Eastern Tule Groundwater Sustainability Agency Land Subsidence Monitoring and Management Plan Public Workshop

March 27, 2023

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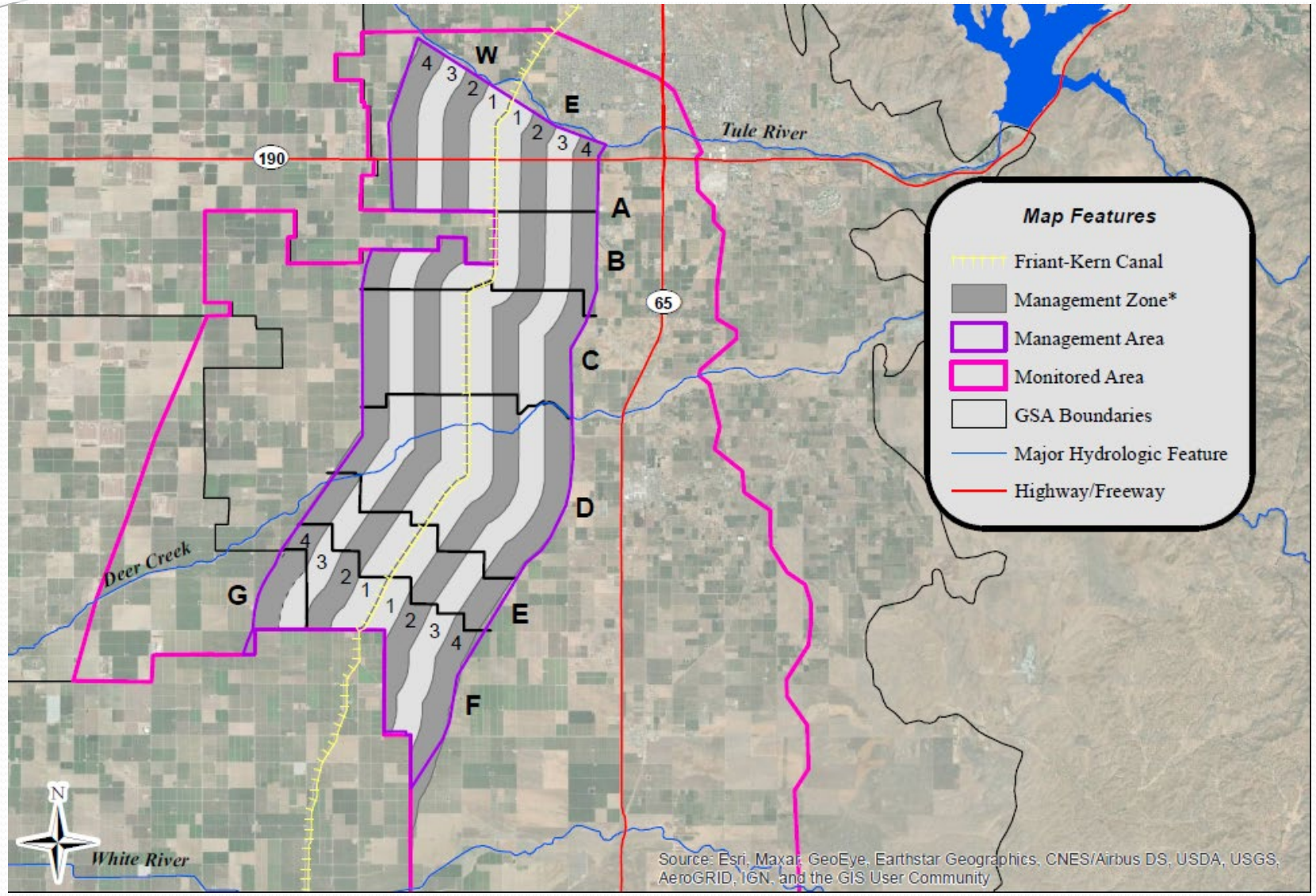
Background

1. ETGSA GSP January 2020
2. LSMP Initiated May 2020
    1. Regular Meetings of the ETGSA Land Subsidence Ad Hoc Committee
    2. Review Draft Plans and Develop Potential Management Actions
3. First Public Workshop July 2021
4. Land Subsidence Monitoring Plan Split Out from the Land Subsidence Management Plan - August 2021
5. Current Version of the Land Subsidence Monitoring Plan Finalized September 2021
6. Management Plan Finalized in February 2022

ETGSA Land Subsidence Monitoring Plan Overview

1. Background
2. Land Subsidence Management Goal
3. Area Encompassed by the Plan
4. Land Subsidence Monitoring Network
5. Land Subsidence Monitoring and Management Committee
6. Reporting

Land Subsidence Management Area



- **Monitored Area**
- **Managed Area**
- **Management Zones**
  - 8 East-West Zones (8, 1/2-mile Zones on Each Side of the FKC)
  - 6 North-South Zones
  - 48 Total Management Zones

