LAKE MEAD WATER QUALITY FORUM

Algae Task Force Update
October 26, 2010

Douglas D. Drury, Ph. D
Clark County Water Reclamation District

2010 ALGAE TASK FORCE MEMBERS

- Doug Drury
- Peggy Roefer
- Todd Tietjan
- Steve Weber
- Dan Fischer
- Scott Shiefer
- Bryan Moore
- Jon Sjoberg
- Bill Shepherd
- Dana LaRonce
- Devon Morgan
- Erik Orsak
- Kevin Eubanks
- Kathy Sertic
- Randy Pahl
- Alan Tinney

1. Reviewed last recommendations from last two Algae Task Forces

2. Collected as much data as possible to address previous work

3. Determine if additional data is needed to explain factors causing algae blooms

4. Review algae growth potential as Lake Mead lowers even more

"GET FEDERAL GOVERNMENT TO FUND MORE RESEARCH"

Research by: NPS, USGS, BOR

"ASSESS NON-POINT SOURCE NUTRIENT LOADINGS"

Additional sampling needed

- **P, lbs/day contributions from entire unit hydrograph**
- **Use SNWA's hydrolab**
- **Use CCRFCD sampler**
- **CCWRD to perform chemical analysis**

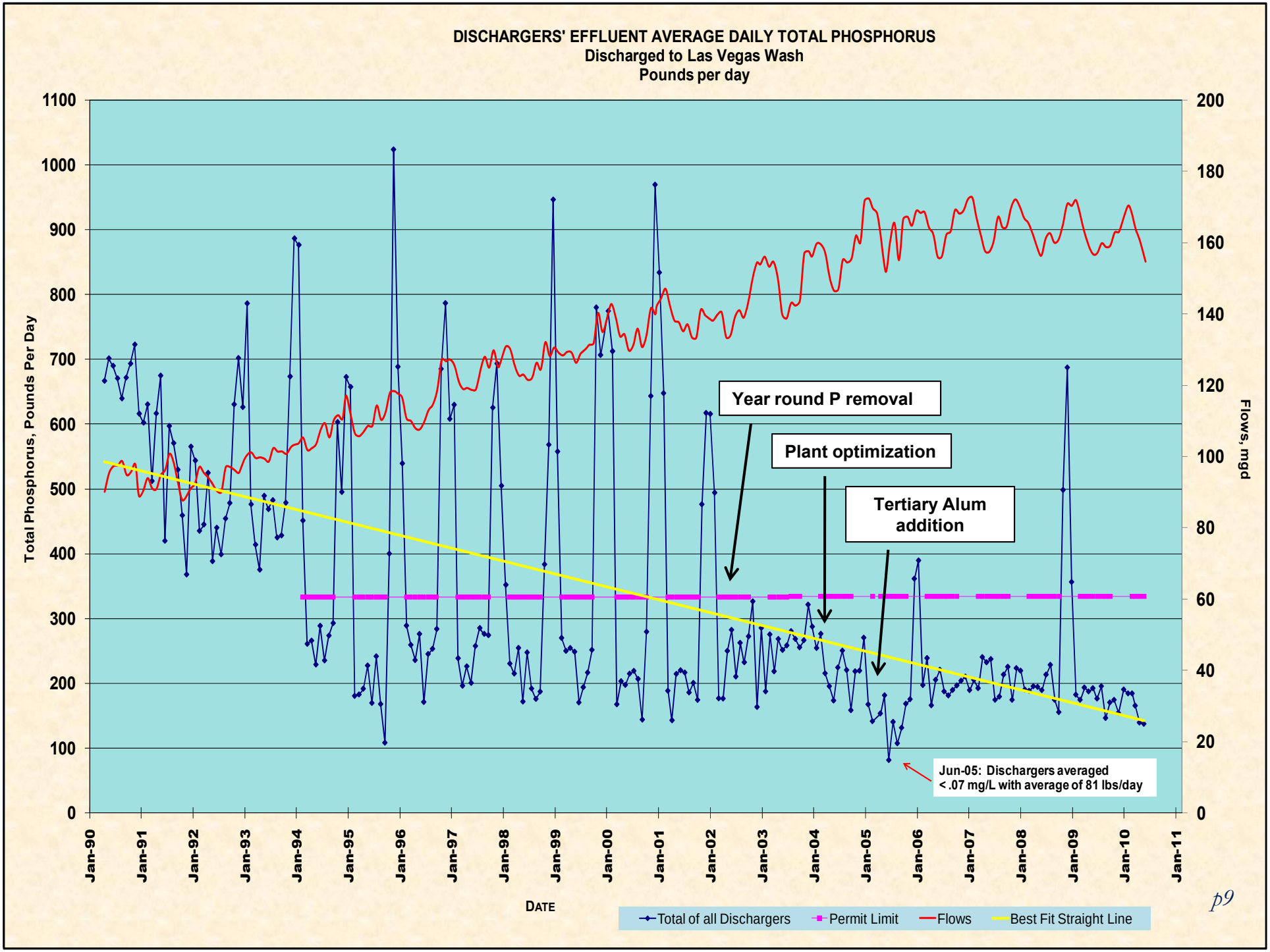
"USE MODEL TO DETERMINE ASSIMILATIVE CAPACITY IN LAS VEGAS BAY AND LAKE MEAD"

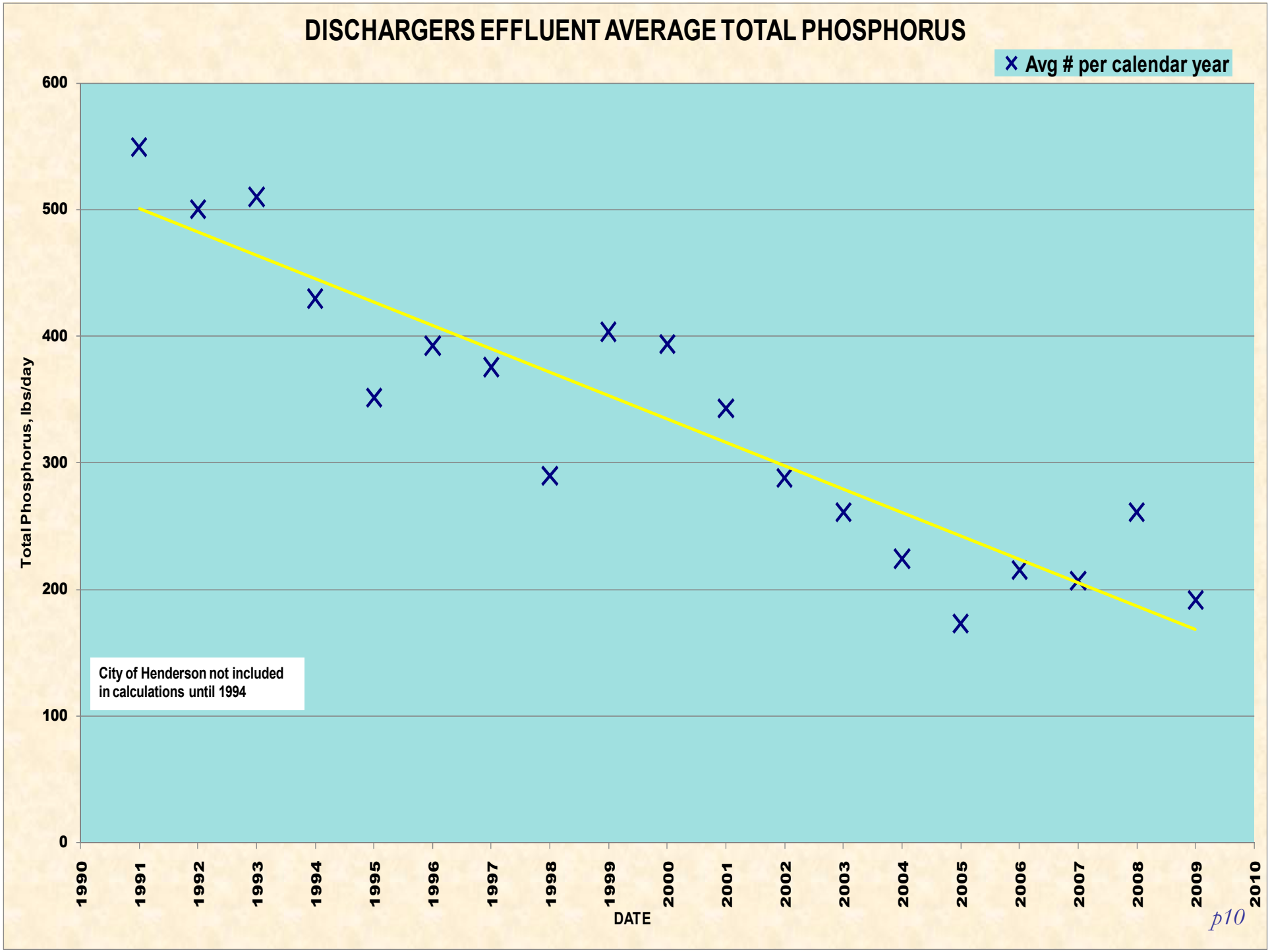
How to handle?

- **Point source contribution < 200 lb/day P for 2009/10**

"BEGIN YEAR ROUND P REMOVAL AT TREATMENT PLANTS"

- 2002 – CCWRD and COH
- 2003 – CLV
- Recent P discharges from CLV
- Plant optimization starting 2004/2005


DISCHARGERS' EFFLUENT AVERAGE DAILY TOTAL PHOSPHORUS
Discharged to Las Vegas Wash
Pounds per day
Total Phosphorus, Pounds Per Day
Flows, mgd
Year round P removal
Plant optimization
Tertiary Alum addition
Jun-05: Dischargers averaged < .07 mg/L with average of 81 lbs/day
DATE
Total of all Dischargers
Permit Limit
Flows
Best Fit Straight Line


DISCHARGERS EFFLUENT AVERAGE TOTAL PHOSPHORUS
Avg # per calendar year
Total Phosphorus, lbs/day
600
500
400
300
200
100
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
DATE
City of Henderson not included in calculations until 1994

"QUAGGA MUSSELS"

- Found in Lake Mead 2007
- Feed on algae
  - Removes chlorophyl
- Quagga population in Las Vegas Bay?

"CONDUCT STUDY TO DETERMINE EXACT CAUSE OF 2001 ALGAL BLOOM"

- **Is this it?**
- **Is it possible?**

"FORM STUDY GROUP TO DETERMINE P LOADINGS FROM HIGH SOURCE AREAS"

- **POTW**
- **Non-point flood discharges – need more data. Should a study group be formed? POTW are monitored daily & submitted monthly for Total P. Should storm flows be monitored more frequently?**
- **Dry weather flow from tributaries**
  - **Highest Total P = 0.1 mg/L for 40 samples**
  - **Highest max month ≤ 5 lbs/P per day**

DRY WEATHER FLOW – TOTAL P lbs/day
JANUARY 2007 – July 2010

	Jan-07	Apr-07	Jul-07	Oct-07	Jan-08	Apr-08	Jul-08	Oct-08	Jan-09	Apr-09	Jul-09	Oct-09	Jan-10	Apr-10	Jul-10	MAX MONTH
FLAMINGO WASH (lb P/day)	0.024	0.075	0.577	0.839	0.362	0.329	0.474	0.433	0.366	0.323	0.735	*	*	0.509	0.514	0.84
SLOAN CHANNEL (lb P/day)	~	~	~	0.29	0.04	0.05	0.05	0.03	0.03	0.08	0.09	*	*	~	0.04	0.29
MONSON CHANNEL (lb P/day)	~	0.04	~	0.03	0.04	0.02	0.07	0.04	0.03	0.04	0.07	*	*	~	~	0.07
DUCK CREEK (lb P/day)	~	~	~	~	0.65	0.57	0.72	0.44	0.79	0.55	3.71	*	*	0.48	2.16	3.71
TOTAL	**0.024**	0.11	0.577	1.16	1.08	0.97	1.31	0.94	1.22	0.98	4.61	~	~	0.99	2.71	4.92
MIN	**0.024**	0.04	0.577	0.03	0.04	0.02	0.05	0.03	0.03	0.04	0.07	~	~	0.48	0.04	0.07
MAX	**0.024**	0.08	0.577	0.84	0.65	0.57	0.72	0.44	0.79	0.55	3.71	~	~	0.51	2.16	3.71
AVG	**0.024**	0.06	0.577	0.39	0.27	0.24	0.33	0.24	0.30	0.25	1.15	~	~	0.50	0.90	1.23
STD DEV	**0.024**	0.029	0.577	0.413	0.294	0.261	0.327	0.231	0.363	0.237	1.734	~	~	0.017	1.109	1.69
COUNT	**1**	2	1	3	4	4	4	4	4	4	4	0	0	2	3	4

n always = 1 sample at each location each month except when no sample was taken

~ = no data

*Rained October 2009

*Rained January 2010

Total P = 4.92 lbs/day maximum

n= 40 samples - highest 3.71 lbs/day

Flamingo Wash calculations for lbs/day based on flow data from USGS website on Total P sample dates

