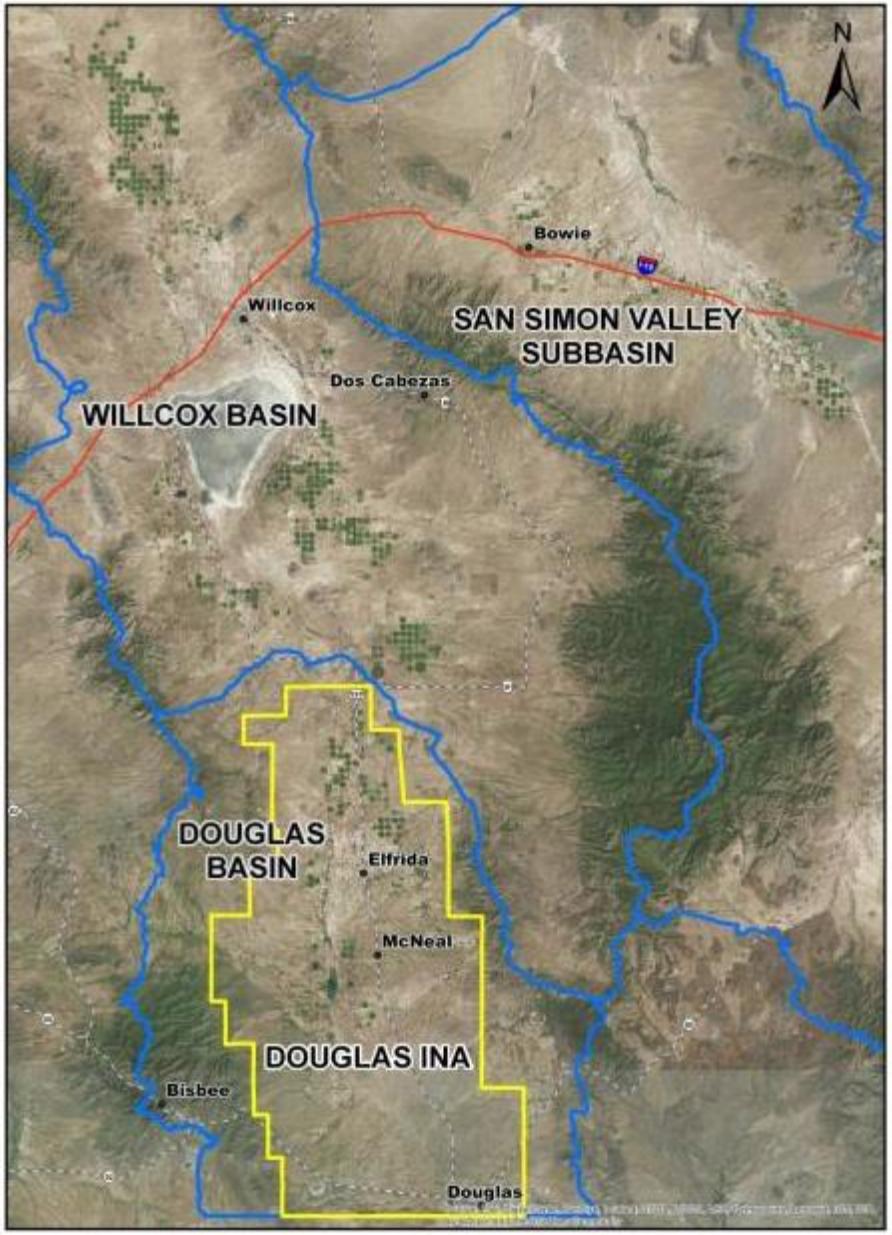
Groundwater Conditions in Southeast Arizona

October 15, 2014

Michael J. Lacey, Director
Arizona Department of Water Resources

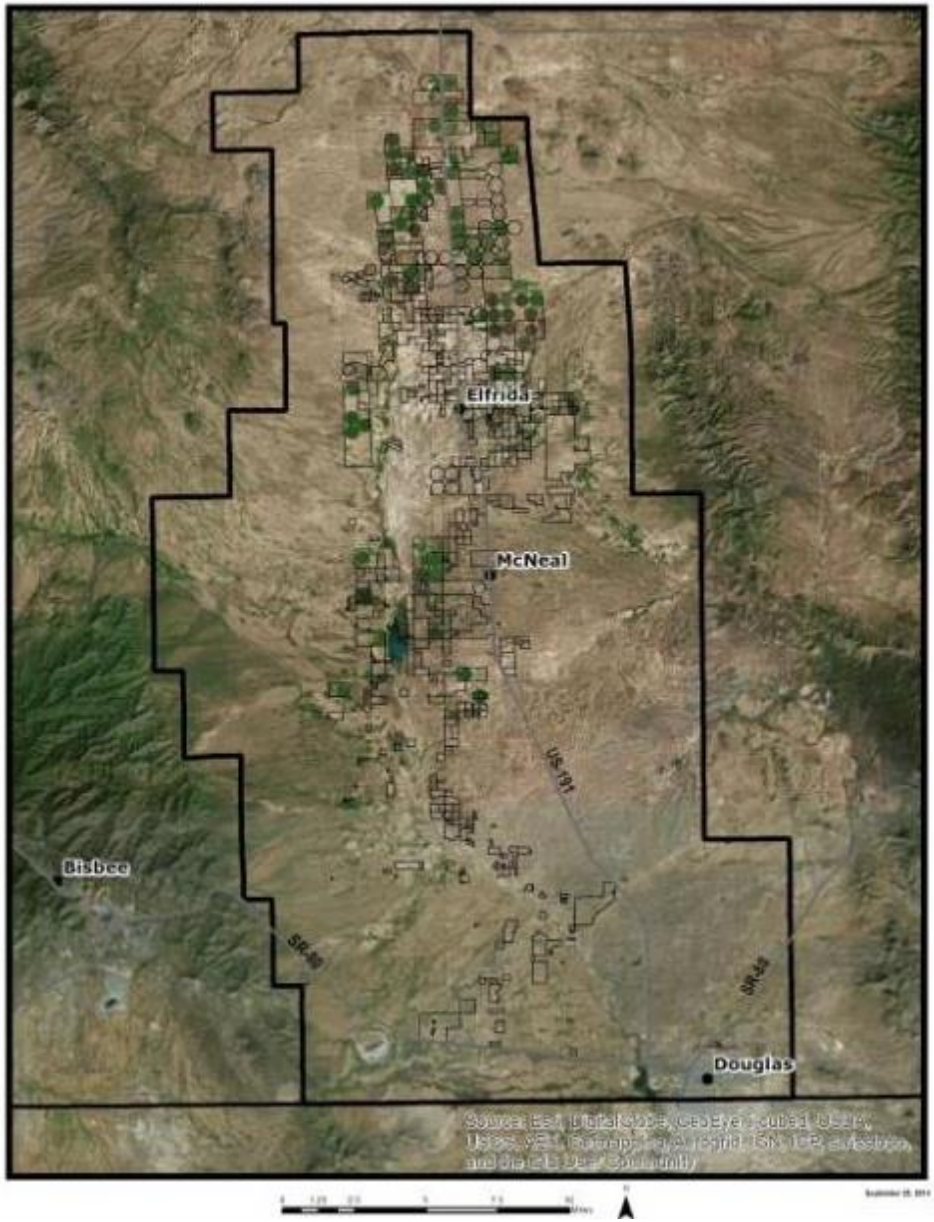
Aerial Image with Irrigated Lands in Southeast Arizona



- City or Town
- Major Road
- Interstate Highway
- Groundwater Subbasins
- Douglas INA
- Arizona Border

Source: ADWR

Map of Douglas Irrigation Non-Expansion Area Irrigation Authority Lands

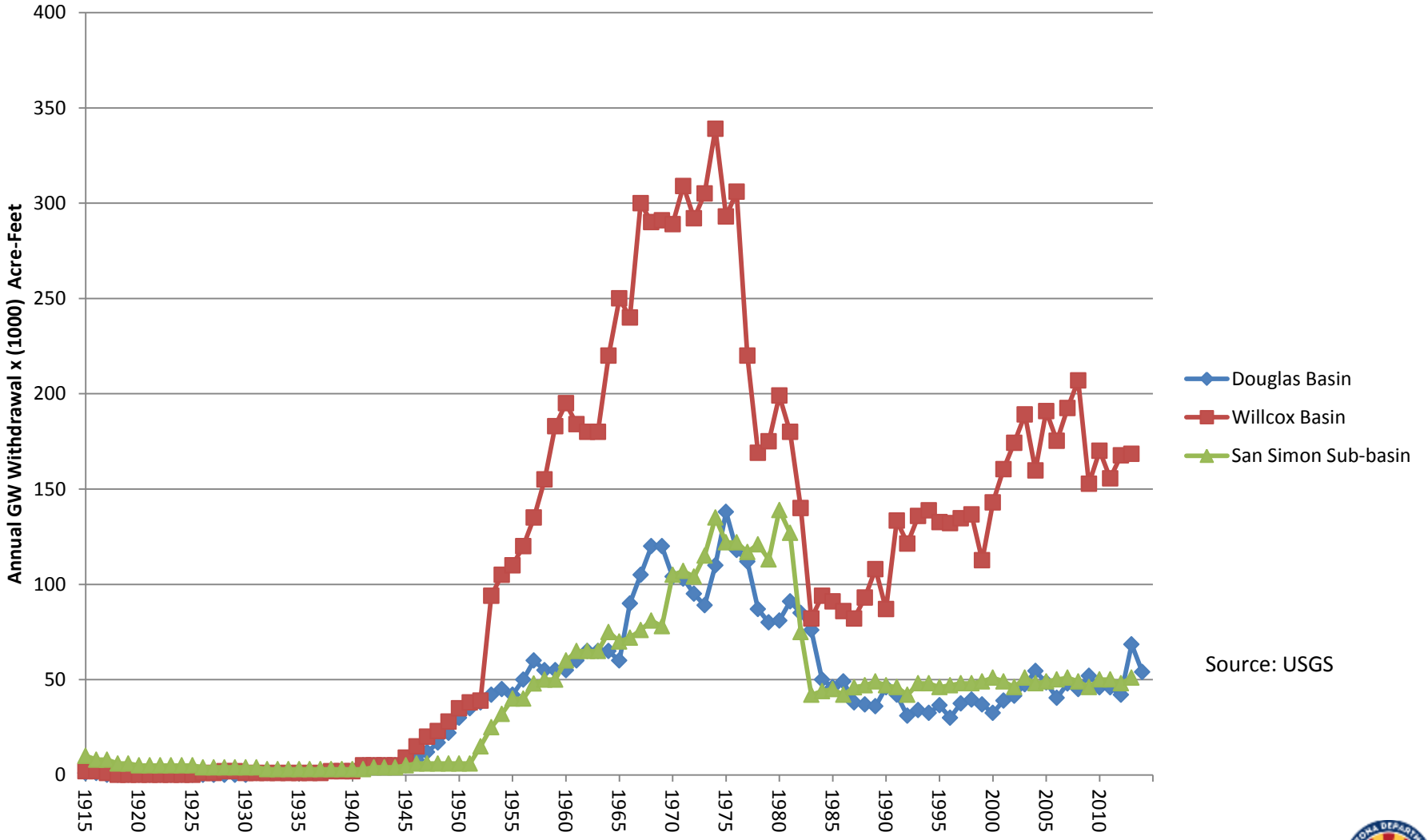


Legend

- Douglas INA
- Major Roads
- Cities

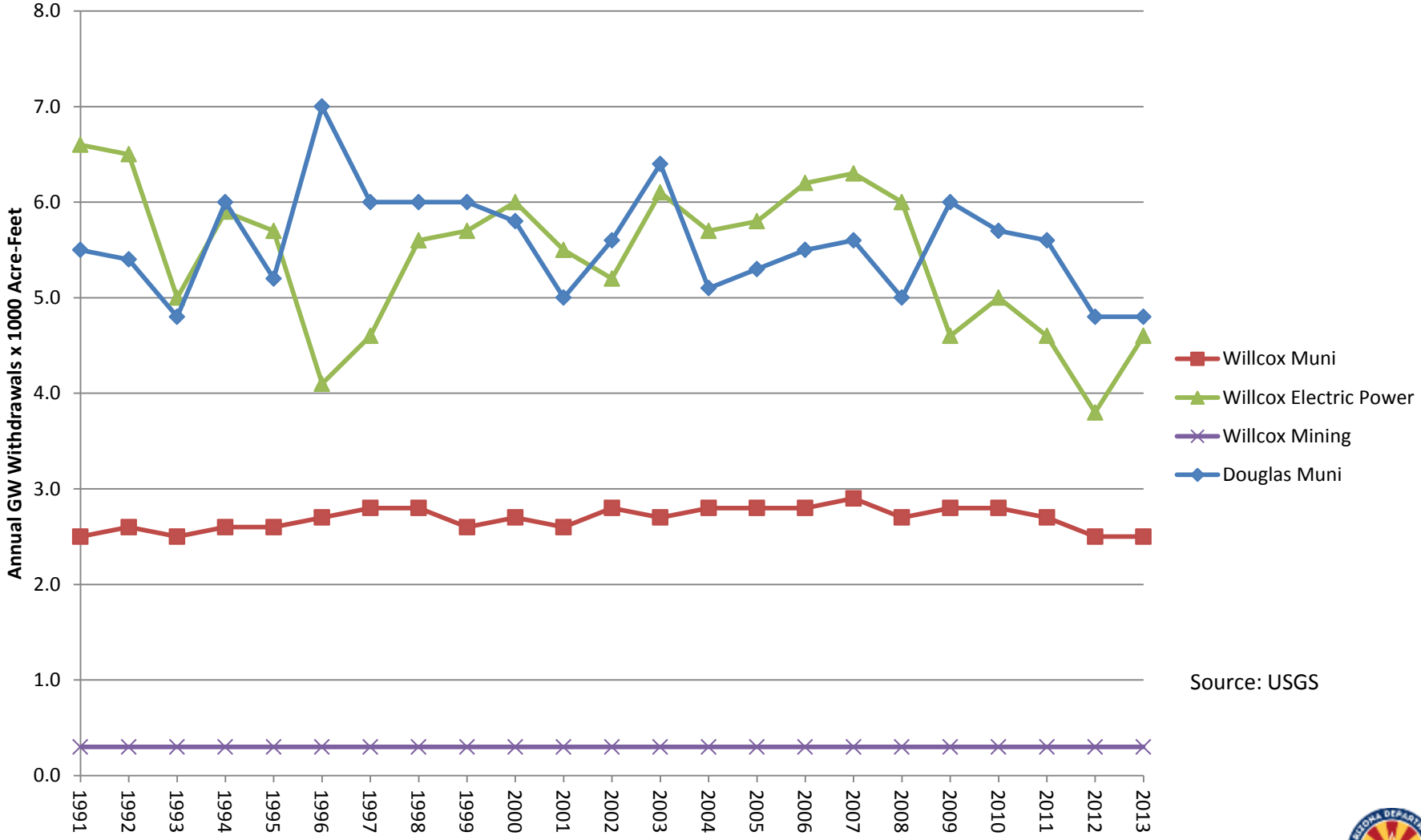
Source: ADWR

Total Estimated Groundwater Withdrawals In The Douglas and Willcox Basins and the San Simon Sub-Basin 1915 to 2013

