North Fork Kings
Groundwater Sustainability Agency

Welcome!

Groundwater Sustainability Plan (GSP) Overview

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Provost & Pritchard Consulting Group

GSP Webinar

August 29, 2019

What Will We Cover?

SESSION 1: SGMA Overview

SESSION 2: Basin Setting

SESSION 3: Sustainable Management Criteria and Monitoring Network

SESSION 4: Projects and Management Actions

LIVE POLL

Is this your first SGMA event?

Yes

No

SESSION 1

SGMA OVERVIEW

What is SGMA?
SGMA = Sustainable Groundwater Management Act

- Unfunded CA law signed by governor Brown in 2014

> **OBJECTIVE:**
>
> Ensure the long-term reliability of groundwater resources and connected surface water resources by requiring “sustainable” management of groundwater basin

- North Fork Kings GSA is one of over 260 Groundwater Sustainability Agencies formed in California to implement the law through local control

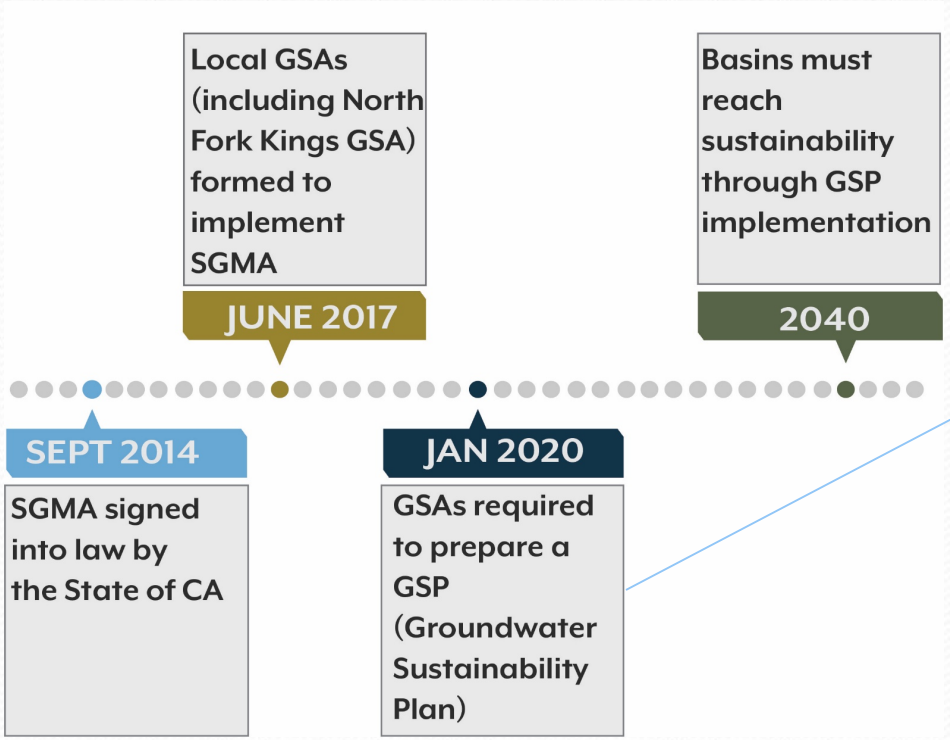
SGMA Overview

Primary reasons for adopting SGMA into law - avoid Undesirable Results:

- Over pumping of groundwater, or overdraft
- Declining groundwater levels
- Drought/volatility in water resources, reduced groundwater storage
- Degradation of water quality
- Impacts to surface water interconnection
- Land subsidence

SGMA Process

North Fork Kings GSA - SGMA Timeline



July 17, 2019
Draft Groundwater Sustainability Plan released for 90-day public review

October 21, 2019
Draft Groundwater Sustainability Plan public review closes

October 23, 2019
Public Hearing

January 2020
Submit final Groundwater Sustainability Plan

SGMA Overview

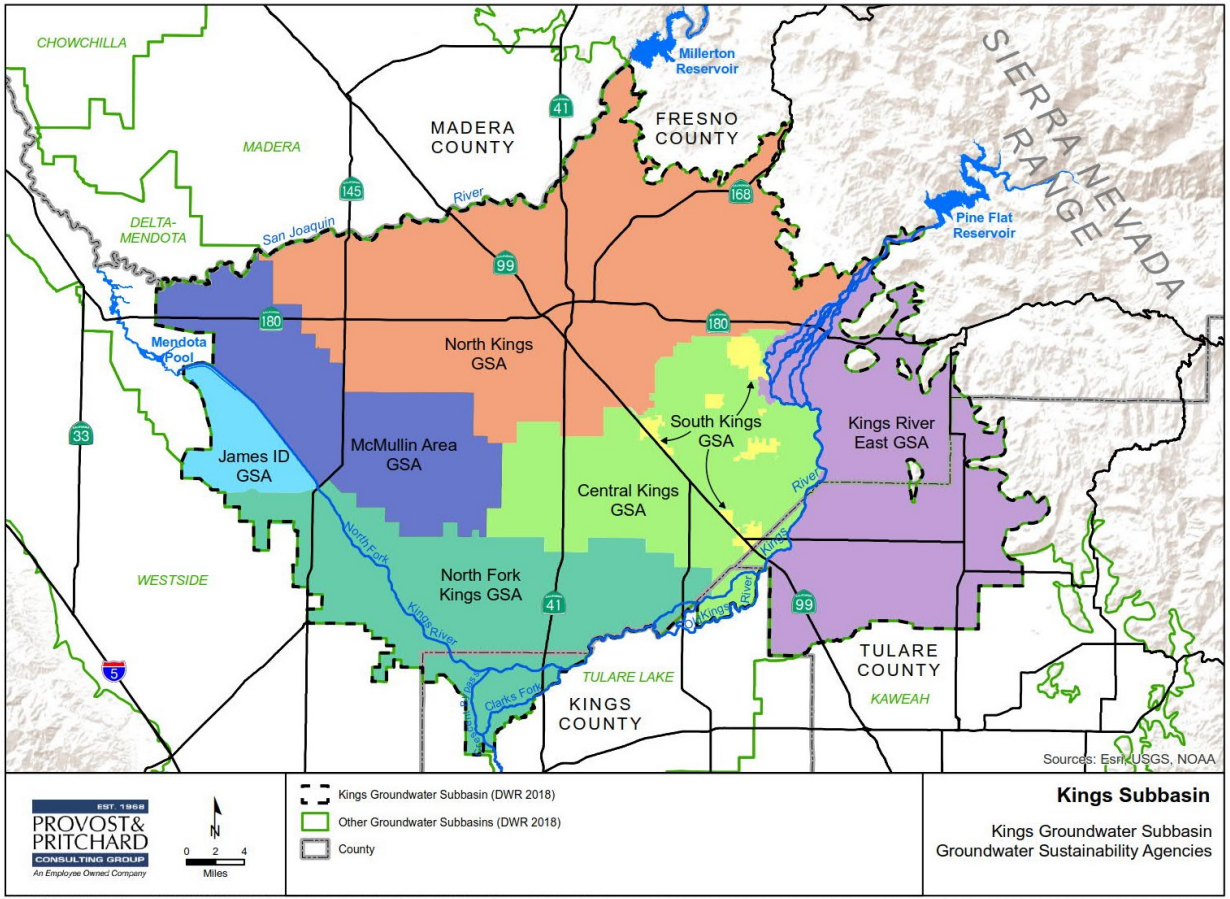
What happens if local GSA does not comply with SGMA?

- Basin would be placed on Probationary status
- Interim plan would be developed by the State and may restrict groundwater extractions
- State imposed management plans and metering of wells
- Groundwater extraction reporting directly to the State
- Fees for groundwater pumping paid to the State directly at a higher cost with no local benefit of project development

SGMA Overview

Groundwater Sustainability Agencies have authority to:

- Conduct studies
- Register and monitor wells
- Set well spacing requirements
- Require groundwater extraction reporting
- Regulate groundwater extractions
- Implement capital projects
- Assess fees to cover costs



Kings Subbasin

- Considered “High Priority” and “Critically Overdrafted”
- 7 GSAs within Kings Subbasin
- Each GSA is preparing its own GSP
- Each GSA must coordinate with other GSAs in the Subbasin on their GSP
- Entire Subbasin must be sustainable by 2040

Who is the North Fork Kings GSA?

- NFKGSA was formed by Special Act Legislation in September 2016
- Encompasses approximately 168,200 acres
- NFKGSA Board of Directors and Members:

DIVISION 1 – Supervisor Mendes
County of Fresno

DIVISION 2 – Frank Zonneveld
Clark's Fork Reclamation District
Laguna Irrigation District
Upper San Jose Water Company

DIVISION 3 – Danielle Roberts
Lanare Community Services District
Laton Community Services District
Riverdale Public Utilities District

DIVISION 4 – Mark McKean
Crescent Canal Company
Stinson Canal & Irrigation Company

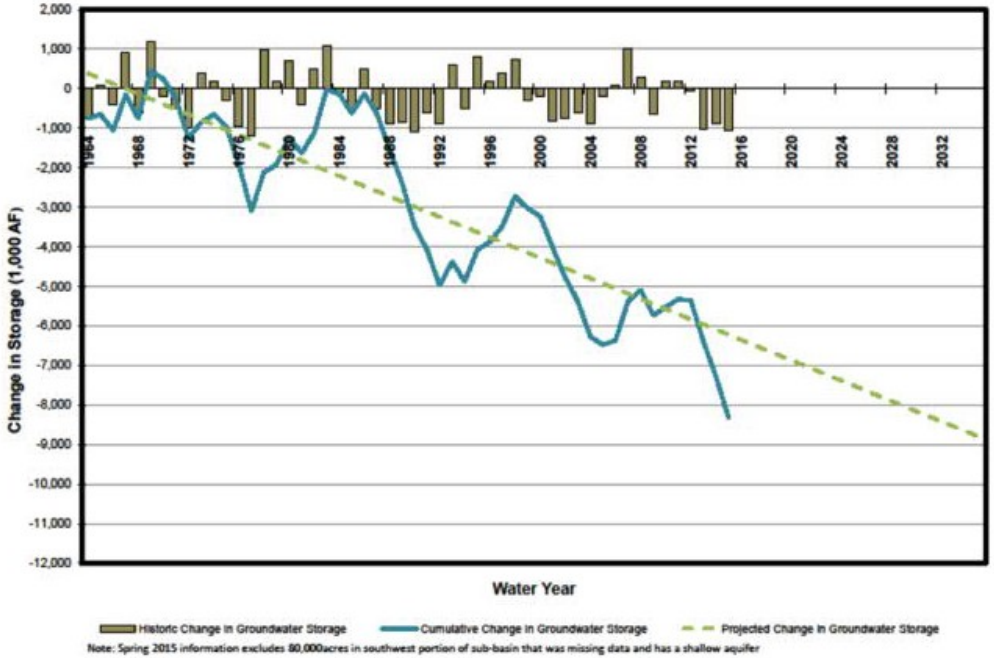
DIVISION 5 – Leonard Acquistapace
Reed Ditch Company
Riverdale Irrigation District

DIVISION 6 – Stephen Maddox, Jr.
Burrel Ditch Company
Liberty Mill Race Company

DIVISION 7 – Tony Campos
Liberty Canal Company
Liberty Water District

Kings Subbasin Groundwater Overdraft

- Not a new issue – Kings Basin IRWMP notes the change in groundwater storage over time:



Historical and Projected Groundwater Level Decline

- Kings coordinated effort estimated current overdraft within the Kings Subbasin at 122,000 acre-feet per year (AF/yr) during the hydrologic base period

- Initial “responsibility” for overdraft assigned to each GSA after evaluating various methodologies

GSP Requirements

- NFKGSA GSP to be consistent with other GSPs in Kings Subbasin through a coordination agreement
- Must also coordinate with adjacent Subbasins (Madera, Westside, & Tulare Lake)
- Implement projects and management actions to achieve sustainability
- Conduct monitoring and data management
- Monitoring data to be submitted to DWR through annual reports
- GSP 5-year updates and DWR review during GSP implementation (Jan. 2040)

What does the GSP do?

Identifies data gaps and documents historic and current groundwater conditions

- Groundwater levels
- Groundwater quality
- Water budgets

Defines an initial path to groundwater sustainability

- Identifies Measurable Objectives and Minimum Thresholds
- Identifies projects to increase water supply
- Identifies management actions to reduce groundwater demands

What doesn't the current GSP do?