Sloan, Monson, and Duck calculations for lbs/day based on flow samples taken by SNWA within 7-10 days of Total P sample dates

DRY WEATHER FLOW – TOTAL P mg/L
JANUARY 2007 – July 2010

	Jan-07	Apr-07	Jul-07	Oct-07	Jan-08	Apr-08	Jul-08	Oct-08	Jan-09	Apr-09	Jul-09	Oct-09	Jan-10	Apr-10	Jul-10	MAX MONTH
FLAMINGO WASH (Total P, mg/L)	0.0005	0.001	0.017	0.019	0.011	0.01	0.016	0.012	0.01	0.01	0.021	*	*	0.016	0.018	0.021
SLOAN CHANNEL (Total P, mg/L)	~	~	~	0.053	0.011	0.012	0.013	0.012	0.01	0.019	0.026	*	*	~	0.015	0.053
MONSON CHANNEL (Total P, mg/L)	~	0.01	~	0.017	0.012	0.014	0.023	0.01	0.01	0.014	0.022	*	*	~	~	0.053
DUCK CREEK (Total P, mg/L)	~	~	~	~	0.01	0.012	0.018	0.01	0.014	0.012	0.1	*	*	0.01	0.056	0.100
TOTAL	0.0005	0.01	0.017	0.09	0.04	0.05	0.07	0.04	0.04	0.06	0.17	~	~	0.03	0.09	0.227
MIN	0.0005	0.00	0.017	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	~	~	0.01	0.02	0.02
MAX	0.0005	0.01	0.017	0.05	0.01	0.01	0.02	0.01	0.01	0.02	0.10	~	~	0.02	0.06	0.10
AVG	0.0005	0.01	0.017	0.03	0.01	0.01	0.02	0.01	0.01	0.01	0.04	~	~	0.01	0.03	0.06
STD DEV	0.0005	0.006	0.017	0.020	0.001	0.002	0.004	0.001	0.002	0.004	0.039	~	~	0.004	0.023	0.03
COUNT	1	2	1	3	4	4	4	4	4	4	4	0	0	2	3	4

n always = 1 sample at each location each month except when no sample was taken

~ = no data

*Rained October 2009

*Rained January 2010

Total P = 0.056 mg/L maximum concentration

n = 40 samples - highest 0.056 mg/L

Flamingo Wash calculations for mg/L based on flow data from USGS website on Total P sample dates

Sloan, Monson, and Duck calculations for mg/L based on flow samples taken by SNWA within 7-10 days of Total P sample dates

	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010	
	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall	# Days of rainfall >.10 inches	Actual rainfall
JANUARY	8	0.87	1	0	5	0.02	0	0.01	11	2.07	0	0.03	0	0.06	1	0.57	0	0.04	6	2.04
FEBRUARY	6	2.21	0	0	0	2.13	7	1.46	9	2.45	0	0.05	1	0.16	0	0.05	4	0.78	4	1.05
MARCH	3	0.16	0	0.1	4	0.32	1	0.23	4	0.47	4	0.19	0	0	2	0.08	0	0	1	0.15
APRIL	1	0.04	0	0	3	0.38	4	0.92	0	0.06	0	0	1	0.08	0	0	0	0.05	1	0.05
MAY	0	0.02	0	0	0	0.01	0	0	0	0	0	0	0	0	1	0.11	0	0	0	0
JUNE	0	0	0	0	0	0	0	0	1	0.07	2	0.06	0	0	0	0	1	0.1	0	0
JULY	2	0.42	1	0.52	6	1.08	1	0.05	2	0.52	2	0.13	5	0.29	1	0.08	3	0.29	0	0
AUGUST	0	0.05	0	0	5	0.83	4	0.51	4	0.26	0	0.04	4	0.76	1	0.07	0	0.02	0	0
SEPTEMBER	0	0	1	0.31	1	0.52	1	0.18	0	0	0	0	2	0.67	0	0.03	0	0	0	0
OCTOBER	0	0	3	0.32	0	0	5	0.59	4	1.45	4	1.07	1	0	1	0.01	0	0	3	0.82
NOVEMBER	2	0.09	1	0.12	3	0.61	5	1.71	0	0	0	0	2	0.64	3	0.47	0	0.02		
DECEMBER	1	0.11	0	0.07	6	0.96	3	2.1	0	0.02	4	0.12	0	0.07	4	1.15	2	0.29		
TOTAL	23	3.97	7	1.44	33	6.86	31	7.76	35	7.37	16	1.69	16	2.73	14	2.62	10	1.59	15	4.11

Days of rainfall data from National Climatological Data Center. Five areas in and around the Las Vegas Valley were considered*

Normal and actual rainfall data from CCRFCD website

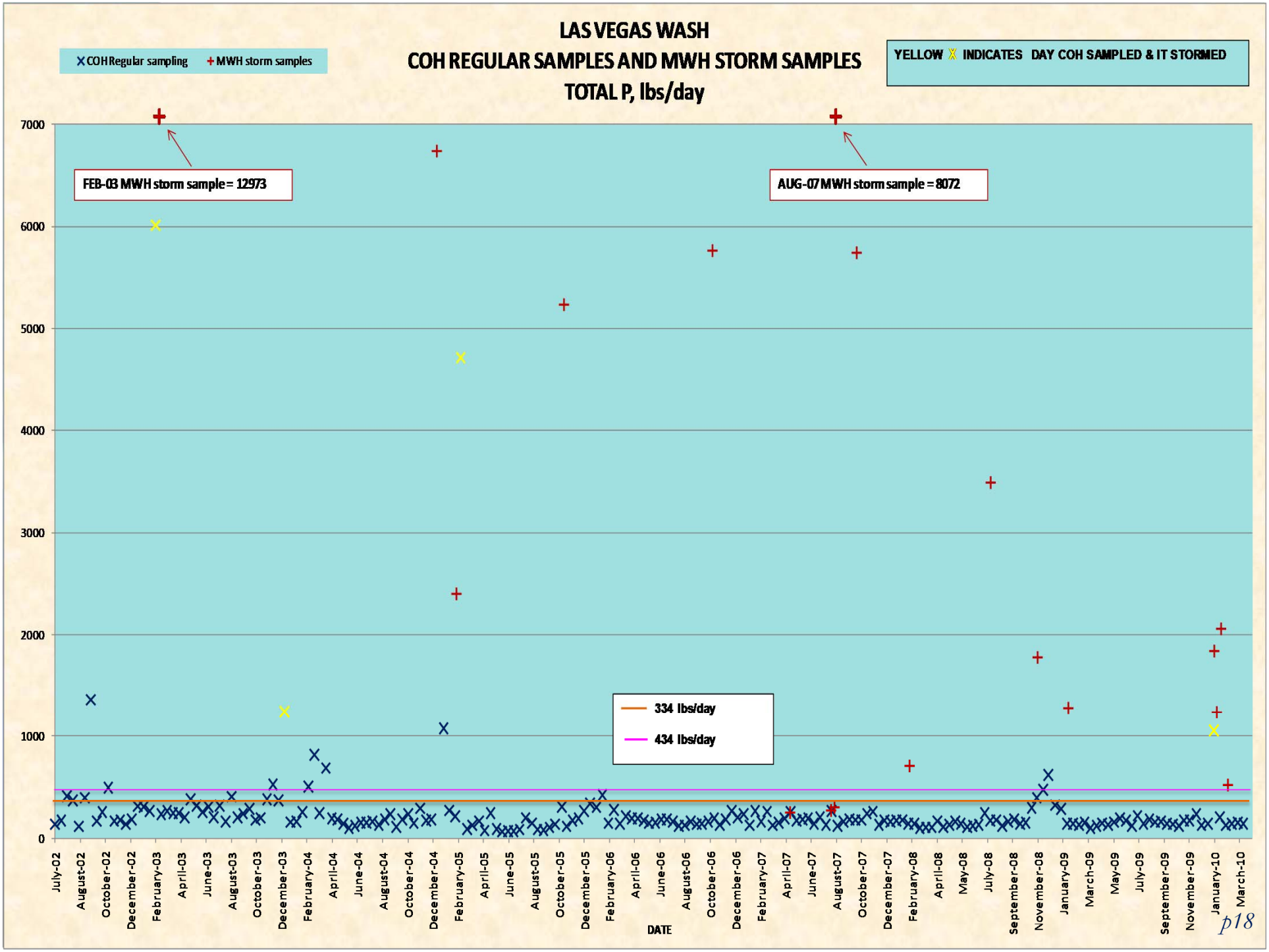
*2010 data based on McCarren Airport and MWH reports only

MWH WET WEATHER MONITORING DATA, 1992-2010 AT LAKE LAS VEGAS

	DATE	FLOW, cfs	TOTAL P, mg/L	TOTAL P, lbs/day
1.	02/12/2003	560	4.30	12973
2.	12/28/2004[a]	544	2.30	6741
3.	02/11/2005[a]	665	0.67	2400
4.	10/25/2005[b]	405	2.40	5237
5.	10/14/2006[a]	823	1.30	5764
6.	04/16/2007[a]	316	0.15	255
7.	07/24/2007[a]	396	0.13	277
8.	08/01/2007[a]	400	0.14	302
9.	08/27/2007[a]	681	2.20	8072
10.	09/22/2007[a]	561	1.90	5743
11.	01/27/2008[a]	503	0.26	705
12.	08/07/2008[a]	249	2.60	3488
13.	11/26/2008[a]	429	0.77	1780
14.	02/07/2009[a]	564	0.42	1276
15.	01/20/2010[b]	616	0.59	1840
16.	01/27/2010[b]	785	0.31	1239
17.	02/06/2010[b]	1010	0.39	2057
18.	02/22/2010[b]	502	0.20	523

[a] Samples were collected below Lake Las Vegas – flow data from USGS station 09419800 aka LW0.55

[b] Samples were collected above Lake Las Vegas – flow data from USGS station 09419700 aka Las Vegas Wash at Pabco Road


LAS VEGAS WASH
COH REGULAR SAMPLES AND MWH STORM SAMPLES
TOTAL P, lbs/day
COH Regular sampling
MWH storm samples
YELLOW X INDICATES DAY COH SAMPLED & IT STORMED
FEB-03 MWH storm sample = 12973
AUG-07 MWH storm sample = 8072
334 lbs/day
434 lbs/day
7000
6000
5000
4000
3000
2000
1000
0
July-02
August-02
October-02
December-02
February-03
April-03
June-03
August-03
October-03
December-03
February-04
April-04
June-04
August-04
October-04
December-04
February-05
April-05
June-05
August-05
October-05
December-05
February-06
April-06
June-06
August-06
October-06
December-06
February-07
April-07
June-07
August-07
October-07
December-07
February-08
April-08
May-08
July-08
September-08
November-08
January-09
March-09
May-09
July-09
September-09
November-09
January-10
March-10
DATE

