CALIFORNIA DEPARTMENT OF WATER RESOURCES

Monitoring Special Study

Technical Work Group #3, July 19, 2021

Salinity Point Source and Ion Sampling

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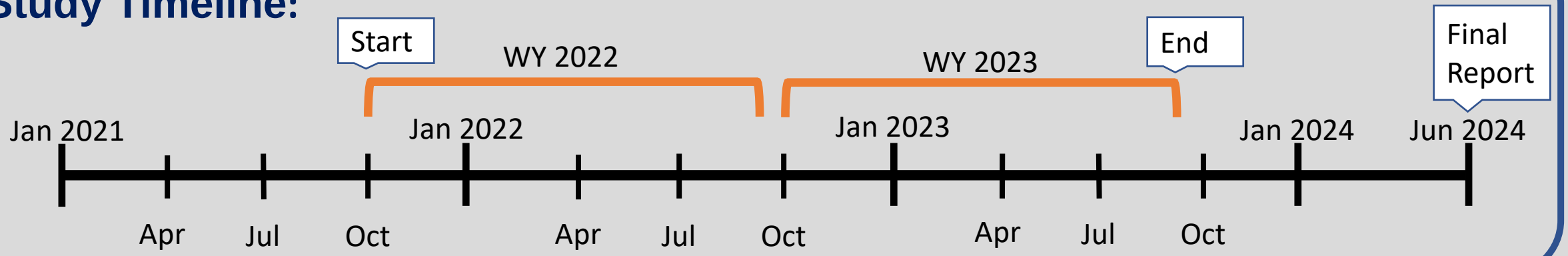
Salinity Point Source and Ion Sampling

Introduction

- 1 of 6 Technical Studies Outlined in the COP Monitoring Special Study
- The primary goal is to further investigate and monitor salinity in the south Delta to improve our understanding of point source contribution.
- Monitoring will be informed by ongoing high-speed EC mapping transects
- Sampling will be used for data assimilation process to inform and improve modeling

Study Timeline:

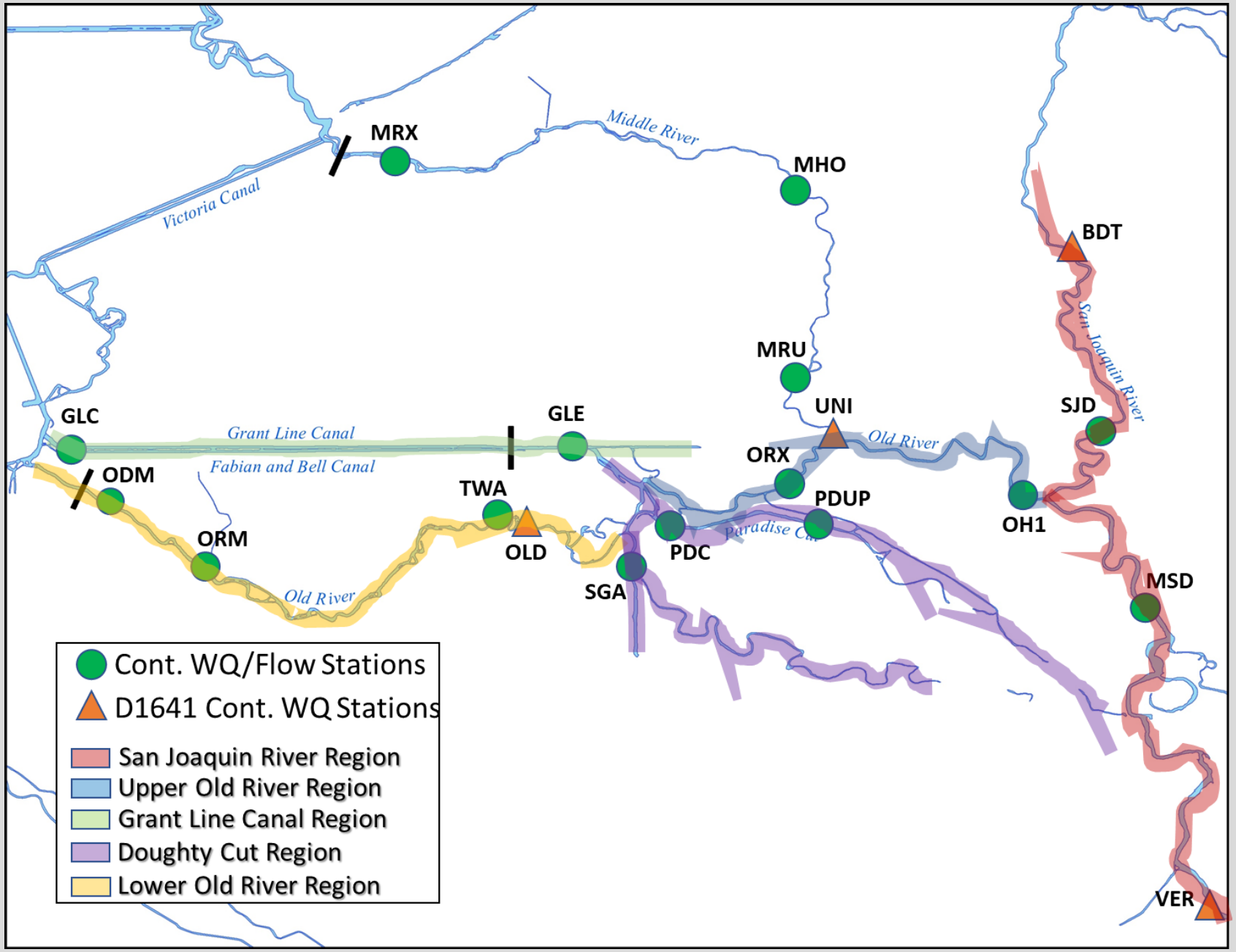


Salinity Point Source and Ion Sampling

Background

Study Area:

- Study area encompasses 5 regions
- Regions are based on differences in hydrology, impairments, salinity sources, and bathymetry
- Within these regions DWR, USBR, and USGS operate an extensive network of flow, stage, and WQ stations
- D1641 salinity compliance stations OLD,UNI, BDT, and VER – are further supported by this extensive network

