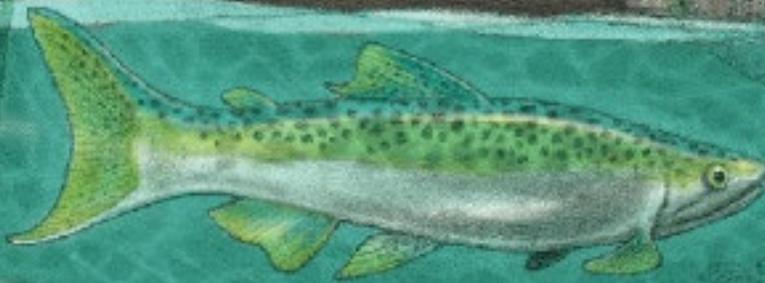




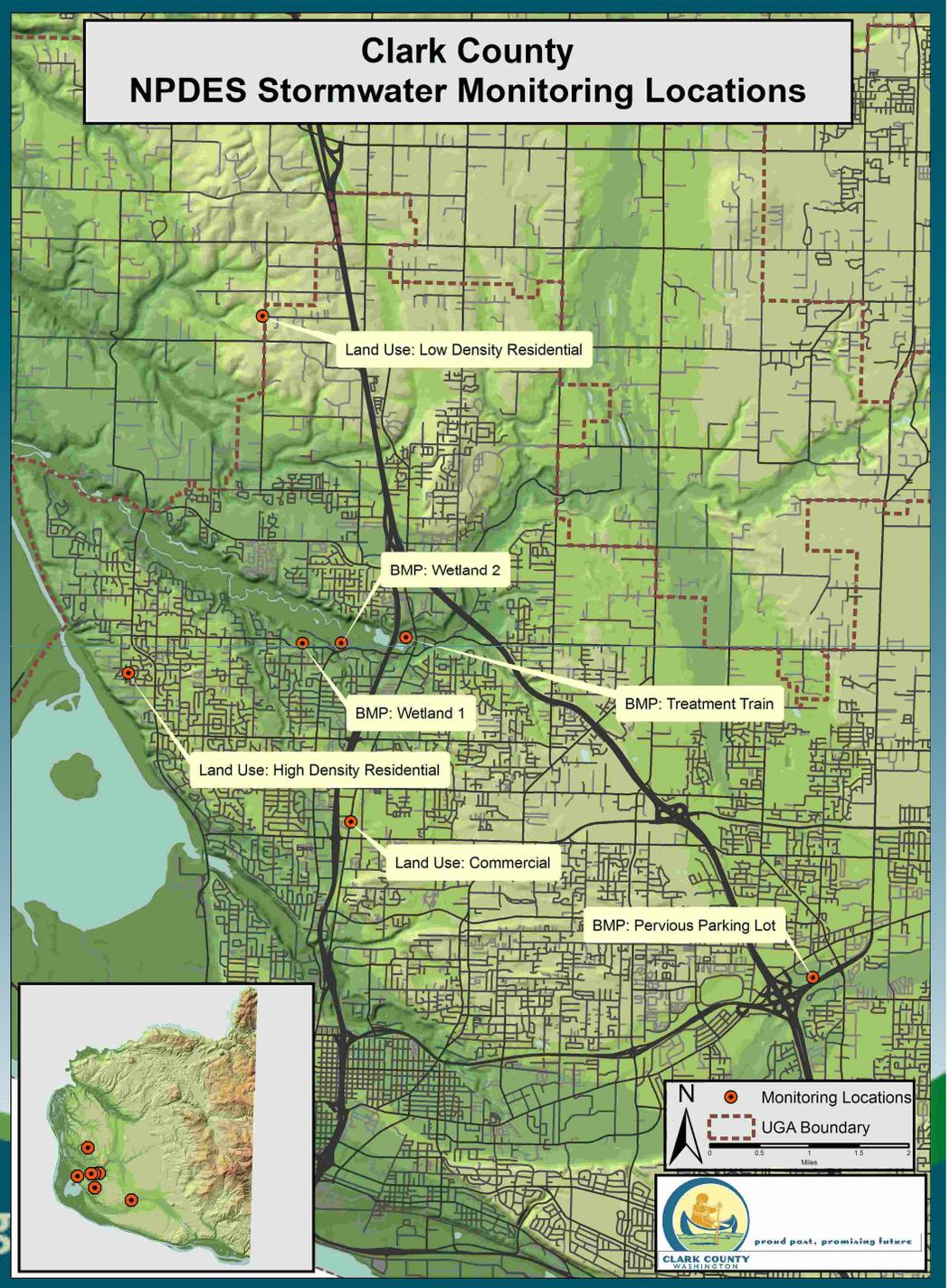
Clark County Clean Water Program

**Department of Environmental
Services
Clean Water Program**



Brief discussion of Clark County's S8 Monitoring Efforts

- Important Factors:
- Planning is Critical
- Site selection
- Logistics
- Troubleshooting
- Lessons learned



Clean Water Program

Successful Planning Includes

- Establishing your monitoring research priority
- Identifying meaningful questions that can be answered
- Keep it simple
- Keep up with technology (know your equipment)



Clean Water Program

Successful Monitoring Site Selection

- Land use
- Size of drainage area
- Safety
- Secure equipment
- Power
- BMP Type



Clean Water Program

Site Selection: Land Use

Things to keep in mind:

Mostly Pervious = slow response to rain events and longer drain time

Mostly impervious = fast response to rain events and shorter drain time



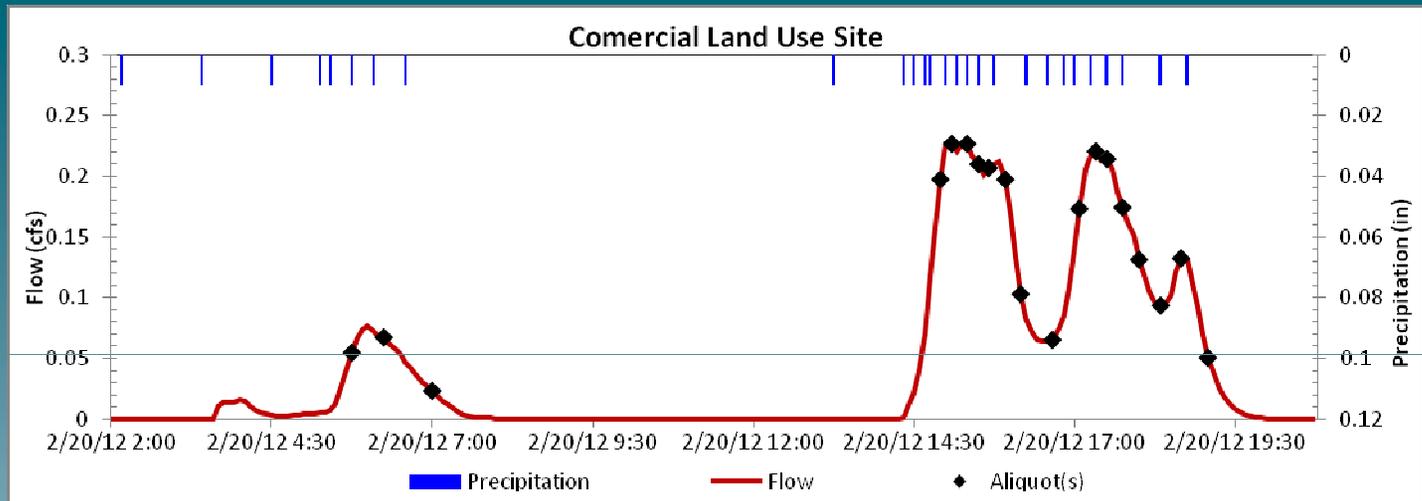
Clean Water Program

Site Selection: Size of Drainage Area

Lessons Learned: Drainage areas with similar impervious percentages

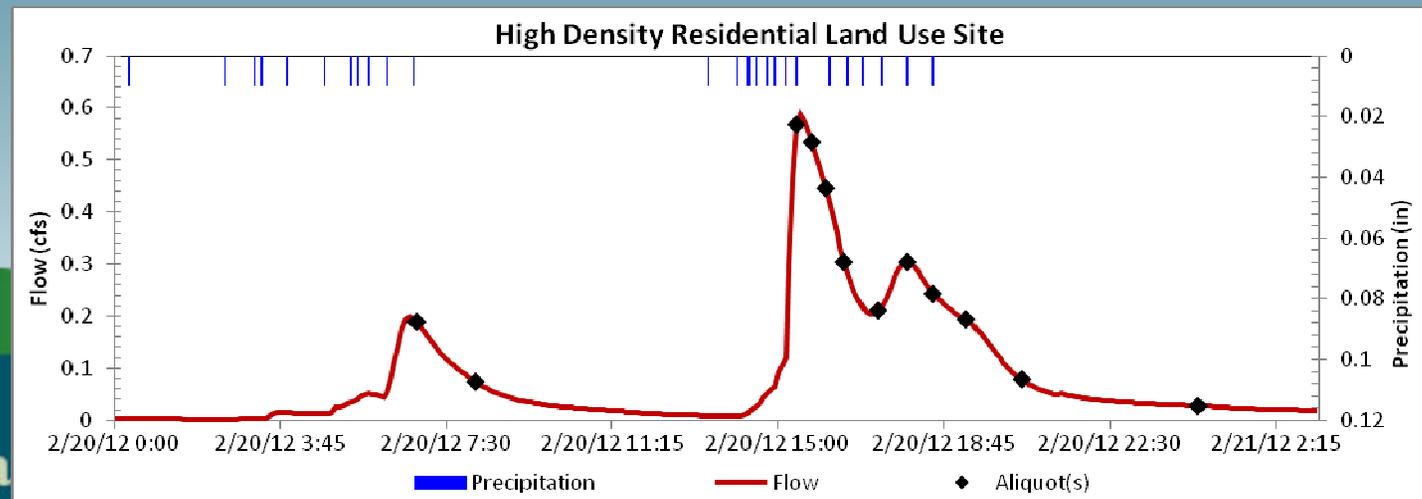
Smaller area is:

- More Flashy



Larger area:

Takes A LOT longer to drain



Clea

Site Selection: Safety

Personnel safety is our number one priority



Clean Water Program

Site Selection: Secure Equipment



Clean Water Program

Site Selection: Power

- LESSONS LEARNED
- Direct connect is definitely the way to go if possible. Two of our sites have direct connect and have never had a power issue, thus no loss of data.
- Solar panels can fail to fully charge samplers, especially in the winter time.
- Increased man hours to swap out batteries
- Make good targets



Clean Water Program

Selecting a Treatment BMP to Monitor

Long-term detention

- Stormwater coming into a facility is not exactly the water going out.
- Random sampling date selection



Short-term detention

- Stormwater coming into a facility may not make it out due to leaks in the system and infiltration.





LOGISTICS:

When is it going to rain?

- **Paid for weather service (TELVENT)**

When to use man hours to set up samplers?

- **75% chance of .25 inches of rain**



Clean Water Program

Continuously Updated Forecast

[http://weather.dtn.com/dtnweather/common/link.do?symbolicName=FORECAST_DAILY](#)

[Favorites](#)
[Clark County Links](#)
[Product Distributors](#)
[Customize Links](#)
[Web Slice Gallery](#)
[PRECIP](#)

[Vancouver Toyota US Green ...](#)
[MxVision WeatherSentry ...](#)

TELVENT MxVision WeatherSentry Online®
 [View Alerts](#)
[Monitored Locations](#)
[Customer Service](#)
[Help](#)
[Sign Out](#)

Public Safety Edition
 [Home](#)
[Settings](#)

User: Clark County
 [Map](#)

[Delete From Favorites](#)

