SAN JOAQUIN RIVER RESTORATION PROGRAM

Seepage and Conveyance Technical Feedback Group Meeting

August 20, 2014

Preliminary draft – subject to change

Patti Ransdell

INTRODUCTION

SAN JOAQUIN RIVER RESTORATION PROGRAM

Agenda

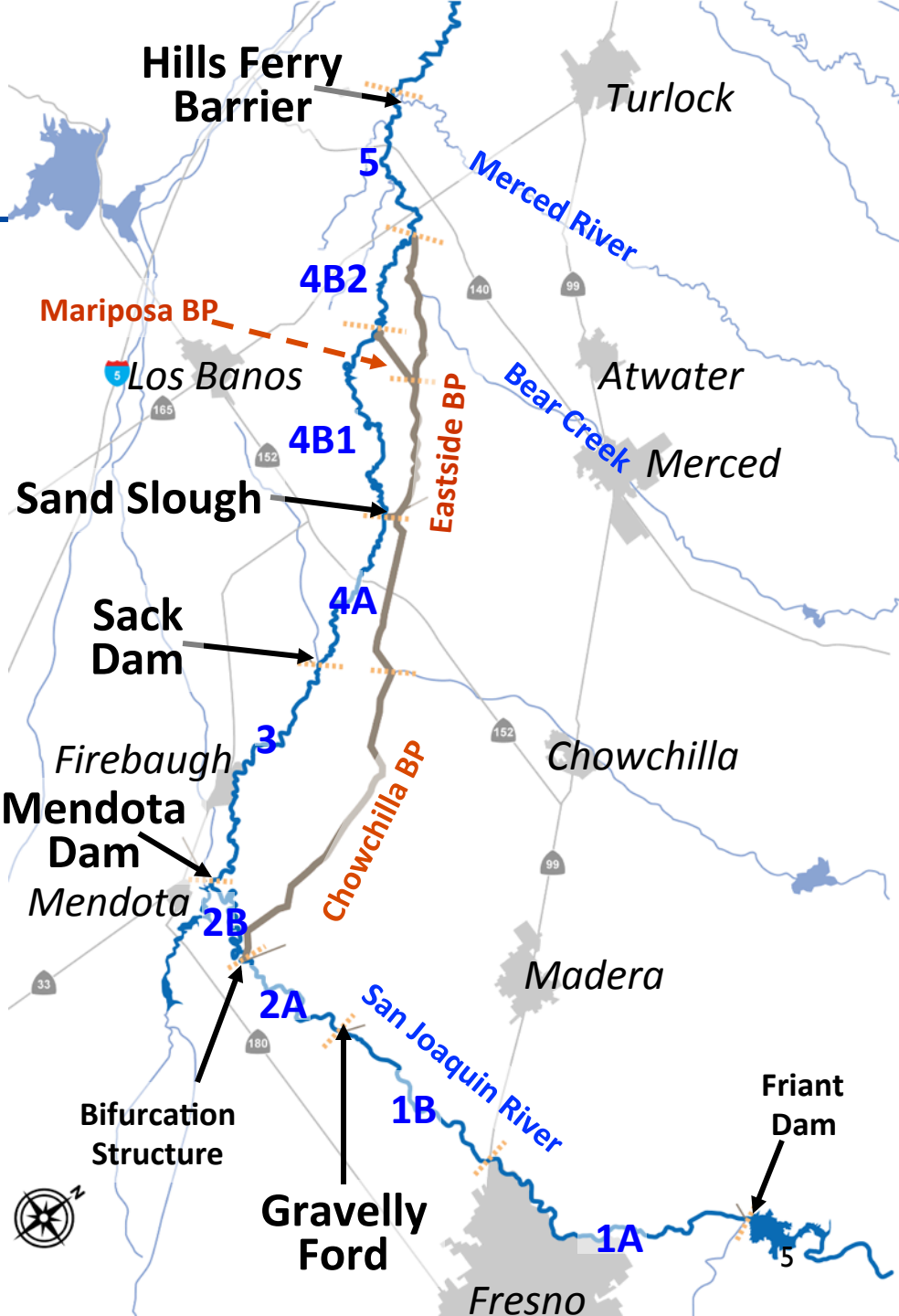
- Introductions
- Restoration Flow Update
- SJRRP Updates
- Status of Seepage Projects
- Site Evaluation and Preliminary Designs
- SJR Levee Evaluations Update
- Wrap-up, Action Items

Katrina Harrison

RESTORATION FLOW SCHEDULE

SAN JOAQUIN RIVER RESTORATION PROGRAM

- SJRECWA Releases
  - To Mendota Pool
  - No flow below Sack Dam
- Critical Water Year Type
  - No water for SJRRP



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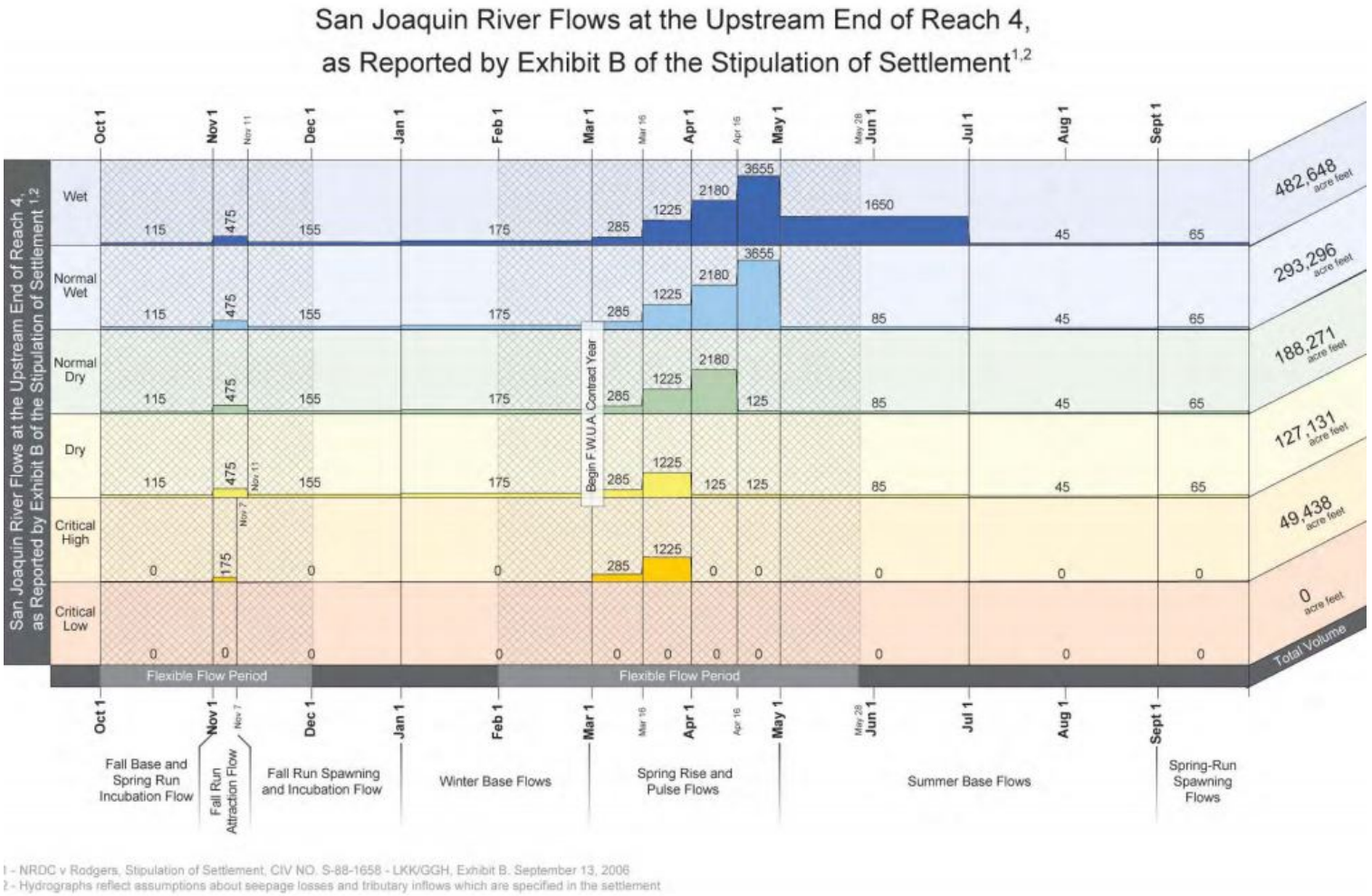
Hydrographs



1 - NRDC v Rodgers, Stipulation of Settlement, CIV NO. S-88-1658 - LKK/GGH, Exhibit B. September 13, 2006
2 - Hydrographs reflect assumptions about seepage losses and tributary inflows which are specified in the settlement

Katrina Harrison

SJRRP UPDATES

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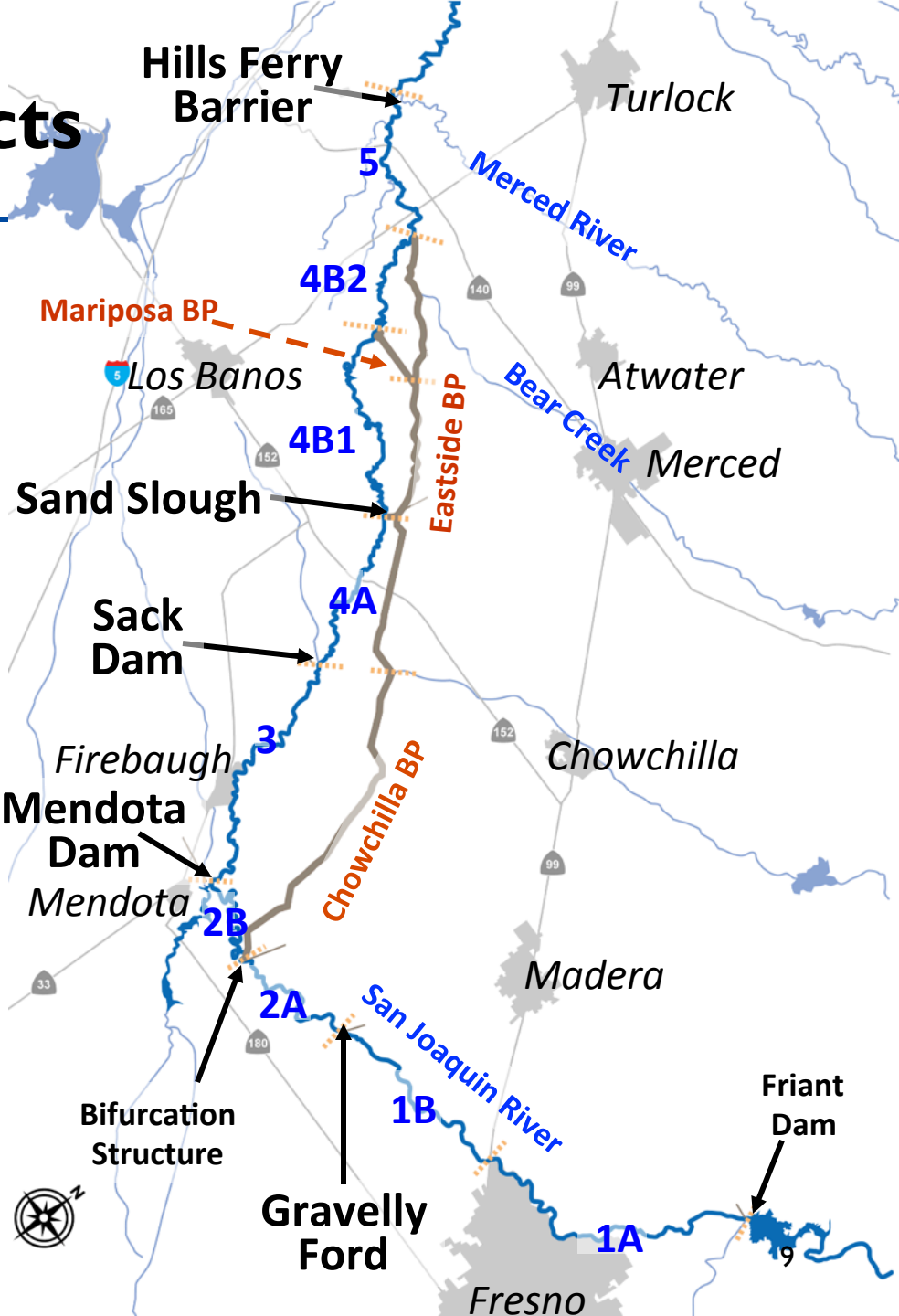
Fisheries Actions

- 54,000 spring-run Chinook salmon bred in the hatchery below Friant were released this spring
- Immature "jack" fish
- Spring-run are an endangered species
- 10j Rule protects landowners from ESA actions if conducting any lawful activity
- No fishing – unlawful activity

Phase I Projects

- Reach 2B
- Arroyo Canal / Sack Dam
- Reach 4B
- Mud and Salt Sloughs



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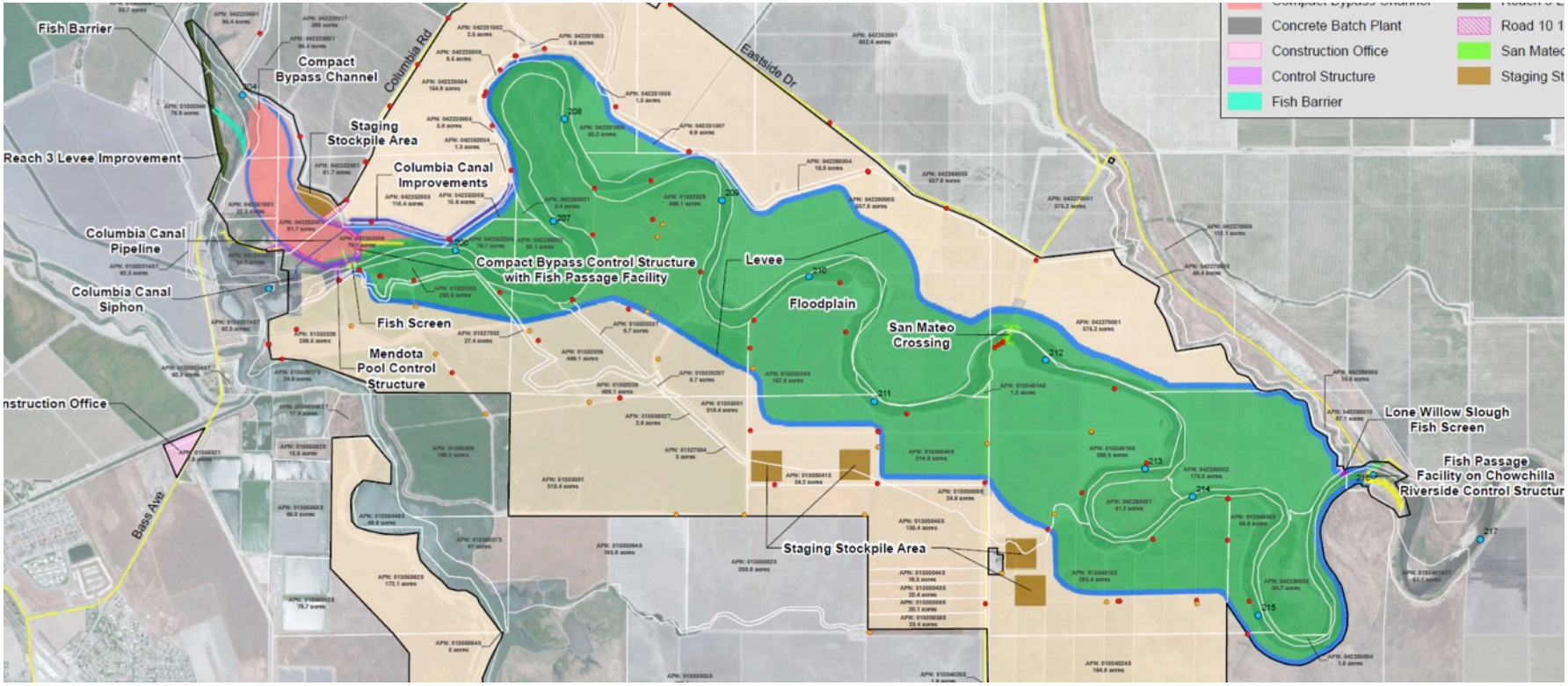
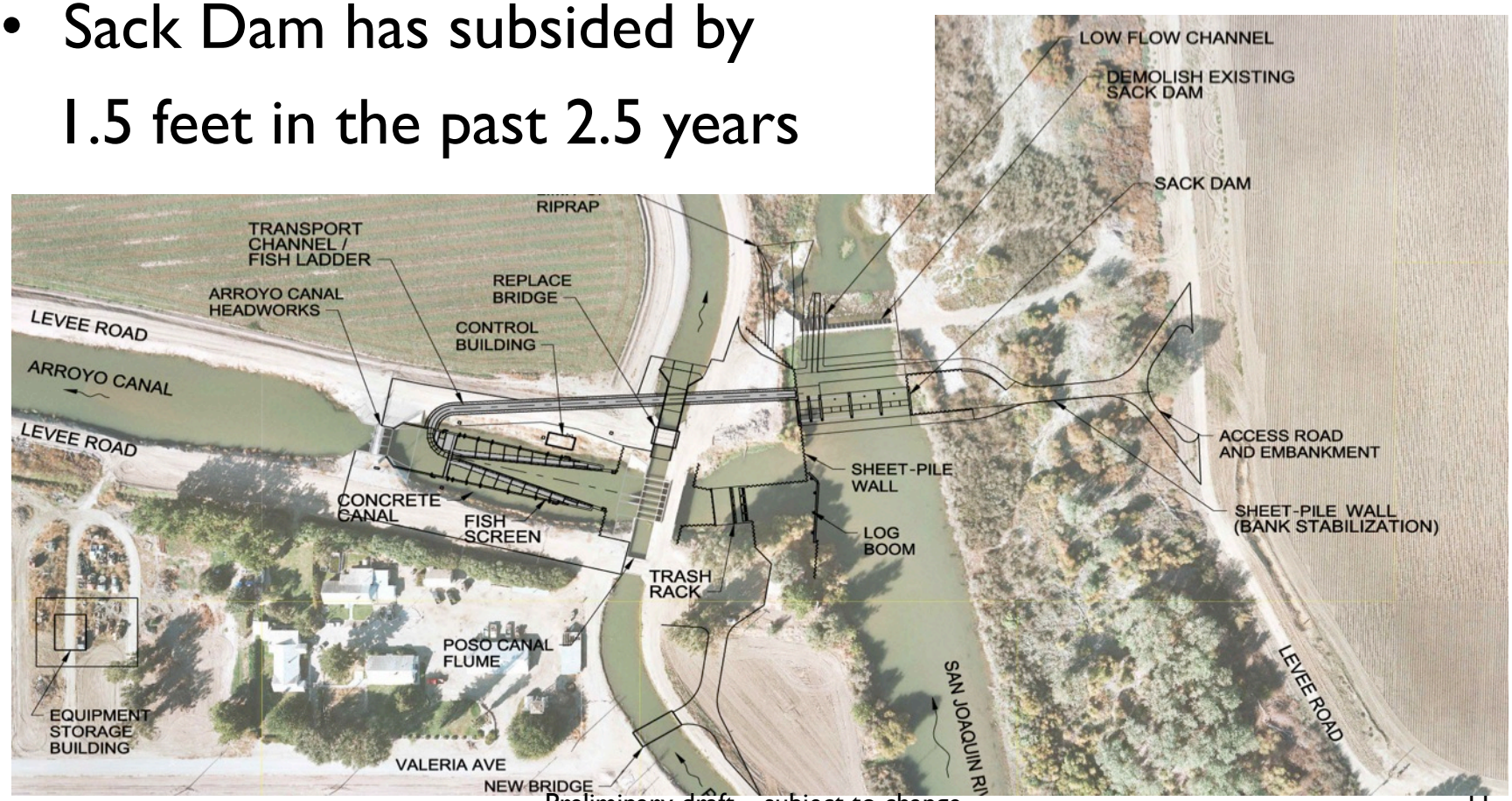
Reach 2B

