Salinas Valley Basin GSA

Forebay Aquifer Subbasin GSP Overview

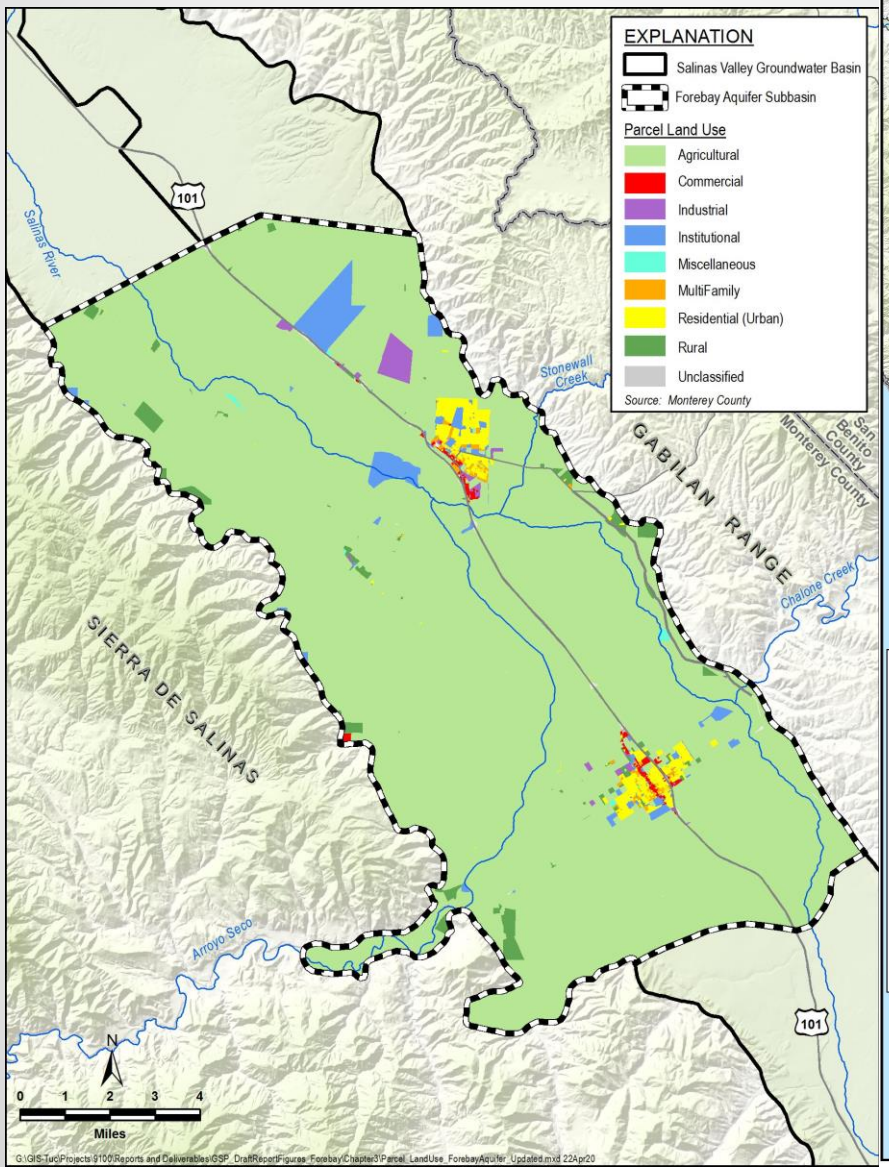
Presented to SVBGSA Board of Directors
August 12, 2021