15 Day Forecast

Clark County

Date	Mon 1/28	Rest of Tue 1/29	Wed 1/30	Thu 1/31	Fri 2/1	Sat 2/2	Sun 2/3	Mon 2/4	Tue 2/5	Wed 2/6	Thu 2/7	Fri 2/8	Sat 2/9	Sun 2/10	Mon 2/11	Tue 2/12
Weather Condition																
Weather	Rain	All Day Rain Likely	All Day Rain Likely	All Day Rain Likely	Mostly Cloudy	Mostly Cloudy	Mostly Cloudy	Scattered All Day Rain Possible	All Day Rain Possible	All Day Rain Likely	All Day Rain Possible	Mostly Cloudy				
Temperature (°F) Low/High	39/44	42/44	41/48	39/49	37/45	33/53	34/49	35/48	35/48	34/45	33/44	32/44	32/45	31/46	31/46	30/47
Feels Like (°F) Low/High	39/44	40/44	38/47	39/49	33/41	28/53	30/47	32/45	32/46	32/42	30/41	30/41	30/44	29/44	30/44	29/45
Dew Point (°F)	39	41	39	40	37	34	36	35	33	33	32	32	32	32	32	32
Humidity (%)	89	93	76	81	85	63	73	72	66	72	72	73	72	71	71	70
Wind Speed (mph)	LV	4	5	LV	5	6	4	5	4	4	4	4	4	4	4	4
Precipitation Chance (%)	-	80	80	67	-	-	-	30	50	69	50	-	-	-	-	-
Precipitation Amount (Rain:in., Snow:in.)	0.73	Rain 0.30	Rain 0.28	Rain 0.05	None	None	None	Rain 0.14	Rain 0.32	Rain 0.17	Rain 0.12	None	None	None	None	None
Evapotranspiration (inches/day)	0.02	0.02	0.04	0.03	0.03	0.06	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.04

[Print](#)



Clean Water Program

Customizable Settings and Alerts

The screenshot shows the 'Alert Criteria' configuration page for Clark County. The interface includes a navigation menu on the left, a top navigation bar with 'View Alerts', 'Monitored Locations', 'Customer Service', 'Help', and 'Sign Out' buttons, and a main content area with a 'Save Changes' button at the bottom.

Alert Criteria

Click on the "Enable" box to turn on an alert. Enter a value for the selected alert where required.

Location:

Recipients: Chad, Ian, Chad Mobil, Ian Mobile Audible Alert:
[Change selections...](#)

Enable	Alert Type	Value	Lead Time
<input type="checkbox"/>	Winds > 115 mph (185 km/h)		
<u>Forecast Conditions</u>			
<input checked="" type="checkbox"/>	Rain >	50 % 0.02 in.	6 hours
<input checked="" type="checkbox"/>	Snow/Ice/Mix >	20 % 0.03 in.	6 hours
<input checked="" type="checkbox"/>	Temp <	32 °F	8 hours
<input checked="" type="checkbox"/>	Temp >	90 °F	5 hours
<input checked="" type="checkbox"/>	Feels Like <	32 °F	5 hours
<input checked="" type="checkbox"/>	Feels Like >	100 °F	5 hours
<input type="checkbox"/>	Humidity <	%	3 hours
<input type="checkbox"/>	Humidity >	%	3 hours
<input checked="" type="checkbox"/>	Wind Speed >	60 mph	3 hours
<u>Weather Bulletins - NWS (United States)</u>			
<input type="checkbox"/>	Warnings - Community Based		