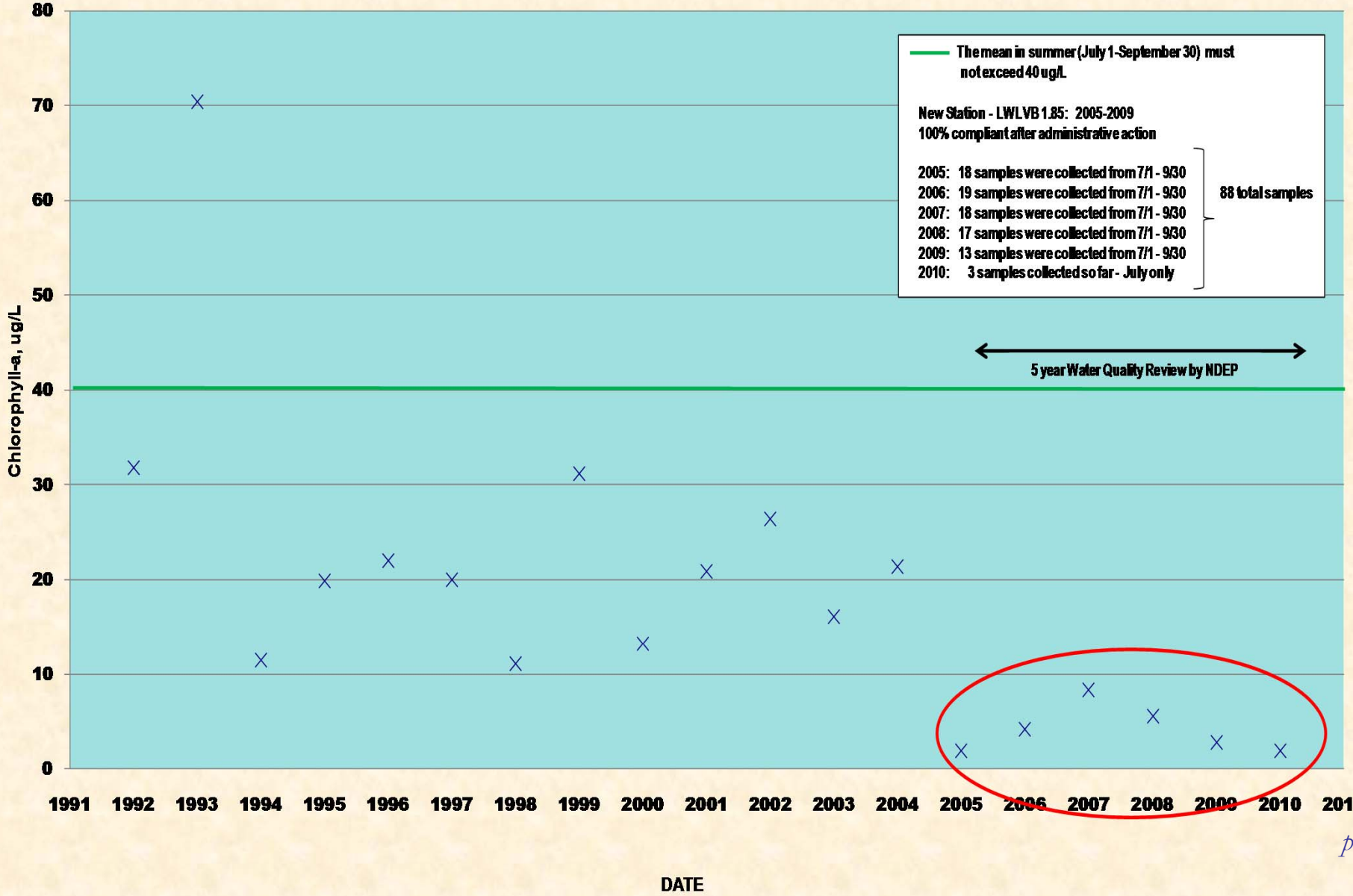
"BUILD SCOP PROJECT TO OBTAIN MORE ASSIMILATIVE CAPACITY"

- **The SCOP project has been suspended and will not be constructed. It has been replaced with the treatment alternative.**

- **For the last 6 years, the dischargers have improved treatment. All of the chlorophyll objectives have been met.**

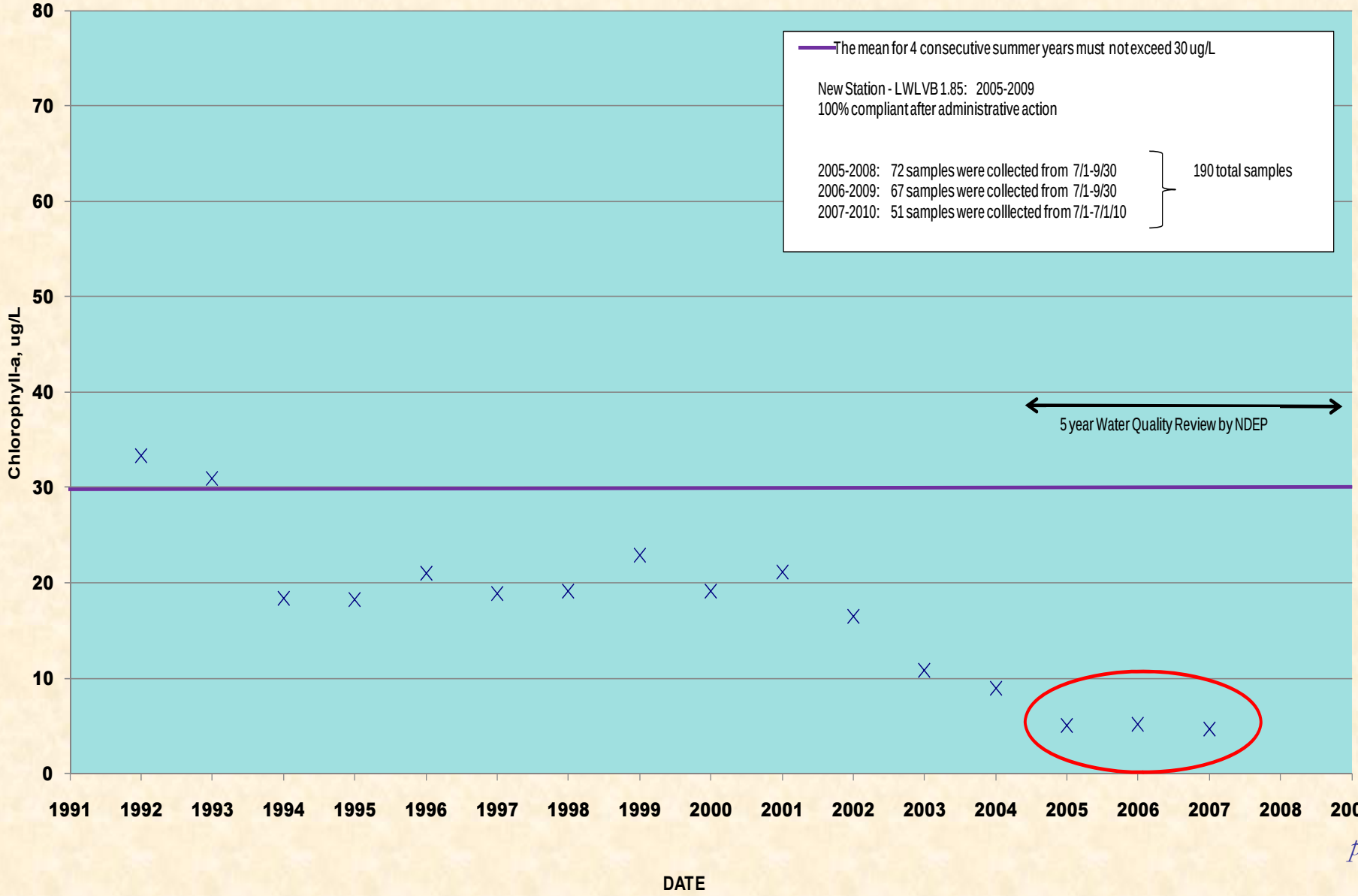
Data Source: Dischargers

Second Sample Station Into Las Vegas Bay
Chlorophyll a, ug/L
Old Station - LM3 (LVB 1.85M) = New Station - LWLVB 1.85 (Effective January 1, 2005)
Chl-a Mean in summer (7/1-9/30) <40 ug/L



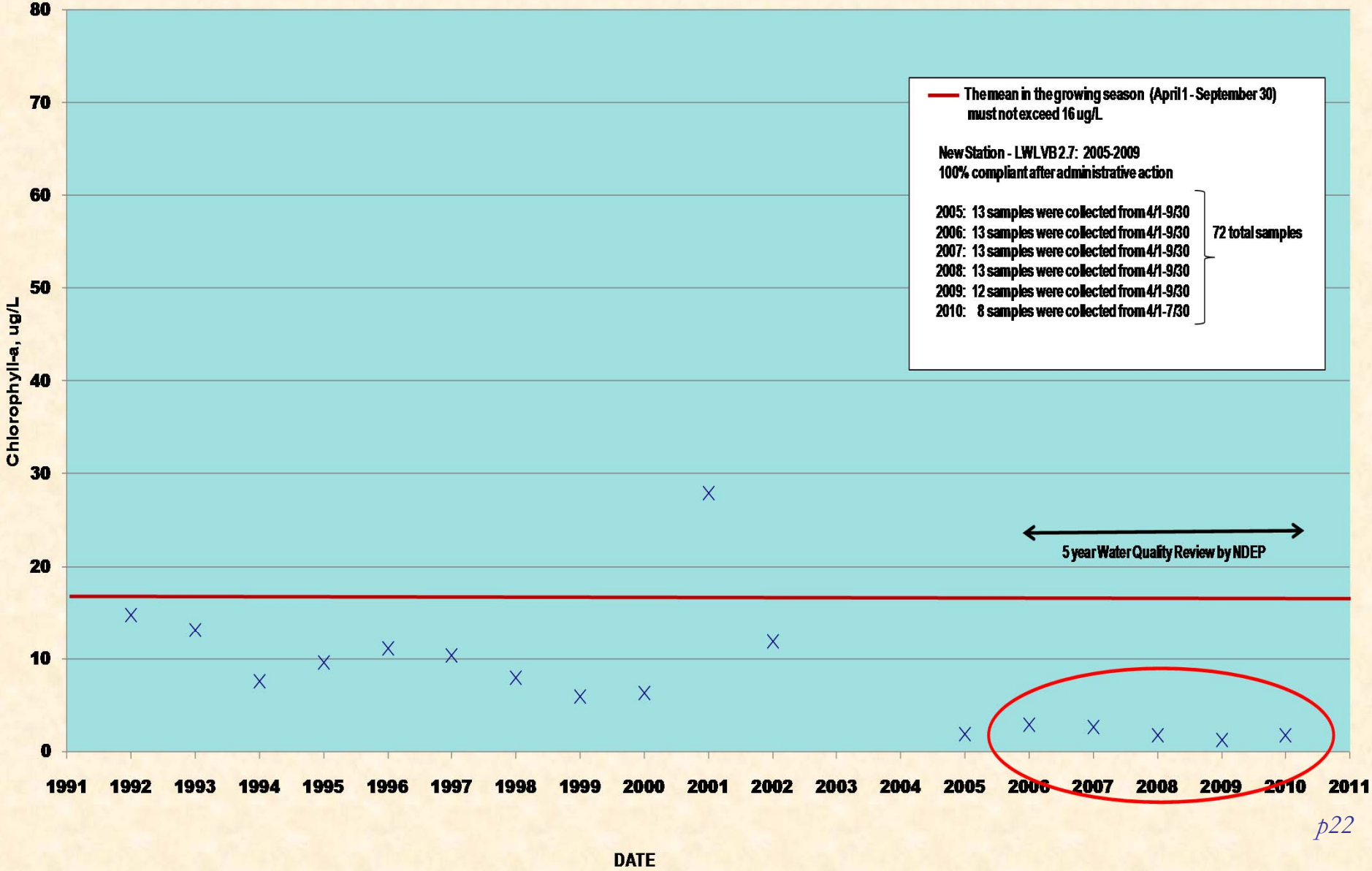
Data Source: Dischargers

Second Sample Station Into Las Vegas Bay
Chlorophyll a, ug/L
Old Station - LM3 (LVB 1.85M) = New Station - LWLVB 1.85 (Effective January 1, 2005)
Chl-a Mean for 4 consecutive summer years (7/1-9/30) <30 ug/L



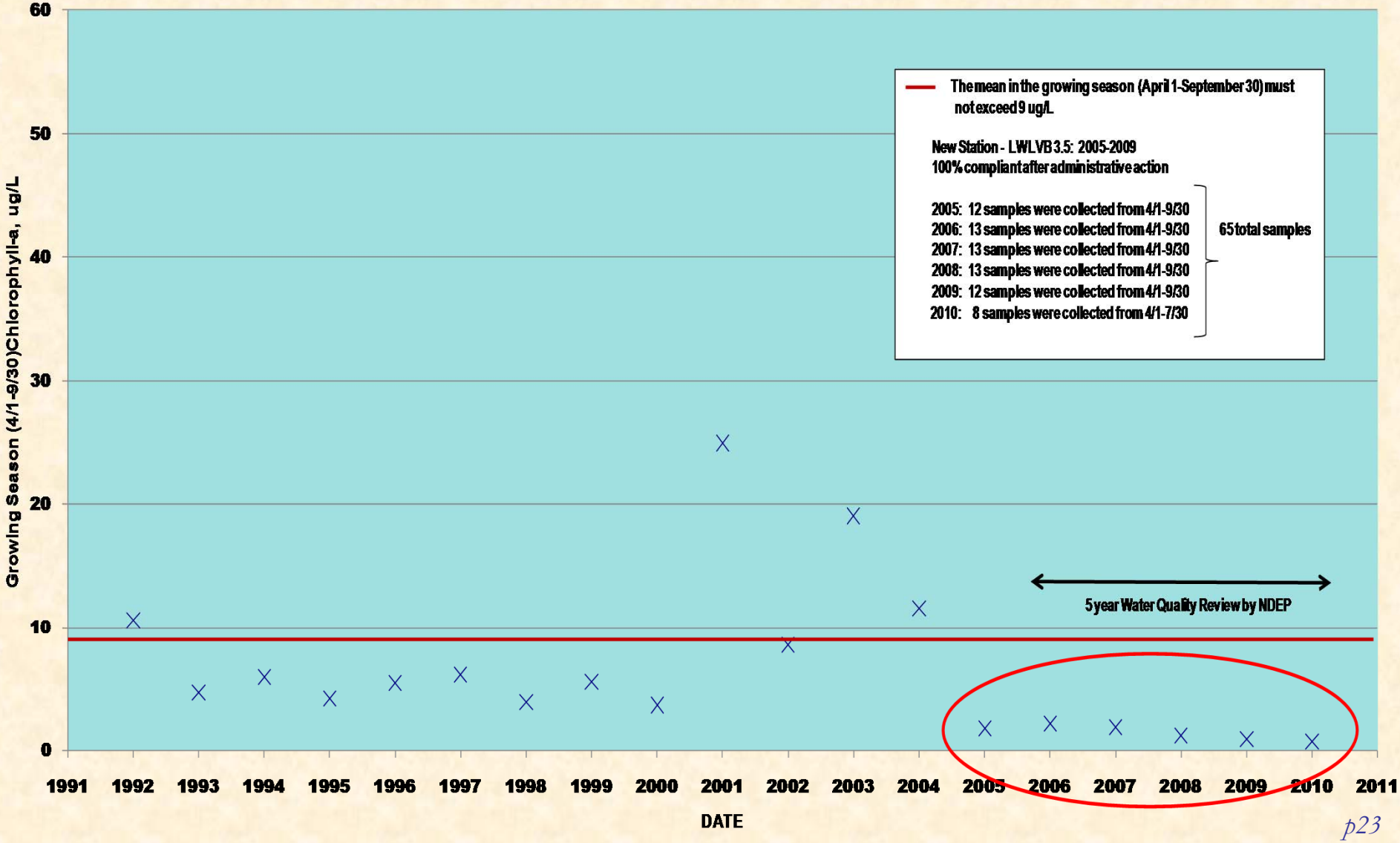
Data Source: Dischargers

Third Sample Station Into Las Vegas Bay
Chlorophyll -a, ug/L
Old Station - LM4 (LVB 2.7) = New Station - LWLVB 2.7 (Effective January 1, 2005)
Chl-a Mean for Growing Season (4/1-9/30) <16 ug/L



