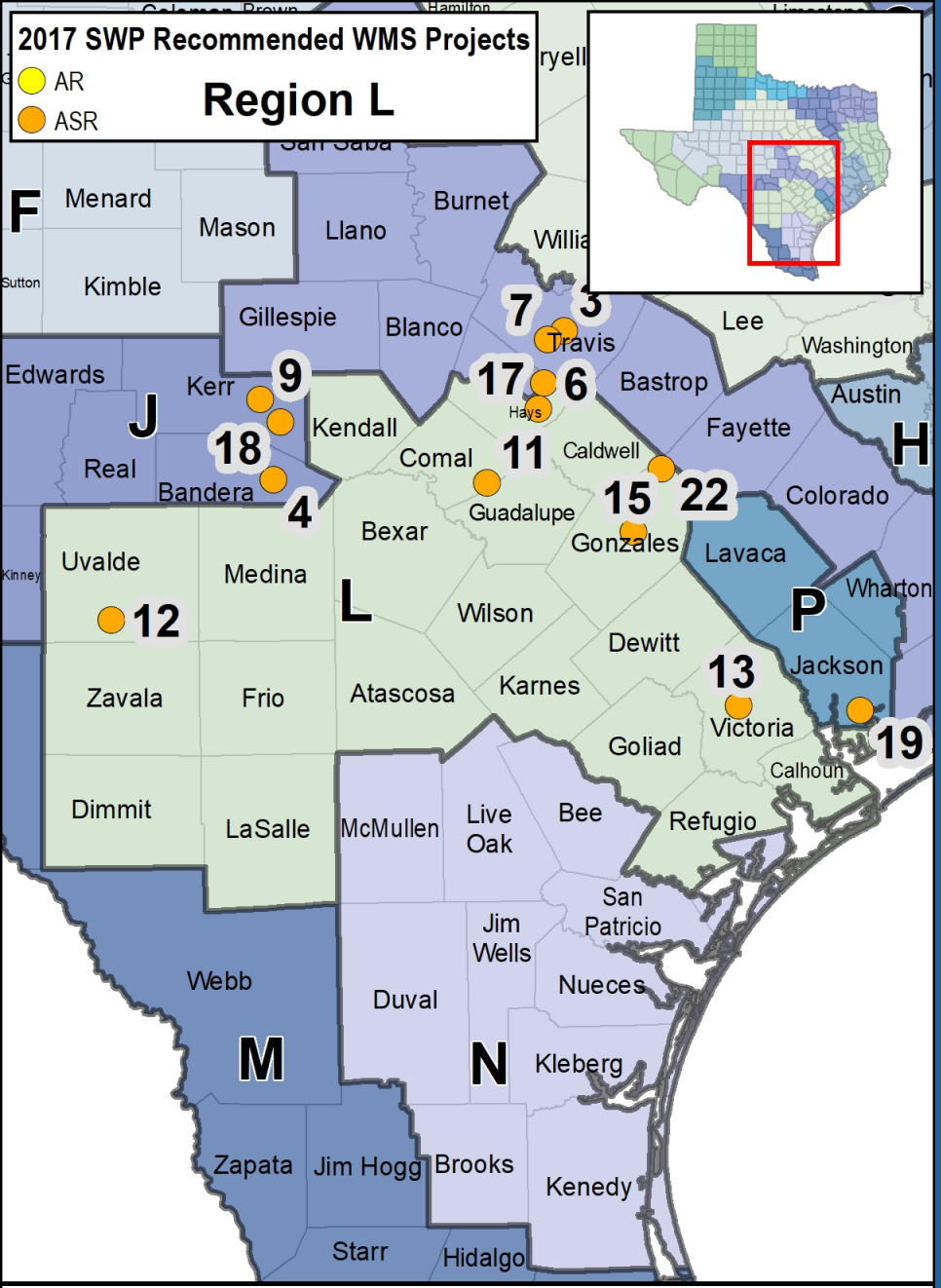
- Online decade: 2020
- Source water: SW
- Target Aquifer: Carrizo-Wilcox Aquifer
- Volume estimate: 5,048 AF/year
- Cost: $312,316,000
- Other: River diversion and 9 ASR wells in Bastrop County

6 – Buda-Hays Co.-Mountain City-Sunset Valley

- Online decade: 2030
- Source water: GW
- Target Aquifer: middle Trinity Aquifer
- Volume estimate: 1,144 AF/year
- Cost: $13,000,000
- Other: excess water only draw during non-drought years

7 – Buda-Hays Co-Creedmoor-Maha WSC

- Online decade: 2030
- Source water: GW
- Target Aquifer: Saline Edwards BFZ
- Volume estimate: 1,000 AF/year
- Cost: $15,000,000
- Other: recovered water might need desalination



11 - City of New Braunfels

- Online decade: 2020
- Source water: probably SW, but could add GW
- Target Aquifer: lower Trinity Aquifer
- Volume estimate: 8,300 AF/year
- Cost: $26,269,000
- Other: pilot study done