- Public Draft EIS/R – March 2015
- Will contain a Preferred Alternative
- Construction in 2017



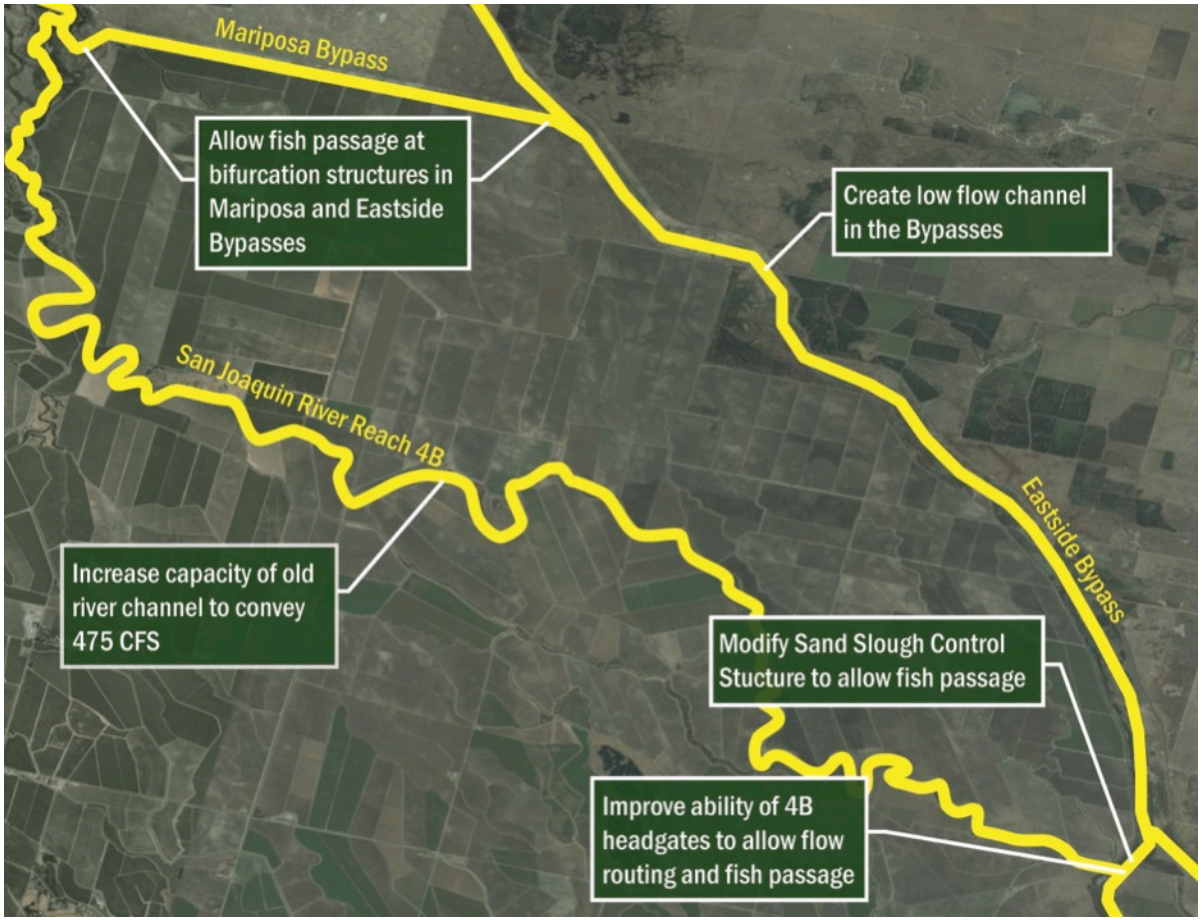
Arroyo Canal / Sack Dam

- Signed FONSI – September 4, 2013
- Financial Assistance ongoing
- Sack Dam has subsided by 1.5 feet in the past 2.5 years



Reach 4B

- Environmental Compliance contract back on
- Public Draft
- Construction



Mud and Salt Sloughs

- On hold pending assessment of need scheduled for 2020 / 2021
- " Modifications to enable the deployment of seasonal barriers to prevent adult anadromous fish from entering false migration pathways in the area of Salt and Mud Sloughs."

Brian Heywood

SEEPAGE PROJECT STATUS

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Seepage Project Approach

- Split potential areas of impact into seepage parcel groups
- Prioritize parcel groups based on most at-risk properties
- Initiate first tier of priority parcel groups

Flow	# Projects
300 cfs	3
700 cfs	1
1,300 cfs	6
2,000 cfs	11
4,500 cfs	70
Total	**91**

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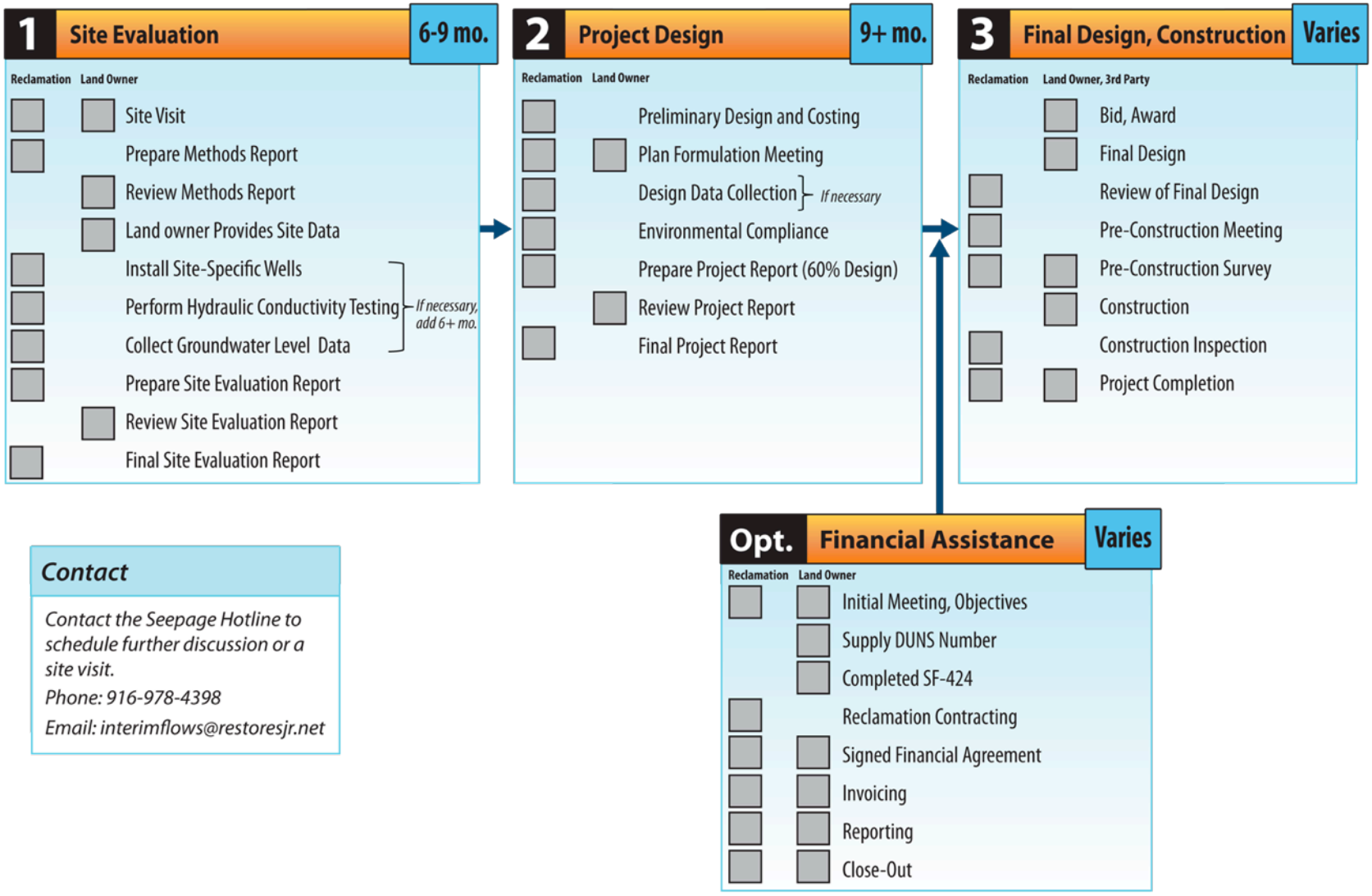
Seepage Project Process



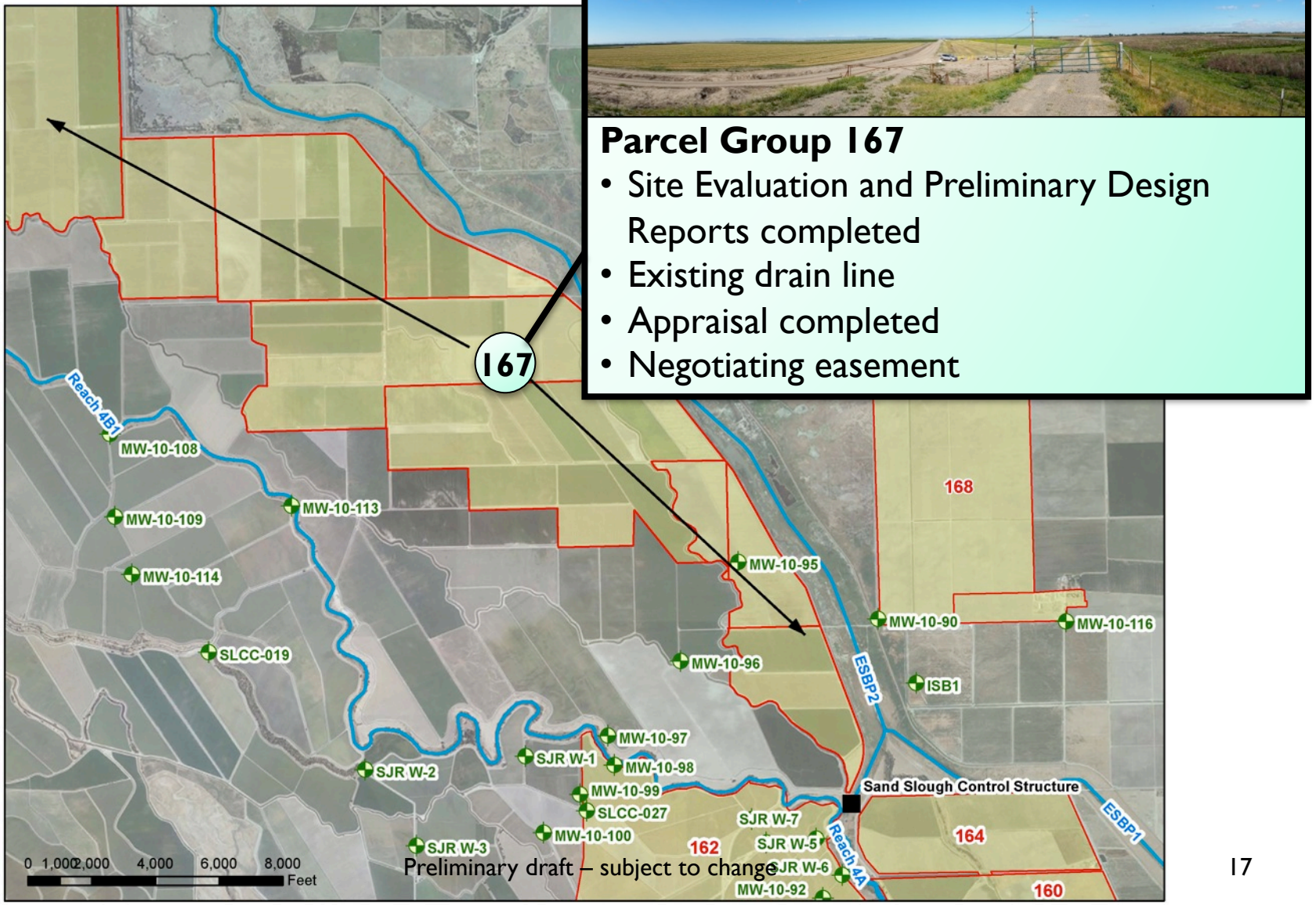
Contact

Contact the Seepage Hotline to schedule further discussion or a site visit.

