BACWA Annual Meeting

27 January 2017

HDR

Brown AND Caldwell

BACWA
BAY AREA
CLEAN WATER
AGENCIES

© 2017 HDR, Inc., all rights reserved.

Agenda

1. Watershed Permit Requirements
2. Project Status
   a) Optimization
   b) Upgrades
   c) Sidestream
3. Role of Averaging Periods
4. Nutrient Load Reduction by Other Means
5. Summary of 2016 Group Annual Report
6. Summary of Preliminary Findings

Watershed Permit

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Francisco Bay Regional Water Quality Control Board

ORDER No. R2-2014-0014
NPDES No. CA0038873

WASTE DISCHARGE REQUIREMENTS FOR NUTRIENTS FROM MUNICIPAL WASTEWATER DISCHARGES TO SAN FRANCISCO BAY

The following dischargers are subject to waste discharge requirements (WDRs) set forth in this Order, for the purpose of regulating nutrient discharges to San Francisco Bay and its contiguous bay segments:

Table 1. Discharger Information

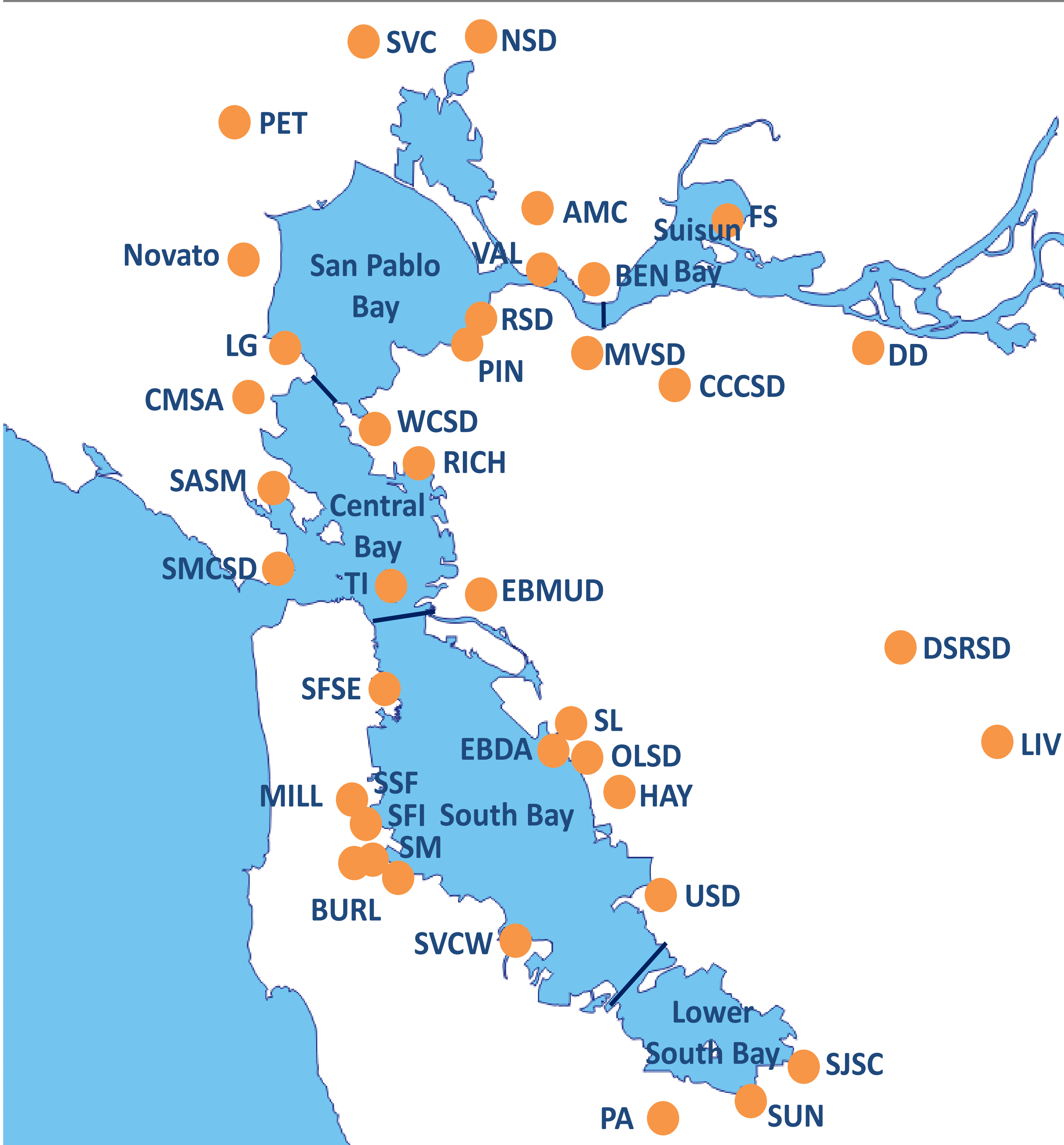
Discharger	Facility Name	Facility Address	Minor/ Major
		151 Mazzetta Court	

April 9, 2014

Watershed Permit Requirements

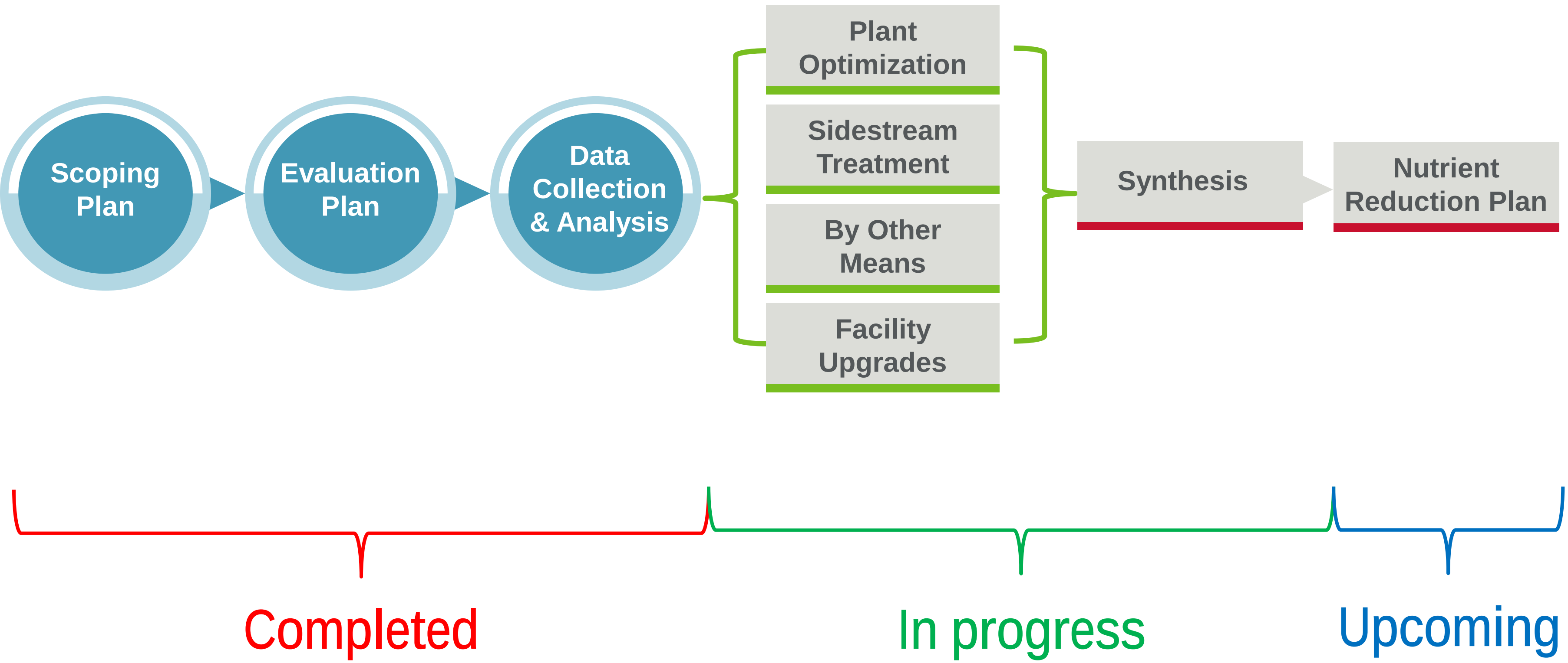
- Issued April 9, 2014 – Regional Water Board Order No. R2-2014-0014
- Requirements:
  - Scoping and Evaluation Plan (Accepted first quarter of 2015)
  - July 2018: Task 1 - Conduct treatment plant optimization and sidestream treatment evaluation for nutrient load reductions (Submittal deadline is July 2018)
  - July 2018: Task 2 - Conduct treatment plant upgrades and analysis of removal by other means for nutrient load reductions (Submittal deadline is July 2018)
  - Annual Reporting (Annual submittal in October from 2015 through 2018)

37 Participating Agencies



Project Status

Overview / Status of Study



Reports Status

Number	Submitted Draft Reports (26 Plants)		Outstanding (11 Plants)
1	American Canyon	FSSD	City of Millbrae
2	Benicia	Hayward	City of Richmond
3	Burlingame	Livermore	LGVSD
4	CCCSD	Mt. View	Pinole/Hercules *
5	City of San Leandro	Napa San	Rodeo *
6	City of Palo Alto	Novato	San Mateo
7	City of Petaluma	Oro Loma	SASM
8	City of San Jose	SFPUC SEP	Sausalito/Marin City *
9	City of Sunnyvale	Silicon Valley Clean Water	SF Airport
10	CMSA	South San Francisco	Sonoma County Water Agency
11	Delta Diablo	Treasure Island	West County
12	DSRSD	USD	
13	EBMUD	Vallejo	

* Analysis completed and included with the presentation preliminary results

Preliminary Optimization Results

Optimization Approach

- Basis of Evaluation
  - Identify no / low cost strategies to reduce effluent nutrients
  - Planning Period: 2025 Horizon
  - Loading: 0% Increase in Flows and 15% Increase in Loads
  - Design Criteria: Aggressive – no permit limits
- Optimization Concepts
  - Use offline tankage
  - Operate in split treatment mode
  - Modify operational mode (e.g., raise SRT)
  - Add chemicals
  - Process control instrumentation
  - Add internal recycle for denitrification

DRAFT Optimization Findings Based on 29 Plants

All results are preliminary

Which nutrients are easiest to remove?

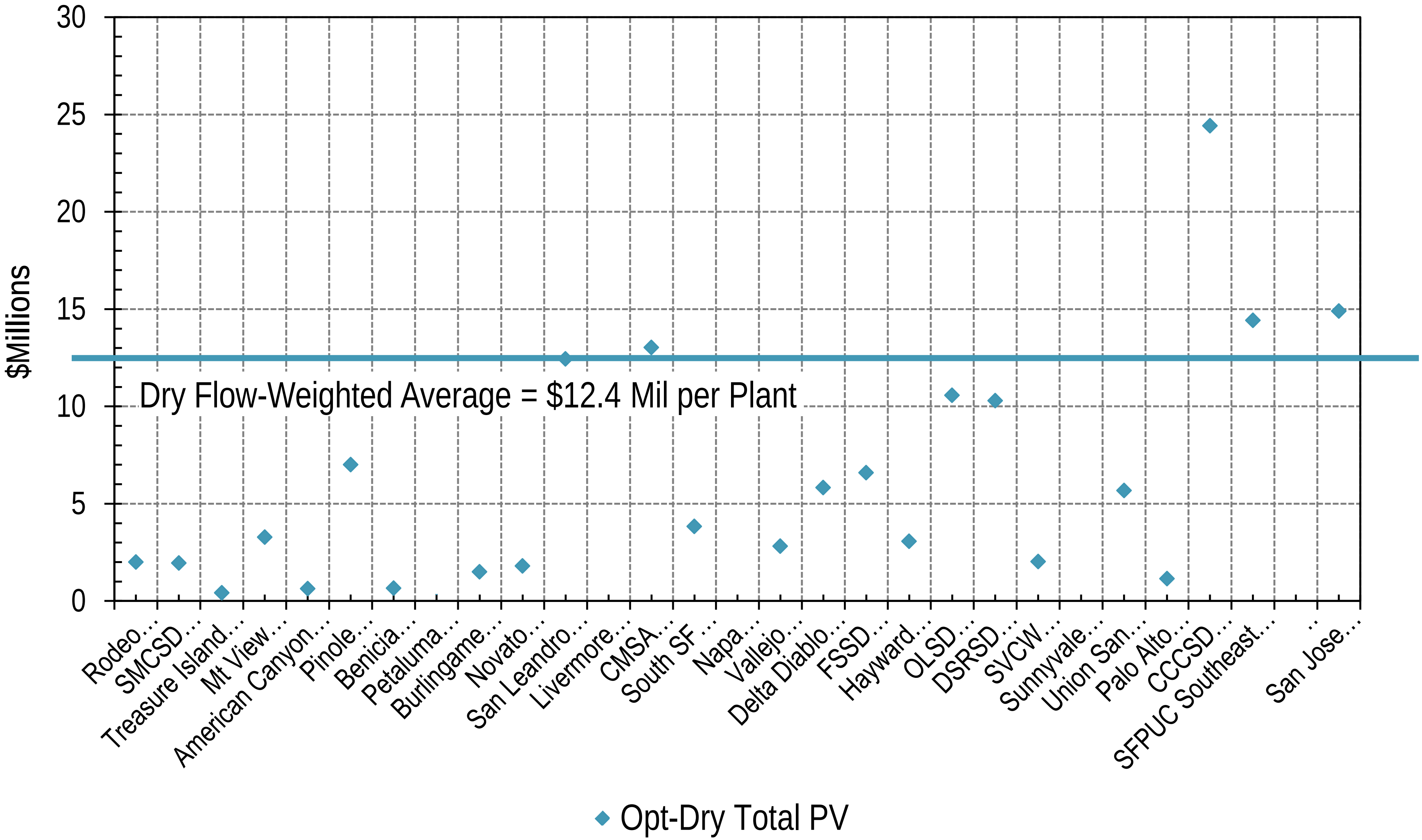
- Ammonia load reduction is most difficult
  - Increasing SRT for plants with act sludge
  - Operating Trickling Filter as a Nitrifying Trickling filter
- TN load reduction is possible if ammonia removal implemented
- TP load is easier to remove
  - Most plants have metal salt chemical feed facilities
  - Some have anaerobic zones
  - Lose TP removal capability by forfeiting anaerobic zone