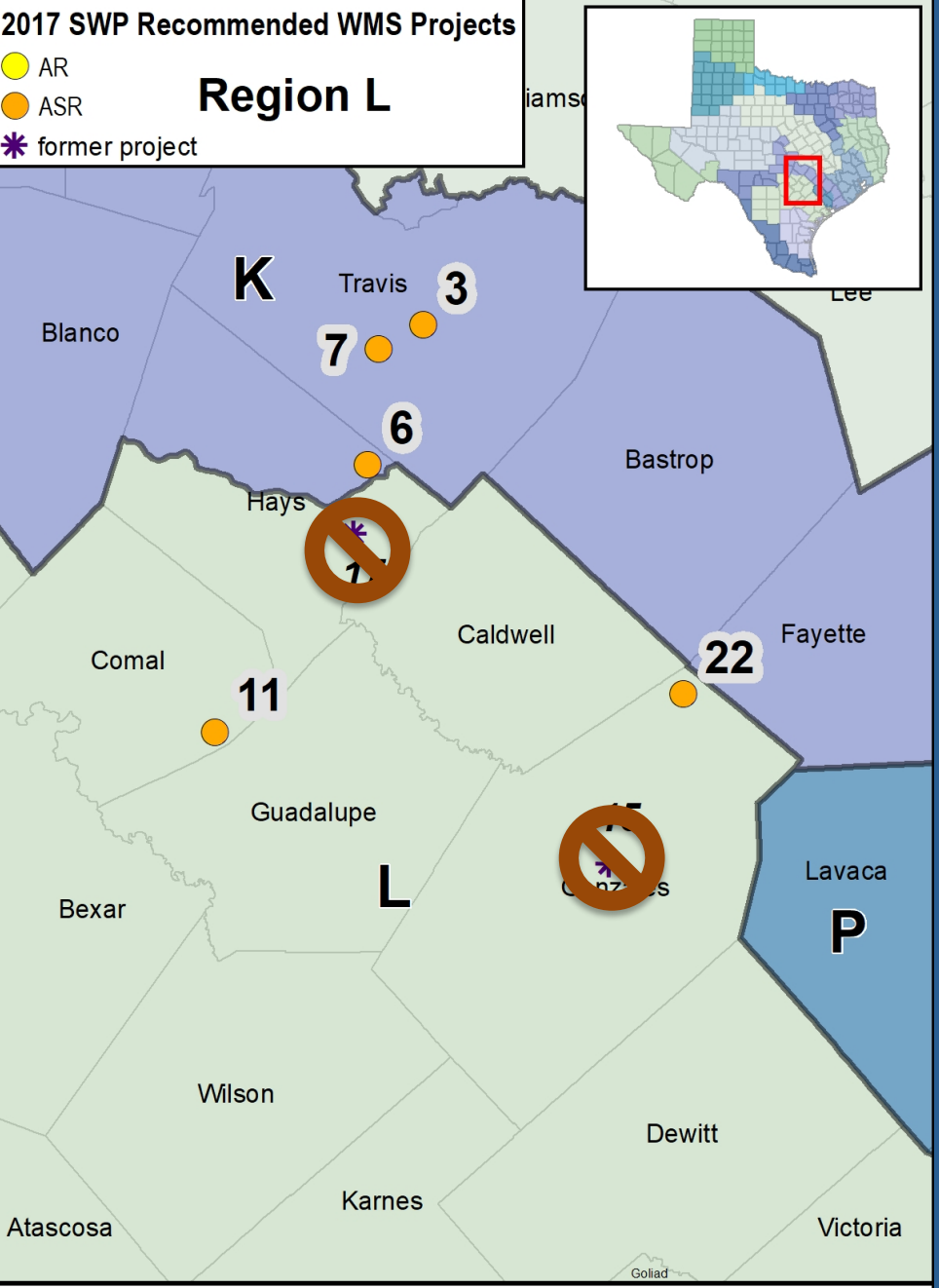
12 – City of Uvalde

- Online decade: 2020
- Source water: GW
- Target Aquifer: Carrizo Aquifer (Zavala County)
- Volume estimate: 758 to 4,000 AF/year
- Cost: $ 32,405,000
- Other: envisioned planned v. MAG-limited plan

13 – City of Victoria

"Victoria ASR"

- Online decade: 2030
- Source water: SW
- Target Aquifer: Gulf Coast Aquifer
- Volume estimate: 7,900 AF/year
- Cost: $ 21,100,000
- Other: 10 new ASR wells and 6 retrofits



22 - Guadalupe-Blanco River Authority Conjunctive Use

- Online decade: 2020
- Source water: SW
- Target Aquifer: Carrizo Aquifer
- Volume estimate: 42,000 AF/year
- Cost: $700,897,000
- Other: added via a SWP amendment to replace #15 & #17

15 – Guadalupe Blanco River Authority Surface Water

- Online decade: 2020
- Source water: SW
- Target Aquifer: Carrizo Aquifer
- Volume estimate: 50,000 AF/year
- Cost: $736,381,000
- Other: replaced by #22

17 – Wimberley and others

- Online decade: 2020
- Source water: SW
- Target Aquifer: Carrizo Aquifer
- Volume estimate: 15,314 AF/year
- Cost: $37,432,000
- Other: replaced by #22