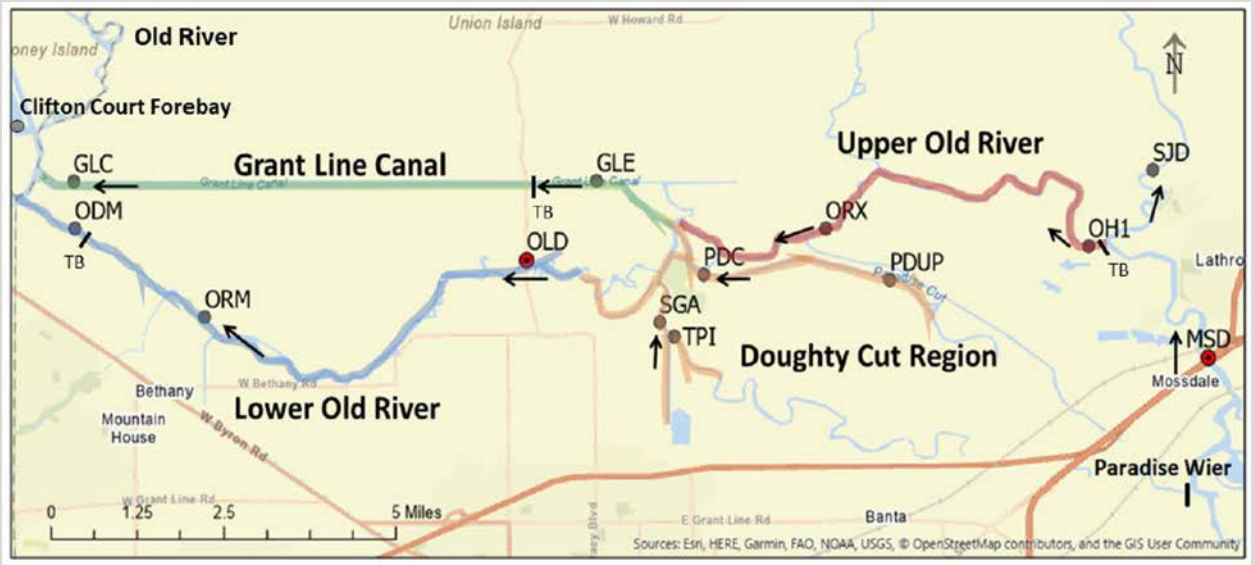


Salinity Point Source and Ion Sampling

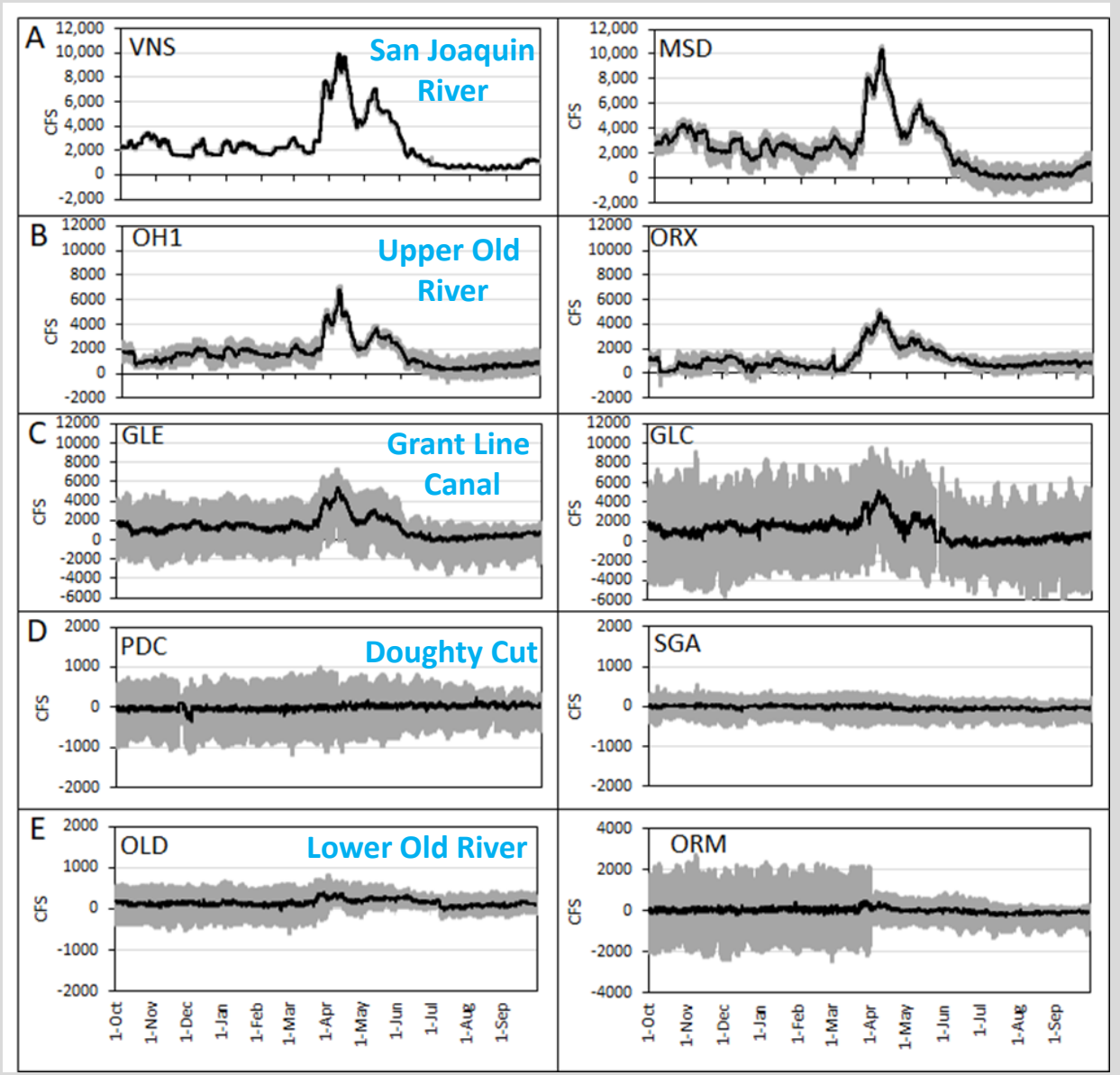
Background

South Delta Hydrology:

- Complex Hydrology – WY Index, Exports, Ag, Urban
- San Joaquin River Primary Water Source– East to West
- Region variability – low outflows in Lower Old River and Doughty Cut Region