Phone: 916-978-4398

Email: interimflows@restoresjr.net

Priority Parcel Groups and Projects Initiated



Monitoring for Site Evaluations

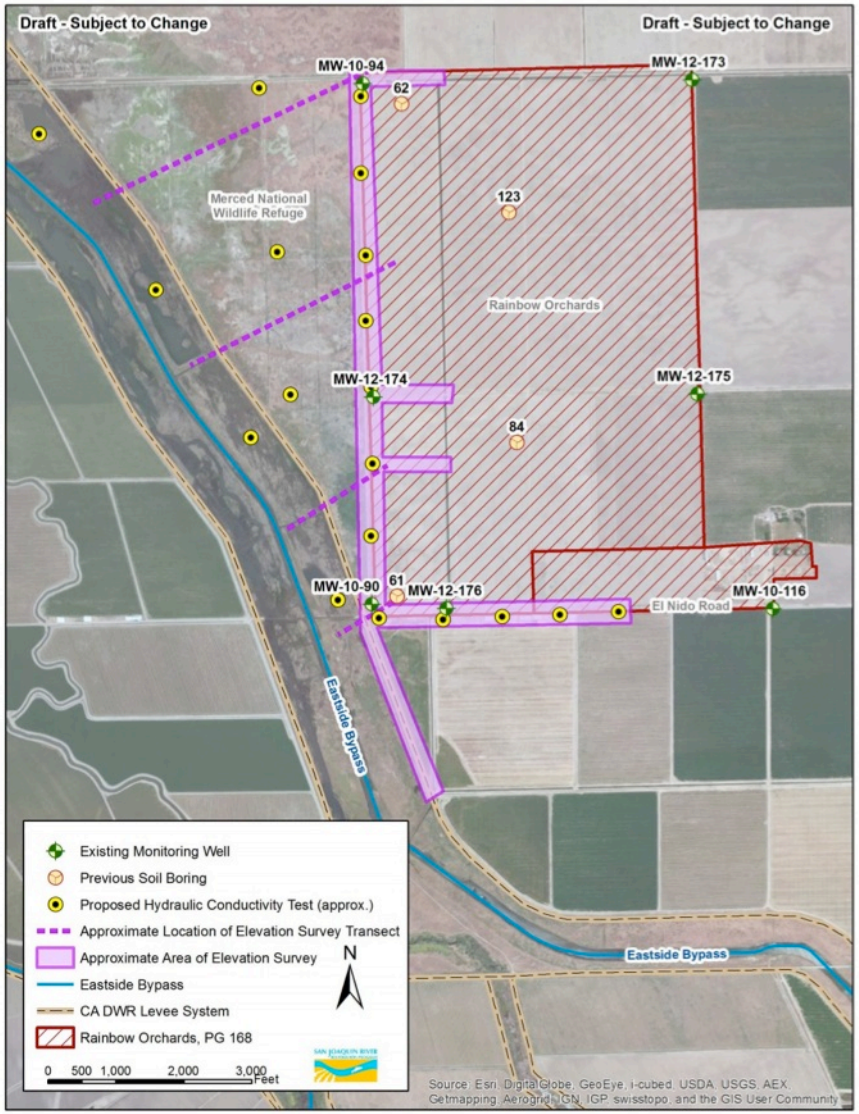
- Groundwater monitoring wells
- Soil salinity
- River flow/stage
- Aerial mapping
- Levee testing (DWR)
- Refuge operations
- Cropping patterns
- Refuge operations

Priority Parcel Groups and Projects Initiated

Parcel Group 168

- Site Evaluation and Preliminary Design Reports completed
- Appraisal Completed
- Working on 60% Design
- Hydraulic conductivity testing

Hydraulic Conductivity Testing



- 47 Hand augered holes
  - Multiple holes per site
    - Testing, Classification
  - 6 to 17.5 ft bgs
- Hyd. Conductivity Testing
  - 18 "pump-out" tests
  - 15 "pump-in tests

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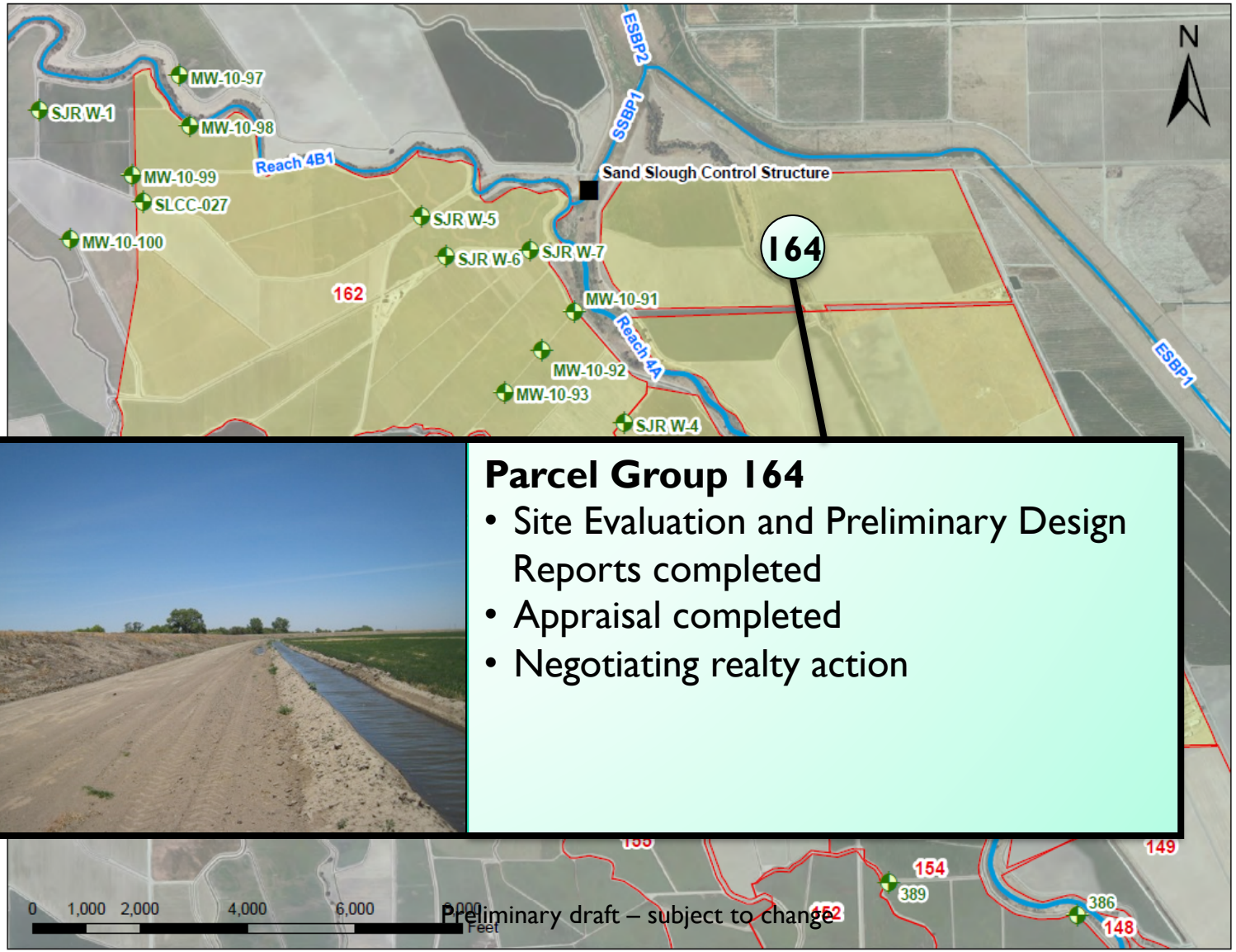
Hydraulic Conductivity Testing

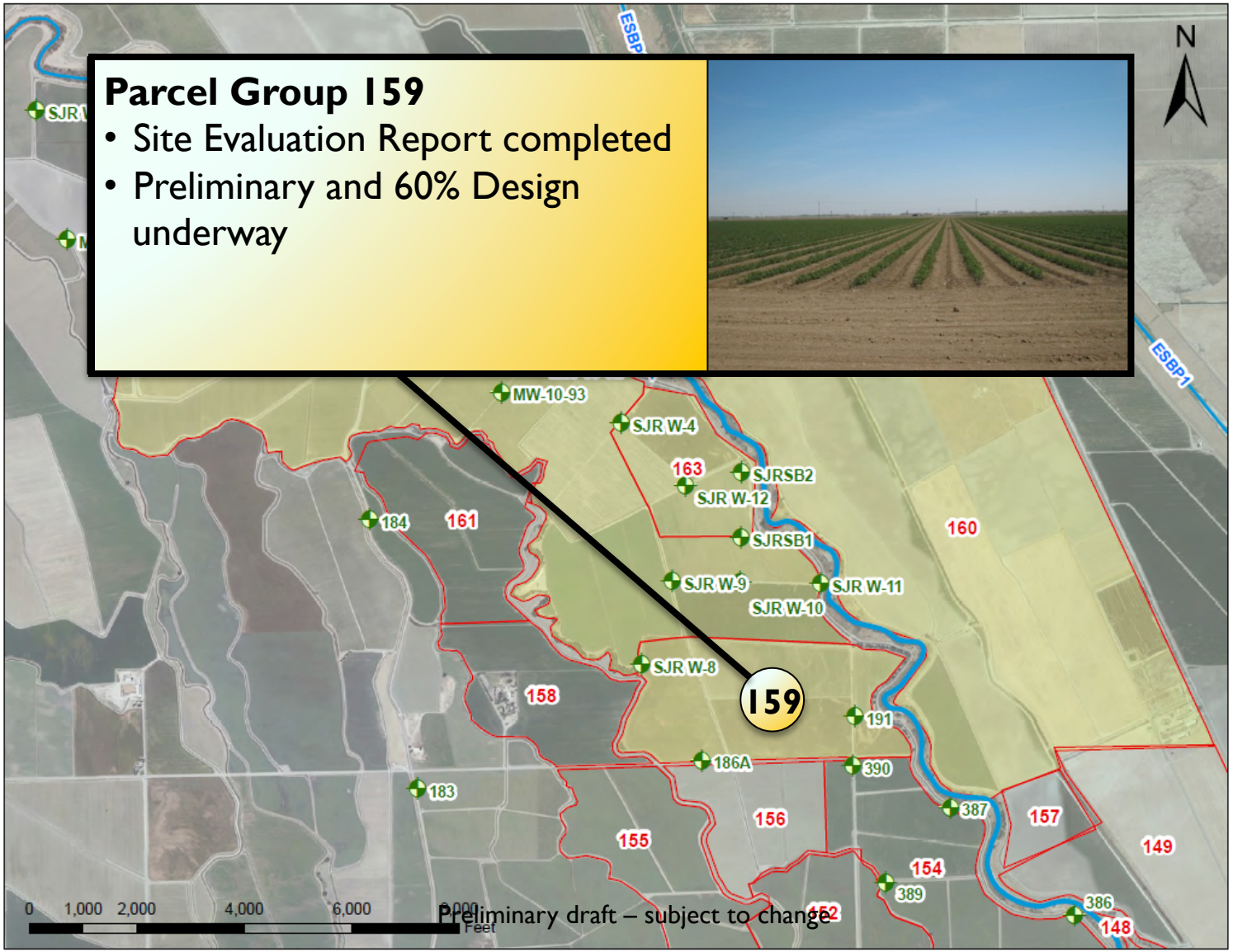
Priority Parcel Groups and Projects Initiated



Parcel Group 164

- Site Evaluation and Preliminary Design Reports completed
- Appraisal completed
- Negotiating realty action

Priority Parcel Groups and Projects Initiated

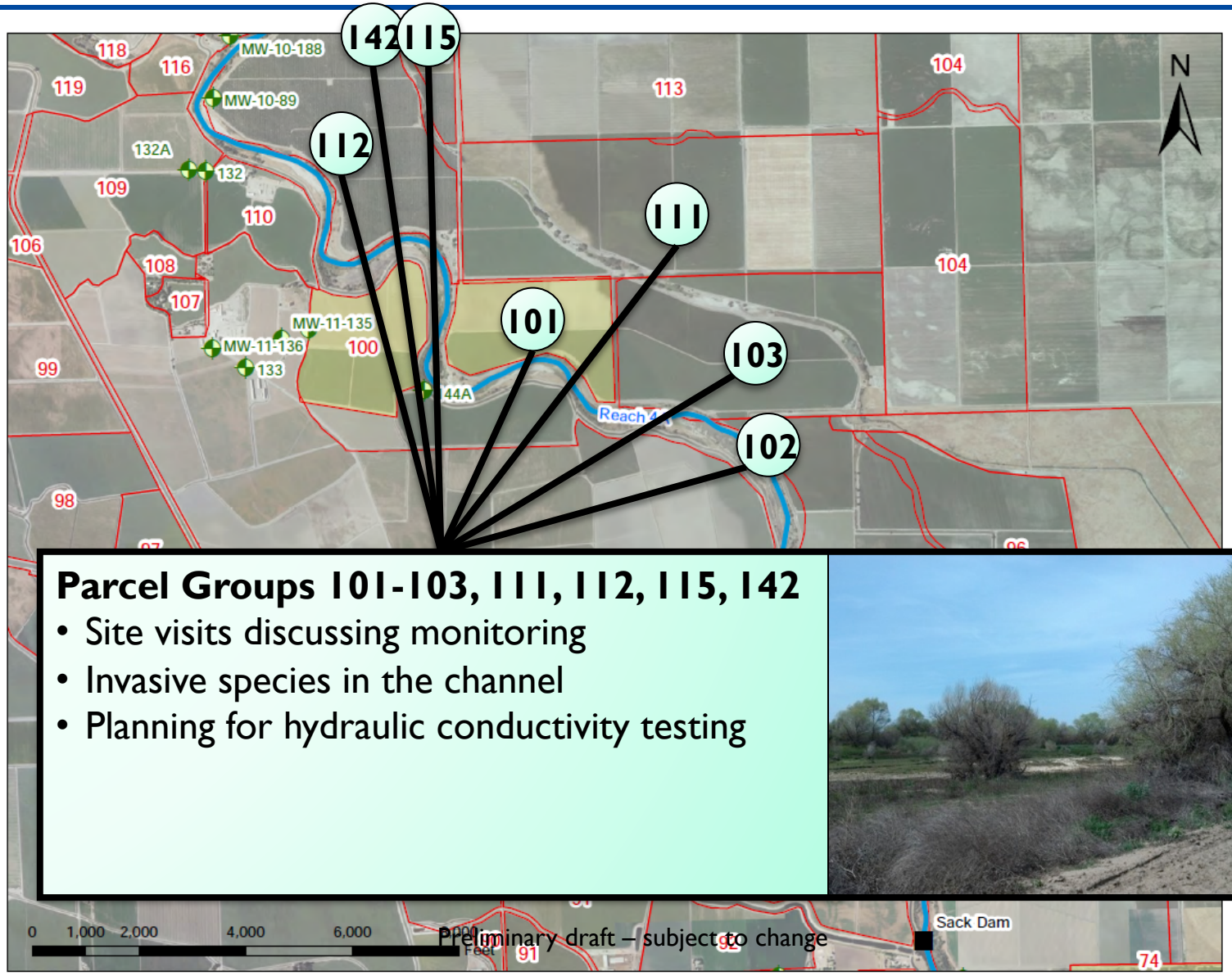


Priority Parcel Groups and Projects Initiated

Parcel Group 154

- Site Evaluation Report underway
- Planning for hydraulic conductivity testing
- Geophysics sand stringer investigation ongoing (but no water to flows to monitor)

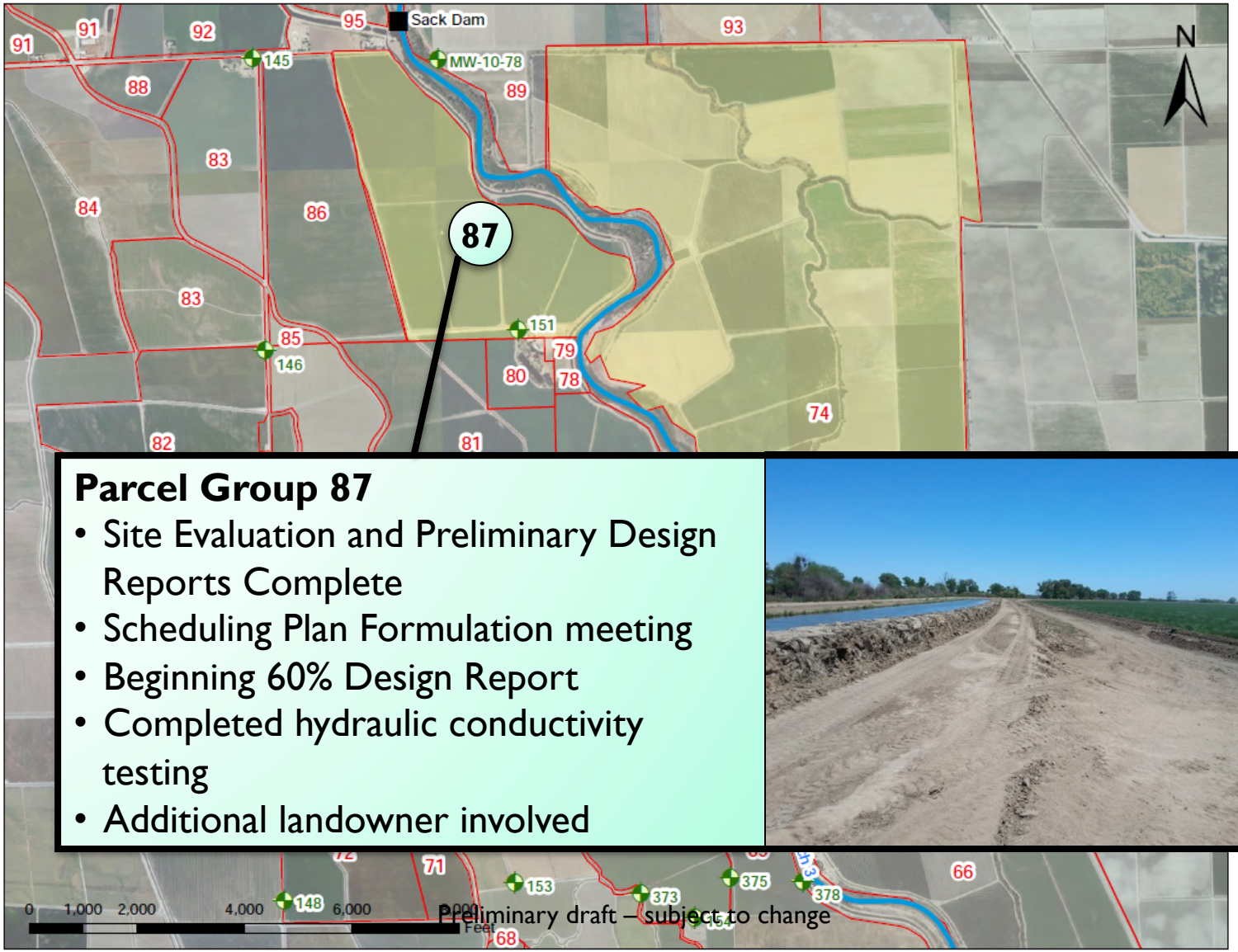
Priority Parcel Groups and Projects Initiated