Figure 5.2.9-1 NBU ASR Location Map

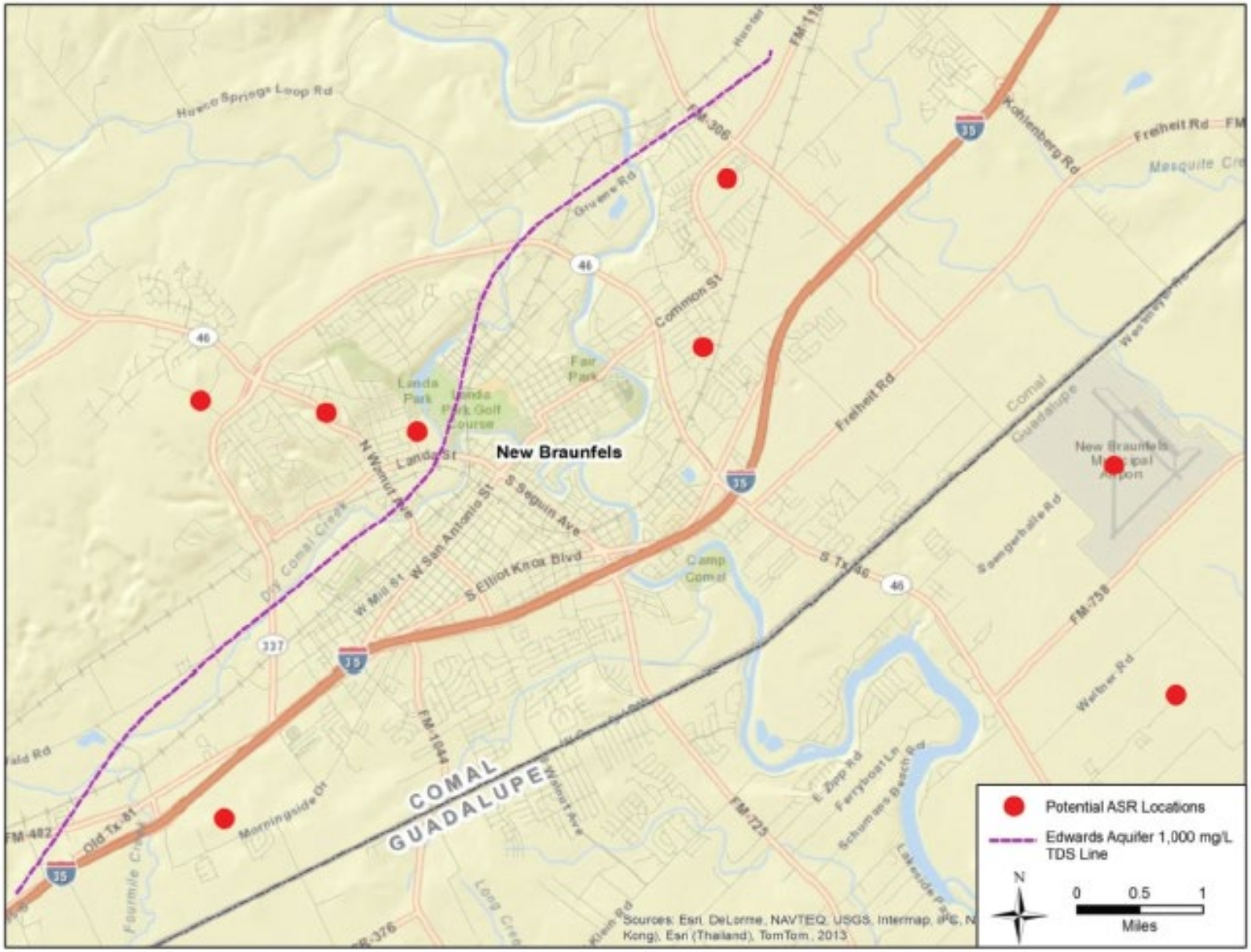