- Require immediate pumping restrictions
- Require changes to crops
- Require land use changes
- Require mandatory land fallowing

- Subsequent GSP updates may need to address these topics

GSP Chapter Outline

- Executive Summary

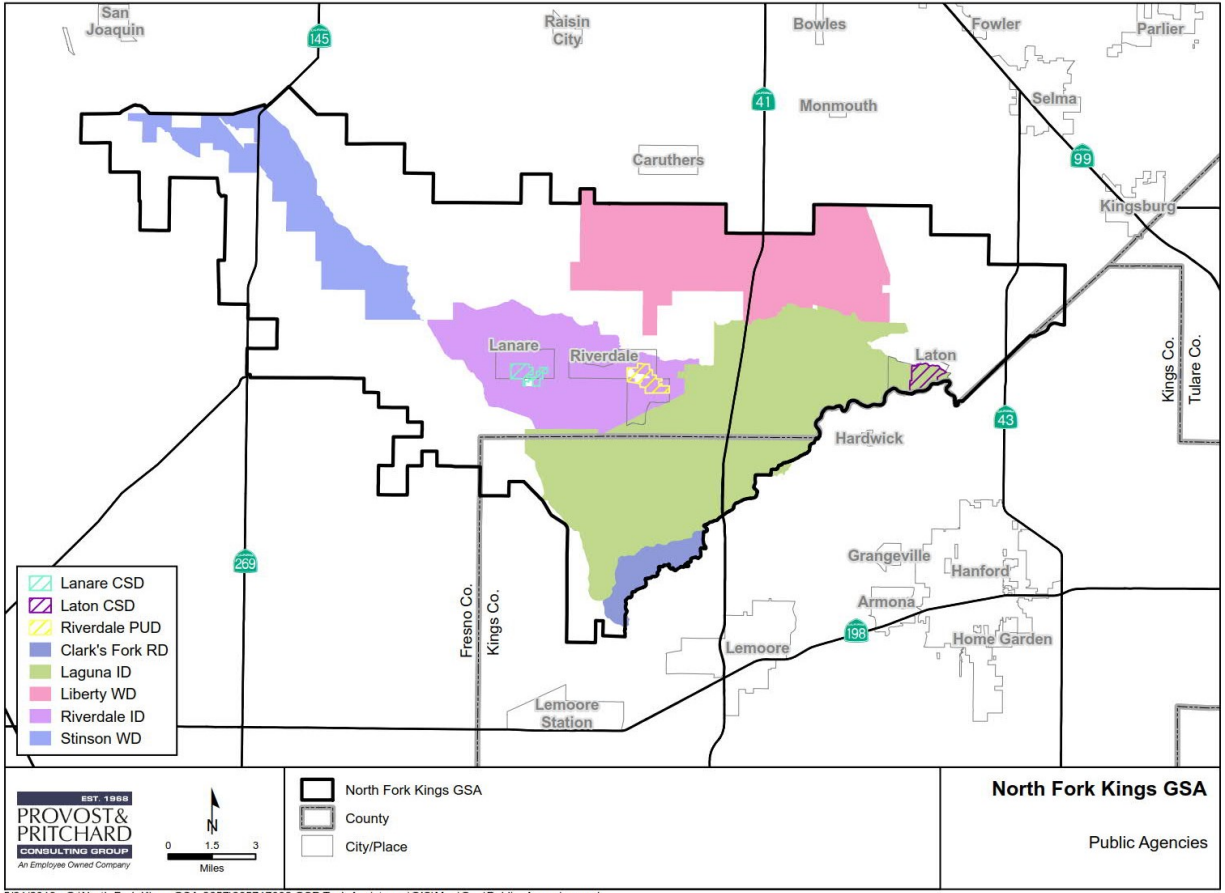
1. Introduction
2. Plan Area
3. Basin Setting
4. Sustainable Management Criteria
5. Monitoring Network
6. Projects and Management Actions to Achieve Sustainability
7. Plan Implementation
8. References and Technical Studies

- Appendices

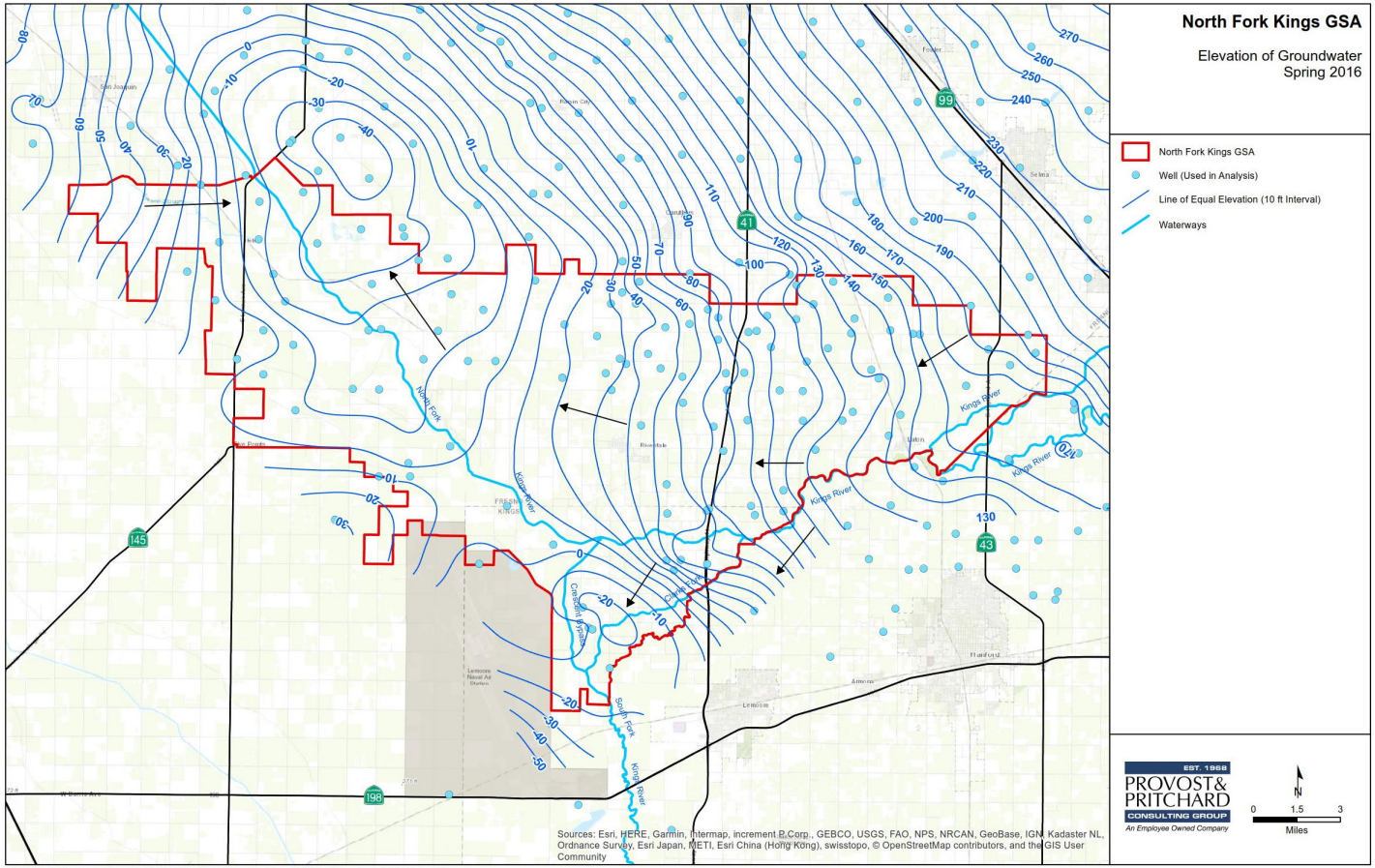
SESSION 2

BASIN SETTING - NFKGSA

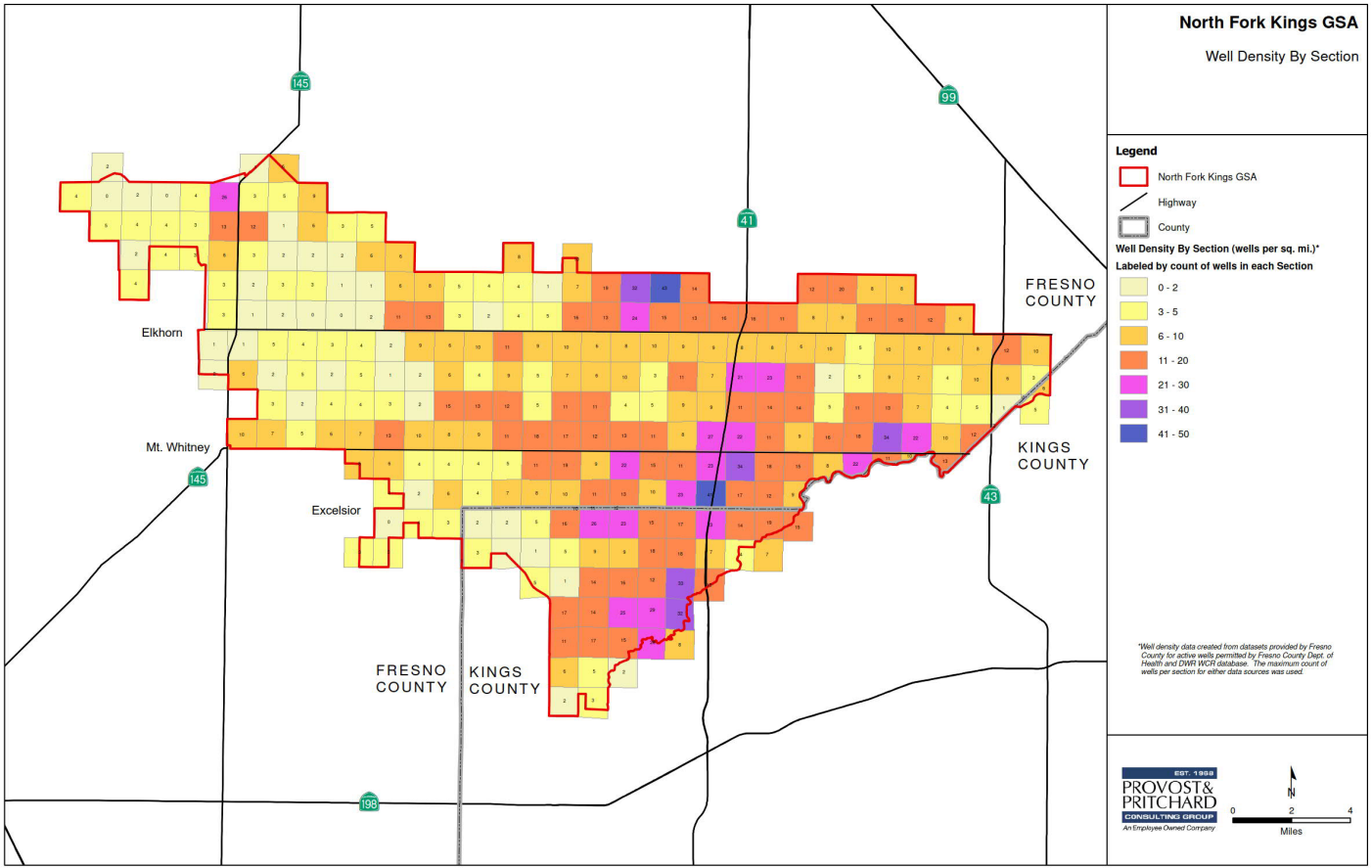
Public Agencies within NFKGSA



Spring 2016 groundwater contour map of unconfined aquifer

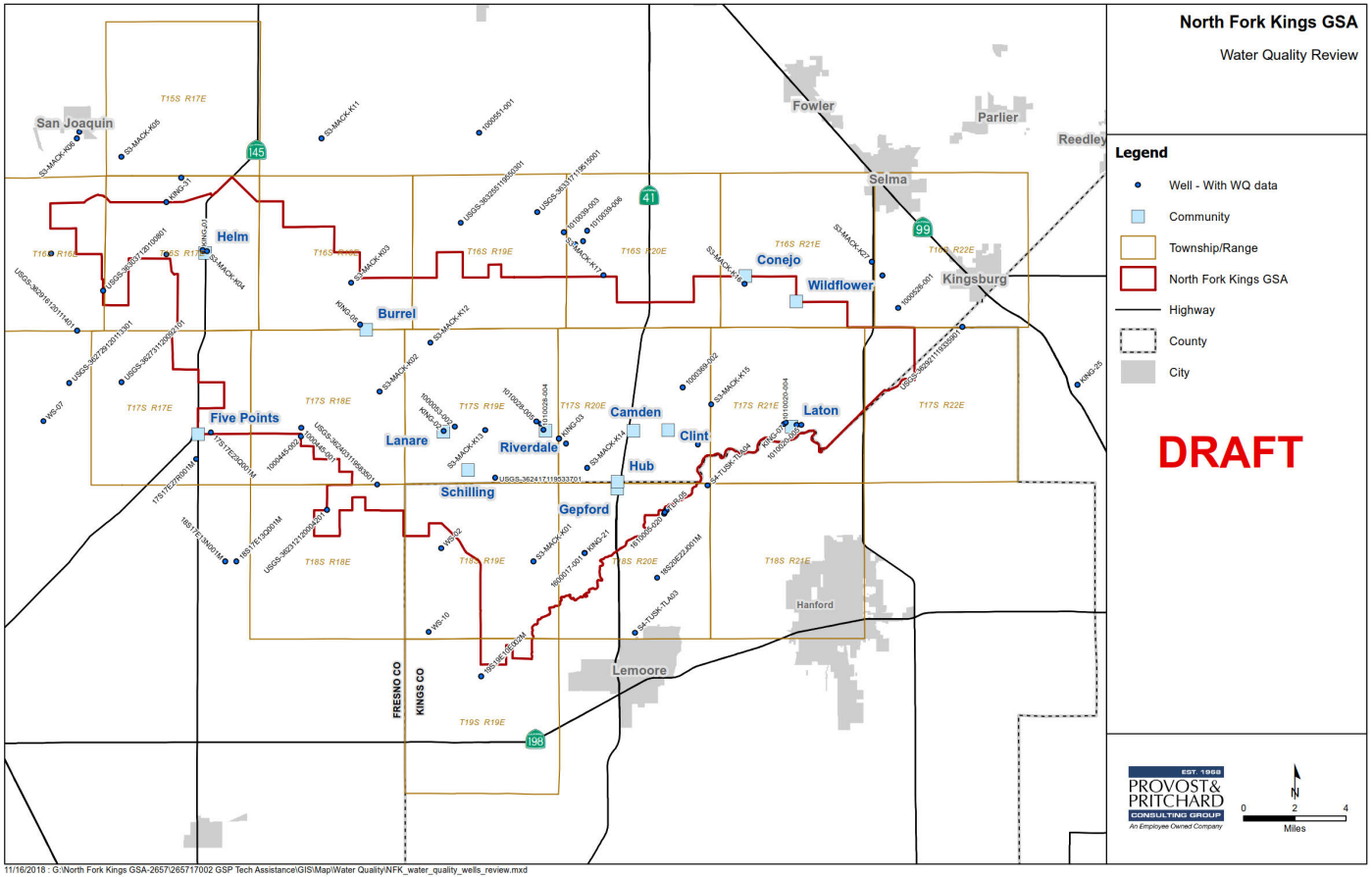


Representative Well Density



Water Quality Review in NFKGSA Vicinity

- Public data from Groundwater Ambient Monitoring and Assessment Program (GAMA) https://www.waterboards.ca.gov/gama/