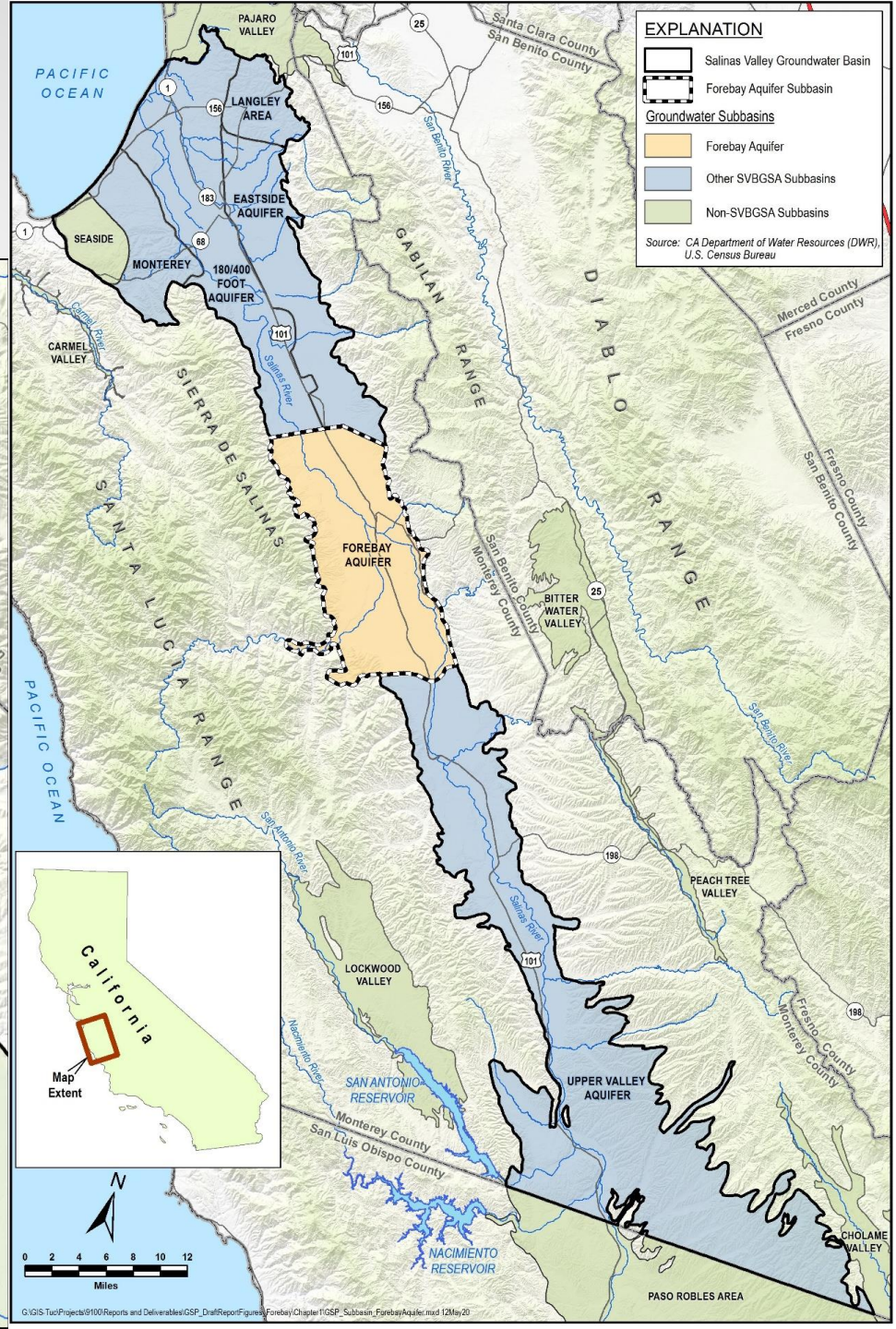
Prepared by

MONTGOMERY & ASSOCIATES

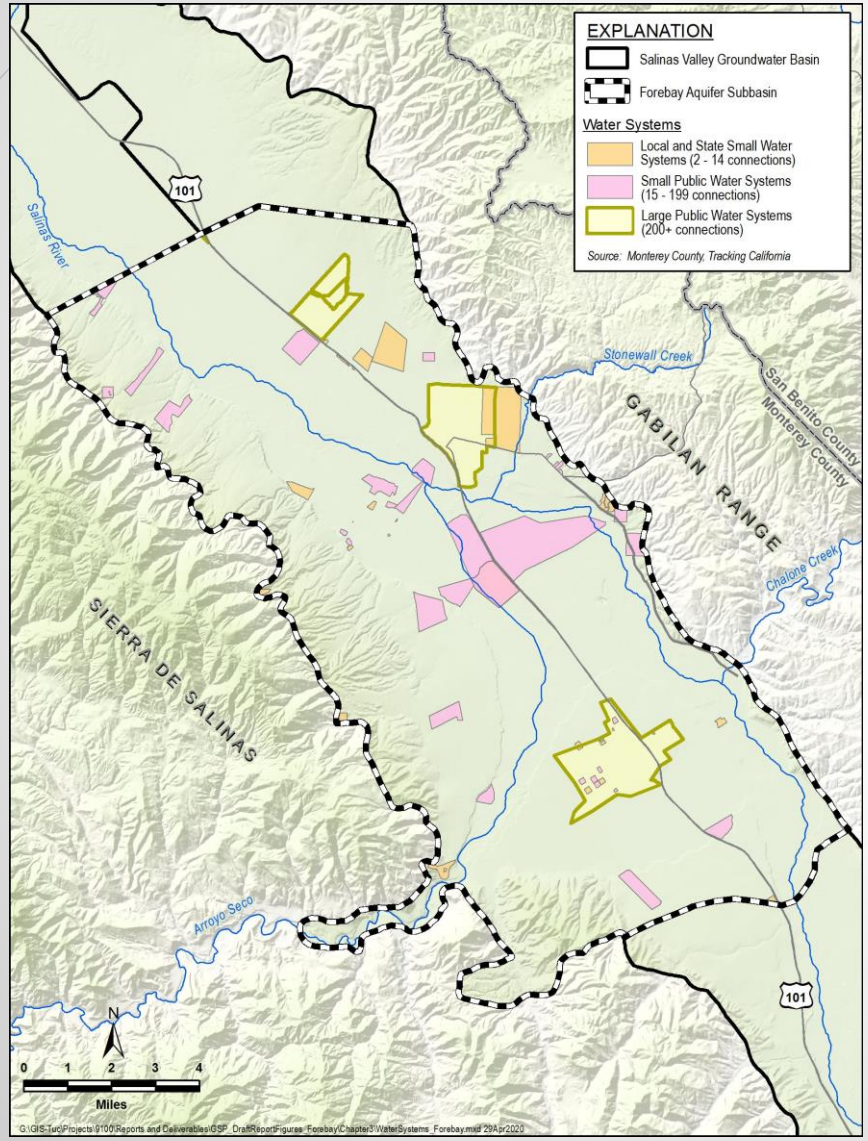
Forebay Aquifer Subbasin

- 94,000 acres
- Most land designated agricultural





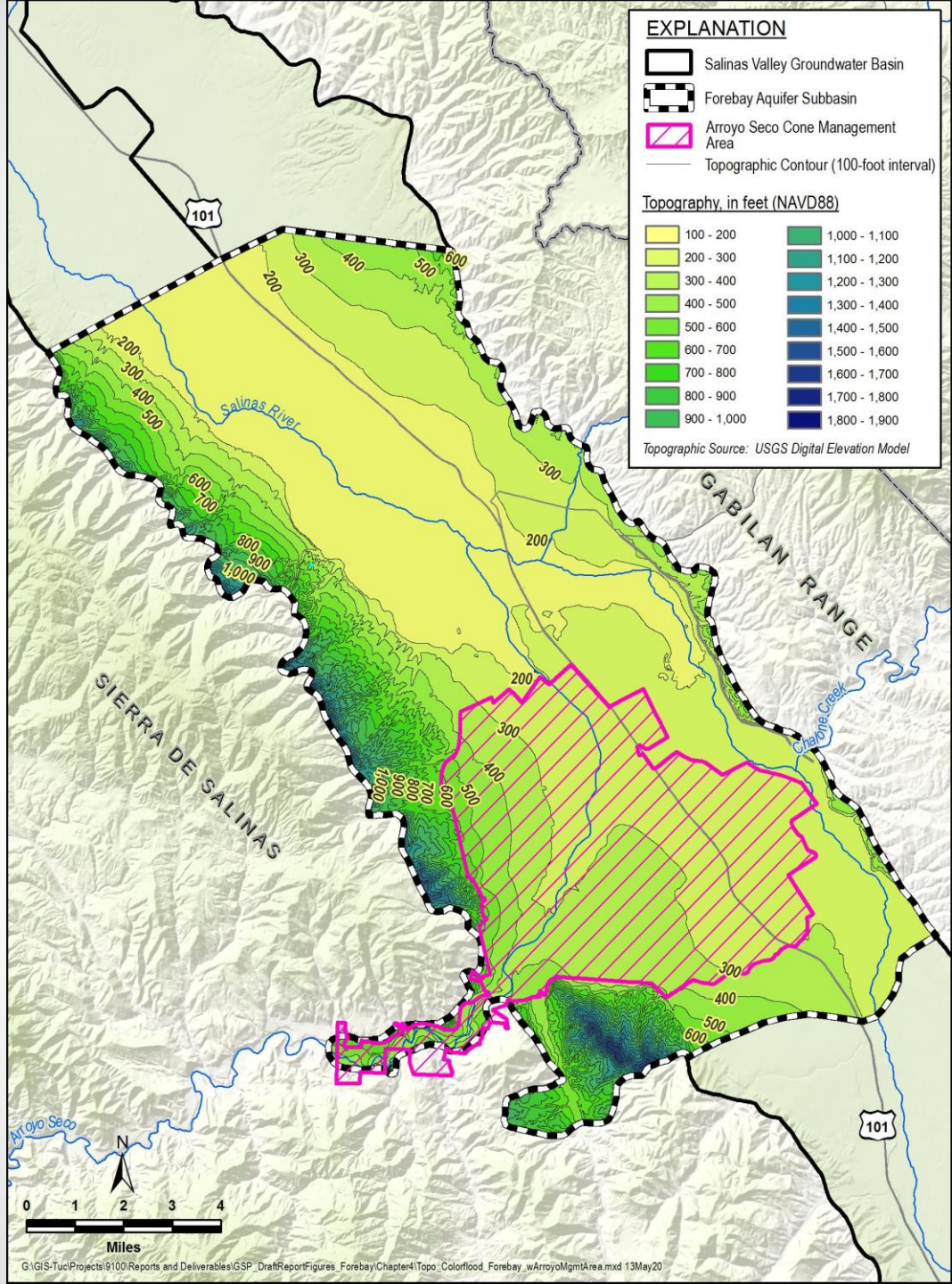
Communities Dependent on Groundwater



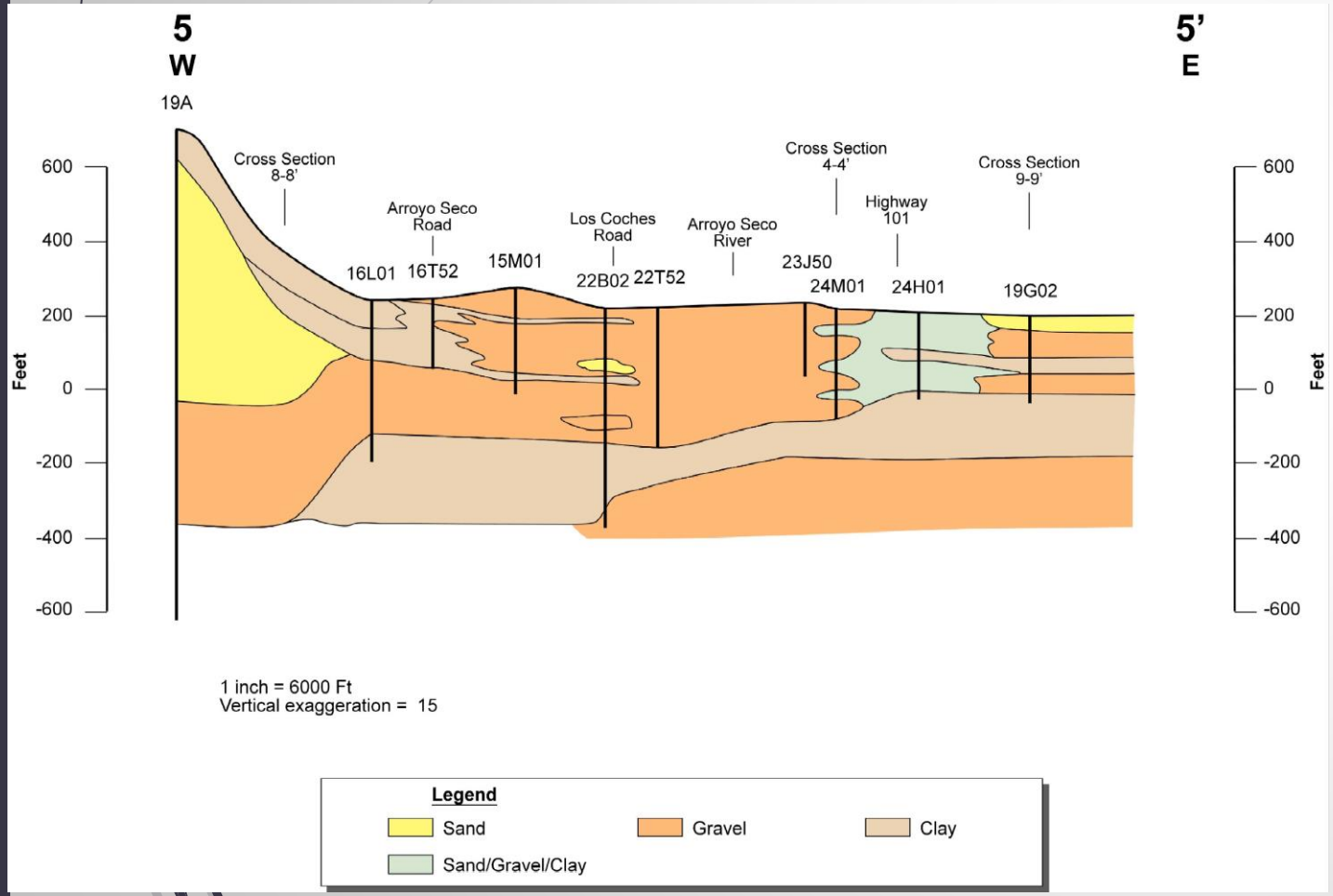
Water Systems	
Local and State Small (2 – 14 connections)	40
Small Public (15 – 199 connections)	21
Large Public (200+ connections)	5

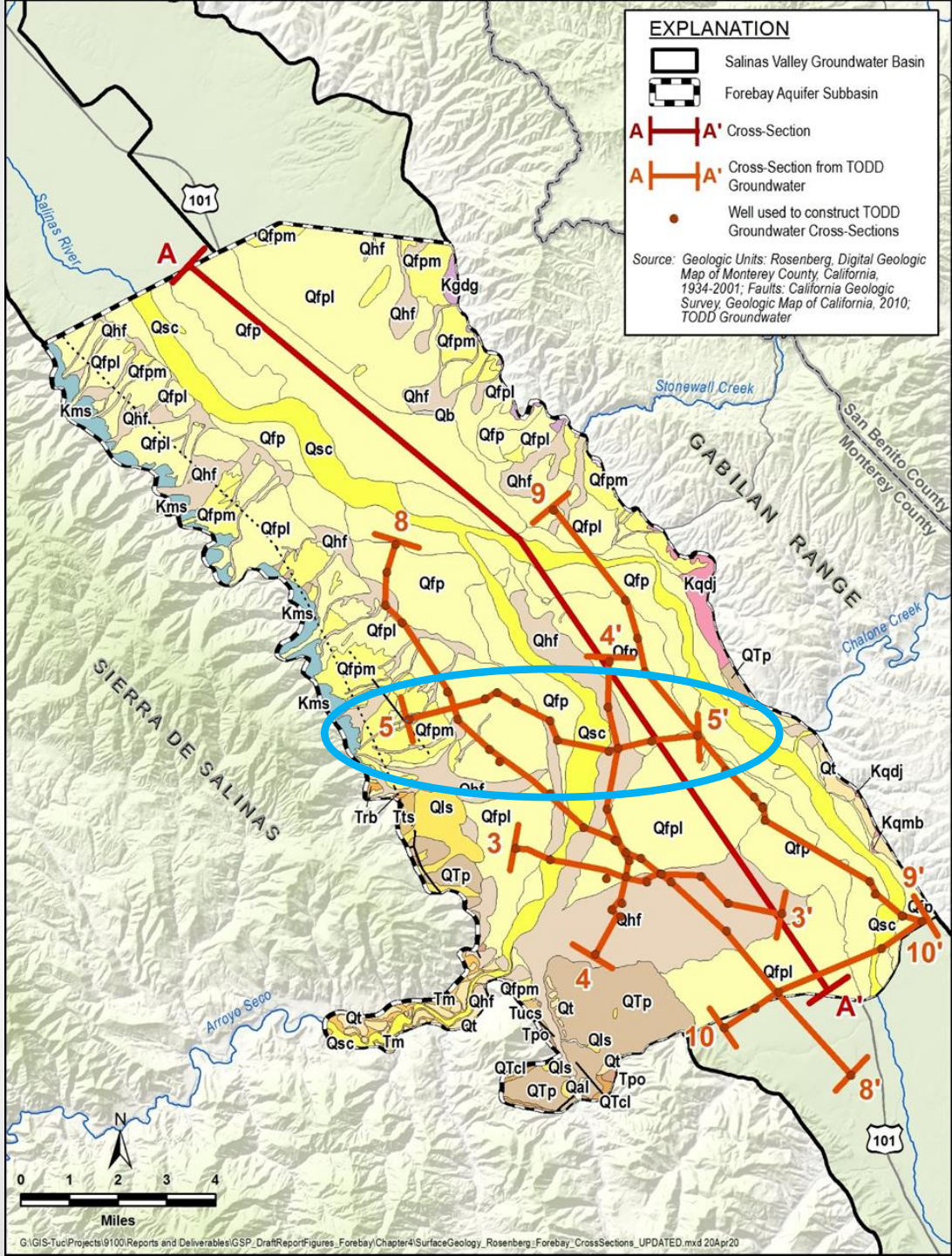
Basin Setting - Topography

- Arroyo Seco Cone
  - Alluvial fan
  - Coarser material than greater Forebay Subbasin
- Arroyo Seco Cone Management Area is outlined in pink