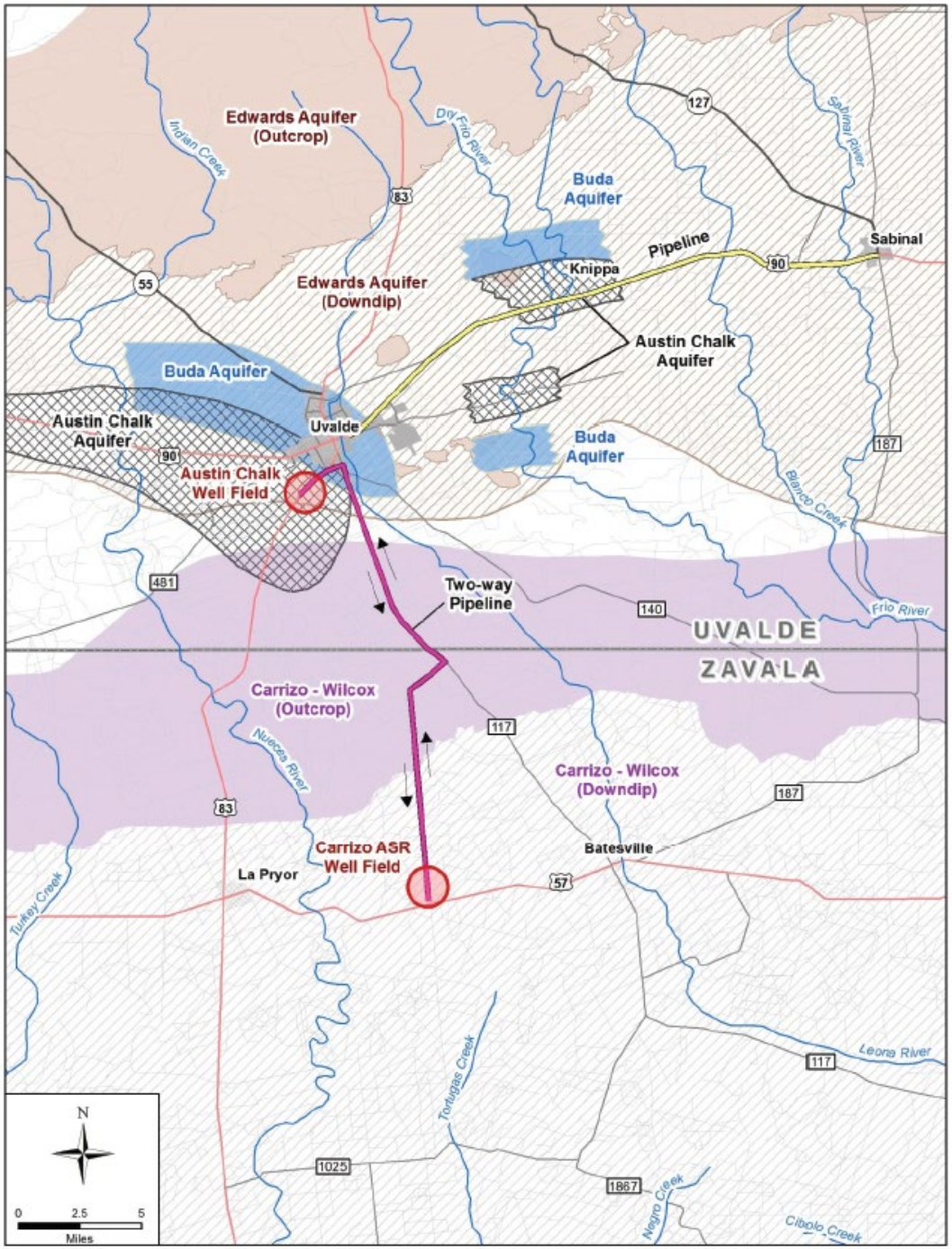
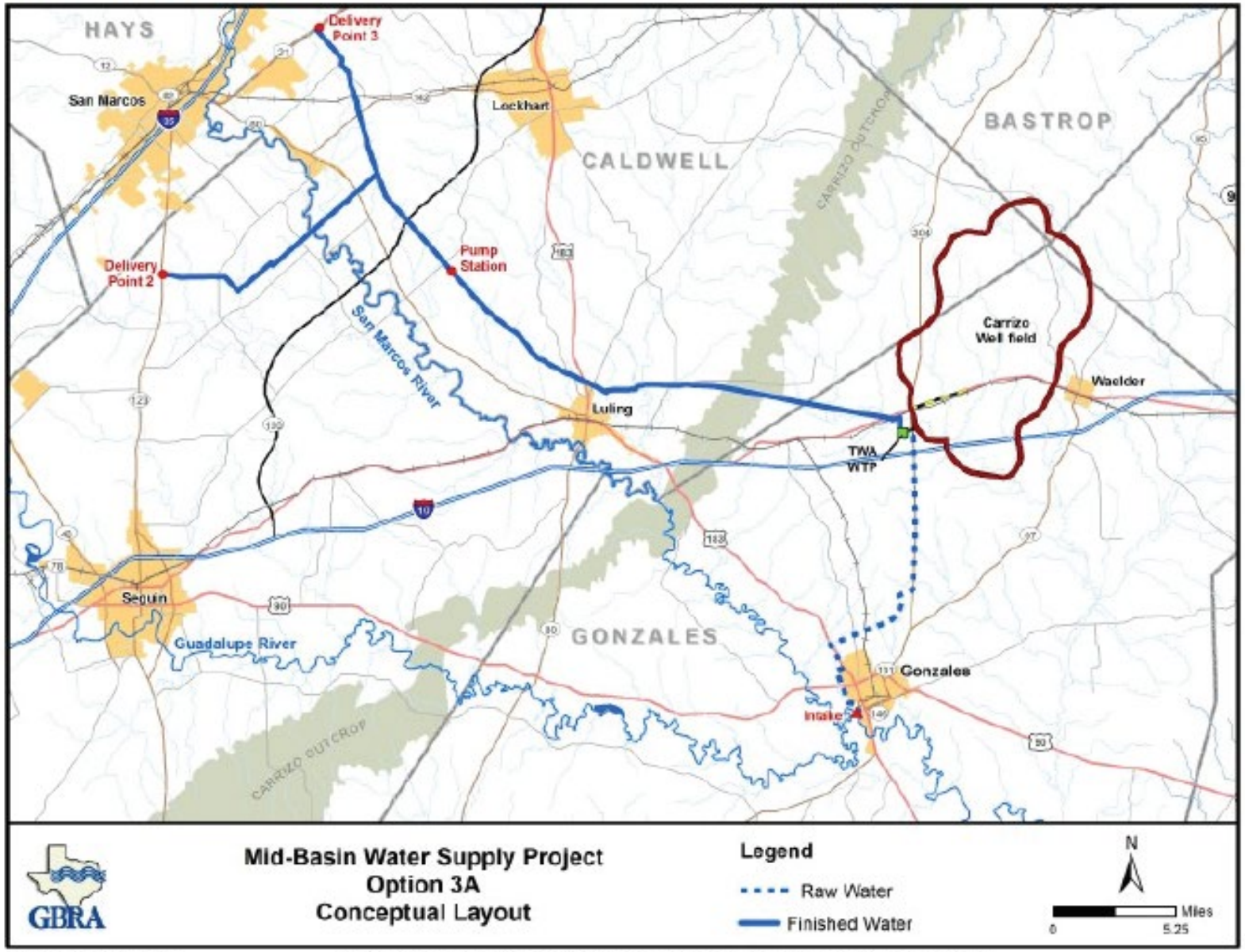