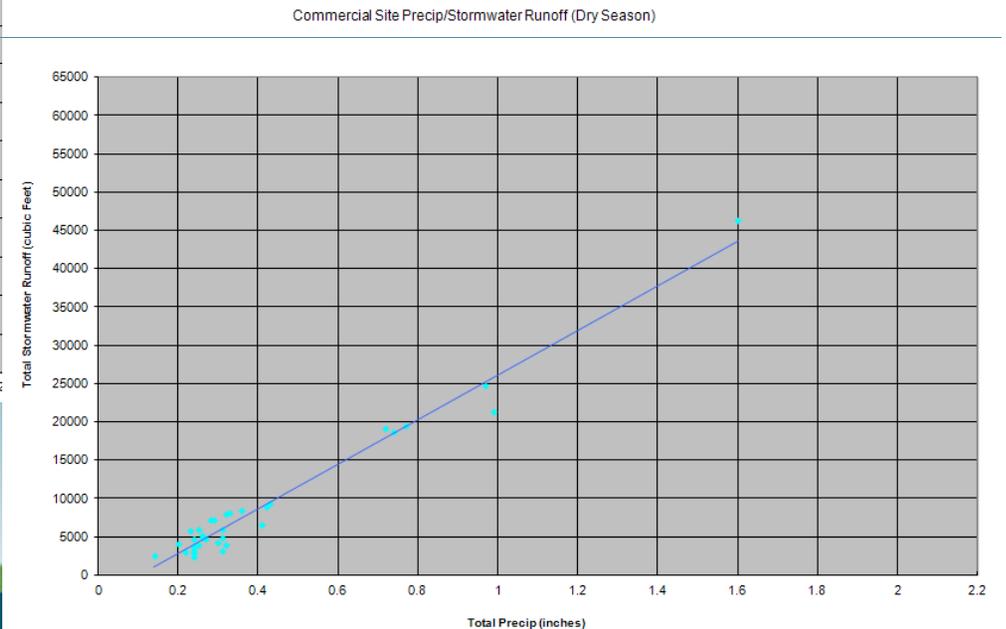
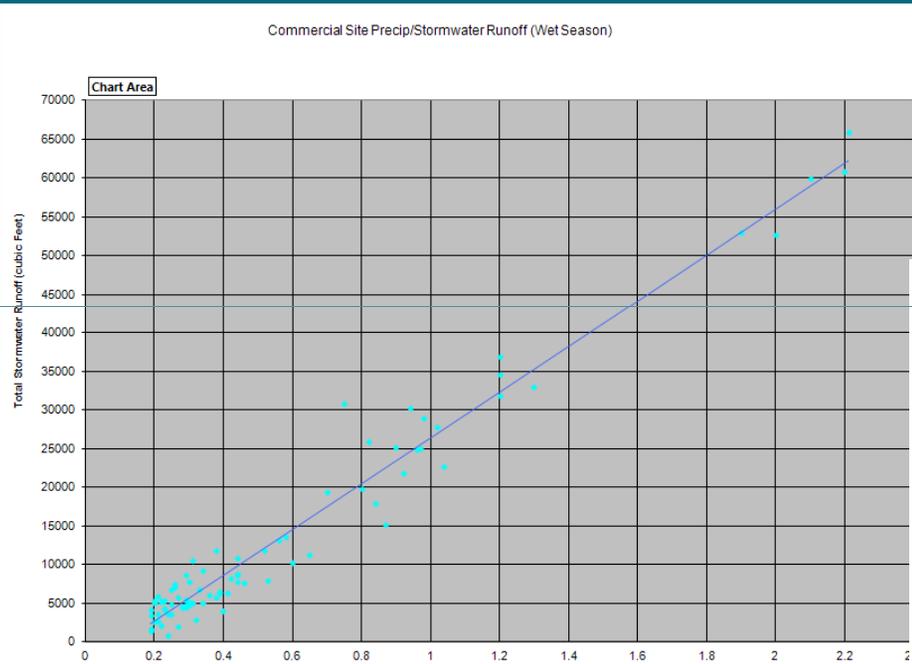
Alerting may be covered by one or more of the following patents: U.S. Patent No. 6,753,784, or U.S. Patent No. 7,602,285



Clean Water Program

Logistics: Hydrology

- Develop a rainfall runoff relationship prior to sampling.
- Lesson Learned: develop a **SEASONAL** rainfall runoff relationship when you have enough data.



Clean Water Program

Logistics: Pacing

Continue to maintain and update your rainfall runoff relationship to develop more accurate pacing calculations