Hydrogeologic Conceptual Model





Forebay Chapter 6 – Water Budgets

Historical Water Budget

	Modeled Historical Average (WY 1980-2016)
Groundwater Pumping	-108,700
Net Stream Exchange	90,300
Groundwater Evapotranspiration	-32,100
Deep Percolation of precipitation and irrigation water	52,200
Net Flow from Adjacent Subbasins/Basin	0
Net Storage Gain (+) or Loss (-)	1,800

+ Indicates increase in storage

- Indicates decrease in storage

Historical Sustainable Yield

	Model Estimate (WY 1980-2016)	Low GEMS Estimate (WY 1995-2016)	High GEMS Estimate (WY 1995-2016)
Total Subbasin Pumping	108,700	151,100	174,500
Change in Storage	1,800	0	0
Estimated Sustainable Yield	110,500	151,100	174,500

Because the subbasin is not in overdraft, it is impossible to estimate the historical sustainable yield, so the water budget contains a range of +/- 1 standard deviation of the GEMS reported pumping

GEMS change in storage set to zero because there has not been a chronic decline in groundwater storage

USING BEST AVAILABLE DATA: GEMS

Forebay Chapter 6 – Water Budgets

Future Water Budget

	Model Estimate 2070
Groundwater Pumping	-117,800
Net Stream Exchange	105,700
Groundwater Evapotranspiration	-35,100
Deep Percolation of precipitation and irrigation water	57,500
Net Flow from Surrounding Watersheds	0
Net Storage Gain (+) or Loss (-)	9,600

+ Indicates increase in storage

- Indicates decrease in storage

Future Sustainable Yield

	Model Estimate 2070	GEMS Estimate 2070
Total Subbasin Pumping	117,800	179,200
Change in Storage	9,600	0
Estimated Sustainable Yield	127,400	179,200

USING BEST AVAILABLE DATA: GEMS

SVOM likely estimates only about 65% of the pumping, according to GEMS reported data, so the SVOM-estimated pumping was adjusted by that percentage

GEMS change in storage set to zero because there has not been a chronic decline in groundwater storage and the model-estimated change in storage was within the model error

Forebay Chapter 6 – Water Budgets

Arroyo Seco Cone Management Area
Historical Water Budget

	Modeled Historical Average (WY 1980-2016)
Groundwater Pumping	-34,200
Net Stream Exchange	15,600
Groundwater Evapotranspiration	-600
Deep Percolation of precipitation and irrigation water	16,900
Net Flow from Adjacent Subbasins/Basin	1,600
Net Storage Gain (+) or Loss (-)	-600

+
Indicates increase in storage

-
Indicates decrease in storage

Arroyo Seco Cone Management Area
Historical Sustainable Yield

	Model Estimate (WY 1980-2016)	Low GEMS Estimate (WY 1995-2016)	High GEMS Estimate (WY 1995-2016)
Total Subbasin Pumping	34,200	44,400	53,000
Change in Storage	-600	0	0
Estimated Sustainable Yield	33,600	44,400	53,000

Because the subbasin is not in overdraft, it is impossible to estimate the historical sustainable yield, so the water budget contains a range of +/- 1 standard deviation of the GEMS reported pumping

GEMS change in storage set to zero because there has not been a chronic decline in groundwater storage

USING BEST AVAILABLE DATA: GEMS

Forebay Chapter 6 – Water Budgets

Arroyo Seco Cone Management Area
Future Water Budget

	Model Estimate 2070
Groundwater Pumping	-37,100
Net Stream Exchange	23,800
Groundwater Evapotranspiration	-1,500
Deep Percolation of precipitation and irrigation water	16,600
Net Flow from Surrounding Watersheds	-1,500
Net Storage Gain (+) or Loss (-)	1,600

\+ Indicates increase in storage

\- Indicates decrease in storage

Arroyo Seco Cone Management Area
Future Sustainable Yield

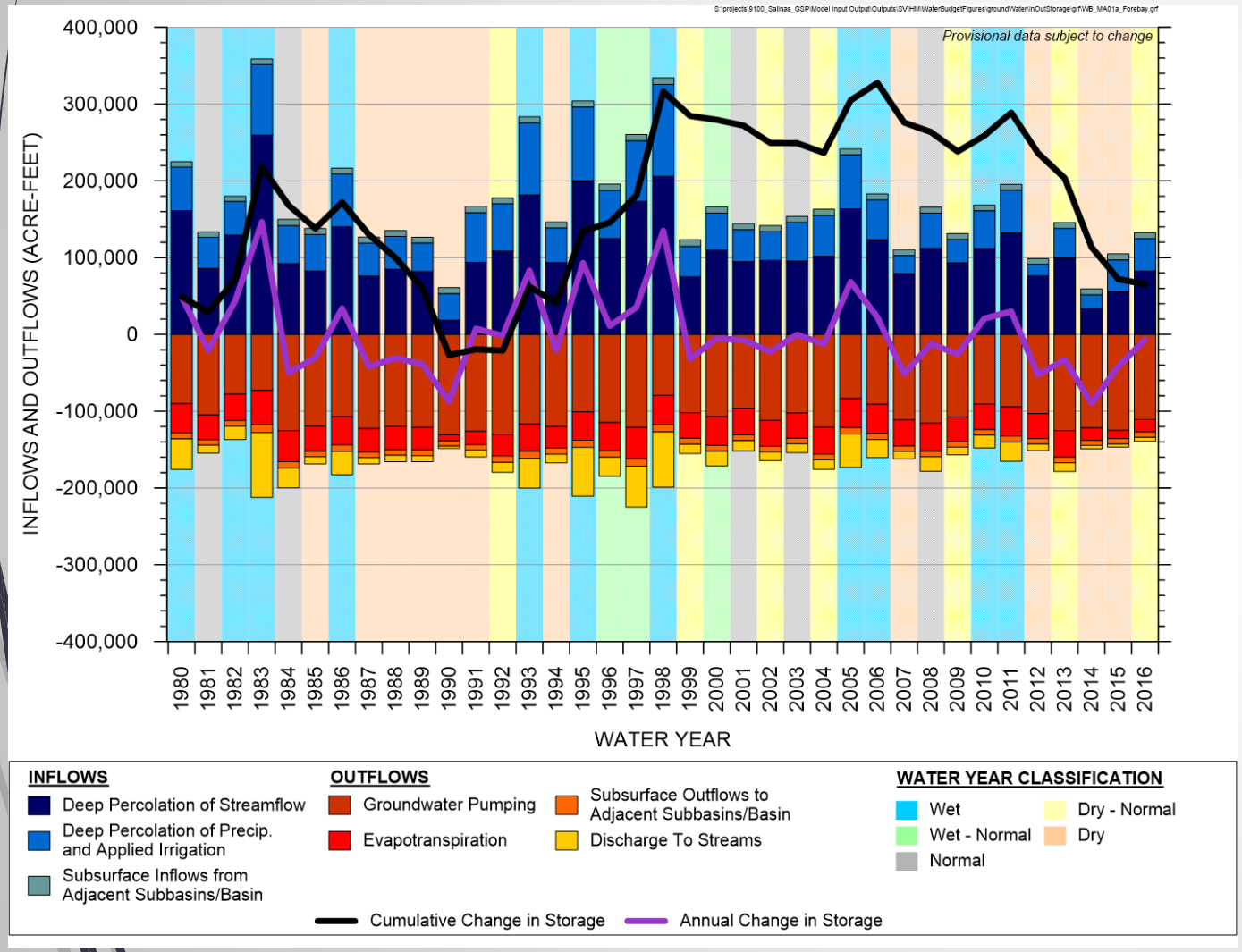
	Model Estimate 2070	GEMS Estimate 2070
Total Subbasin Pumping	37,100	55,400
Change in Storage	1,600	0
Estimated Sustainable Yield	38,700	55,400

USING BEST AVAILABLE DATA: GEMS

SVOM likely estimates only about 67% of the pumping, according to GEMS reported data, so the SVOM estimated pumping was adjusted by that percentage

GEMS change in storage set to zero because there has not been a chronic decline in groundwater storage and the model-estimated change in storage was within the model error

Groundwater Budget Summary



- Overall – there is no chronic decline in water levels and Forebay is in balance
- Historical and future water budgets are both averages of many years/hydrologic periods
- Current is a snapshot and does not tell us much since it only views change from one year to the next
- Future water budget incorporates average climate change, but does not represent short-term climate change effects
- The water budget will be refined with future versions of the SVIHM/SVOM that have pumping estimates that better reflect observed data.

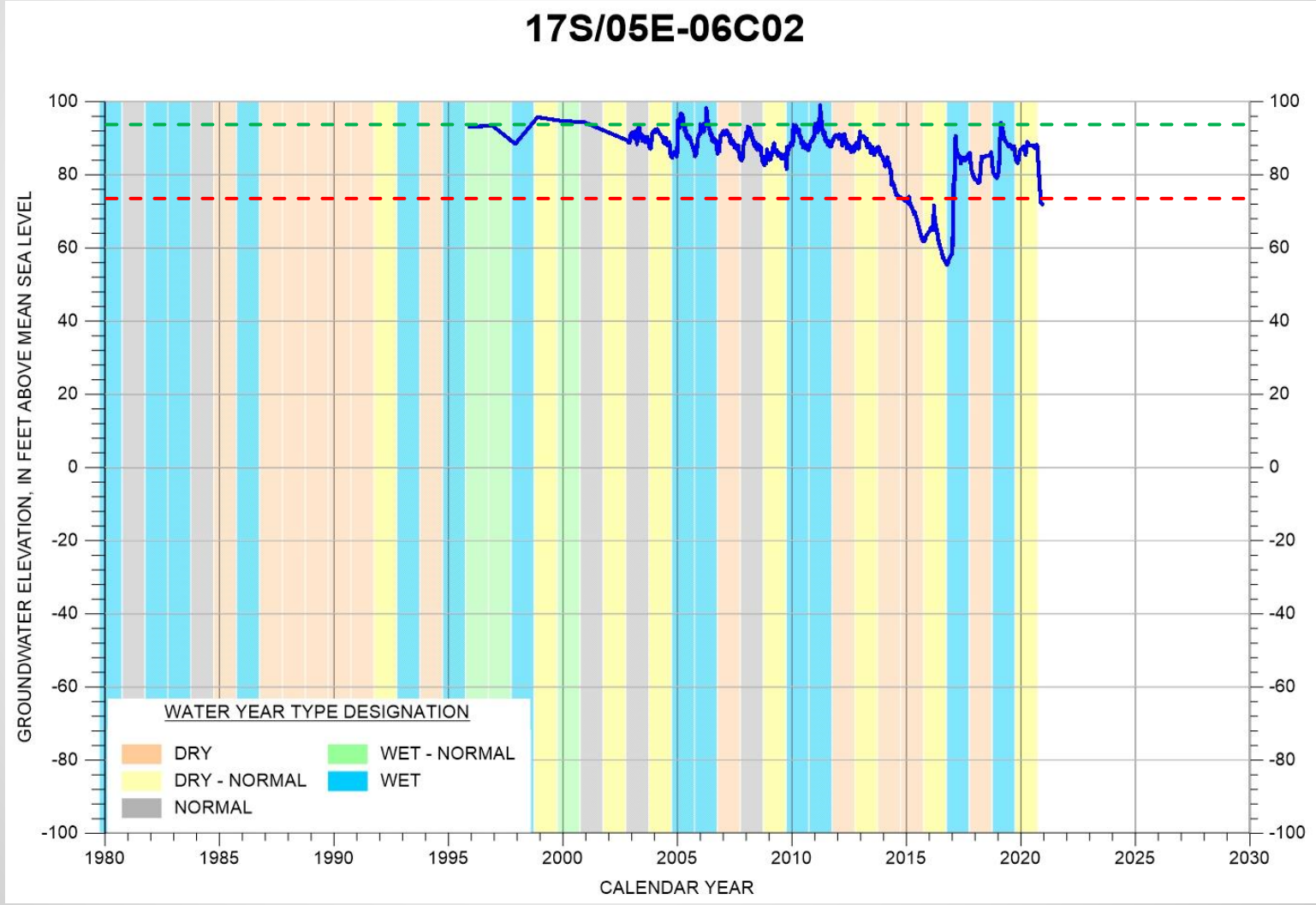
Groundwater conditions/SMC – **Groundwater Levels**

1. Chronic lowering of groundwater levels SMC

Measurable Objective (MO):
2015 groundwater elevations + 75% of difference between 2015 and 1998

Minimum Threshold (MT):
Set to December 2015 groundwater elevations

Undesirable Result:
Over the course of any one year, more than 15% of groundwater elevation minimum thresholds are exceeded.