Parcel Groups 101-103, 111, 112, 115, 142

- Site visits discussing monitoring
- Invasive species in the channel
- Planning for hydraulic conductivity testing

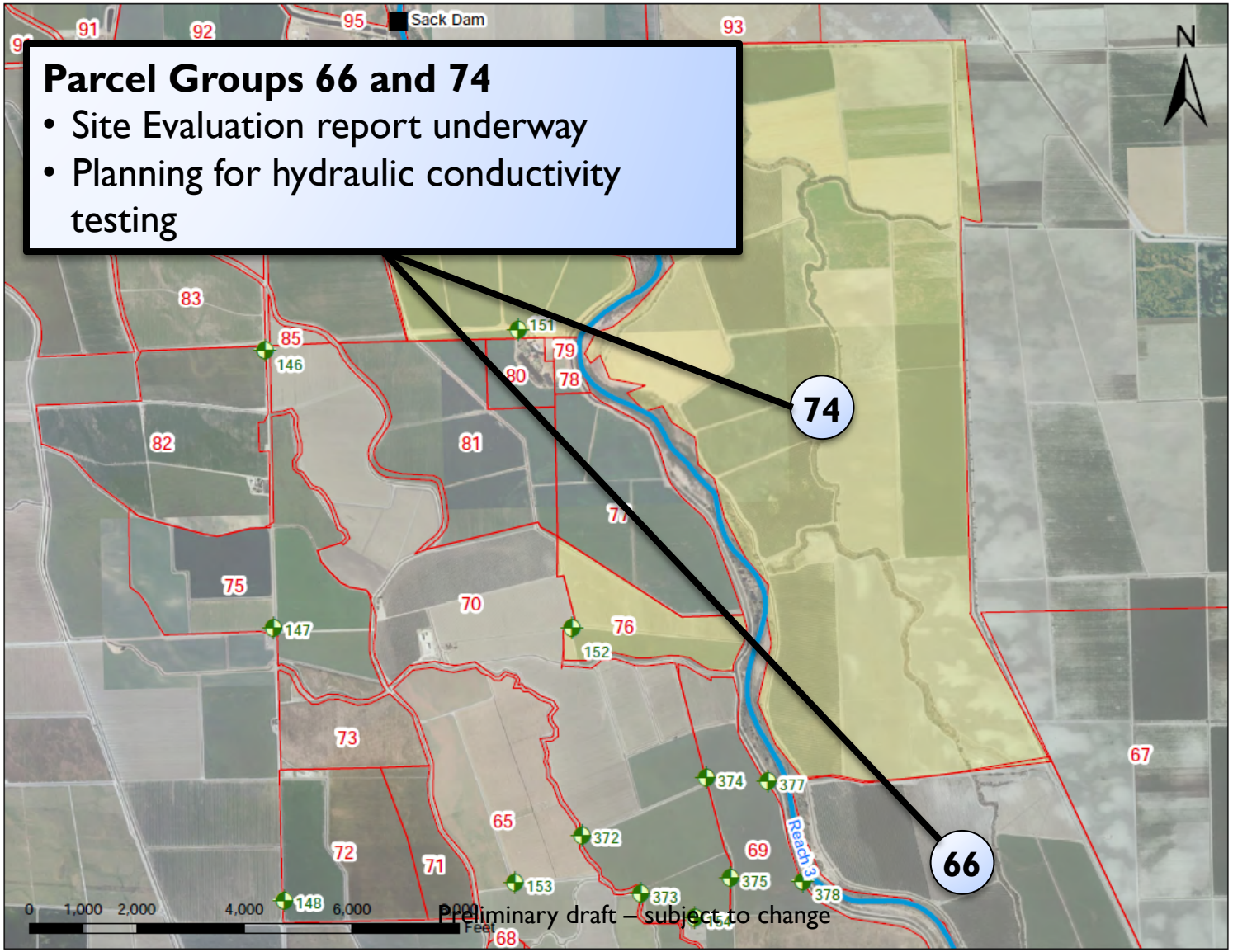
Priority Parcel Groups and Projects Initiated



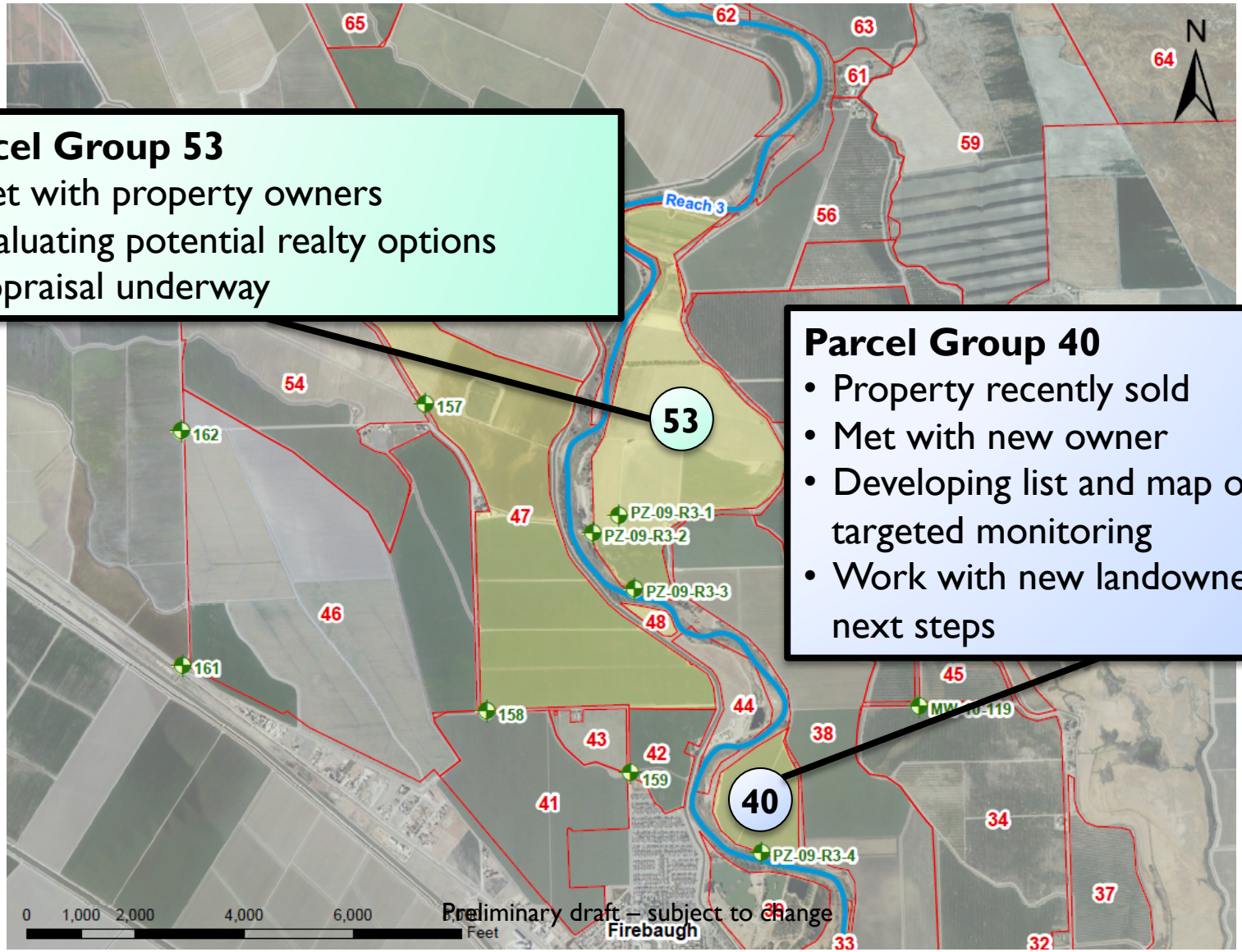
Parcel Group 87

- Site Evaluation and Preliminary Design Reports Complete
- Scheduling Plan Formulation meeting
- Beginning 60% Design Report
- Completed hydraulic conductivity testing
- Additional landowner involved

Priority Parcel Groups and Projects Initiated



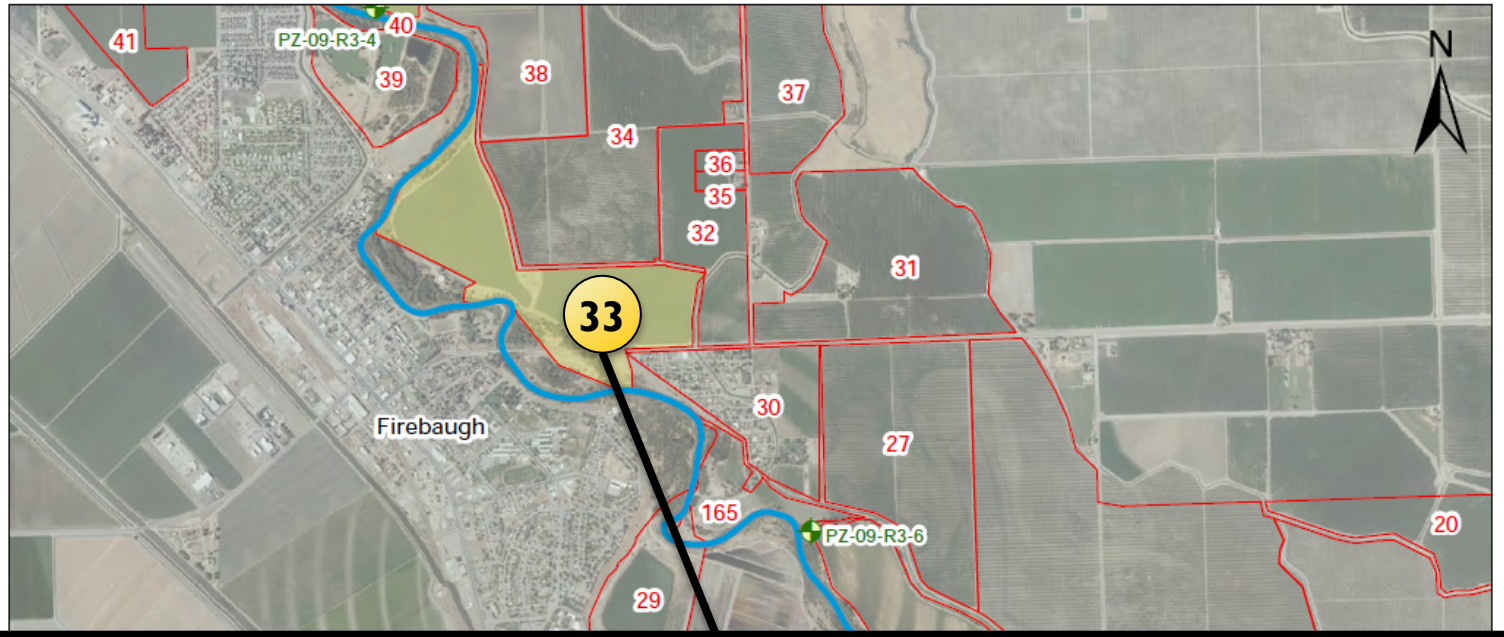
Priority Parcel Groups and Projects Initiated



Parcel Group 53
- Met with property owners
- Evaluating potential realty options
- Appraisal underway

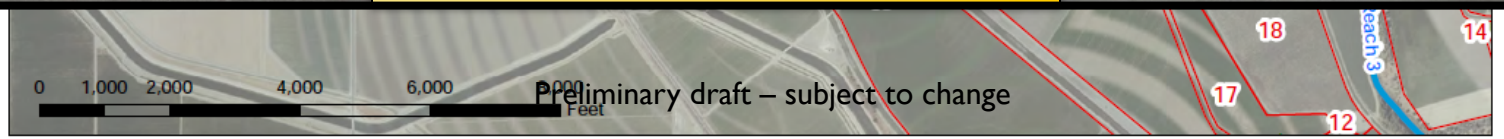
Parcel Group 40
- Property recently sold
- Met with new owner
- Developing list and map of targeted monitoring
- Work with new landowner on next steps

Priority Parcel Groups and Projects Initiated

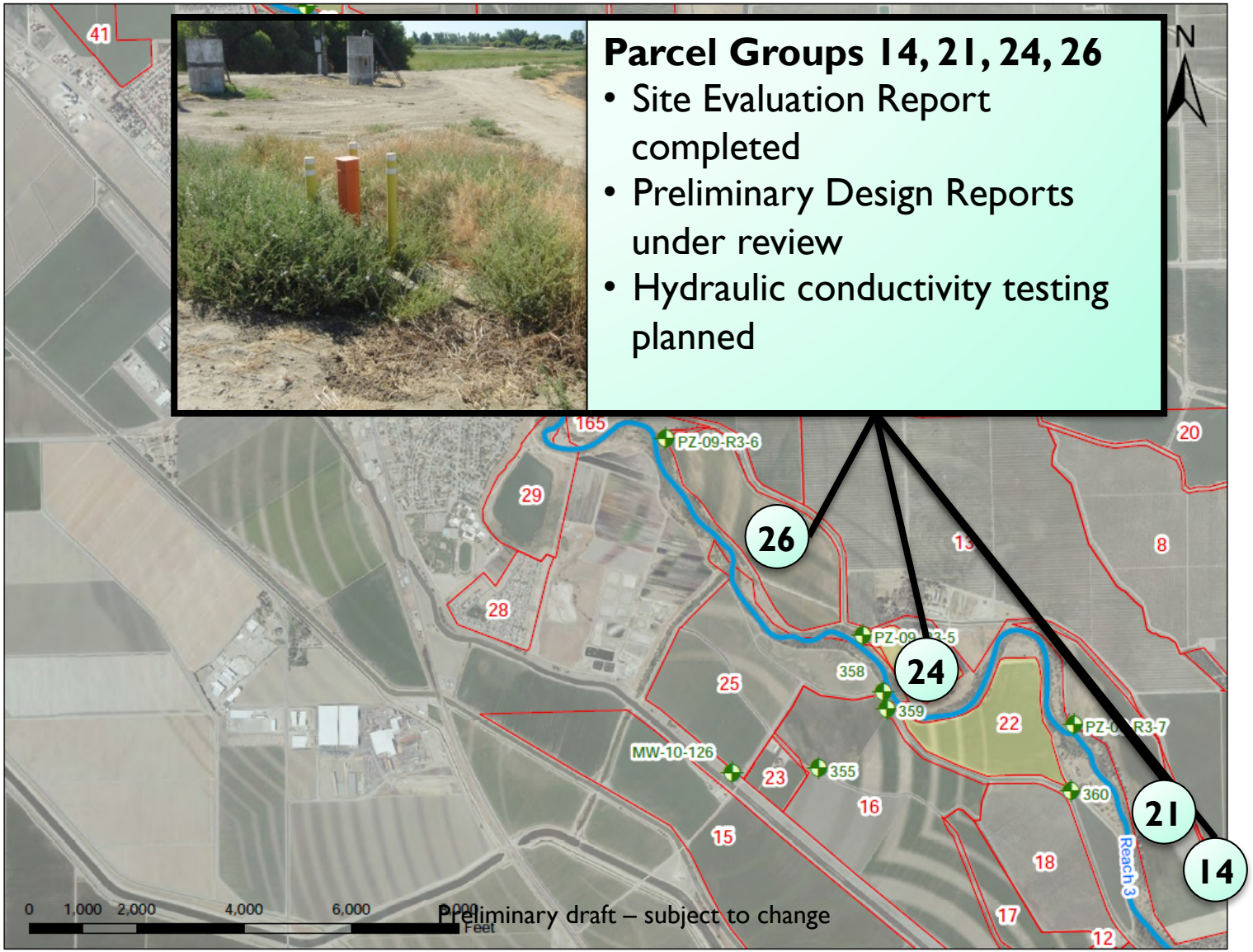


Parcel Group 33

- Wells installed November 2013
- Site Evaluation just underway



Priority Parcel Groups and Projects Initiated



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SAN JOAQUIN RIVER RESTORATION PROGRAM

Seepage Projects Summary

Flow	# Sites*	Site Visits Performed	Site Evaluations Begun / Completed	Preliminary Designs Begun / Completed	60 % Designs
>300 cfs	3	3	3 / 3	3 / 3	1 / 0
300 - 700 cfs	2	2	2 / 2	2 / 0	
700 - 1,300 cfs	6	5	2 / 1	2 / 2	1 / 0
1,300 - 2,000 cfs	11	5	1 / 1	1 / 1	
2,000 - 4,500 cfs	70	2	0 / 0	0 / 0	
Total	**92**	**17**	**8 / 7**	**8 / 6**	

*Based on initial parcel prioritization.