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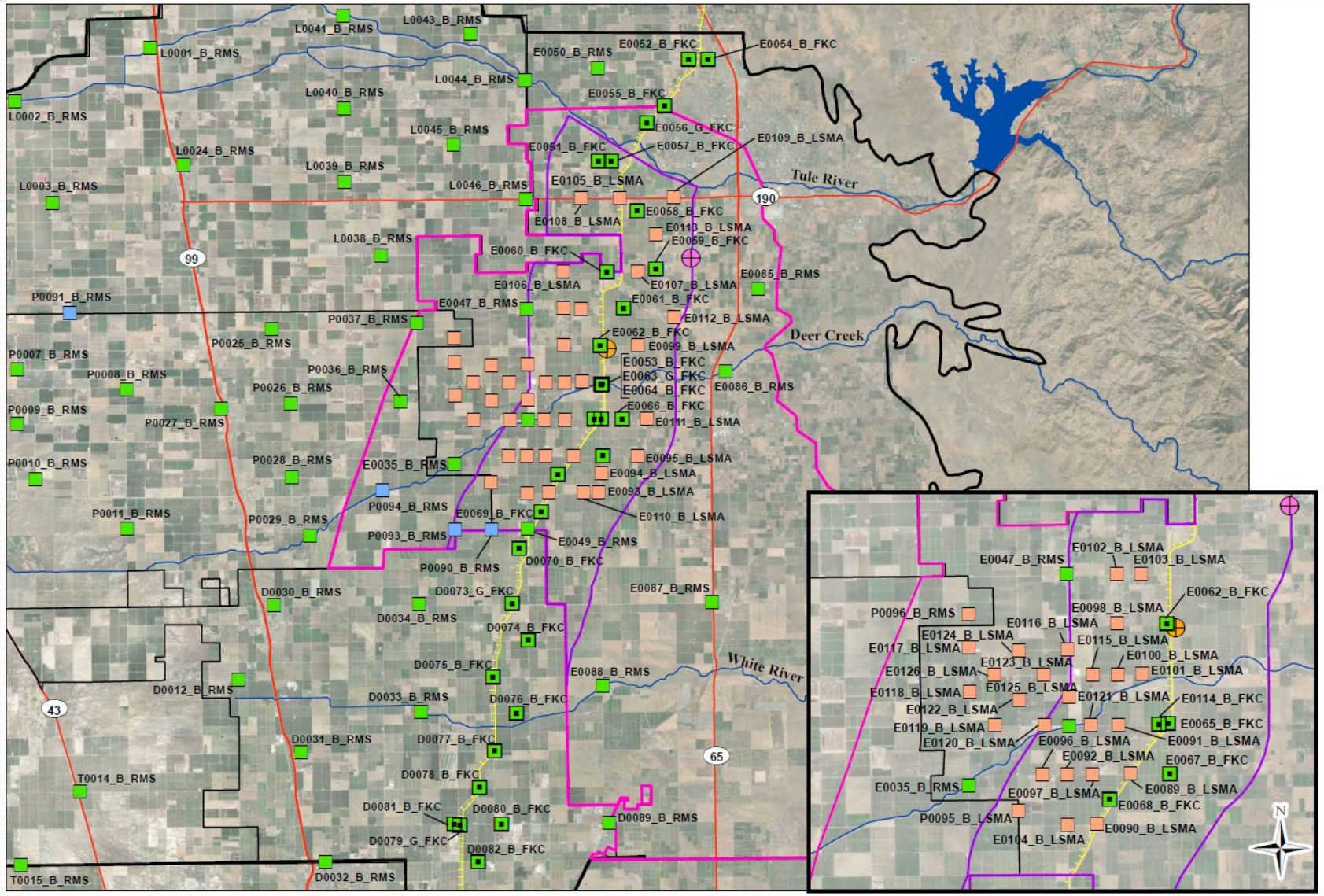
Land Elevation Monitoring Network



Map Features

- Friant Water Authority Benchmark (Measured by the Tule Subbasin)
- Benchmark Monitoring Began 2020
- Benchmark Monitoring Began 2021
- Benchmark Monitoring Began 2022
- USGS Extensometer
- Porterville CGPS Station

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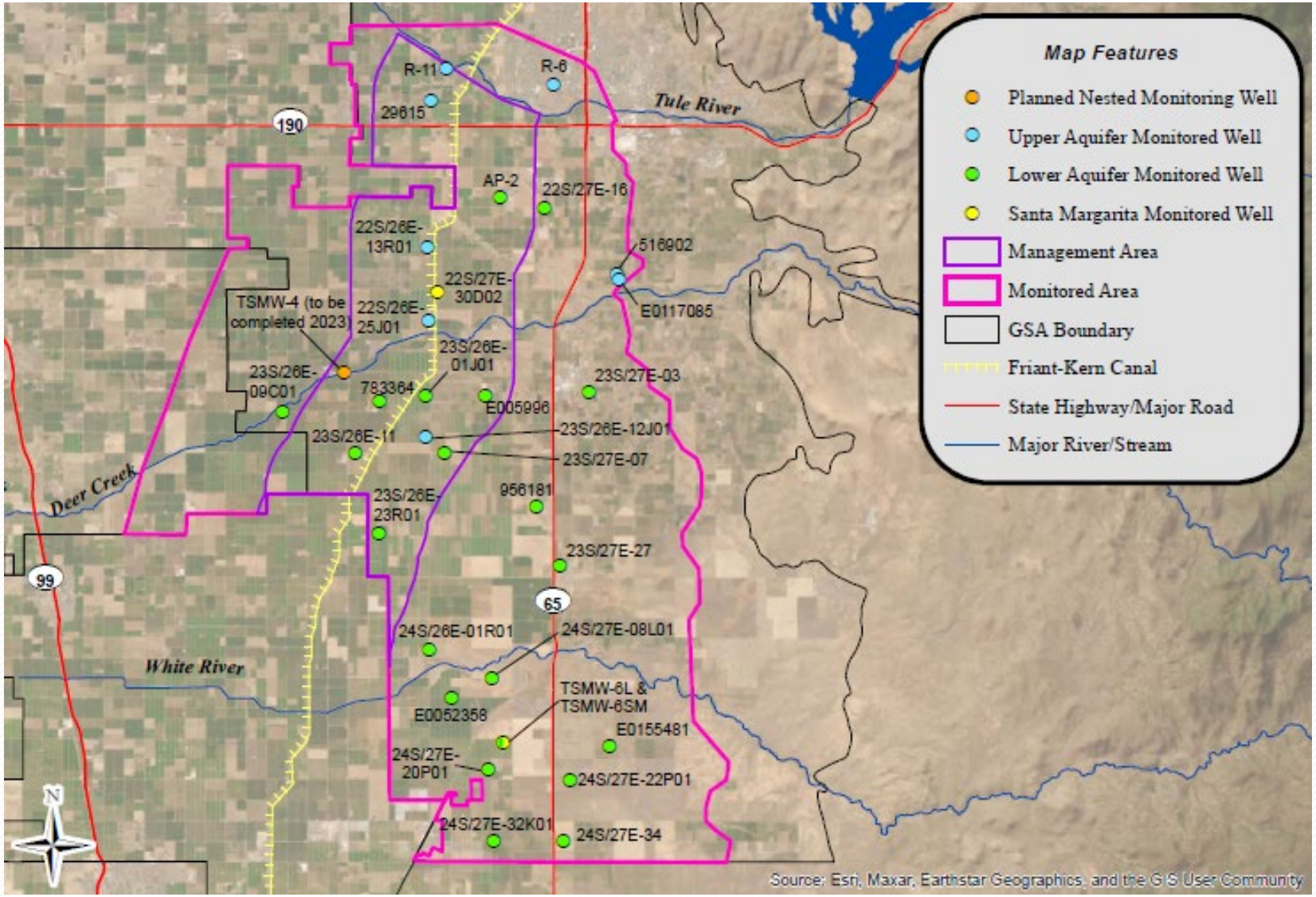
Groundwater Level Monitoring Network



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Land Subsidence Monitoring Committee

- Representation – Technical Experts from:
  - ETGSA
  - FWA
  - Pixley Irrigation District
  - Tule Subbasin Technical Advisory Committee
  - County of Tulare
  - White Area Growers

Land Subsidence Monitoring Committee

- Responsibilities:
  - Review and Analyze Monitoring Data
  - Review Land Surface Elevation Monitoring Trends
  - Review Proposed Refinements to the LSMP
  - Provide Recommendations to the ETGSA Board

Reporting

- Committee has Met in February 2022, September 2022, and February 2023.
  - First Annual Report Submitted March 2022
  - Second Annual Report Submitted February 2023

Land Subsidence Management Goal

The goal of the Eastern Tule Land Subsidence Management Plan is to implement groundwater management measures necessary to minimize future non-recoverable land subsidence along the Friant-Kern Canal in the SGMA transition period from 2020 – 2040 and to arrest nonrecoverable land subsidence along the Friant-Kern Canal after 2040.