Measurable Objective – 2015 elevation + 75% of difference between 2015 and 1998 elevation

Minimum Threshold – 2015 elevation

Groundwater conditions/SMC – ***Groundwater Levels***

1. Chronic lowering of groundwater levels SMC

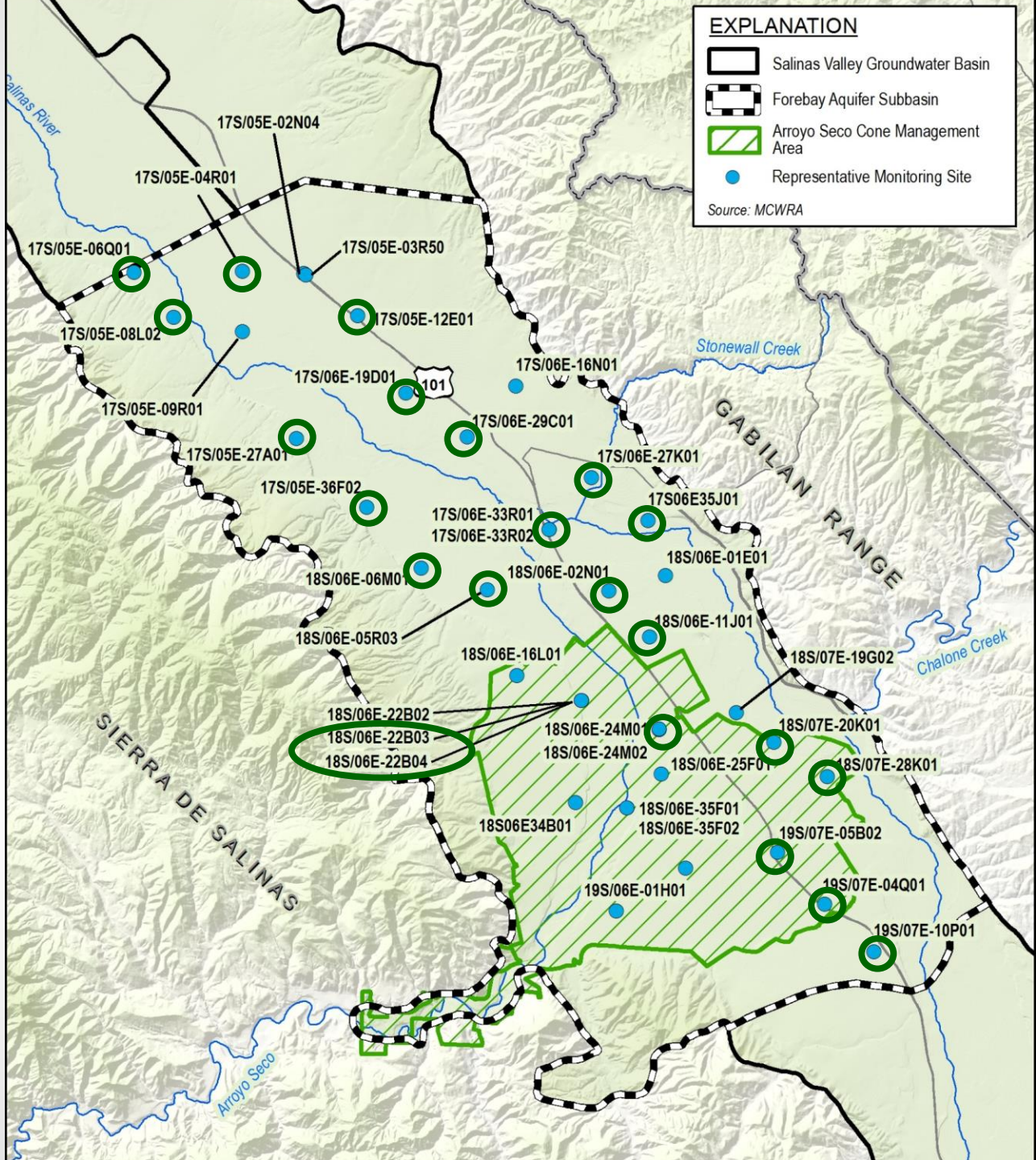
Measurable Objective (MO):
2015 groundwater elevations + 75% of difference between 2015 and 1998

Minimum Threshold (MT):
Set to December 2015 groundwater elevations

Undesirable Result:
Over the course of any one year, more than 15% of groundwater elevation minimum thresholds are exceeded.

No wells were below the MT in 2019

Wells circled in green were above the MO in 2019



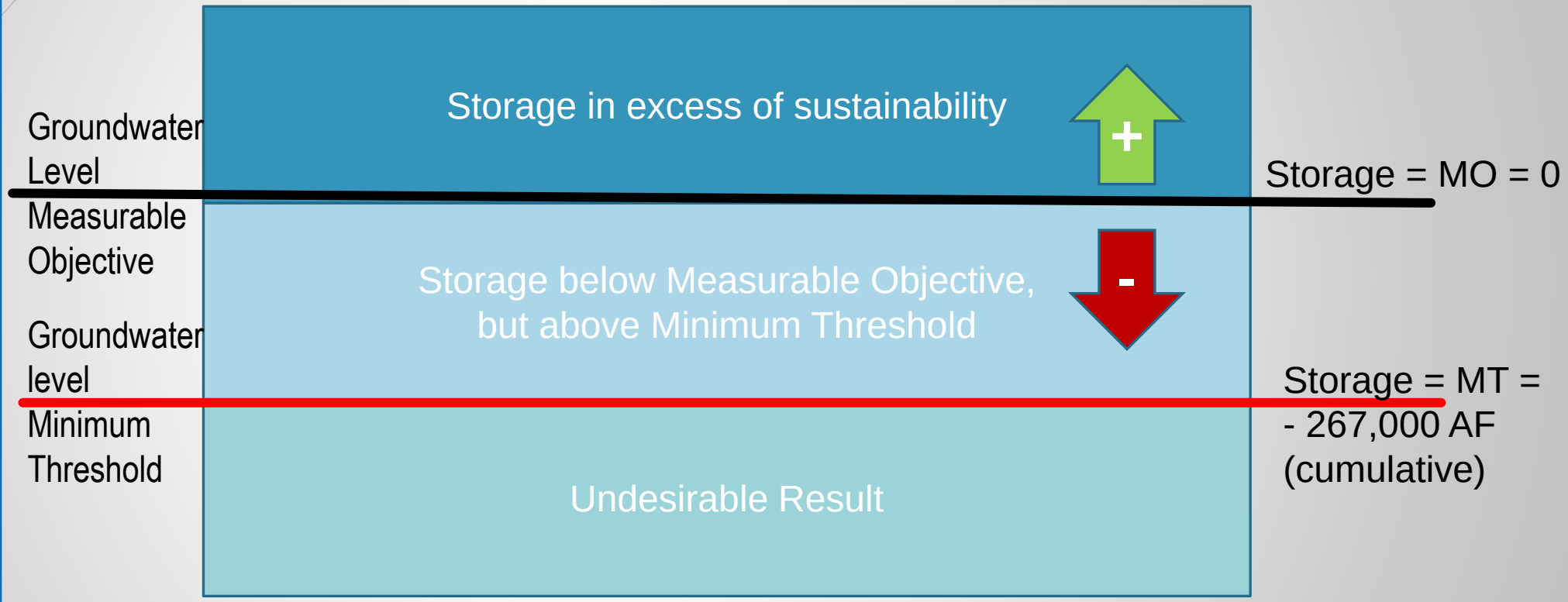
Groundwater conditions/SMC – **Groundwater Storage**

2. Reduction of groundwater storage

Measurable Objective (MO):
Set to zero when the groundwater elevations are held at the groundwater level measurable objectives.

Minimum Threshold (MT):
Set to -267,000 acre-feet below the measurable objective. This reduction is based on the groundwater level minimum thresholds.

Undesirable Result:
There is an exceedance of the minimum threshold.