Costs

- Total PV = $171M Dry and $212M Wet
- Total PV ranged from $0.5M to $28M per plant
- Flow-weighted Total PV unit cost = $0.4/gpd
- Not all plants can reduce ammonia/TN loads for both dry and wet seasons:
  - 18 of 29 plants for dry season reduction
  - 15 of 29 plants for wet season reduction
- Overall Load Reduction from Current Discharge
  - Overall Ammonia/TN load reduction is 10-14%
  - Overall TP load reduction is 45-50%

DRAFT Optimization Total PV Costs

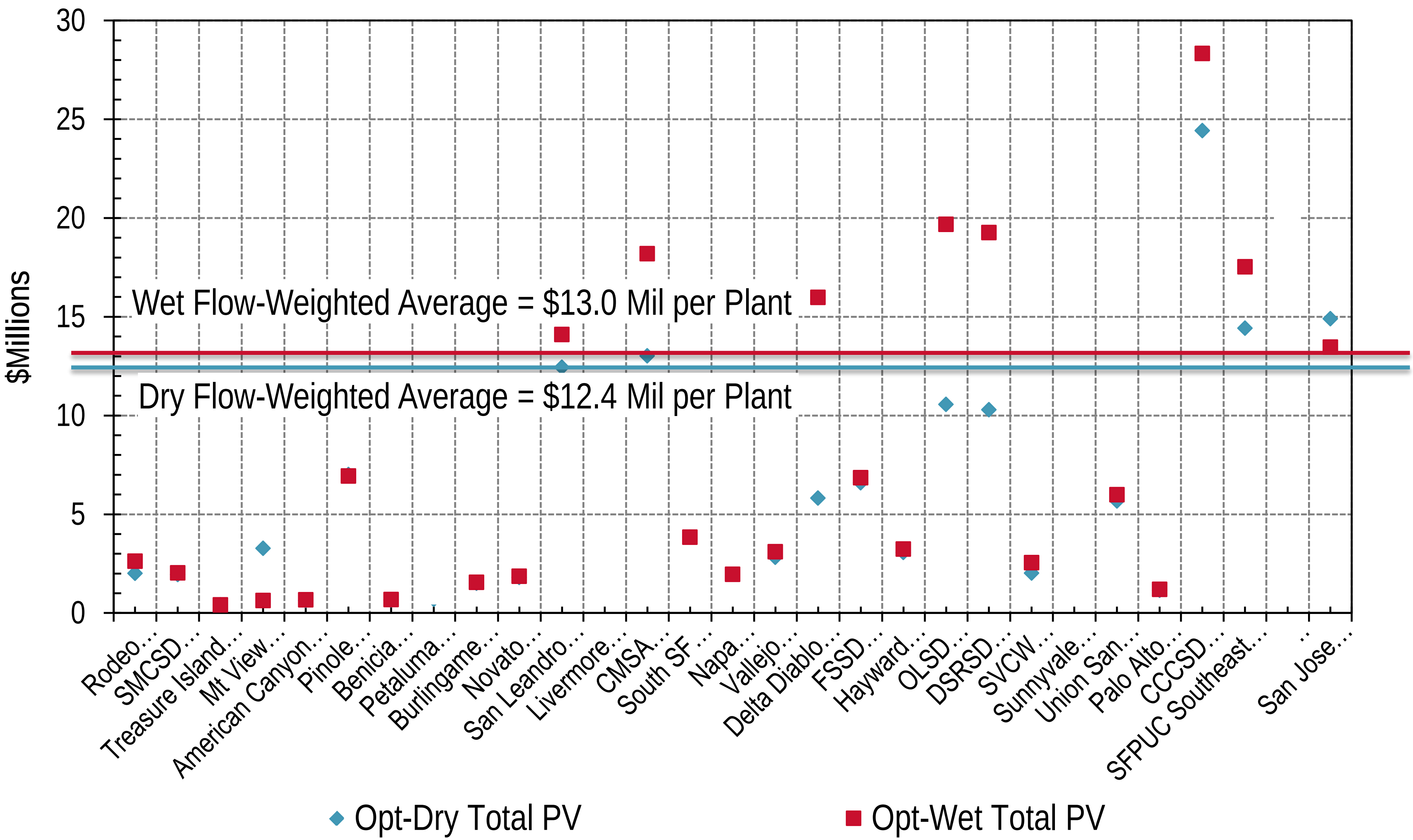
All results are preliminary



*Draft Results are Sorted by Permitted Capacity

DRAFT Optimization Total PV Costs

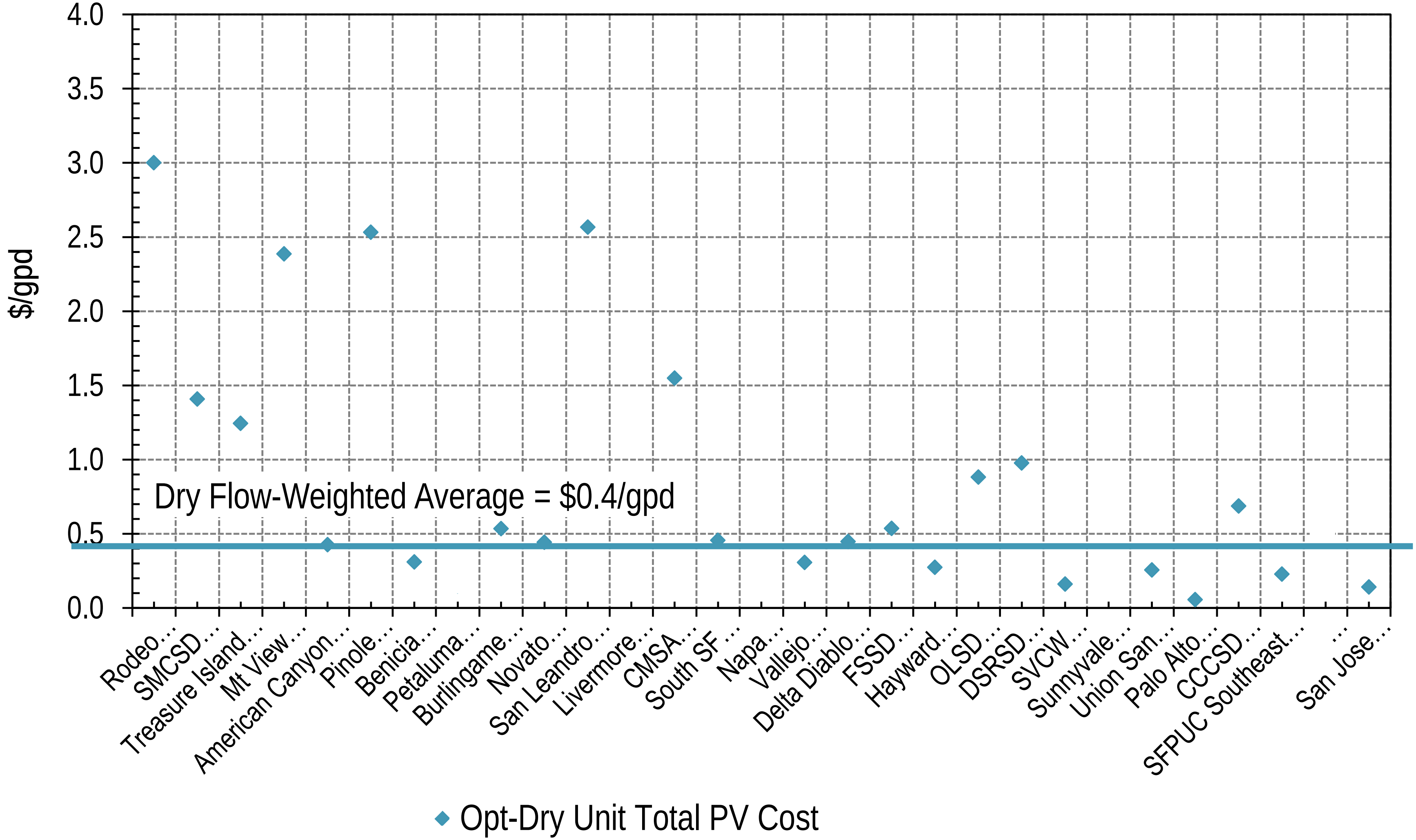
All results are preliminary



*Draft Results are Sorted by Permitted Capacity

DRAFT Optimization Total PV Unit Costs

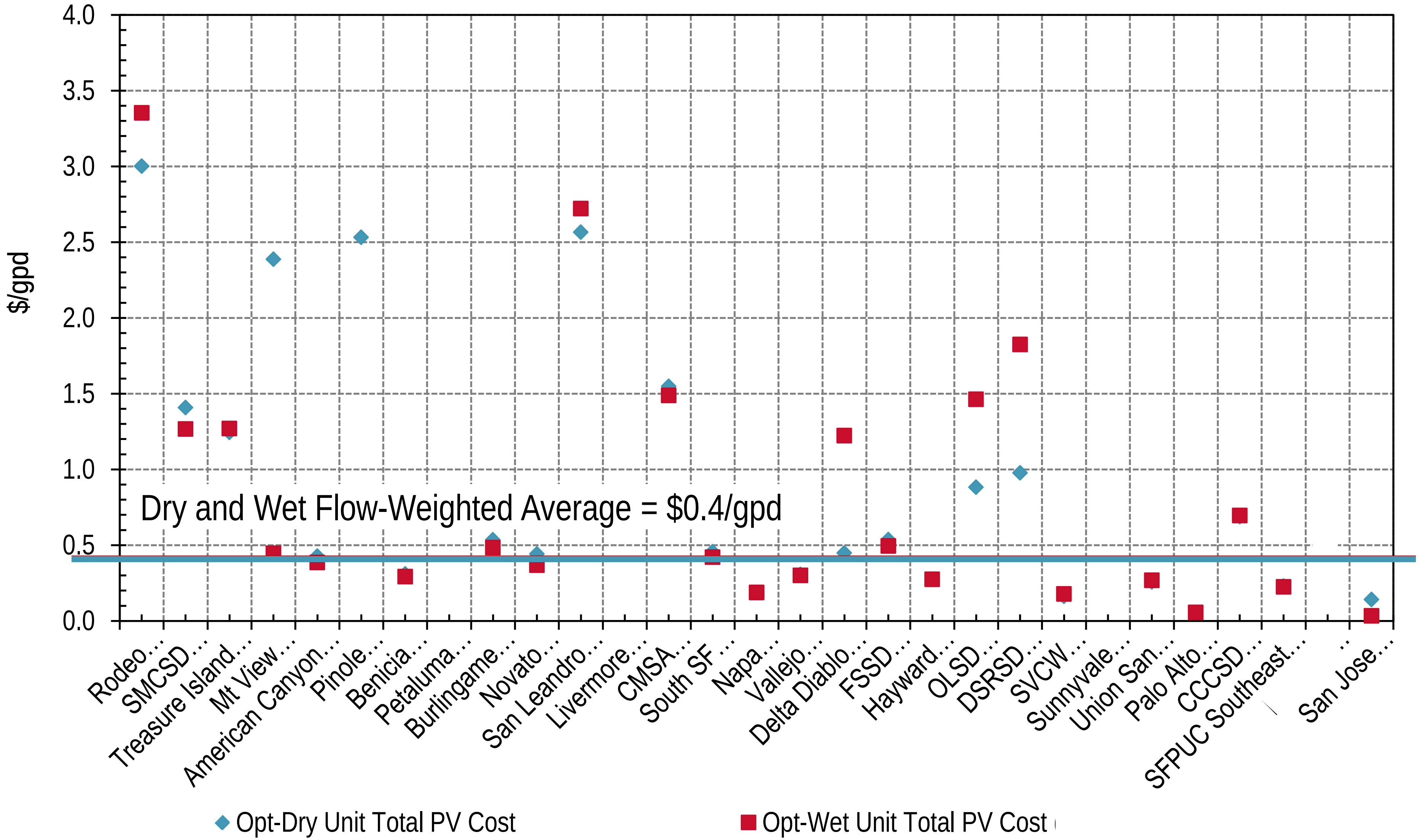
All results are preliminary



*Draft Results are Sorted by Permitted Capacity

DRAFT Optimization Total PV Unit Costs

All results are preliminary



*Draft Results are Sorted by Permitted Capacity

DRAFT Optimization Findings Based on 29 Plants

All results are preliminary

Which nutrients are easiest to remove?