The **Maximum Allowable Land Subsidence** at the Canal is **3 Feet**

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The Land Subsidence Management Plan Will Be Implemented in Accordance with the Following Action Criteria

- Tier 1 – Land Subsidence Between 0 and 1.49 feet
- Tier 2 - Land Subsidence Between 1.5 and 1.99 feet
- Tier 3 - Land Subsidence Between 2 and 2.49 feet
- Tier 4 - Land Subsidence Between 2.5 and 3 feet

All Land Subsidence will be Measured Relative to a Baseline in January 2020

Tiered Land Subsidence Mitigation Approach

- Management Actions Will Be Required Within Any Given Management Zone where Land Subsidence Exceeds the Action Criteria

Immediate Actions Independent of the Tiered Criteria

- Monitoring
  - Add additional land elevation benchmarks and begin surveying them on a quarterly basis.
  - Develop an existing well database.
- Projects
  - Infrastructure projects to supply water to areas with limited access
  - Construction of Aquifer Storage and Recovery Wells
  - Purchasing Easements for a set aside program

Immediate Actions Independent of the Tiered Criteria

- Projects (Continued)
  - In-lieu Program
    - Parcels receiving, or with the possibility of receiving, surface water could develop programs with relevant surface water entities to receive either surface water, or groundwater from other areas, to be delivered to said lands.
  - Land Repurposing Program
    - Develop conservation easements, either between the landowner and GSA or other groups
    - Partner with local groups to further develop Land Fallowing Program and apply for grant funds

Immediate Actions Independent of the Tiered Criteria

- Projects (Continued)
  - Project Funding
    - Traditional Water Penalty Revenue
    - Grant Funding
- Outreach
- Subbasin-Wide Monitoring

ETGSA Land Subsidence Management Area (LSMA) Management Zone Tiers

LSMA Management Action Tier	Cumulative Land Subsidence	Requirement Management Actions (Groundwater Extraction Restrictions)
Tier 1	Between: **0 ft & 1.49 ft**	No additional restrictions beyond the established Rules and Regulations for the ETGSA Greater Tule Management Area
Tier 2	Between: **1.50 ft & 1.99 ft**	All actions in Tier 1 apply plus the following additional management actions: • Limit extractions within the Management Area to 60% of current year Tier 1 Penalty Allocation, allocated to lands within the Tier 2 Management Zone. • The remaining 40% of Tier 1 Penalty Allocation is available to be extracted or transferred outside of the Management Area, provided such use and transfer is otherwise consistent with the ETGSA Rules and Regulations. • Any wells implementing pumping of any water 600 ft below land surface will require a meter and reporting of the data monthly to the ETGSA staff, and subject to meter specifications as defined in the ETGSA Rules and Regulations.
Tier 3	Between: **2.00 ft & 2.49 ft**	All actions in Tier 1 and Tier 2 apply plus the following additional management actions: • Limit extractions within the Management Area to 30% of current year Tier 1 Penalty Allocation, allocated to lands within the Tier 2 Management Zone. • The remaining 70% of Tier 1 Penalty Allocation is available to be extracted or transferred outside of the Management Area, provided such use and transfer is otherwise consistent with the ETGSA Rules and Regulations. • Any wells implementing pumping of any water 600 ft below land surface will require a meter and reporting of the data monthly to the ETGSA staff, and subject to meter specifications as defined in the ETGSA Rules and Regulations.
Tier 4	Between: **2.50 ft & 2.99 ft**	All actions in Tiers 1 through Tier 3 apply plus the following additional management actions: • No extraction of Tier 1 Penalty Allocation within the Management Area. • Extraction of Tier 1 can occur in the Management Area if analyses and data are provided to demonstrate that it will not result in additional land subsidence.

Tier 1 – 0 to 1.49 Feet

Propose revisions to ETGSA Recharge and Banking Policies to limit pumping from ASR or groundwater banking/recharge projects to the volume of water recharged minus an established leave behind. Pumping of recharged water outside of irrigation/water districts would be limited to 90 percent of water so recharged (e.g. 10 percent “leave behind”).

Tier 2 – 1.5 to 1.99 Feet

All Actions in Tier 1 Apply Plus the Following:

- Limit extractions within the Management Area to 60%* of available Tier 1 Penalty Allocation. (*Water Code* § 10726.4(a)(2).) Any wells implementing pumping of any water 600 ft below land surface will require a meter and reporting of the data monthly to the ETGSA staff, and subject to meter specifications as defined in the ETGSA Rules and Regulations.

- The remaining 40% of Tier 1 Penalty Allocation is available to be extracted or transferred outside of the Management Area, provided such use and transfer is otherwise consistent with the ETGSA Rules and Regulations.

**As additional data becomes available and as projects, monitoring, and management actions are implemented, the groundwater flow model used to estimate the percentage reduction of Tier 1 extractions within the Management Area may be adjusted to reflect new data.*

Tier 3 – 2 to 2.49 Feet

All Actions in Tiers 1 and 2 Apply Plus the Following:

- Limit extractions within the Management Area to 30%* of available Tier 1 Penalty Allocation. (*Water Code* § 10726.4(a)(2).) Any wells implementing pumping of any water 600 ft below land surface will require a meter and reporting of the data monthly to the ETGSA staff, and subject to meter specifications as defined in the ETGSA Rules and Regulations.

- The remaining 70% of Tier 1 Penalty Allocation is available to be extracted and or transferred outside of the Management Area, provided such use and transfer is otherwise consistent with the ETGSA Rules and Regulations.

**As additional data becomes available and as projects, monitoring, and management actions are implemented, the groundwater flow model used to estimate the percentage reduction of Tier 1 extractions within the Management Area may be adjusted to reflect new data.*

Tier 4 – 2.5 to 3 Feet

All Actions in Tiers 1 through 3 Apply Plus the Following:

No extraction of Tier 1 Penalty Allocation within the Management Area. (*Water Code* § 10726.4(a)(4).) Extraction of Tier 1 Penalty Allocation can occur in the Management Area if analyses and data are provided to demonstrate that it will not result in additional land subsidence.