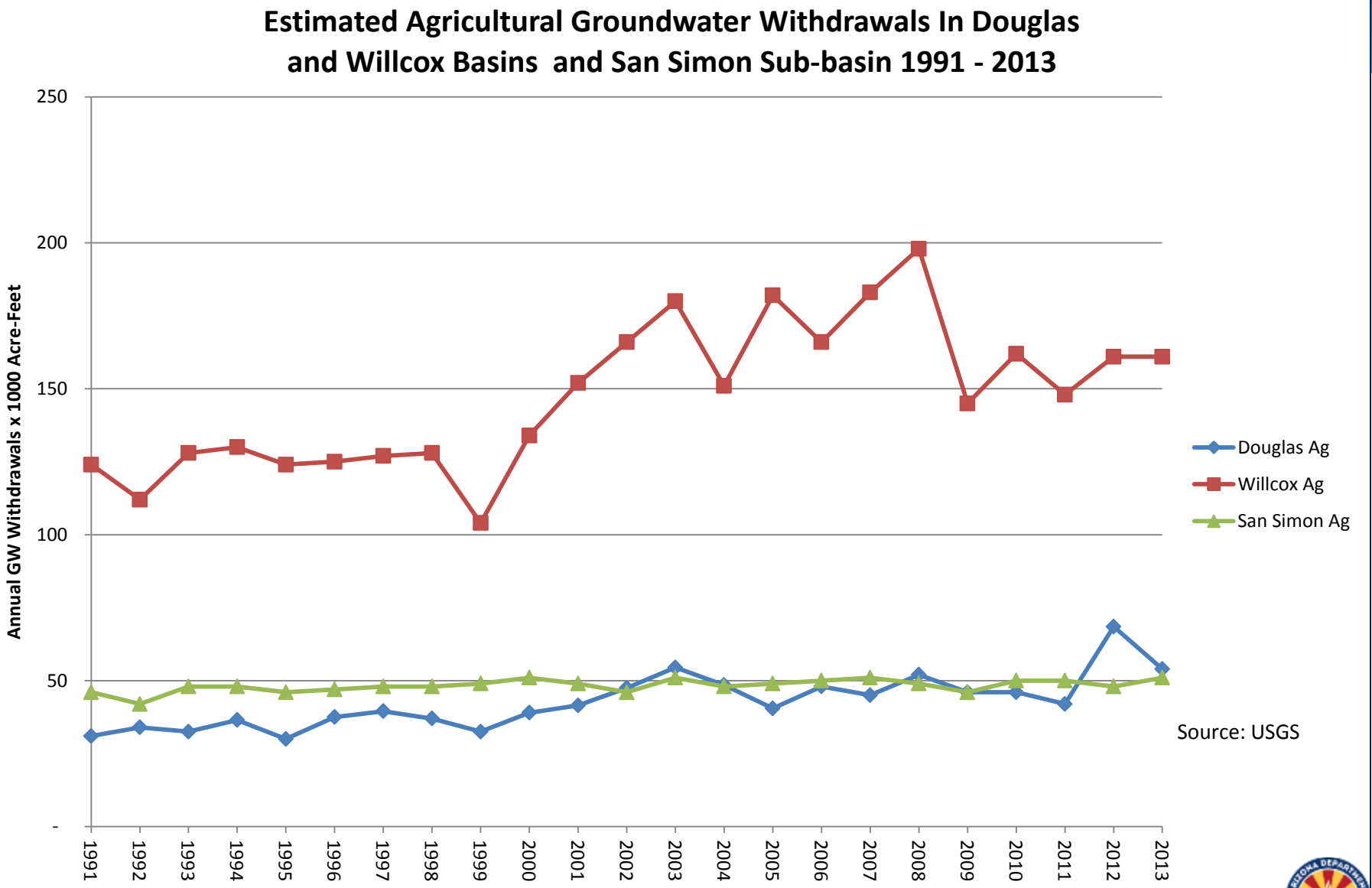


Source: USGS

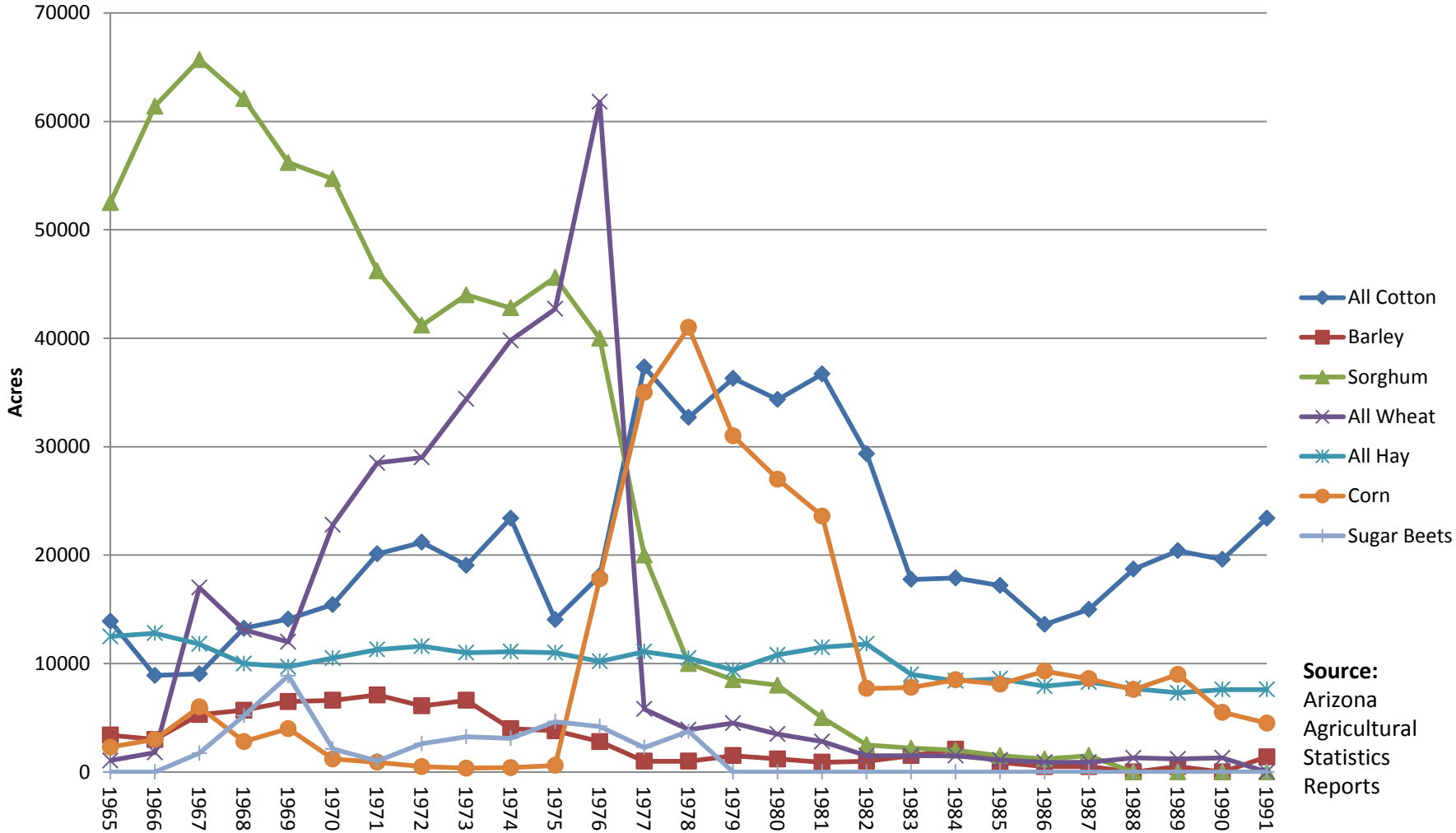
Estimated Municipal, Electric Power and Mining Groundwater Withdrawals In Douglas and Willcox Basins 1991 - 2013



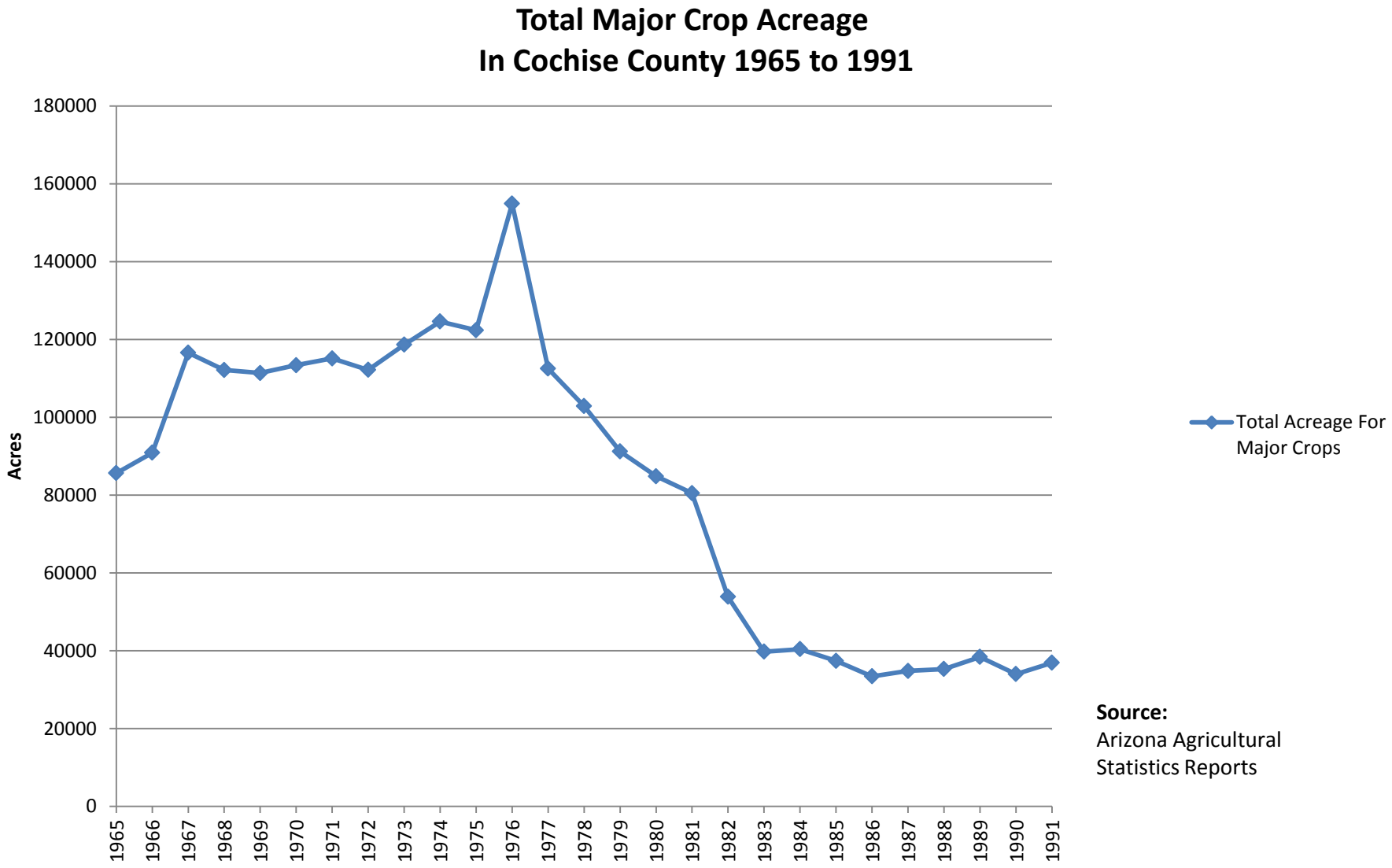
Source: USGS


Estimated Agricultural Groundwater Withdrawals In Douglas and Willcox Basins and San Simon Sub-basin 1991 - 2013
Annual GW Withdrawals x 1000 Acre-Feet
250
200
150
100
50
-
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Douglas Ag
Willcox Ag
San Simon Ag
Source: USGS

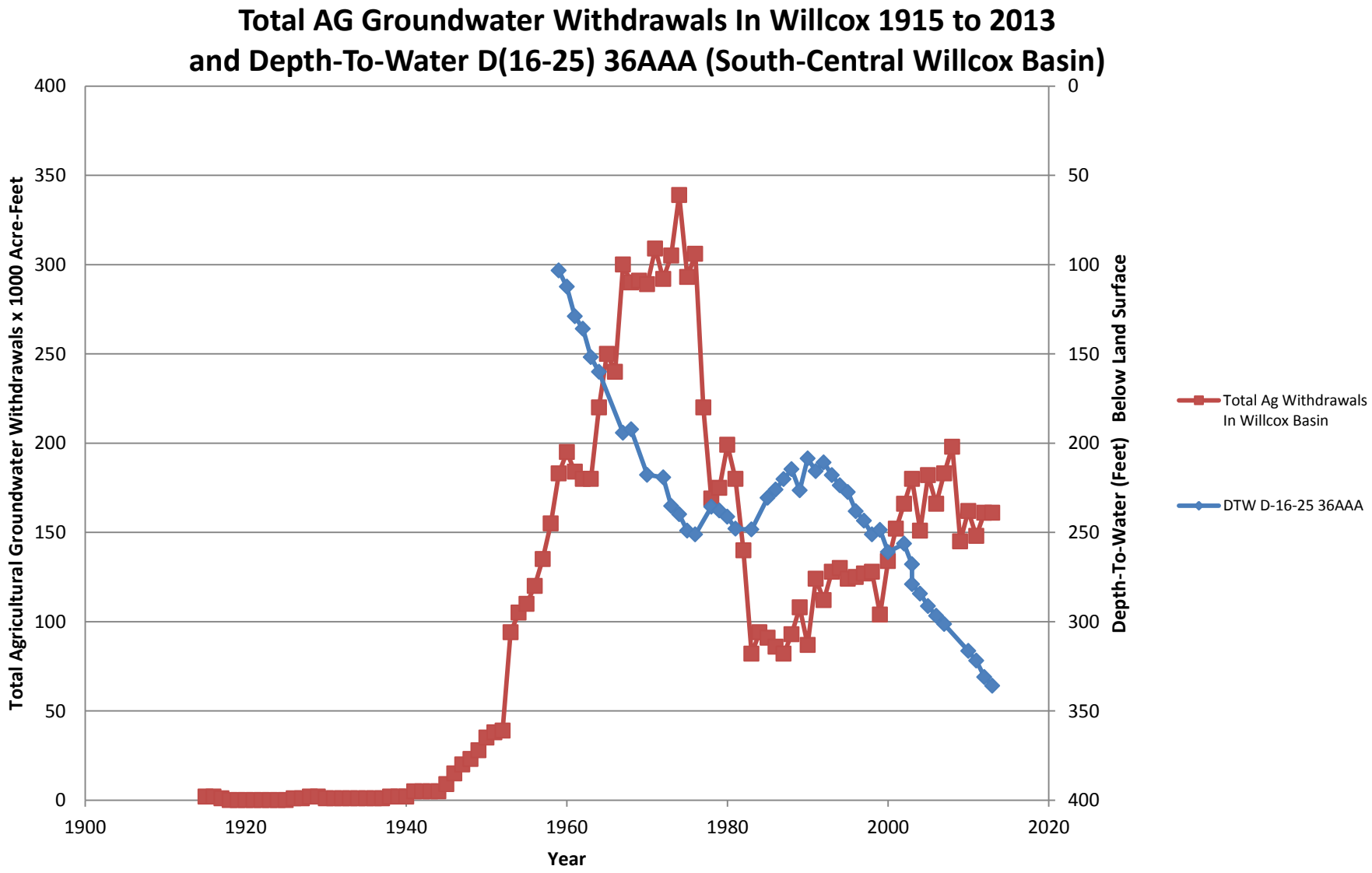
Major Crop Acreages
In Cochise County 1965 to 1991