- Ammonia load reduction is most difficult
  - Increasing SRT for plants with act sludge
  - Operating Trickling Filter as a Nitrifying Trickling filter
- TN load reduction is possible if ammonia removal implemented
- TP load is easier to remove
  - Most plants have metal salt chemical feed facilities
  - Some have anaerobic zones
  - Lose TP removal capability by forfeiting anaerobic zone

Costs

- Total PV = $171M Dry and $212M Wet
- Total PV ranged from $0.5M to $28M per plant
- Flow-weighted Total PV unit cost = $0.4/gpd
- Not all plants can reduce ammonia/TN loads for both dry and wet seasons:
  - 18 of 29 plants for dry season reduction
  - 15 of 29 plants for wet season reduction

Load Reduction with Respect to Current Discharge:

- Overall Ammonia/TN load reduction is 10-14%
- Overall TP load reduction is 45-50%

Preliminary Upgrades Results

Upgrades Approach

- Basis of Evaluation
  - Identify upgrade strategies to meet effluent targets
  - Planning Period: 30 Years
  - Loading: Permitted Capacity
  - Design Criteria: Reliability – meet permit limits
- Concepts
  - Sidestream Treatment
  - Design Facilities for Level 2 that could be further upgraded to meet Level 3 – no stranded assets
  - Technology Status: Established Technologies

<u>Treatment Levels</u>

Level	Ammonia	TN	TP
Level 1	--	Optimization	--
Level 2	2 mg N/L	15 mg N/L	1.0 mg P/L
Level 3	2 mg N/L	6 mg N/L	0.3 mg P/L

DRAFT Upgrade Findings Based on 29 Plants

All results are preliminary

Which nutrients are easiest to remove?

- Ammonia is the most difficult and expensive
  - Bigger basins due to increasing SRT for plants with act sludge
  - Expanded aeration system
  - Additional pumping
- TN load reduction requires ammonia removal
  - Level 3 typically require an external carbon source
- TP load is the simplest and most straight forward to remove
  - Level 3 requires tertiary filtration
  - Many upgrades use MBR which include filtration in Level 2 already

Costs

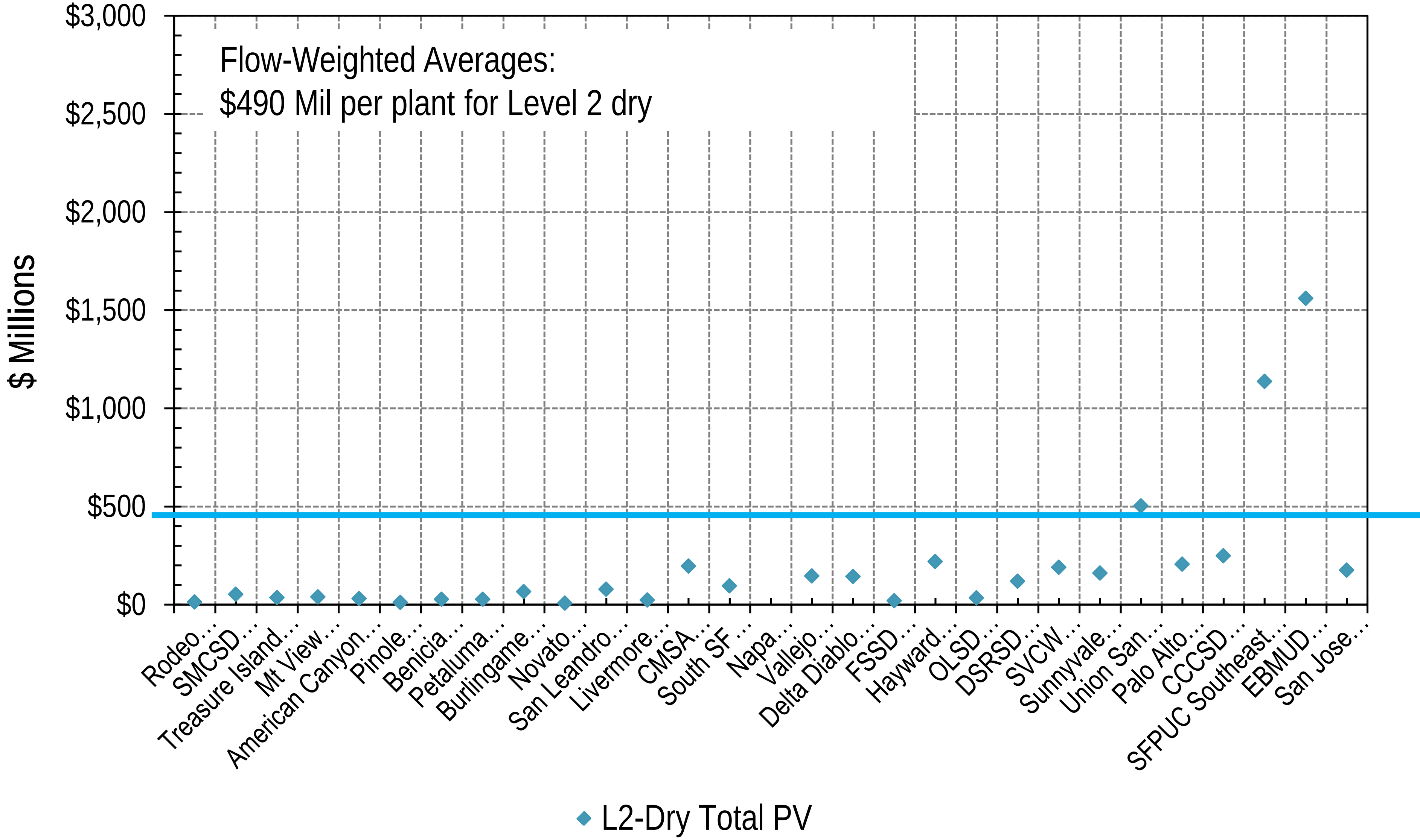
- Total PV Costs
  - Level 2 = $5,575M Dry and $7,080M Wet
  - Level 3 = $7,310M Dry and $9,040M Wet
- Total PV Cost Range per Plant
  - Level 2 = $3.5M to $2,240M per plant
  - Level 3 = $22M to $2,470M per plant
- Total PV Unit Costs
  - Level 2: $0.4 to $43 per gpd treated
  - Level 3: $2.9 to $46 per gpd treated

Load Reduction with Respect to Current Discharge:

- Level 2 and 3: >90% for Ammonia
- Level 2: about 55-60% for TN and TP
- Level 3: about 80-85% for TN and TP