Groundwater conditions/SMC – **Groundwater Storage**

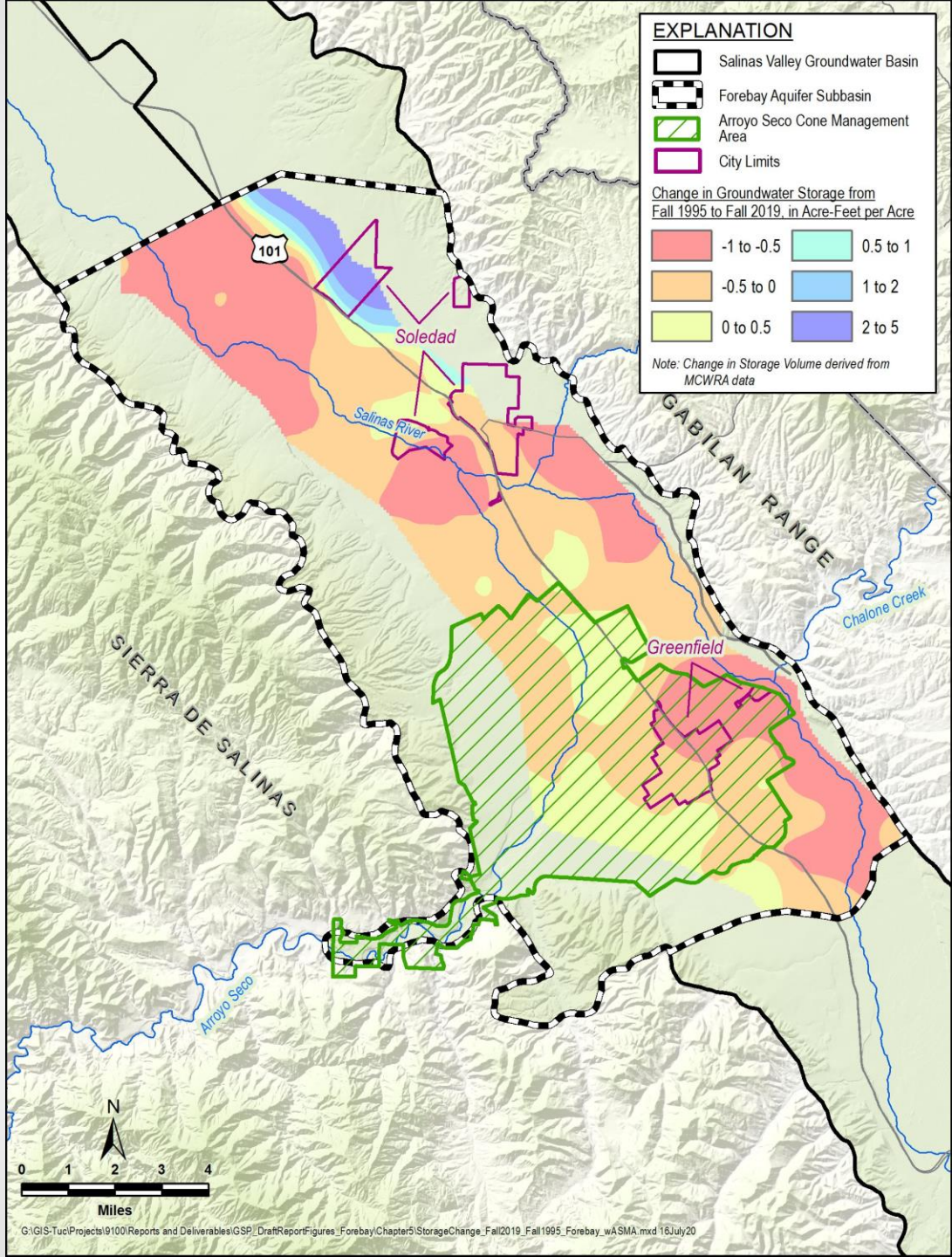
2. Reduction of groundwater storage

Measurable Objective (MO):
Set to zero when the groundwater elevations are held at the groundwater level measurable objectives.

Minimum Threshold (MT):
Set to -267,000 acre-feet below the measurable objective. This reduction is based on the groundwater level minimum thresholds.

Undesirable Result:
There is an exceedance of the minimum threshold.

Historical change in groundwater storage near zero



Groundwater conditions/ SMC – **Water Quality**

3. Degraded Groundwater Quality

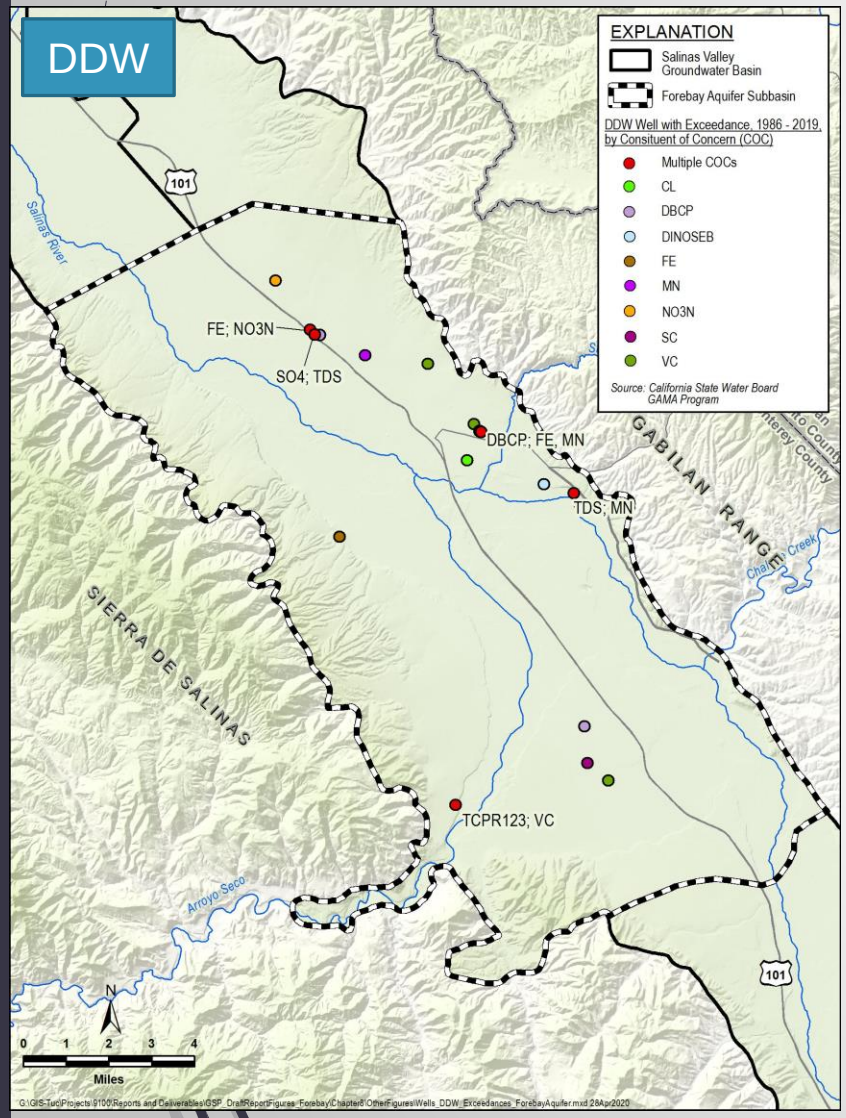
Measurable Objective (MO)
Zero additional exceedances of either the regulatory drinking water standards (potable supply wells) or the Basin Plan objectives (irrigation supply wells) beyond those observed in 2019 for groundwater quality constituents of concern.

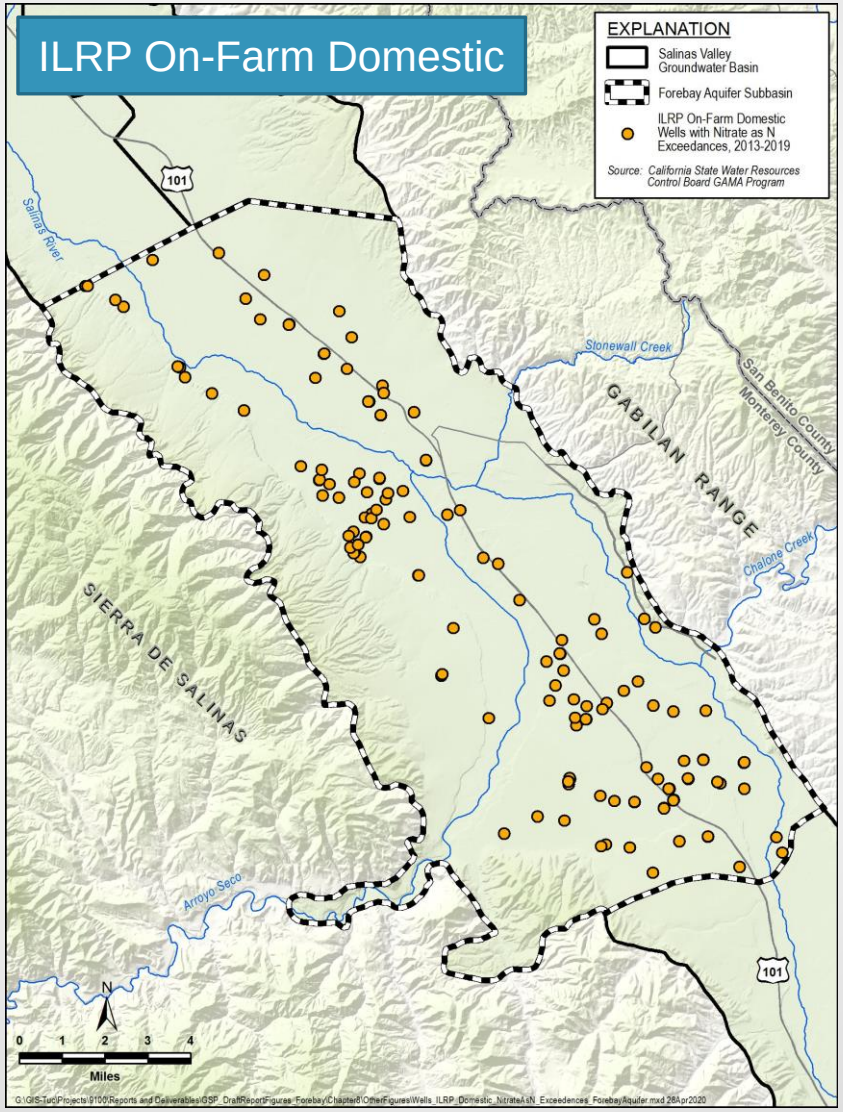
Minimum Threshold (MT)
Same as the measurable objective.

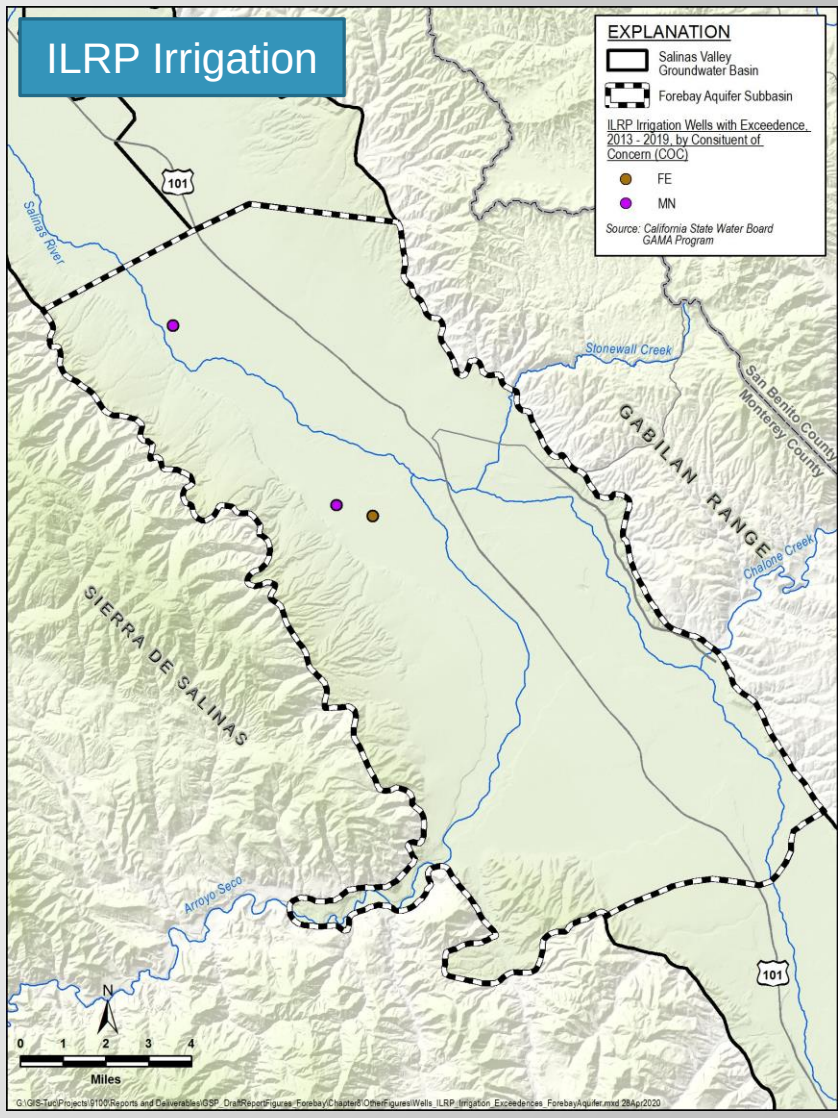
Undesirable Result:
The minimum threshold is exceeded as a direct result of projects or management actions taken as part of GSP implementation.