	Sites Completed	Sites in Planning Stage
Hyd. Cond. Testing for 60% Design	2	4

Eric Abrahamsen

SITE EVALUATIONS

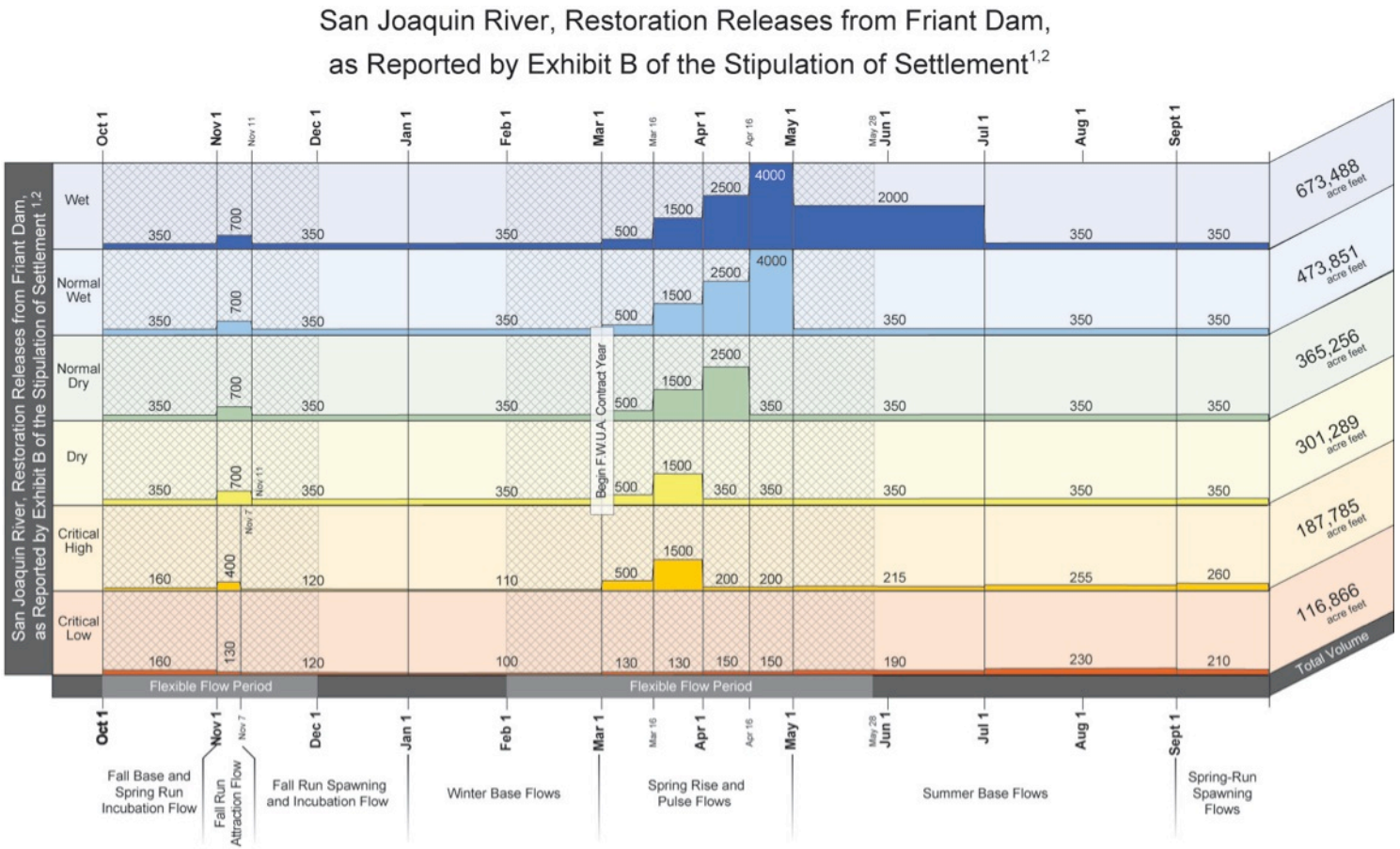
SAN JOAQUIN RIVER RESTORATION PROGRAM

Site Evaluations

- Purpose
  - Evaluate the property's susceptibility to seepage damage from Restoration flows in the SJR/ Bypasses
  - Provide direction on preferred seepage mitigation designs

Level of Protection

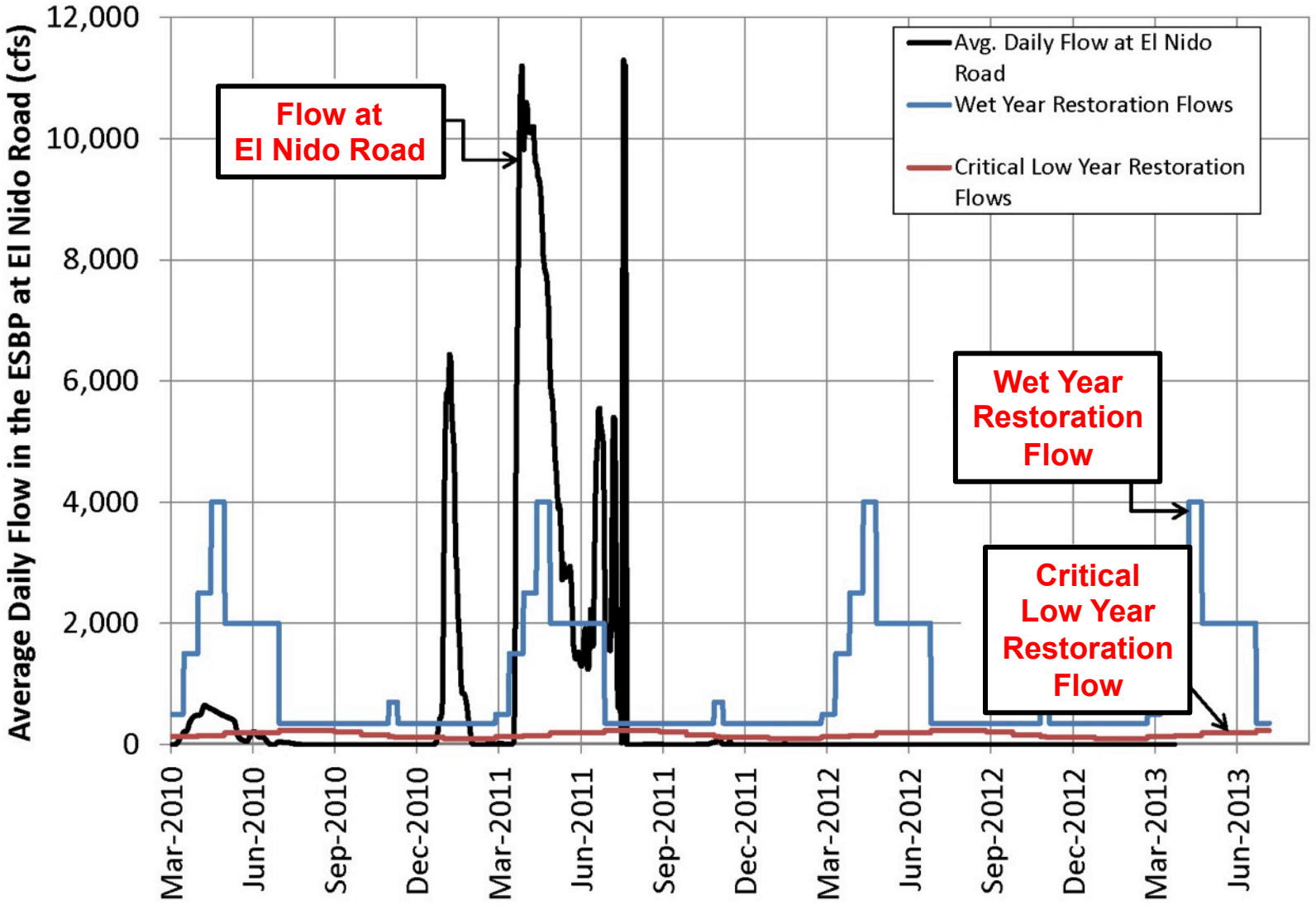
SJRRP Hydrograph



Level of Protection

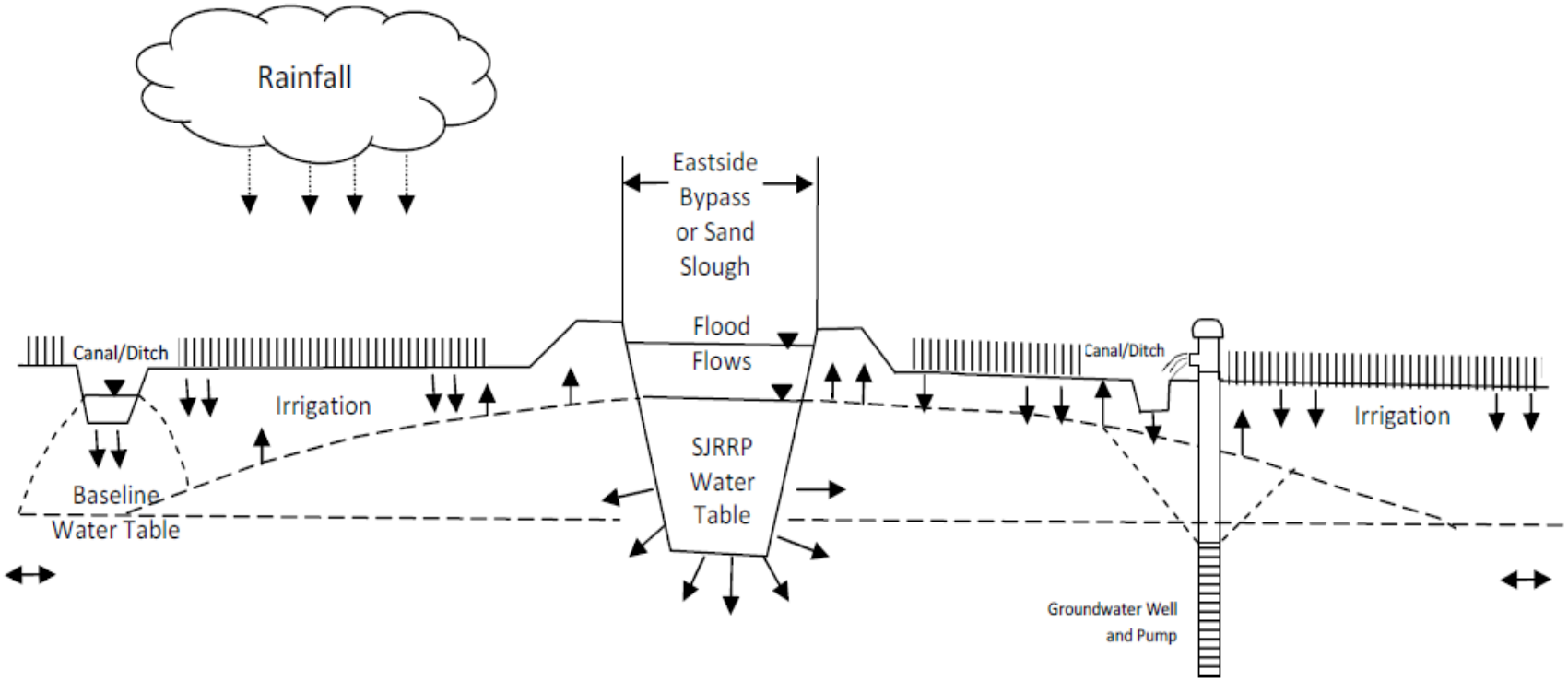
- 4,500 cfs design flow
  - Based on 4,500 cfs design capacity from the Settlement
  - Water surface elevation from the SJRRP HEC-RAS Model,
  - Protection intended for Restoration Flows, not Flood Flows
- Pre-existing shallow groundwater
  - Addressed during Site Evaluation
  - SJRRP designs are not intended to improve existing conditions

Wet Year Restoration Hydrograph vs. 2010/2011 Flood Flows



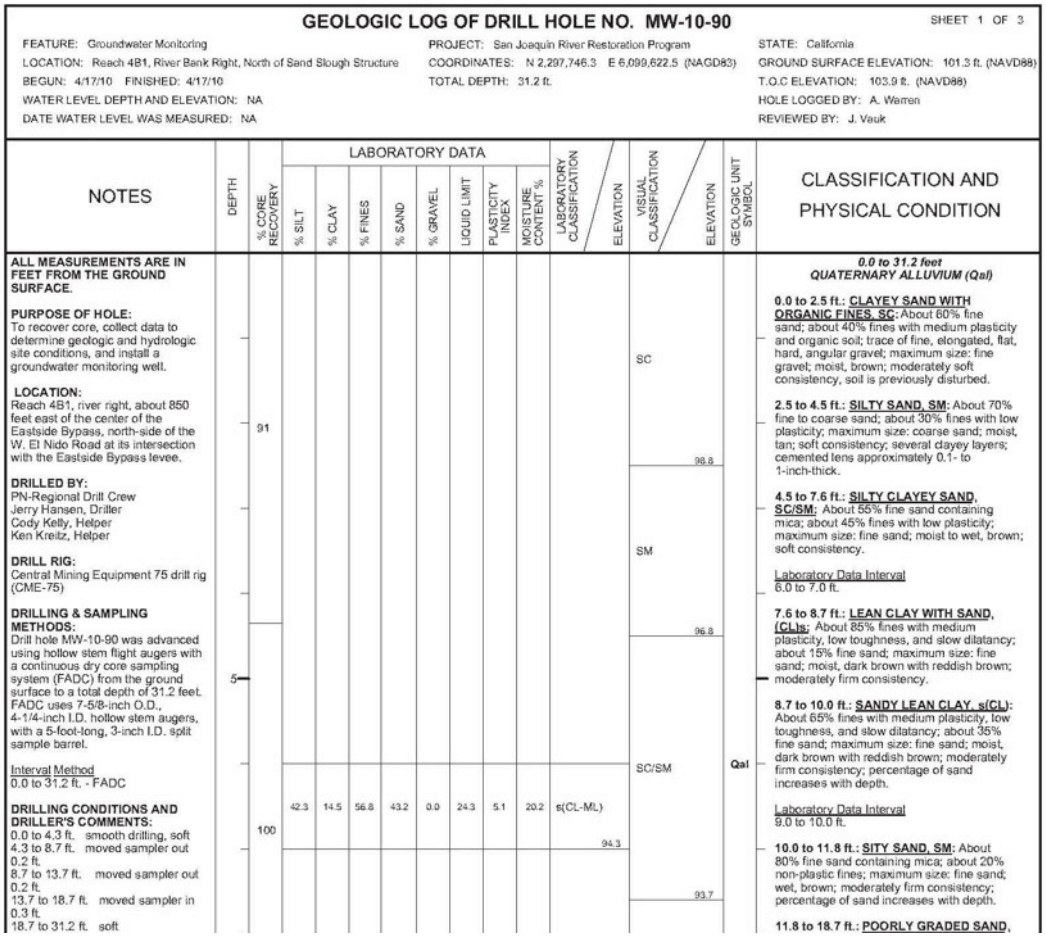
Site Evaluation Data Evaluated

Conceptual Model of Factors Influencing Groundwater Levels



Site Evaluations Data Evaluated

- Monitoring wells
  - Construction
  - Geologic logs
  - Groundwater quality
  - Groundwater levels
  - Depth to barrier
- Soil borings
  - Geologic logs
  - Hydraulic conductivity
  - Depth to barrier