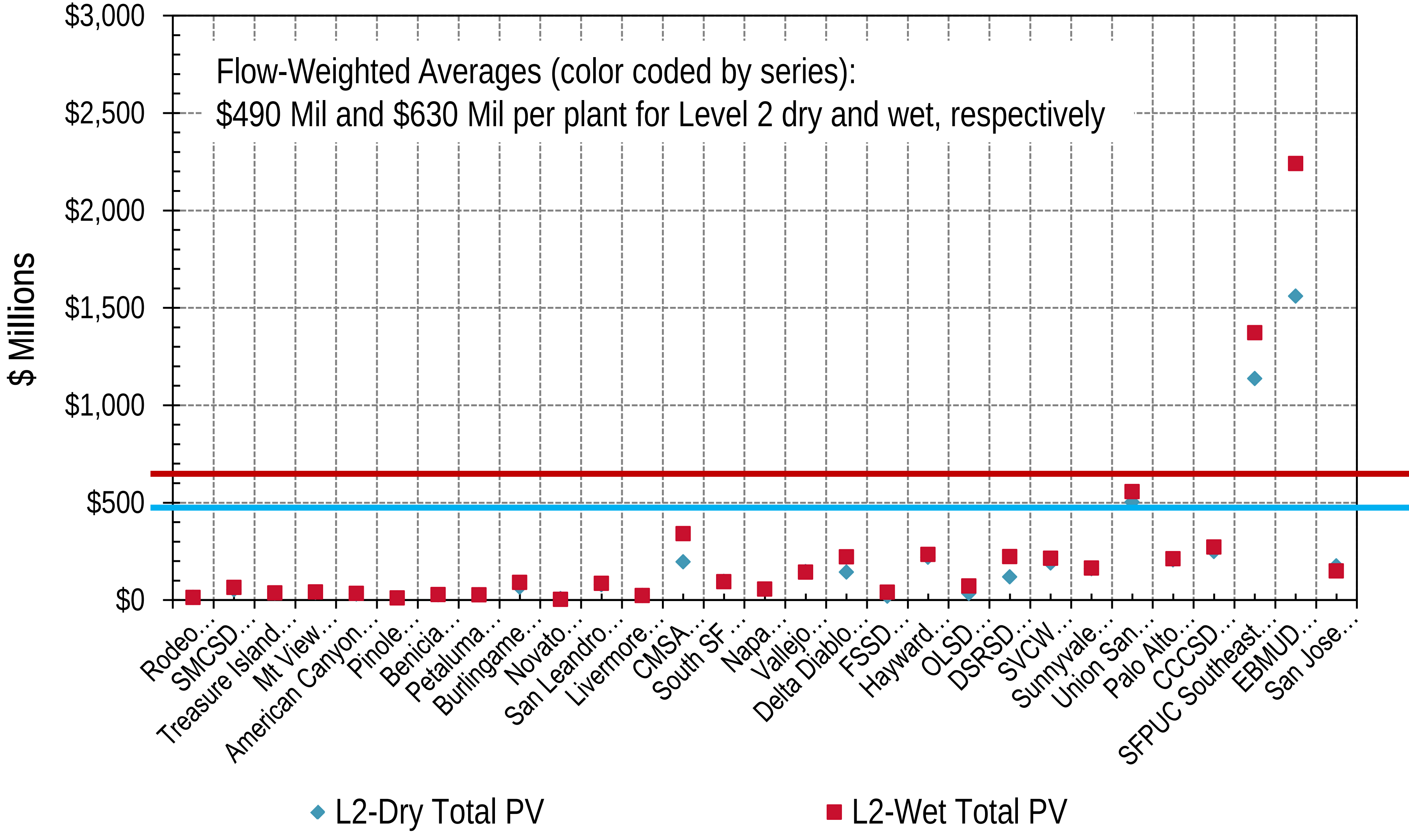
DRAFT Total PV Costs for Upgrades

All results are preliminary



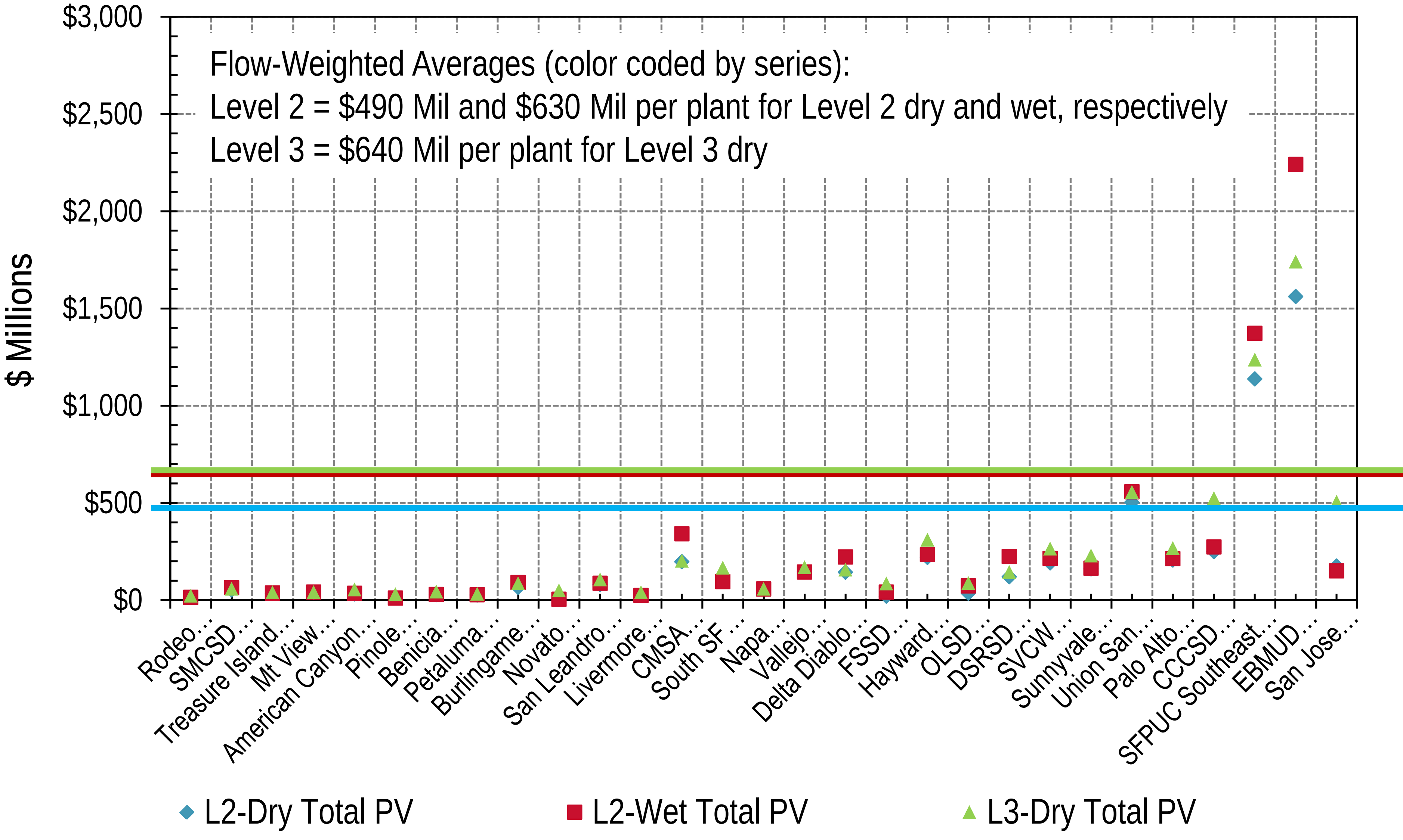
DRAFT Total PV Costs for Upgrades

All results are preliminary



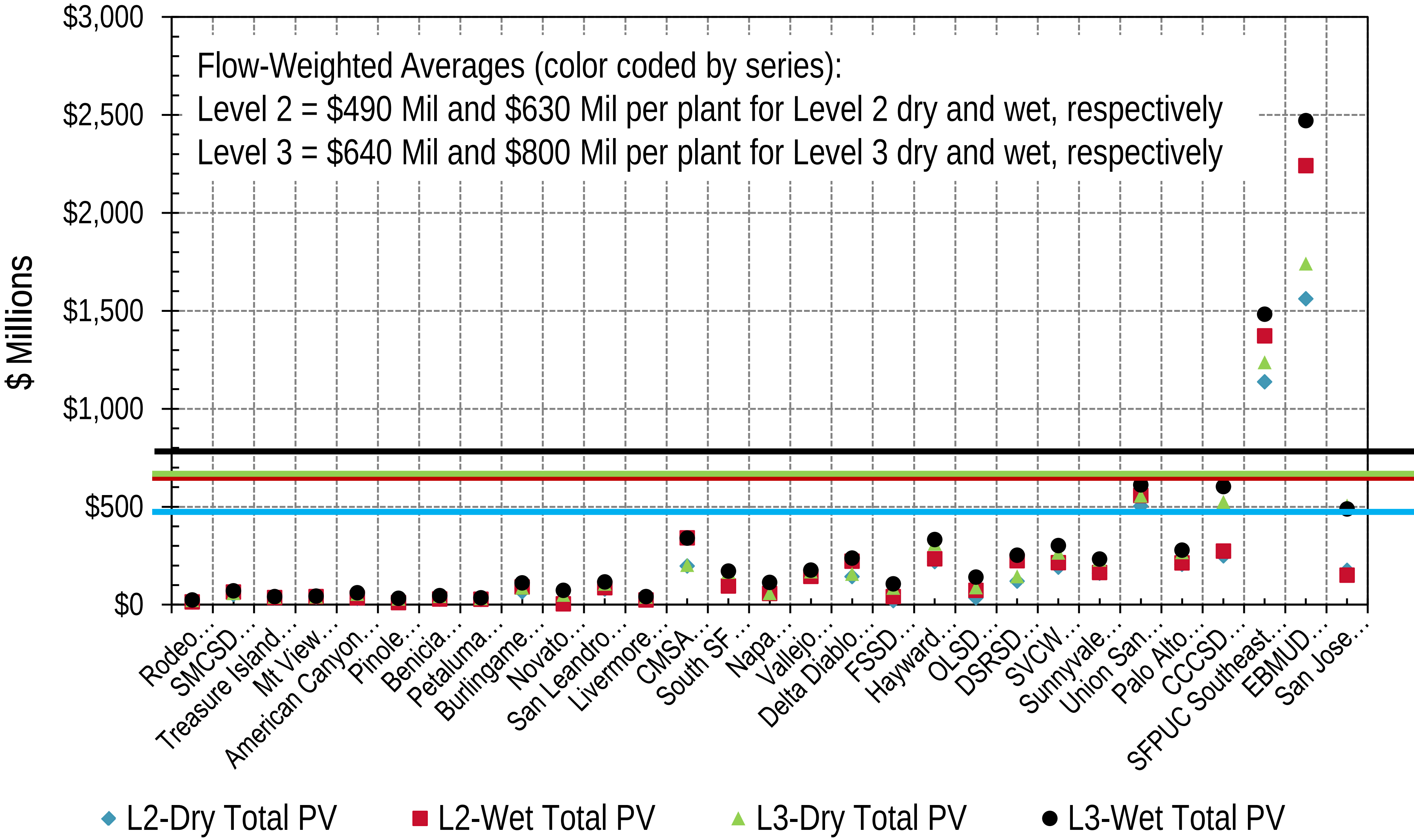
DRAFT Total PV Costs for Upgrades

All results are preliminary



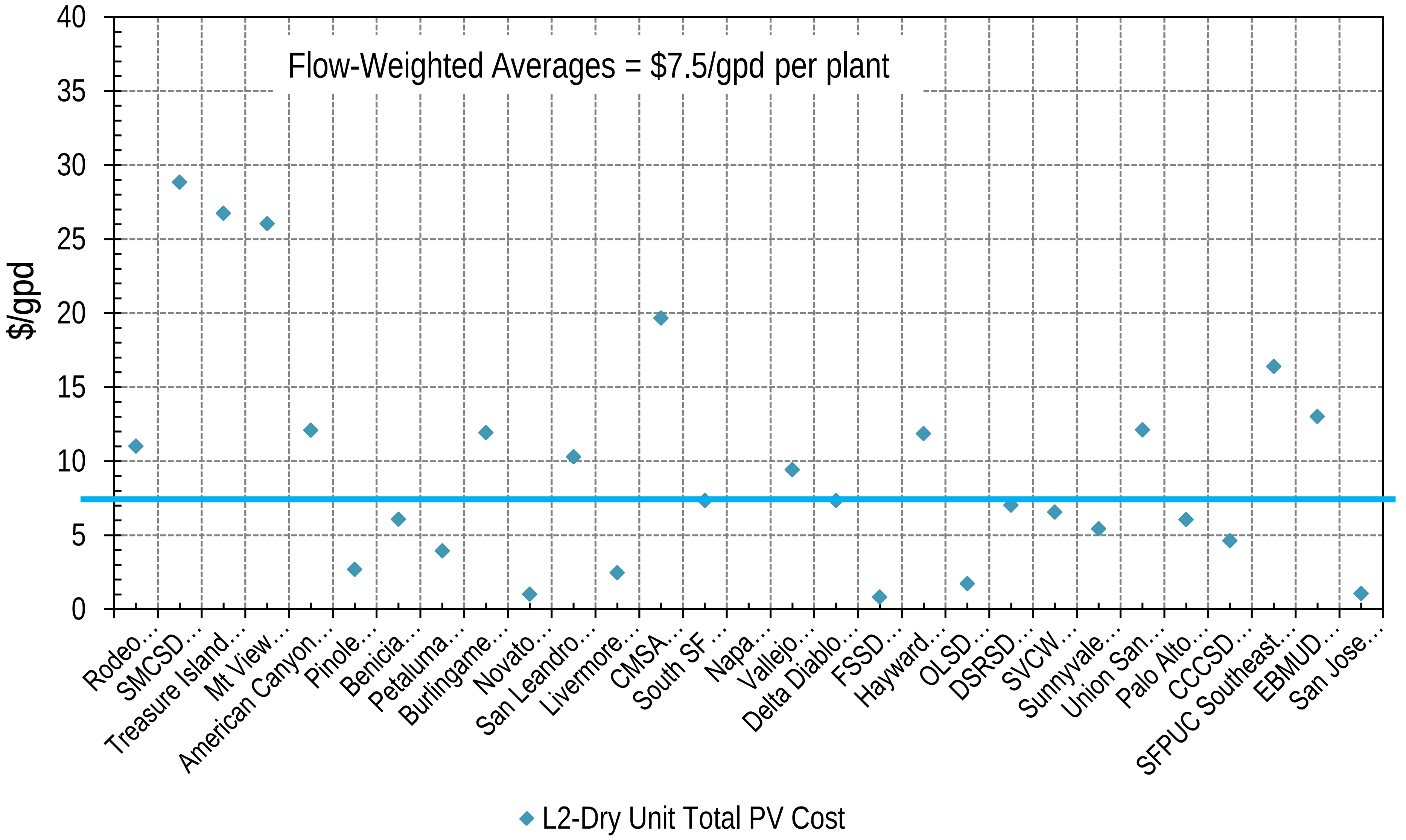
DRAFT Total PV Costs for Upgrades

All results are preliminary



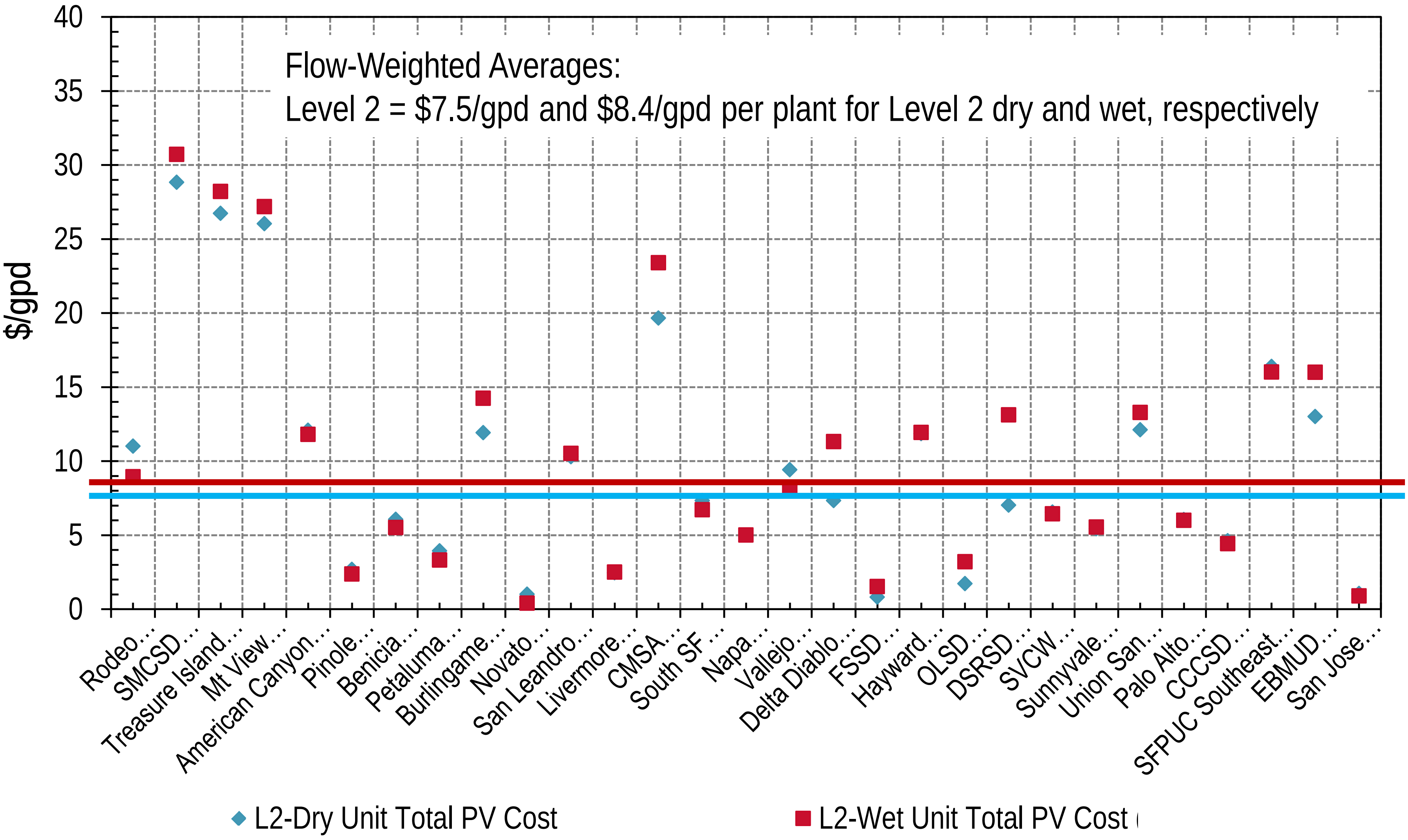
DRAFT Total PV Unit Costs for Upgrades

All results are preliminary



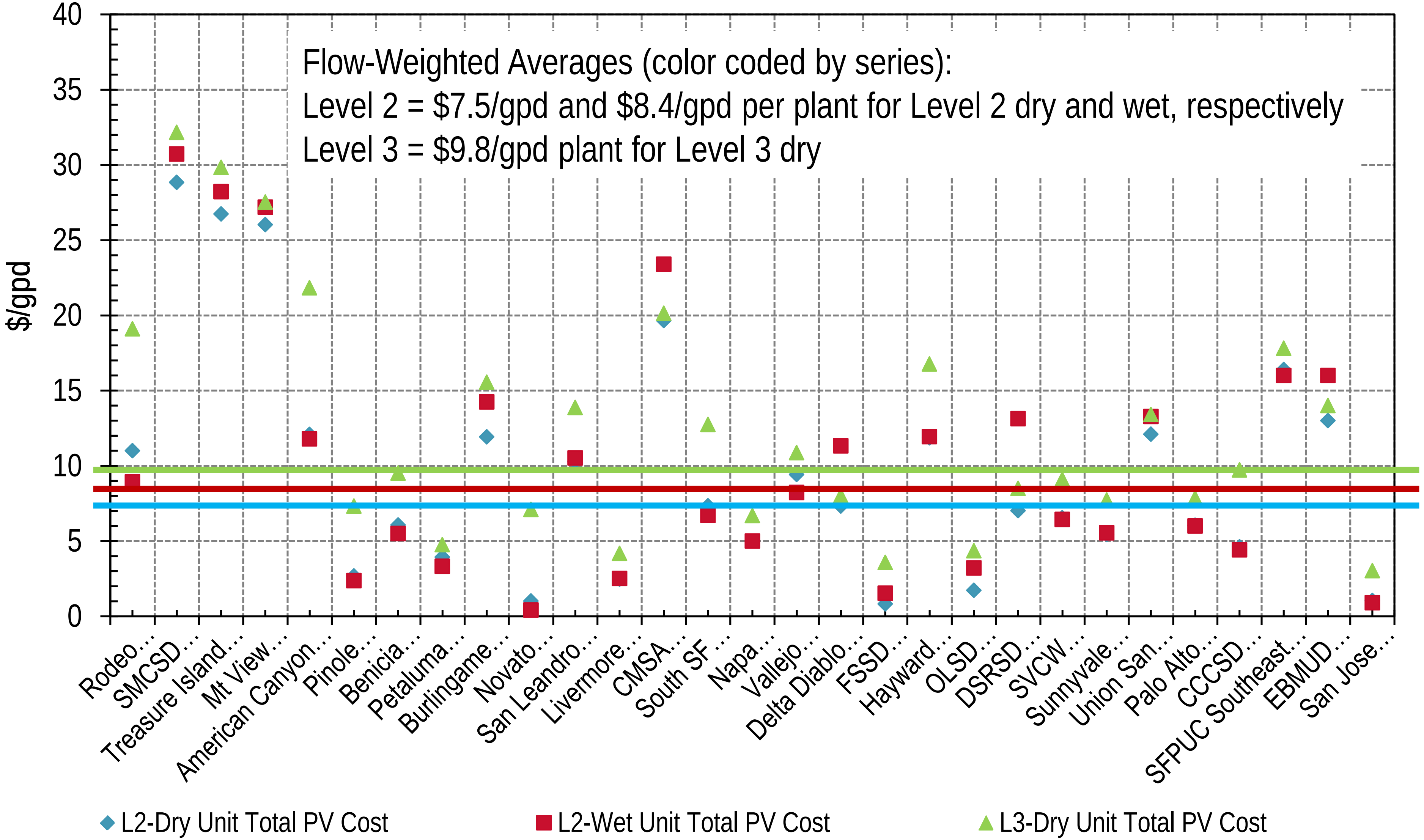
DRAFT Total PV Unit Costs for Upgrades

All results are preliminary



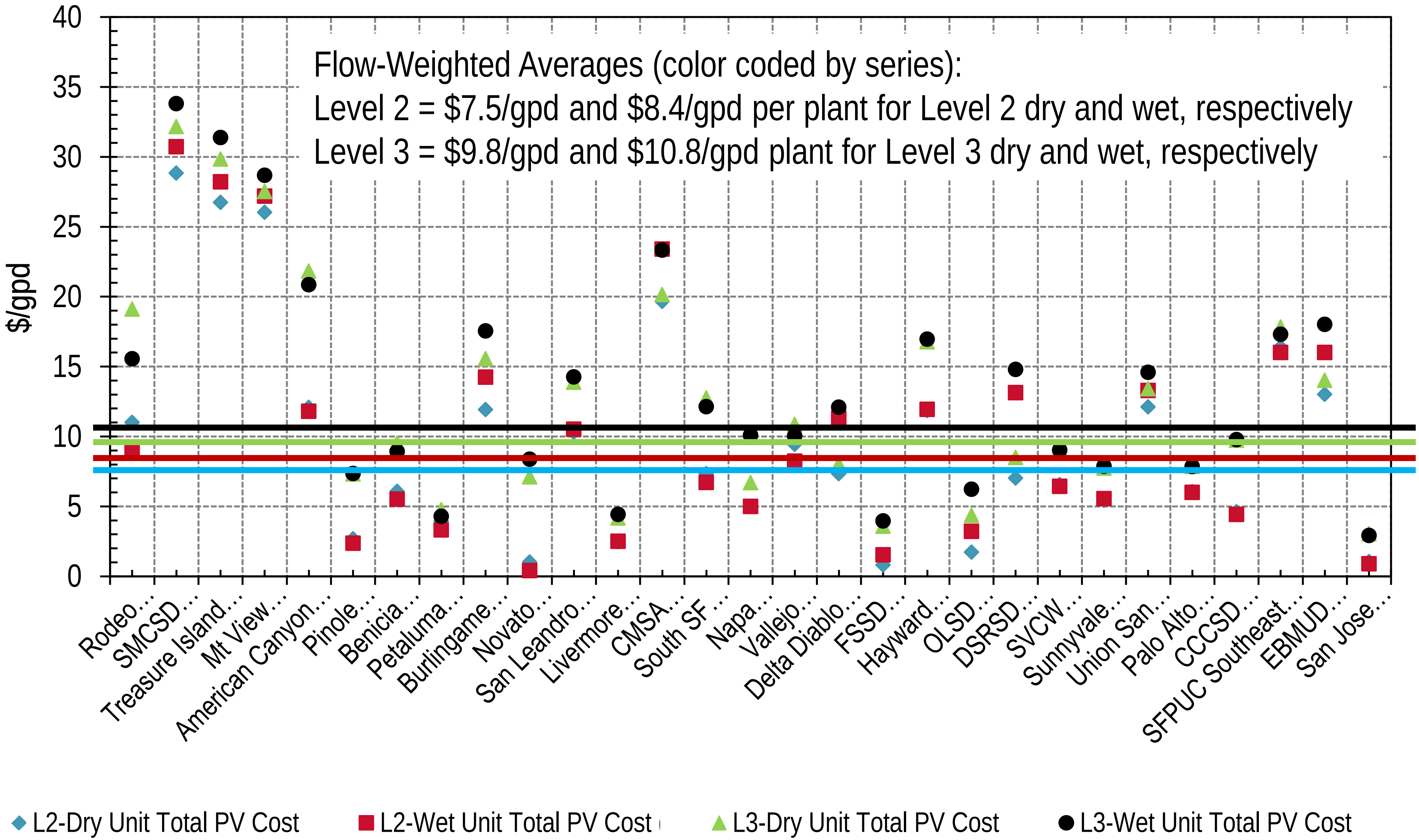
DRAFT Total PV Unit Costs for Upgrades

All results are preliminary



DRAFT Total PV Unit Costs for Upgrades

All results are preliminary



DRAFT Upgrade Findings Based on 29 Plants

Which nutrients are easiest to remove?

- Ammonia is the most difficult and expensive
  - Bigger basins due to increasing SRT for plants with act sludge
  - Expanded aeration system
  - Additional pumping
- TN load reduction requires ammonia removal
  - Level 3 typically require an external carbon source
- TP load is the simplest and most straight forward to remove