Source: Arizona Agricultural Statistics Reports

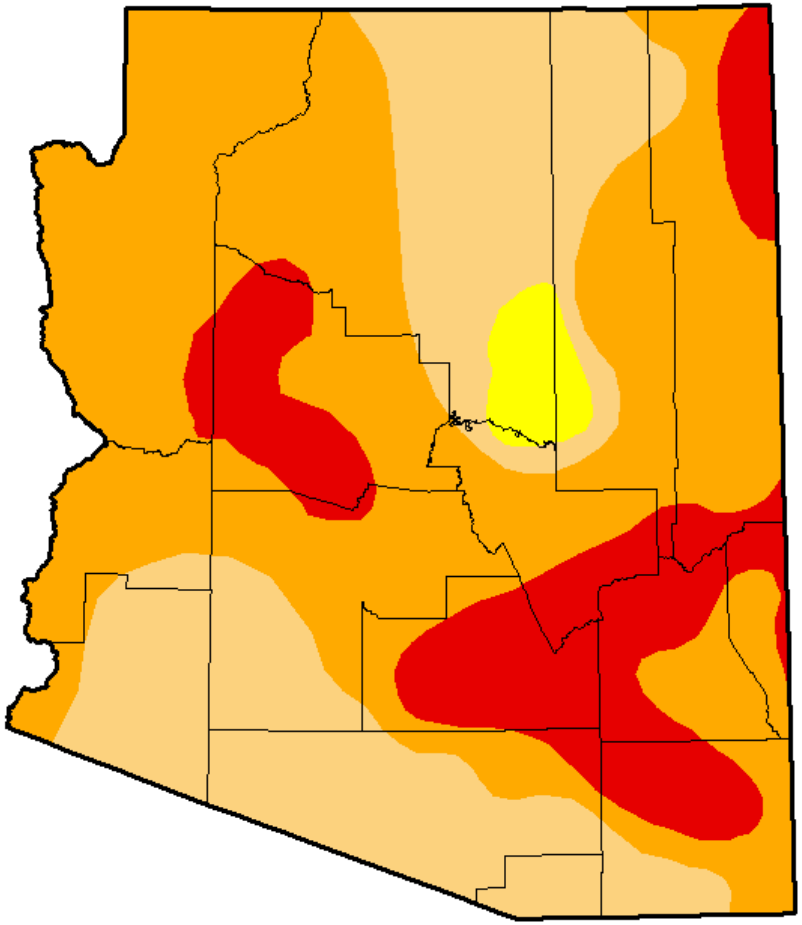


Source:
Arizona Agricultural Statistics Reports

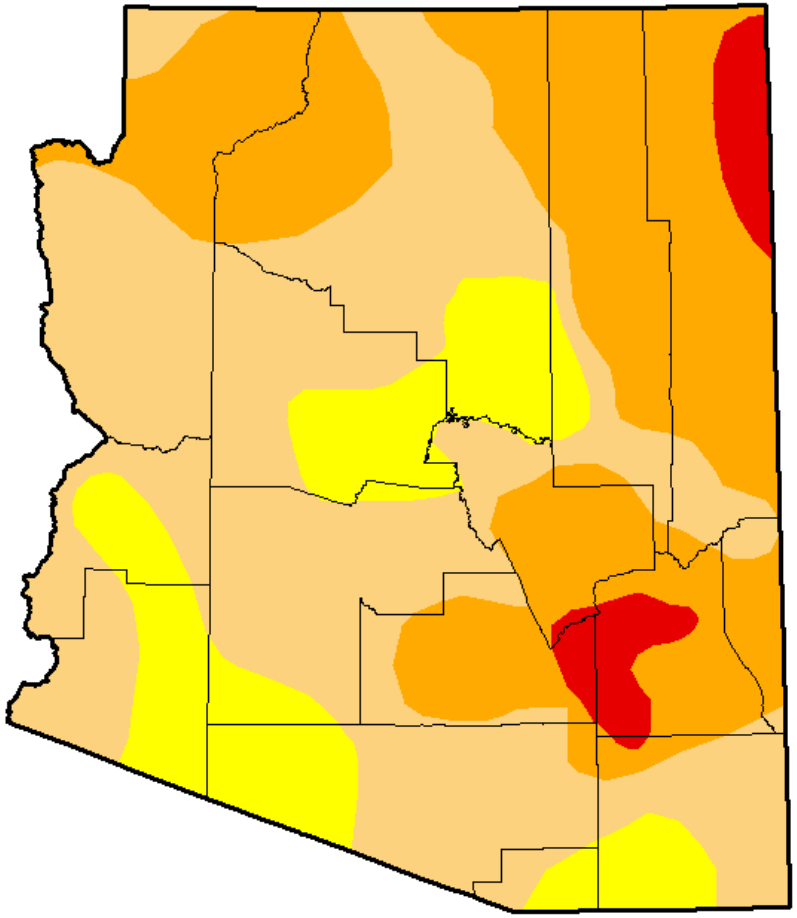

Total AG Groundwater Withdrawals In Willcox 1915 to 2013
and Depth-To-Water D(16-25) 36AAA (South-Central Willcox Basin)
Total Agricultural Groundwater Withdrawals x 1000 Acre-Feet
Depth-To-Water (Feet) Below Land Surface
Year
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
1900
1920
1940
1960
1980
2000
2020
Total Ag Withdrawals In Willcox Basin
DTW D-16-25 36AAA

Short Term Drought Status Map

July 29, 2014



October 7, 2014



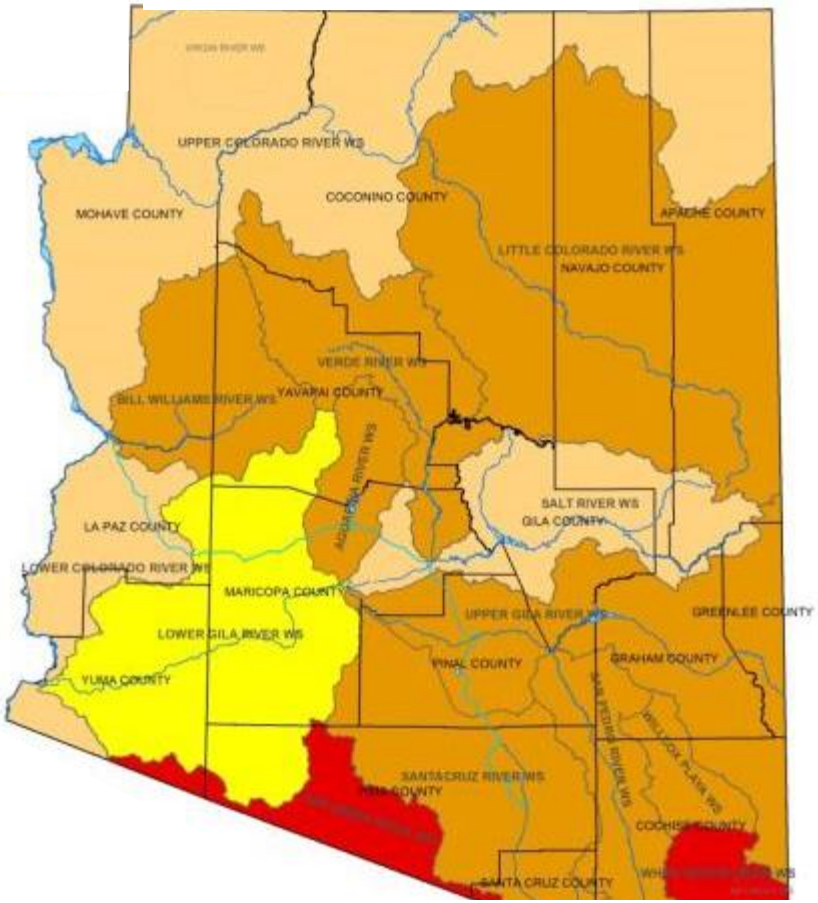
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

http://droughtmonitor.unl.edu/

Long Term Drought Status Map

July 2013



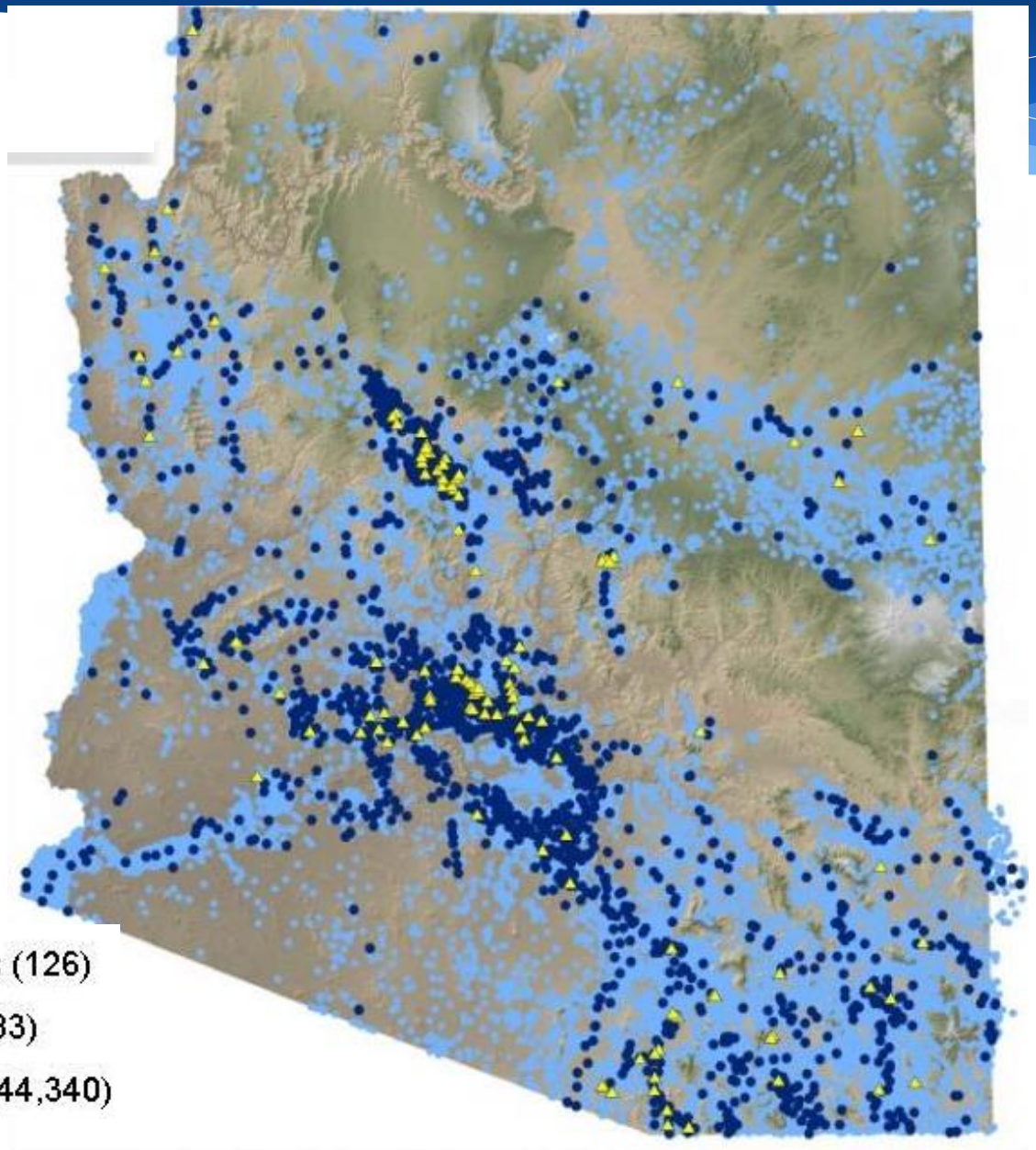
July 2014

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Source: Arizona Drought Monitoring Technical Committee

Groundwater Wells Used to Monitor Annual Changes in Groundwater Levels



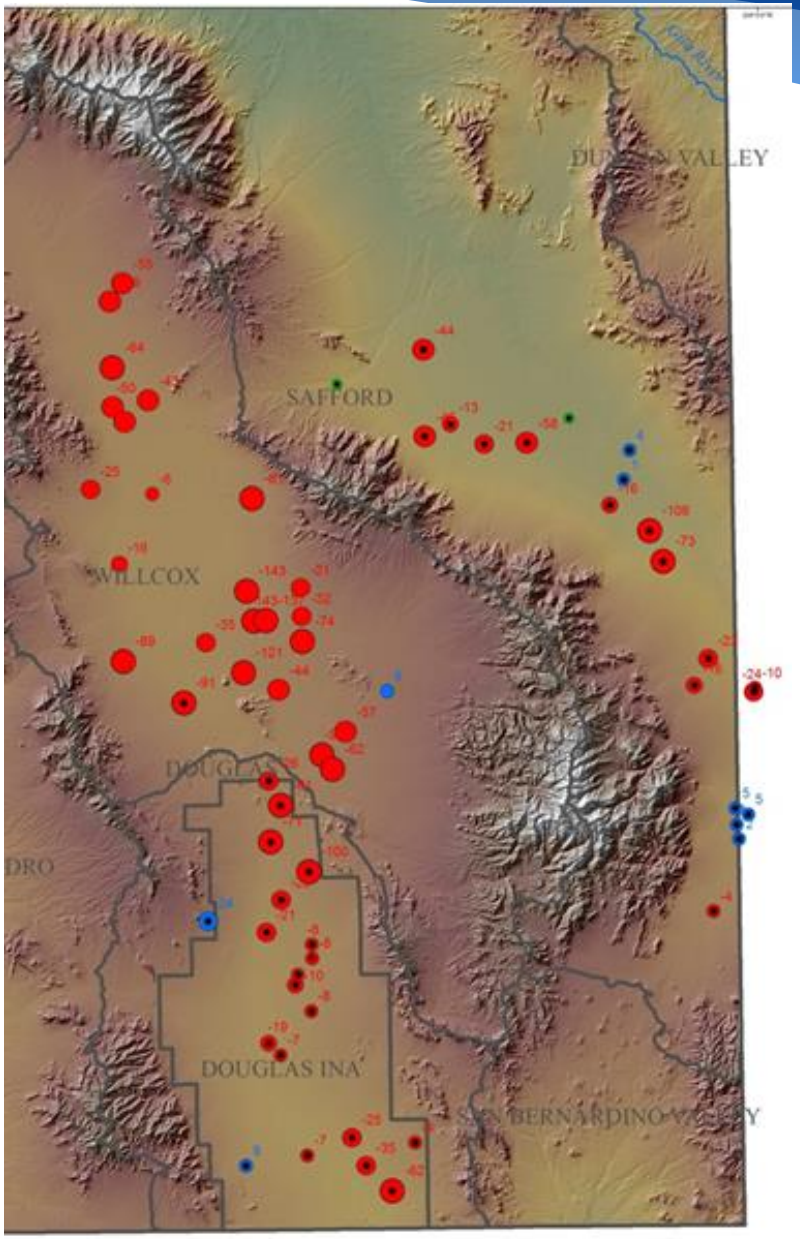
Automated Wells (126)

Index Wells (1,783)

All GWSI Wells (44,340)

Source: ADWR Land Subsidence Monitoring Report No. 2

Groundwater Level Changes in Willcox, Douglas, Douglas INA Basins and the San Simon Sub-basin (1993 to 2013)