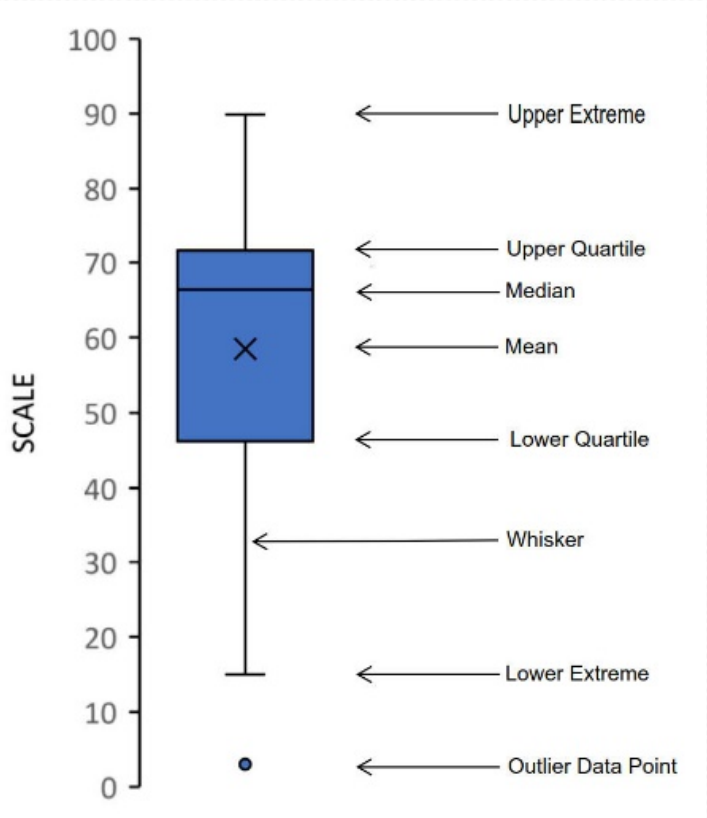


Chemicals of Concern in NFKGSA Vicinity

- Earliest records dated prior to 1989.
- X = California Maximum Contaminant Level (MCL) exceedances

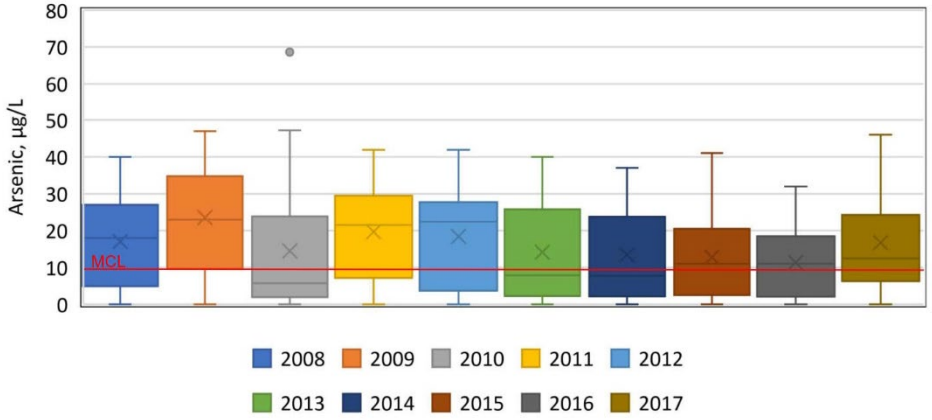
Chemical	Shallow Zone (0 to 150 ft deep)	Intermediate Zone (150 ft deep to E-clay)	Deep Zone (Below E-clay)
Arsenic	X	X	X
Chromium (Total)	X		
Fluoride		X	X
Gross Alpha		X	X
Lead	X		X
Nitrate	X	X	X
1,2,3-Trichloropropane	X	X	X
Uranium	X	X	
Aluminum		X	
Iron	X	X	X
Manganese	X	X	X
Total Dissolved Solids	X	X	X

Water Quality - Box and Whisker Plots

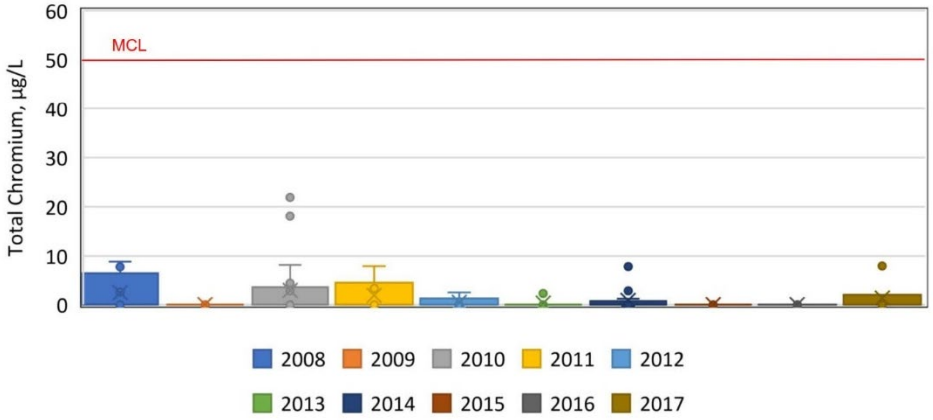


- The box portion of the plot shows the upper and lower quartiles and represent the likely variation of the data set. The difference between the upper and lower quartile values is known as the inter-quartile range. The mean value of a data set is the sum of all the data point values divided by the number of data points in the set. This value is shown as an “X’ in the plot. The median value is the value of the data point in the middle of a data set that has been sorted sequentially from smallest to largest. The upper extreme and the lower extreme are called the whiskers.
- Queries focused on identifying the highest recorded concentration for each constituent for the most recent 10-year period across all zones.

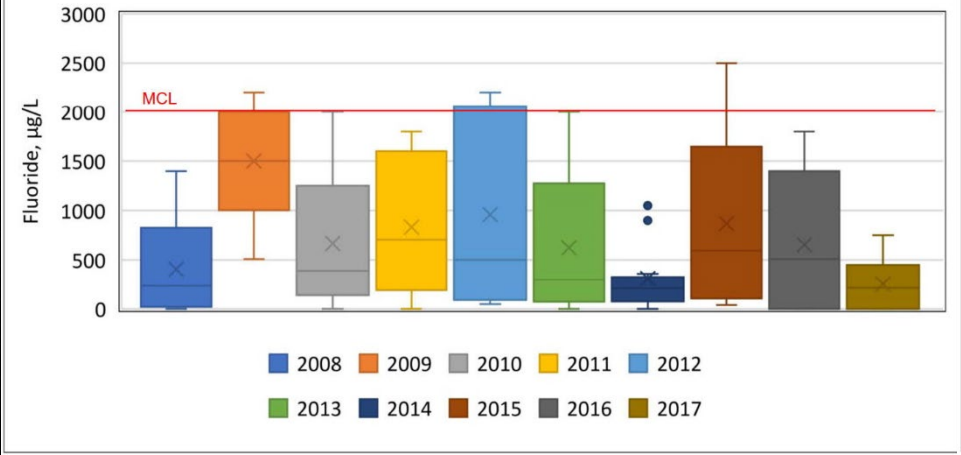
Arsenic Concentration Variation, 2008 to 2017



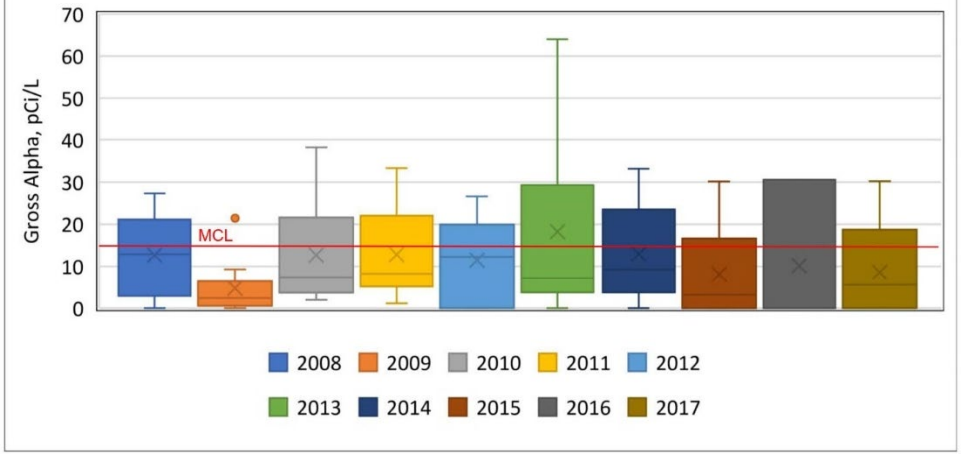
Total Chromium Concentration Variation, 2008 to 2017



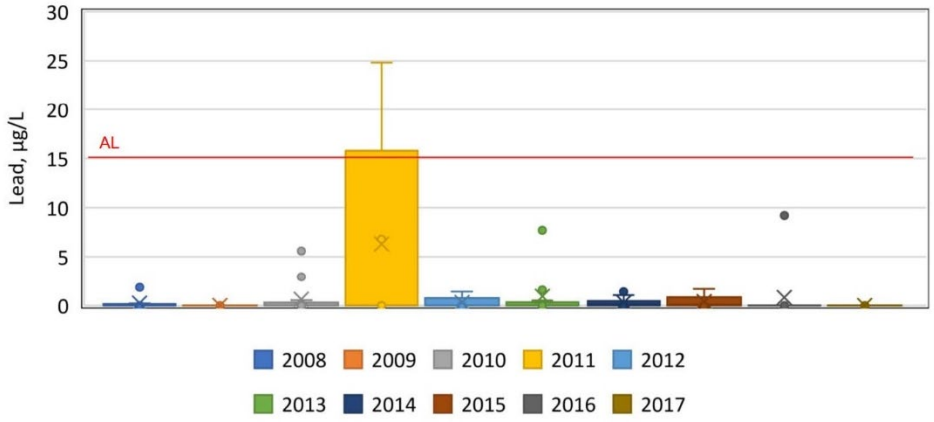
Fluoride Concentration Variation, 2008 to 2017



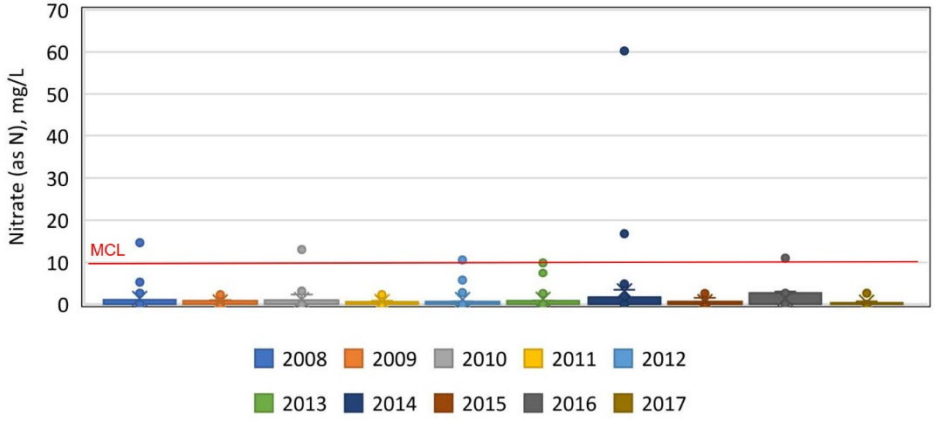
Gross Alpha Concentration Variation, 2008 to 2017