  - Level 3 requires tertiary filtration
  - Many upgrades use MBR which include filtration in Level 2 already

Costs

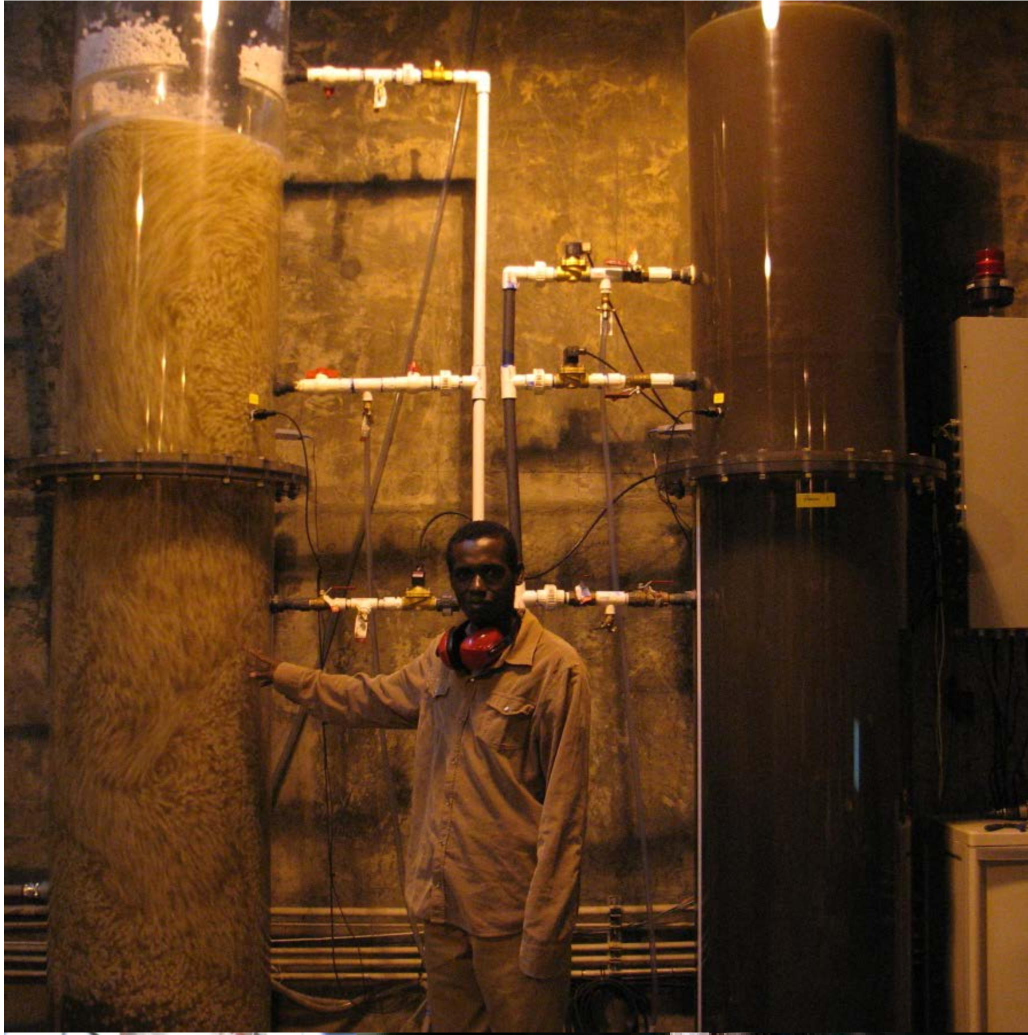
- Total PV Costs
  - Level 2 = $5,575M Dry and $7,080M Wet
  - Level 3 = $7,310M Dry and $9,040M Wet
- Total PV Cost Range per Plant
  - Level 2 = $3.5M to $2,240M per plant
  - Level 3 = $22M to $2,470M per plant
- Total PV Unit Costs
  - Level 2: $0.4 to $43 per gpd treated
  - Level 3: $2.9 to $46 per gpd treated

Load Reduction with Respect to Current Discharge:

- Level 2 and 3: >90% for Ammonia
- Level 2: about 55-60% for TN and TP
- Level 3: about 80-85% for TN and TP

Sidestream Approach

- Basis of Evaluation
  - Identify upgrade strategies to reduce nutrients
  - Planning Period: 30 Years
  - Loading: Design Capacity
  - Design Criteria:
    - Year-round sidestream
    - Sufficient Dewatering Frequency ($\geq$4 days/week)
    - Water temperature governs technology selection
- Concepts
  - Ammonia/TN Removal:
    - Conventional nitrification technology
    - Deammonification technology
  - TP Removal: metal salt precipitation
- Acknowledgements
  - EPA Regional Grant led by EBMUD
  - Agencies that hosted pilots