Current Status of Land Subsidence in the ETGSA Management Area

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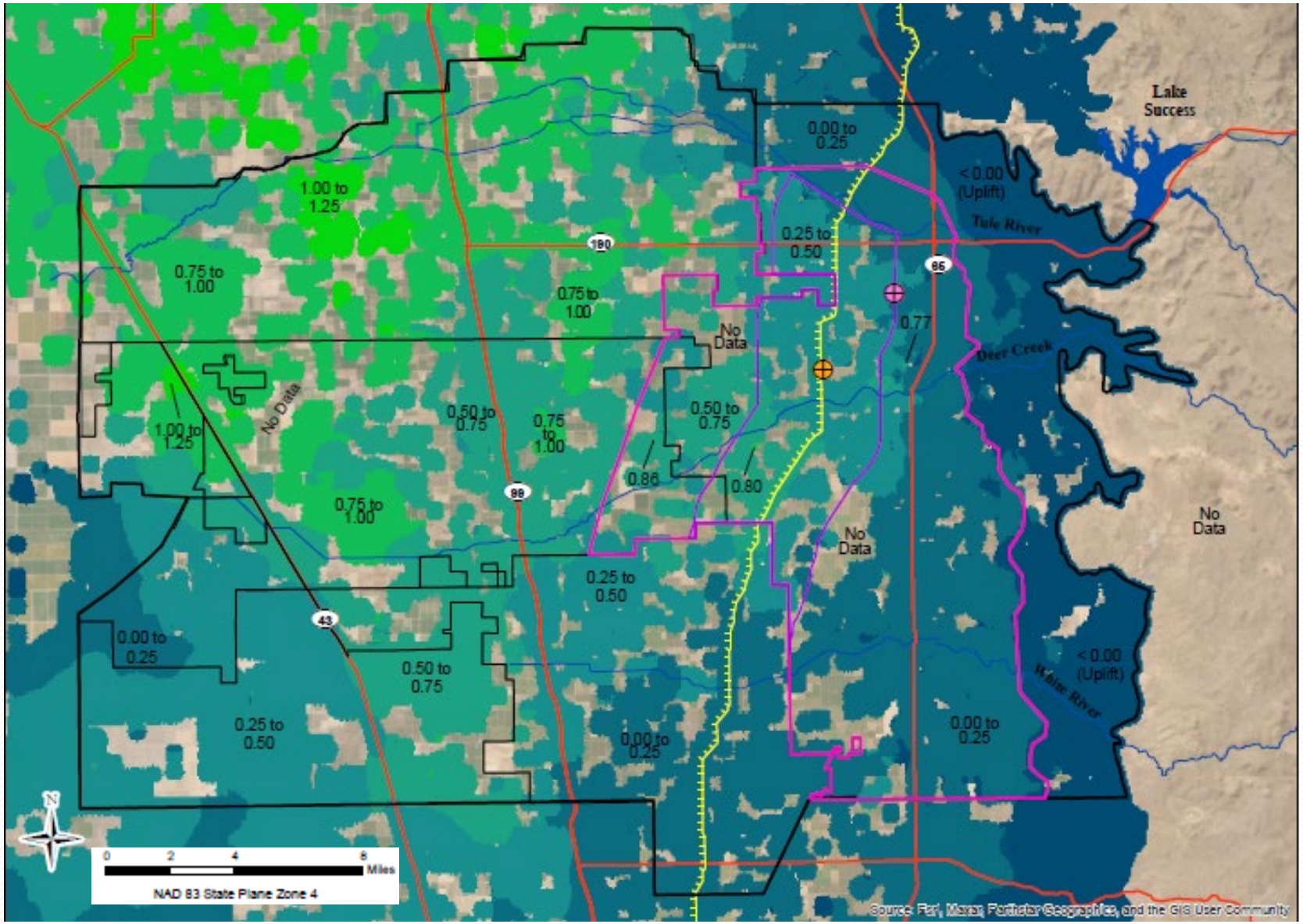
InSAR Satellite Data Oct 2021 – Sept 2022



Map Features

- USGS Extensometer
- Porterville GPS Station

InSAR Subsidence from October 2021 to September 2022 (ft)

- 3.00 to 3.25
- 2.75 to 3.00
- 2.50 to 2.75
- 2.25 to 2.50
- 2.00 to 2.25
- 1.75 to 2.00
- 1.50 to 1.75
- 1.25 to 1.50
- 1.00 to 1.25
- 0.75 to 1.00
- 0.50 to 0.75
- 0.25 to 0.50
- 0.00 to 0.25
- < 0.00 (Uplift)

- Management Area
- Monitored Area
- Subbasin Boundary
- GSA Boundary
- Friant-Kern Canal
- Major Hydrologic Feature
- State Highway/Major Road

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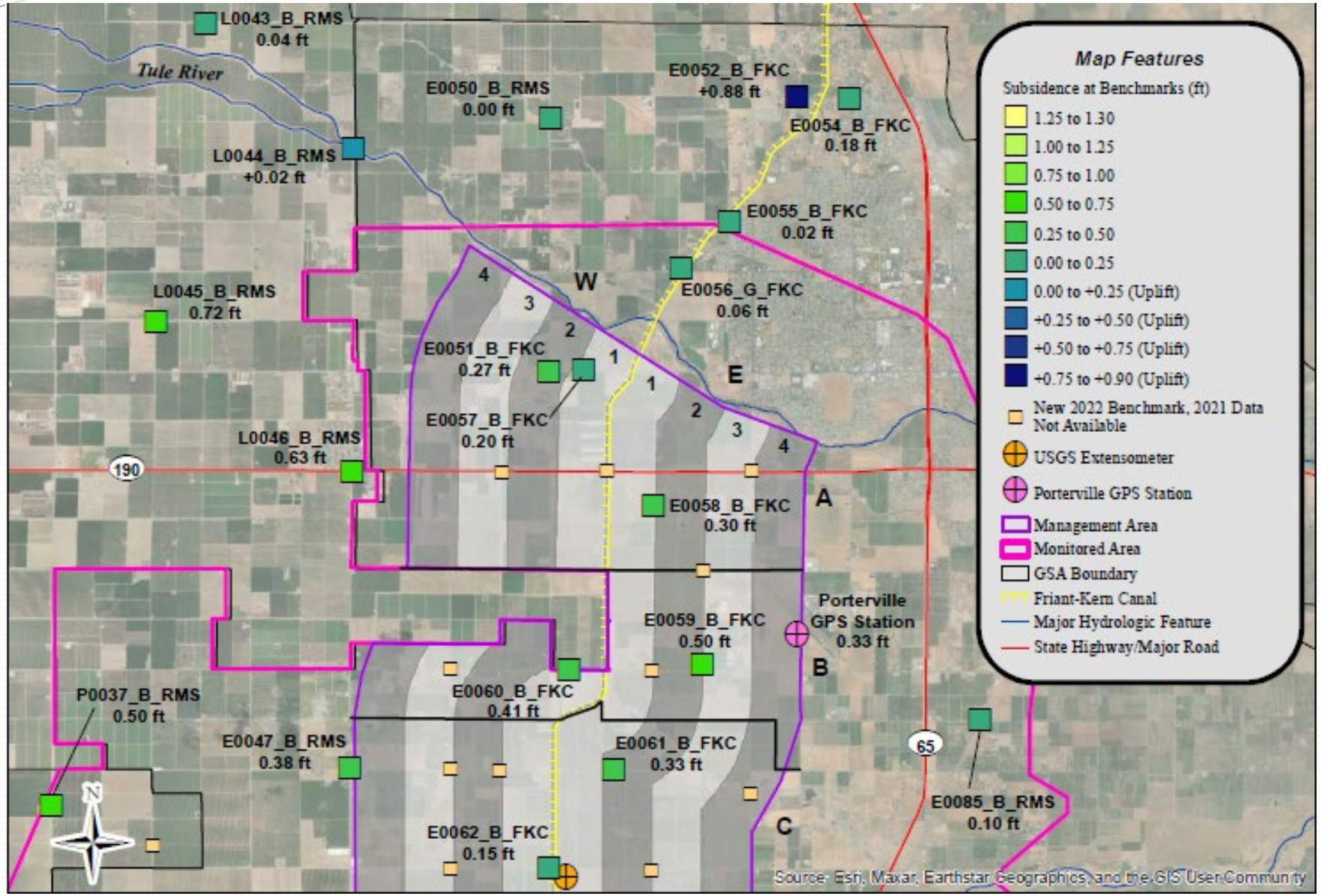
Benchmark Survey Results – July 2021 – July 2022