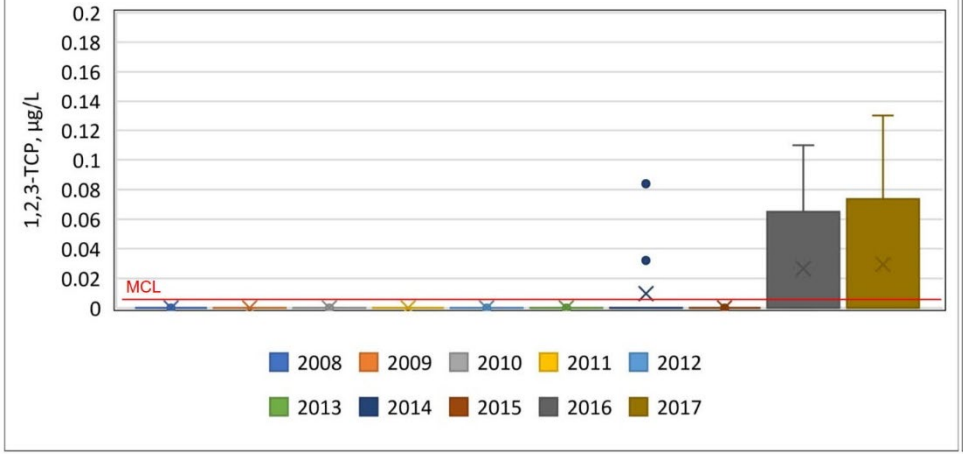
Lead Concentration Variation, 2008 to 2017



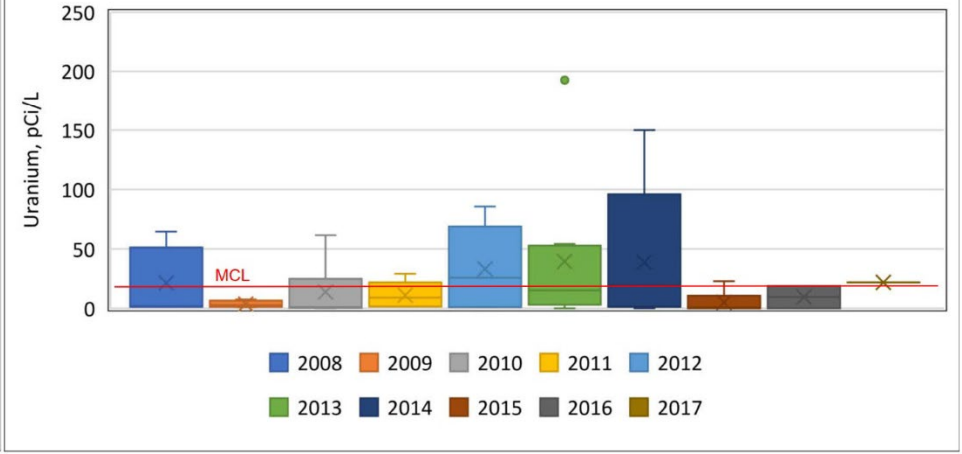
Nitrate Concentration Variation, 2008 to 2017



1,2,3-TCP Concentration Variation, 2008 to 2017



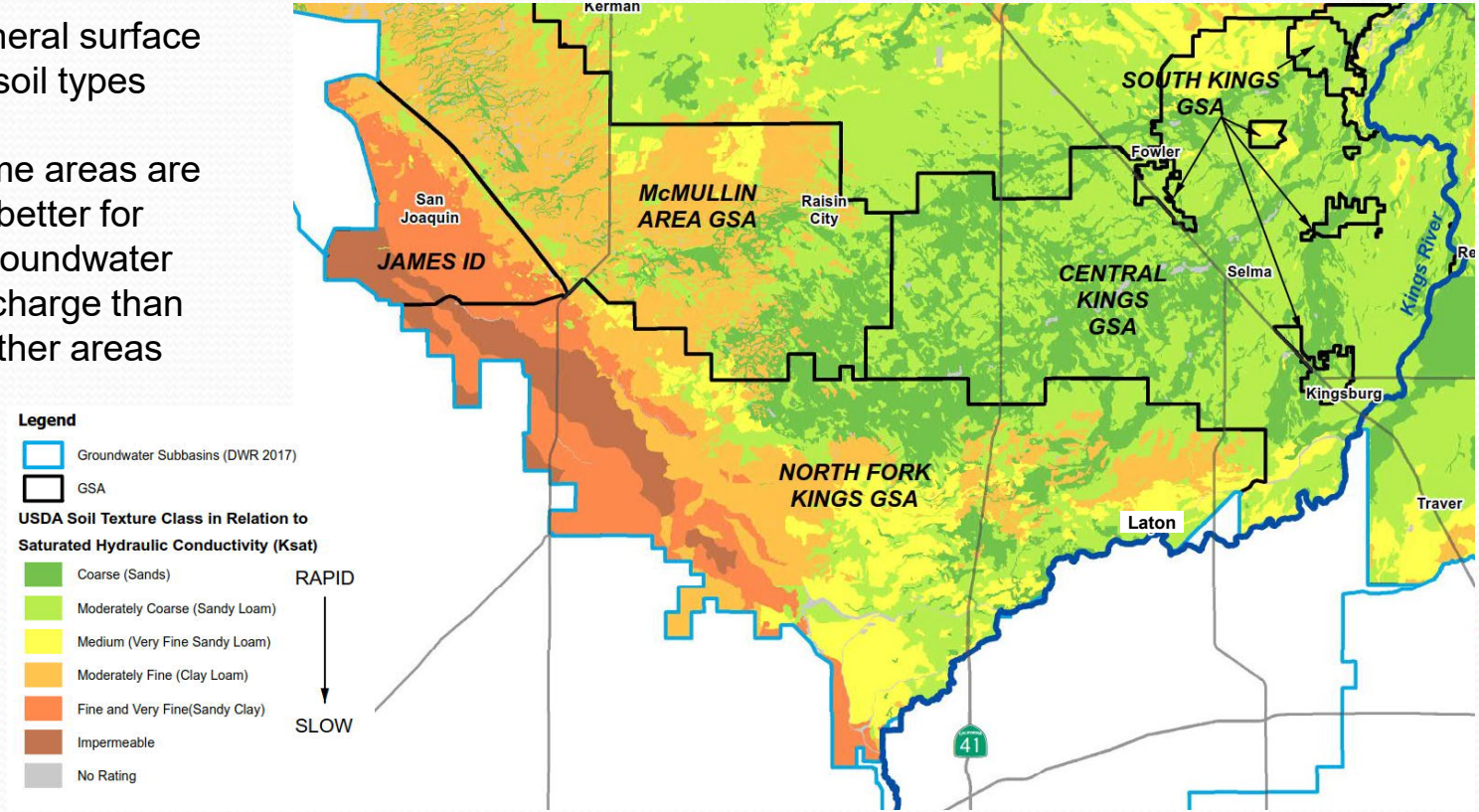
Uranium Concentration Variation, 2008 to 2017



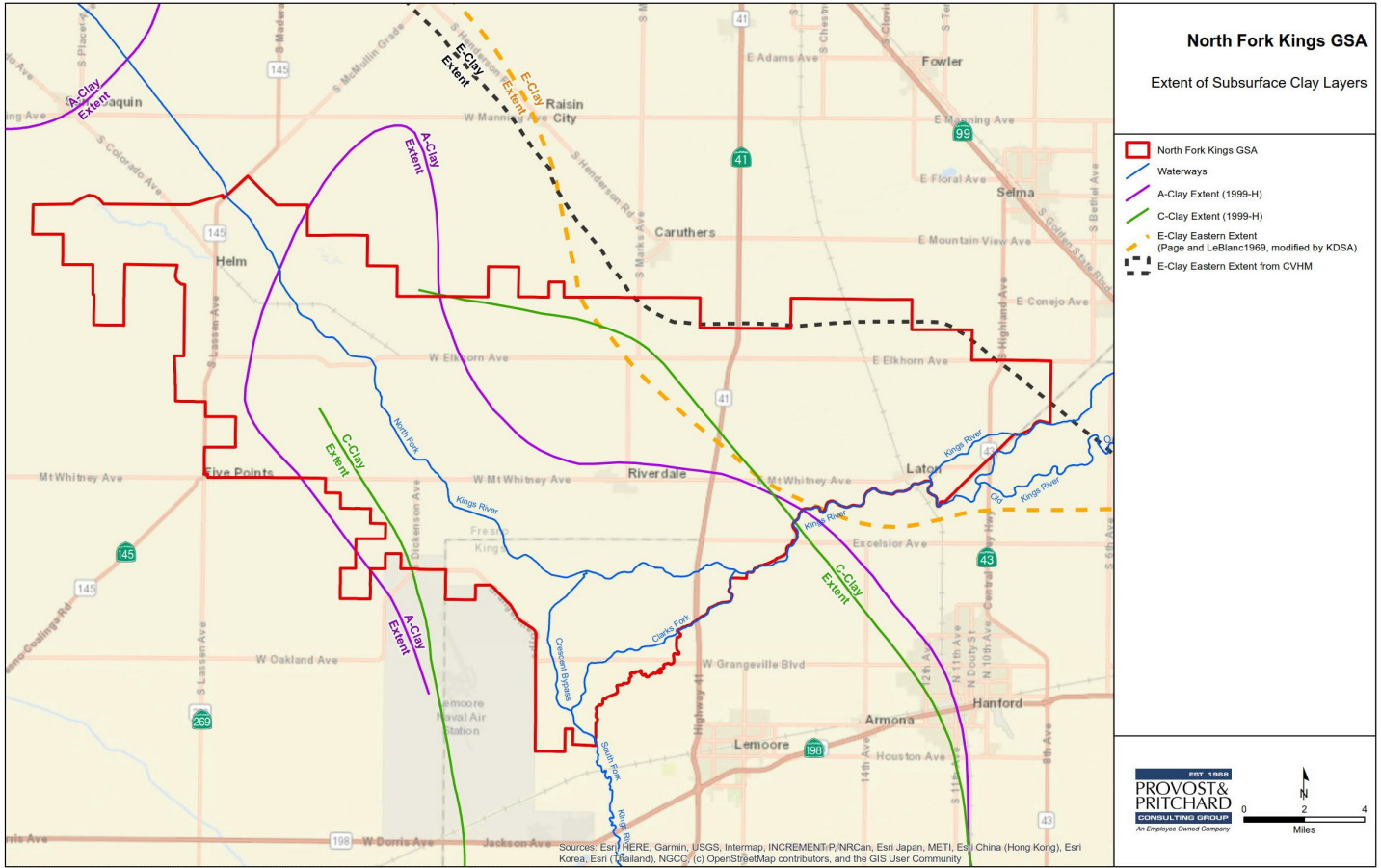
Soil Types in and near NFKGSA

General surface soil types

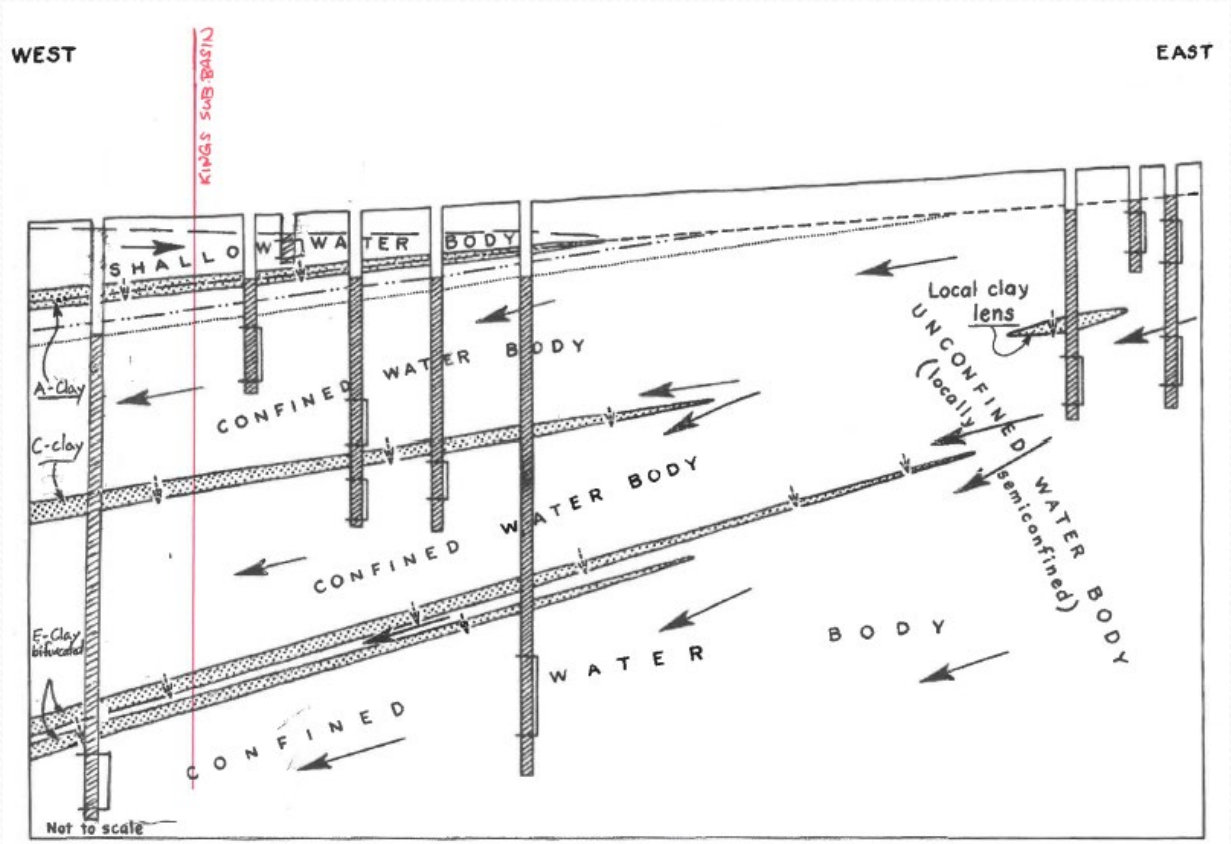
Some areas are better for groundwater recharge than other areas