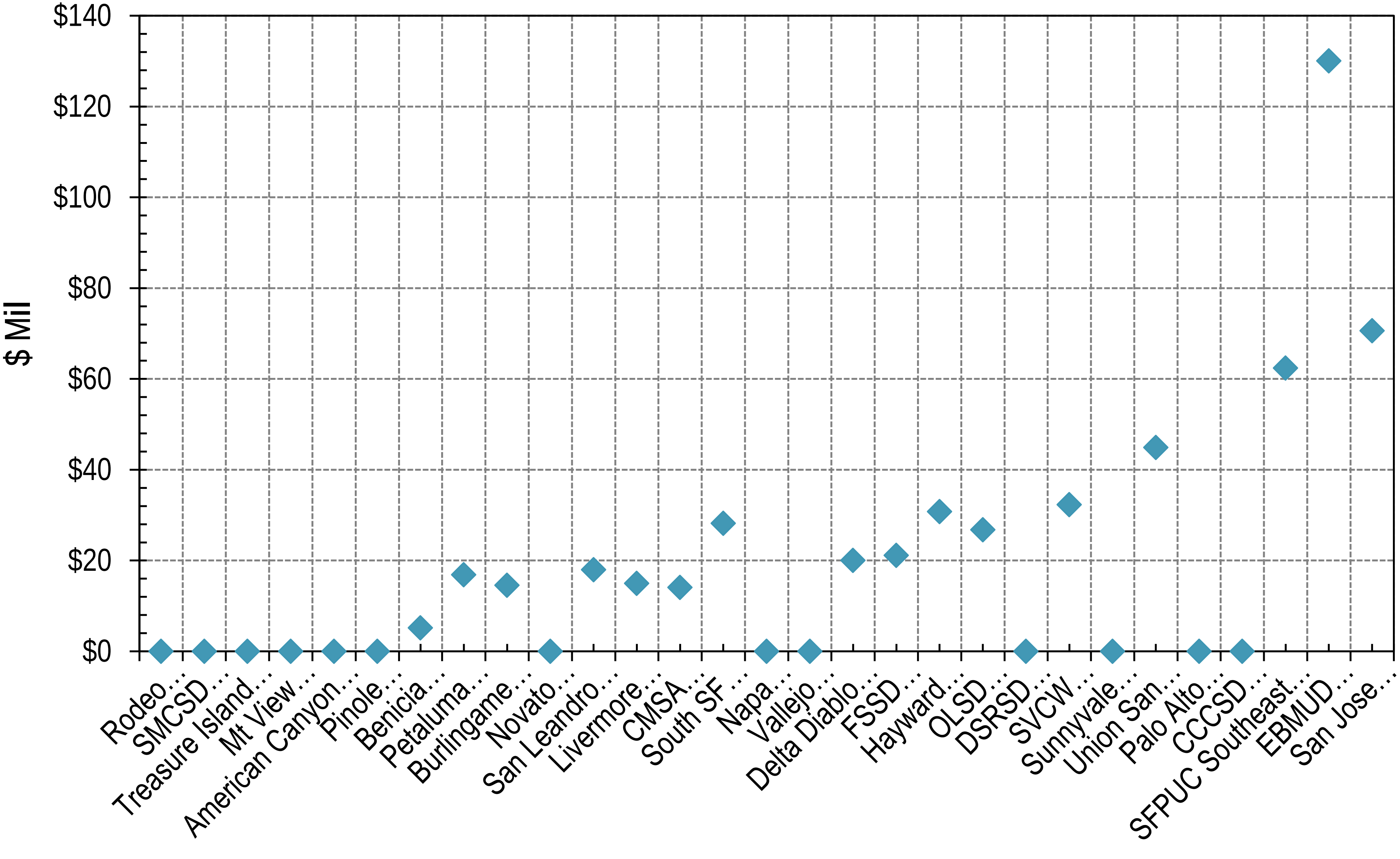


DRAFT Plants Eligible for Sidestream Treatment by Subembayment

Subembayment	No. Plants Eligible for Ammonia Discharge Reduction to the Bay	No. Plants Eligible for Total Nitrogen Discharge Reduction to the Bay
Suisun Bay	1	2
San Pablo Bay	1	4
Central Bay	6	6
South Bay	11	11
Lower South Bay	0	2
Total	19	25

DRAFT Total PV Costs for Sidestream

All results are preliminary



DRAFT Sidestream Findings for the 29 Plants

- Criteria used for screening:
  - Year-round sidestream
  - Year-round discharge
  - Sufficient dewatering frequency (≥4 days/week)
- Number of candidate plants
  - 19 out of 37 plants if ammonia reduction is the discharge objective
  - 25 out of 37 plants if TN reduction is the discharge objective
- Costs
  - The Total PV costs is $550M
  - Flow-weighted average = $1.9/lb N removed
- The overall Ammonia/TN load reduction from Current Discharge is 22 and 17 percent, respectively

Summary of DRAFT Dry Results (Represents 29 Plants)

Parameter	Units	Optimization	Sidestream	Level 2	Level 3
Planning Horizon	Years	10	30	30	30
Total PV Cost	$ Mil	171	550	5,575	7,310
Total PV Range per Plant	$ Mil	0.6 – 24	5.1 – 130	10.9 – 1,560	16 – 1,740
TN Load Reduction	lb N/d	15,500	17,800–21,200	86,100	124,100
TN Load Reduction Range	lb N/d	20 – 6,500	70 – 8,600	10 – 25,100	30 – 31,500
TN Load Reduction Ave	%	14	17 - 22	58	83
Unit Total PV Cost Range	$/gpd	0.1 – 2.8	--	0.8 – 29	3.0 – 32
Unit Total PV Cost Flow-Weighted Average	$/gpd	0.4	--	7.5	9.8
Unit TN Cost Range	$/lb N	0.4 – 8.2*	1.2 – 6.5	1.1 – 164	1.7 – 178
Unit TN Cost Flow-Weighted Average	$/lb N	1.6*	1.9	5.8**	8.3

* Excludes Benicia

** Excludes Sunnyvale and San Jose

All results are preliminary

Summary of DRAFT Dry Results (Represents 29 Plants)

Parameter	Units	Optimization	Sidestream	Level 2	Level 3
Planning Horizon	Years	10	30	30	30
Total PV Cost	$ Mil	171	550	5,575	7,310
Total PV Range per Plant	$ Mil	0.6 – 24	5.1 – 130	10.9 – 1,560	16 – 1,740
TN Load Reduction	lb N/d	15,500	17,800–21,200	86,100	124,100
TN Load Reduction Range	lb N/d	20 – 6,500	70 – 8,600	10 – 25,100	30 – 31,500
TN Load Reduction Ave	%	14	17 - 22	58	83
Unit Total PV Cost Range	$/gpd	0.1 – 2.8	--	0.8 – 29	3.0 – 32
Unit Total PV Cost Flow-Weighted Average	$/gpd	0.4	--	7.5	9.8
Unit TN Cost Range	$/lb N	0.4 – 8.2*	1.2 – 6.5	1.1 – 164	1.7 – 178
Unit TN Cost Flow-Weighted Average	$/lb N	1.6*	1.9	5.8**	8.3

* Excludes Benicia

** Excludes Sunnyvale and San Jose

All results are preliminary

Summary of DRAFT Wet Results (Represents 29 Plants)

Parameter	Units	Optimization	Sidestream	Level 2	Level 3
Planning Horizon	Years	10	30	30	30
Total PV Cost	$ Mil	212	415	7, 060	8,980
Total PV Range per Plant	$ Mil	0.6 – 24	5.1 – 130	3.5 - 2,240	23 – 2,470
TN Load Reduction	lb N/d	18,000	17,800–21,200	86,400	131,500
TN Load Reduction Range	lb N/d	20 – 6,100	70 – 8,600	10 – 25,100	30 – 31,500
TN Load Reduction Ave	%	14	17 - 22	62	85
Unit Total PV Cost Range	$/gpd	0.2 – 3.4	--	0.4 – 43	2.9 – 46
Unit Total PV Cost Flow-Weighted Average	$/gpd	0.4	--	8.4	10.8
Unit TN Cost Range	$/lb N	0.3 – 32*	1.2 – 6.5	0.5 – 104	1.5 – 57
Unit TN Cost Flow-Weighted Average	$/lb N	2.3*	1.9	6.5**	5.6

* Excludes Benicia

** Excludes Sunnyvale and San Jose

All results are preliminary

Summary of DRAFT Wet Results (Represents 29 Plants)

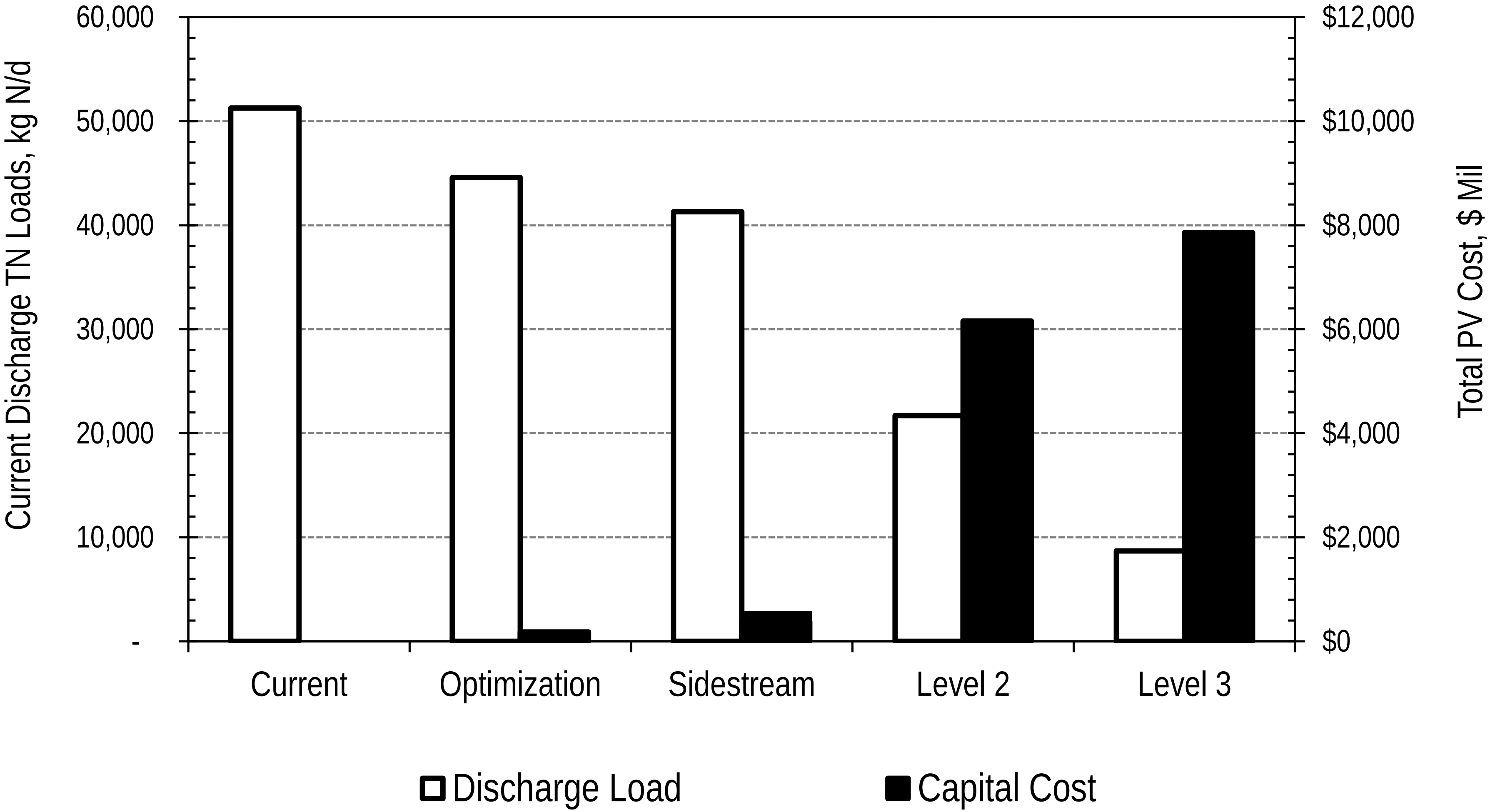
Parameter	Units	Optimization	Sidestream	Level 2	Level 3
Planning Horizon	Years	10	30	30	30
Total PV Cost	$ Mil	212	415	7, 060	8,980
Total PV Range per Plant	$ Mil	0.6 – 24	5.1 – 130	3.5 - 2,240	23 – 2,470
TN Load Reduction	lb N/d	18,000	17,800–21,200	86,400	131,500
TN Load Reduction Range	lb N/d	20 – 6,100	70 – 8,600	10 – 25,100	30 – 31,500
TN Load Reduction Ave	%	14	17 - 22	62	85
Unit Total PV Cost Range	$/gpd	0.2 – 3.4	--	0.4 – 43	2.9 – 46
Unit Total PV Cost Flow-Weighted Average	$/gpd	0.4	--	8.4	10.8
Unit TN Cost Range	$/lb N	0.3 – 32*	1.2 – 6.5	0.5 – 104	1.5 – 57
Unit TN Cost Flow-Weighted Average	$/lb N	2.3*	1.9	6.5**	5.6