WY2018

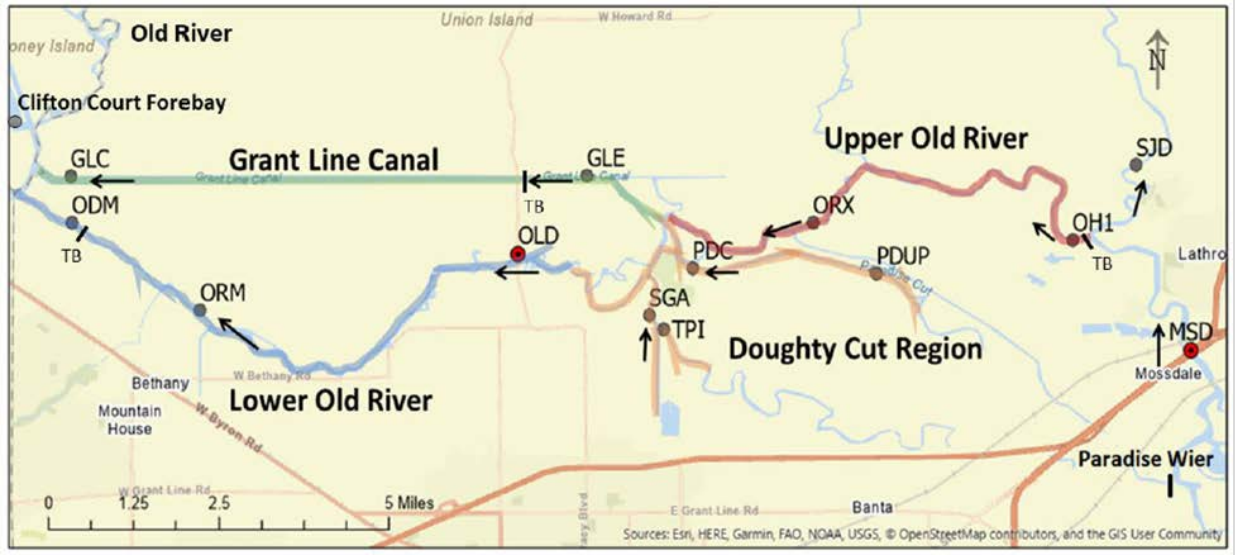


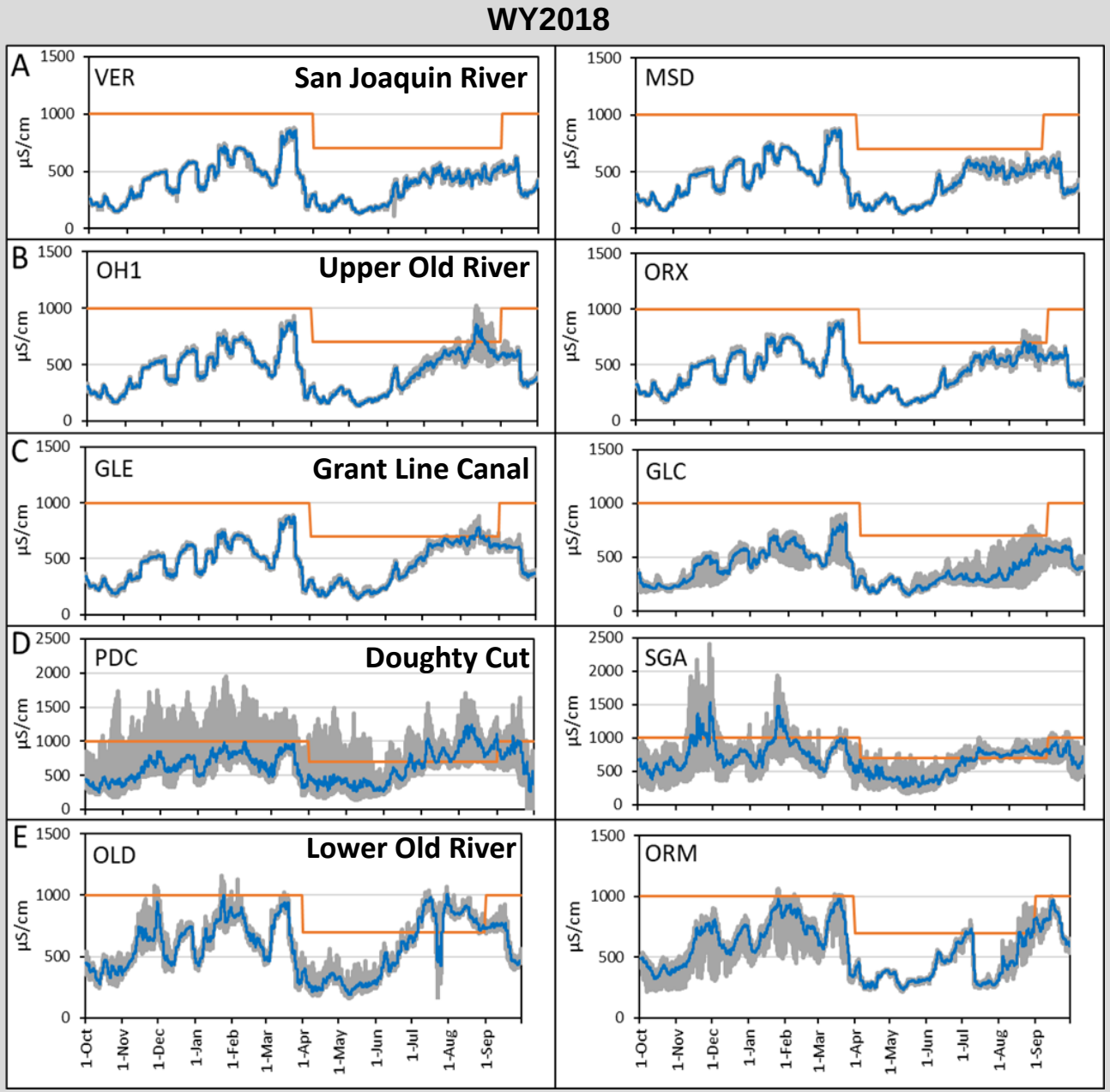
Salinity Point Source and Ion Sampling

Background

South Delta Salinity:

- San Joaquin River EC trends reflected in Upper Old River & Grant Line – Sacramento River lowers EC from west in Grant Line Canal
- EC Trends deviate in Lower Old River and Doughty Cut Regions
- EC trends are often tied to Delta Island agricultural practices – high pumping Jun-Aug & winter discharge



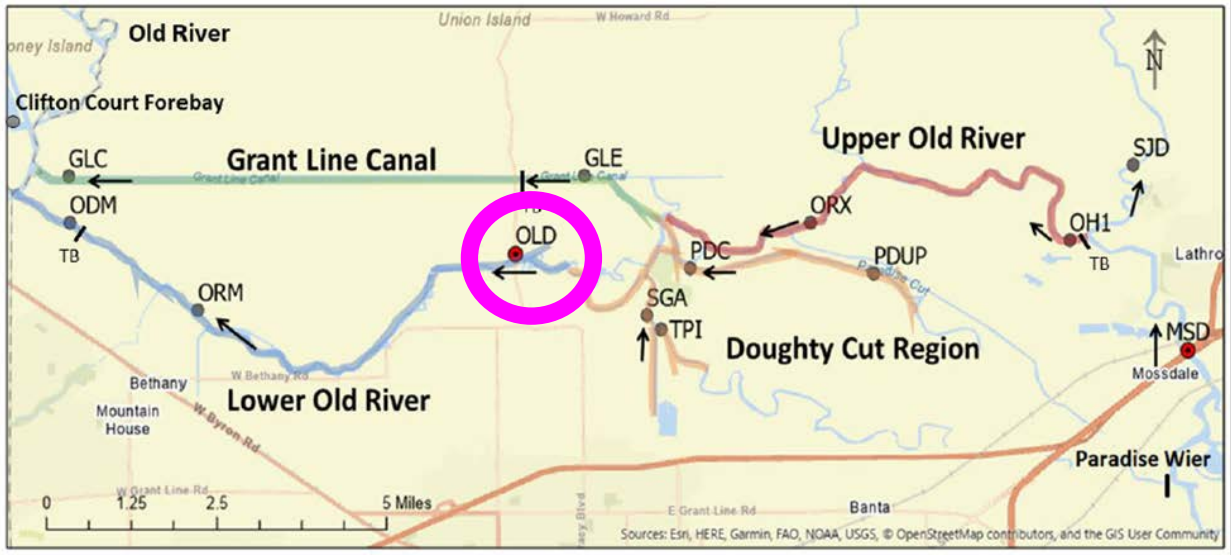


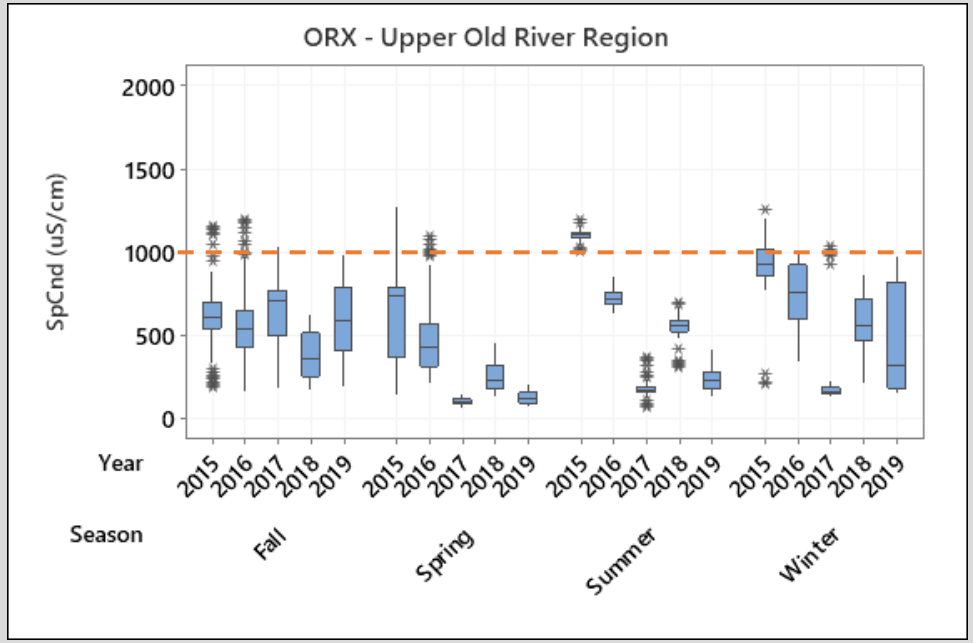
Salinity Point Source and Ion Sampling

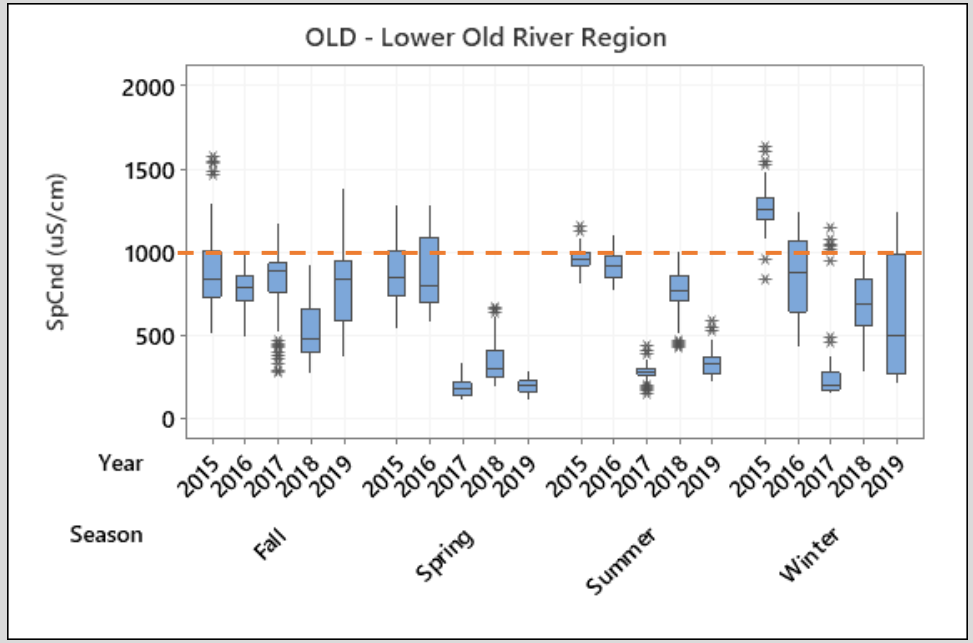
Background

South Delta Salinity:

- WY Type – San Joaquin River Outflow – Drives EC Trend
- Lower Old River – always higher EC in all years and seasons
- OLD Compliance station has long history of exceeding D1641 standards





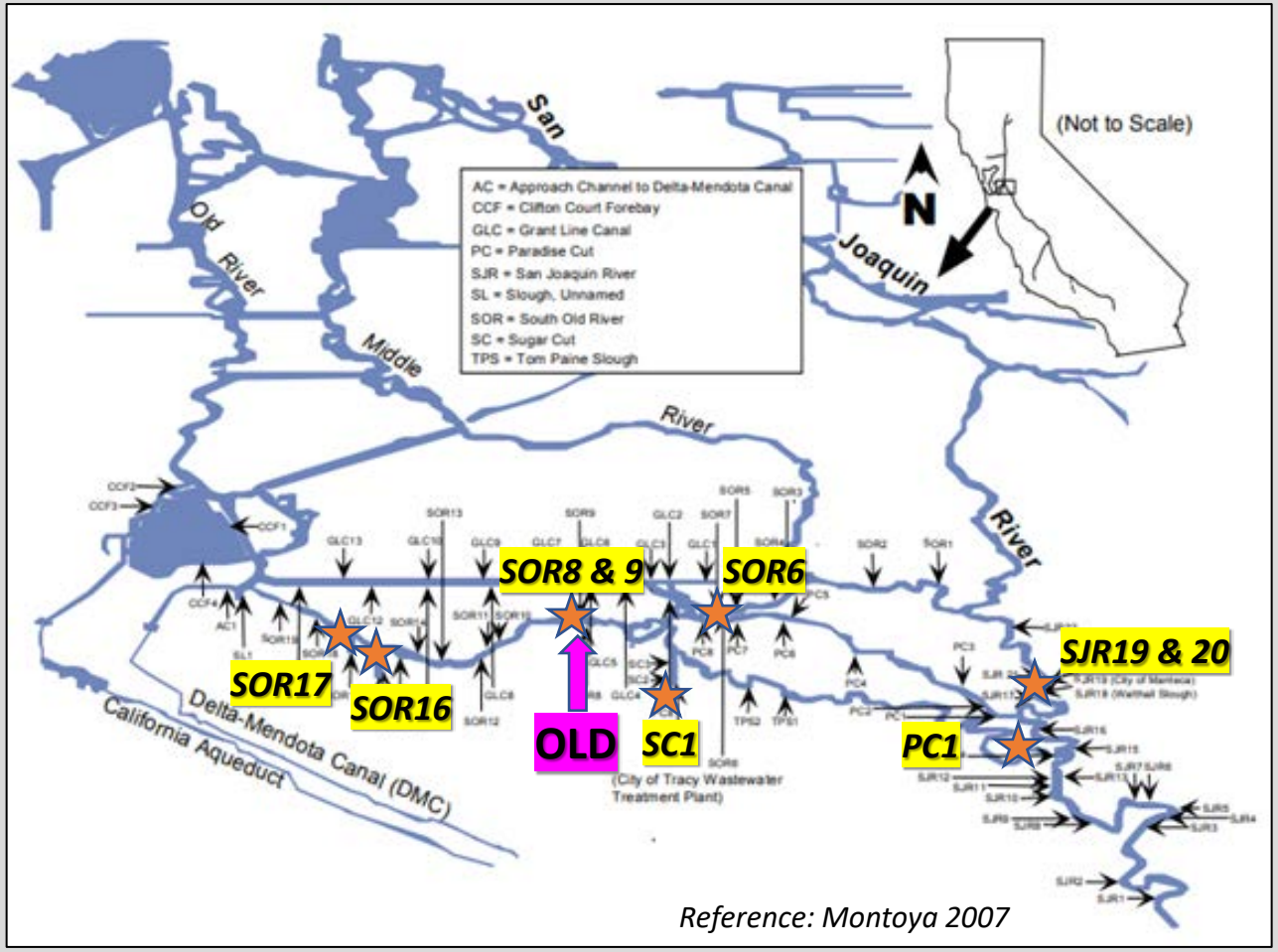


Salinity Point Source and Ion Sampling

Background

South Delta Salinity Point Sources:

- Montoya 2007 – reported there were 74 saline discharges situated in the waterways in the south Delta upstream of SWP and CVP export sites
- Point sources are primarily agricultural, followed by treated sewage wastewater, urban runoff, and groundwater
- Drains in Tom Paine Slough and Paradise Cut were highest in EC, with Grant Line Canal lowest, and Old River variable-based on location – South Delta drains averaged 1,496 µS/cm
- Largest point sources in San Joaquin River were cities of Manteca and Lathrop (SJR19) & Browns Sand Excavation Site (SJR20)
- Large point sources in Old River and Doughty Cut regions included: City of Tracy wastewater discharge (SOR6), Mountain House (SOR16), Wicklund Road outfall (SOR17), Drains upstream (SOR8) and downstream of OLD (SOR9)
- Deuel Vocational Institution (PC1) & Leprino Wastewater Ponds in Sugar Cut (SC1) – were high EC hotspots in Paradise and Sugar Cut