Figure 5.2.15-1 Preliminary Facilities Design for Uvalde ASR Region L Plan

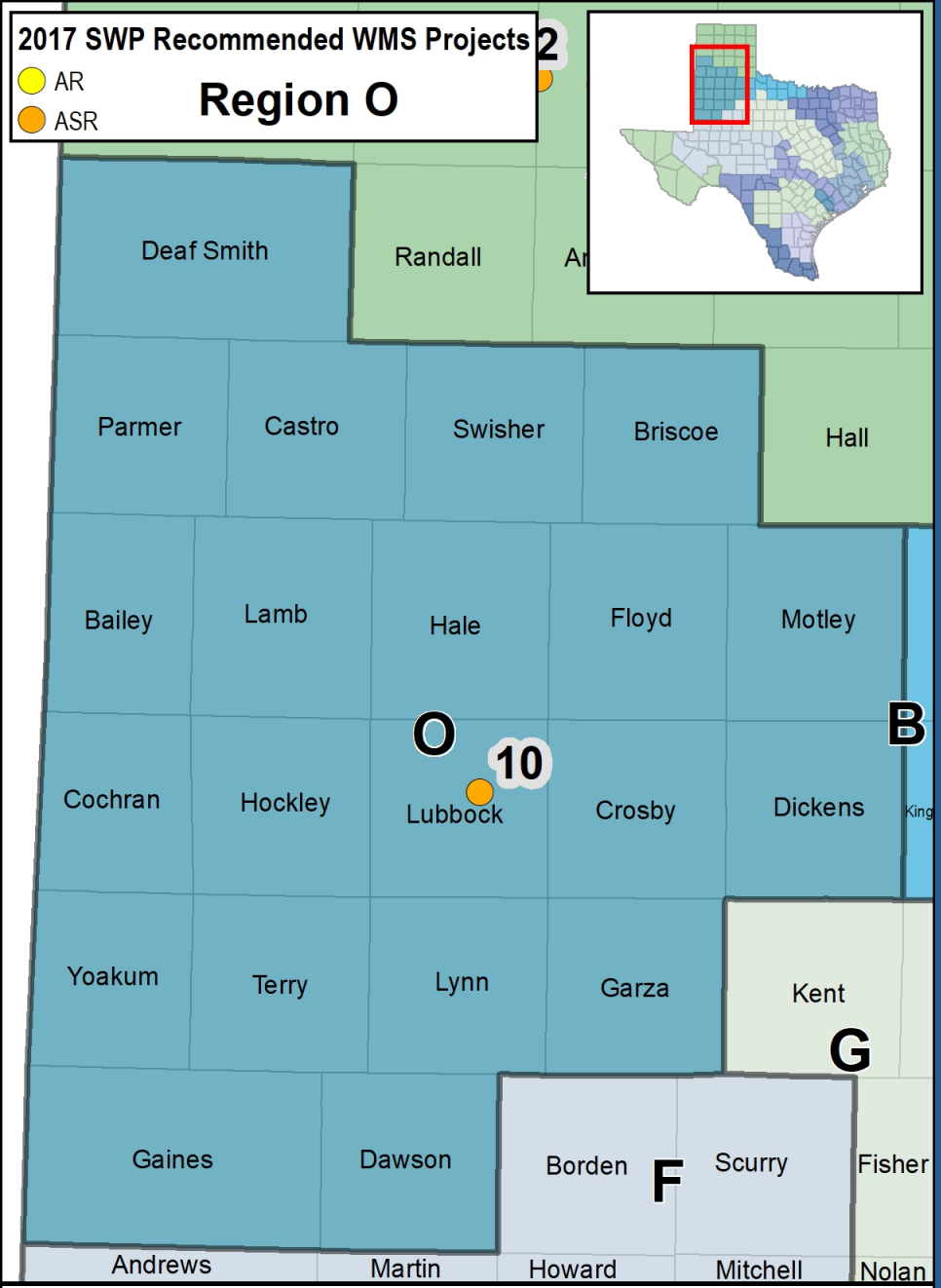


2016 South Central Texas Regional Water Plan, Volume II
Aquifer Storage and Recovery (ASR) for Uvalde

Figure 5.2.32-1 MBWSP – Conjunctive Use Conceptual Layout



2016 South Central Texas Regional Water Plan, Volume II
GBRA Mid-Basin Water Supply Project – Conjunctive Use with ASR



10 – City of Lubbock

- Online decade: 2030
- Source water: mixed, SW-GW
- Target Aquifer: Ogallala Aquifer
- Volume estimate: 6,090 AF/year
- Cost: $62,345,000
- Other: 45 ASR wells, assuming 20% loss to nearby wells

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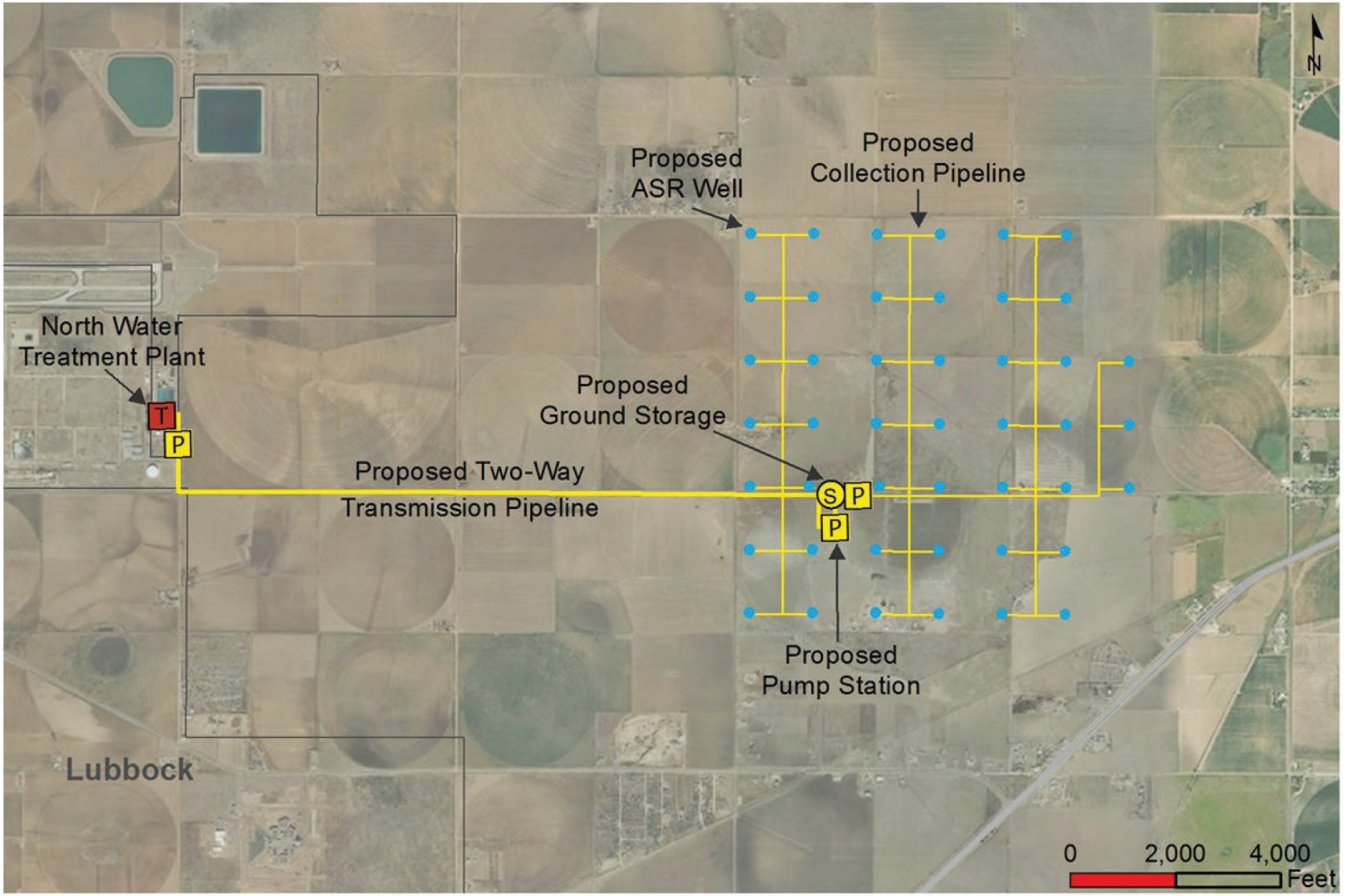