	Number of Wells Sampled for COC	Minimum Threshold/Measurable Objective – Number of Wells Exceeding Regulatory Standard from latest sample
DDW Wells		
1,2 Dibromo-3-chloropropane	24	3
1,2,3-Trichloropropane	36	2
Beryllium	35	1
Chloride	34	1
Di(2-ethylhexyl) phthalate	30	1
Dinoseb	34	3
Iron	32	6
Lindane	23	1
Manganese	32	4
Nitrate (as nitrogen)	42	5
Polychlorinated Biphenyls	19	1
Specific Conductance	36	1
Sulfate	33	1
Thallium	35	1
Total Dissolved Solids	33	4
Vinyl Chloride	36	4
ILRP On-Farm Domestic Wells		
Iron	38	8
Manganese	38	2
Nitrate (as nitrogen)	**251**	**162**
Nitrate + Nitrite (sum as nitrogen)	**111**	**62**
Nitrite	158	1
Specific Conductance	**261**	**71**
Sulfate	261	34
Total Dissolved Solids	**231**	**90**
ILRP Irrigation Wells		
Iron	48	1
Manganese	48	2

Groundwater conditions/SMC – Current Water Quality Exceedance Maps







Groundwater conditions/SMC – **Subsidence**

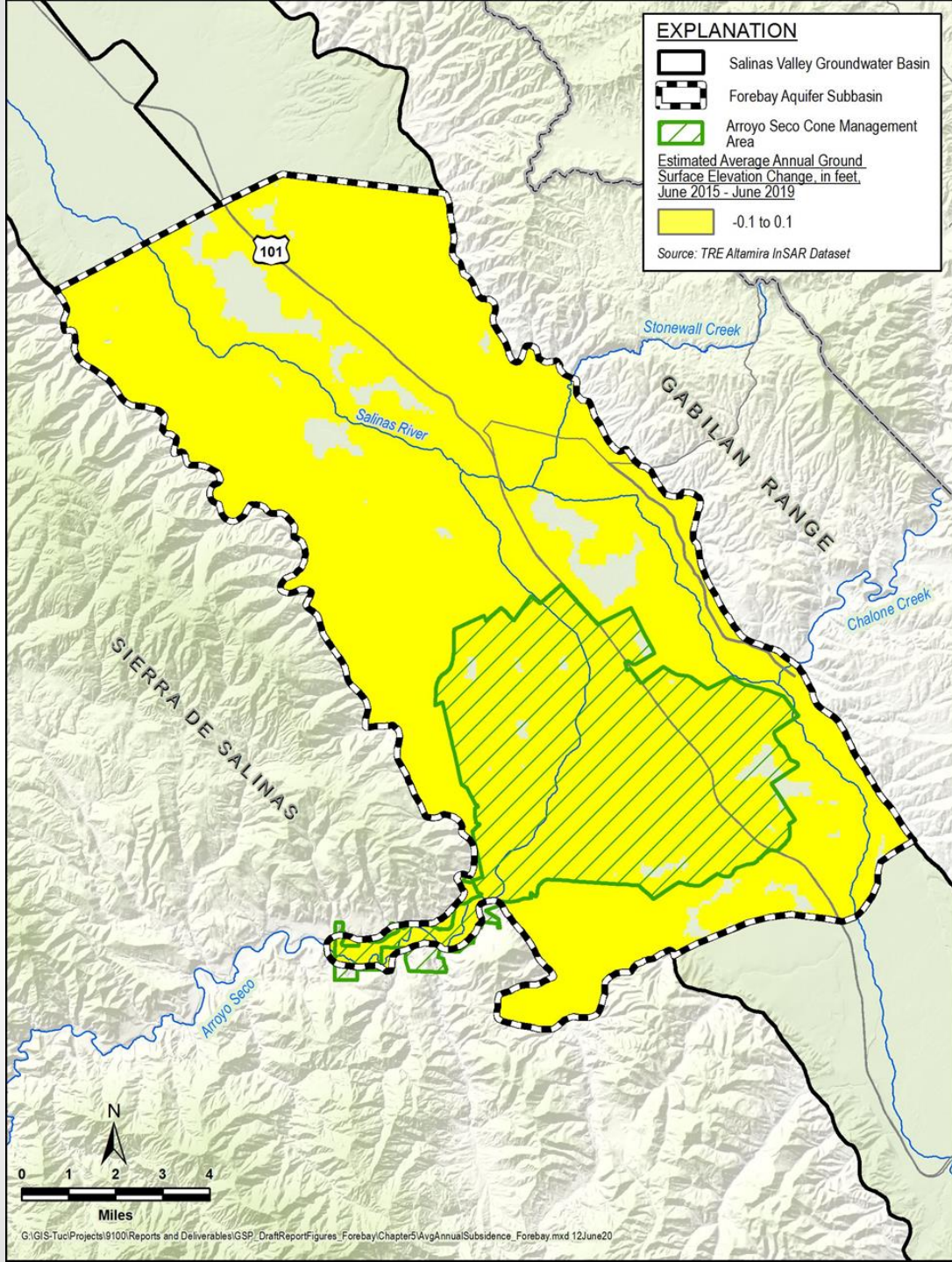
4. Subsidence

Measurable Objective (MO):
0.1 feet per year. This is a long-term rate of zero feet per year plus 0.1 feet per year of estimated land movement to account for InSAR measurement errors.

Minimum Threshold (MT):
0.133 feet per year. This is the rate that results in less than one foot of cumulative subsidence over a 30-year implementation horizon, plus 0.1 feet per year of estimated land movement to account for InSAR measurement errors.

Undesirable Result:
There is no exceedance of minimum threshold for subsidence.

- Negligible current subsidence
- Future subsidence due to groundwater conditions is unlikely



Groundwater conditions/SMC – **Interconnected Surface Water**

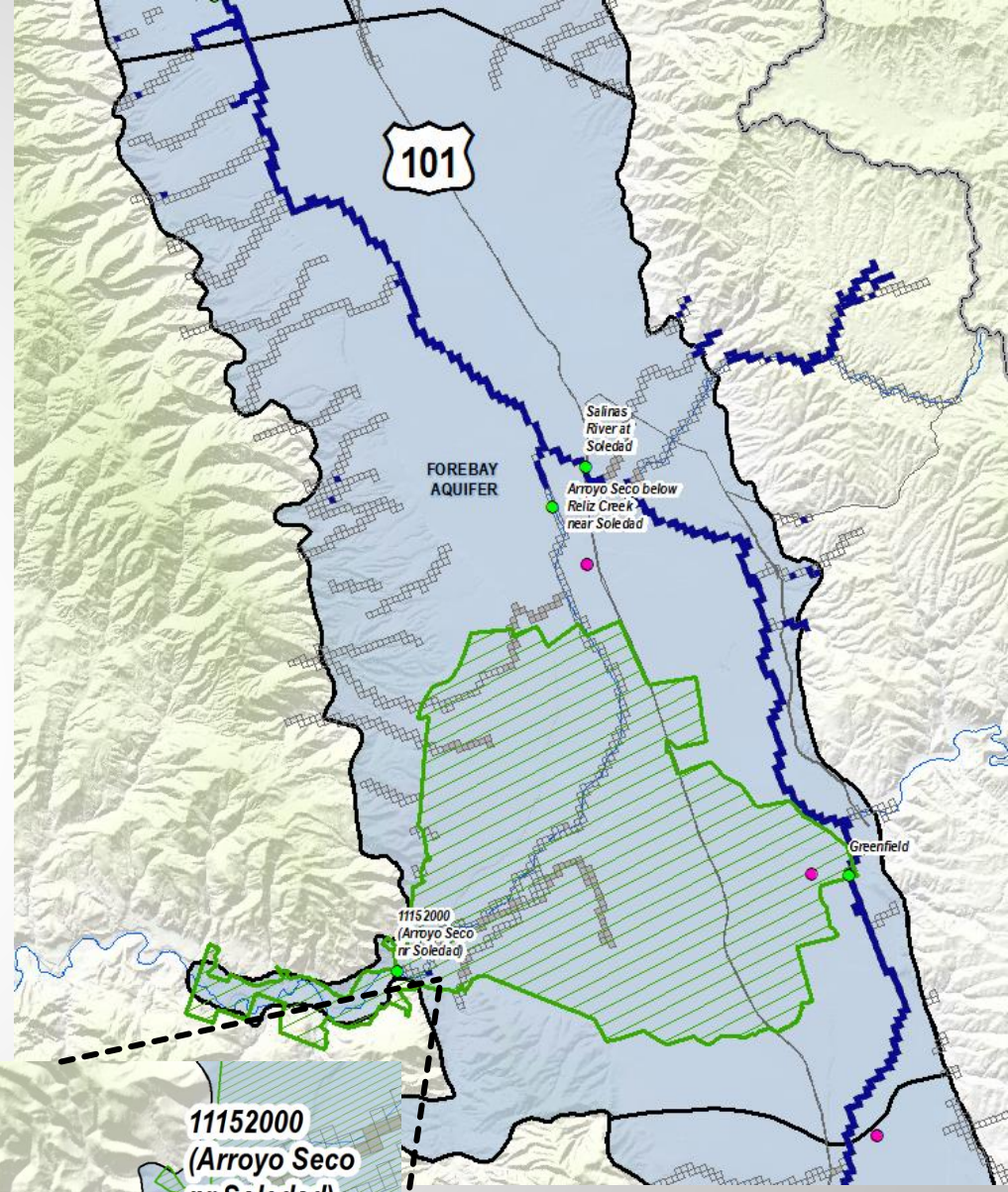
5. Depletion of Interconnected Surface Water (ISW)

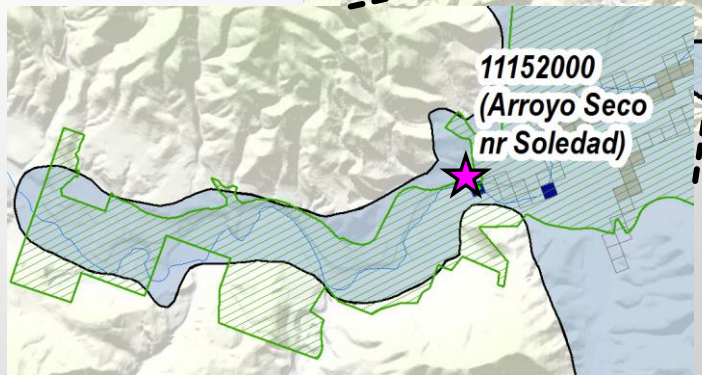
Measurable Objective (MO):
Established by proxy using shallow groundwater elevations near locations of ISW, are set to 75% of the distance between 2015 and 1998 shallow groundwater elevations.