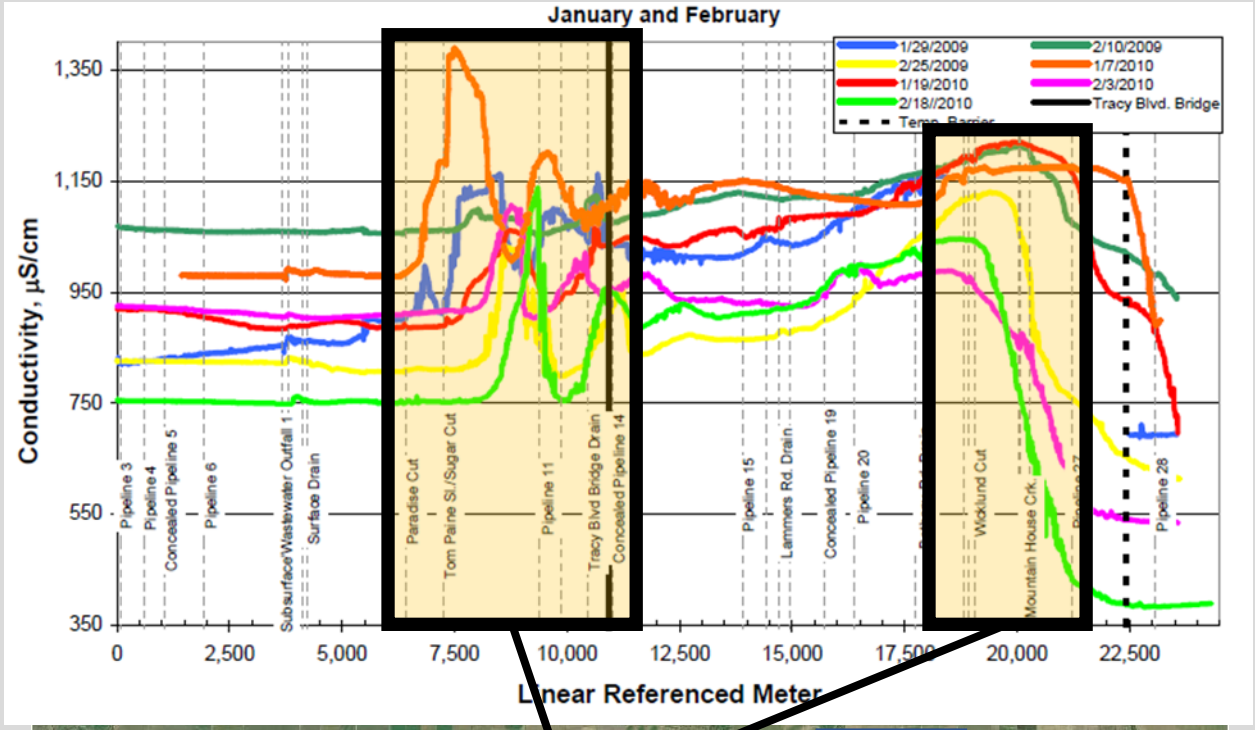
Reference: Montoya 2007

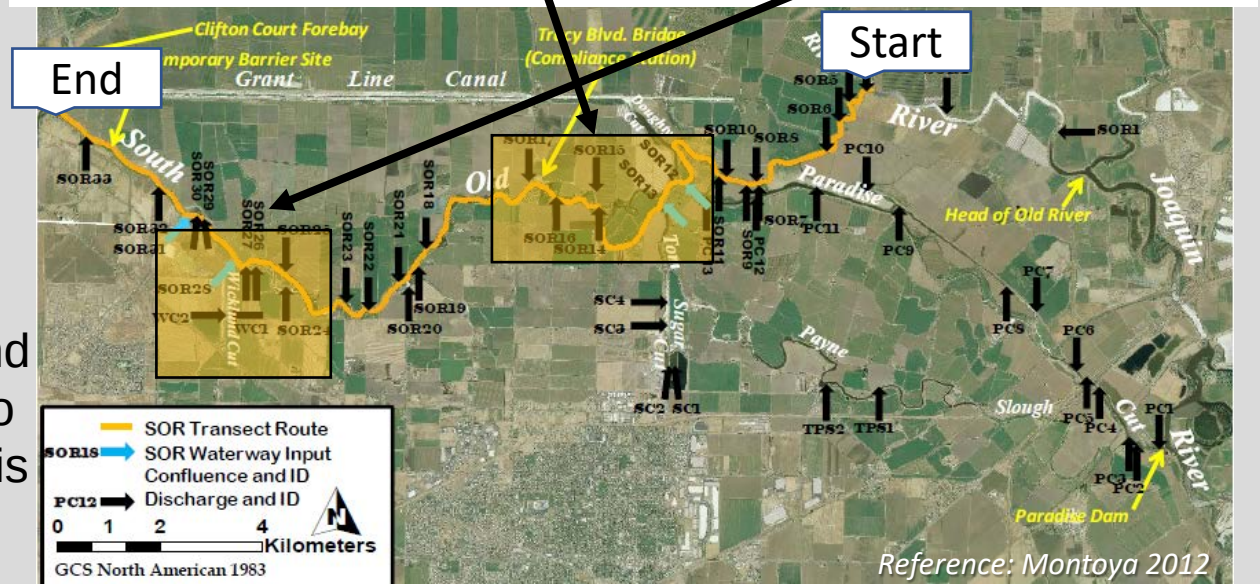
Salinity Point Source and Ion Sampling

Background

South Delta Salinity Point Sources:

- Montoya 2007 concluded that salinity at OLD vs. SJR at Vernalis was always 100 to 185 µS/cm higher
- OLD station appeared to be especially influenced by saline inputs that originate from Tom Paine Slough, Paradise Cut, and groundwater influence
- 2009-10 EC transect data reported by Montoya 2012 further provided evidence of increased salinity near Paradise Cut, Sugar Cut/Tom Paine Slough, near OLD station, and further downstream at Wicklund Cut and Mountain House Creek
- Brown 2016 – Further concluded that Paradise Cut and Sugar Cut have a large effect on EC near OLD, due to the net flow (dilution) past the station being small – this differs from Grant Line Canal

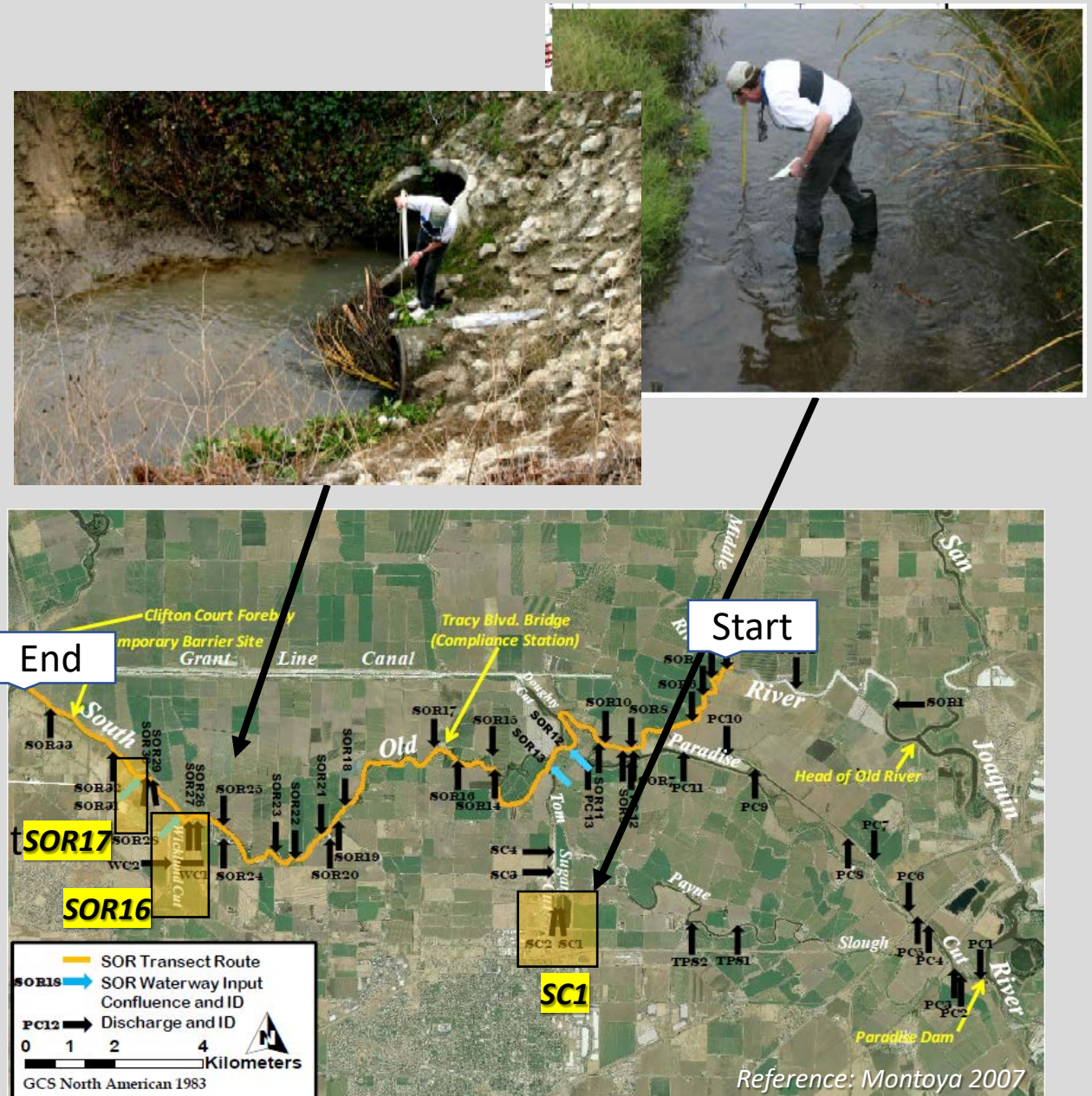




Background

South Delta Salinity Point Sources:

- Montoya 2007 determined that point sources at (SC1) Sugar Cut Leprino Wastewater Ponds, Wicklund Rd. Outfall (SOR16), and Mountain House Creek (SOR17) were the primary groundwater contributors to Old River
- High salinities in agricultural return water and groundwater has been linked to soils in the south Delta being composed of heavily mineralized, eroded marine sedimentary rock (Davis 1961)
- Montoya 2007 ion water sample analysis found that SC1 and SOR16 were the same mineralogy (ion ratio) - this suggests these waterways are being recharged by the same groundwater



Salinity Point Source and Ion Sampling

Background

South Delta Ion Analysis:

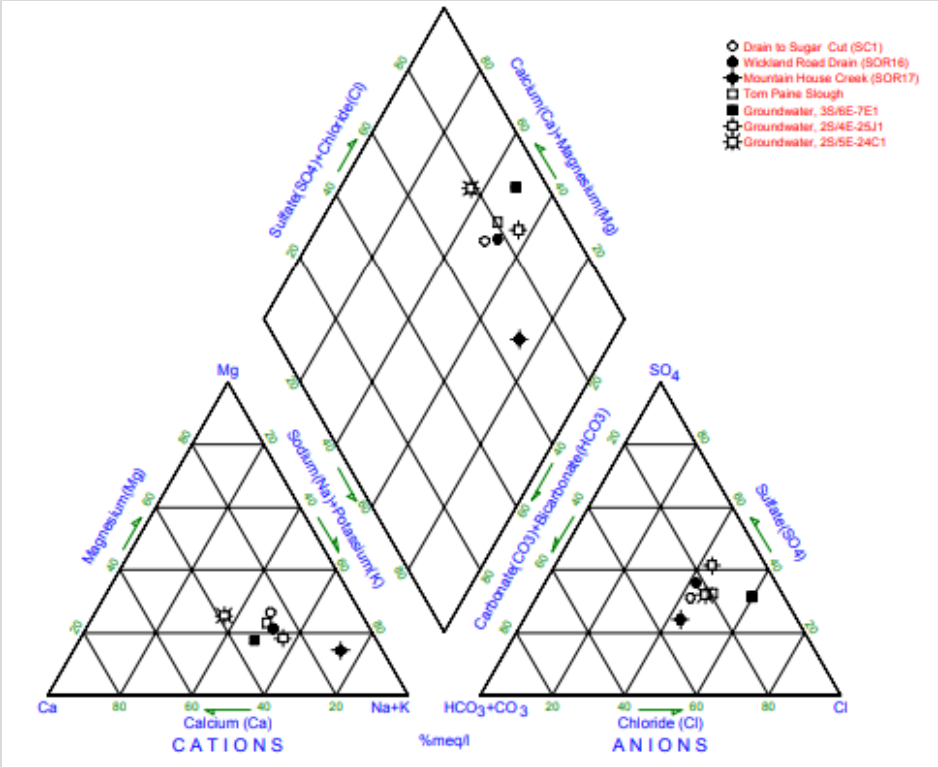
- Montoya 2004 & Denton 2015 identified through Delta ion data that there are differing ratios in salinity derived from seawater, Sacramento River and San Joaquin River sources – this can be used to identify a source waters “fingerprint”

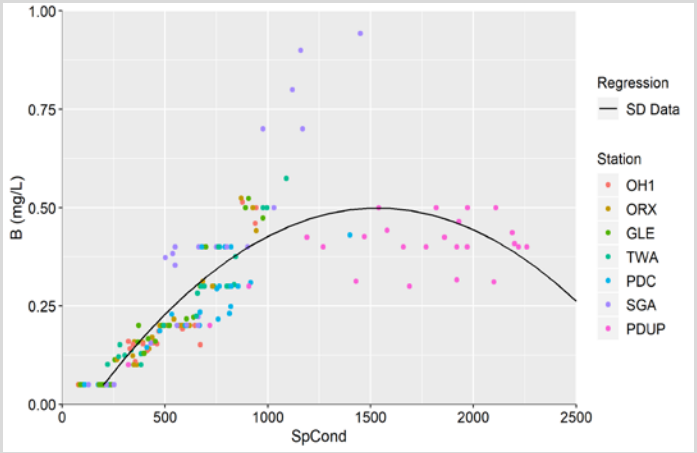
- Chloride, Sulfate, Sodium, Magnesium, Potassium, Bromide Boron, Nitrate, Alkalinity, Hardness, TDS

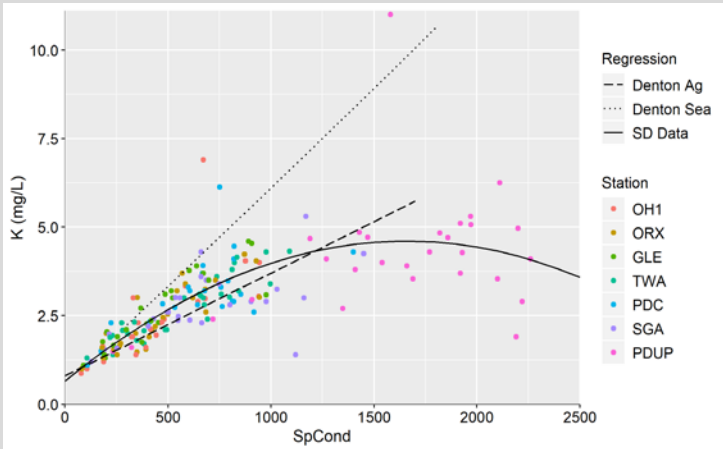
- Montoya 2007 collected standard mineral (ion) data to determine groundwater versus channel water fingerprints.

- This allowed for Montoya to determine that Tom Paine Slough, SC1, SOR16, & SOR17 had same fingerprint as nearby wells

- DWR has collected ion data 2018-current and are finding unique ion fingerprints in Paradise Cut and Sugar Cut







Questions, Comments & Input

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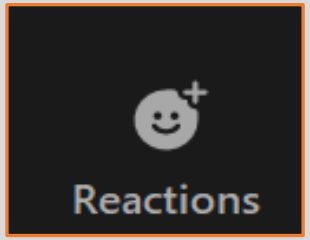


Raise Hand via "Reactions Menu"

Salinity Point Source and Ion Sampling

Problem Statement

- High salinity is a shared issue for all south Delta water users. We know that salinity concentrations are higher in Old River from near the junction of Doughty Cut to Old River near Mountain House. There are more than 50 different potential salinity point sources from either municipal, agricultural, or groundwater within this reach. We want to determine which point sources are the primary contributors to elevated salinity in lower Old River at the OLD compliance station.

Hypothesis

- Local point source discharges from both agriculture and municipal in Old River and the adjacent tributaries of Paradise Cut and Sugar Cut/Tom Paine Slough are contributing to periodic elevated salinity and non-compliance per Water Rights D-1641 at the Old River at Tracy Blvd. (OLD) monitoring station.

Study Questions

1. What are the temporal and regional salinity concentrations (as measured by specific conductance) for documented discharge points sources in surface waters of Old River, Paradise Cut and Sugar Cut/Tom Paine Sloughs?

2. Are there unique ionic concentrations associated with the variable regional surface water and groundwater salinity point sources?

3. Do Sugar Cut and Paradise Cut contribute to the specific conductance concentrations in Old River over an outgoing tide (high to low)?

4. Can unique ion concentrations in Paradise and Sugar Cut/Tom Paine Slough be identified in tidally dispersed water in Old River?

5. Are salinity point sources from Paradise and Sugar Cut contributing to non-compliance at Old River at Tracy Road (OLD) or are Old River point sources a more significant factor?

Study Approach

Task 1. Salinity Point Source Recon: Map Development and Drone Imagery

- Literature Review and On-Water Recon
- Mapping and georeferenced imagery of pumps, drains, and other return water sources
- Boat, drone and land-based monitoring
- Focus will be on Doughty Cut and Lower Old River Regions
- Preliminary study area recon and annual flights WY22-23