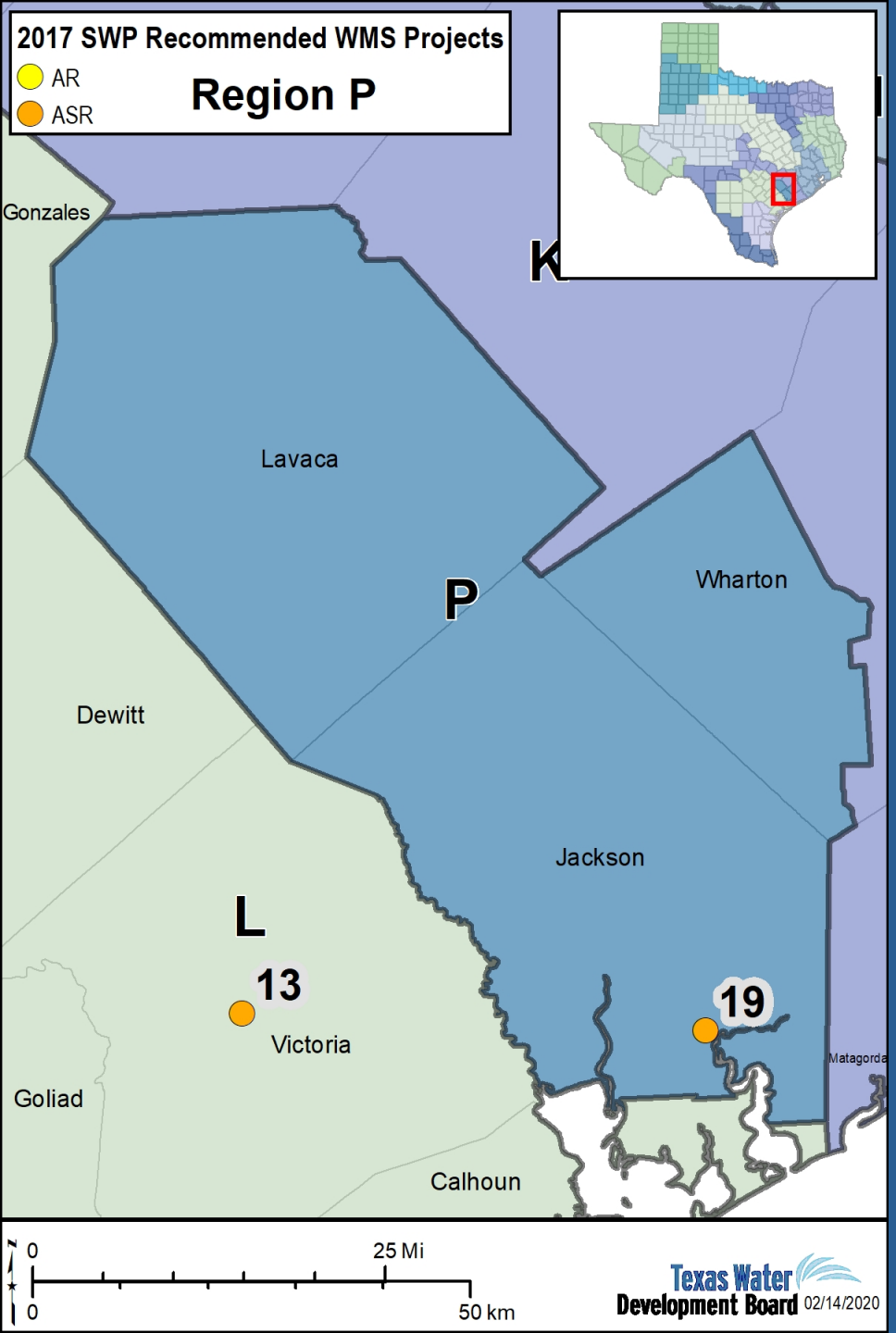
Figure 5-3

Source: City's Strategic Water Supply Plan (City of Lubbock, 2013)