Data Source: Dischargers

Fourth Station into Las Vegas Bay
Chlorophyll-a, ug/L
Old Station - LM5 (LVB 3.5) = New Station - LWLVB 3.5 (Effective January 1, 2005)
Chl-a Mean for Growing Season (4/1-9/30) <9 ug/L

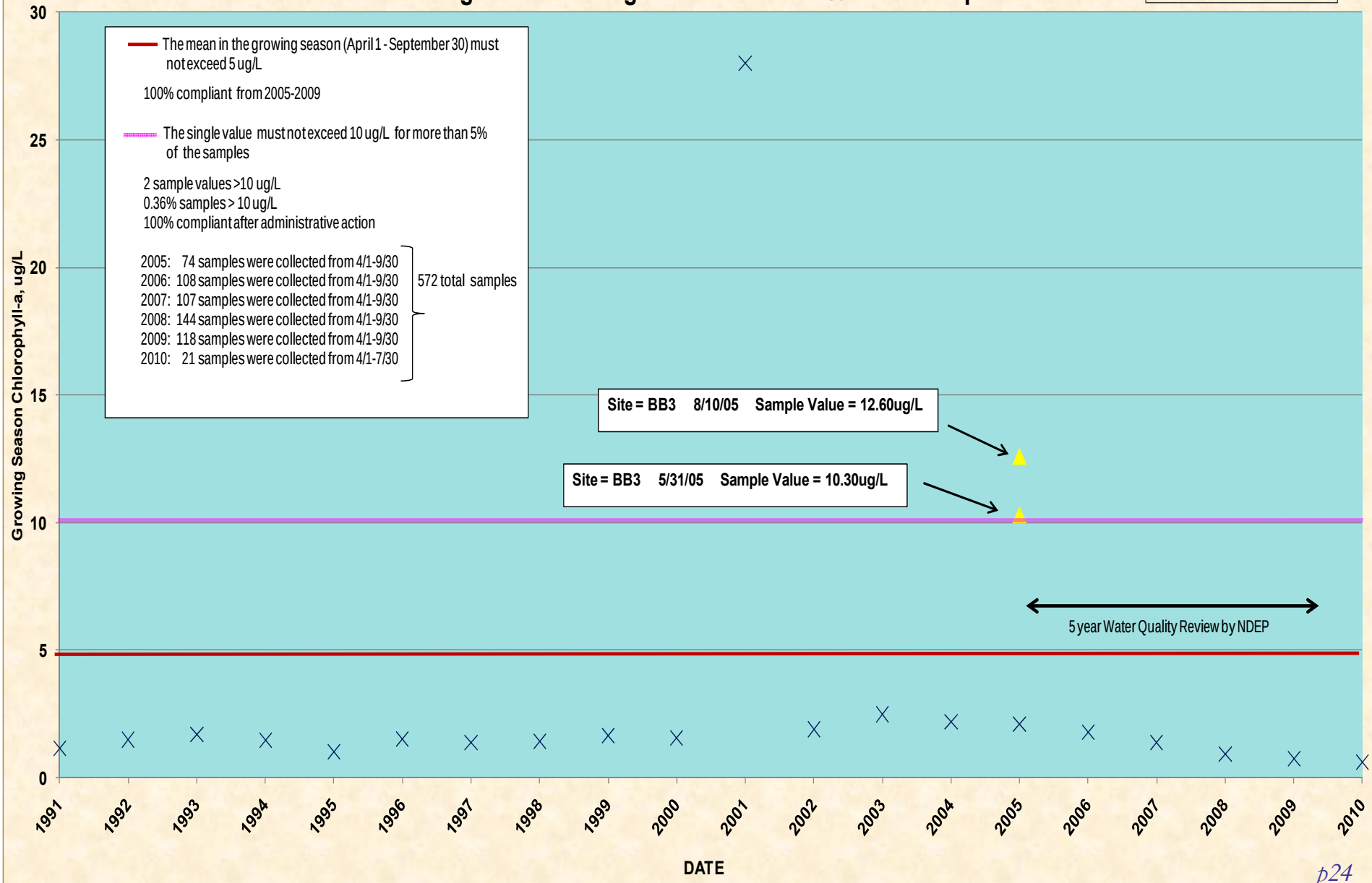


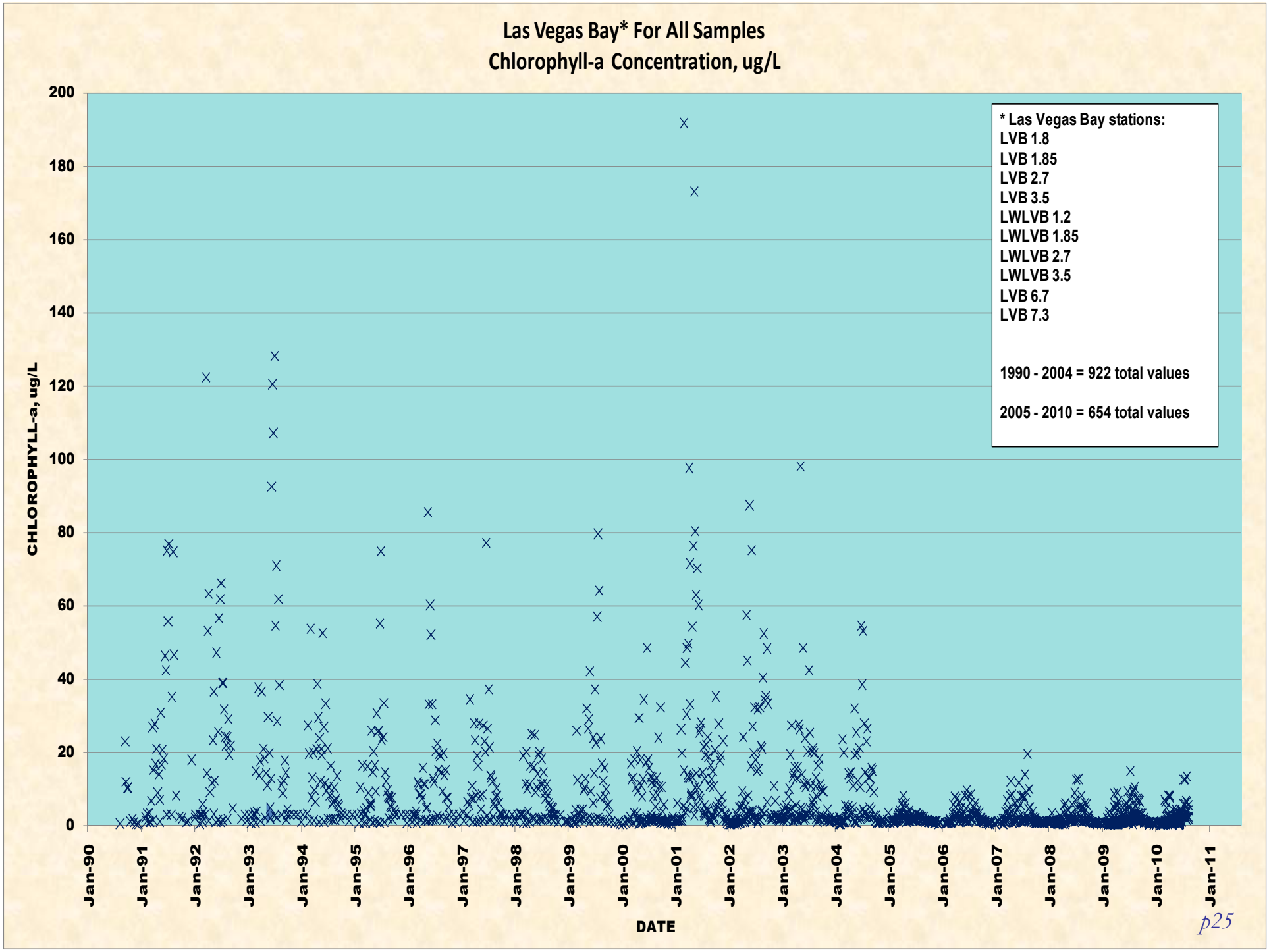
Data Source: Dischargers
SNWA

ALL STATIONS IN OPEN WATER OF BOULDER BASIN
Chlorophyll-a
Mean for growing season (April 1 - September 30) ≤ 5ug/L
The single value ≤ 10 ug/L for more than 5% of the samples

ALL STATIONS INCLUDES:

BB3	CR346.4
BB7	CR348.4
CR 342.5	CR350SE0.55
CR342.9	CR361.8
CR344.9	



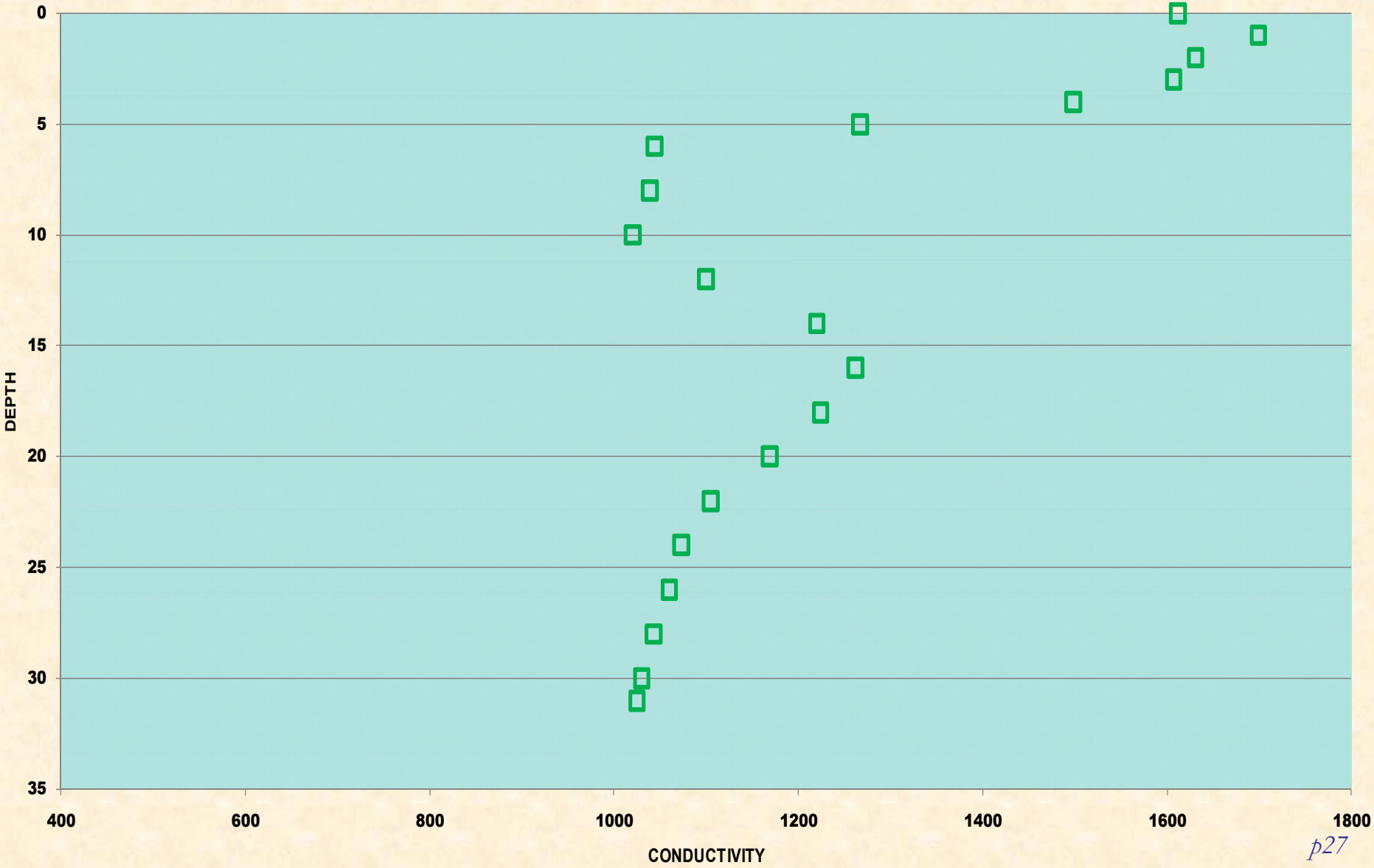

Las Vegas Bay* For All Samples
Chlorophyll-a Concentration, ug/L
CHLOROPHYLL-a, ug/L
200
180
160
140
120
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
DATE
* Las Vegas Bay stations:
LVB 1.8
LVB 1.85
LVB 2.7
LVB 3.5
LWLVB 1.2
LWLVB 1.85
LWLVB 2.7
LWLVB 3.5
LVB 6.7
LVB 7.3
1990 - 2004 = 922 total values
2005 - 2010 = 654 total values