Northern Management Area

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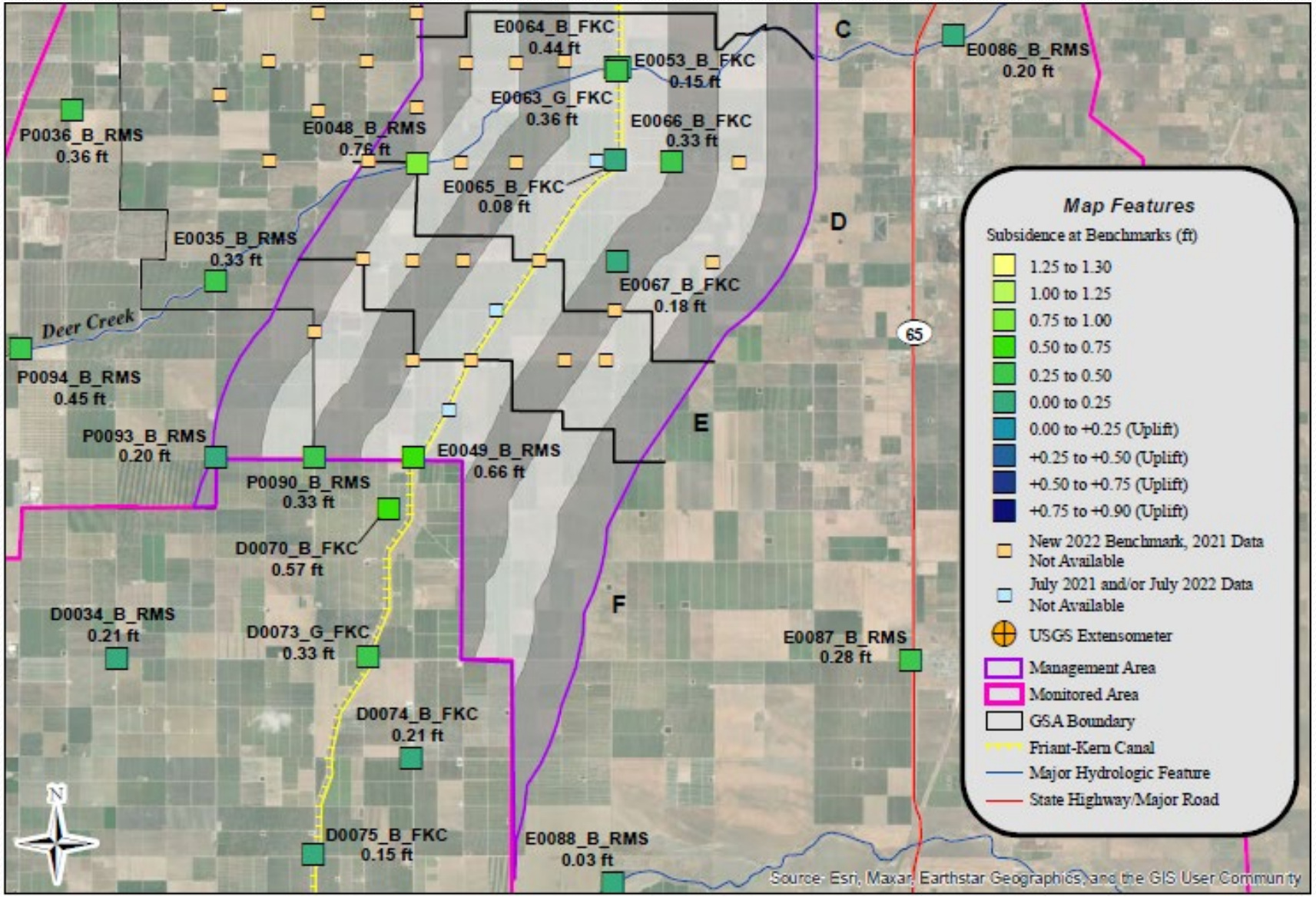
Benchmark Survey Results – July 2021 – July 2022