Daniel B. Stephens & Associates, Inc.
10/27/2015
JN WR11.0030

LLANO ESTACADO REGION

CRMWA to Aquifer Storage and Recovery Infrastructure

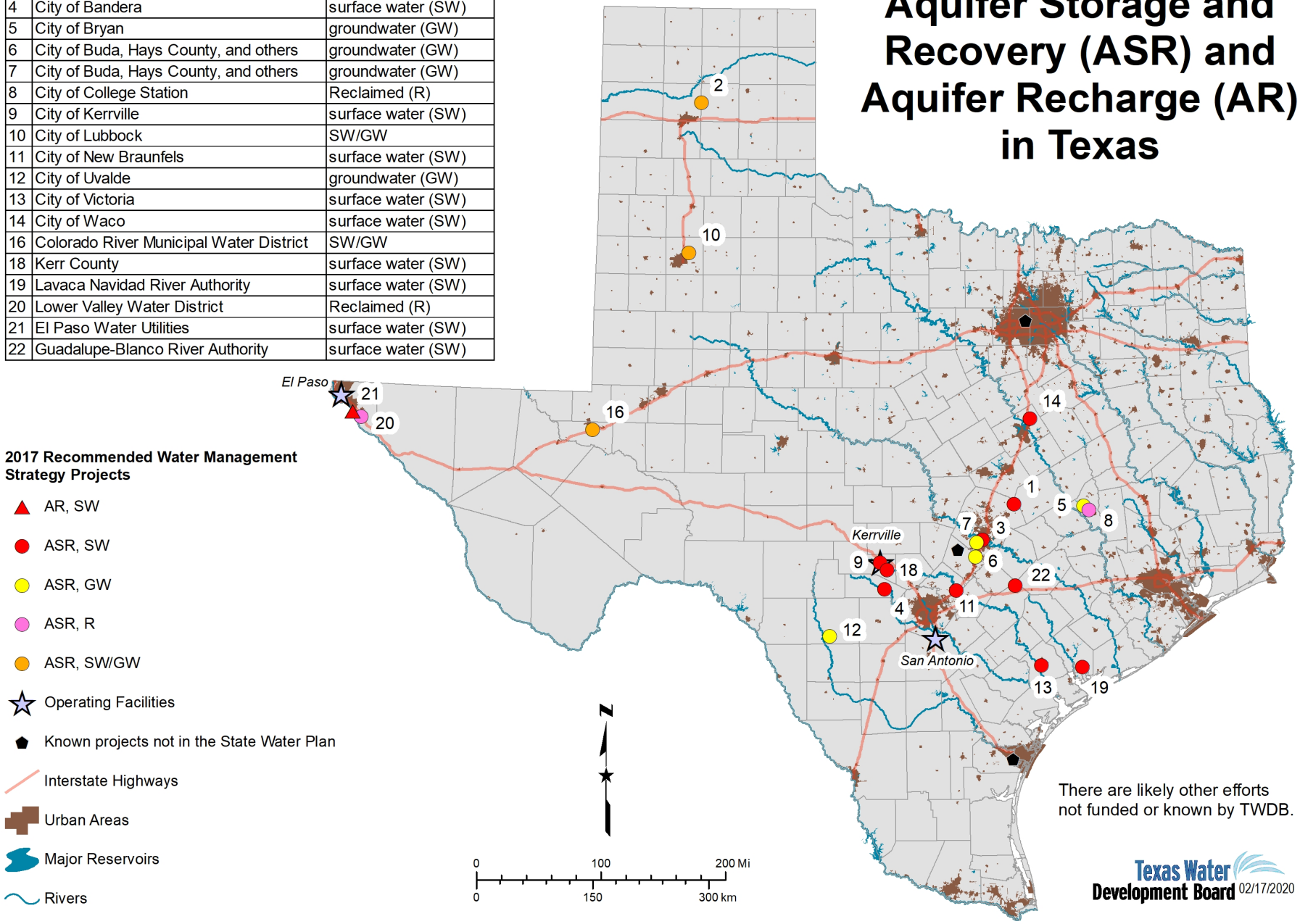


19 - Lavaca Navidad River Authority

- Online decade: 2020
- Source water: SW
- Target Aquifer: Gulf Coast Aquifer
- Volume estimate: 14,163 AF/year
- Project Cost: $130,169,000
- Other notes: feasibility study done, same one as Victoria

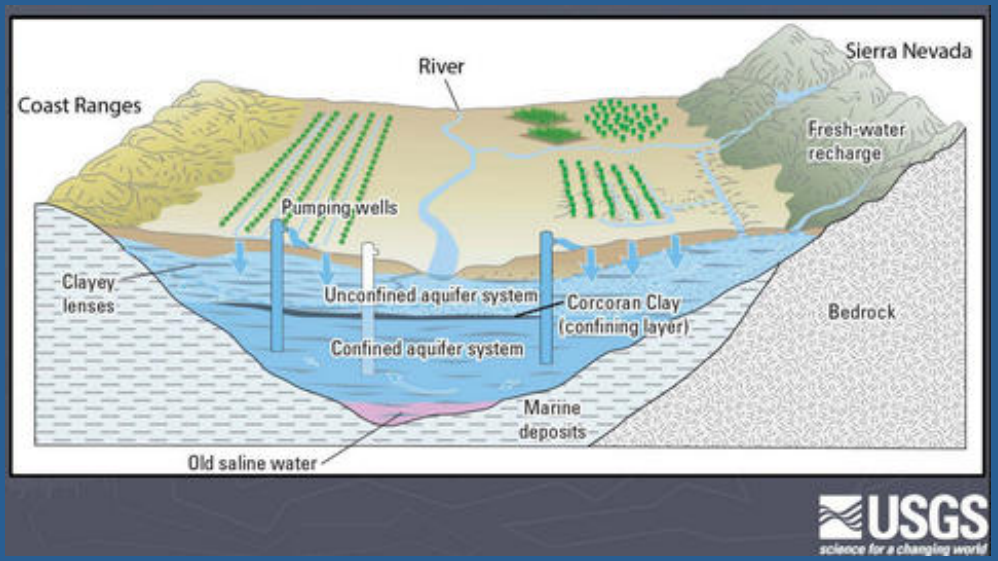
Aquifer Storage and Recovery (ASR) and Aquifer Recharge (AR) in Texas

ID	Project sponsor	Source Water Type
1	Brazos River Authority	surface water (SW)
2	Canadian River Municipal Authority	SW/GW
3	City of Austin	surface water (SW)
4	City of Bandera	surface water (SW)
5	City of Bryan	groundwater (GW)
6	City of Buda, Hays County, and others	groundwater (GW)
7	City of Buda, Hays County, and others	groundwater (GW)
8	City of College Station	Reclaimed (R)
9	City of Kerrville	surface water (SW)
10	City of Lubbock	SW/GW
11	City of New Braunfels	surface water (SW)
12	City of Uvalde	groundwater (GW)
13	City of Victoria	surface water (SW)
14	City of Waco	surface water (SW)
16	Colorado River Municipal Water District	SW/GW
18	Kerr County	surface water (SW)
19	Lavaca Navidad River Authority	surface water (SW)
20	Lower Valley Water District	Reclaimed (R)
21	El Paso Water Utilities	surface water (SW)
22	Guadalupe-Blanco River Authority	surface water (SW)



Conjunctive Use

- Coordinated use of ground- and surface water to maximize or sustain yields
- ASR adds agility

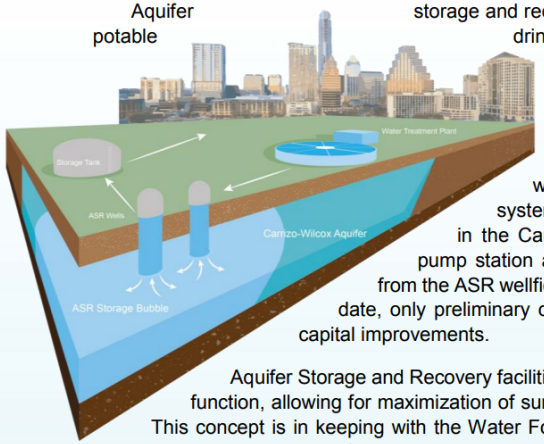


- Flexibility
- Max water rights
- Capture excess water for later use
- Use surface water when it is high, switch to groundwater when it is dry
- Improve water quality
- Improving economic costs
- Irrigation
- Flexible infrastructure can be more expense

Pairing with WTP or WWTP

- Meet water quality requirements for injection
- Utilize reclaimed water
- Prepare recovered water for distribution

