



# Assessment of Solids Formation in the Inland Empire Brine Line

## **SAWPA Solids Formation Workshop** March 8, 2016

*Emily Owens-Bennett, P.E., Bryan Trussell, P.E., Rhodes Trussell, Ph.D., P.E.  
Trussell Technologies, Inc.*

# Acknowledgements

- Western Municipal Water District
  - Fred Kipfer



- E.S. Babcock & Sons, Inc. Environmental Laboratories



- Orange County Sanitation District
  - Dave Yager

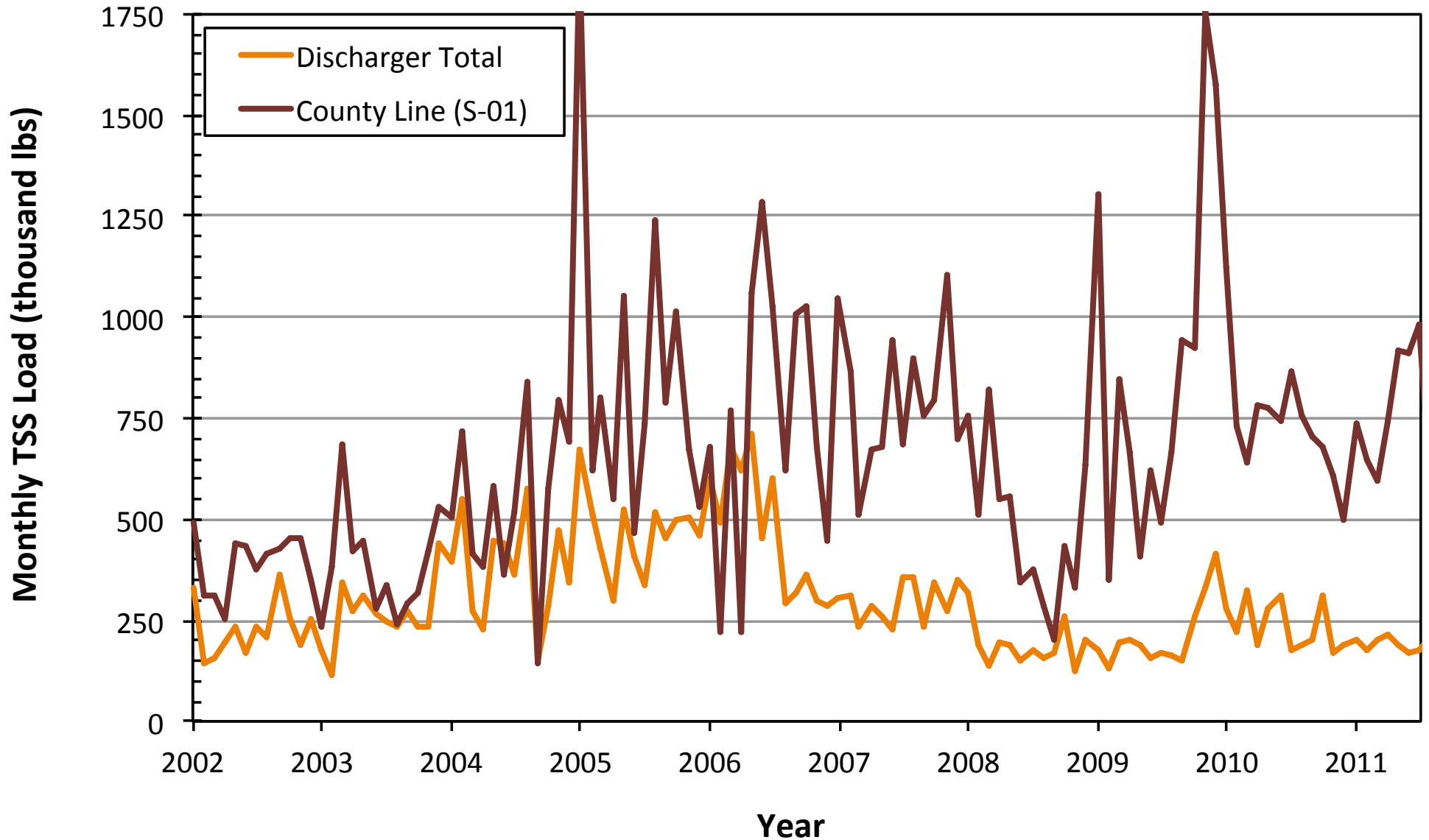


# Presentation Overview

- Review of Previous Work
- New Metering Station
- Update on Solids Formation
- Conclusions and Recommendations