Southern Management Area

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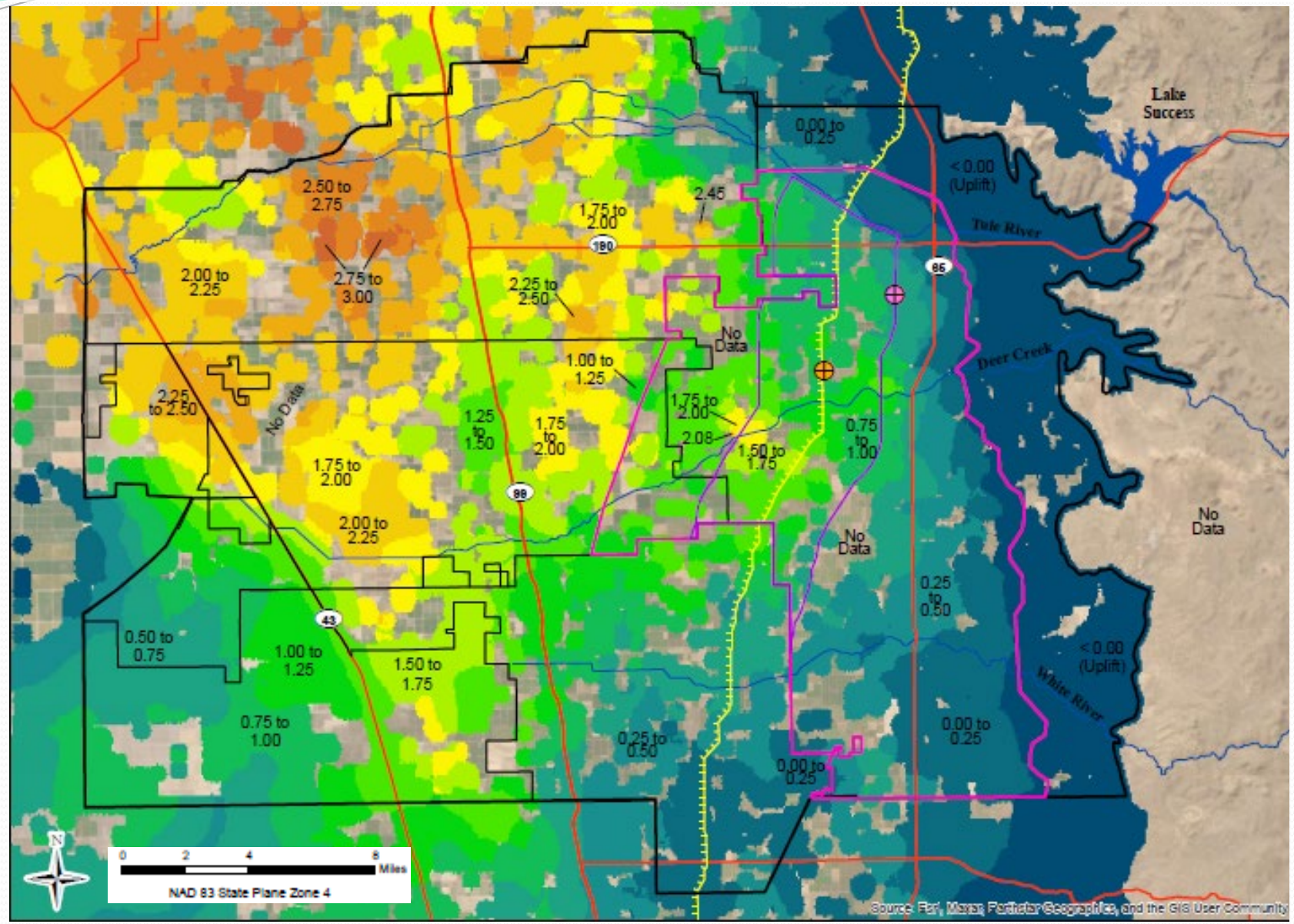
InSAR Satellite Data Jan 2020 – Sept 2022



Map Features

- USGS Extensometer
- Porterville GPS Station

InSAR Subsidence from January 2020 to September 2022 (ft)

- 3.00 to 3.25
- 2.75 to 3.00
- 2.50 to 2.75
- 2.25 to 2.50
- 2.00 to 2.25
- 1.75 to 2.00
- 1.50 to 1.75
- 1.25 to 1.50
- 1.00 to 1.25
- 0.75 to 1.00
- 0.50 to 0.75
- 0.25 to 0.50
- 0.00 to 0.25
- < 0.00 (Uplift)
- Management Area
- Monitored Area
- GSA Boundary
- Subbasin Boundary
- Friant-Kern Canal
- Major Hydrologic Feature
- State Highway/Major Road

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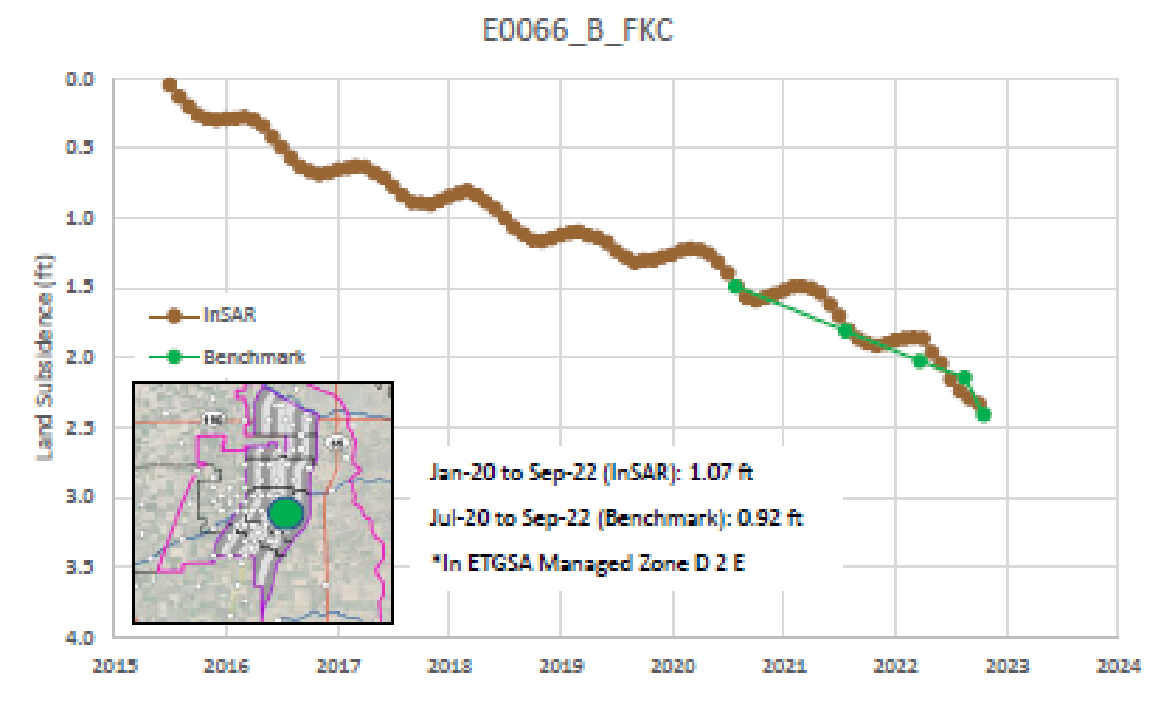
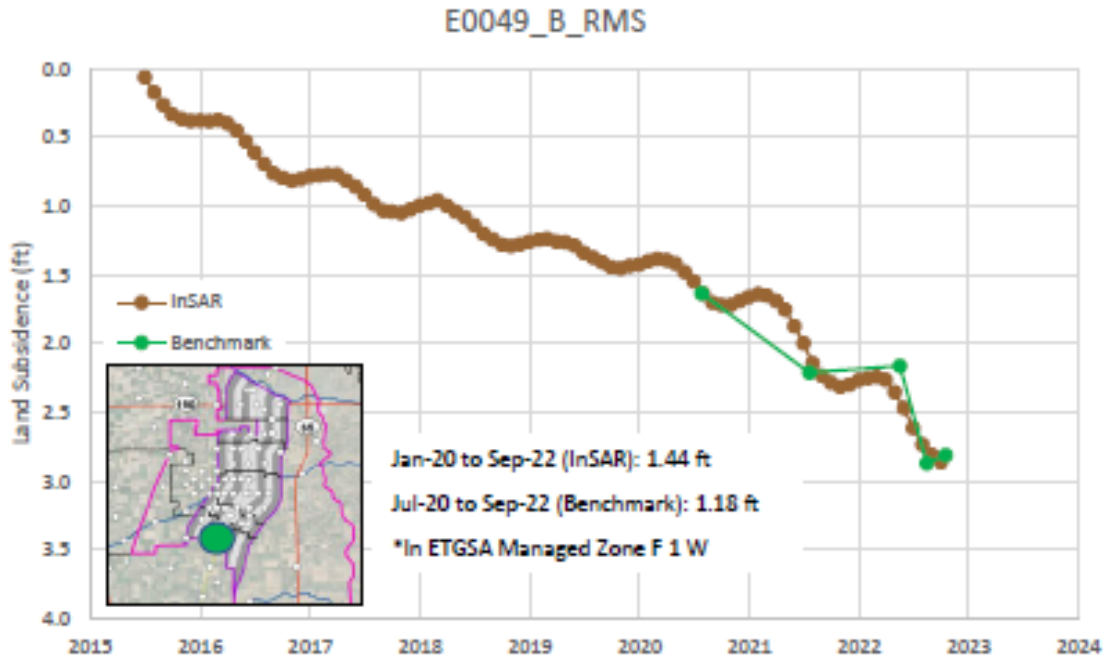
Comparison of Benchmark and InSAR Land Subsidence Rates