9.1.3.1 Aquifer Storage and Recovery – S1

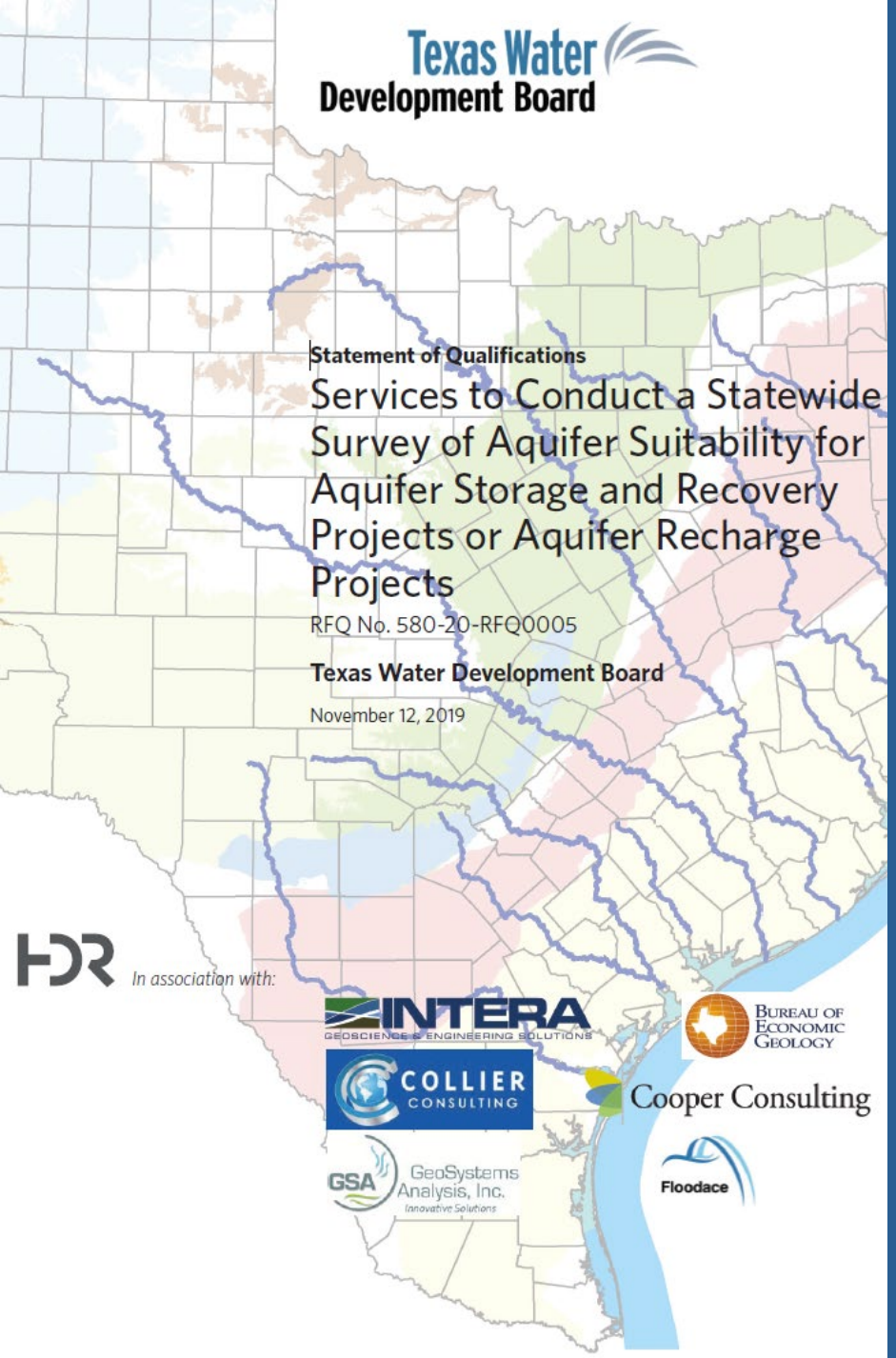


storage and recovery (ASR) is a strategy in which water (ex: drinking water) can be stored in an aquifer during wetter periods and recovered for use during drier periods. The Carrizo-Wilcox ASR strategy recommended in Water Forward for implementation by the 2040 planning horizon includes facilities to pipe treated drinking water from the City of Austin's distribution system to an ASR wellfield for injection and storage in the Carrizo-Wilcox aquifer. Facilities also include a pump station and storage tank to convey recovered water from the ASR wellfield to the City of Austin distribution system. To date, only preliminary costs for an ASR pilot are include in the AW capital improvements.

Aquifer Storage and Recovery facilities would be planned to serve solely a storage function, allowing for maximization of surface water resources during drought periods. This concept is in keeping with the Water Forward guiding principle of maximizing locally available water resources. Site selection will depend on favorable hydrogeology to fulfill the ASR facility's intended storage purpose. In implementing this option, Austin Water would work to develop and

2017 SWP ASR in a nut shell

- Online decades:
  - 2020 (12), 2030 (6), 2040 (1), multi (1)
- Source water types
  - Groundwater (4-8), surface water (9-13), reclaim (2-3), mix (3-5)
- Target aquifers
  - Carrizo-Wilcox (4), Edwards BFZ (1), Gulf Coast (2), Hueco Bolson (2), Ogallala (2), Pecos Valley (1), Queen City-Sparta (1), Trinity (7)
- Estimated Volume
  - ~500 (#7) to 42,000 (#22) AF, average 7,883 AF
- Estimated $/AF (2070)
  - $93 to $3,069, average ~$1,000
- Estimated Project cost
  - $1,258,000 to $700,897,000, average ~$86 million
- If implemented = 123,000 AF/year by 2070
  - 1.5% of all recommended WMS



1. Literature Review
2. Hydrogeological Parameter
3. Excess Water
4. Water Supply Needs
5. Final Suitability Rating
6. Public Data Display
7. Final Report to Legislature by 12/15/2020

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Innovative Water Technologies
http://www.twdb.texas.gov/innovativewater/index.asp

2017 Water Plan
http://www.twdb.texas.gov/waterplanning/swp/2017/index.asp