Date	Rate	Flow	Volume	Flow	Volume	Flow	Volume
6/12/2012	0.25			5835	Dry		389
5/1/2012	0.25			3960	Dry		264
5/23/2012	0.26			5163	Dry		344
9/15/2010	0.26	148	27.3	4797	Dry		320
5/22/2010	0.27	6.9	4.6	4605	Dry		307
5/30/2010	0.28	6.8	19.2	7161	Dry		477
5/19/2010	0.29	22.9	4.4	7090	Dry		473
5/17/2010	0.3	12.3	6.1	4268	Dry		285
5/7/2011	0.31			5942	Dry		396
5/20/2010	0.31	14.2	4.3	4767	Dry		318
6/15/2010	0.31	116	4.3	3052	Dry		203
7/1/2010	0.32	26.3	12.5	3937	Dry		262
9/17/2010	0.32	25.9	4.8	7846	Dry		523
6/8/2010	0.33	40.3	22.1	3012	Dry		204
6/10/2010	0.36	6.7	12.7	3441	Dry		233
5/12/2011	0.41			6511	Dry		434
8/31/2010	0.42	28.2	19.4	3803	Dry		257
5/21/2010	0.43	11.9	14	9283	Dry		619
6/3/2010	0.72	26.6	17.2	19165	Dry		1278
5/28/2010	0.74	44.6	18.4	18688	Dry		1246
6/1/2010	0.77	27.1	27.5	19425	Dry		1295
5/25/2010	0.97	35.8	15.8	24648	Dry		1643
9/18/2010	0.99	10.4	11.6	21322	Dry		1421
6/6/2010	1.6	43.1	23.7	46222	Dry		3081

Wet Seaman Pacing Needr	180	Need 10 liter; 72 max before battle change
Wet Seaman Pacing Needr	300	Need 10 liter; 72 max before battle change
Wet Seaman Pacing Needr	800	Need 10 liter; 72 max before battle change
Wet Seaman Pacing Needr	1200	Need 10 liter; 72 max before battle change
Dry Seaman Pacing Needr	130	Need 10 liter; 72 max before battle change
Dry Seaman Pacing Needr	200	Need 10 liter; 72 max before battle change
Dry Seaman Pacing Needr	650	Need 10 liter; 72 max before battle change
Dry Seaman Pacing Needr	1100	Need 10 liter; 72 max before battle change

Chad's Storm Hydro Data Summary Info.xls [Compatibility Mode]