"CHARACTERIZE LAS VEGAS WASH INSERTIONS INTO THE BAY"

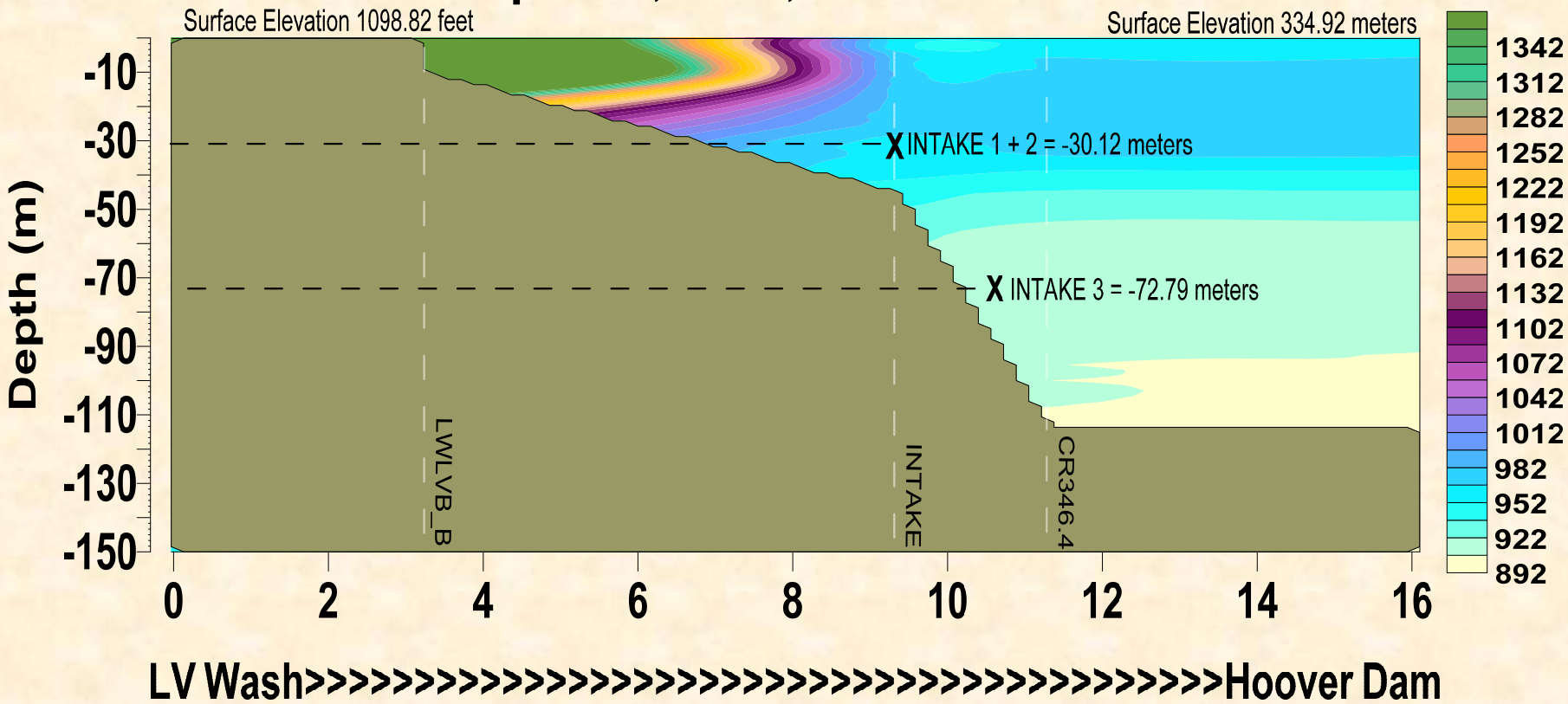
- **Conductivity plots in the Las Vegas Bay**
  - **Diurnal Las Vegas Wash fluctuations**
- **Collect more conductivity, pH, temperature, and D.O. data at Station LWLVB 0.6 and LWLVB 0.3 (can we collect data at these sites?)**
- **Collect samples more frequently at**
  - **Surface**
  - **Above the thermocline**
  - **Off the bottom**
- **Aerial photo of storm flows entering Las Vegas Bay**

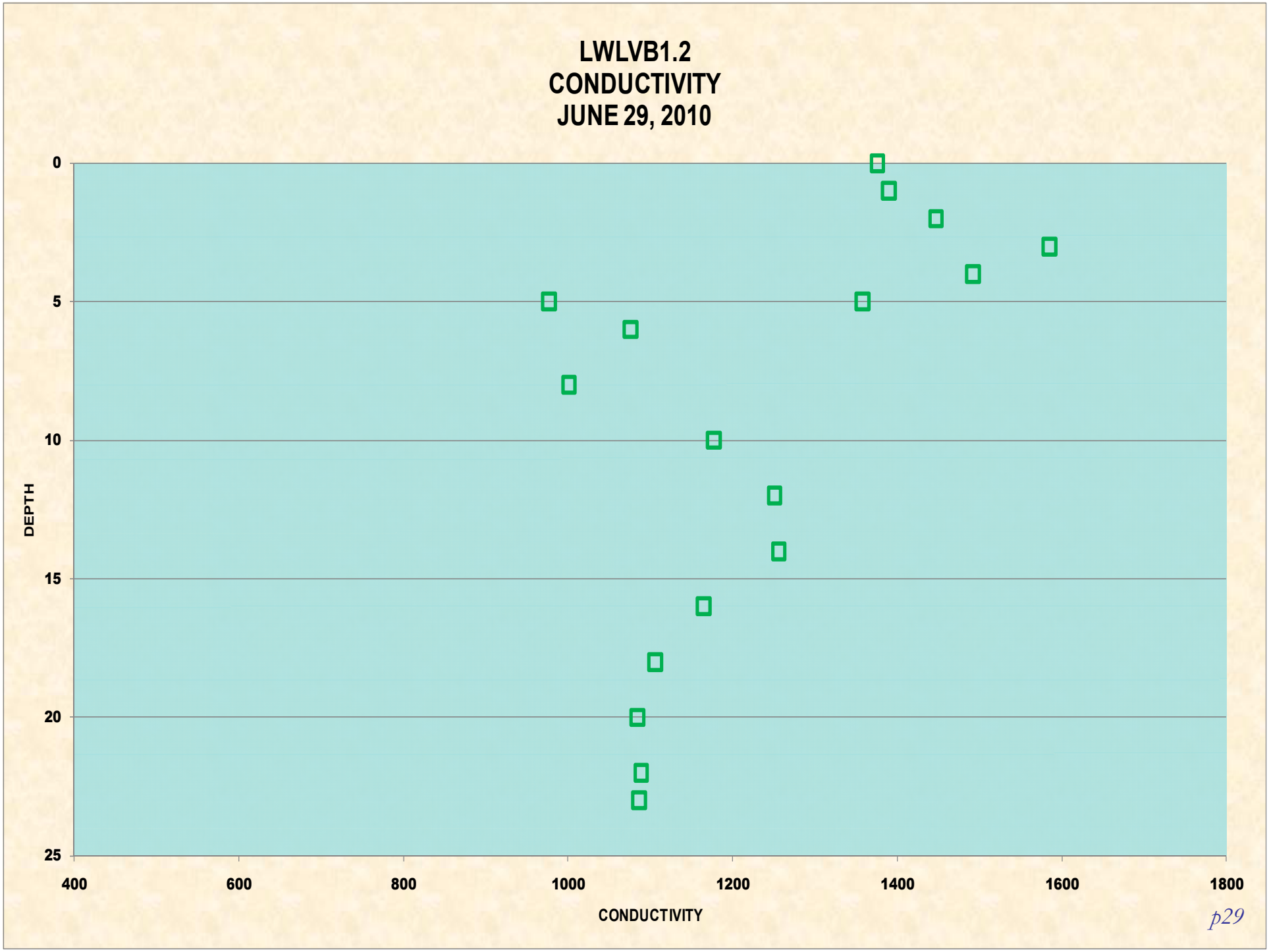
Storm on April 22, 2010 with precipitation > .10 inch

LWLVB1.2 CONDUCTIVITY APRIL 26, 2010

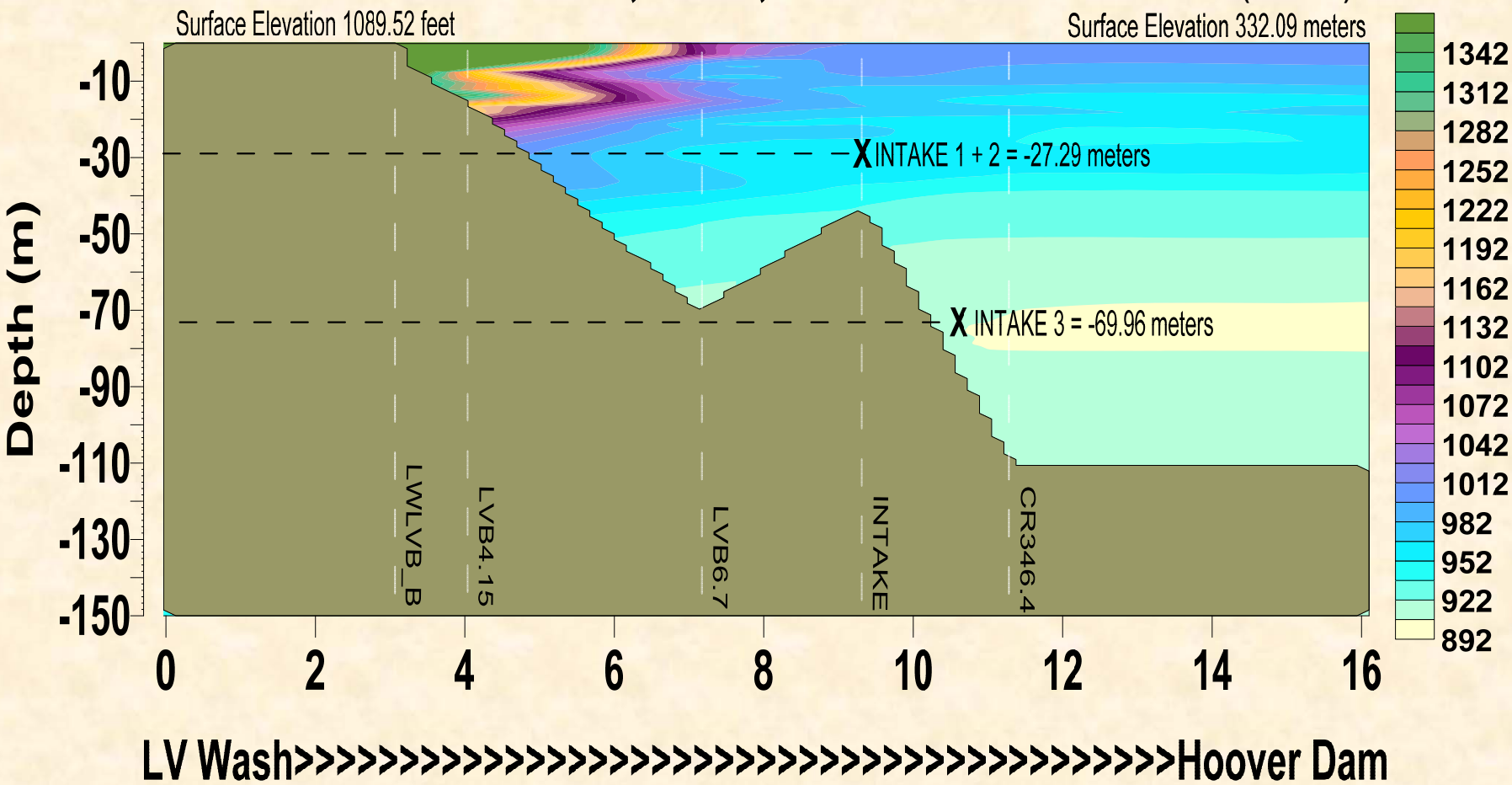


April 22, 2010, Conductance


Surface Elevation 1098.82 feet
Surface Elevation 334.92 meters
INTAKE 1 + 2 = -30.12 meters
INTAKE 3 = -72.79 meters
LWLVB_B
INTAKE
CR346.4
Depth (m)
-10
-30
-50
-70
-90
-110
-130
-150
0
2
4
6
8
10
12
14
16
1342
1312
1282
1252
1222
1192
1162
1132
1102
1072
1042
1012
982
952
922
892
LV Wash>>>