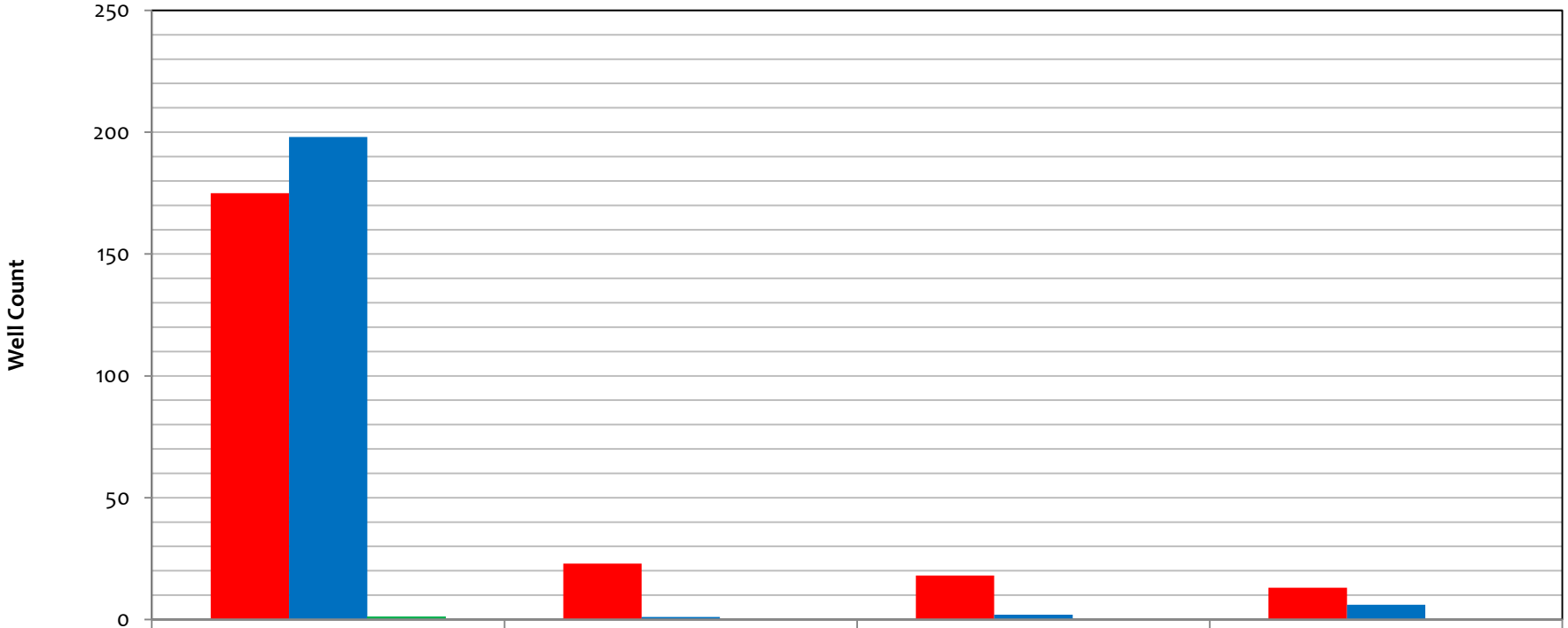


Explanation

Groundwater Level Change (feet)

- > 40
- 20 to 40
- 10 to 20
- 1 to 10
- < 1 foot change
- -1 to -10
- -10 to -20
- -20 to -40
- -40 to -60
- > -60
- Streams
- Groundwater Basin

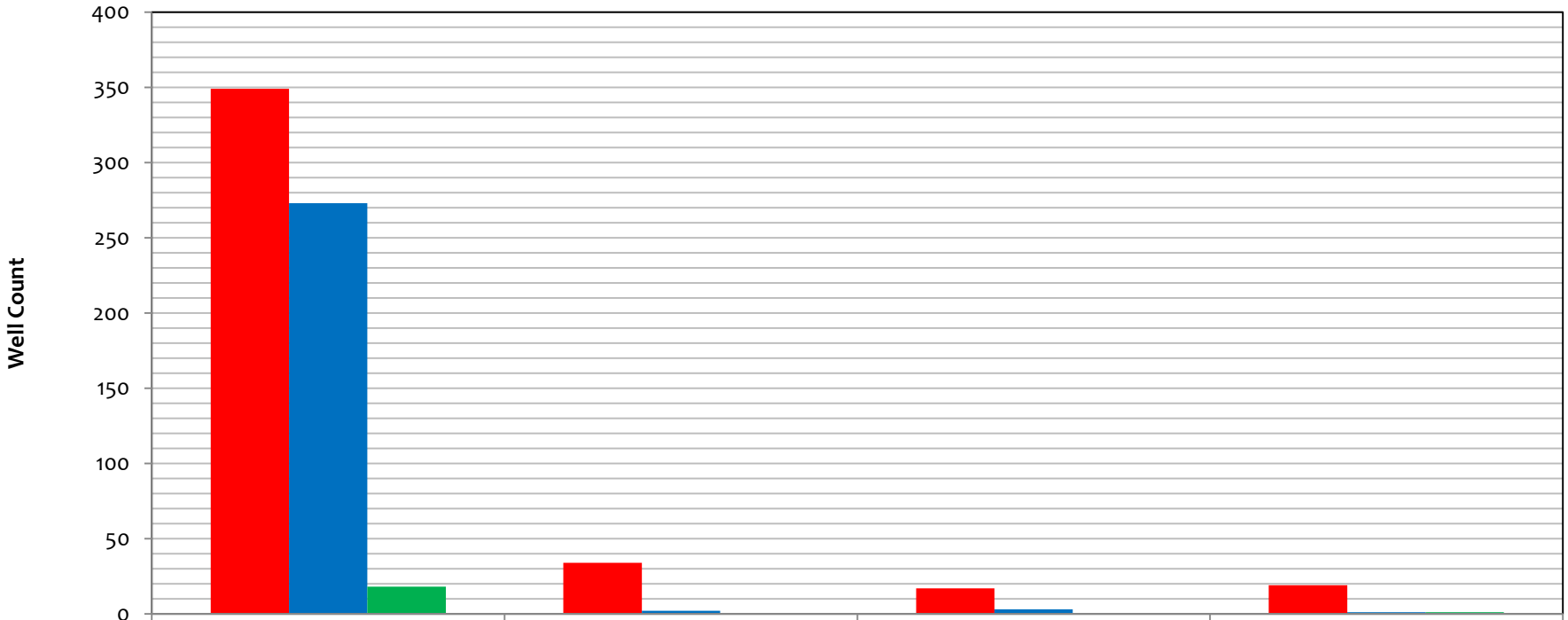
1993 to 2013 Water Level Change Counts



	Active management areas	Willcox Basin	Douglas INA + Douglas Basin	San Simon Sub-basin
Declining	175	23	18	13
Rising	198	1	2	6
No change	1	0	0	0

Source: ADWR State Wide Groundwater Level Changes In Arizona Water Years 1993 to 2003 to 2013 and 2012 to 2013

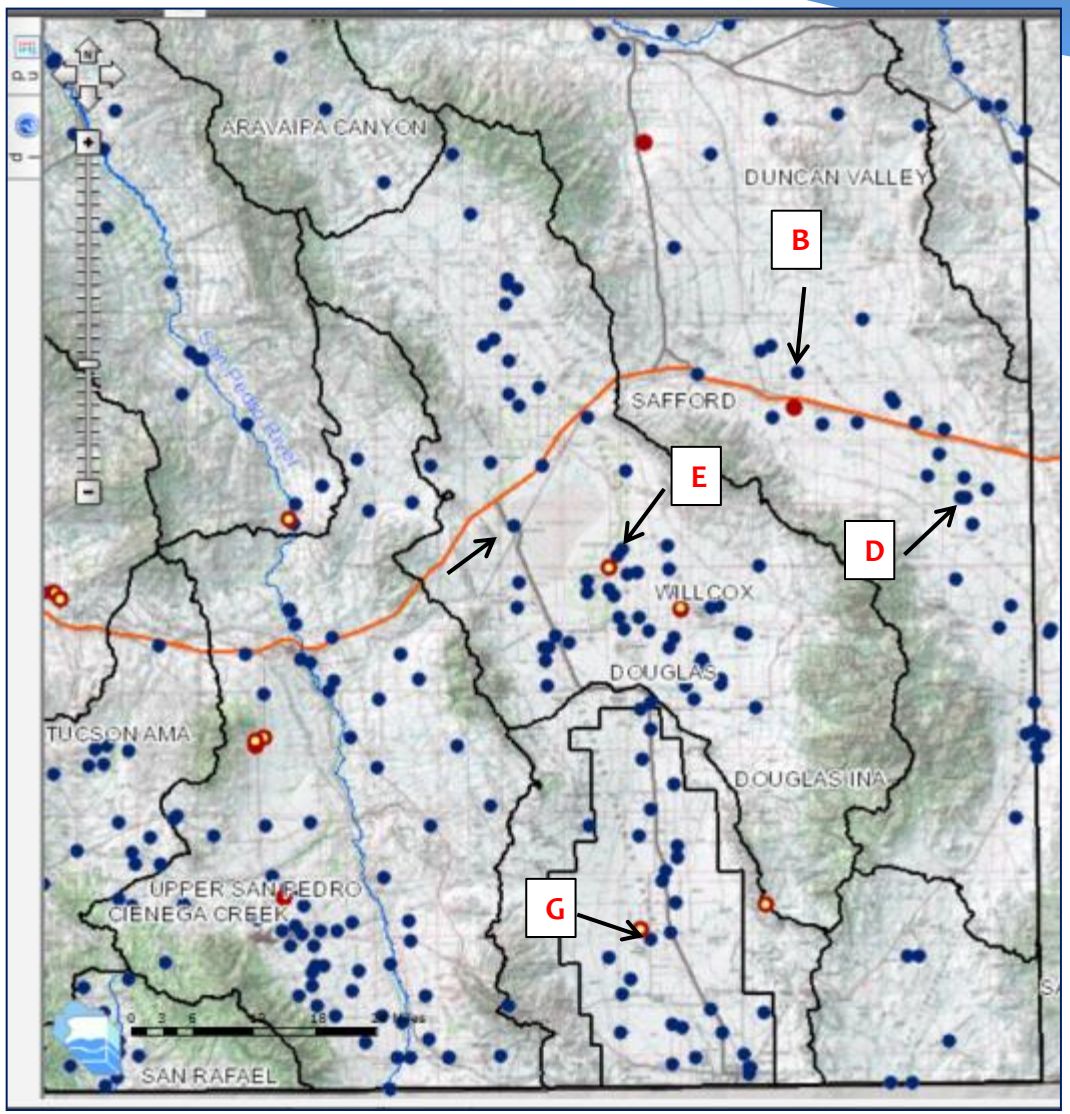
2012 to 2013 Water Level Change Counts



	Active management areas	Willcox Basin	Douglas INA + Douglas Basin	San Simon Sub-basin
Declining	349	34	17	19
Rising	273	2	3	1
No change	18	0	0	1

Source: ADWR State Wide Groundwater Level Changes In Arizona Water Years 1993 to 2003 to 2013 and 2012 to 2013

Locations of Wells Showing Hydrograph Examples



LEGEND

B — Location Of Well With Hydrograph

ADWR Index Well

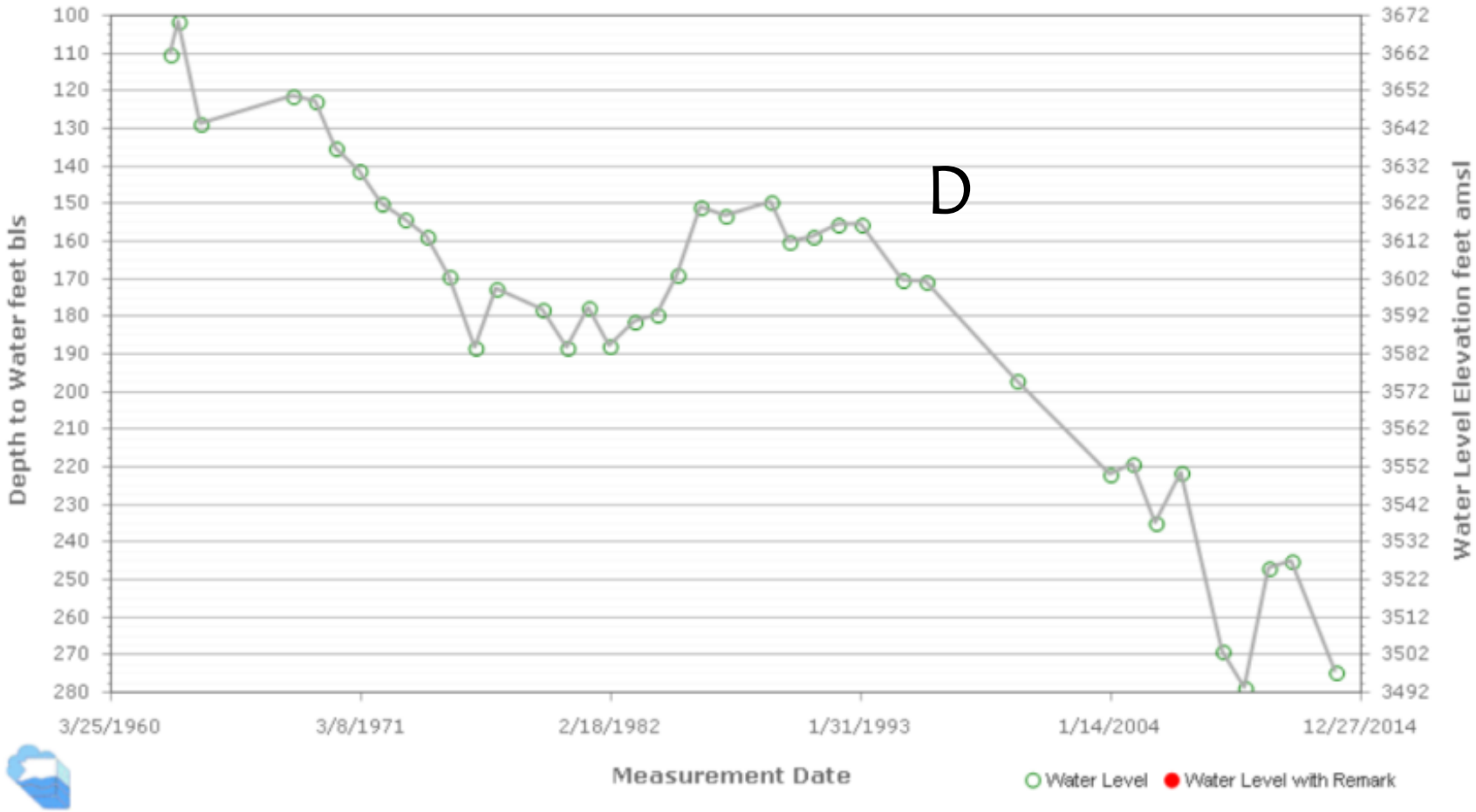
ADWR Automated Monitoring Well

ADWR Automated Monitoring Well With Radio Telemetry

Hydrograph for Well near San Simon

Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
D-14-31 35BCC	321016109094501		32° 10' 12.8"	109° 9' 27.5"	3772	IRRIGATION	800	16	12/24/1958	11/6/2013	274.6	3497.4



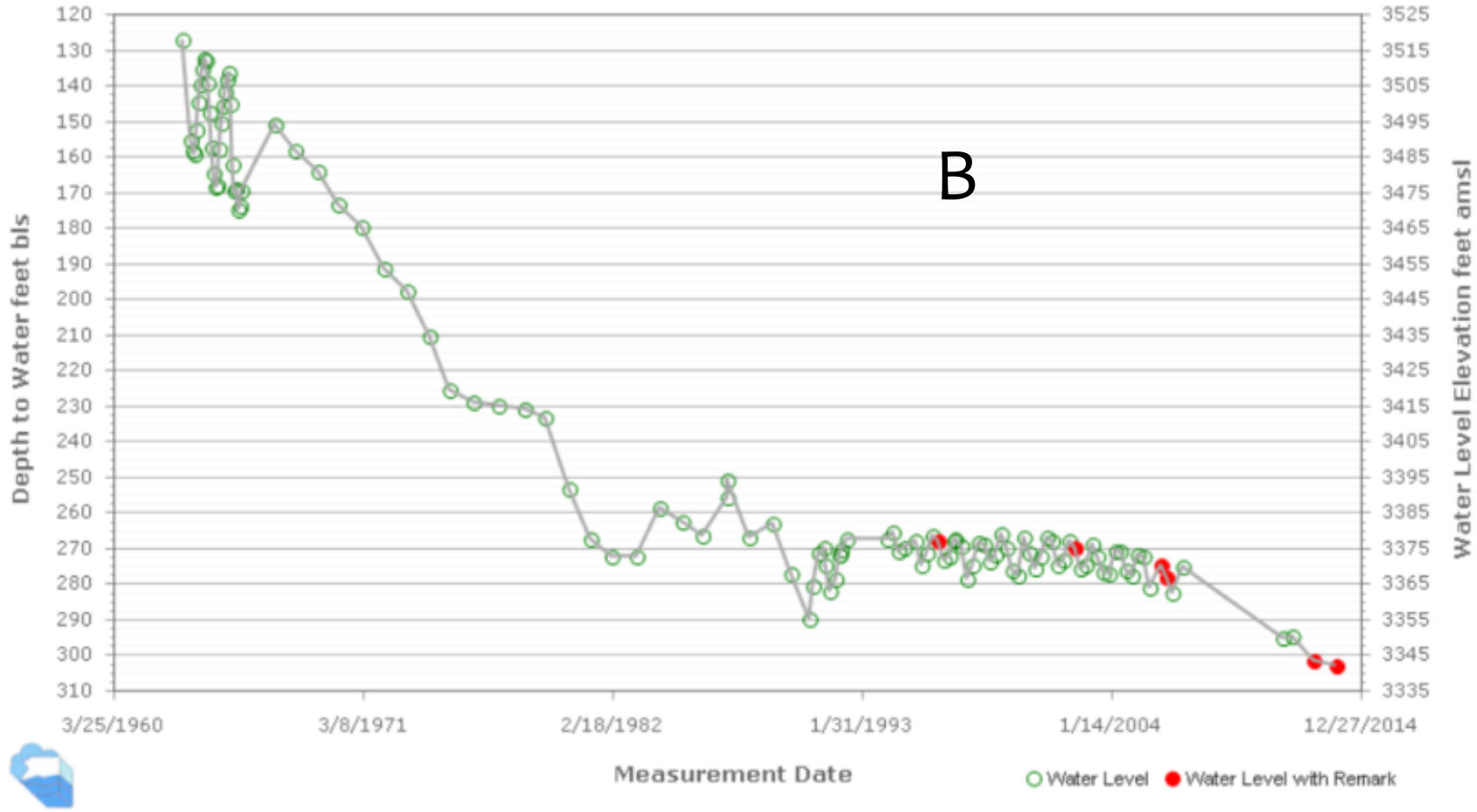
GWSI is ADWR's technical database of well locations, construction data, and water levels.