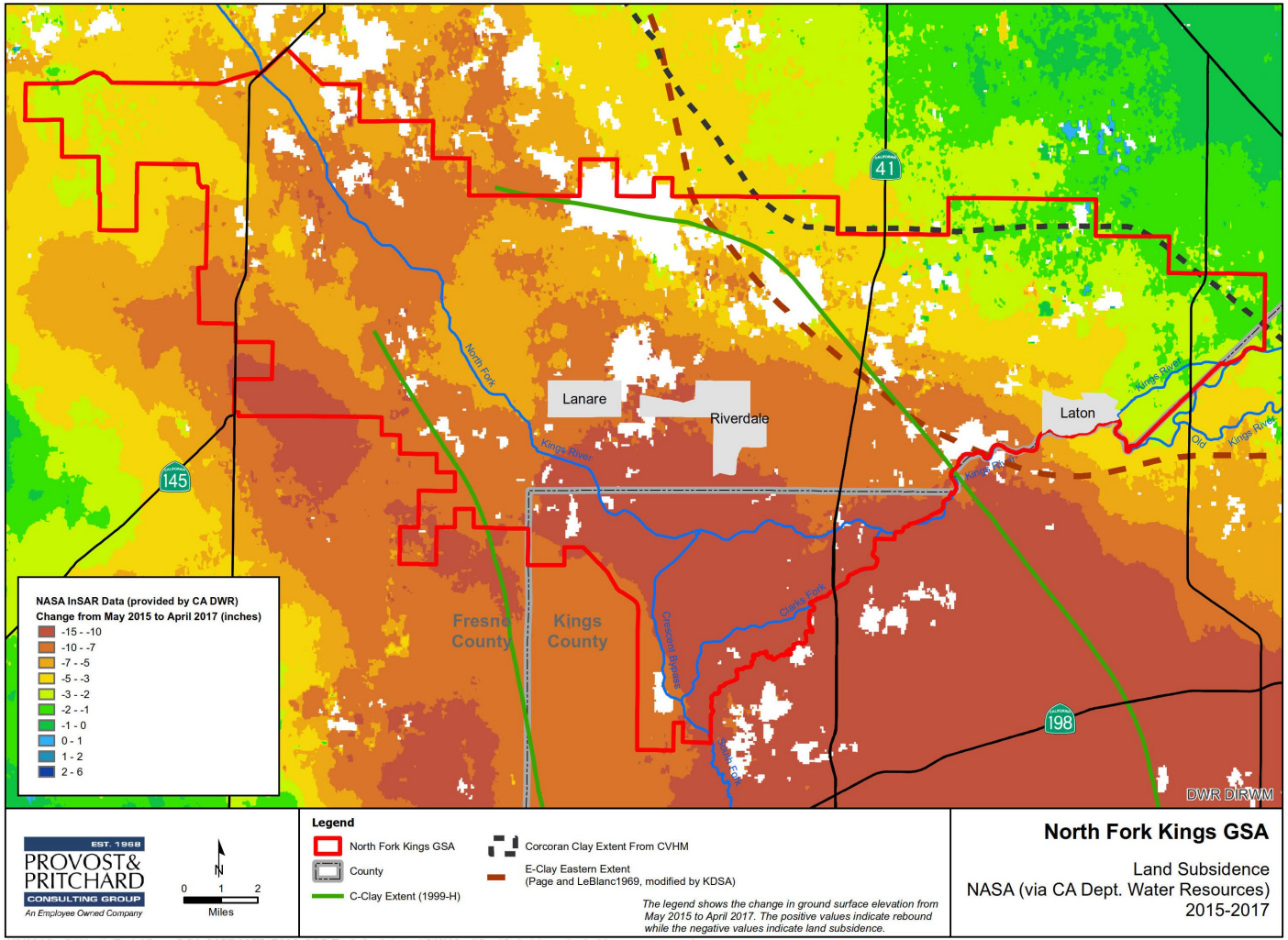
Complicated geology - multiple primary clay layers



Complicated geology - Unconfined vs Confined aquifers



DWR – NASA satellite monitoring of land subsidence
May ’15 – April ‘17



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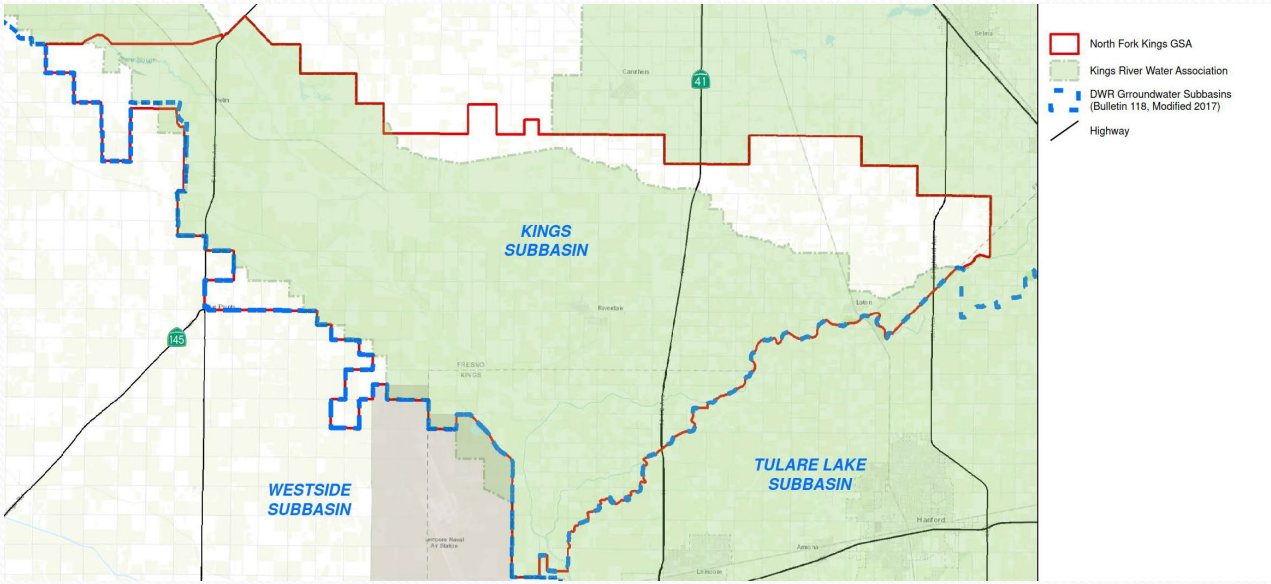
Water Budget

- Water budget summarizes water use and is used to estimate amount of groundwater pumped
- Water demand not met by surface water or precipitation is met by groundwater pumping
- Surface water supply within NFKGSA almost exclusively Kings River water
- Approximately 22% of NFKGSA area is outside the Kings River service area



Water Budget Components

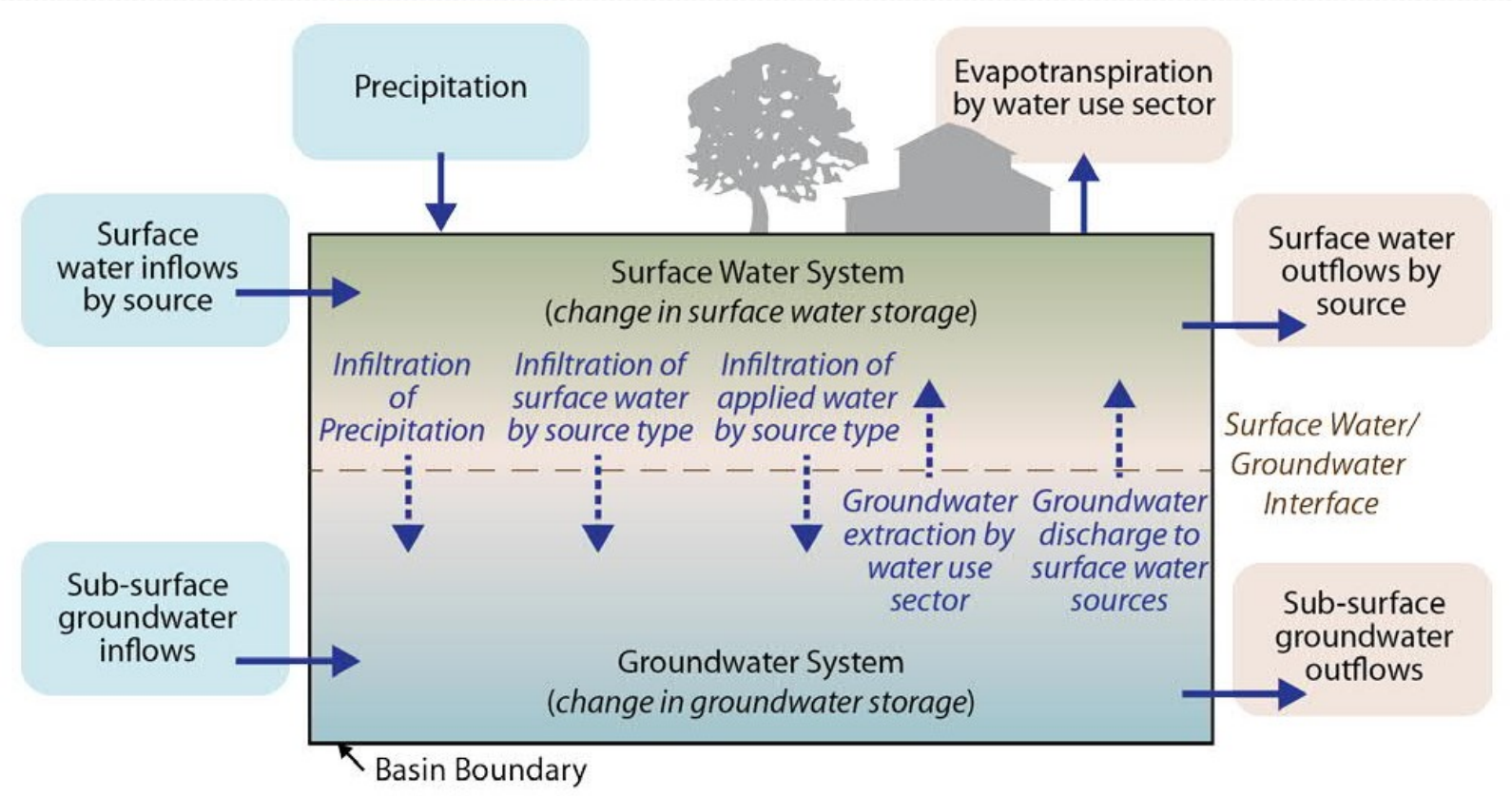
- Summarize all water sources (inputs) and water uses (outputs)
- Estimated change in groundwater storage = Inputs – Outputs
  - Water into groundwater system minus water out of groundwater system
- Apply confidence intervals (error %) to indicate relative uncertainty of components
- Compare change in groundwater storage estimated from water budget to calculated change in storage based on groundwater contours from actual water level data
- Water budget needed to estimate groundwater pumping since pumping is not metered
- Historical, Current and Future Water Budgets required

Water Budget Components

Description
Supply
1) Surface Water for Irrigation and Recharge
2) Surface Water for M&I and Recharge
3) Groundwater Pumping for Irrigation (Agency Wells)
4) Groundwater Pumping for Irrigation (Private Wells, unknown)
Groundwater Pumping for Dairies
5) Groundwater Pumping for M&I (Agency Wells)
6) Groundwater Pumping for M&I (Private Wells)
7) Precipitation
8) Spill Inflows
9) Other Supply - Kings River seepage
Total Supply
Demand
Consumptive Use
10) Evapotranspiration met by Applied Water
11) Evapotranspiration met by Effective Precipitation
12) Evapotranspiration of M&I
13) Other Consumptive Use - dairy
Other Consumptive Use - riparian vegetation
Consumptive Subtotal