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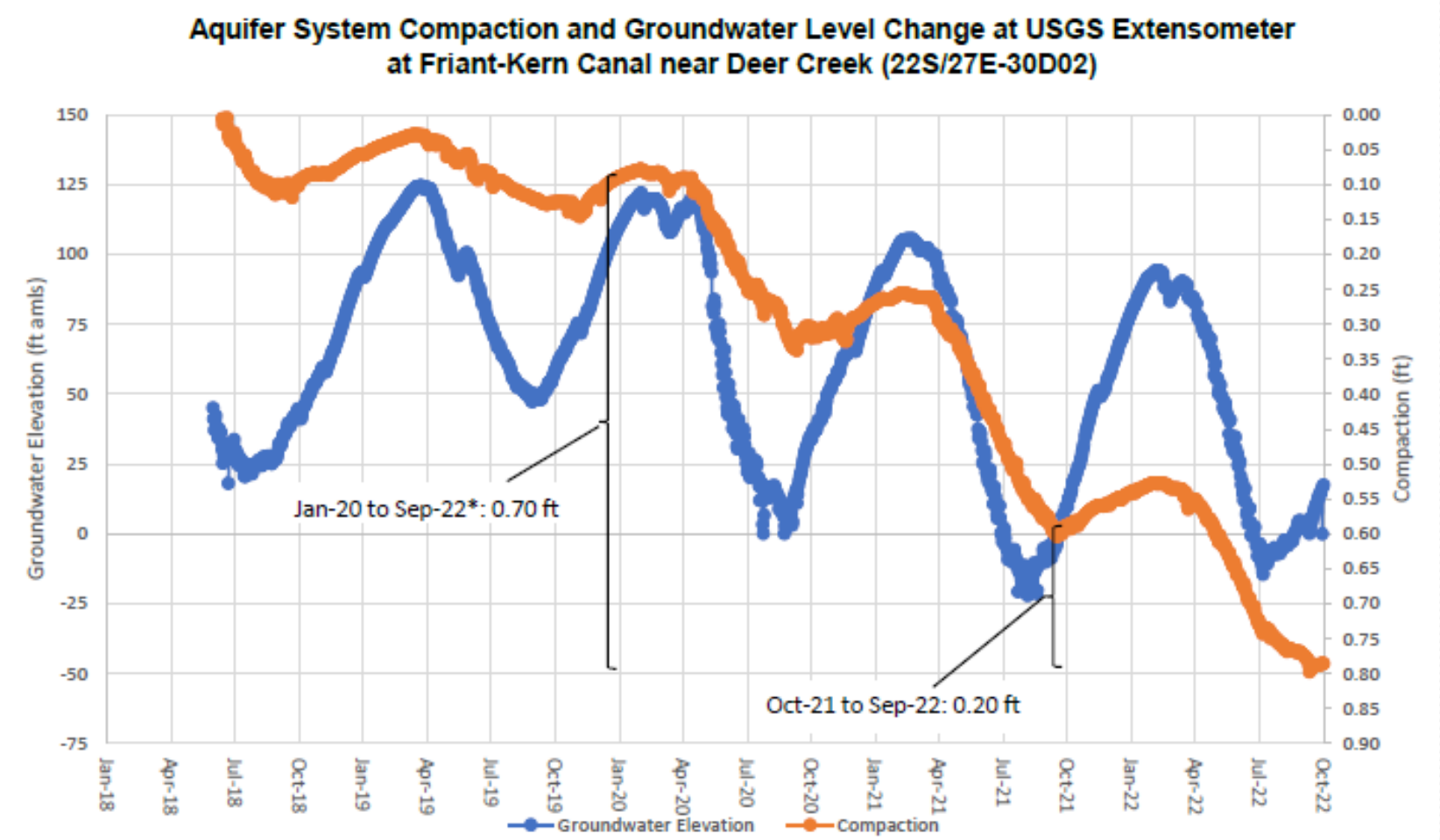
Aquifer Compaction at USGS Extensometer



Notes:

Data from USGS Site 355933119062001, https://maps.waterdata.usgs.gov/mapper/index.html

Extensometer depth 1,180 ft bgs and screened interval 1,083 to 1,180 ft bgs.