# REVIEW OF PREVIOUS WORK

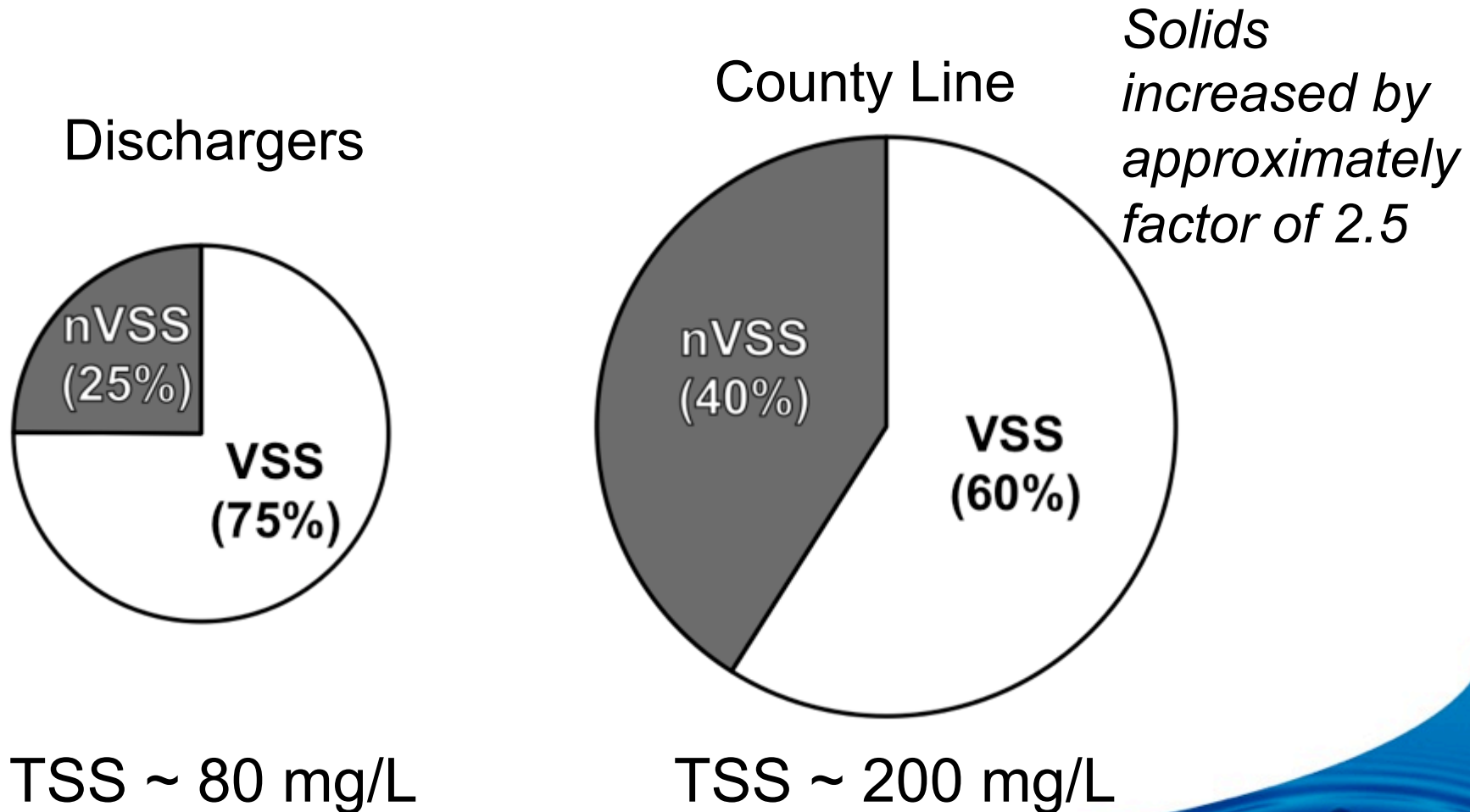
# Solids Difference in Brine Line



\*Values represent monthly average loading. When no monitoring occurred for an individual discharger in a given month, surrounding average measurements were substituted.

# Solids Formation in Brine Line

- TSS was increasing and changing in composition



# Expert Panel Findings

## Identified likely causes of solids formation:

- Precipitation of inorganic salts (*likely a major factor*)
- Formation from organics (e.g., coagulation of dissolved/colloidal organics, biogrowth) (*likely a minor factor*)
- Existing data not conclusive; additional studies recommended

## Noted that standard measurement techniques may not be appropriate for Brine Line

- VSS likely represents contributions from inorganics