	A	B	C	G	H	K	L	M	N
1	Event	Dur (hr)	F (in)	Dry P (hr)	Flow Durat (hr)	Std Val	Se	Approx. Pacing (cf) - Storm Val	Ert. Storm Aliqu (Storm volume)
37	4/12/2010	7	0.3	62.9	5.9	5180	Wet	345	24
38	10/5/2011		0.31			5065	Wet	338	28
39	2/12/2010	13	0.31	7.2	11.8	10536	Wet	702	59
40	3/11/2012		0.32			2808	Wet	187	16
41	4/5/2010	24	0.33	15.8	11.5	6802	Wet	453	23
42	2/29/2012		0.34			5003	Wet	334	17
43	3/5/2011		0.34			9192	Wet	613	31
44	1/5/2012		0.36			6077	Wet	405	20
45	3/23/2012		0.38			5759	Wet	384	19
46	2/14/2010	9	0.38	16.9	12.2	11751	Wet	783	39
47	4/27/2012		0.39			6452	Wet	430	22
48	4/11/2012		0.39			6327	Wet	422	21
49	3/24/2010	19	0.4	31.2	5.6	4051	Wet	270	14
50	2/26/2012		0.41			6251	Wet	417	21
51	12/25/2010	28	0.42	16.4	17.2	8140	Wet	543	27
52	2/13/2011		0.44			8824	Wet	588	29
53	2/23/2010	28	0.44	175	24.6	8665	Wet	578	29
54	10/30/2010	17	0.44	31.3	10.2	10833	Wet	722	36
55	1/5/2011	10	0.44	115	17.4	7751	Wet	517	26
56	4/28/2010	5	0.46	20.6	3.8	7659	Wet	511	26
57	10/28/2010	20	0.52	37.3	25.9	11829	Wet	799	39
58	1/18/2012		0.53			7925	Wet	528	26
59	12/19/2010	20	0.56	16.7	20.9	13059	Wet	871	44
60	4/2/2010	8	0.58	32.6	9.7	13558	Wet	904	45
61	11/13/2010	32	0.6	20.2	19.2	10274	Wet	685	34
62	4/5/2011		0.65			11272	Wet	751	38
63	10/8/2010	16	0.7	104	25.6	19375	Wet	1292	24
64	1/14/2011		0.75			30714	Wet	2048	38
65	11/6/2010	14	0.8	9.7	10.2	19714	Wet	1314	25
66	10/10/2010	9	0.82	11.2	14.2	25823	Wet	1722	32
67	11/9/2010	23	0.84	10.1	18.2	17824	Wet	1188	22
68	4/26/2010	26	0.87	67.2	16.8	15152	Wet	1010	19
69	2/25/2010	22	0.9	22.8	23.1	25194	Wet	1630	31
70	11/29/2010	23	0.92	33.5	22.2	21822	Wet	1455	27
71	4/17/2011		0.94			30210	Wet	2014	38
72	12/13/2010	30	0.96	7	20.3	24915	Wet	1661	31
73	3/11/2011		0.97			24956	Wet	1664	31
74	11/1/2010	10	0.98	32	10.7	28857	Wet	1924	36
75	2/16/2011		1.02			27742	Wet	1849	35
76	4/25/2011		1.04			22696	Wet	1513	28
77	3/11/2010	39	1.2	22.4	36.7	34587	Wet	2306	29
78	3/28/2010	42	1.2	45.5	35.5	31744	Wet	2116	26
79	12/11/2010	18	1.2	20.1	20.5	36879	Wet	2459	31