The Aquifer Compression Trend Suggests that the Net 0.7-ft of Compression Since January 2020 is Non-Recoverable

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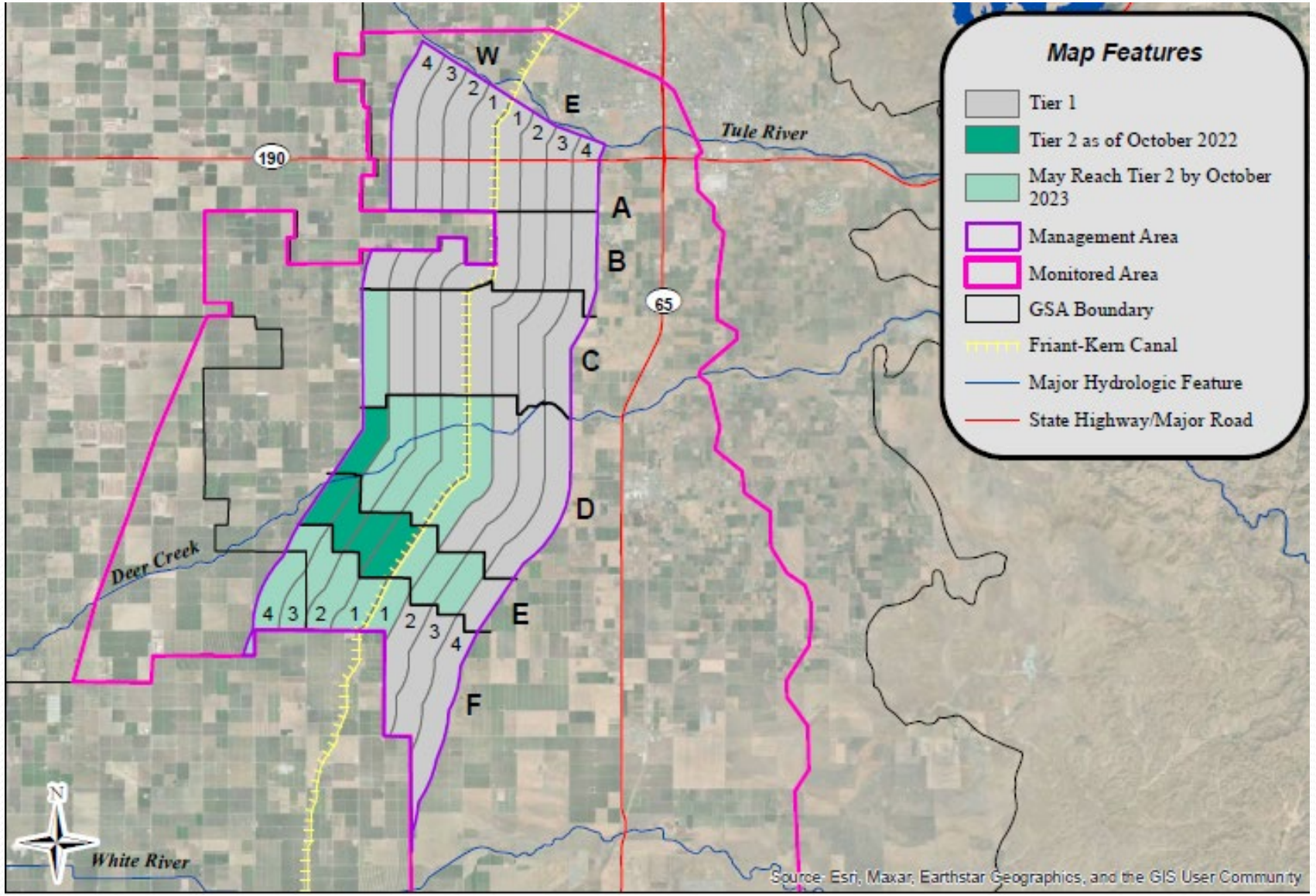
Management Zone Tier Status As Of February 2023



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Cumulative Land Subsidence by LSMA Management Zone

January 2020 to September 2022

Management Zone			Cumulative Land Subsidence	Management	Tier Land Subsidence Range
Name	North- South	East -West	(ft)	Tier	(ft)
E4W	E	4W	1.74	Tier2	1.5 - 2 ft
E3W	E	3W	1.66	Tier2	1.5 - 2 ft
D4W	D	4W	1.61	Tier2	1.5 - 2 ft
E2W	E	2W	1.56	Tier2	1.5 - 2 ft
E1W	E	1W	1.5	Tier2	1.5 - 2 ft
F1E	F	1E	1.46	Tier1	0 - 1.49 ft
F1W	F	1W	1.44	Tier1	0 - 1.49 ft
F2W	F	2W	1.43	Tier1	0 - 1.49 ft
E1E	E	1E	1.42	Tier1	0 - 1.49 ft
D3W	D	3W	1.4	Tier1	0 - 1.49 ft
F4W	F	4W	1.38	Tier1	0 - 1.49 ft
F3W	F	3W	1.36	Tier1	0 - 1.49 ft
D2W	D	2W	1.35	Tier1	0 - 1.49 ft
D1W	D	1W	1.27	Tier1	0 - 1.49 ft
E2E	E	2E	1.26	Tier1	0 - 1.49 ft
C4W	C	4W	1.22	Tier1	0 - 1.49 ft
D1E	D	1E	1.19	Tier1	0 - 1.49 ft
E3E	E	3E	1.16	Tier1	0 - 1.49 ft
D2E	D	2E	1.06	Tier1	0 - 1.49 ft
C3E	C	3E	1	Tier1	0 - 1.49 ft
F2E	F	2E	1	Tier1	0 - 1.49 ft
B4W	B	4W	0.99	Tier1	0 - 1.49 ft
C3W	C	3W	0.99	Tier1	0 - 1.49 ft
C4E	C	4E	0.98	Tier1	0 - 1.49 ft
C1W	C	1W	0.98	Tier1	0 - 1.49 ft
D3E	D	3E	0.97	Tier1	0 - 1.49 ft
C2W	C	2W	0.96	Tier1	0 - 1.49 ft
C1E	C	1E	0.94	Tier1	0 - 1.49 ft
D4E	D	4E	0.94	Tier1	0 - 1.49 ft
F3E	F	3E	0.92	Tier1	0 - 1.49 ft
E4E	E	4E	0.91	Tier1	0 - 1.49 ft
A4W	A	4W	0.89	Tier1	0 - 1.49 ft
C2E	C	2E	0.88	Tier1	0 - 1.49 ft
B2E	B	2E	0.87	Tier1	0 - 1.49 ft
B3E	B	3E	0.87	Tier1	0 - 1.49 ft
B1W	B	1W	0.85	Tier1	0 - 1.49 ft
B1E	B	1E	0.83	Tier1	0 - 1.49 ft
B2W	B	2W	0.83	Tier1	0 - 1.49 ft
B3W	B	3W	0.83	Tier1	0 - 1.49 ft
A3W	A	3W	0.78	Tier1	0 - 1.49 ft
A2W	A	2W	0.71	Tier1	0 - 1.49 ft
F4E	F	4E	0.7	Tier1	0 - 1.49 ft
B4E	B	4E	0.69	Tier1	0 - 1.49 ft
A1W	A	1W	0.67	Tier1	0 - 1.49 ft
A1E	A	1E	0.64	Tier1	0 - 1.49 ft
A2E	A	2E	0.62	Tier1	0 - 1.49 ft
A3E	A	3E	0.54	Tier1	0 - 1.49 ft
A4E	A	4E	0.5	Tier1	0 - 1.49 ft

Cumulative Land Subsidence by LSMA Management Zone

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Questions