Description
Groundwater Recharge
14) Groundwater Inflow
15) Deep Percolation of Irrigation Water
16) Deep Percolation of Precipitation
17) Deep Percolation of M&I Water
18) Seepage of Channels & Pipelines
19) Seepage - Reservoirs
20) Urban Stormwater - Recharge
21) Local Streams/Rivers - Recharge
22) Groundwater - Intentional Recharge
23) Other Recharge
GW Recharge Subtotal
Nonrecoverable Losses
24) Groundwater - Outflow
25) Evaporation - Channels
26) Evaporation - Reservoirs & Recharge Basins
27) Precipitation - Evaporation and Runoff
28) Operational Spills
29) Groundwater - Export
30) Other Losses
Nonrecoverable Subtotal

Simplified Basin Water Budget Diagram

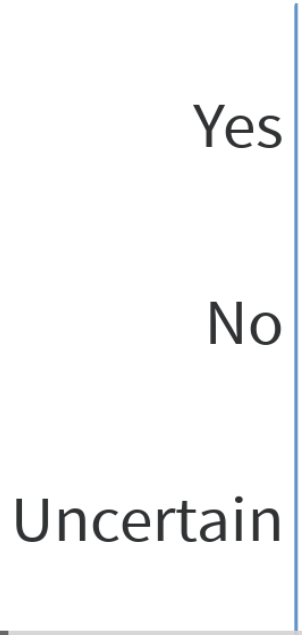


Summary of Water Budget Estimates

- Historical, Current, and Future water budgets prepared for average, wet, and dry years
  - Historical water budget prepared for hydrologic average base period (Oct. 1996 – Sept. 2011)
  - Best available information was used, but better data is needed to improve accuracy
  - **Current overdraft** estimated to be an average of **63,100 AF/yr**
  - Climate change information factored into 2040 and 2070 future water budgets
  - **Future 2040 overdraft** estimated to be **68,900 AF/yr** if water supply and cropping pattern remained constant
  - Projects and management actions identified to achieve **0 AF/yr** avg overdraft in 2040
- The preliminary GSP project list will be updated continuously:
  - Identified groundwater recharge projects are estimated to yield an approximate annual average **62,800 AF/yr** based on historic floodwater availability

LIVE POLL

Would you be willing to share your groundwater levels to support better groundwater management?



SESSION 3

SUSTAINABLE MANAGEMENT CRITERIA AND MONITORING NETWORK

Sustainable Management Criteria (SMC)

- Sustainability indicators

- Significant & Unreasonable – defined using the following:

  - Undesirable Results
  - Minimum Thresholds
  - Measurable Objectives
  - Sustainability Goal

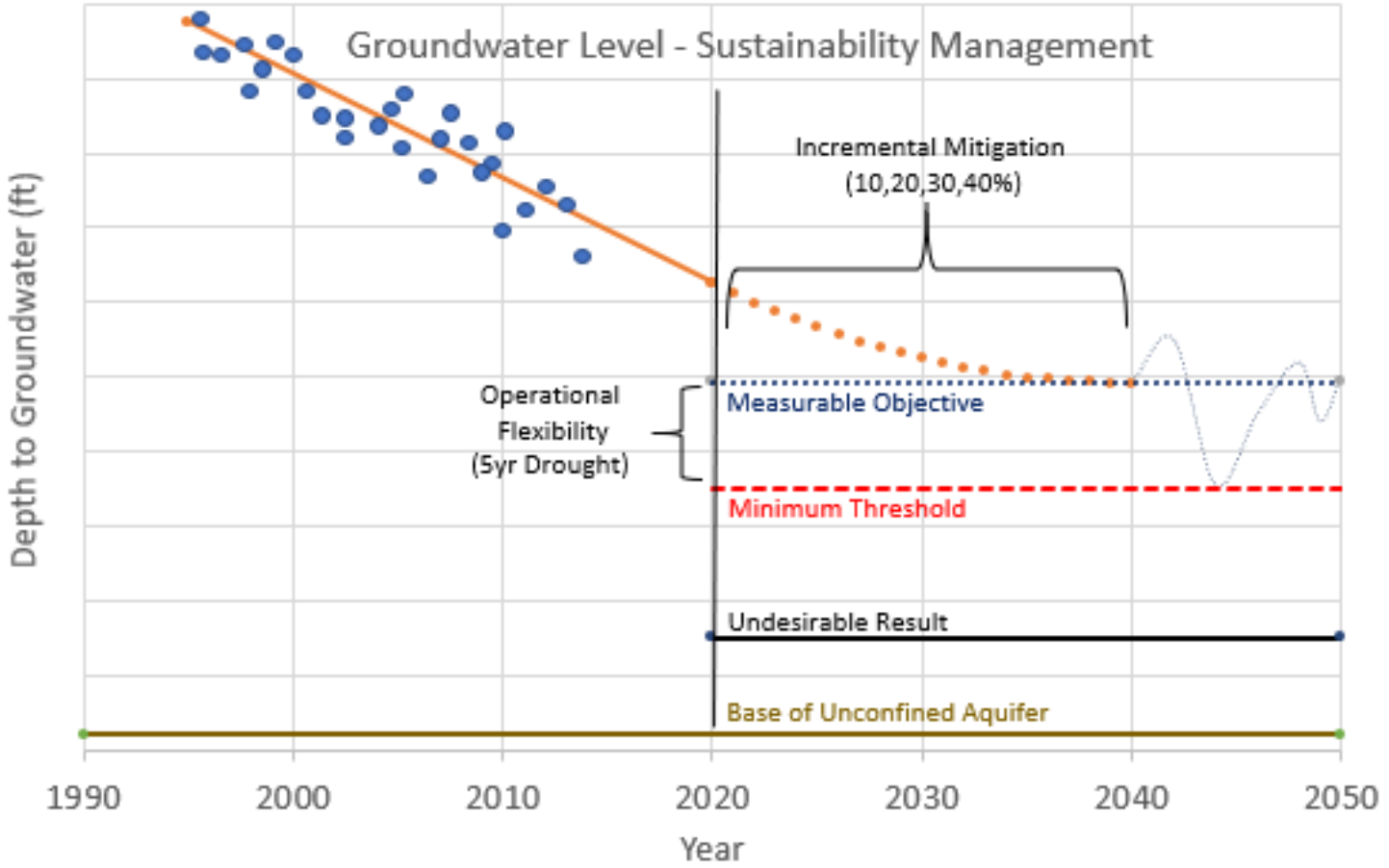
Must be agreed to, and be consistent in the GSPs of all GSAs within the subbasin

Water Level SMC

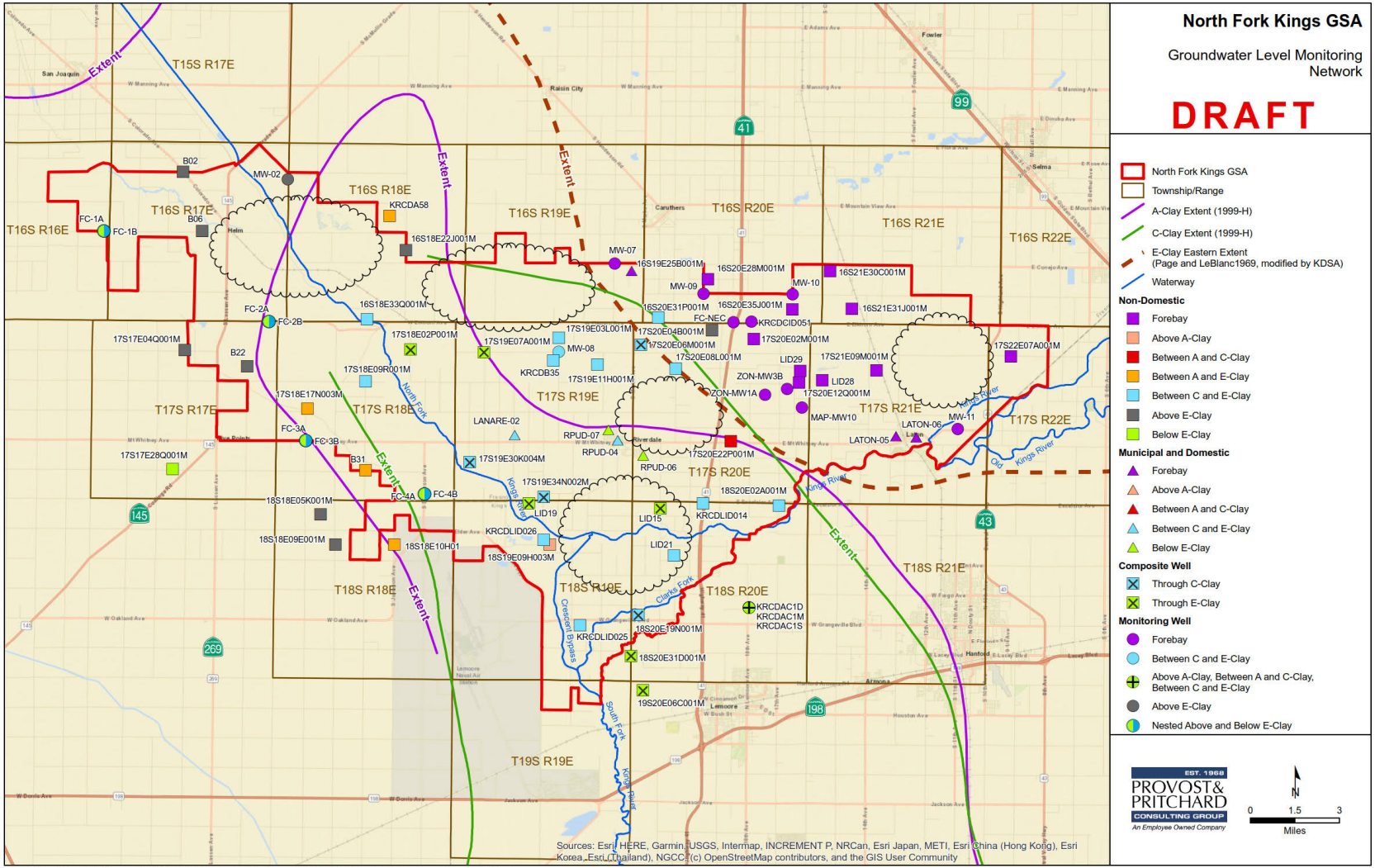
- The GSAs within the Kings Subbasin have defined the Undesirable Result for groundwater levels to be significant and unreasonable when either:
  - the water level has declined to a depth that a new productive well cannot be constructed, or
  - the water level has declined to a depth that water quality cannot be treated for beneficial use.

- NFKGSA defined undesirable results when one of the indicator wells in the monitoring network has dropped below the Minimum Threshold.

Water Level SMC



Well ID	Interim Milestones (Elevation in feet)				Measurable Objective	Minimum Threshold
	2020	2025	2030	2035	2040	2040
364002N1197624W001	63.1	42.2	24.90	13.7	9.8	-56.8
364591N1200135W001	-44.4	-61.3	-75.2	-84.5	-87.4	-141.1
364603N1197510W001	57.8	40.6	26.5	17.0	14.0	-55.3
364667N1197041W001	119.6	108.3	98.9	92.7	90.7	40.2
364668N1198257W001	19.1	2.1	-12.0	-21.4	-24.4	-78.6
364682N1198732W001	-3.3	-21.5	-36.6	-46.7	-49.8	-108.0
364739N1196227W001	158.5	147.1	137.7	131.4	129.4	81.2
364813N1198968W001	-10.9	-25.7	-38.0	-46.1	-48.7	-96.0
364816N1197785W001	72.6	51.5	34.1	22.5	18.8	-48.4
364893N1200127W001	-52.2	-71.0	-86.6	-96.9	-100.2	-160.2
364916N1198366W001	11.9	-5.4	-19.7	-29.2	-32.2	-87.3
364960N1197554W001	92.0	76.3	63.3	54.6	51.9	1.9
364967N1197193W001	115.6	102.3	91.2	83.8	81.5	38.9
365143N1198529W001	32.4	16.4	3.1	-5.7	-8.5	-59.7
365150N1197327W001	116.4	102.8	91.5	84.0	81.6	38.3
B06	-4.2	-14.3	-22.6	-28.1	-29.8	-61.8
B22	-11.2	-17.4	-22.5	-25.9	-26.9	-49.6
B31	3.5	-8.6	-19.1	-27.0	-30.9	-67.8
CID51	89.5	71.7	57.0	47.2	44.2	-12.5
LID14	58.6	40.2	22.4	14.8	11.6	-47.2
LID25	-20.7	-42.4	-60.4	-72.3	-76.1	-145.3
LID26	0.1	-14.4	-26.4	-34.4	-36.9	-83.2


North Fork Kings GSA
Groundwater Level Monitoring Network
DRAFT
North Fork Kings GSA
Township/Range
A-Clay Extent (1999-H)
C-Clay Extent (1999-H)
E-Clay Eastern Extent (Page and LeBlanc1969, modified by KDSA)
Waterway
Non-Domestic
Forebay
Above A-Clay
Between A and C-Clay
Between A and E-Clay
Between C and E-Clay
Above E-Clay
Below E-Clay
Municipal and Domestic
Forebay
Above A-Clay
Between A and C-Clay
Between C and E-Clay
Below E-Clay
Composite Well
Through C-Clay
Through E-Clay
Monitoring Well
Forebay
Between C and E-Clay
Above A-Clay, Between A and C-Clay, Between C and E-Clay
Above E-Clay
Nested Above and Below E-Clay
PROVOST& PRITCHARD CONSULTING GROUP
EST. 1968
An Employee Owned Company
N
0 1.5 3
Miles
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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Storage Change SMC

- Estimated storage change for the Kings Subbasin -1.8 MAF, or avg. -122,000 AF/yr

- An Undesirable Result would occur if the total amount of water in storage was less than the estimated amount of groundwater in storage below the Minimum Thresholds established by the Water Level SMC.