Created on 9/19/2014

Hydrograph for Well near Bowie

Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
D-12-28 25DCC	322116109262201		32° 21' 16.8"	109° 26' 24.3"	3645	UNUSED	1700	18	9/1/1955	11/29/2011	294.2	3350.8



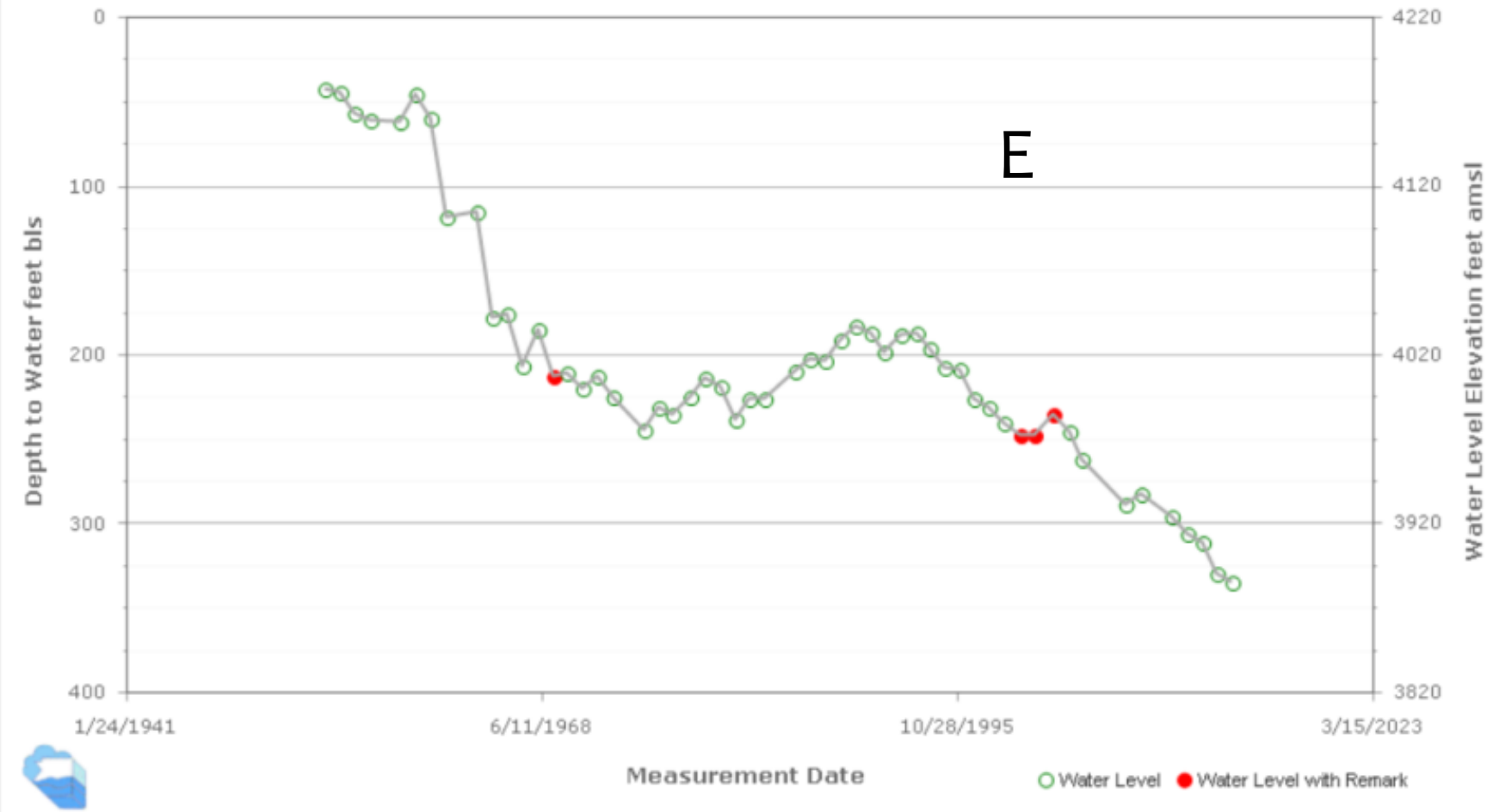
GWSI is ADWR's technical database of well locations, construction data, and water levels.

Created on 9/19/2014

Hydrograph for Well in the Willcox Basin

Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
D-15-25 25AAD	320614109442401	604416	32° 6' 17.6"	109° 44' 20.4"	4220	IRRIGATION	515	18	8/1/1953	11/6/2013	334.7	3885.3



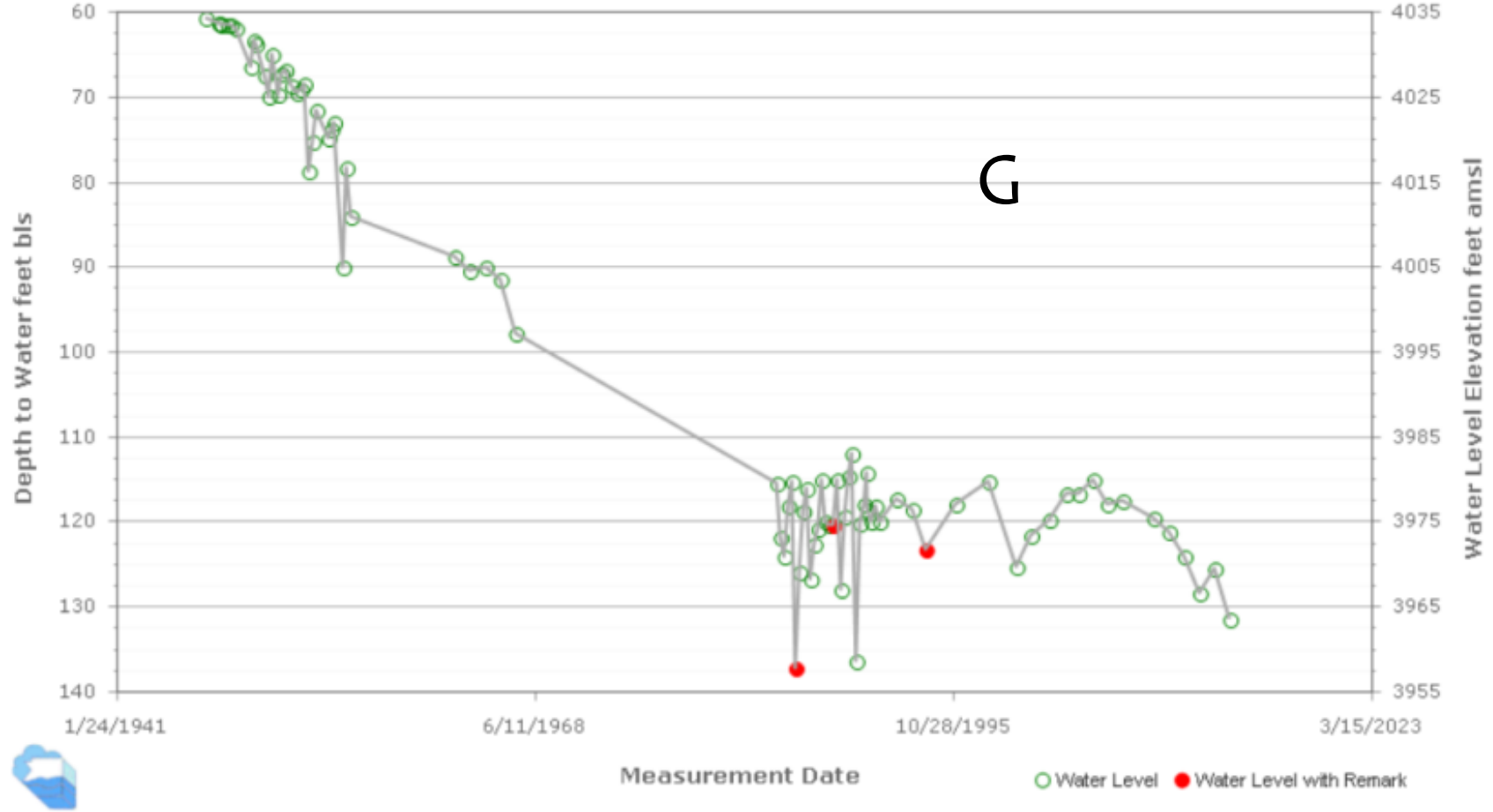
GWSI is ADWR's technical database of well locations, construction data, and water levels.

Created on 9/15/2014

Hydrograph for Well in Douglas INA

Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
D-22-26 04DAD	313242109415501		31° 32' 41.4"	109° 41' 52.8"	4095	DOMESTIC	275	12	5/1/1946	11/6/2013	131.3	3963.7



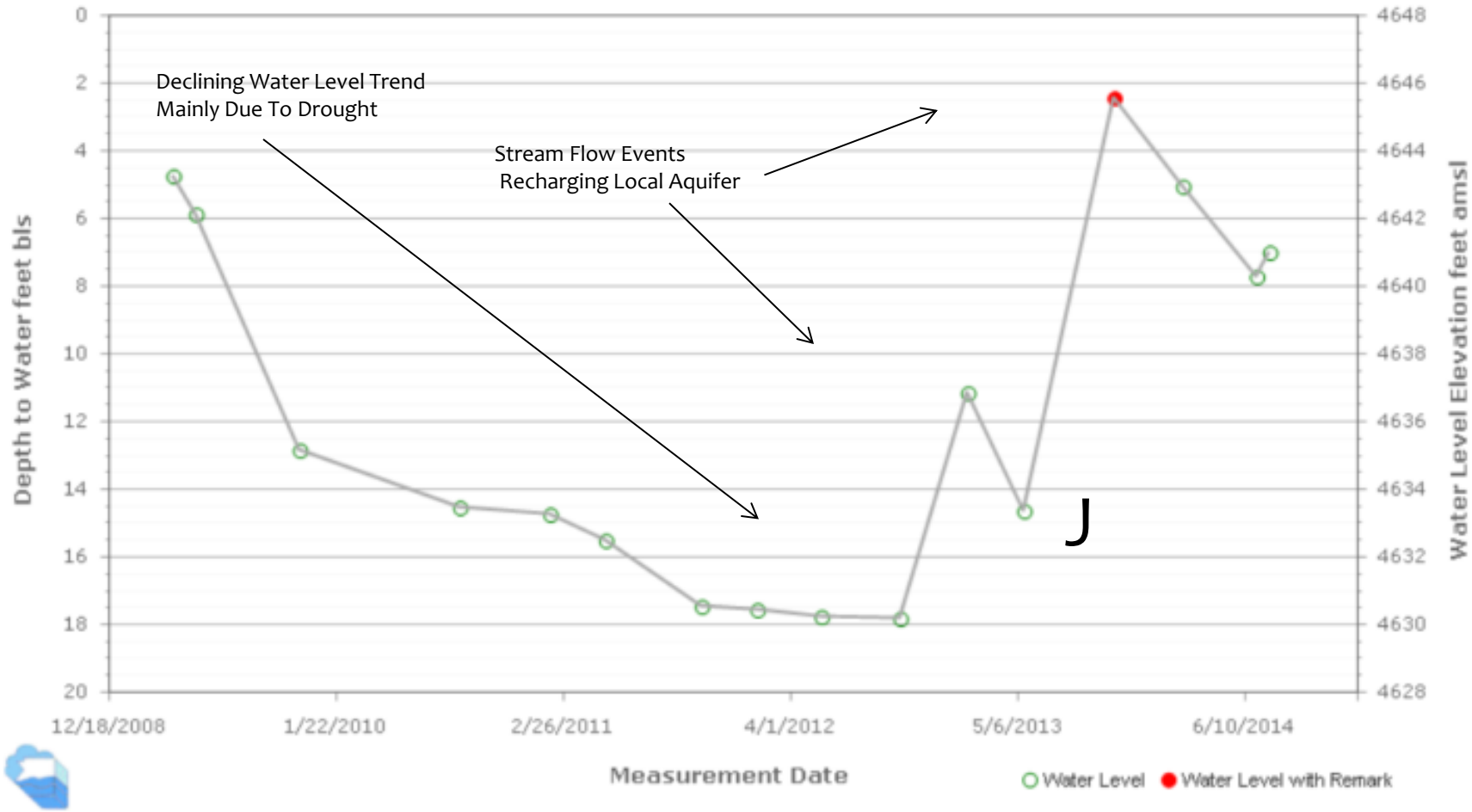
GWSI is ADWR's technical database of well locations, construction data, and water levels.