LWLVB1.2
CONDUCTIVITY
JUNE 29, 2010
DEPTH
0
5
10
15
20
25
400
600
800
1000
1200
1400
1600
1800
CONDUCTIVITY

June 29, 2010, Conductance

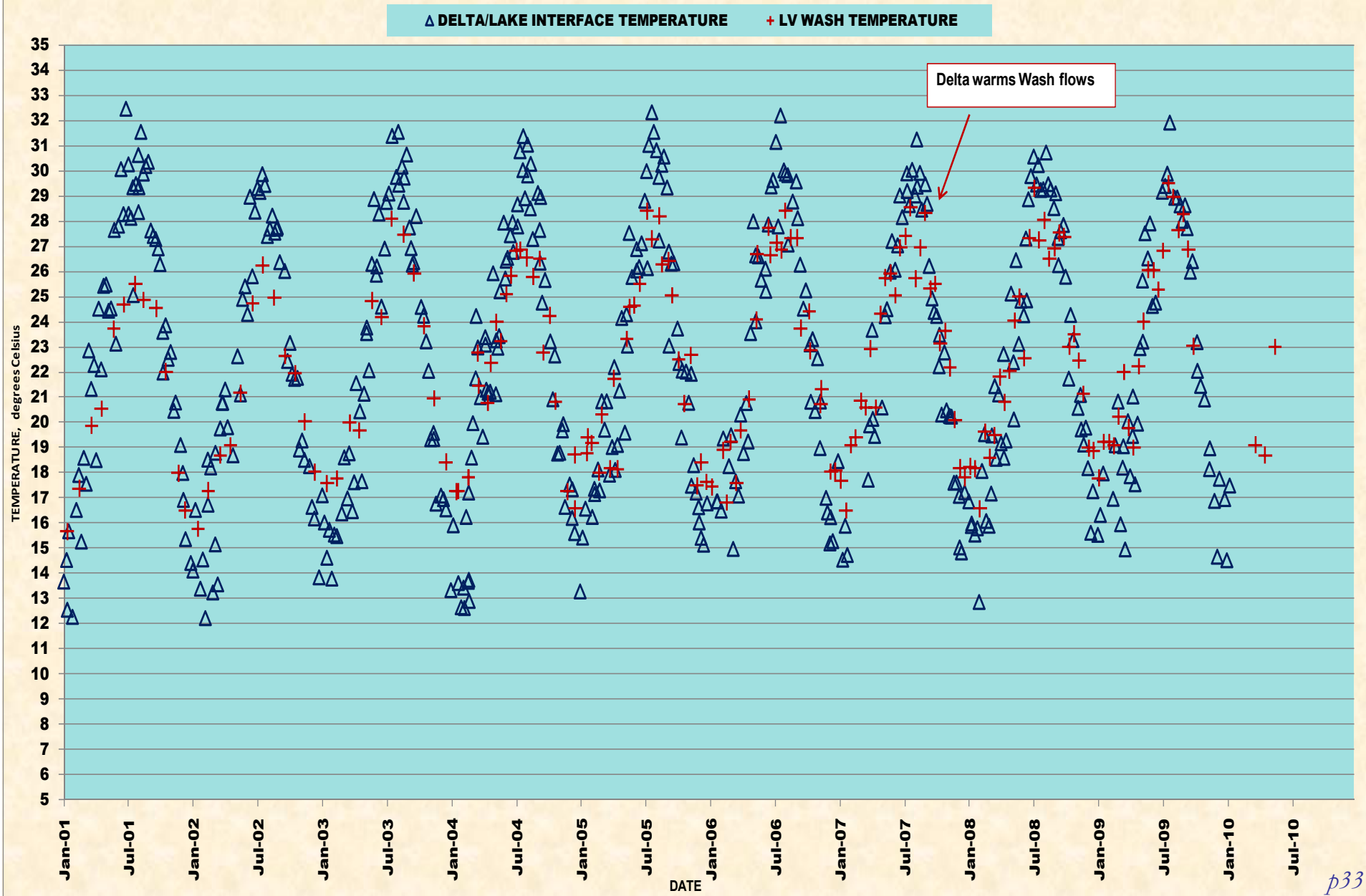

(~8 miles)
Surface Elevation 1089.52 feet
Surface Elevation 332.09 meters
INTAKE 1 + 2 = -27.29 meters
INTAKE 3 = -69.96 meters
LWLVB_B
LVB4.15
LVB6.7
INTAKE
CR346.4
Depth (m)
-10
-30
-50
-70
-90
-110
-130
-150
0
2
4
6
8
10
12
14
16
1342
1312
1282
1252
1222
1192
1162
1132
1102
1072
1042
1012
982
952
922
892
LV Wash>>>

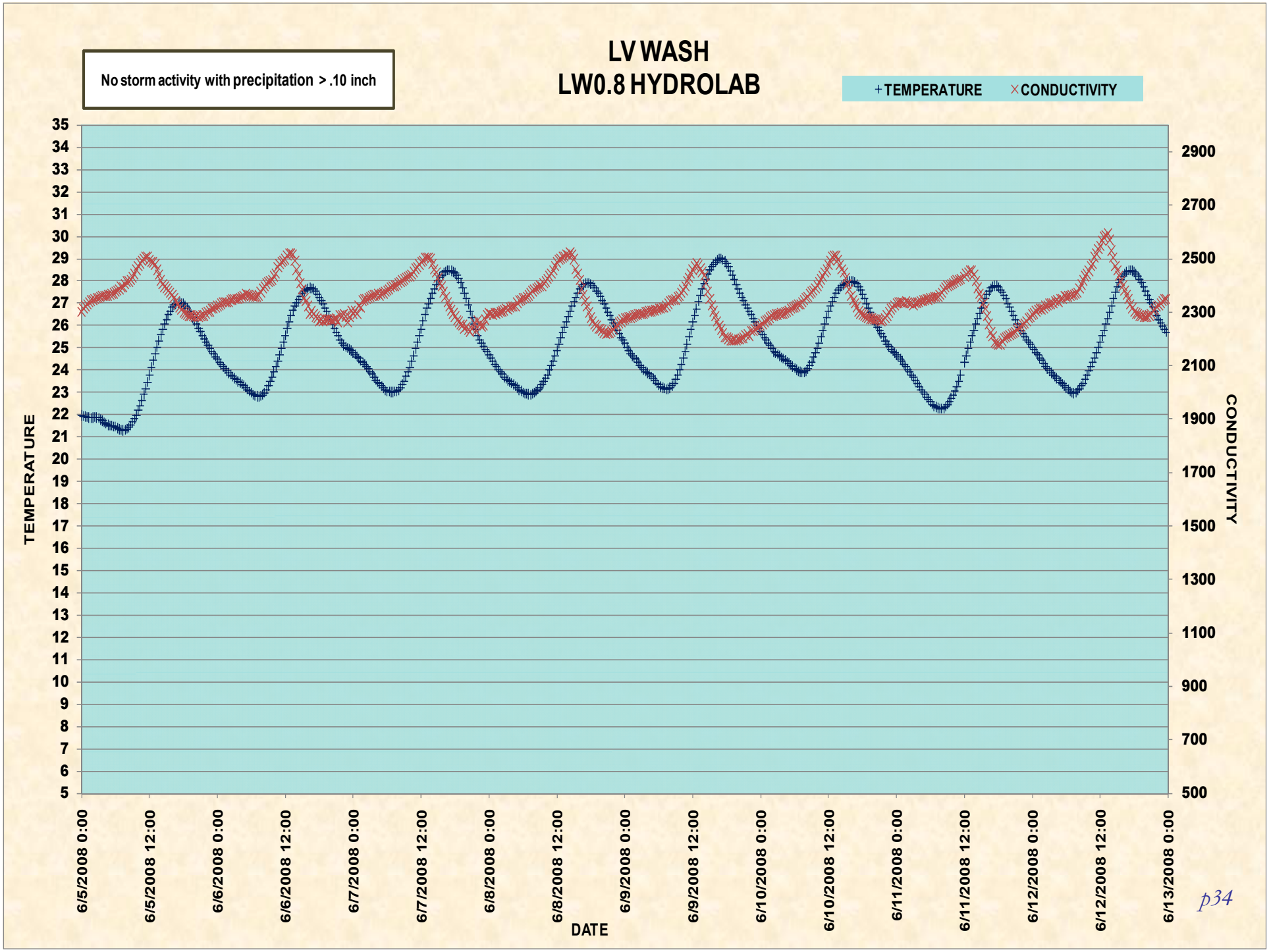
OLD BOAT RAMP
Feb. 2005 - 1143 ft.
Feb. 2007 - 1129 ft.
Aug. 2010 - 1087 ft.
LAS VEGAS BAY OF
LAKE MEAD

“CHARACTERIZE LAS VEGAS WASH TEMPERATURE INCREASES ACROSS DELTA”

Data Sources: Dischargers
SNWA
BOR

LV WASH (LW0.55 & LW 0.8) AND DELTA/LAKE INTERFACE TEMPERATURE 2001-2010




No storm activity with precipitation > .10 inch
LV WASH
LW0.8 HYDROLAB
TEMPERATURE
CONDUCTIVITY
TEMPERATURE
CONDUCTIVITY
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
6/5/2008 0:00
6/5/2008 12:00
6/6/2008 0:00
6/6/2008 12:00
6/7/2008 0:00
6/7/2008 12:00
6/8/2008 0:00
6/8/2008 12:00
6/9/2008 0:00
6/9/2008 12:00
6/10/2008 0:00
6/10/2008 12:00
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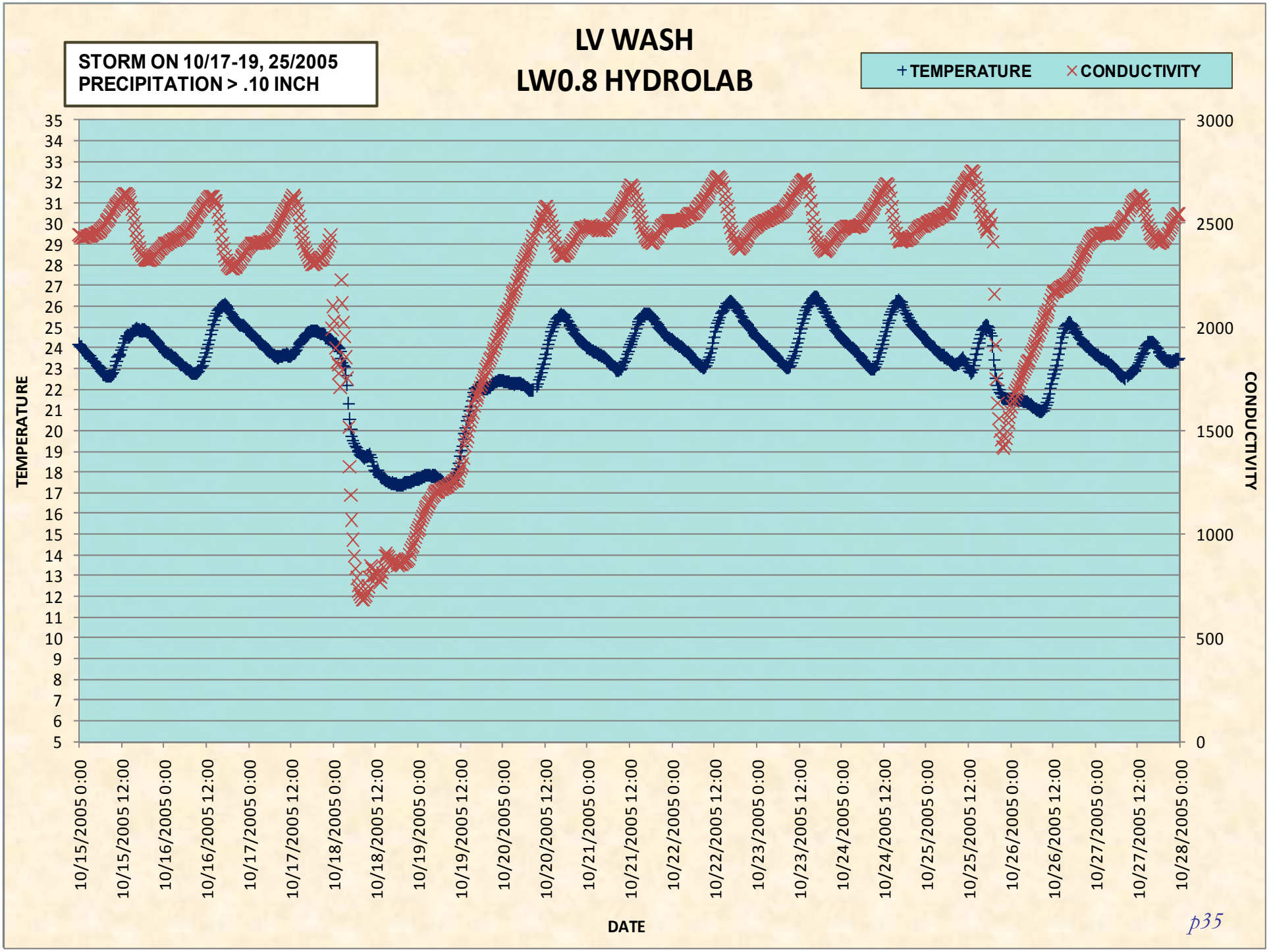
6/11/2008 12:00
6/12/2008 0:00
6/12/2008 12:00
6/13/2008 0:00
DATE