Minimum Threshold (MT):
Established by proxy using shallow groundwater elevations near locations of ISW, are set to groundwater elevations observed in December 2015.

Undesirable Result:
There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor ISW.

- No interconnected surface water monitoring points yet
  - Green dots are USGS gauge and MCWRA River Series measurement site
  - Pink dots are existing wells that will be added to network
- One shallow well will be added on Arroyo Seco (pink star)

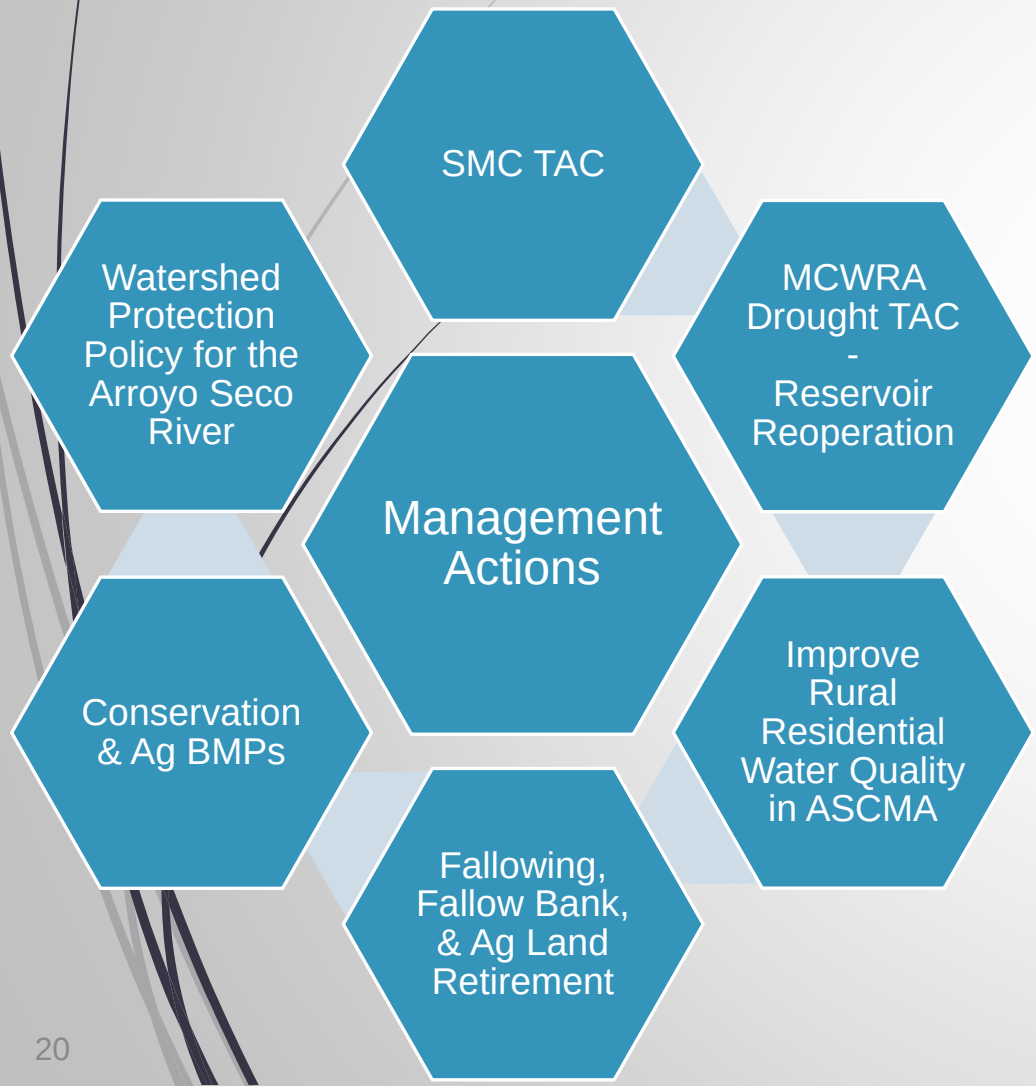


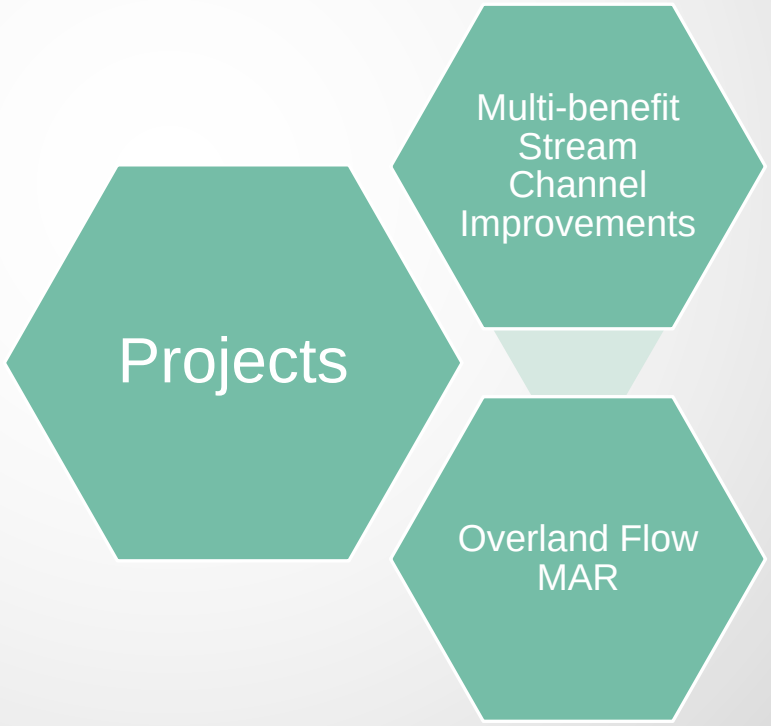


Summary of Current Conditions in Relation to SMC

- Forebay Aquifer Subbasin has not historically been in overdraft, nor experienced chronic lowering of groundwater levels
- From 1980 to 2016, the subbasin was in overdraft during only 3 years
- Given that the Subbasin's extraction is currently close to the sustainable yield, this chapter includes a robust set of potential management actions and projects that could be undertaken if needed

Management Actions and Projects





Forebay SMC TAC

Technical committee that reviews groundwater conditions and provides science-based advice on management actions & projects to Subbasin Planning Committee.

Will consider recharge projects, demand management, and groundwater quality mitigation.

Cost: staffing costs plus $10,000/yr.

Conservation & Ag BMPs

Promotes agricultural best management practices (BMPs) and supports use of evapotranspiration data as an irrigation management tool for growers.

Cost: Approximately $100,000 for 4 workshops, grant writing, and demonstration trials. Cost could be reduced if shared between subbasins.

Fallowing, Fallow Bank, & Ag Land Retirement

A voluntary program of incentives for fallowing or retiring agricultural land

Includes a fallow bank, whereby anybody fallowing land could draw against the bank to offset lost profit.

Cost: $430-$1,270/AF if land is fallowed

$830-$2,070/AF if land is retired

MANAGEMENT ACTIONS

Improve Rural Residential Water Quality in Arroyo Seco Cone Management Area

Description: Educate rural residents about common groundwater quality issues and options for obtaining safe and aesthetic water.

Benefits: Bottled water, in-home reverse osmosis, and/or an expansion of public water systems

Costs: $3,000 for outreach and education.

Watershed Protection Policy for the Arroyo Seco River

- Ensure continued recharge from Arroyo Seco River and habitat for threatened fish
- Costs would be staff time only to prepare policy resolutions for the ASGSA and SVBGSA Board of Directors

MANAGEMENT ACTIONS FOR ASCMA

MCWRA Drought Reoperation

Support the existing Drought Technical Advisory Committee (D-TAC), which plans reservoir releases during drought conditions.

No additional costs since already formed.

Reservoir Reoperation

Collaborate with MCWRA to evaluate potential reoperation scenarios.

Could be paired with projects such as the MCWRA Interlake Tunnel and Winter Release with ASR projects.

Cost: approximately $400,000 - $500,000

Management Actions

Multi-benefit Stream Channel Improvements

Prune native vegetation and remove non-native vegetation, manage sediment, and enhance floodplains for recharge. Includes 3 components:

1. **Stream Maintenance Program**, Multi-subbasin cost of $0.6M-$1.0M/yr.
2. **Invasive Species Eradication**, Multi-subbasin benefits of 2,790-20,880 AF/yr., cost of $16.5M or $60-$600/AF
3. **Floodplain Enhancement and Recharge**, benefits of 400 AF/yr. for 4 basins in Forebay alone, cost of $4.5M or $930/AF

Managed Aquifer Recharge with Overland Flow

Description: Construct recharge basins for managed aquifer recharge of overland flow before it reaches streams.

Benefits: approximately 400 AF/yr. for 4 recharge basins; could be scaled up or down

Cost: $4,128,000 for 4 recharge basins, or $870/AF

Project Options Over 50 Year Planning Horizon

Implementation Actions

Well Registration

- Register all production wells, including domestic wells

Water Quality Partnership

- Form a working group for agencies and organizations to collaborate on addressing water quality concerns.

GEMS Expansion & Enhancement

- Update current GEMS program, by collecting groundwater extraction data from wells in areas not currently covered by GEMS and improving data collection

Dry Well Notification System

- Develop a system for well owners to notify the GSA if their wells go dry. Refer those owners to resources to assess and improve their water supplies. Form a working group if concerning patterns emerge.