Created on 9/15/2014

Hydrograph for Leslie Canyon Well
(Located on the Southern Border of the Douglas INA)

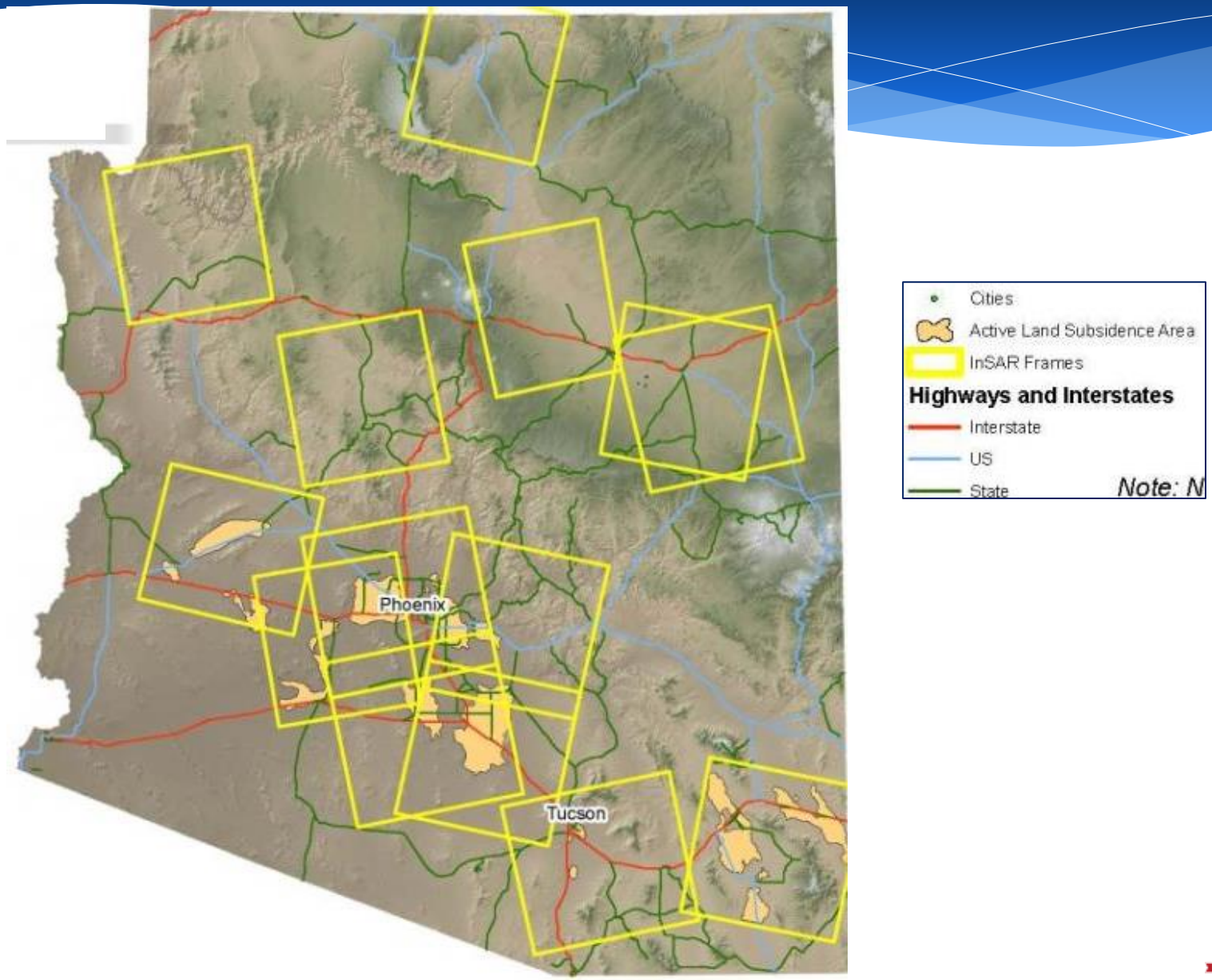
Arizona GroundWater Monitoring Site Hydrograph

Local ID	Site ID	Registry ID	Latitude NAD27	Longitude NAD27	Alt. (ft amsl)	Water Use	Well Depth (ft)	Case Dia. (in)	Drill Date	Latest WL Date	DTW (ft)	WL Elv. (ft)
D-21-28 21BCB	313533109301801	203421	31° 35' 29.9"	109° 30' 18.0"	4647.8	OBSERVATION	24.5			7/23/2014	7	4640.8



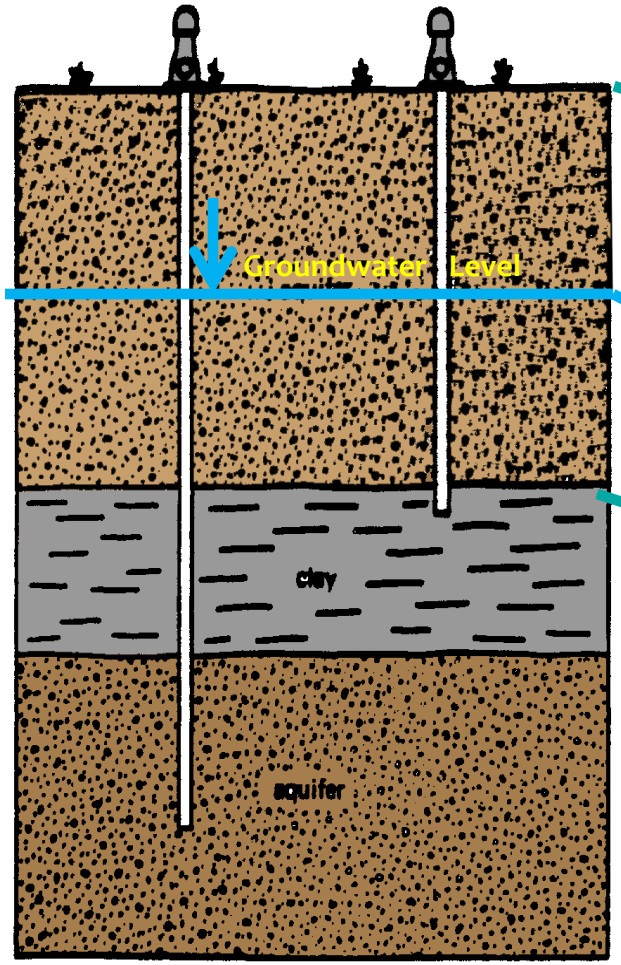
Leslie Canyon well is a state drought index well that is remotely located In a bedrock area and essentially unaffected by regional groundwater pumping but sensitive to impacts of drought and recharge from stream flow In Leslie Canyon

Satellite Frames Used to Collect InSAR Data



Source: ADWR Land Subsidence Monitoring Report No. 2

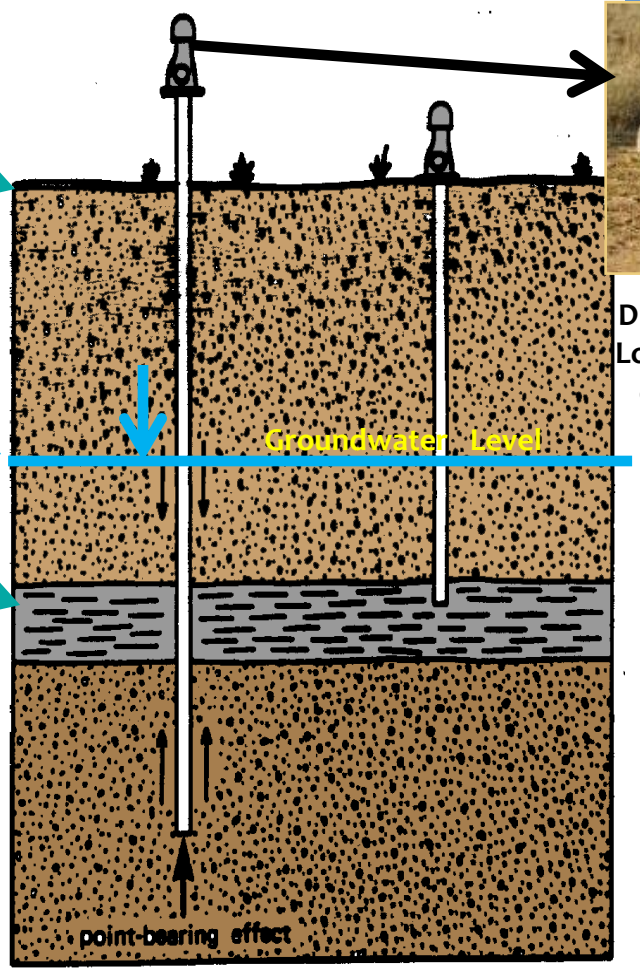
Land Subsidence and Groundwater Withdrawal



Land Subsidence

Declining Groundwater

Compaction



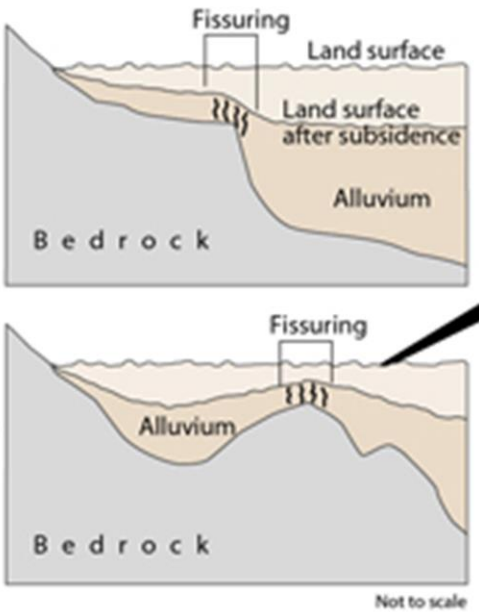
Displaced Well Example: Located a mile northeast of the Intersection of Dragoon and Cochise Stronghold Roads, Cochise County, AZ

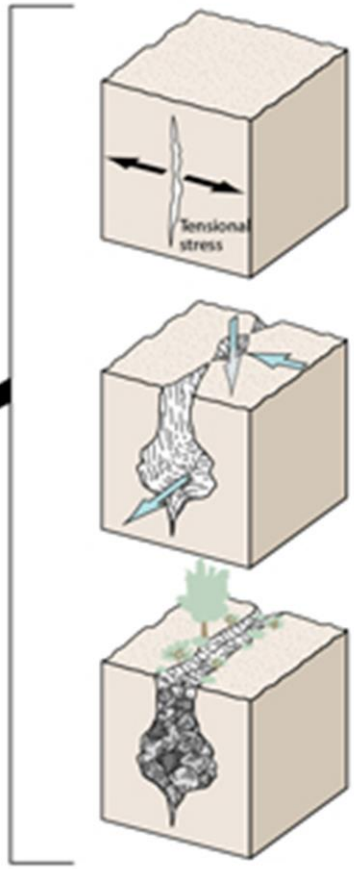
Earth Fissure Development

Earth Fissure Formation by Differential compaction

As the land surface subsides, alluvium stretches and eventually fails, generally in a region of abrupt change in alluvium thickness.

Fissures are concentrated in areas where the thickness of the alluvium changes, such as near the margin of basins or where bedrock is near the surface.





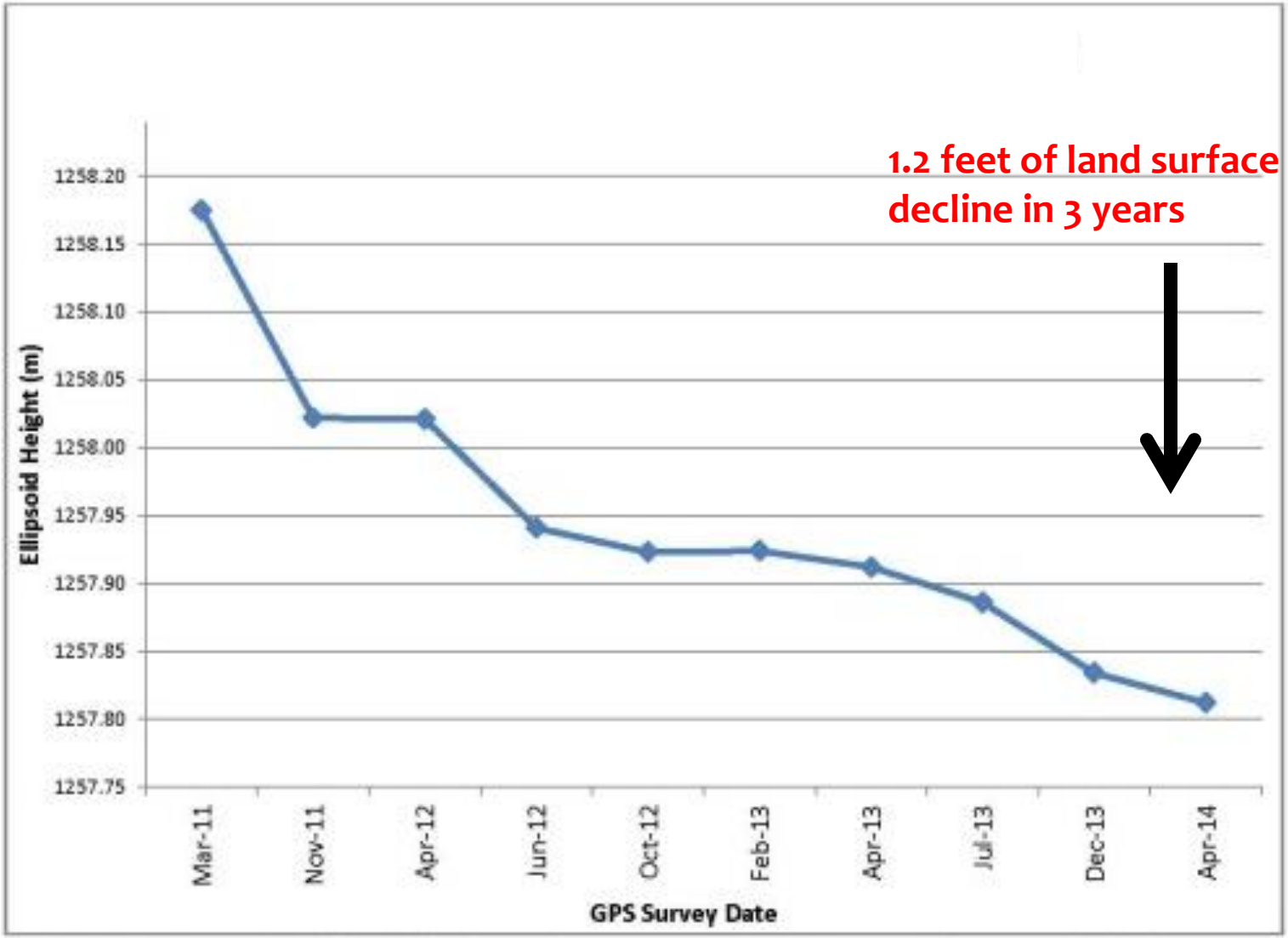
Lateral stresses induce tension cracking.

Surface water infiltrates, dissolving the natural cement bonding the soil, connecting hairline cracks, and further eroding and enlarging the fissure.

Fissure progressively enlarges, capturing surface runoff, sediment, and debris. Eventually vegetation establishes itself, creating a line of vegetation along the trace of the fissure.