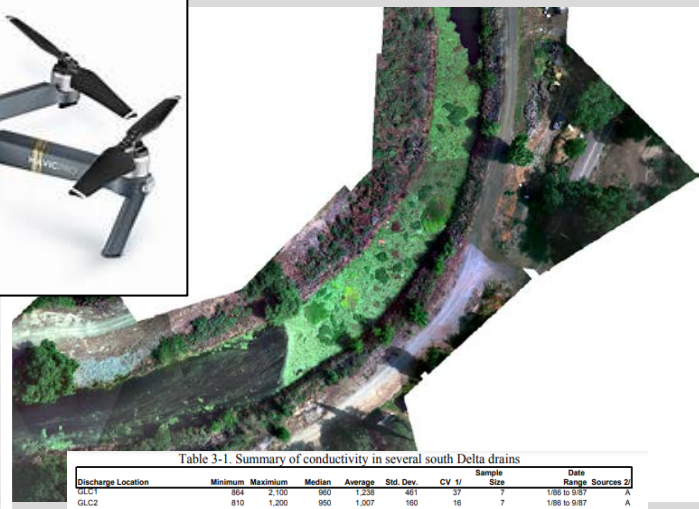


Table 3-1. Summary of conductivity in several south Delta drains

Discharge Location	Minimum	Maximum	Median	Average	Std. Dev.	CV 1/	Sample Size	Date Range	Sources 2/
GLC1	864	2,100	960	1,238	461	37	7	1/86 to 9/87	A
GLC2	810	1,200	950	1,007	160	16	7	1/86 to 9/87	A
GLC3	620	1,500	791	868	296	34	7	1/86 to 9/87	A
GLC5	718	3,230	1,050	1,202	788	66	9	1/86 to 9/87	A
GLC7	820	1,420	1,165	1,096	215	20	8	1/86 to 9/87	A
GLC8	720	1,400	1,100	1,124	235	21	8	1/86 to 9/87	A
GLC11	550	2,600	1,525	1,589	642	40	8	1/86 to 9/87	A
GLC13	550	1,410	1,090	999	367	37	7	1/86 to 9/87	A
PC1	700	2,500	1,150	1,382	733	53	6	1/86 to 9/87	A
PC2	450	2,150	1,405	1,352	566	42	6	1/86 to 9/87	A
PC4	1,400	3,060	1,810	2,037	572	28	11	4/88 to 10/91	B
PC5	710	2,300	1,600	1,641	498	30	9	1/86 to 9/87	A
PC6	1,200	3,160	1,880	1,988	499	25	20	4/87 to 10/91	B
PC6	1,400	2,900	1,550	1,740	494	28	8	1/86 to 9/87	A
PC7	1,230	2,710	1,725	1,798	396	22	18	4/87 to 10/91	B
PC7	1,100	2,600	1,450	1,543	497	32	7	1/86 to 9/87	A
PC8	545	2,680	1,548	1,558	494	32	61	4/87 to 9/97	B
PC8	1,200	2,400	1,700	1,659	419	25	7	1/86 to 9/87	A
SOR3	350	2,550	1,200	1,253	762	61	7	1/86 to 9/87	A
SOR4	750	1,800	960	1,058	377	36	7	1/86 to 9/87	A
SOR6	620	2,500	743	1,009	672	67	7	1/86 to 9/87	A
SOR7	780	2,700	905	1,323	922	70	4	1/86 to 9/87	A
SOR8	1,100	3,880	2,100	2,063	937	45	7	1/86 to 9/87	A
SOR9	920	1,400	1,010	1,076	162	15	8	1/86 to 9/87	A
SOR12	1,200	2,600	1,655	1,785	550	31	8	1/86 to 9/87	A
SOR13	2,400	4,100	2,600	2,779	543	20	8	1/86 to 9/87	A
TPS1	1,300	3,570	1,815	2,238	953	43	8	1/86 to 9/87	A
TPS2	1,100	4,500	2,600	2,597	1,235	48	7	1/86 to 9/87	A
All stations combined (n=28)	350	4,500	1,300	1,496	763	51	285		
Middle River Drains (n=8)	121	3,290	740	947	635	67	56	1/86 to 9/87	A
Victoria Canal Drains (n=5)	350	3,010	620	821	533	65	34	1/86 to 9/87	A
West Delta Drains (n=8)	270	2,800	763	862	440	51	53	1/86 to 9/87	A
South Delta Tile Drainage (n=14)	1,900	4,230	3,100	3,098	704	23	27	6/1/86 and 6/13/86	C
West Delta Tile Drainage (n=14)	780	2,870	1,760	1,822	498	27	20	6/2/86 and 6/16/86	C
CCF1 to CCF4	897	6,970	3,683	3,822	2,821	74	8	6/20/2002	D

1/ Coefficient of Variation
2/ Sources
A: Belden et al. 1989
B: DWR 1990, 1994, and 1999 MWQI data query request
C: Chilcott et al. 1988
D: Unpublished DWR Operations and Maintenance Data

Study Approach

Task 2. Agricultural and Urban Point Source Salinity Monitoring and Sampling

- Deploy additional continuous EC monitoring equipment at identified point sources
- Collect additional discrete measurements and water samples to support continuous monitoring
- High Speed EC Mapping will be incorporated into this effort and help identify point sources
- Added monitoring will focus on Lower Old River, Paradise Cut and Sugar Cut/Tom Paine Slough
- Equipment and sample collection to occur WY22-23 – ongoing High Speed EC Mapping will help inform monitoring