Summary of Management Actions

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
A1	Forebay SMC Technical Advisory Committee (TAC)	Establish TAC to review groundwater conditions and provide advice on management actions and projects	Potential for increased groundwater elevations, increased groundwater storage, decreased groundwater extraction, protection of water quality	Dependent on specific recommendations implemented	Staffing costs plus $10,000 per year
A2	Conservation and Agricultural BMPs	Promote agricultural BMPs and support use of ET data as an irrigation management tool for growers	Better tools assist growers to use water more efficiently; decreased groundwater extraction	Unable to quantify benefits until specific BMPs are identified and promoted	Approximately $100,000 for 4 workshops, grant writing, and demonstration trials. Cost could be reduced if shared between subbasins.
A3	Improve Rural Residential Water Quality in ASCMA	Educate rural residents about common groundwater quality issues and options for obtaining safe and aesthetic potable water in their homes	Improve rural domestic water quality by supplying bottled water, installing reverse osmosis units, and/or extending public water supply systems	To be determined	$3,000 for outreach and education. Program does not include cost for bottled water, reverse osmosis units

Summary of Management Actions

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
A4	Watershed Protection Policy for Arroyo Seco River	Establish a Watershed Protection Policy for protecting the Arroyo Seco River watershed	Ensure continued recharge from Arroyo Seco River and habitat for threatened fish	Protection of the Arroyo Seco River watershed maintains sustainable conditions in the ASCMA	Costs would be staff time only to prepare policy resolutions for the ASGSA and SVBGSA Board of Directors
A5	Fallowing, Fallow Bank, and Agricultural Land Retirement	Includes voluntary fallowing, a fallow bank whereby anybody fallowing land could draw against the bank to offset lost profit from fallowing, and retirement of agricultural land	Decreased groundwater extraction for irrigated agriculture	Dependent on program participation	$430-$1,270/AF if land is fallowed $830-$2,070/AF if land is retired
A6	MCWRA Drought Reoperation	Support the existing Drought Technical Advisory Committee (D-TAC) when it develops plans for how to manage reservoir releases during drought conditions	Additional regular winter reservoir releases; drought resilience	Unable to quantify benefits since drought operations have yet to be triggered	No additional costs since already formed.
A7	Reservoir Reoperation	Collaborate with MCWRA to evaluate potential reoperation scenarios	Additional regular annual reservoir releases; drought resilience	Unable to quantify benefits until feasibility study completed	Approximately $400,000 - $500,000

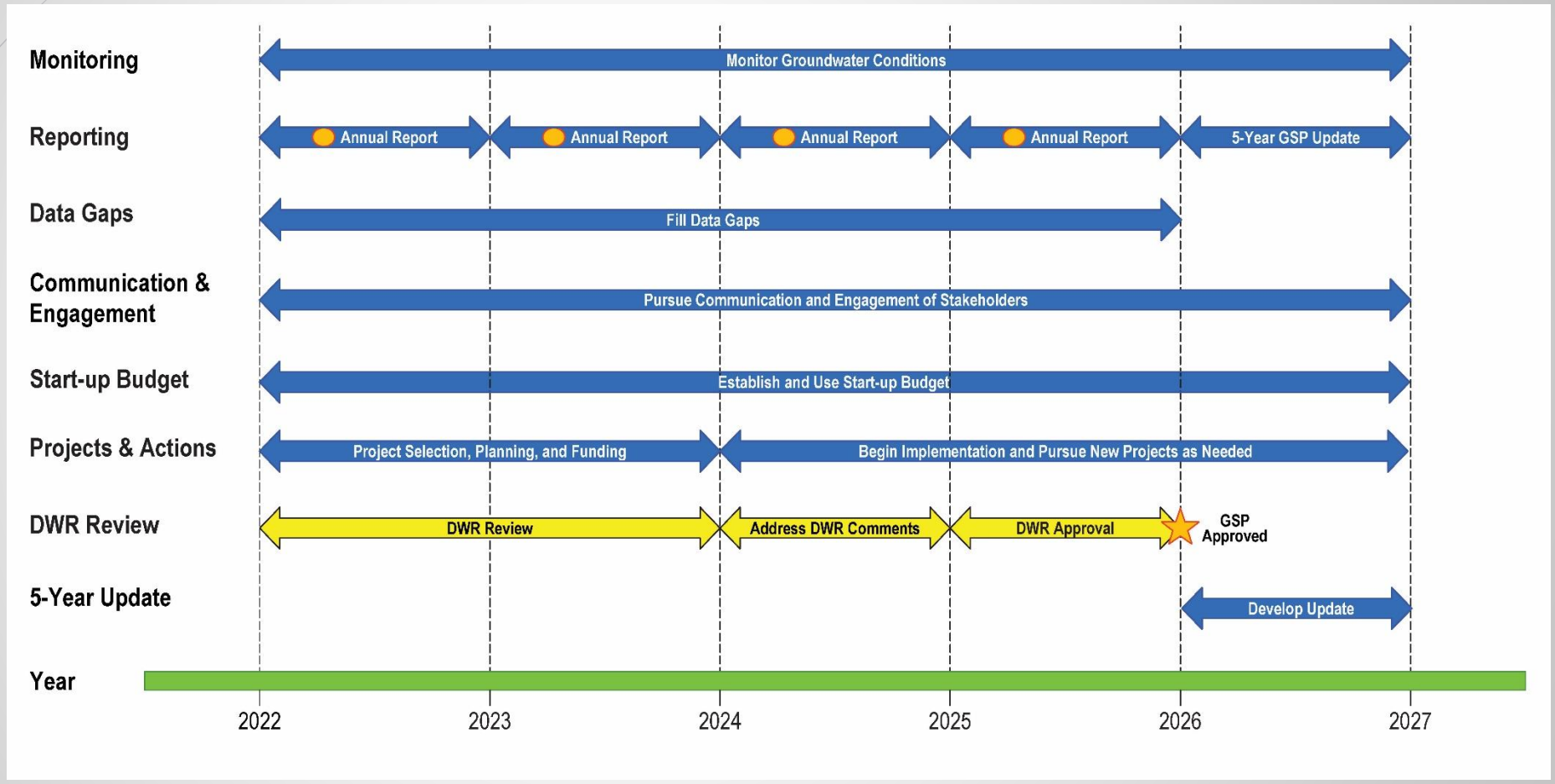
Summary of Projects

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
B1	Multi-benefit Stream Channel Improvements	Prune native vegetation and remove non-native vegetation, manage sediment, and enhance floodplains for recharge. Includes 3 components: 1. Stream Maintenance Program 2. Invasive Species Eradication 3. Floodplain Enhancement and Recharge	Groundwater recharge, flood risk reduction, returns streams to a natural state of dynamic equilibrium	Component 1: Multi-subbasin benefits not quantified Component 2: Multi-subbasin benefits of 2,790 to 20,880 AF/yr. of increased recharge Component 3: Forebay benefits of 400 AF/yr. from 4 recharge basins	<u>Component 1</u> Multi-subbasin Cost: $150,000 for annual administration and $95,000 for occasional certification; $780,000 for the first year of treatment on 650 acres, and $455,000 for annual retreatment of all acres <u>Component 2</u> Multi-subbasin Average Cost: $16,500,000 Unit Cost: $60 to $600/AF <u>Component 3</u> Forebay Cost: $4,464,000 Unit Cost: $930/AF
B2	Managed Aquifer Recharge with Overland Flow	Construct basins for managed aquifer recharge of overland flow before it reaches streams	Groundwater recharge, less stormwater and erosion, more regular surface temperature	400 AF/yr. in increased recharge	Capital Cost: $4,128,000 Unit Cost: $870/AF

Summary of Implementation Actions

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
C1	Well Registration	Register all production wells, including domestic wells	Better informed decisions, more management options	N/A – Implementation Action	Not estimated at this time
C2	GEMS Expansion and Enhancement	Update current GEMS program by collecting groundwater extraction data from wells in areas not currently covered by GEMS and improving data collection	Better informed decisions	N/A – Implementation Action	Not estimated at this time
C3	Dry Well Notification System	Develop a system for well owners to notify the GSA if their wells go dry. Refer those owners to resources to assess and improve their water supplies. Form a working group if concerning patterns emerge.	Support affected well owners with analysis of groundwater elevation decline	N/A – Implementation Action	Not estimated at this time
C4	Water Quality Partnership	Form a working group for agencies and organizations to collaborate on addressing water quality concerns	Improve water quality	N/A – Implementation Action	Not estimated at this time

Implementation Schedule



Adaptive Management

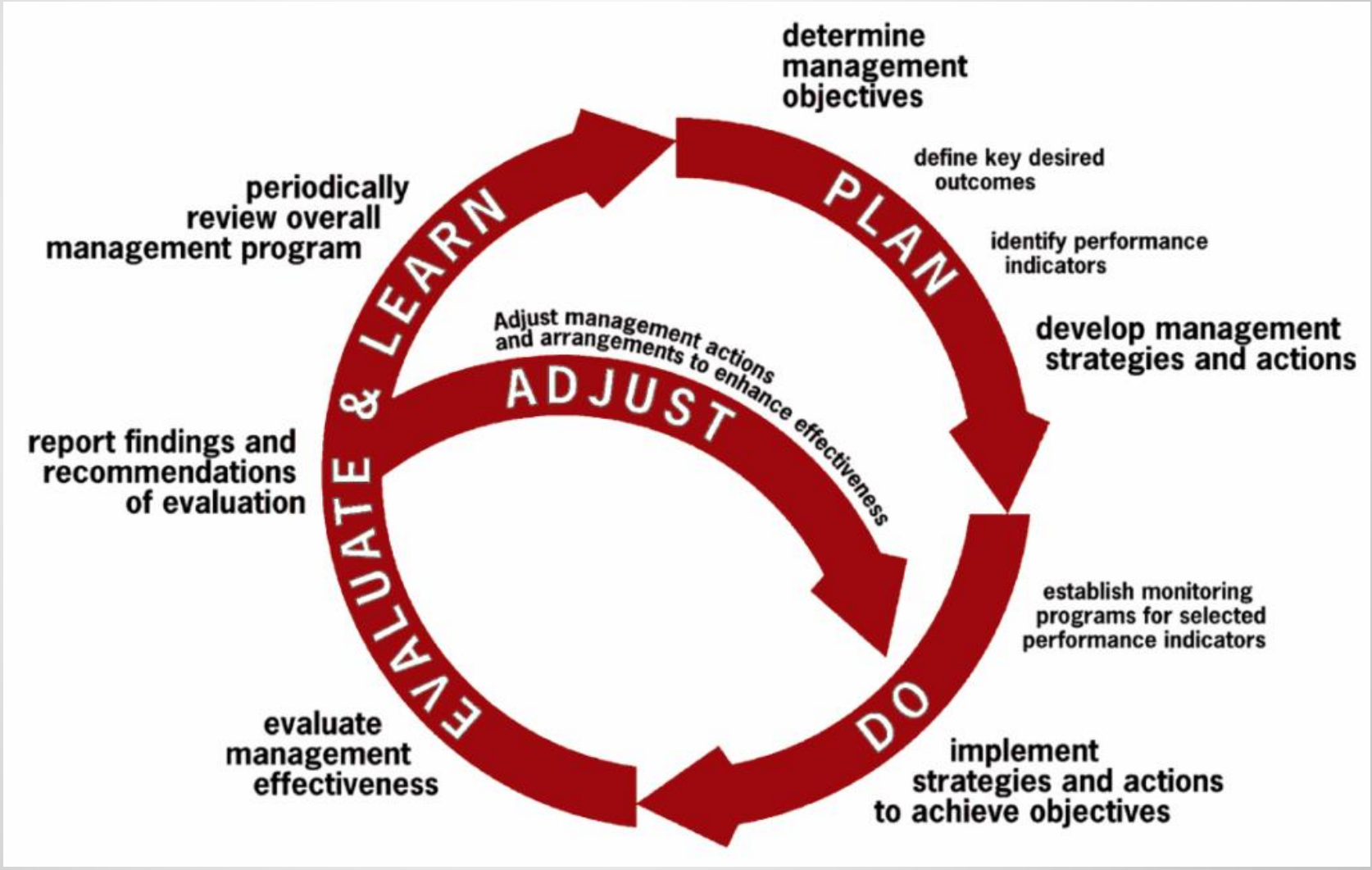


Image source: https://reefresilience.org/management-strategies/marine-protected-areas/adaptive-management

Questions