80	1/11/2011	30	1.3	58.8	28.2	33010	Wet	2201	28
81	11/17/2010	35	1.9	48.6	28.2	52976	Wet	3532	44
82	12/27/2010	56	2	8.2	48.8	52674	Wet	3512	44
83	10/23/2010	69	2.1	7.2	64.1	59878	Wet	3992	50
84	12/7/2010	53	2.2	10.7	42.5	60769	Wet	4051	51
85	3/2/2011		2.21			65868	Wet	4391	55
86	6/20/2010	9	0.14	24.7	1.8	2508	Dry	167	19
87	9/7/2010	3	0.2	6.5	7.5	4104	Dry	274	32
88	5/4/2010	11	0.22	16.8	4.4	2951	Dry	197	23
89	9/26/2010	2	0.23	65.2	4.8	5800	Dry	387	45
90	5/25/2012		0.24			4720	Dry	315	36
91	7/12/2011		0.24			3063	Dry	204	24
92	6/18/2011		0.24			2331	Dry	155	18
93	5/3/2010	12	0.24	68.2	2.1	3740	Dry	249	29
94	5/9/2010	10	0.24	44.6	7.4	2801	Dry	187	22



Keep Track of Stormwater Capturing Efforts: Records are Critical

In addition to using pacing calculations, keep track of all stormwater sampling efforts for future use

- Forecast Precip
- Actual Precip
- Pacing
- Number of Aliquots
- Notes
- Successful sample

Forecast Precip	Actual Precip	Offset	Pacing	# Aliquots	Notes	SET-UP DATE	SAMPLE DATE	Location / Client
.22	.18	.04	140	3	SOLID FIBRUS			
.30	.27	.03	200	19	SOLID May 6:00 PM BROWN OUT	01 FEB 12	28 FEB 12	
.34-.75	.34	.03	400	12	SOLID	19 FEB 12	20 FEB 12	
.4	.25	.15	—	—	JUST A GRAB SAMPLE	05 MAR 12	05 MAR 12	G
.68	.80	—	—	—	JUST A GRAB	—	20 MAR 12	G
.25	.80	—	—	—	JUST A GRAB	—	27 MAR 12	G WET
0	.8	—	—	—	RETRIEVED & DEPLOYED SCHIMMEL SAMPLE	16 MAY 12		DRY
.35	.12	.80	200	12	BOB SAID KEEP SAMPLE RAIN SHORT	15 JUN 12	18 JUN 12	NOT A FULL SAMPLE
.16	.07	.80	130	2	SPITTY SUMMER RAIN	29 JUN 12	30 JUN 12	WYZC
.51	1.11	.79	250	72	FIRST FLUSH MAY 09 BUT 7:25	11 OCT 12	12 OCT 12	G
.85	.54	.81	600	13	* STOPPED SAMPLING b/c DRY PENNS NOT MET.	26 OCT 12	27 OCT 12	
.29	.32	.81	250	13	SOLID	02 OCT 12	02 NOV 12	
.97	.89	.81	500	15	SOLID * DOES NOT COUNT, PACING, CHANGE, AND SPREAD	08 NOV 12	11 NOV 12	
.38-.8	.59	.81	425	24	SOLID	16 NOV 12	17 NOV 12	
.4-.6	.21	.79	325	16	SOLID	10 DEC 12	11 DEC 12	G
.8	.37	.79	550	12	DIVY POLYD NOT MET PACING A LITTLE HIGH	06 JAN 13	07 JAN 13	