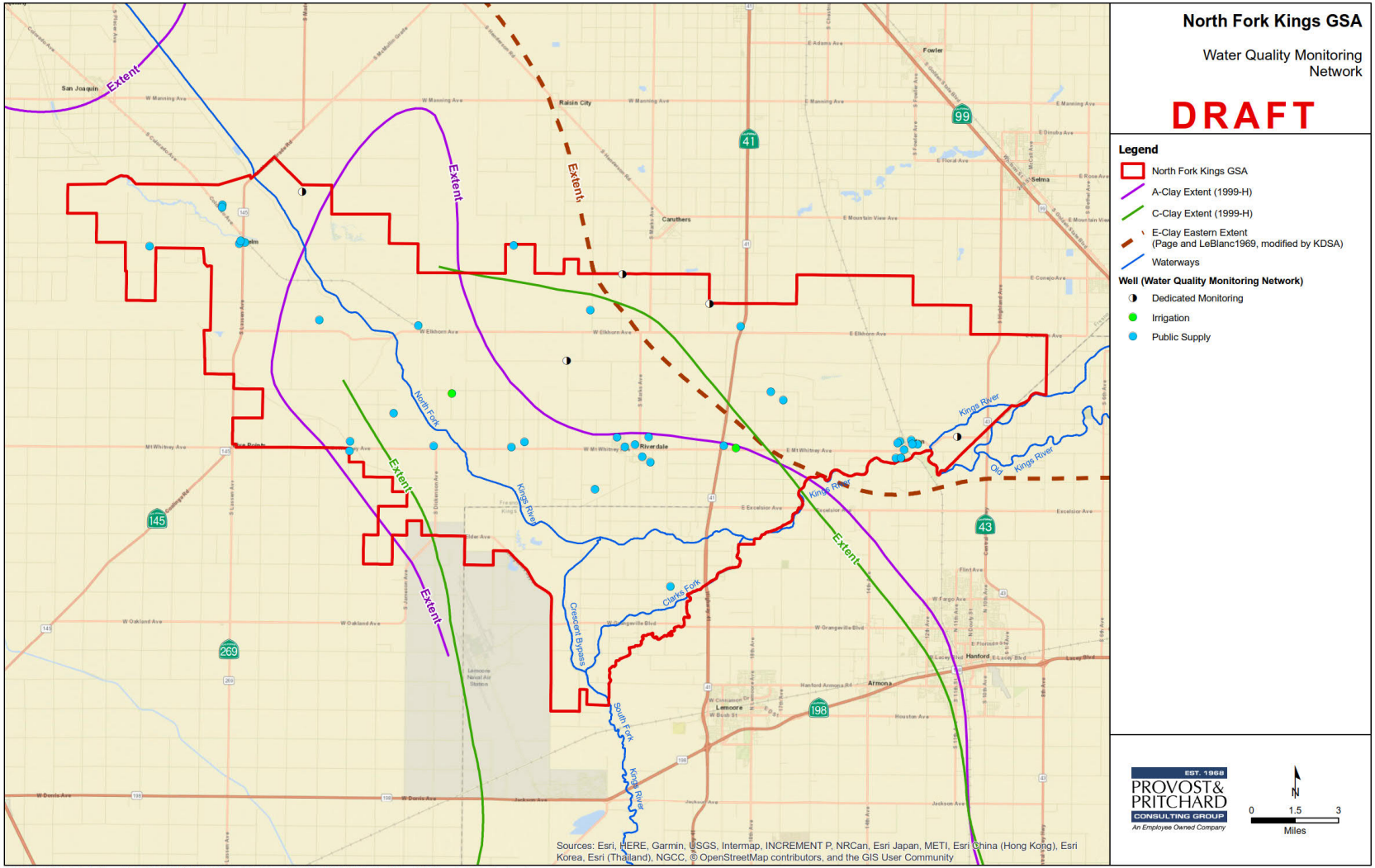
Water Quality SMC

- The determination of Undesirable Results will be based on the aggregated effect of:
  - 1) the degradation of water quality in excess of MCLs (i.e. California potable water standards) where concentrations of chemicals of concern were historically below MCLs; and
  - 2) a statistically significant increase in groundwater degradation where concentrations of chemicals of concern were historically above MCLs.

- The occurrence of an Undesirable Result will be defined as 15% of representative monitoring wells having reached either of these two criteria for two consecutive years at the same wells.

Water Quality SMC

Chemical of Concern	California Primary MCL	California Secondary MCL	Lifetime Health Advisory Level
Arsenic	10 µg/L	-	-
Chromium (Total)	50 µg/L	-	-
Fluoride	2,000 µg/L	-	-
Gross Alpha	15 pCi/L	-	
Lead *	15 µg/L	-	-
Nitrate	10 mg/L (as N)	-	-
1,2,3-Trichloropropane	0.005 µg/L	-	-
Uranium	20 pCi/L		
Aluminum	1,000 µg/L	200 µg/L	-
Iron	-	300 µg/L	-
Manganese	-	50 µg/L	-
Total Dissolved Solids	-	500 mg/L to 1,000 mg/L	



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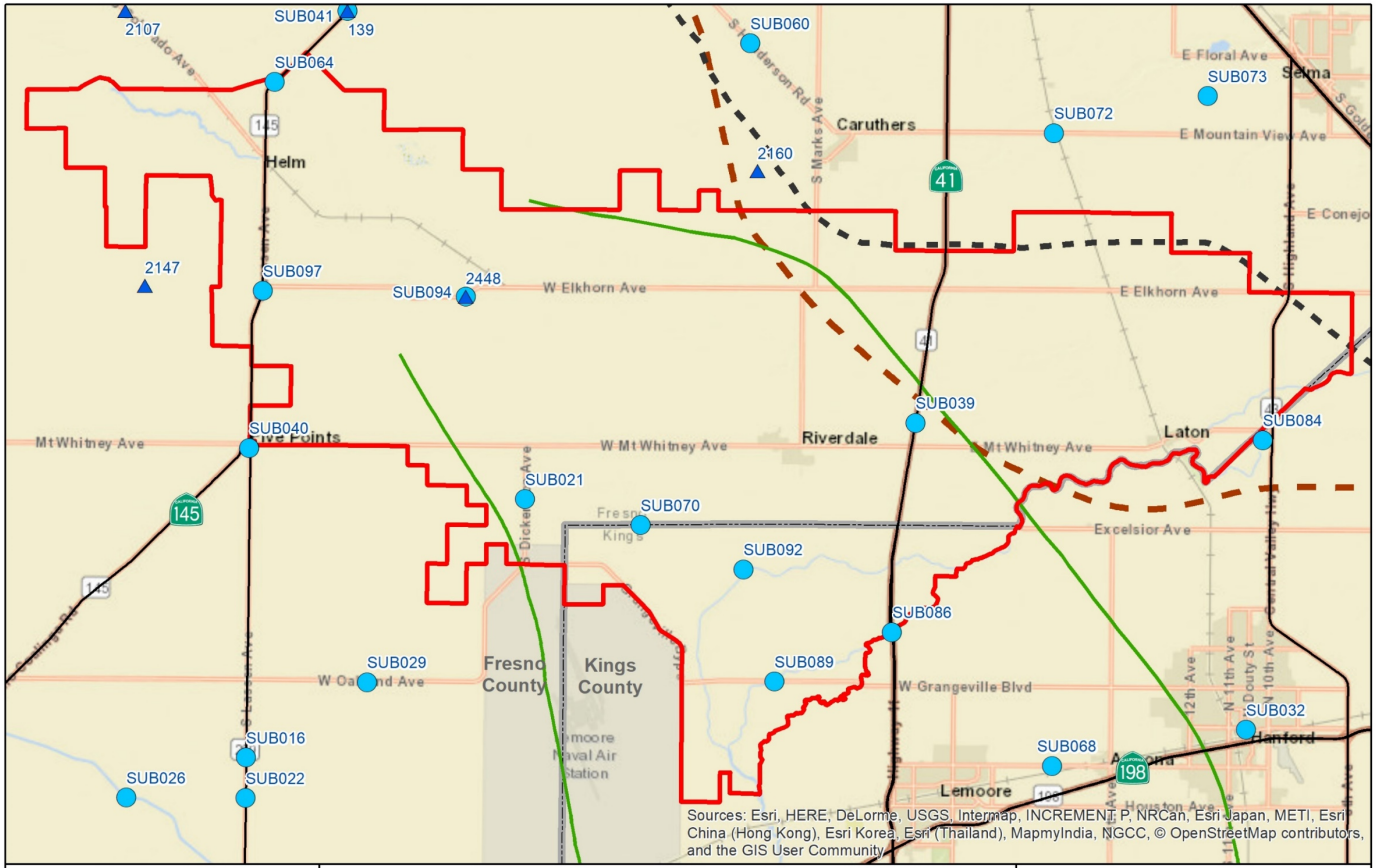
Land Subsidence SMC

- An Undesirable Result would be the significant and unreasonable loss of functionality of levees, canals, structures, and other critical infrastructure such as bridges, roads or highways, wells, and pumps within the Kings Subbasin due to land subsidence.
- NFKGSA is not currently experiencing any known significant issues due to land subsidence along the major highways or levee infrastructure.
- The exceedance of the Minimum Threshold at just one monitoring site is significant.

Sustainability Indicator	Interim Milestones (Inches)				Measurable Objective	Minimum Threshold
	2020	2025	2030	2035	2040	2040
Annual Subsidence Rate	N/A	N/A	N/A	N/A	-10	-20
Cumulative Subsidence	0	-20	-40	-60	-80	-160



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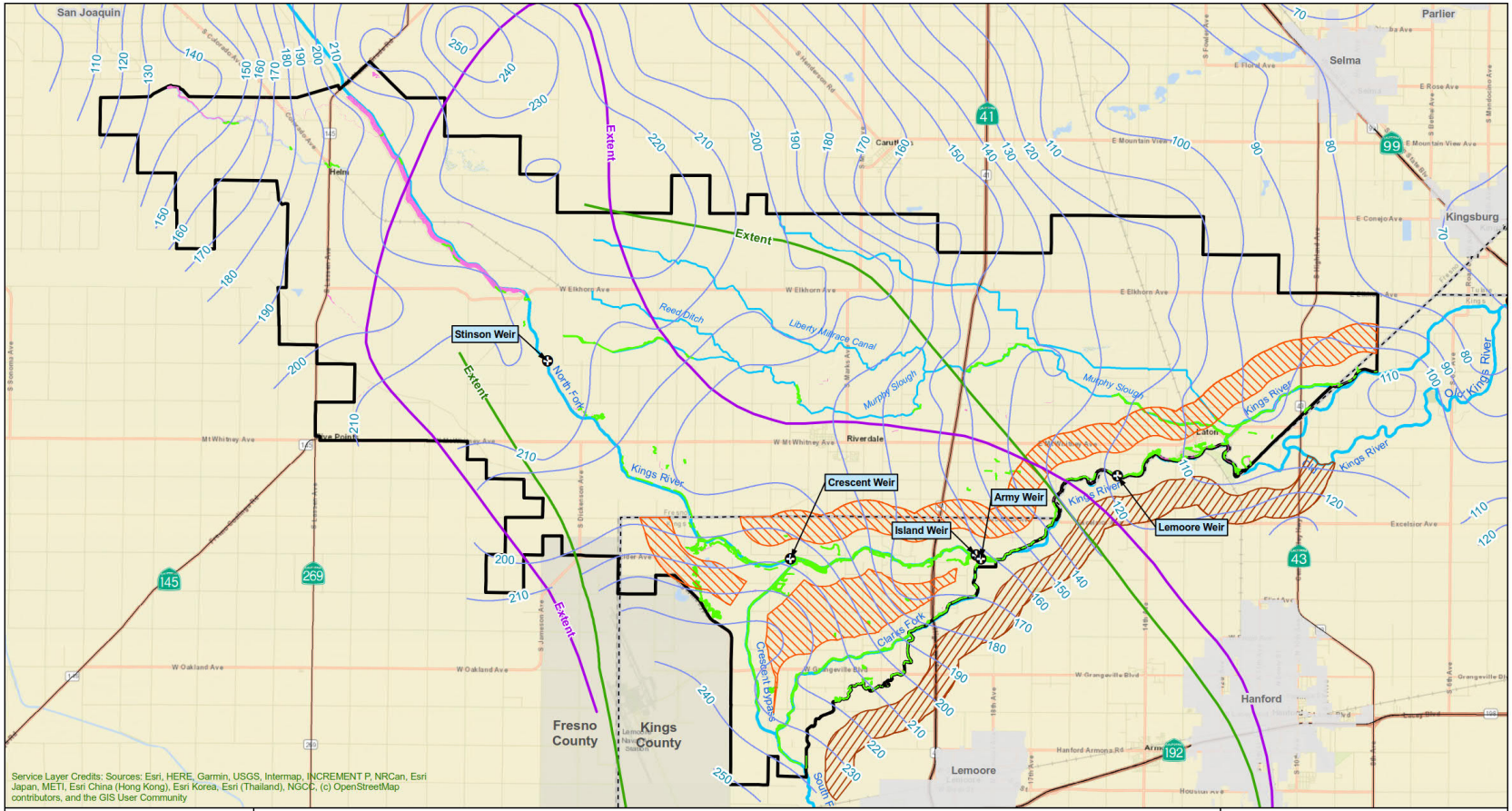
Interconnected Surface Water and Groundwater SMC

- An Undesirable Result would be the significant and unreasonable reduction of surface waters within the Kings Subbasin due to groundwater pumping. The major surface waters in the Kings Subbasin include the Kings River and the San Joaquin River.