* Excludes Benicia

** Excludes Sunnyvale and San Jose

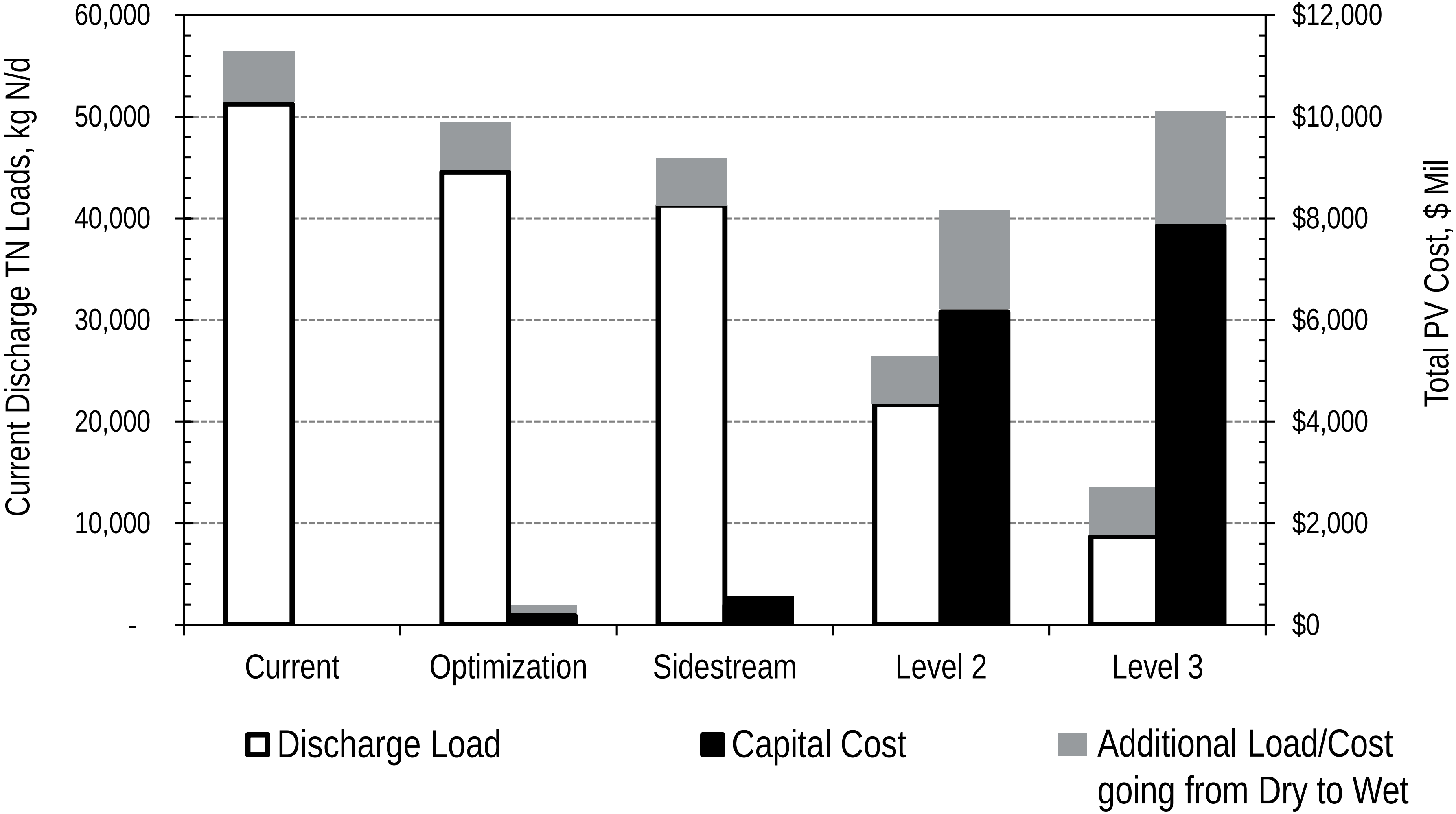
All results are preliminary

DRAFT: Projecting Baywide Preliminary Total N Results (Dry Season)



- Optimization = 10-yr planning horizon
- Sidestream and Upgrades (Level 2 and 3) = 30-yr planning horizon

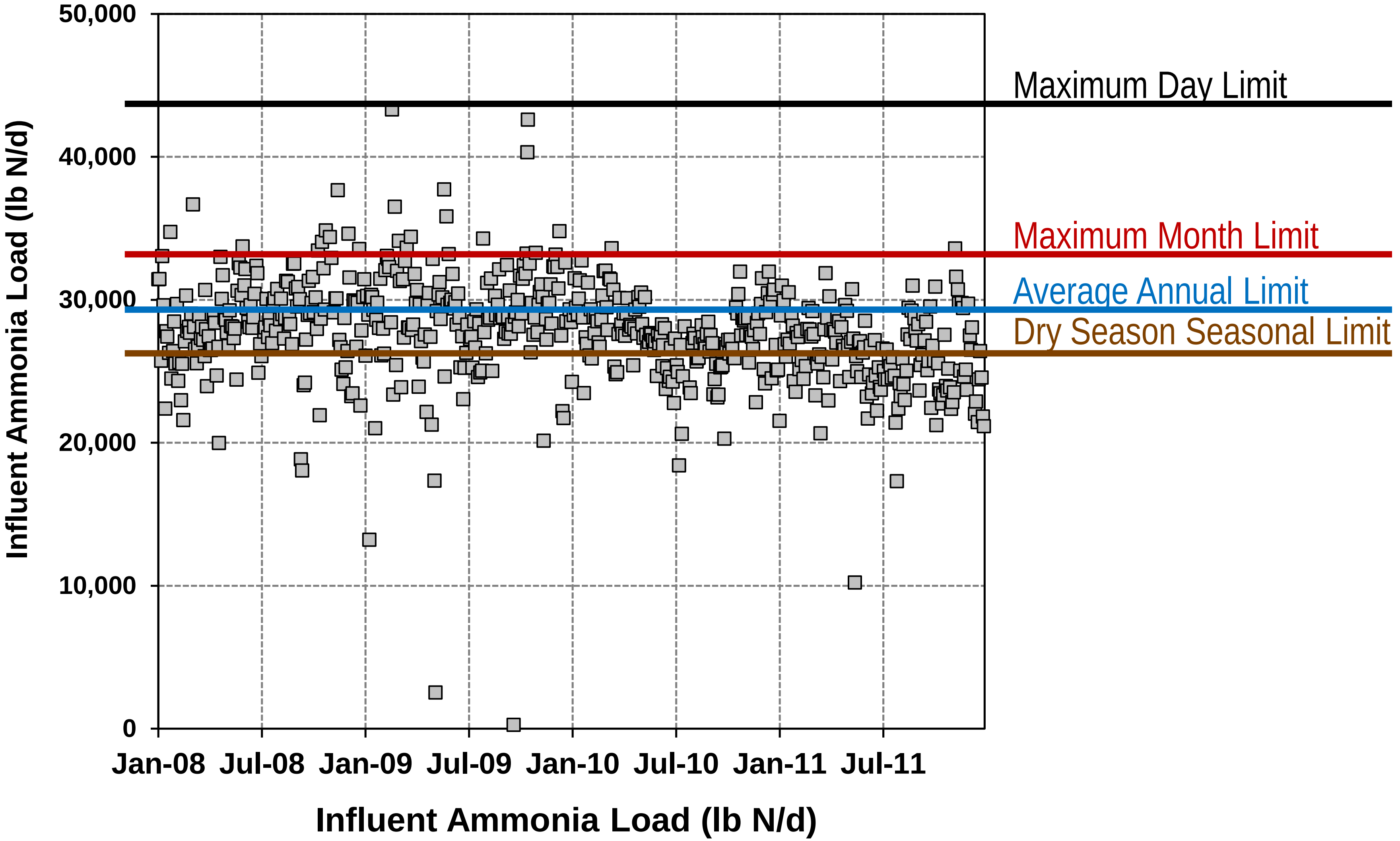
DRAFT: Projecting Baywide Preliminary Total N Results (Dry plus Wet Season)



- Optimization = 10-yr planning horizon
- Sidestream and Upgrades (Level 2 and 3) = 30-yr planning horizon

Role of Averaging Periods

Importance of Averaging Periods



Role of Averaging Periods on SRT and Basin Volume

Averaging Periods Govern the SRT and Overall Basin Volume

Role of Averaging Periods on Cost: Oro Loma for Level 3

Parameter	Units	Dry Season			Wet Season		
		Ave Annual	Max Month	Max Day	Ave Annual	Max Month	Max Day
Capital PV	$ Mil	60	68	84	66	73	110
O&M	$ Mil /yr	5.7	6.0	6.3	6.1	6.6	7.1
O&M PV	$ Mil	130	134	140	137	147	159
Total PV	$ Mil	190	202	224	203	221	267
NH4 Load Reduction *	%	97	99	>99	92	99	>99

* Based on 6-years historical data from Hampton Roads Sanitation District VIP Plant

Nutrient Load Reduction by Other Means

BACWA Recycled Water Survey 2015

Agency Name (Recycled Water Producer):

Recycled Water Distributors/Retailers:

CURRENT AND PROJECTED FUTURE AMOUNT OF RECYCLED WATER BY USE CATEGORY (in acre-feet)

	Total Distribute	Confidence (see Note B)	Golf Course Irrigation (See Note C)	Landscape (see Note D)	Commercial (see Note E)	Industrial (see Note F)	Agricultural (see Note G)	Environmental Enhancement (see Note H)	Internal Use (see Note I)	GW Recharge for Indirect Potable Reuse	Surface Water Augmentation	Direct Potable Reuse	Other Non-potable Reuse (See Note J)	RO concentrate or other return	Comments
Type of RW (See Note A):															
Current			0	0	0	0	0	0	0	0	0	0	0	0	
Future															
Future															
Future															
Future															
Future															
Future															

2015 MONTHLY RECYCLED WATER DISTRIBUTION DATA BY USE CATEGORY (in acre-feet)

	TOTAL		Golf Course	Landscape	Commercial	Industrial	Agricultural	Environ. Enhance	Internal Use	GW Recharg	Surface Water	Direct Potable	Other Non-	Return Flows	Comments
January															
February															
March															
April															
May															
June															
July															
August															
September															
October															
November															
December															
TOTAL															

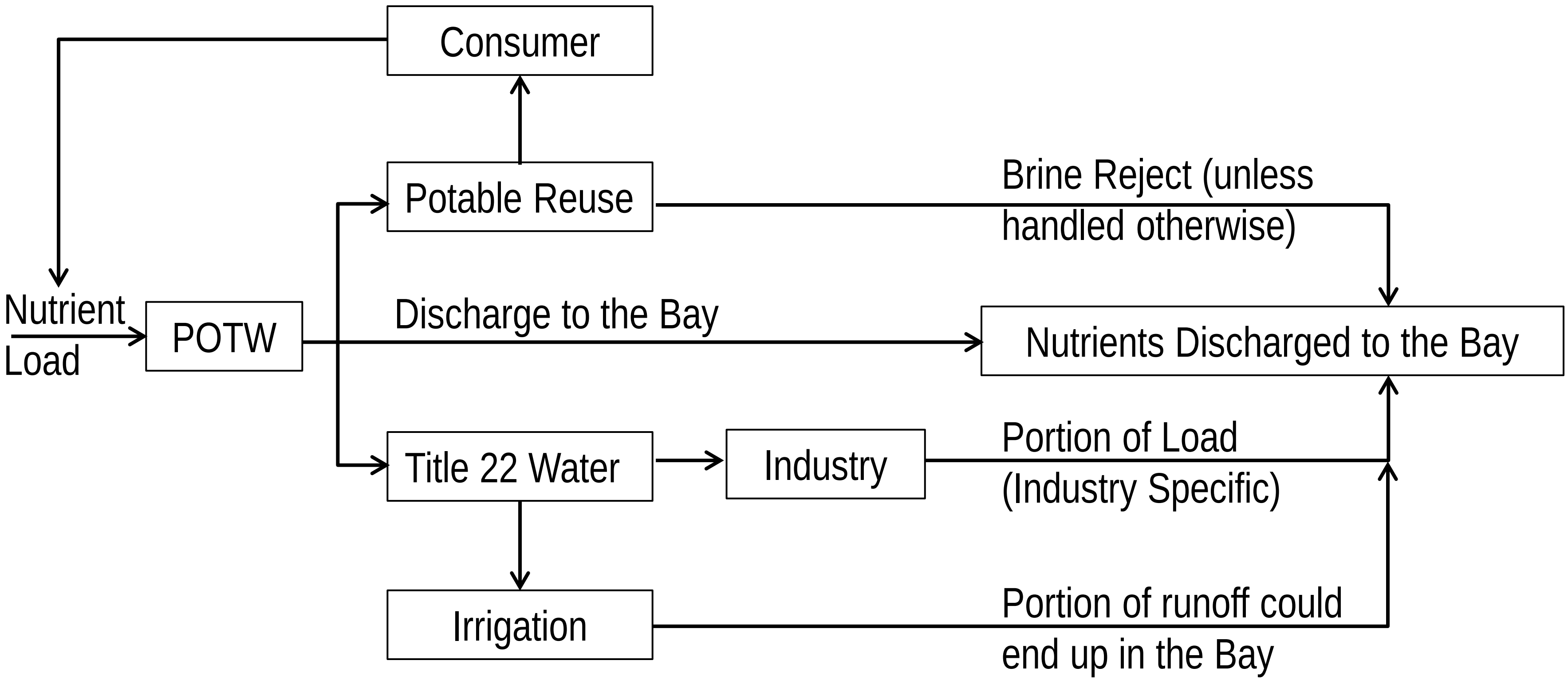
Data | README | Potable Reuse Definitions