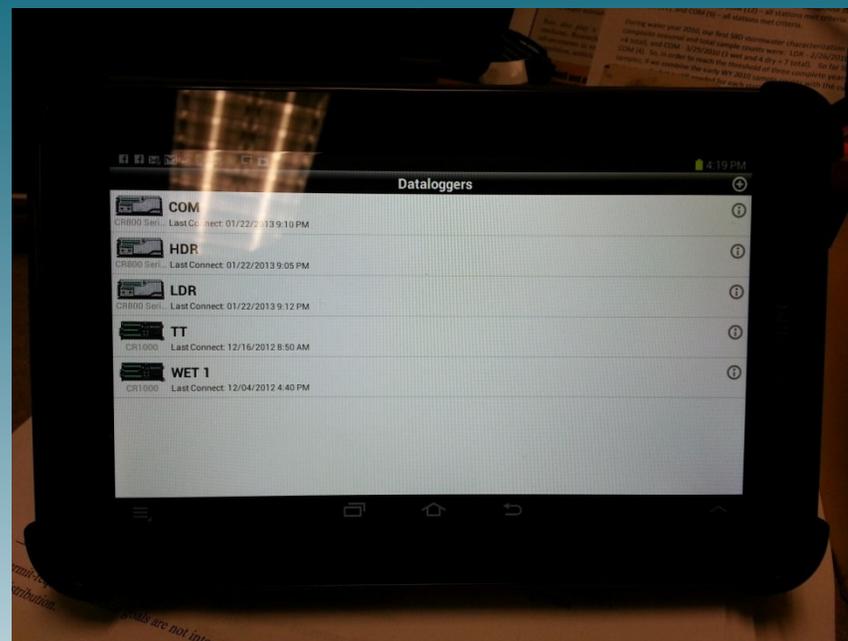
Clean Water Program

Programming Samplers to Capture Storms; Keeping up with Technology

Remotely programming is key. We capture 95% of all the storms we target.

From anywhere, Clark County has remote access to any of our samplers via Smart Phone, Tablet, or VPN into work desktop from any internet source .

Allows checking status and changing settings of samplers as weather forecast changes.



Samsung Tablet programming samplers using the Loggernet Ap.



Clean Water Program

Lessons Learned: Planning is Key

Clearly define monitoring research priority:

- Develop meaningful questions that can be answered
- Keep it simple

Come up with multiple sites that can address research priority:

- Know your drainage area: land use, drainage area size
- Know all mapped storm sewer infrastructure
- Plan equipment installation for each potential site

BMP Type and sampling design:

- Long detention ~ random sampling
- Short detention ~ paired sampling



Clean Water Program

Lessons Learned: Hydrology; Pacing

Sampler and hydrology equipment selection:

- Automated samplers
- Weirs, flumes, other? What works best for site set up?

Understand site hydrology:

- Develop and maintain rainfall/runoff relationship
- Develop pacing values for predicted storm volume that provide the maximum hydrograph coverage incase storm is lighter or heavier than forecasted
- Capture representative samples and ensure required minimum lab volume for a valid stormwater sample.



Clean Water Program

Lessons Learned: Reducing Staff Costs

Weather service:

- When to deploy staff: customizable alerts sent to staff based on current and predicted weather observations

Remote programming is key:

- Ability to program samplers anywhere, anytime without site visits as weather forecast changes

Laboratory partnership:

- Sample processing can be done by lab staff, eliminating monitoring staff time splitting sample.
- Communication is critical.



Clean Water Program

For More Information

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Clean Water Program

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Clean Water Program