Modified from Galloway et al., 1999

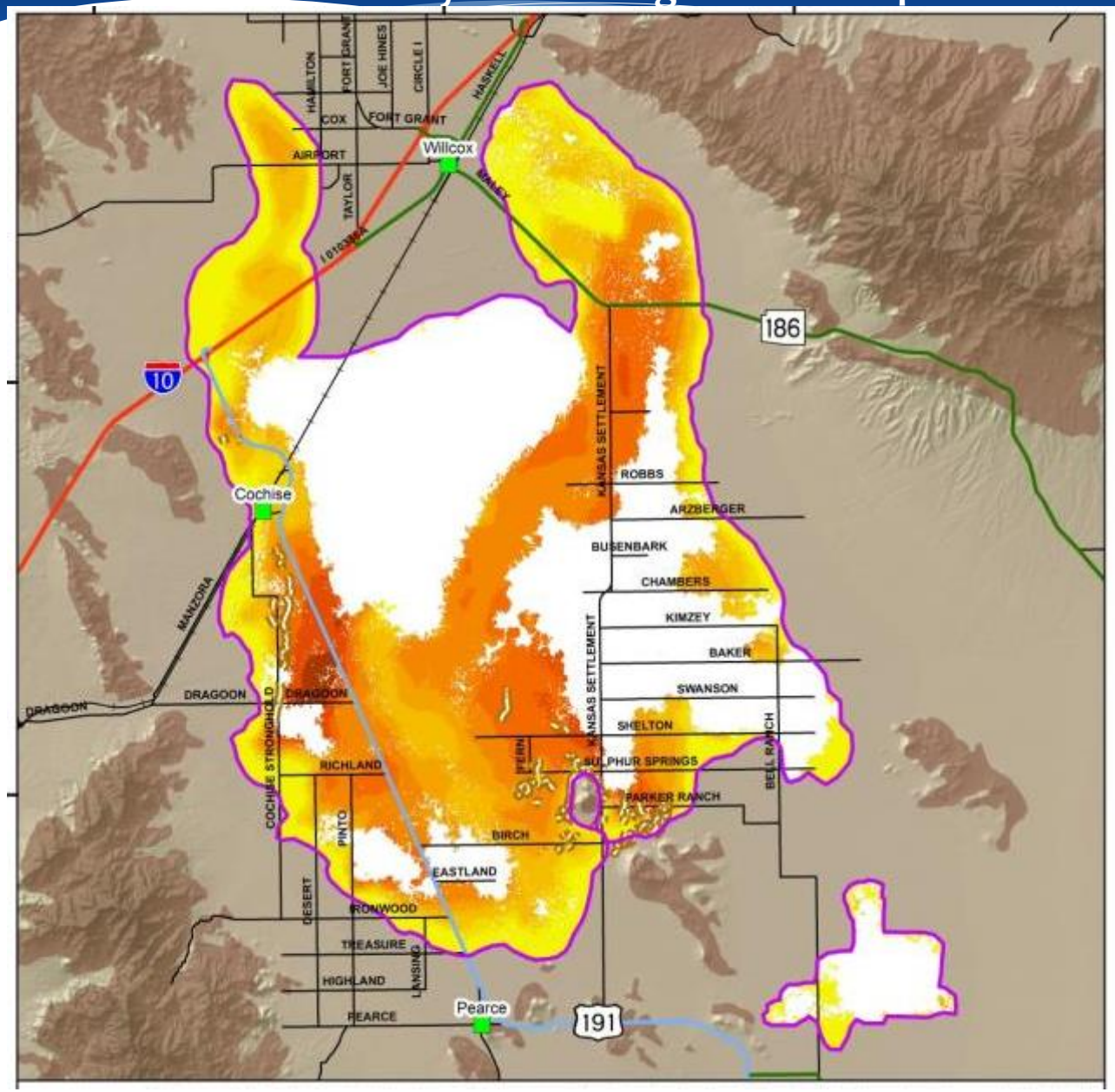
Cochise County GPS Survey for Land Subsidence Monitoring & InSAR Support (March 2011 through April 2014)



Graph 2 – GPS Survey data for land subsidence along Dragoon Rd in the Kansas Settlement Land Subsidence Feature

Source: ADWR Land Subsidence Monitoring Report No. 2

Land Subsidence in the Willcox and Kansas Settlement Areas
May 2010 through March 2014



Explanation

05/05/2010 To 03/21/2014

Total Land Subsidence (cm)

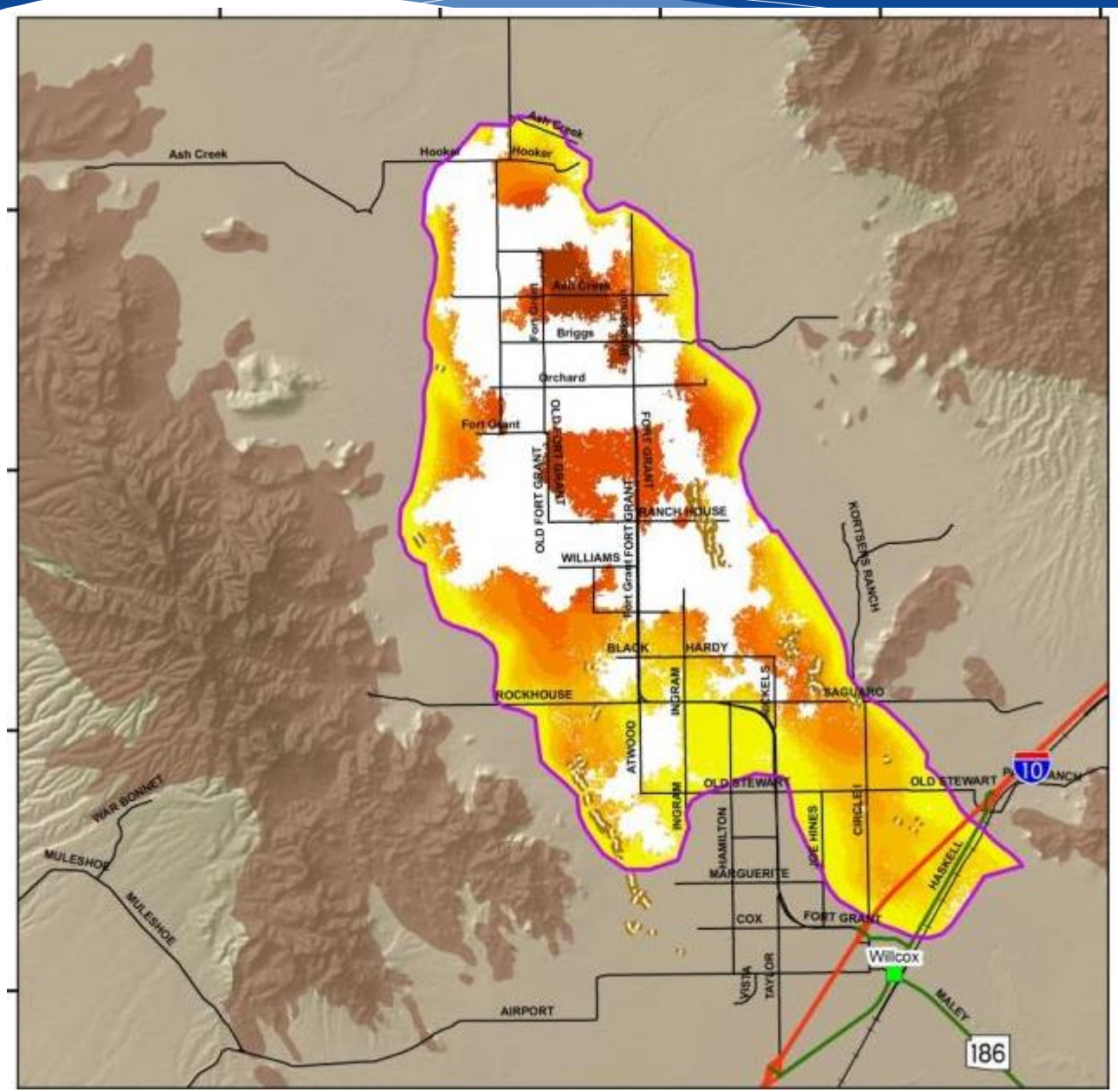
- Decorrelation/No Data
- Greater Than 40 cm
- 25 to 40 cm
- 15 to 25 cm
- 10 to 15 cm
- 6 To 10 cm
- 4 To 6 cm
- 2 To 4 cm
- 1 To 2 cm
- 0 To 1 cm

- Subsidence Feature
- Hardrock
- Earth Fissures
- Cities/Towns

Highways and Interstates

- Interstate
- US
- State
- Roads
- Railway

Land Subsidence in the Fort Grant Road and Willcox Areas (May 2010 through March 2014)



Explanation

05/05/2010 To 03/21/2014

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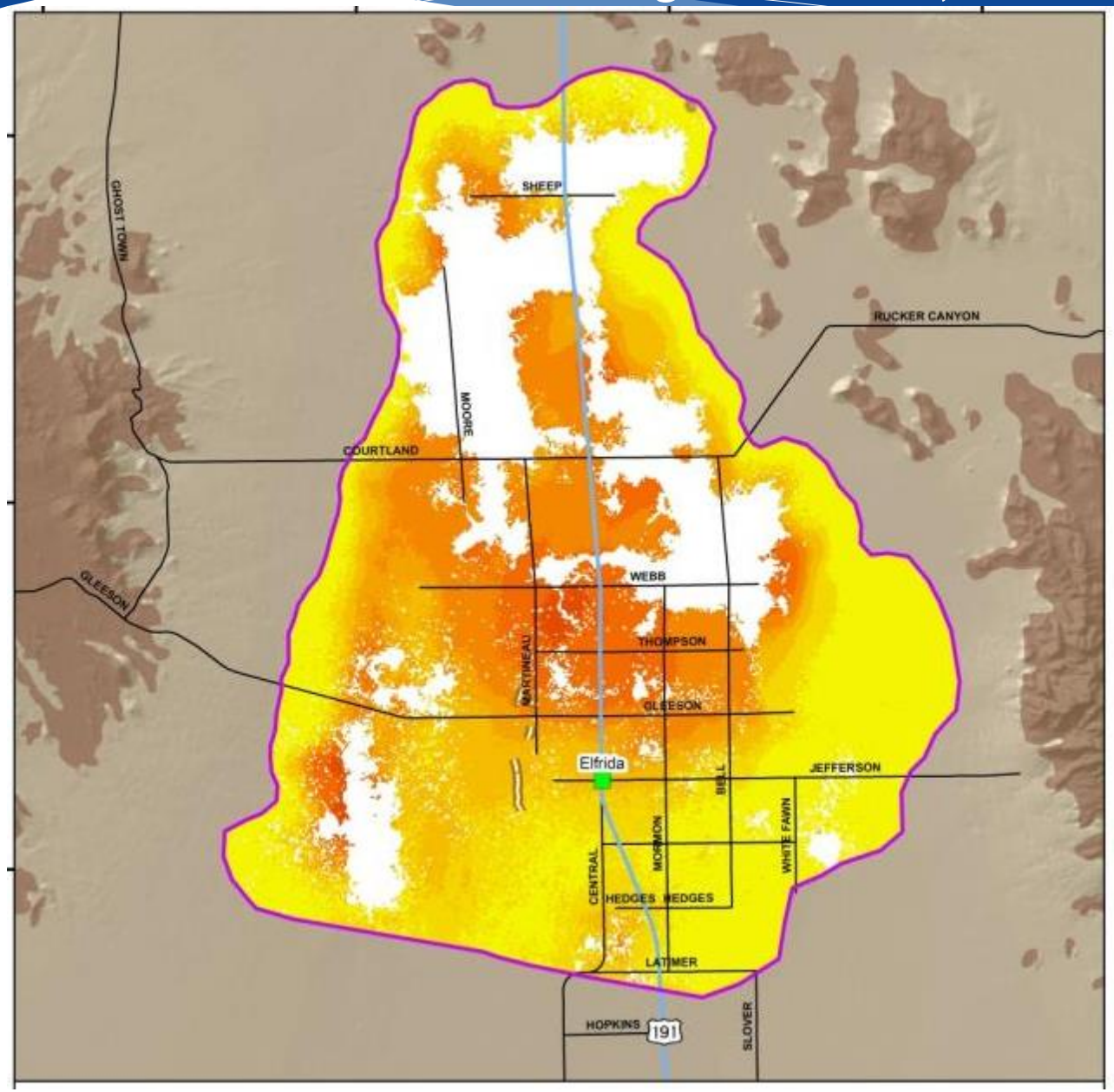
- 1 To 2 cm
- 0 To 1 cm

- Subsidence Feature
- Hardrock
- Earth Fissures
- Cities/Towns

Highways and Interstates

- Interstate
- US
- State
- Roads
- Railway

Land Subsidence in the Elfrida Area (Douglas INA) (May 2010 through March 2014)



Explanation

05/05/2010 To 03/21/2014

Total Land Subsidence (cm)

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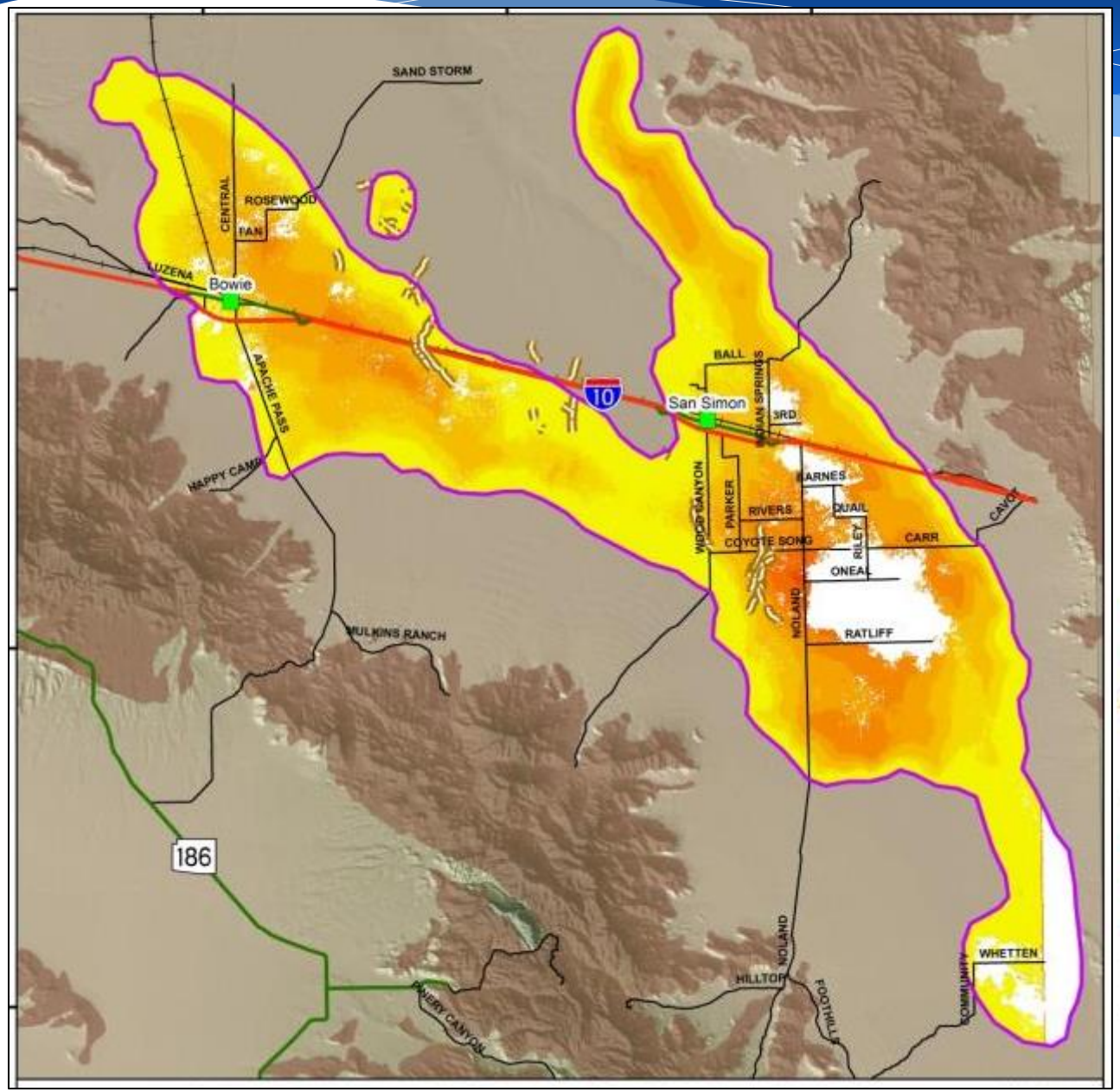
- 25 to 40 cm
- 15 to 25 cm
- 10 to 15 cm
- 6 To 10 cm
- 4 To 6 cm
- 2 To 4 cm
- 1 To 2 cm
- 0 To 1 cm

- Subsidence Feature
- Hardrock
- Earth Fissures
- Cities/Towns

Highways and Interstates

- Interstate
- US
- State
- Roads
- Railway

Land Subsidence in the Bowie and San Simon Areas (May 2010 through March 2014)



Explanation

05/05/2010 To 03/21/2014

Total Land Subsidence (cm)

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- Subsidence Feature
- Hardrock
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- Cities/Towns