GEOLOGIC LOG OF DRILL HOLE NO. MW-10-90 SHEET 1 OF 3

FEATURE: Groundwater Monitoring
LOCATION: Reach 4B1, River Bank Right, North of Sand Slough Structure
BEGUN: 4/17/10 FINISHED: 4/17/10
WATER LEVEL DEPTH AND ELEVATION: NA
DATE WATER LEVEL WAS MEASURED: NA
PROJECT: San Joaquin River Restoration Program
COORDINATES: N 2,297,746.3 E 6,099,622.5 (NAGD83)
TOTAL DEPTH: 31.2 ft.
STATE: California
GROUND SURFACE ELEVATION: 101.3 ft. (NAVD88)
T.O.C ELEVATION: 103.9 ft. (NAVD88)
HOLE LOGGED BY: A. Warren
REVIEWED BY: J. Vauk

NOTES	DEPTH	% CORE RECOVERY	LABORATORY DATA: % SILT	% CLAY	% FINES	% SAND	% GRAVEL	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	LABORATORY CLASSIFICATION	ELEVATION	VISUAL CLASSIFICATION	ELEVATION	GEOLOGIC UNIT SYMBOL	CLASSIFICATION AND PHYSICAL CONDITION
ALL MEASUREMENTS ARE IN FEET FROM THE GROUND SURFACE. **PURPOSE OF HOLE:** To recover core, collect data to determine geologic and hydrologic site conditions, and install a groundwater monitoring well. **LOCATION:** Reach 4B1, river right, about 850 feet east of the center of the Eastside Bypass, north-side of the W. El Nido Road at its intersection with the Eastside Bypass levee. **DRILLED BY:** PN-Regional Drill Crew Jerry Hansen, Driller Cody Kelly, Helper Ken Kreitz, Helper **DRILL RIG:** Central Mining Equipment 75 drill rig (CME-75) **DRILLING & SAMPLING METHODS:** Drill hole MW-10-90 was advanced using hollow stem flight augers with a continuous dry core sampling system (FADC) from the ground surface to a total depth of 31.2 feet. FADC uses 7-5/8-inch O.D., 4-1/4-inch I.D. hollow stem augers, with a 5-foot-long, 3-inch I.D. split sample barrel. Interval Method 0.0 to 31.2 ft. - FADC **DRILLING CONDITIONS AND DRILLER'S COMMENTS:** 0.0 to 4.3 ft. smooth drilling, soft 4.3 to 8.7 ft. moved sampler out 0.2 ft. 8.7 to 13.7 ft. moved sampler out 0.2 ft. 13.7 to 18.7 ft. moved sampler in 0.3 ft. 18.7 to 31.2 ft. soft															***0.0 to 31.2 feet*** ***QUATERNARY ALLUVIUM (Qal)*** **0.0 to 2.5 ft.: CLAYEY SAND WITH ORGANIC FINES, SC:** About 60% fine sand; about 40% fines with medium plasticity and organic soil; trace of fine, elongated, flat, hard, angular gravel; maximum size: fine gravel; moist, brown; moderately soft consistency, soil is previously disturbed. **2.5 to 4.5 ft.: SILTY SAND, SM:** About 70% fine to coarse sand; about 30% fines with low plasticity; maximum size: coarse sand; moist, tan; soft consistency; several clayey layers; cemented lens approximately 0.1- to 1-inch-thick. **4.5 to 7.6 ft.: SILTY CLAYEY SAND, SC/SM:** About 55% fine sand containing mica; about 45% fines with low plasticity; maximum size: fine sand; moist to wet, brown; soft consistency. Laboratory Data Interval 6.0 to 7.0 ft. **7.6 to 8.7 ft.: LEAN CLAY WITH SAND, (CL)s:** About 85% fines with medium plasticity, low toughness, and slow dilatancy; about 15% fine sand; maximum size: fine sand; moist, dark brown with reddish brown; moderately firm consistency. **8.7 to 10.0 ft.: SANDY LEAN CLAY, s(CL):** About 65% fines with medium plasticity, low toughness, and slow dilatancy; about 35% fine sand; maximum size: fine sand; moist, dark brown with reddish brown; moderately firm consistency; percentage of sand increases with depth. Laboratory Data Interval 9.0 to 10.0 ft. **10.0 to 11.8 ft.: SITY SAND, SM:** About 80% fine sand containing mica; about 20% non-plastic fines; maximum size: fine sand; wet, brown; moderately firm consistency; percentage of sand increases with depth. **11.8 to 18.7 ft.: POORLY GRADED SAND,**
		91											SC	98.8		
													SM	96.8		
	5												SC/SM	93.7	Qal	
		100	42.3	14.5	56.8	43.2	0.0	24.3	5.1	20.2	s(CL-ML)	94.3				

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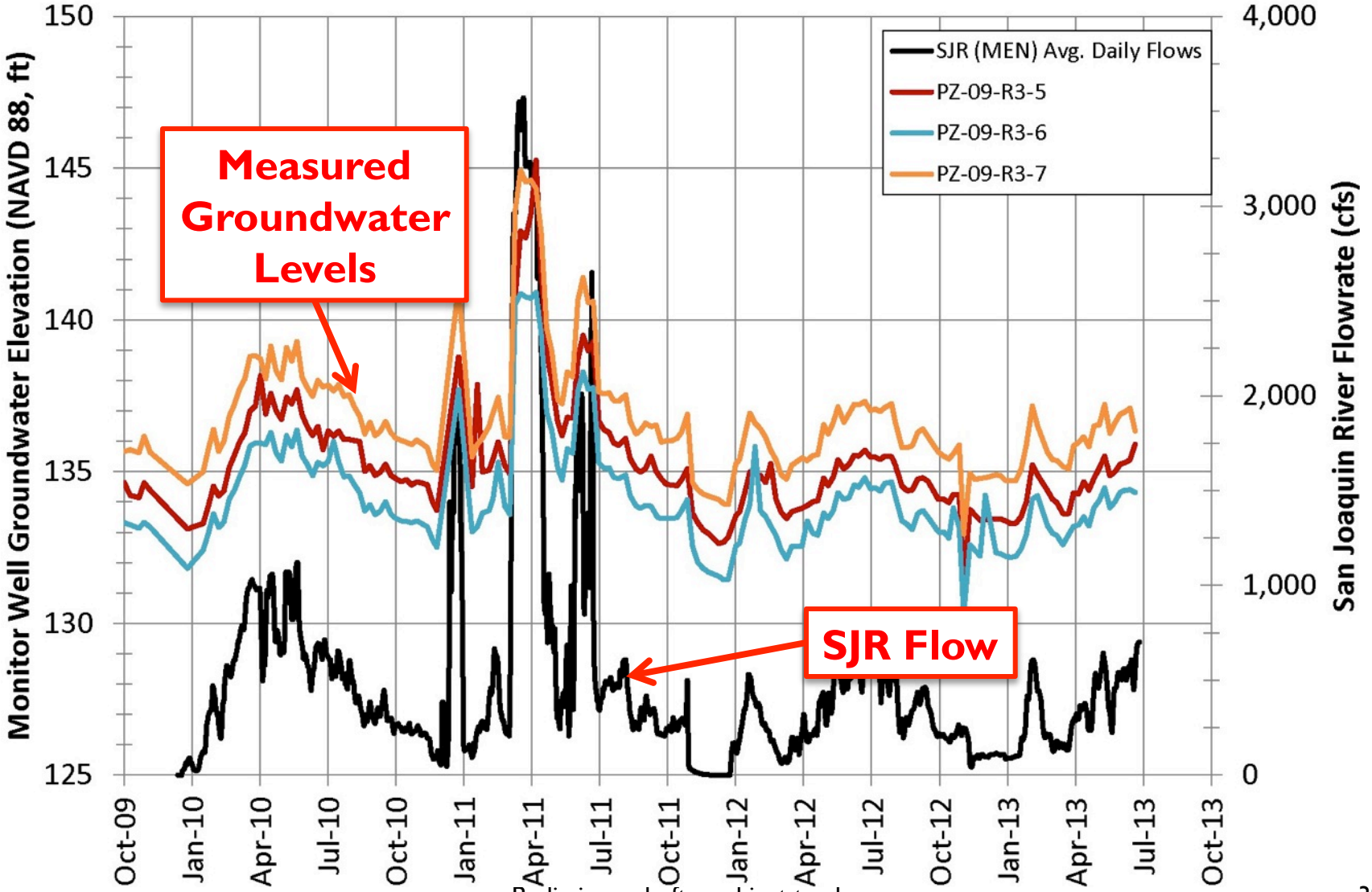
Site Evaluations Data Evaluated



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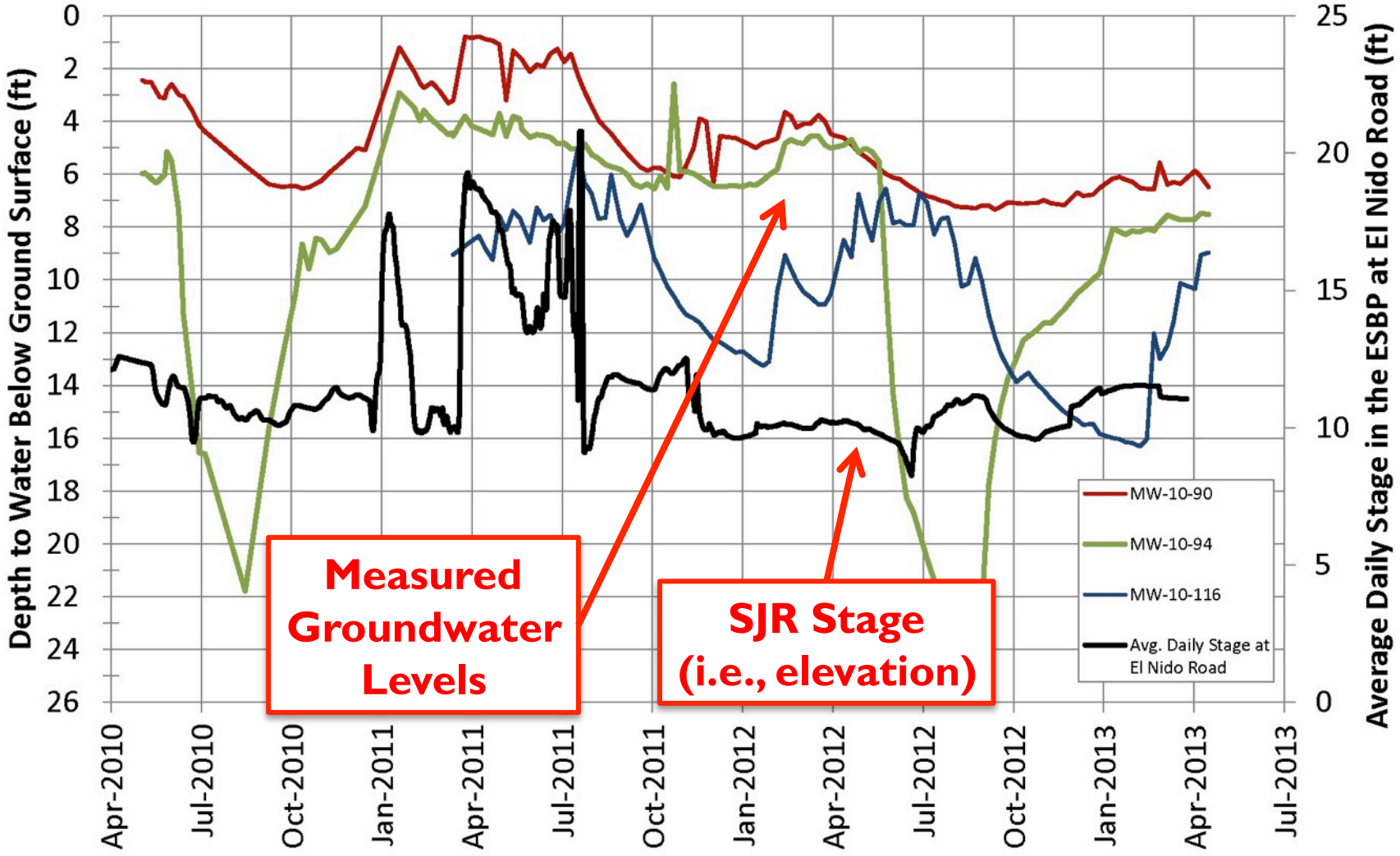
Site Evaluations Data Evaluated

Example Hydrograph from Monitoring Well Data



Site Evaluations Data Evaluated Cont.

- Climate
- Irrigation practices
- Soils and salinity
- DWR (NULE) levee assessments
  - Geomorphic assessment
  - Geotechnical assessment
  - Cone penetration testing (CPT)
- Topography
  - LiDAR
- Subsidence
- Historic Observations
  - Past locations on the SJR (historic maps)
  - Past impacts due to flooding events (landowner reported, 2011 observations)
  - Paleo-channel mapping
  - Groundwater Model
- HEC-RAS hydraulic model
  - Determination of water surface elevations in relation to nearby ground

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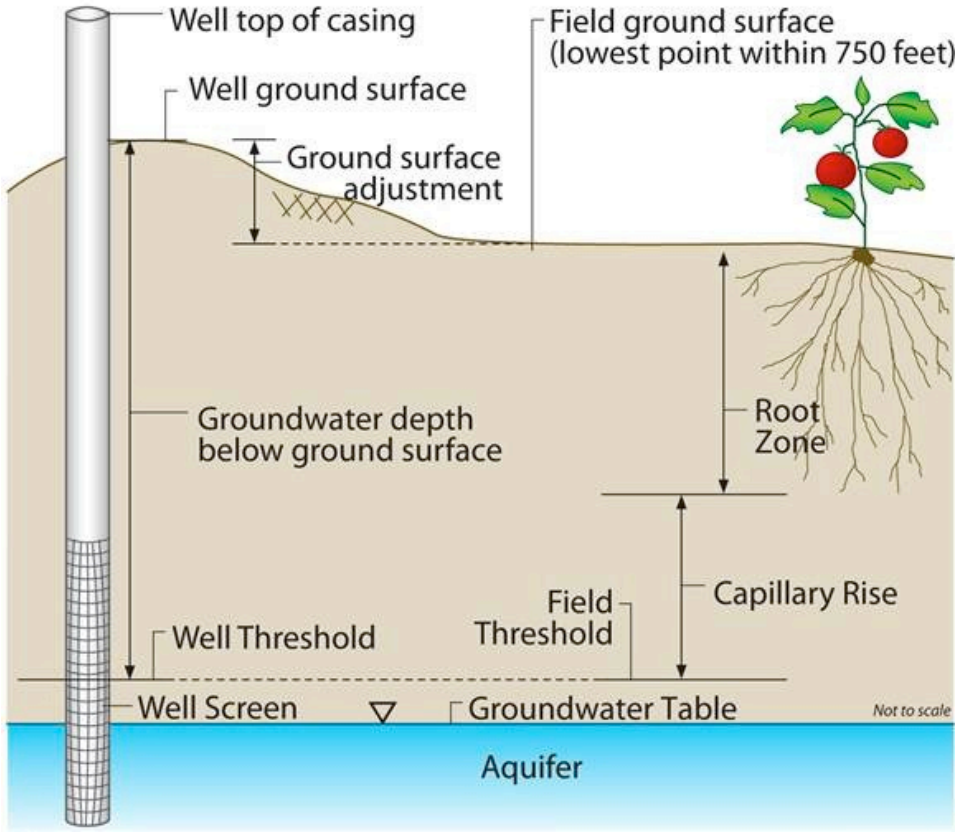
Seepage Threshold

- Shallower of two methods
  - Agricultural method
    - Effective root zone
    - Capillary fringe
  - Historical groundwater method



SAN JOAQUIN RIVER RESTORATION PROGRAM

Data Evaluation

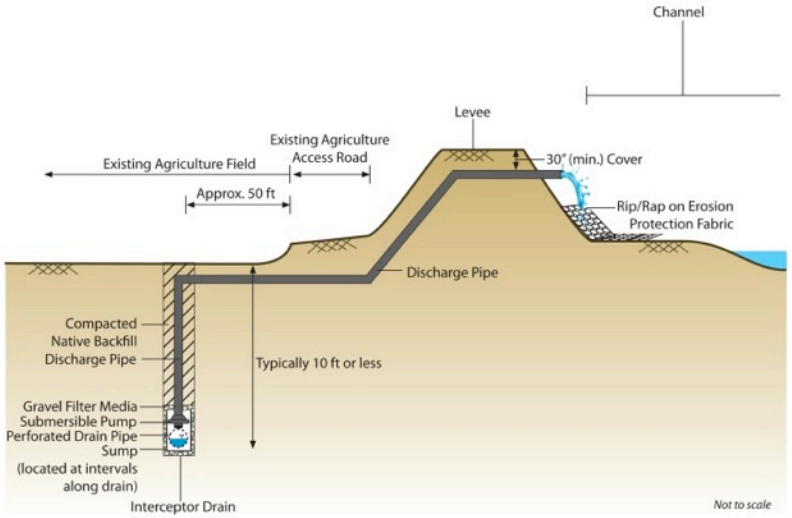
- Does the data indicate a possible seepage impact influenced by SJRRP Restoration Flows?
- Which seepage projects are feasible based upon the data?
- Which alternatives will be effective in mitigating the impacts from SJRRP Restoration Flows?
- Develop initial screening of seepage project alternatives
- Present findings to the landowner