STORM ON 10/17-19, 25/2005
PRECIPITATION > .10 INCH
LV WASH
LW0.8 HYDROLAB
TEMPERATURE
CONDUCTIVITY
TEMPERATURE
CONDUCTIVITY
DATE
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
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19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
3000
2500
2000
1500
1000
500
0
10/15/2005 0:00
10/15/2005 12:00
10/16/2005 0:00
10/16/2005 12:00
10/17/2005 0:00
10/17/2005 12:00
10/18/2005 0:00
10/18/2005 12:00
10/19/2005 0:00
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10/20/2005 0:00
10/20/2005 12:00
10/21/2005 0:00
10/21/2005 12:00
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10/25/2005 0:00
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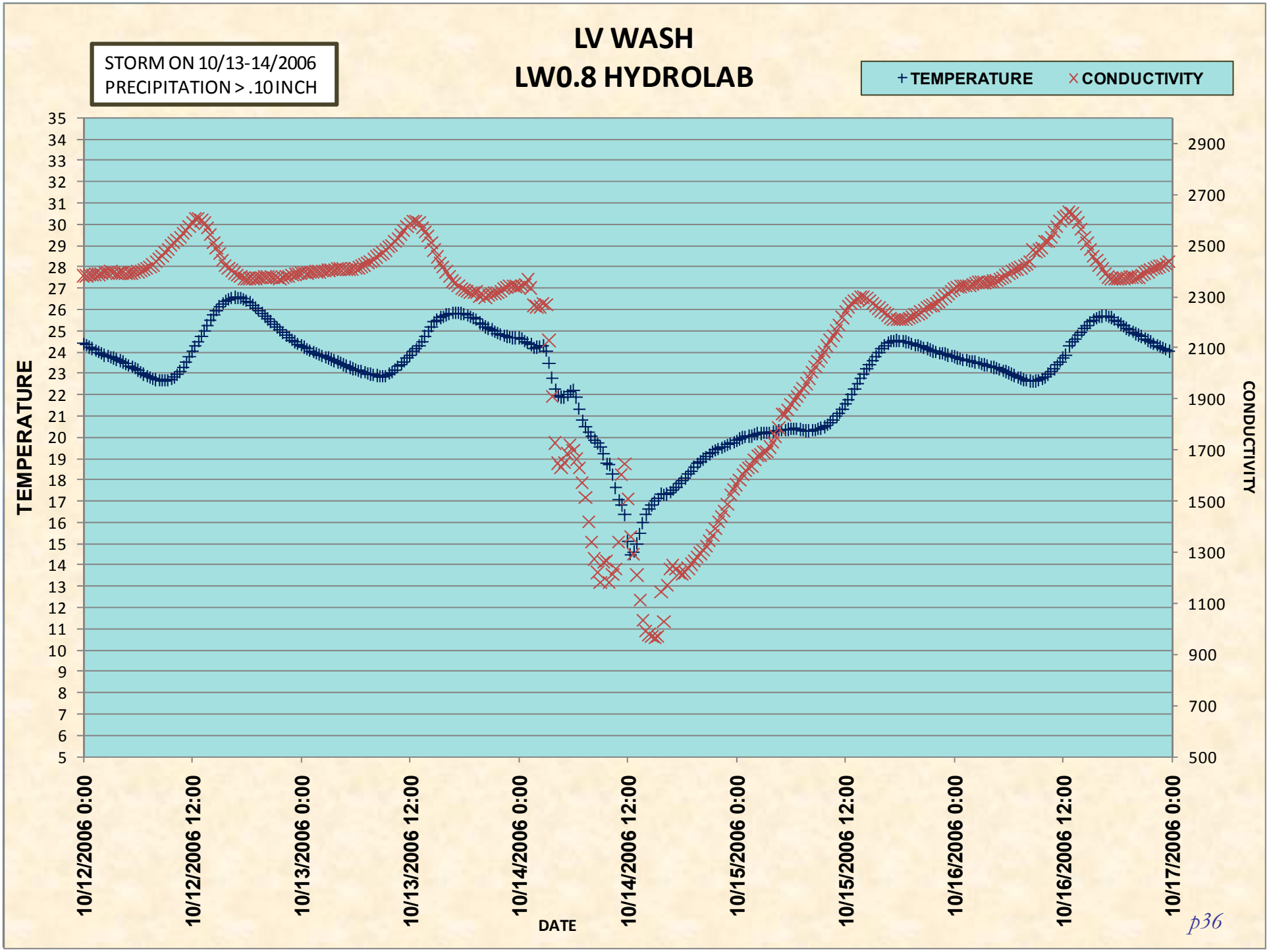
10/27/2005 12:00
10/28/2005 0:00


LV WASH
LW0.8 HYDROLAB
STORM ON 10/13-14/2006
PRECIPITATION > .10 INCH
TEMPERATURE
CONDUCTIVITY
TEMPERATURE
CONDUCTIVITY
DATE
35
34
33
32
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18
17
16
15
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11
10
9
8
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2900
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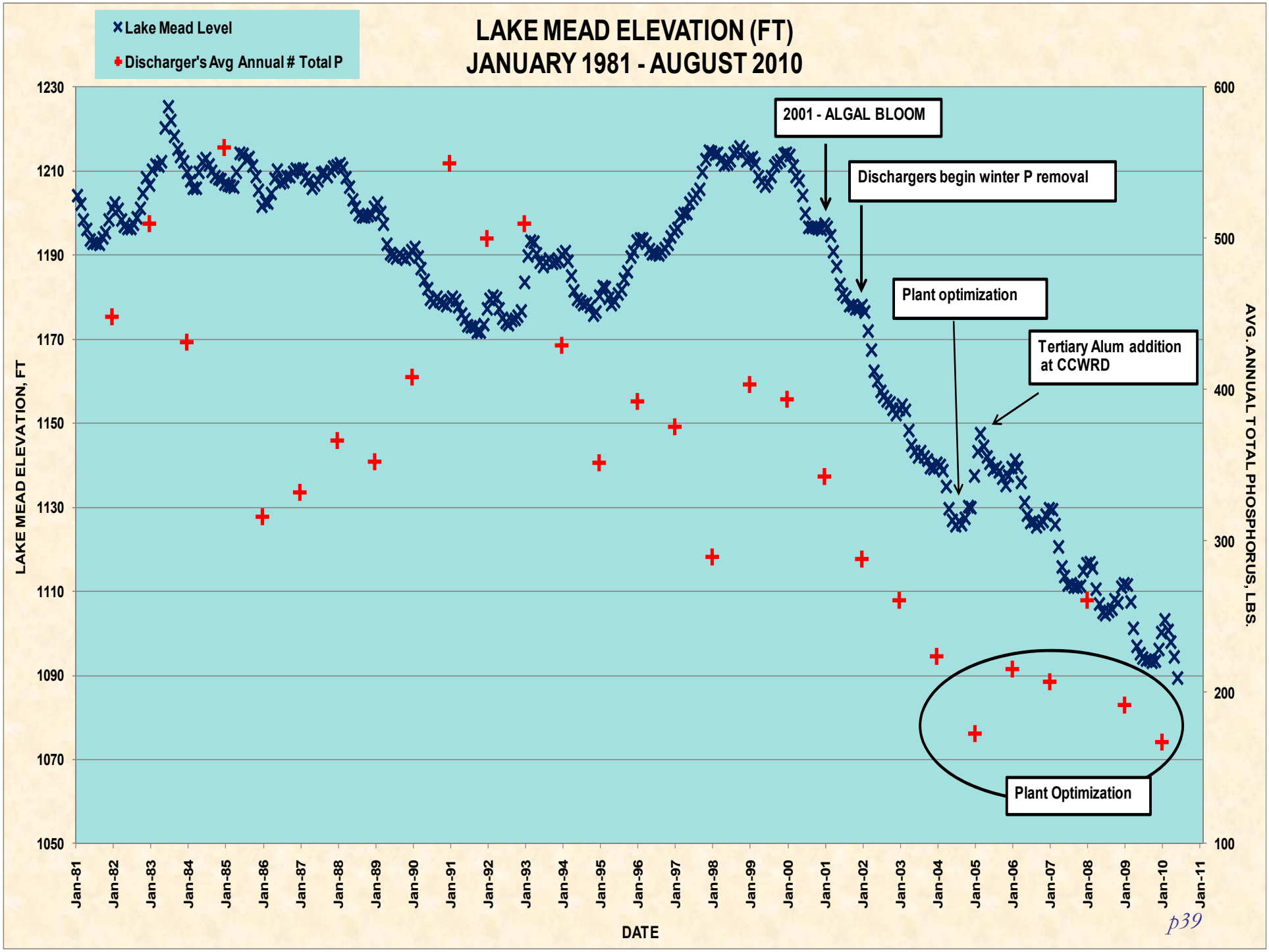
1900
1700
1500
1300
1100
900
700
500
10/12/2006 0:00
10/12/2006 12:00
10/13/2006 0:00
10/13/2006 12:00
10/14/2006 0:00
10/14/2006 12:00
10/15/2006 0:00
10/15/2006 12:00
10/16/2006 0:00
10/16/2006 12:00
10/17/2006 0:00

"FURTHER STUDY NUTRIENT RELEASE FROM SEDIMENT AS LAKE MEAD LOWERS"

- BOR study?
- USGS study?
- New sample sites as lake levels drop
  - Use stationary sample sites LVB 6.7 and LVB 7.3
  - Don't sample sites after they cross over LVB 7.3
- Lake Mead continues to lower and algae blooms have not been a problem

LAS VEGAS WASH WATER LEVELS
LAKE LAS VEGAS
NORTH SHORE RD
Feb. 1998 - 1214 ft.
Feb 1999 - 1213 ft.
CAMPGROUND
Feb. 2001 - 1197 ft.
Feb. 2002 - 1177 ft.
Feb. 2003 - 1154 ft.
OLD BOAT RAMP
Feb. 2005 - 1143 ft.
Feb. 2007 - 1129 ft.
Feb. 2009 - 1111 ft.
Feb. 2010 - 1103 ft.
Aug. 2010 - 1087 ft.
LAS VEGAS BAY OF LAKE MEAD
©2009 Google
Imagery Date: May 29, 2010
36°06'59.86" N 114°51'47.18" W elev 0 ft
Eye alt 9458 ft