- Due to existing river management programs and/or the lack of continuous interconnected surface water within the Kings Subbasin, Undesirable Results to surface water related to groundwater pumping are not likely to occur.

- NFKGSA will pursue additional groundwater monitoring along the Kings River where the Nature Conservancy identified potential groundwater dependent vegetation.



Interconnected Surface Water Review

North Fork Kings GSA

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LIVE POLL

Of the 4 relevant undesirable results, my biggest concern is:

Groundwater levels

Groundwater storage

Water quality q

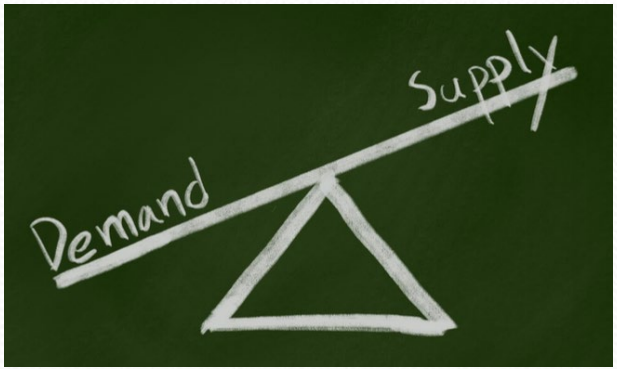
Land subsidence

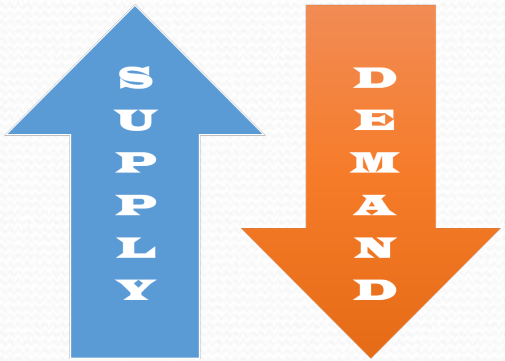
SESSION 4

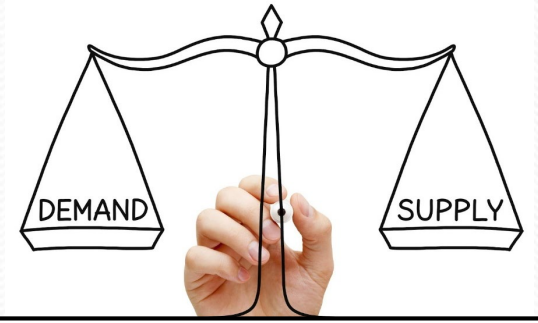
PROJECTS AND MANAGEMENT ACTIONS

Achieving Sustainability

- There are basically only two ways to achieve sustainability and eliminate overdraft:
  - Increase water supply – primarily through project development
  - Reduce water demand – primarily through management actions
- Increasing water supply will be the emphasis, but there are hurdles to overcome
- Demand reduction through management actions will likely need to be initiated within 5 - 10 years if project development and implementation is not progressing







Average Overdraft = 0 AF/yr

Project List

This preliminary list of projects identified in the GSP will be continuously updated with new projects

DRAFT

Project ID	Project Title	Implemented By	Estimated Benefits AF/yr		Generalized Priority	Estimated Capital Cost to GSA	Estimated Cost per Acre-Foot
			Avg Annual Recharge	Demand Reduction			
NFK1	Basin 11 Improvement Project	Laguna ID	1,420		High		
NFK2	Basin 11 Expansion Project	Laguna ID	1,110		High		
NFK3	Laton North Recharge Project	Laguna ID	3,080	390	High		
NFK4	North Fork Regional Recharge Project	NFKGSA /LID	11,660	280	High	$20.8M	$151
NFK5	Zonneveld Pond Improvement Project	Laguna ID	430		High		
NFK6	On-Farm Recharge	Landowners	5,000 *		High		
NFK7	Cerini Recharge Project	Crescent / Stinson	6,500 *		High		
NFK8	Kamm Recharge Project	Landowner	10,400 *		High		
NFK9	Terra Linda Recharge Project	Landowner	1,560	210	High		
NFK10	Misc. Landowner Recharge Basins	Landowners	4,180 *	500	High		
NFK11	Upgradient Recharge Outside NFKGSA	NFKGSA	4,500 *	430	High	$17.1M	$265
NFK12	Mussel Slough Recharge Project	Laguna ID	4,730	700	Medium		
NFK13	Misc. Dry Well Recharge Systems	Landowners	2,000 *		Medium		
NFK14	Misc. Reverse Subsurface Tile Systems	Landowners	2,000 *		Medium		
NFK15	Laton North Phase 2 Recharge Project	NFKGSA	3,080	390	Medium	$2.5M	$65
NFK16	Pires Recharge Project	Laguna ID	550		Low		
NFK17	North Fork Group Site 16	NFKGSA	130 *		Low	$0.4M	$214
NFK18	North Fork Group Site 3	Laguna ID	320		Low		
NFK19	North Fork Group Site 6	Reed Ditch Co.	150		Low		
Subtotal			62,800	2,900		$40.8M	

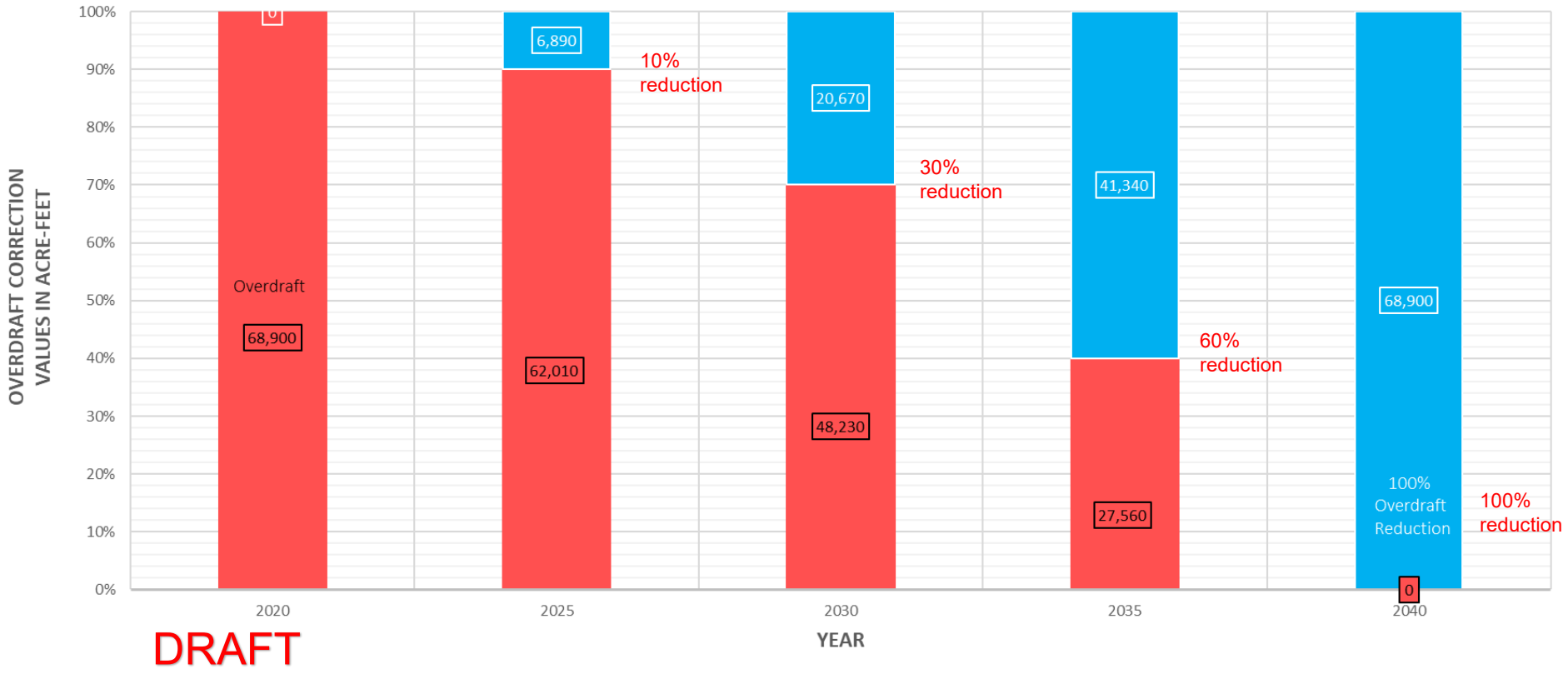
* = project is scalable, estimated annual benefits could be increased

Potential Management Actions

- Management Actions are programs and policies that will aid the GSA in achieving sustainability primarily through improving data collection, monitoring, and groundwater demand reduction
- A suite of potential management actions are presented in the GSP that may be implemented at the GSA level or landowner level if GSA project implementation does not eliminate overdraft
- Management Action categories included in the GSP:
  - Education and Outreach
  - Well Head Requirements
  - Groundwater Allocation
  - Groundwater Marketing/Trading
  - Fees and Incentives
  - Groundwater Pumping Restrictions

- Specific details of future policies and programs will be developed during GSP implementation
- GSA will establish the response criteria for Minimum Thresholds exceedances

NFKGSA GLIDE PATH TO SUSTAINABILITY



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NFKGSA PLAN IMPLEMENTATION SCHEDULE

Estimated Projects and Management Actions	2020 - 2025	2025 - 2030	2030 - 2035	2035 - 2040	Beyond 2040
Plans to Fill Data Gaps					
NFK1 - Basin 11 Improvements					
NFK2 - Basin 11 Expansion					
NFK3 - Laton North Recharge Project					
NFK4 - North Fork Regional Recharge Project					
NFK 5 - Zonneveld Pond Improvements					
NFK 6 - On-farm Recharge					
NFK 7 - Cerini Recharge Project					
NFK 8 - Kamm Recharge Project					
NFK 9 - Terra Linda (Coelho) Farm Recharge Project					
NFK 10 - Landowner Recharge Basins					
NFK11 - Upgradient Recharge Outside NFKGSA					
NFK12 - Mussel Slough Ranch Recharge					
NFK13 - Dry Wells Along Canals					
NFK14 - Reverse Tile Drains					
NFK15 - Laton North Phase 2 Recharge Project					
NFK16 - Pires Recharge Project					
NFK17 - North Fork Group Site 16					
NFK18 - North Fork Group Site 3 (Dias Pond)					
NFK19 - North Fork Group Site 6					
Education and Outreach					
Well Head Requirements					
Groundwater Allocation					
Groundwater Marketing/Trading					
Fees and Incentives					
Groundwater Pumping Restrictions					

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Legend

- Planning
- Implementation
- Benefits Realized
- Ongoing O&M

GSP Implementation

- First Priorities
  - Develop projects to augment the groundwater supply
  - Develop a data management system and fill data gaps
  - Secure funding through grants, Proposition 218 Elections, local agencies, and potential management actions
- Second Priority
  - Implement management actions to reduce groundwater demand

LIVE POLL

How much per year would you be willing to invest in projects that increase groundwater recharge?

$50/acre

$100/acre

$150/acre

$200/acre

$250/acre

In your view, what is the North Fork Kings GSA's most important role?

Increase surface water supply

Increase water use efficiency

Improve data on groundwater

Build projects like recharge basins and canals

Implement programs that create incentives to reduce water demand


Questions?

Wrap Up & Next Steps for NFKGSA Stakeholders

- Webinar Evaluation
- Download GSP from NFKGSA website at www.northforkkings.org/gspcomment
- Provide written comments by October 21, 2019
- Office Hours Chat September 24, 2019 from 2:00-4:00 pm
  - Riverdale Education Center. *Online chat info to come*.
- Public Hearing October 23, 2019 at 5:30 pm
  - Riverdale Education Center