Mike Day

PRELIMINARY DESIGNS AND ESTIMATES

Seepage Project Alternatives

- Physical
  - Slurry walls; sheet piles
  - Seepage plug
  - Drainage ditch
  - Interceptor lines
  - Shallow groundwater pumps
  - Buildup of low lying areas
  - Channel conveyance improvements
- Non-Physical
  - Seepage easements



SAN JOAQUIN RIVER RESTORATION PROGRAM

Project Alternative Screening

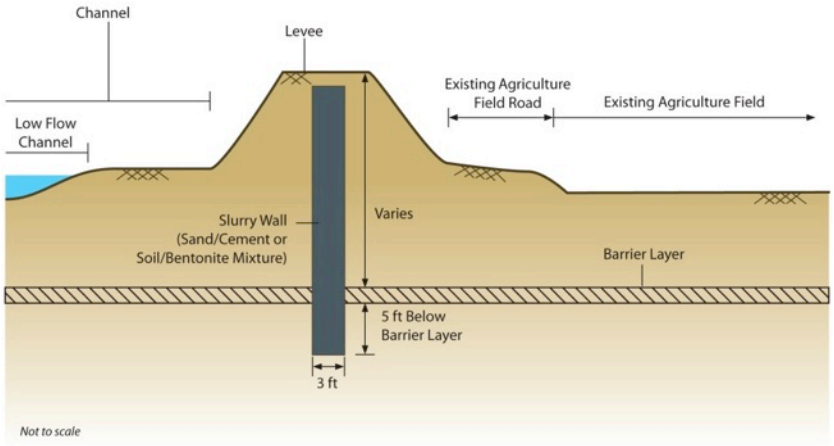
- Alternatives reviewed, but typically not selected
  - Sheet piles
    - Expensive compared to slurry walls
  - Seepage plug
    - Needs site dewatering, expensive
  - Buildup of low lying areas
    - Need proper borrow material, ag soil suitability, expensive
  - Shallow groundwater pumps
    - Expensive
  - Drainage Ditch
    - Levee safety criteria places ditch away from toe and into farmed field

Project Alternative Screening

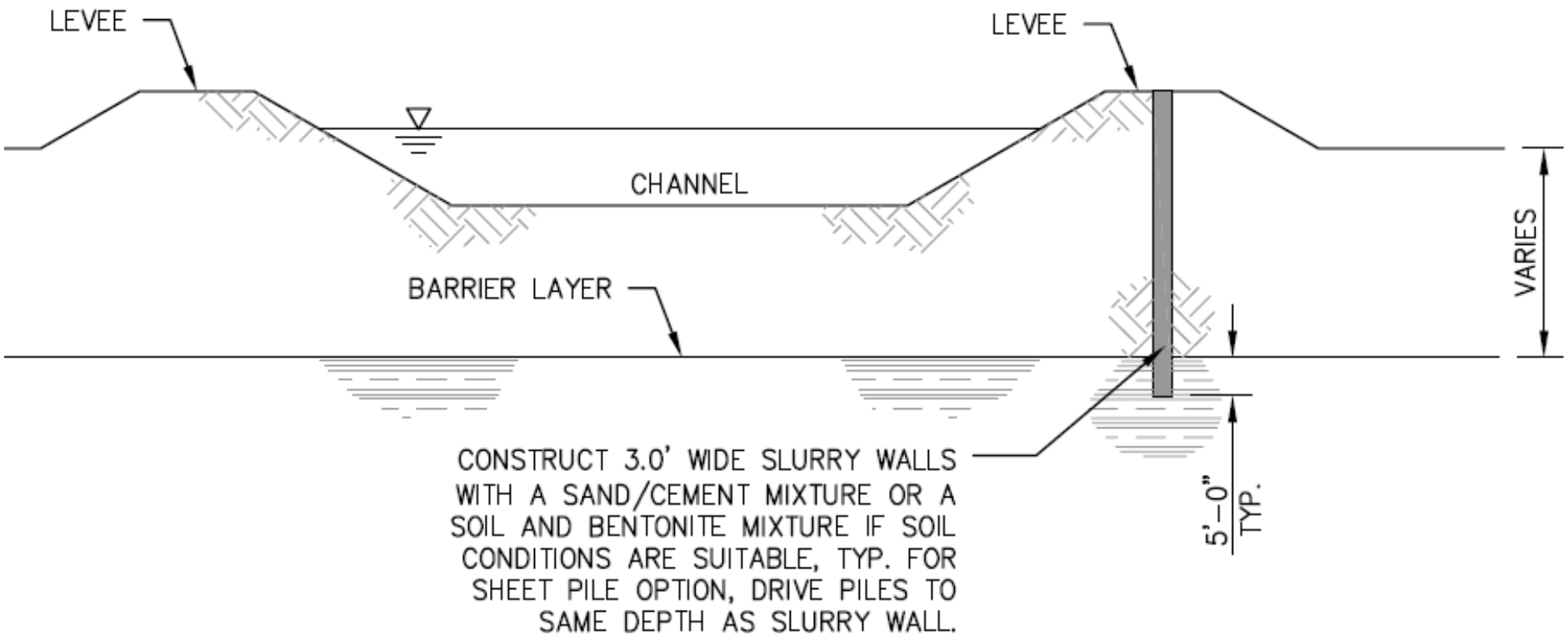
- Alternatives typically not screened out
  - Slurry walls
  - Interceptor lines
  - Pumping of existing wells to supplement other options
  - Seepage easements

Slurry Wall Preliminary Design

- Located in the center of the existing levee embankments
- Depth to barrier determined by utilizing geologic information from geologic logs
- Extend from the top surface of the embankment to depths 5 feet into the barrier
- 3 feet in width
- Soil-bentonite slurry, sand-cement could be used if needed/required



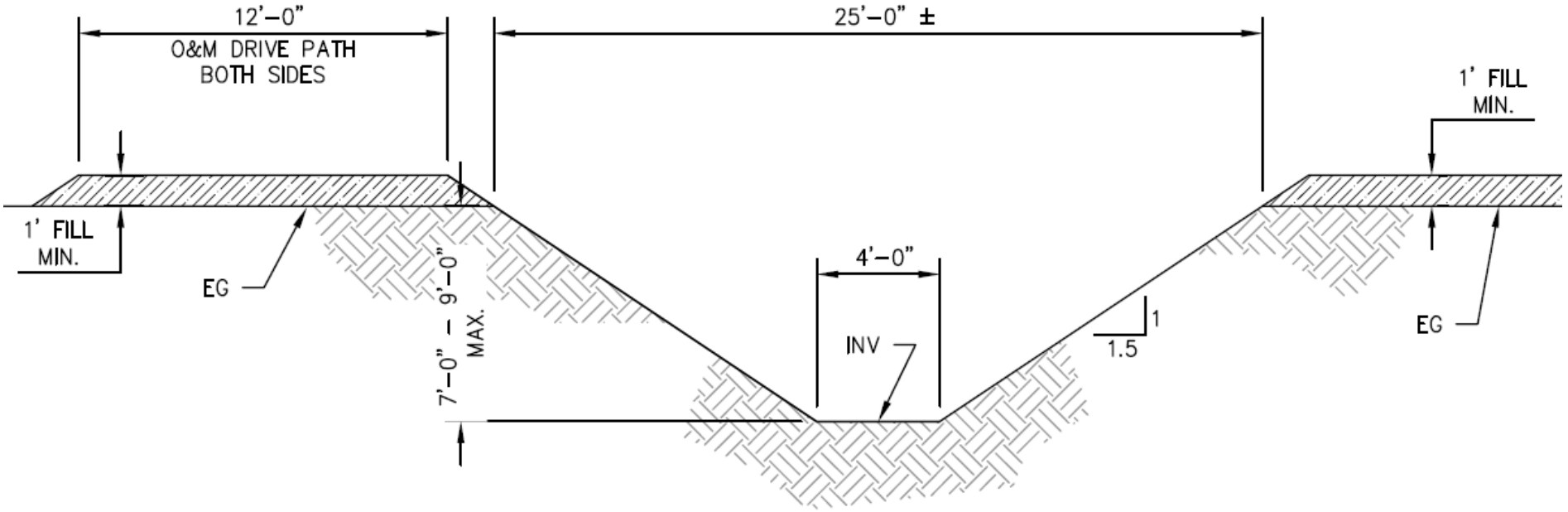
Slurry Wall – Typical Detail



Drainage Ditch Preliminary Design

- Trapezoidal shaped ditch with 4-foot bottom width and 1.5:1 side slopes
- Invert depths of at least one foot below the seepage threshold
- Ditch sized for same flows as the interceptor line
- Discharges to local canals or ESBP/SJR/Sand Slough
- DWR Urban Levee Design Criteria followed for set-backs from the toe of the levees
  - 20-foot drive path, 50-foot set back from edge of field
  - Ditch invert above an additional 10:1 sloped surface past the 70 feet

Drainage Ditch – Typical Detail



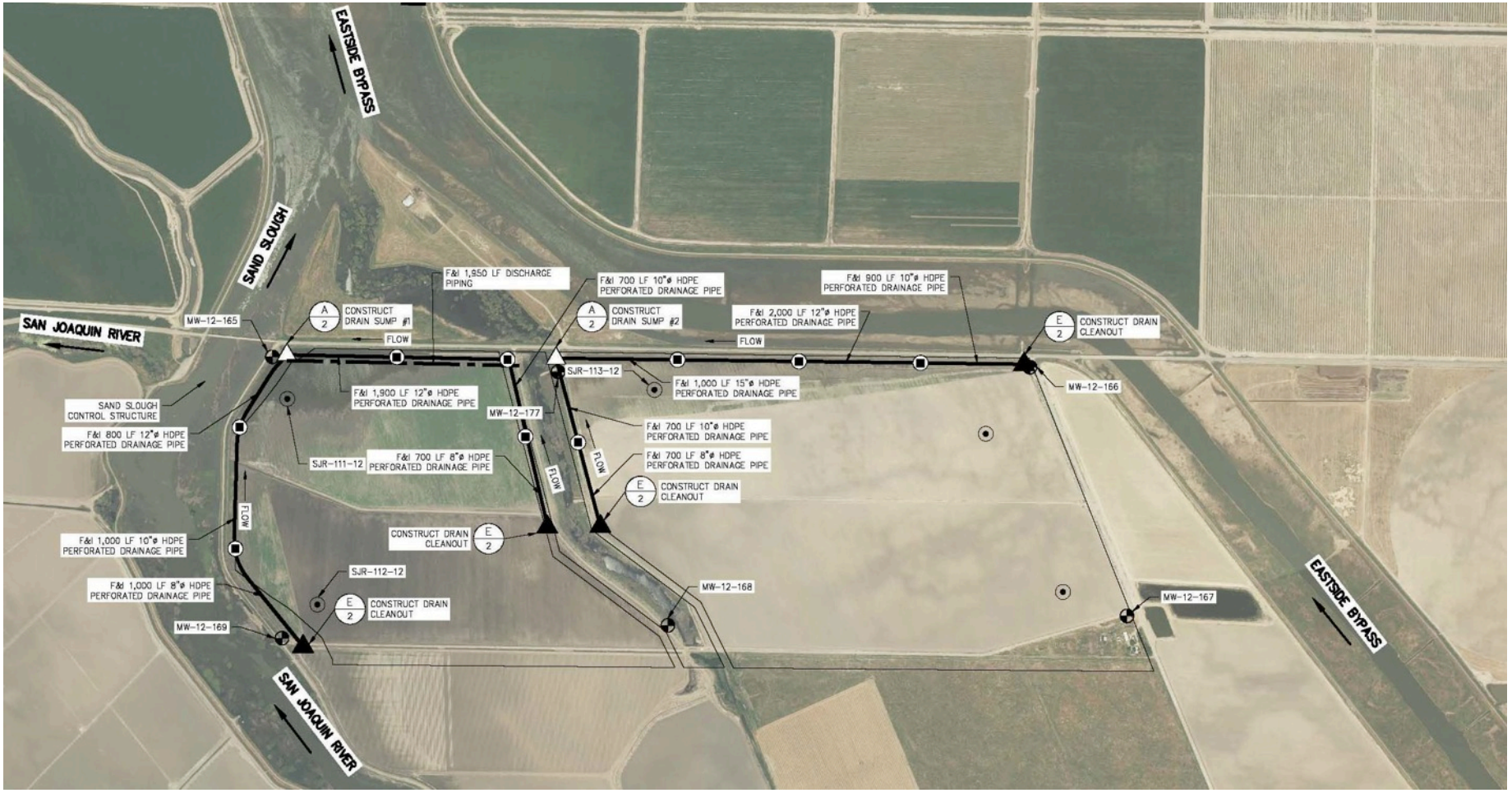
Interceptor Line Preliminary Design

- USBR Drainage Manual methodology followed
- Channel water surface elevation from SJRRP HEC-RAS model
- Pipe invert depths of at least one foot below the seepage threshold (typically of 6 to 9.5 feet)
- HDPE single wall drainage pipe, diameters of 8-, 10-, 12-, and 15-inches
- Minimum pipe slope of 1 foot per 1,000 feet, except in special site conditions
- Well graded engineered sand and gravel filter, minimum 4-inches thick placed all around the pipe

Interceptor Line Prelim. Design Cont.

- A channel distance flow-path adjustment was made for a river compared to a canal
- Manholes spaced to allow a maximum 1,000 feet pipe run from the manhole for maintenance purposes
- Electric driven submersible pumps
- Dual discharges to local irrigation canals or drains and the SJR/Sand Slough/ESBP facilities
- Installation would be by a "tile drain" trenching machine

Interceptor Line – Example Site Plan



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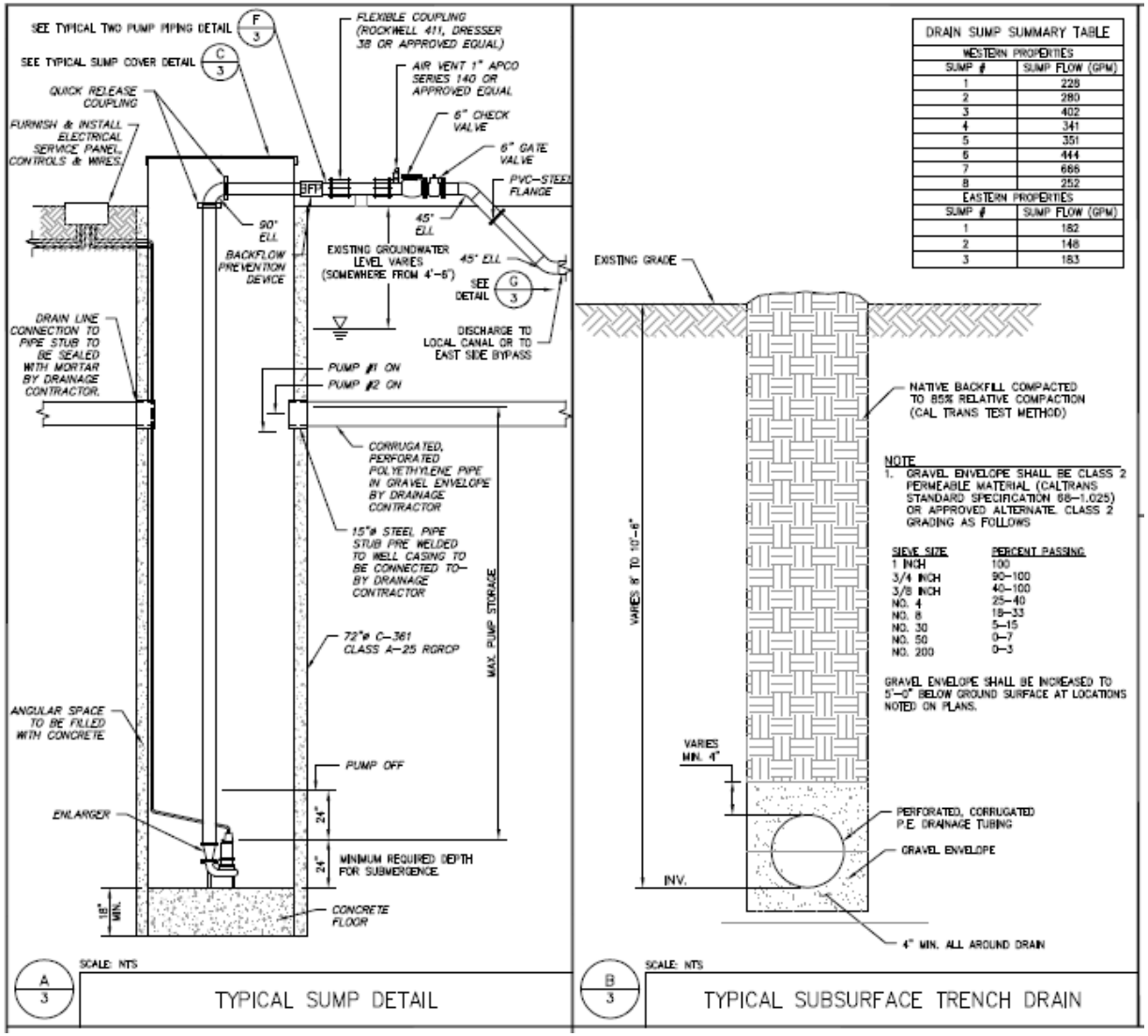
Interceptor Line – Typical Details