Recycled Water Survey

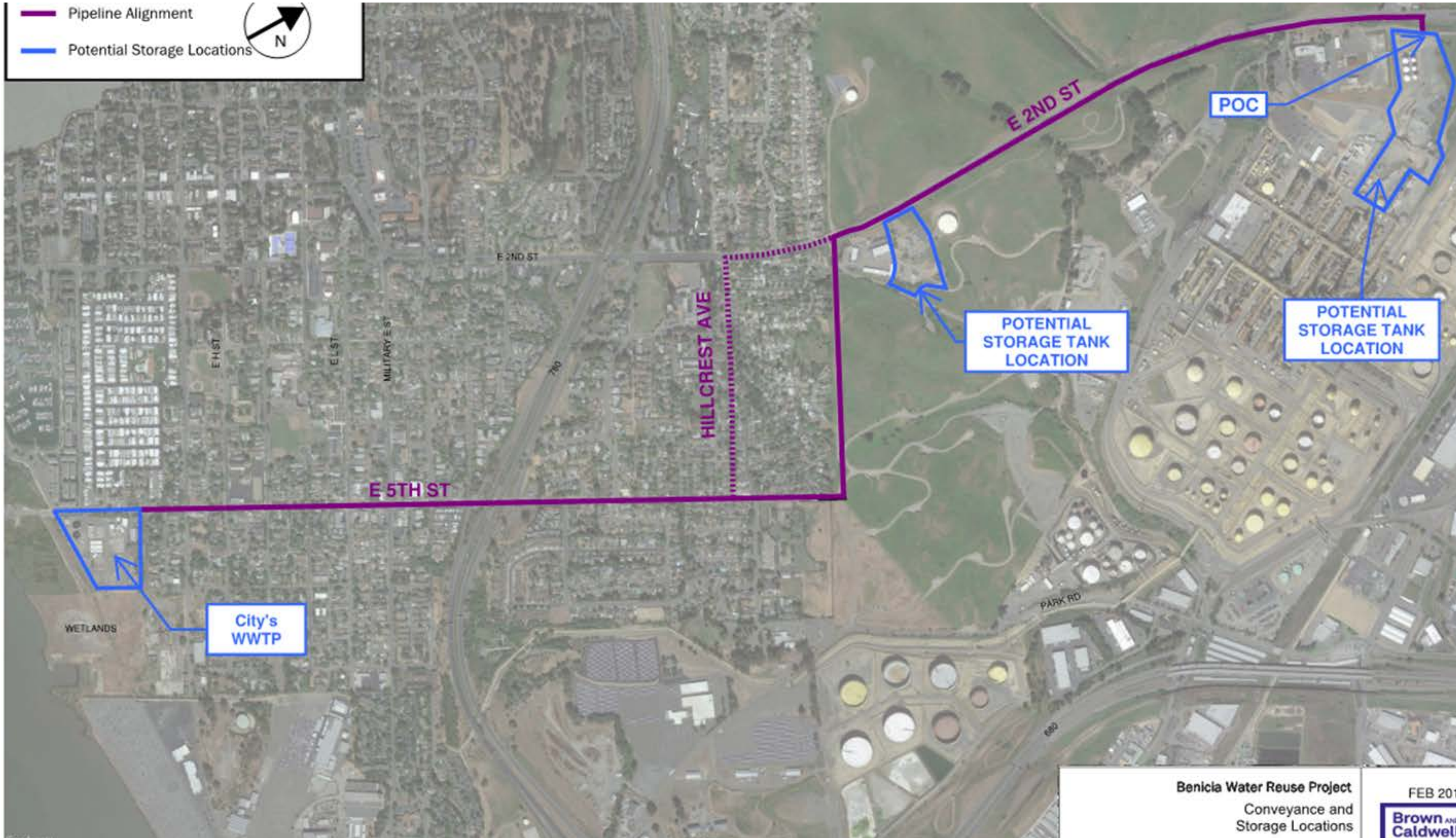
Preliminary Recycled Water Survey Results Distribution

- Overall: About half of the plants have completed the surveys (22).
- We are still quantifying the water uses (purple pipe vs potable reuse) and where the loads end up

Fate of Nutrients that Exit a POTW (Excludes Biosolids)



City of Benicia: Recycled Water Project



Produce up to 2,200 AFY (~2mgd) of Title 22 Recycled Water at the City's WWTP for use as cooling tower makeup water at the Valero Benicia Refinery and irrigation water for City customers

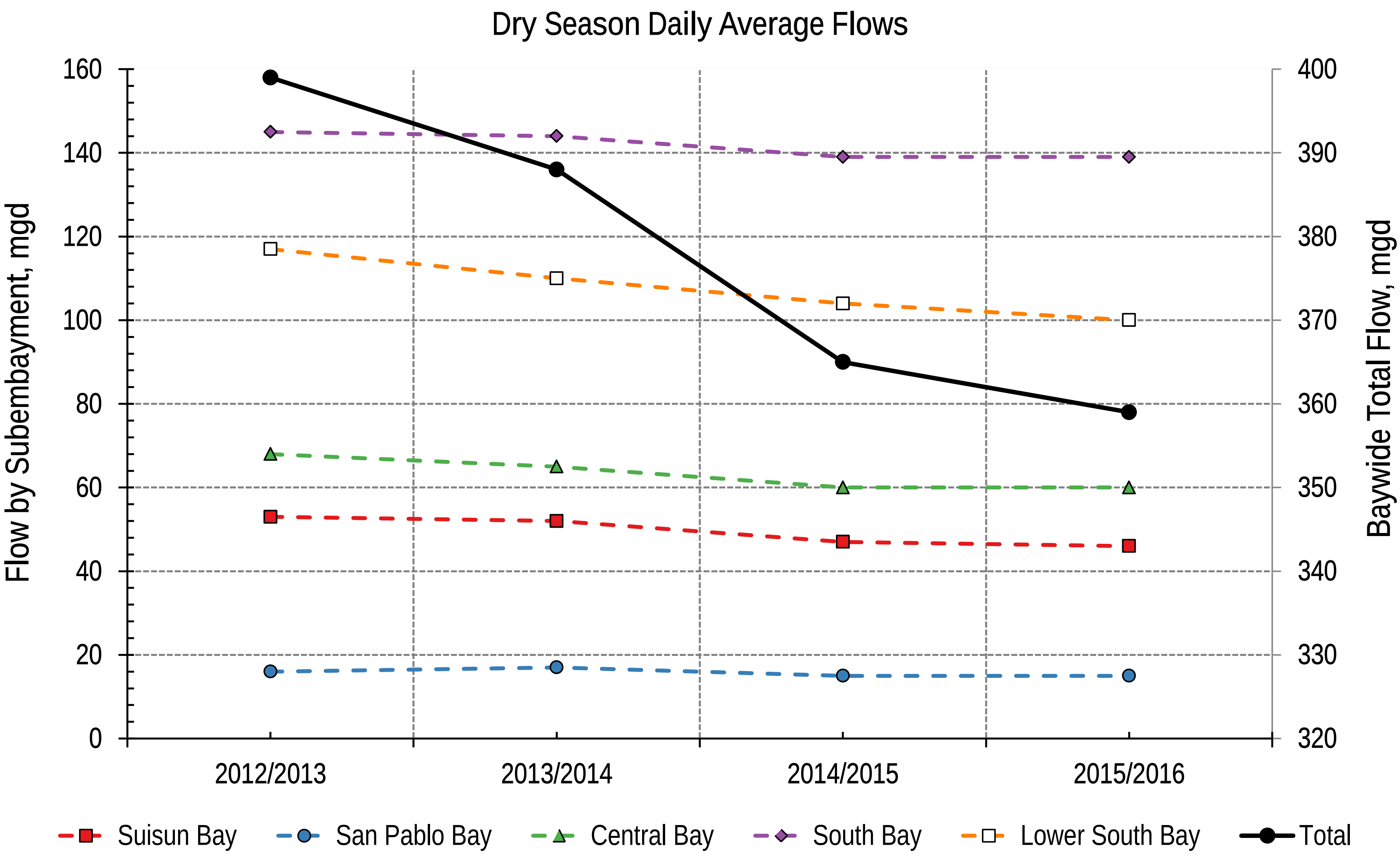
Group Annual Report (GAR)
Submitted on 9/30/2016

2016 Group Annual Report: Changes from 2015 Submittal

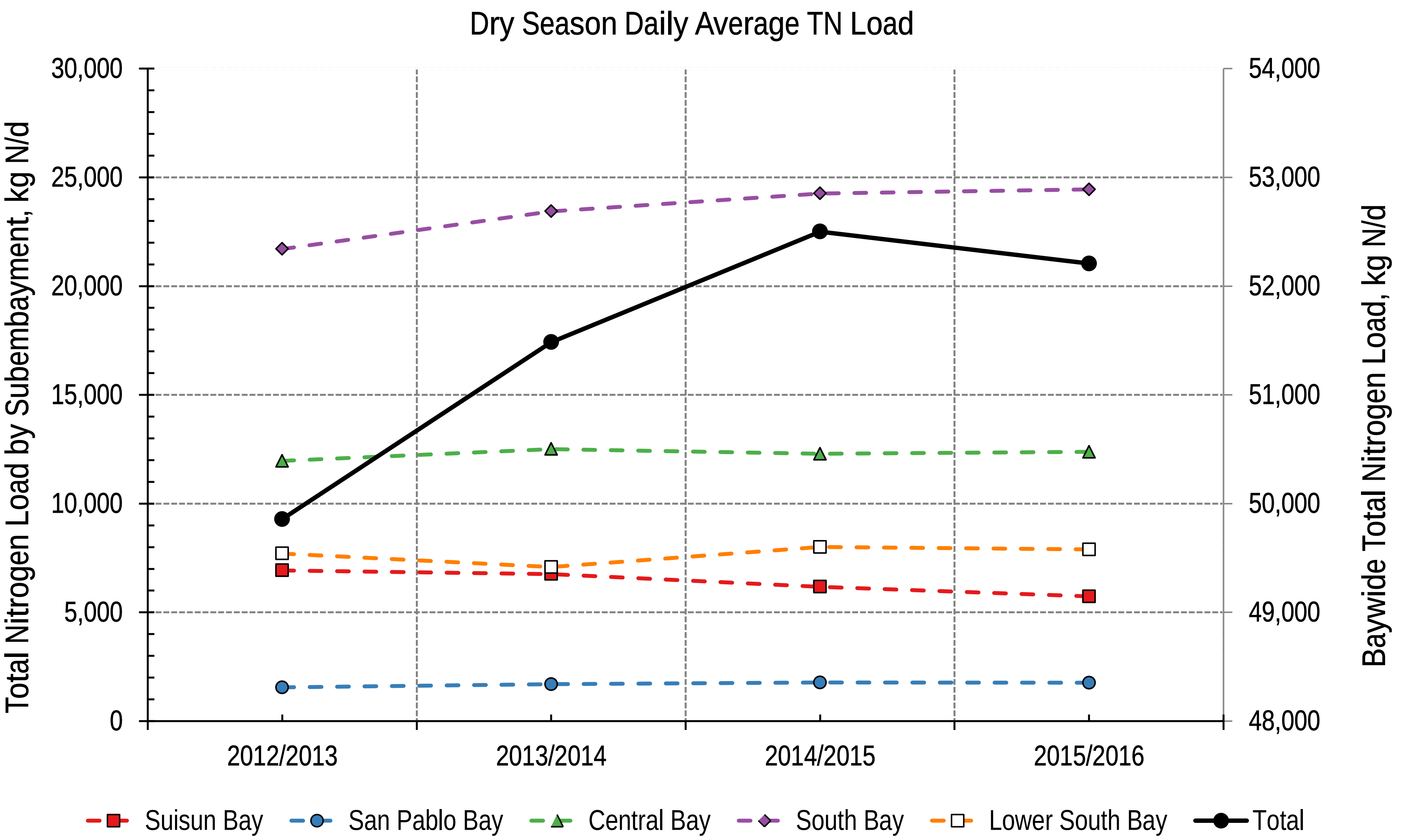

Bay Area Clean Water Agencies
Nutrient Reduction Study
Group Annual Report
Nutrient Watershed Permit Annual Report
2016
October 1, 2016
BACWA
BAY AREA
CLEAN WATER
AGENCIES

- Provided Input:
  - SRP Terminology / Data Reporting
    - Dissolved orthophosphate
  - Recycled Water Data Collection
- Used the template to streamline 2016 data collection
- Raw influent data collected to avoid misinterpretation of flow and load data
- Added the percent change in slope with respect to initial three years of data
- Next year: refine the statistical approach

2016 GAR Results (Flow)



2016 GAR Results (TN Load)



Schedule

- Complete all draft reports by March 31, 2017
- Address comments and submit updated plant reports by July 31, 2017
- Prepare draft summary report by September 30, 2017

DRAFT: Summary of Draft Report Findings

- 29 out of 37 plants have been analyzed.
  - We anticipate changes to each plant's draft report based on plant provided comments (after draft reports are all released).
  - The evaluation is not intended to serve as a pre-design. The concepts are all plant specific that will require more detailed analysis to verify/confirm any report findings.
- Findings from the 29 plants evaluated thus far:
  - Ammonia removal is the most difficult and expensive of the nutrients evaluated
  - Costs increase with each treatment level and the wet season is typically more expensive than dry.
  - Nutrient load reduction increases with treatment level
- Draft Costs for the 29 plants evaluated thus far:
  - Optimization: the Total PV costs are $171M to $212M for dry and wet, respectively
  - Sidestream: the Total PV costs are $550M
  - Upgrades: Total PV costs range from $5.6B for Level 2 dry to $9.0B for Level 3 wet
- The final results will provide information in parallel with the science plan to assist with making informed management/policy decisions

BACWA Annual Meeting

27 January 2017

Brown AND Caldwell

BACWA BAY AREA CLEAN WATER AGENCIES

© 2017 HDR, Inc., all rights reserved.

Hip Pocket

2016 GAR Results (Ammonia Load)