LAKE MEAD ELEVATION (FT)
JANUARY 1981 - AUGUST 2010
Lake Mead Level
Discharger's Avg Annual # Total P
2001 - ALGAL BLOOM
Dischargers begin winter P removal
Plant optimization
Tertiary Alum addition at CCWRD
Plant Optimization
LAKE MEAD ELEVATION, FT
AVG. ANNUAL TOTAL PHOSPHORUS, LBS.
DATE
1230
1210
1190
1170
1150
1130
1110
1090
1070
1050
600
500
400
300
200
100
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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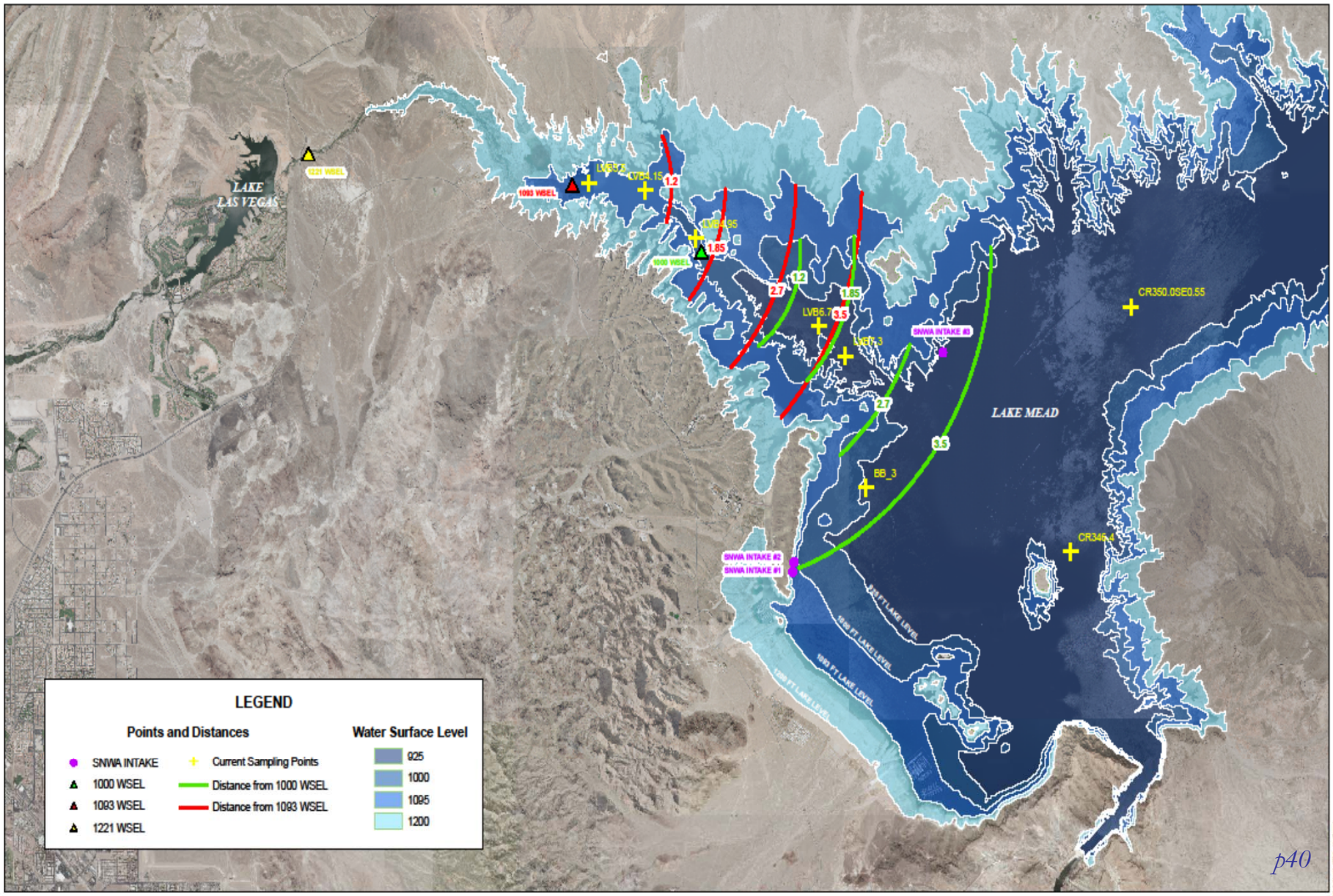
Jan-08
Jan-09
Jan-10
Jan-11



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Clark County Water Reclamation DISTRICT

LAS VEGAS WASH / BAY INTERFACE

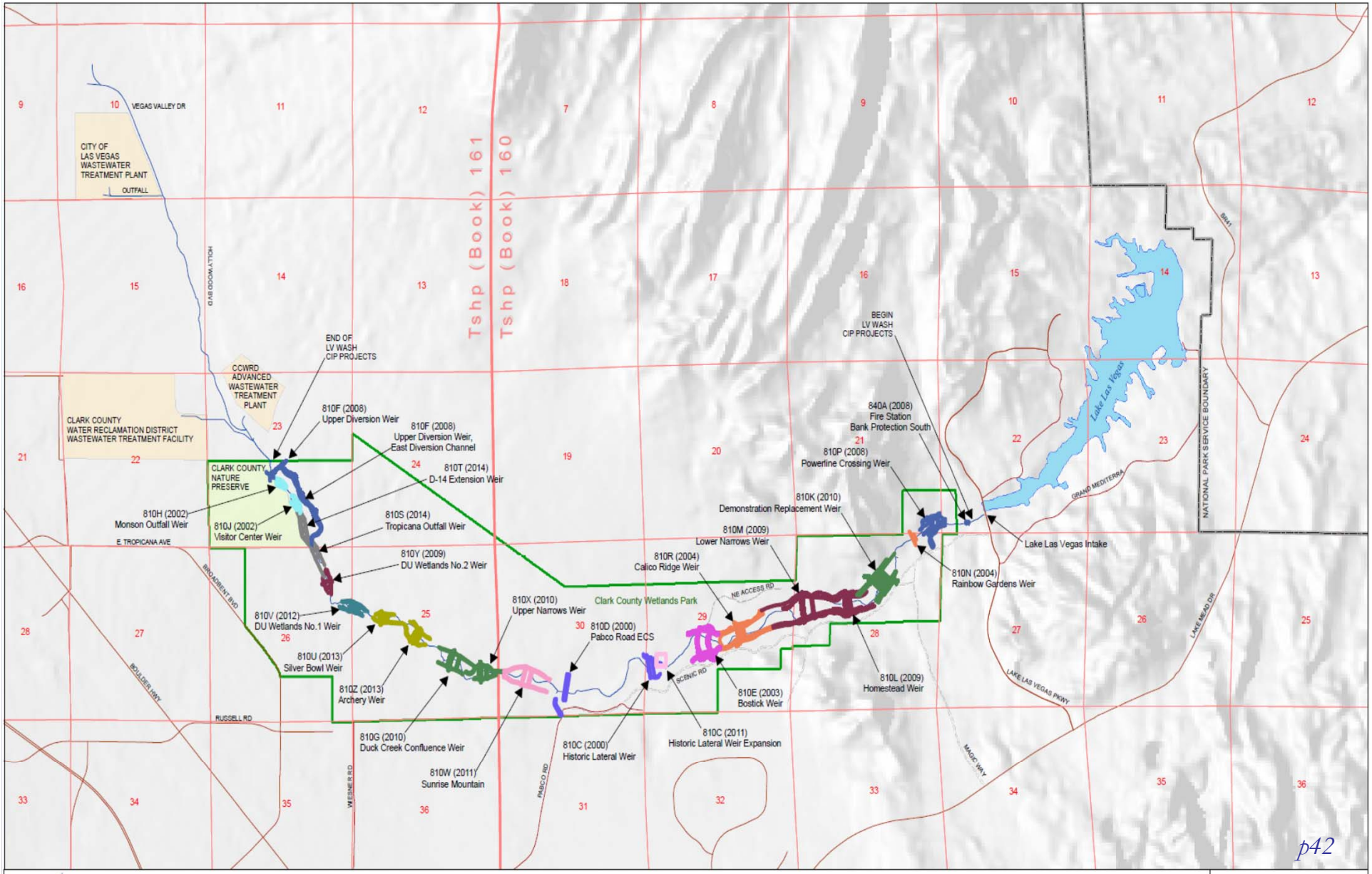
MAP UPDATED 7/23/2010

1 in = 1 miles

0 0.5 1 2 Miles

"DETERMINE IMPACTS FROM CONSTRUCTION OF EROSION CONTROL STRUCTURES"

- 50% completion of erosion control structures
- Construction ongoing since 2001 algae bloom
- No algae blooms since 2001. Therefore, building of erosion control structures have not been a factor



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Southern Nevada Water Authority

SNWA LAS VEGAS WASH CAPITAL IMPROVEMENTS PLAN GRADE CONTROL STRUCTURES

Project Construction Completion Year

2000 | 2003 | 2008 | 2010 | 2012 | 2014
2002 | 2004 | 2009 | 2011 | 2013

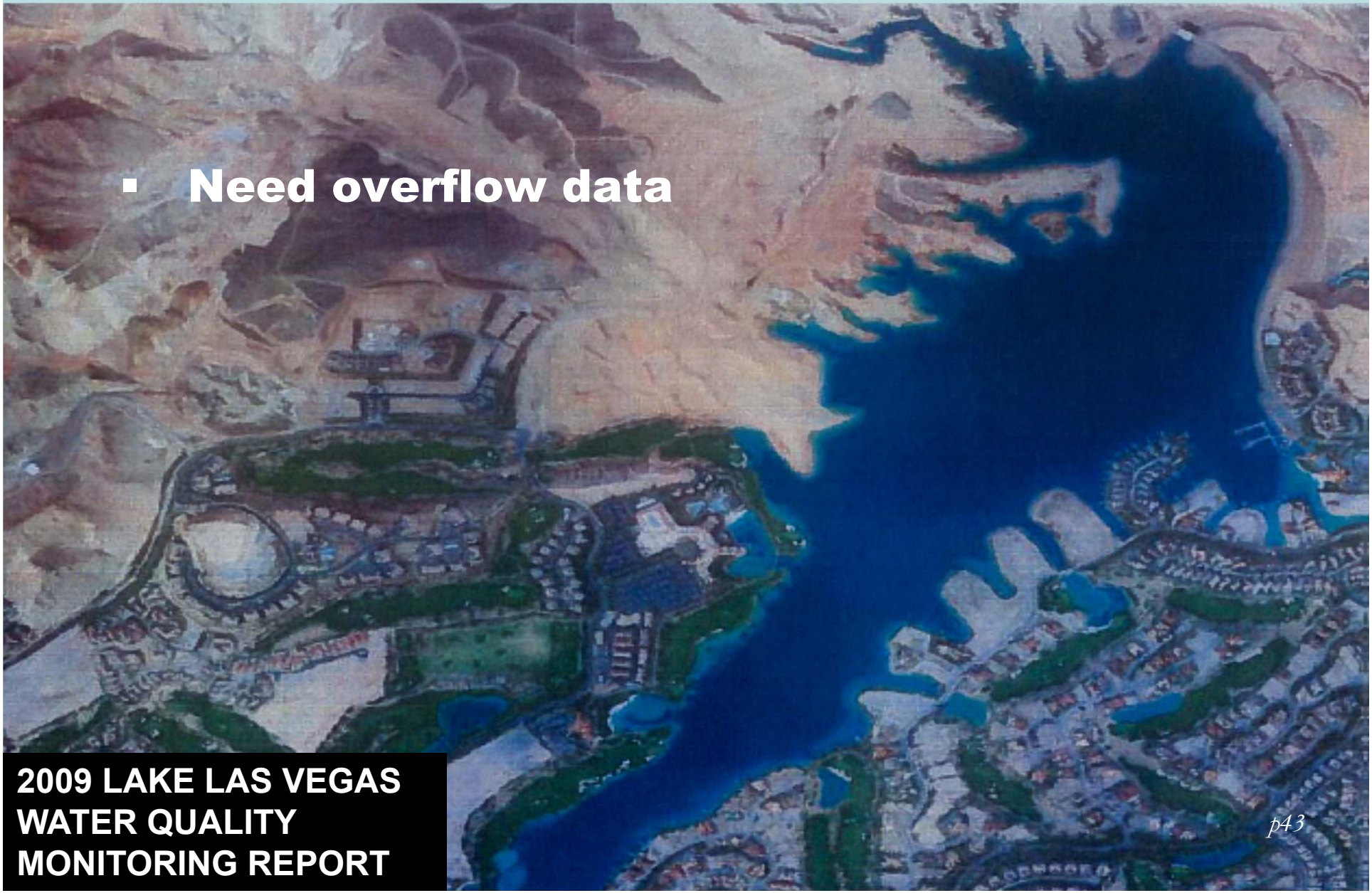
Official Wash Facilities Engineering CIP Map.

Map produced by SNWA-Engineering, KTM, Spatial Information Team.
SPC NV-E, NAD83.
Analyst: EN

1 Inch = 3000 Feet, or Scale = 1:36,000
(Original 11x17 map only)

MAP-ID: WFE-010
DATE: 7 NOV 2007

"CHARACTERIZE IMPACTS FROM LAKE LAS VEGAS"



- **Need overflow data**

2009 LAKE LAS VEGAS WATER QUALITY MONITORING REPORT