Interceptor Line – Photos

Drain Sump,
Submersible Pump

Drain Installation

Cost Estimates

- Discussed methods with local contractors that do the type of work being estimated
  - Inquip Associates: slurry walls
  - Viking Drillers: shallow pumping
  - McElvaney/LIDCO Imperial Valley: interceptor lines
  - M.A. McClish: sheet piles
- Approach similar to methods used by contractors to review, evaluate, and bid work
- Estimated materials and hours for equipment/labor

Cost Estimates

- Rates developed from Granite Construction labor rate sheet (union wages) and equipment rate sheet, or Caltrans standard rates – all with 15% markup
- Local area material suppliers plug sales tax and 15% markup
  - Granite Materials & Local Ready Mix Suppliers: aggregates related materials & ready mix concrete
  - Groeniger: PVC/DIP pipe, valves, fittings, etc.
  - Piranha Precast: RCP pipe & precast materials
- 25% contingency

Present Worth Cost Development

- 50 year economic analysis
- Federal Water Resource Planning 2013 discount rate 3.75%
- Operations & maintenance costs included
- 25% contingency cost added to replacements
- No design or mobilization costs included in replacement costs
- Replacement frequency

Project Item	Replacement Frequency
Discharge Piping	20 years
Submersible Pumps	15 years
Wells	25 years
Electrical Motors, Controls, Connections	15 years
Drainage Sump & Manhole Structures	40 years
Interceptor Lines	40 years
Slurry Wall, Sheet Piles, Seepage Plug	50 years +

O&M Cost Assumptions

- Electric cost of $0.18/ KWH (average PG&E small agricultural rate)
- Pumps operate 365 days/ yr, seven days/wk, 24 hrs/day
- Hydro-jetting of interceptors every four years
- Clean out ditches every 5 years and remove one foot of sediment
- Weed spraying annually for easement area and drainage ditch

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Summary of Costs

Seepage Project Alternative	Unit	Estimated Initial Cost Range ($/unit)**	Present Worth Cost Range ($/unit)**
Slurry Walls	foot	$1,100 - $1,300	$1,100 - $1,300
Sheet Piles	foot	$2,300 - $2,600	$2,300 - $2,600
Seepage Plug	foot	$1,900 - $2,200	$1,900 - $2,200
Drainage Ditch	foot	$190 - $450	$390 - $760
Interceptor Lines	foot	$180 - $250	$390 - $490
Shallow Groundwater Pumps	foot	$640 - $840	$1,300 - $1,600
Seepage Easements	acre	Based upon appraisal	Based upon appraisal
Buildup of Low Lying Areas (4-foot)*	acre	$31,000	$31,000
Buildup of Low Lying Areas (7-foot)*	acre	$58,000	$58,000
Channel Conveyance Improvements	n/a	n/a	n/a

Notes:

*Approximately 3,000 cubic yard/acre for 4-foot buildup, and 7,900 cubic yard/acre for 7-foot buildup

**Costs from preliminary designs prepared

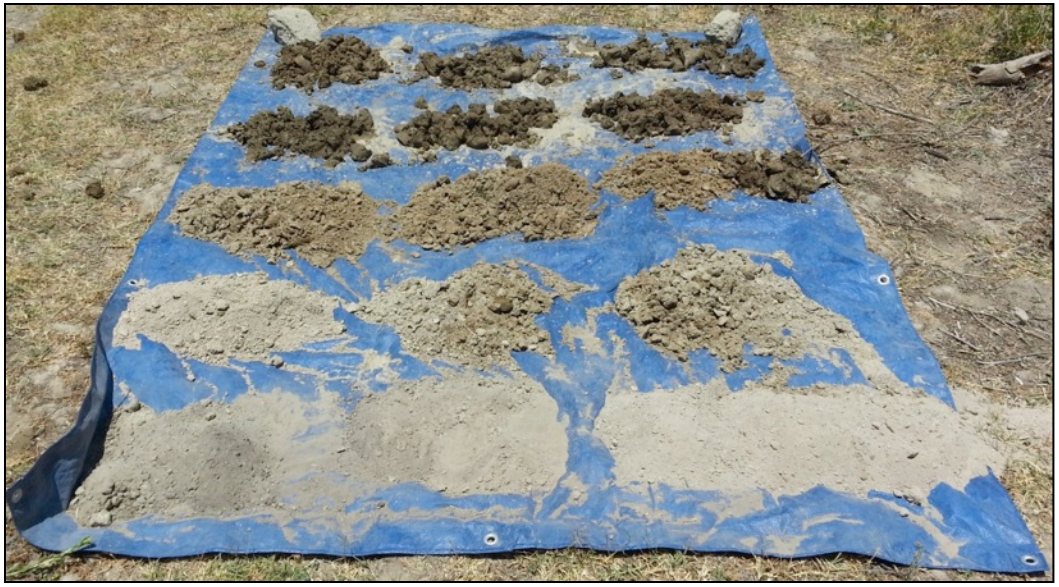
n/a: not addressed in this analysis

Mike Day

60% DESIGNS

Hydraulic Conductivity Investigation

- Performed most tests along edge of property at SJR
- Tested historic channels
- Tests spaced about every 1,000 feet
- In areas of known seepage, tests about 500 feet apart



- Hand augered 4-inch hole to 15-foot or less and logged soils

Hydraulic Conductivity Investigation

- Pump in tests performed in dry hole above the water table
- Pump out tests performed if water table encountered
  - Constant Flow (not able to drain the hole)
  - Hand Auger method (pump is able to evacuate the borehole)

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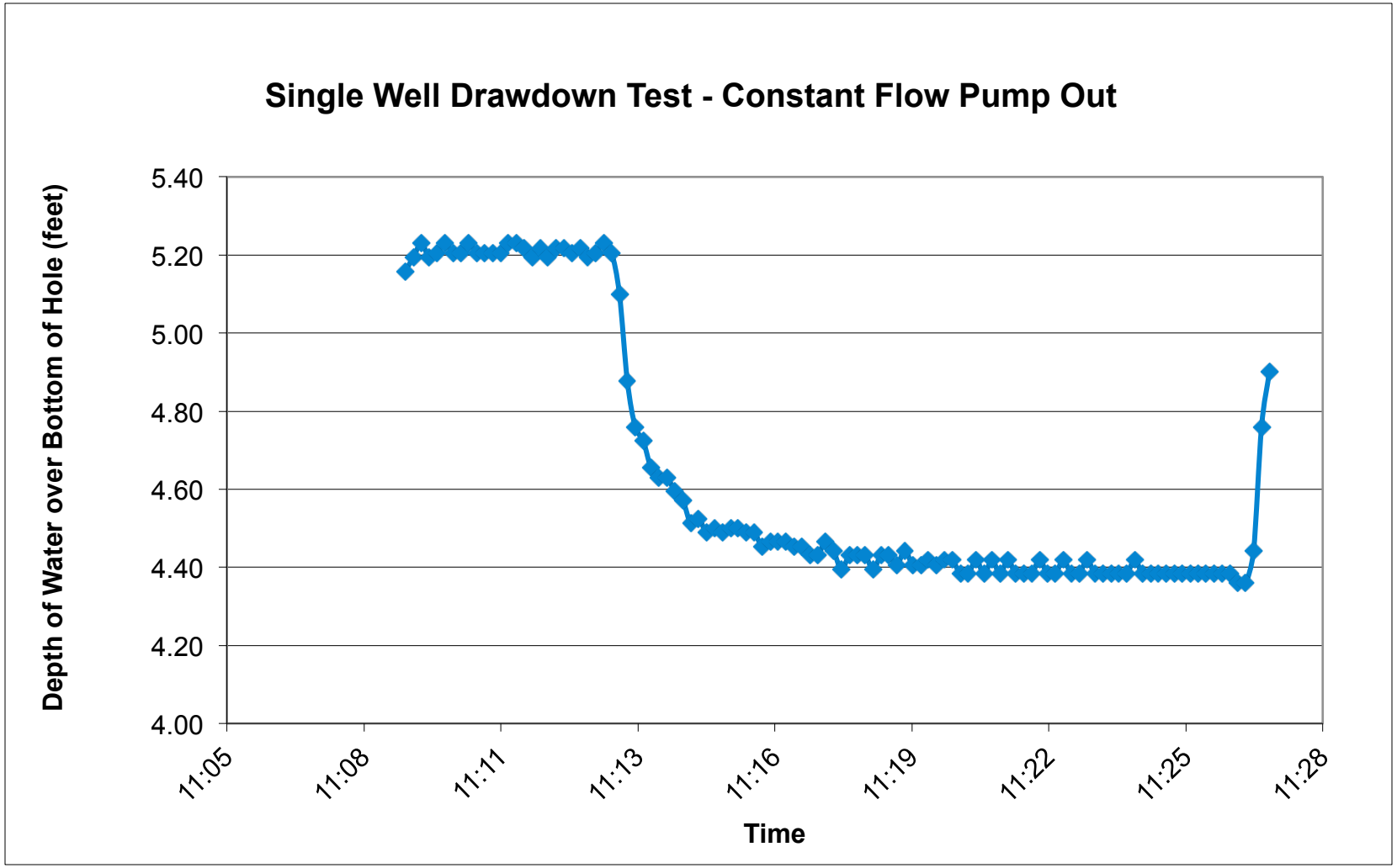
Hydraulic Conductivity Investigation



60% Design Documents

- Topographic survey along proposed interceptor alignment conducted
- Weighted hydraulic conductivity values applied across the site
- Interceptor pipelines, sumps, pumps and discharge lines sized
- Plans for construction prepared – plan view, profiles and details
- Standard specifications
- Quantities and cost estimate

Katrina Harrison

REALTY ACTIONS

Purpose and Objective

- Variety of options available for groundwater seepage mitigation
- Realty Actions include:
  - Seepage License Agreements (Rentals)
  - Seepage Easements (Permanent)
  - Acquisition
- Compensate for higher groundwater levels under the property

Realty Process

- Goal: Maintain "arms-length" relationship with appraiser
- Solution: Office of Valuation Services (OVS)
- Reclamation contracts with OVS to:
  - Write a scope of work
  - Hire an appraiser
  - Review and revise the appraisal
  - Approve the appraisal for government use

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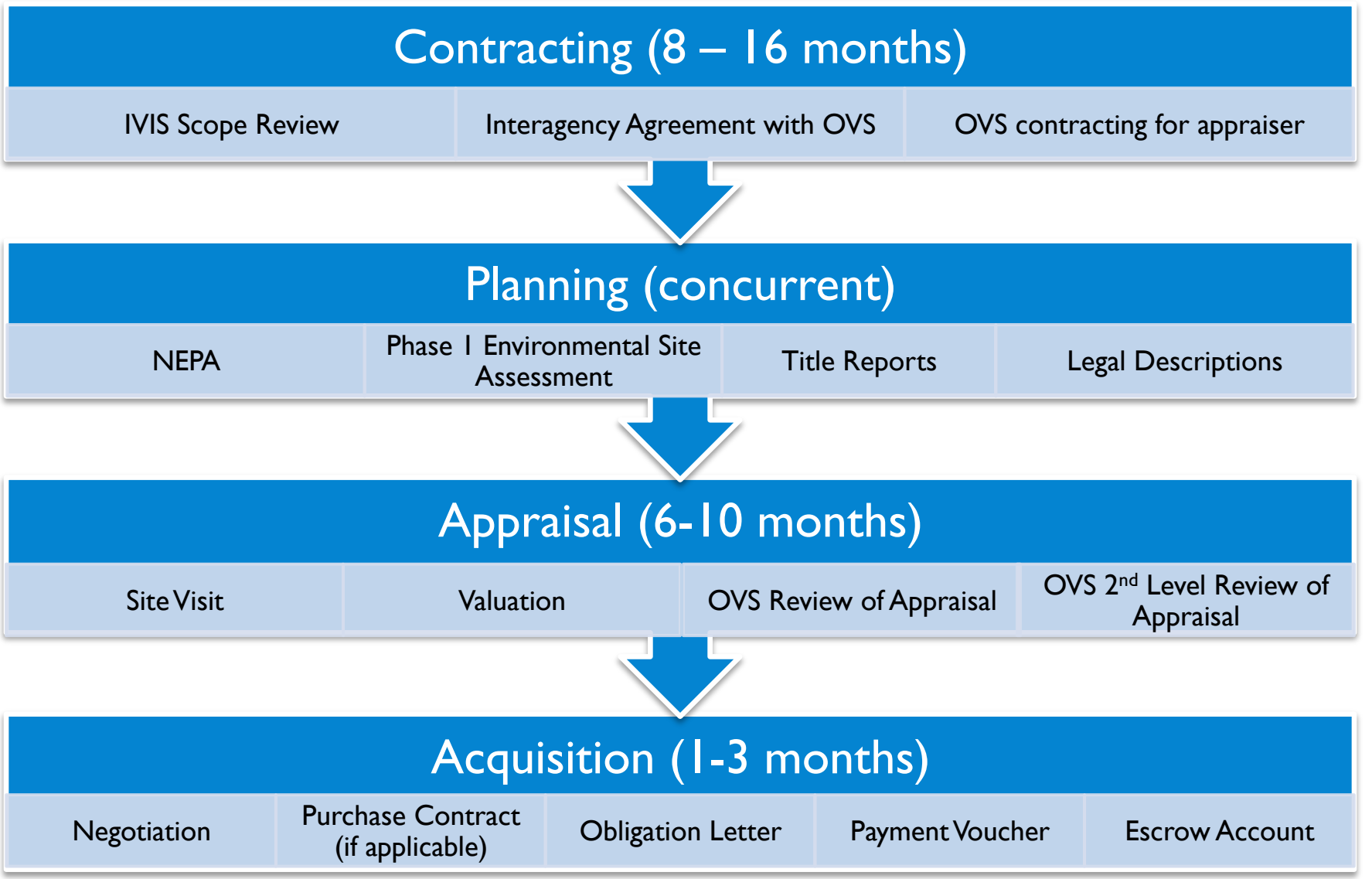
Land Acquisition Process



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Requests of Landowner

- Appraiser site visit access
- Answer appraiser questions
- HAZMAT site visit access
- Interview by Reclamation HAZMAT
- Negotiation
- Land ownership, if necessary

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Valuation

- Reclamation must offer the appraised value as a minimum
- Appraisals based on market value, comparison properties for a change in the highest and best use pre and post acquisition
- Reclamation can pay more than the appraised value, with justification
- Landowner may, at their own cost, obtain their own appraisal, which Reclamation will consider

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Licenses and Easements

- License Agreements
  - Temporarily allow higher groundwater levels
  - Rental rates for property
- Seepage Easements
  - Permanently allow higher groundwater levels
  - Encumbrance on deed
  - Recorded with the County

Easement Language

- the permanent right
- regardless of future crop changes or other improvements made by the Grantor
- to raise groundwater levels
- as a result of water released in a manner consistent with the San Joaquin River Restoration Settlement Act, or any amendment of that statute, or to comply with any court order requiring releases from Friant Dam in order to comply with California Fish and Game Code Section 5937 or any other laws intended to protect fish in the San Joaquin River,
- and the right to raise groundwater levels as a result of refuge water supply in the San Joaquin River

Realty Agreements Summary

- Compensation may provide additional flexibility to the landowner for seepage project construction
- Reclamation will negotiate on terms
- Each parcel is unique and we will consider special circumstances brought to our attention during negotiations

QUESTIONS

Contact

- Technical Feedback Group: Katrina Harrison
  - 916-978-5465
  - KHarrison@usbr.gov
- Seepage Concerns: Seepage Hotline
  - 916-978-4398
  - InterimFlows@restoresjr.net