Highways and Interstates

- Interstate
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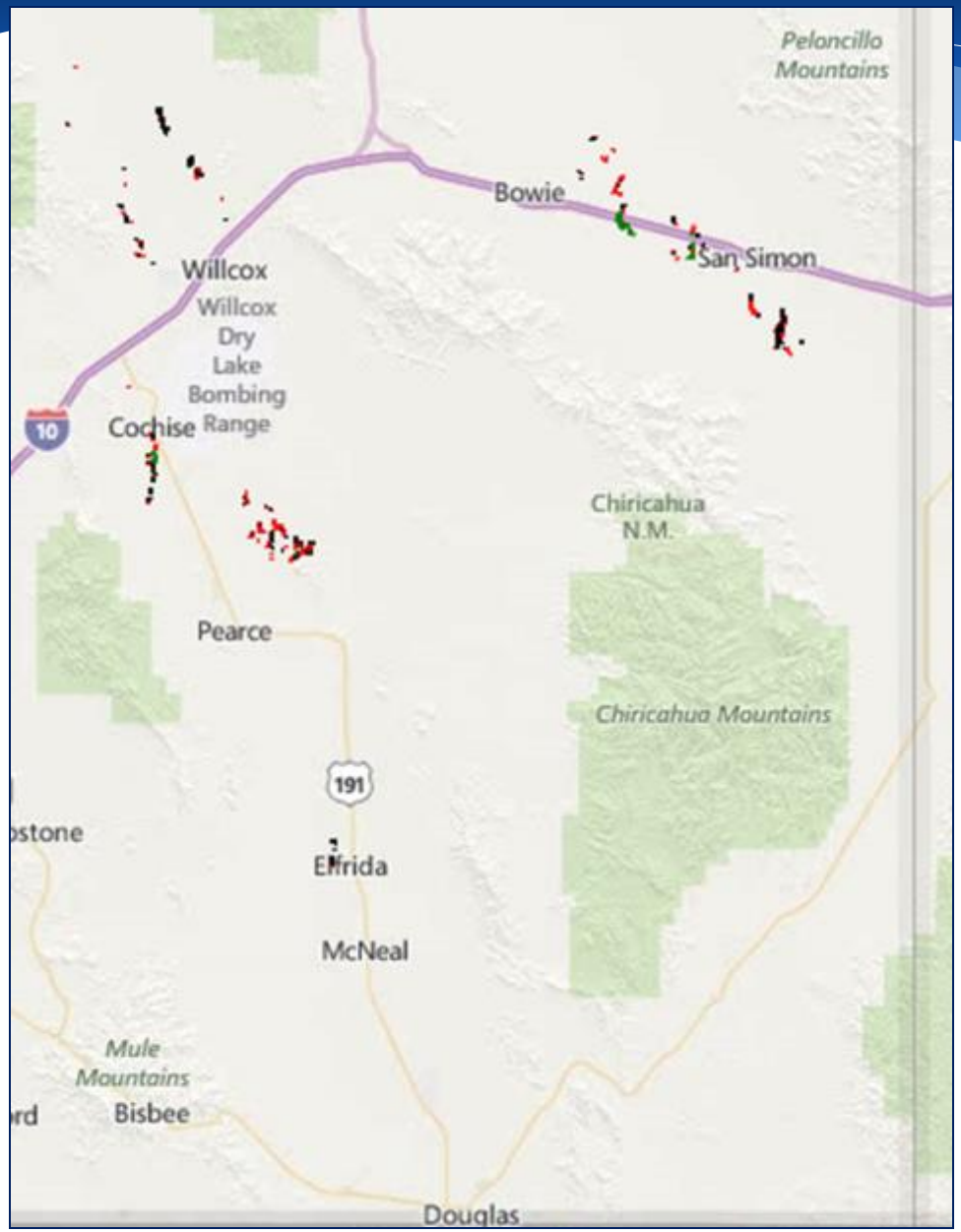
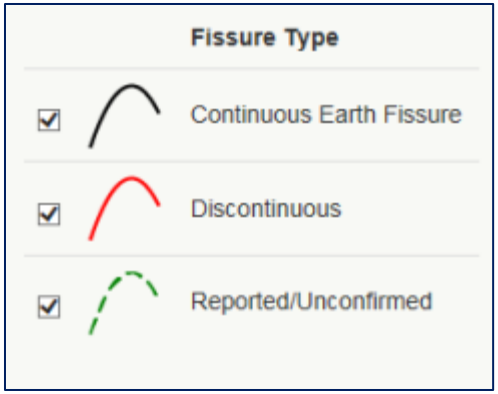
Cochise County Earth Fissures





Source: Arizona Geological Survey

Strategies for meeting Current and Future Water Demand for the Cochise Planning Area

Identified in Arizona's Strategic Vision for Water Supply Sustainability (ADWR, January 2014)

- Expanded Monitoring of Water Use & Data Collection
- Local Aquifer Management
- Enhanced Conservation Programs
  - Agricultural
  - Municipal
- Enhanced Protection of Municipal Supplies

Procedures for Creating a Subsequent Active Management Area

Subsequent Active Management Area

Option #1:

Order of the Director

Option #2:

By Petition & Election

Creating a Subsequent Active Management Area
Option #1: Order of the Director

Director must determine that certain criteria exists in a groundwater basin(s)

- AMA practices are necessary to preserve the existing supply of groundwater for future needs; or
- Land subsidence or fissuring is endangering property or potential groundwater storage capacity; or
- Use of groundwater is resulting in actual or threatened water quality degradation.

Director must hold a public hearing

- To Consider: (1) whether to issue an order declaring the area as an AMA; and (2) the boundaries of the AMA and the boundaries of any sub-basins within the AMA
- Irrigation of new acres is prohibited pending the final determination after a public hearing.
- Director must present factual data in support of an AMA.
- Any person may submit oral or written evidence for or against AMA.
- In making his determination, the Director shall give full consideration to public comment and to recommendations made by local political subdivisions.

Director Must Issue findings

- Director must issue findings and an order within 30 days of hearing.
- Order must be published once each week for two consecutive weeks.
- Order becomes effective after final publication
- Notice of the findings and order must be published once each week for two consecutive weeks.
- Order becomes effective after final publication.
- The director's findings and order are subject to requests for rehearing and to judicial review.

Creating a Subsequent Active Management Area
Option #2: By Petition and Election

Petition

- Petition forms to be the same as for initiative petitions.
- Petitioner must comply with A.R.S. §19-111.
- Requires at least 10% of registered voters within the groundwater basin boundaries.
- Submitted to Board of Supervisors of the county where the groundwater basin is located.
- If the groundwater basin is located in more than one county, then the number of registered voters required to sign the petition shall be 10% of the registered voters residing within the boundaries of the groundwater basin within the county in which the plurality of registered voters resides.
- Petition submitted to that county's Board of Supervisors.

Election

- If enough signatures are submitted, an election must be called by <u>each</u> county in which the groundwater basin is located, and held within 60-90 days.
- All registered voters living within the groundwater basin may vote.
- Irrigation of new acres is prohibited after an election is called until the final results of the election are certified.

Procedures for Creating a Subsequent Irrigation Non-Expansion Area

Subsequent Irrigation Non-Expansion Area

Can only be created by Order of the Director

Option #1:

Director's Decision

Option #2:

By Petition Submitted to Director

Creating a Subsequent Irrigation Non-Expansion Area
Option #1: Director's Decision

Director Must Determine that certain criteria exist in a basin (s) or sub-basin(s)

- There is insufficient groundwater to provide a reasonably safe supply for irrigation of the cultivated lands in the area at the current rates of withdrawal; and
  - The establishment of an AMA is not necessary.
- Director initiates the creation of an INA and calls for a public hearing

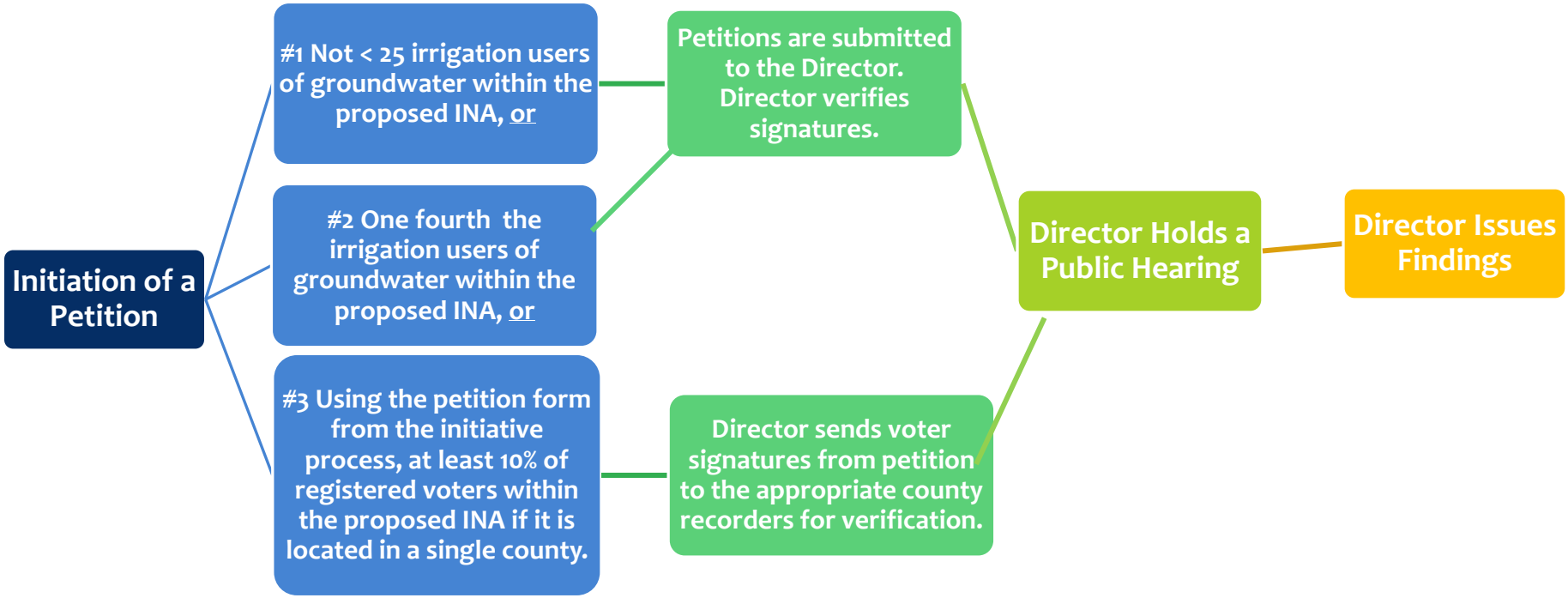
Director Holds a Public Hearing

- Director must advertise and hold a public hearing to consider: (1) whether to issue an order declaring the area as an INA; and (2) the boundaries of the proposed INA.
- *Beginning on the date of the notice of the initiation of designation procedures, the irrigation of new acres is prohibited pending the final determination after a public hearing.*
- Director must present factual data in support of <u>or</u> in opposition to an INA.
- Any person may submit oral or written evidence for or against an INA. In making his determination, the Director shall give full consideration to public comment and to recommendations made by local political subdivisions.

Director Issues Findings

- Director must issue findings and an order within 30 days of hearing.
- Notice of the findings and order must be published once each week for two consecutive weeks.
- Order becomes effective after final publication. The order must address both criteria A. and B. listed above.
- The director's findings and order are subject to requests for rehearing and to judicial review.

Creating a Subsequent Irrigation Non-Expansion Area
Option #2: Initiation of a Petition



Options for Groundwater Regulation:
Mandatory Regulations- Active Management Area versus Irrigation Non-Expansion Area

Active Management Area

- Irrigation of New Agricultural Lands Prohibited
- Groundwater Right or Permit Required to Withdraw Groundwater from a Non-Exempt Well
- Groundwater Rights and Permits Generally have Annual Volumetric Limitations (Allotments)
- Restrictions on Exempt Wells
- Well Spacing Requirements
- Metering Requirements
- Annual Reporting Requirements
- Assured Water Supply Requirements
- Groundwater Withdrawal Fees and Water Quality Assurance Revolving Fund Fees
- Restrictions on Filling and Refilling Bodies of Water
- Groundwater Transportation Laws
- Mandatory Conservation Requirements
  - Agriculture
  - Municipal
  - Industrial Uses

Irrigation Non-Expansion Area

- Irrigation of New Agricultural Lands Prohibited
- Metering Requirements (for non-exempt wells only)
- Annual Reporting Requirements (for non-exempt wells)

- No New Industrial Use Regulations
- No New Municipal Use Regulations
- No Conservation Requirements for any Sectors
- No New Assured/Adequate Water Supply Requirements
- No Annual Volumetric Allotment for Water Users
- No Groundwater Withdrawal Fees

Questions?

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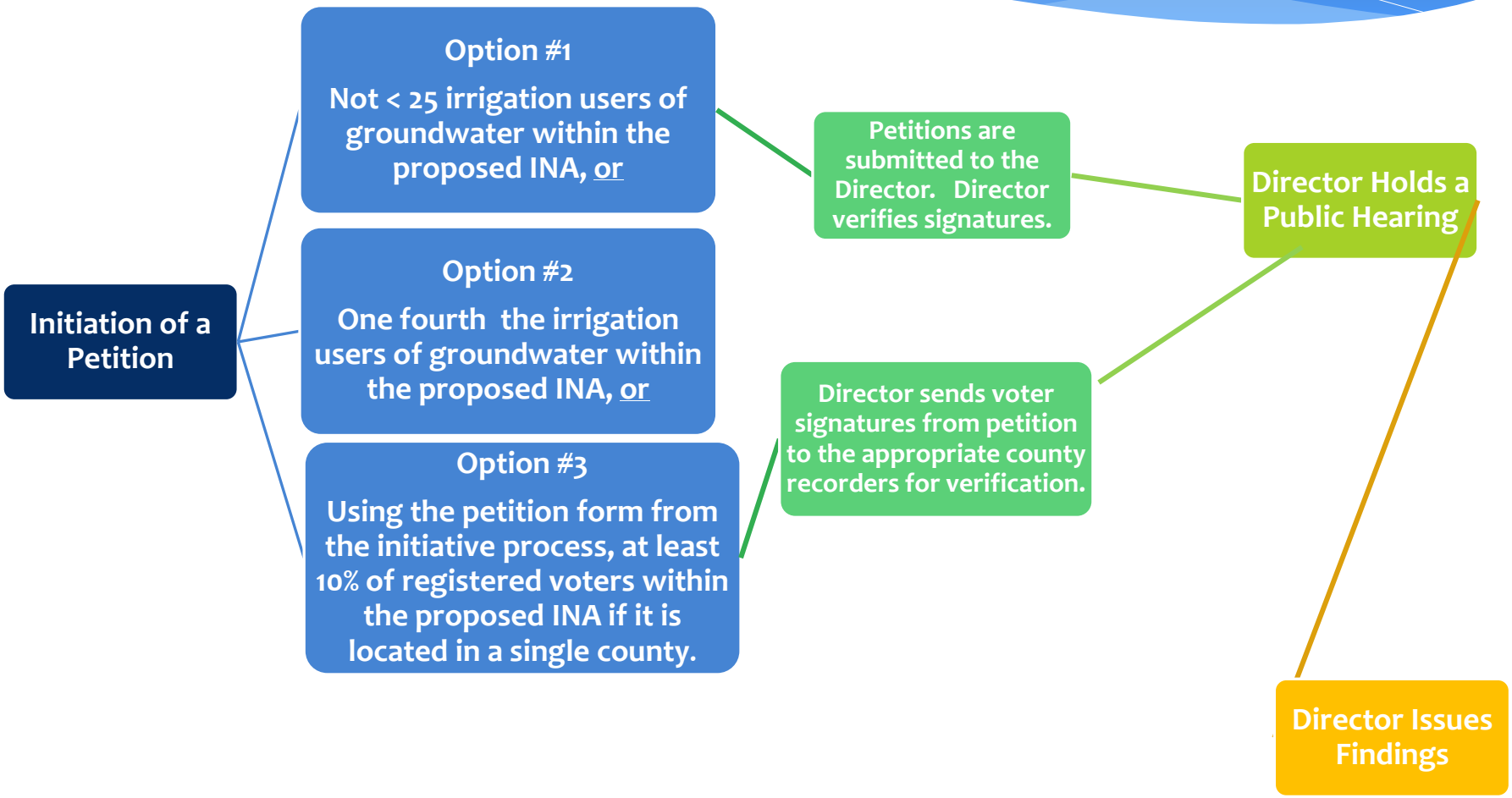
Creating a Subsequent Irrigation Non-Expansion Area
Option #2: Initiation of a Petition