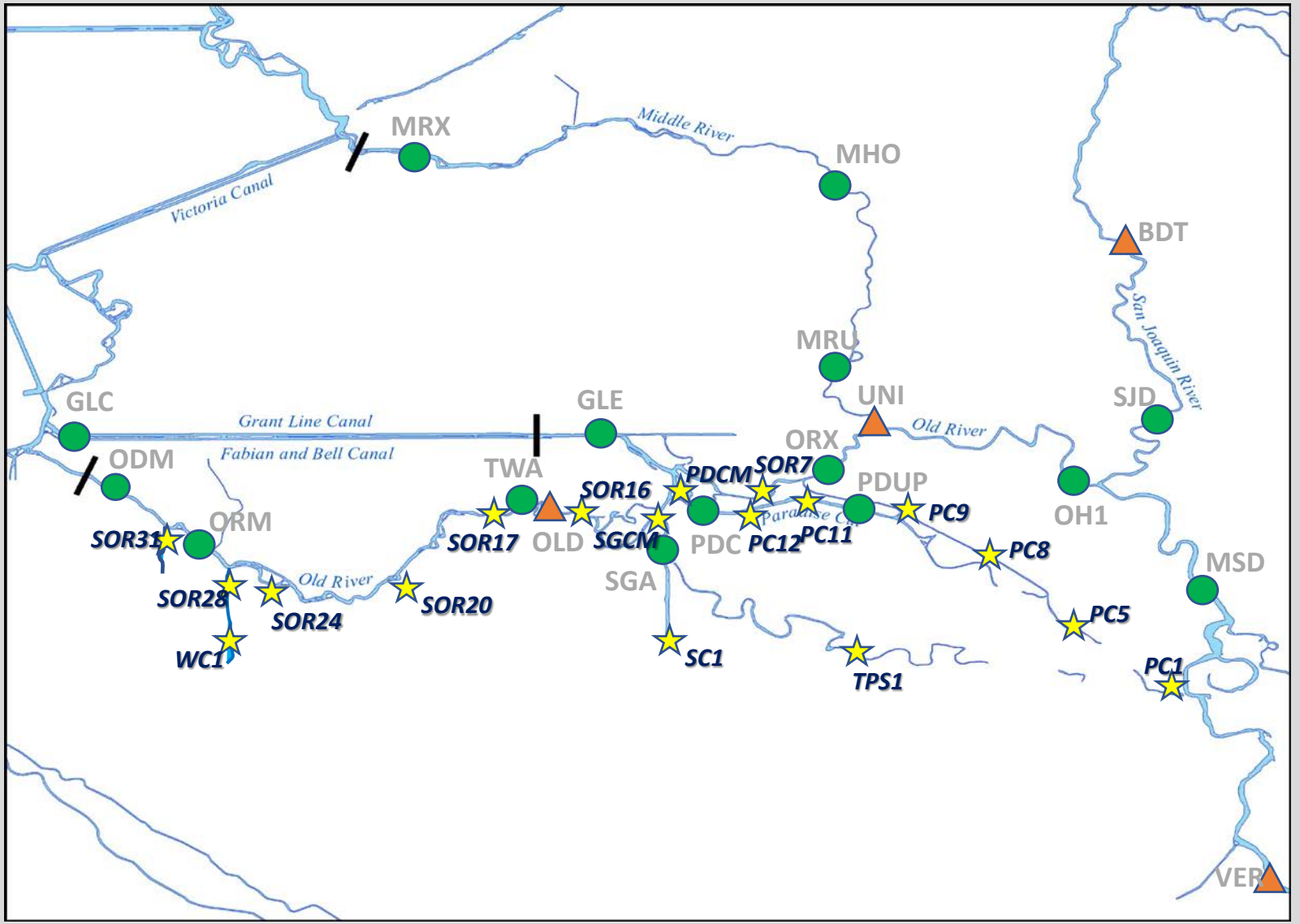
Study Approach

Task 2. Agricultural and Urban Point Source Salinity Monitoring and Sampling

- Proposed additional continuous and/or discrete monitoring sites

#	StationCode	Input Label	Input Type
1	SOR7	Wastewater Outfall (Tracy)	TSW
2	SOR16	Tracy Blvd. Bridge Drain	Ag, Grnd
3	SOR17	Pipeline 14 (concealed)	Ag
4	SOR20	Lammers Rd. Drain	Urb
5	SOR24	Bethany Rd. Drain	Ag, Grnd
6	SOR28	Wicklund Cut	Ag, Grnd, Urb
7	SOR31	Mountain House Creek	Ag, Urb
8	WC1	Surface Drain	Ag, Grnd, Urb
9	SGCM	Mouth of Sugar Cut	Ag, Grnd, Urb
10	PDCM	Mouth of Paradise Cut	Ag, Grnd
11	SC1	Surface Drain	Ag, Grnd, Urb
12	TPS1	Surface Drain	Ag
13	PC1	Pipeline 1	SJR
14	PC5	Surface Drain	Ag
15	PC8	Surface Drain	Ag
16	PC9	Pipeline 7	Ag
17	PC11	Pipeline 9	Ag
18	PC12	Pipeline 10	Ag

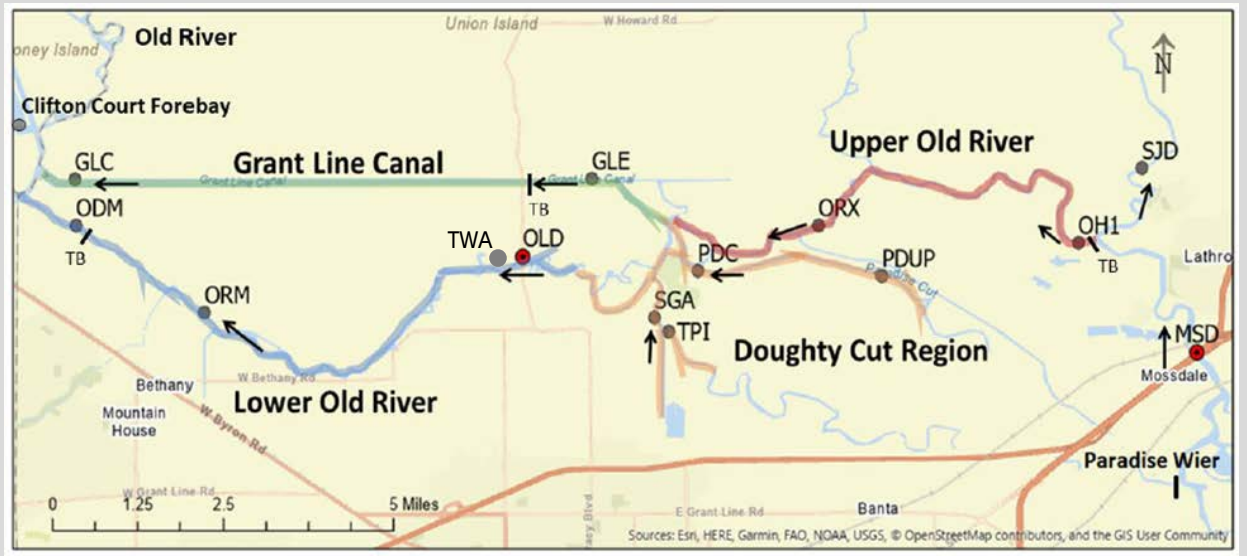
Ag = Agriculture
SJR = San Joaquin River
Grnd = Groundwater Influence
Urb = Urban Runoff
TSW = Treated Sewage Wastewater



Study Approach

Task 3. Ion Sampling

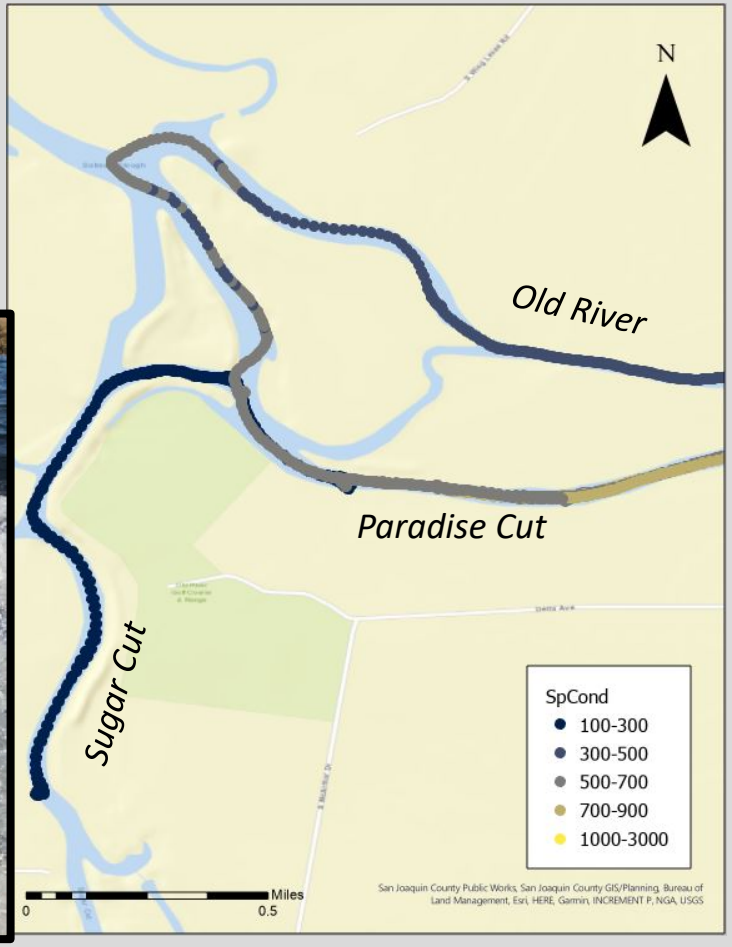
- Collect discrete water samples for standard ion analyses
- Baseline sample collection will continue (started in 2018) at sites: ORX, PDC, PDUP, SGA, and TWA
- Propose added collection at Task 2 identified salinity point sources in Old River, Paradise Cut, and Sugar Cut/Tom Paine Slough – and/or other groundwater sources
- Combine ion sample collection w/ High Speed EC mapping data to determine water source tidal dispersion in Paradise and Sugar Cut
- Baseline sampling occurs monthly WY22-23 – added point source sampling will align with peak discharge periods



Study Approach

Task 4. Downstream Tidal Salinity Dispersion using High Speed EC and Ion Mapping of Paradise and Sugar Cut Sloughs

- Perform repeat High Speed Boat EC transect mapping during outgoing (ebb) tide in Paradise Cut and Sugar Cut Sloughs
- Determine salinity dispersion under varied seasons and tides
- Collect additional Ion samples to determine “fingerprint”
- Perform these transects over WY22-23 – seasonally – focus on periods of higher point source discharge



Study Approach

Task 5. Groundwater Investigations

- Past research and assessments of soils in south Delta have determined they are extra-saline (Diablo Range)
- No active DWR monitoring wells in region of interest – Paradise Cut and Sugar Cut
- Lack of understanding of the irrigation practices and well use in islands around Paradise, Sugar Cut/Tom Paine Slough and Lower Old River
- We want to know more and add a monitoring plan in MSS

We need your help – Can we collaborate?

Questions, Comments & Input

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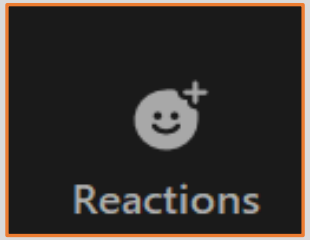

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(ICF) 2016. *Evaluation of Salinity Patterns and Effects of Tidal Flows and Temporary Barriers in South Delta Channels.* Report prepared by Russ Brown, environmental consultant, ICF, to Jacob McQuirk, Chief Engineer, DWR, Bay-Delta Office, South Delta Temporary Barriers. September. (ICF 00568.13) Sacramento, CA.

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