- Additional studies to characterize the solids needed

## Identified potential solids control measures:

- pH adjustment
- Aeration control
- Addition of precipitation inhibitors
- Elimination of discharge constituents
- Dilution of brine wastes with others waters

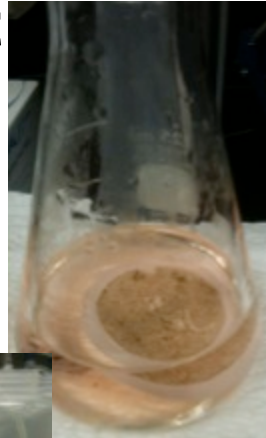
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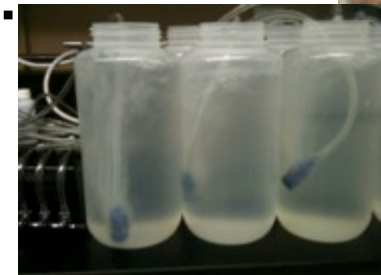
## Noted that standard measurement techniques may not be appropriate for Brine Line

- VSS likely represents contributions from inorganics
- Additional studies to characterize the solids needed (Ongoing)



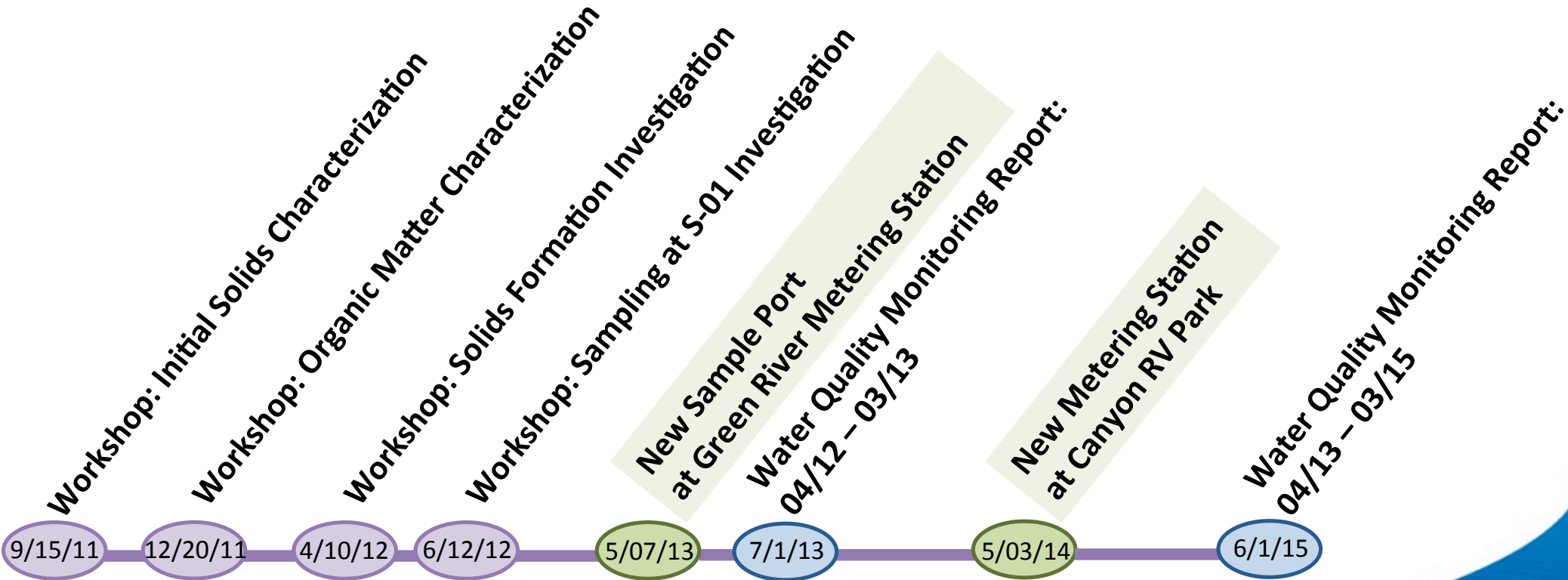
## Identified potential solids control measures:

- pH adjustment (2012 Trussell Tech studies)
- Aeration control (2012 Trussell Tech studies)
- Addition of precipitation inhibitors
- Elimination of discharge constituents (Ongoing, e.g., Chino II)
- Dilution of brine wastes with others waters (Not considered)





# Brine Line Investigation



# Solids Characterization

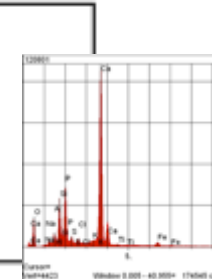
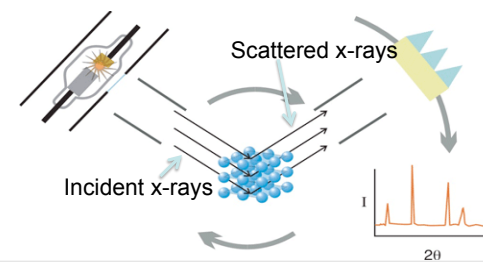
## Overview of analyses



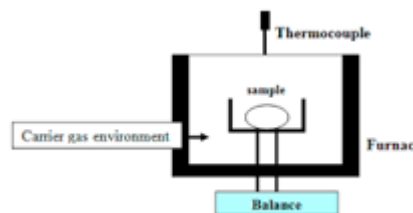
Brine Line  
Solids at  
County Line

Inorganic  
analyses

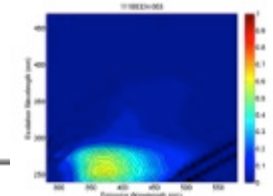
1. Mineral composition (XRD)
2. Elemental composition (ICP, EDX)
3. Waters of hydration (TGA)



Organic analysis

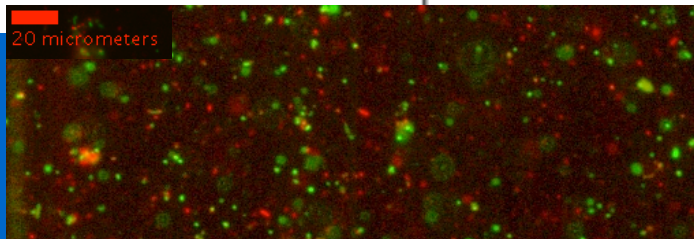
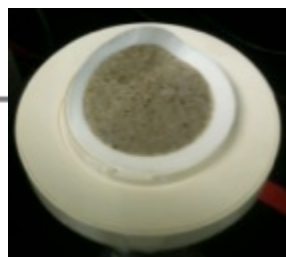


1. Estimate organic contribution from **indirect** and **direct** POC measurements
2. Organic matter characterization (TGA, FTIR, EEM)
3. Biological characterization (HPC, fluorescence microscopy)

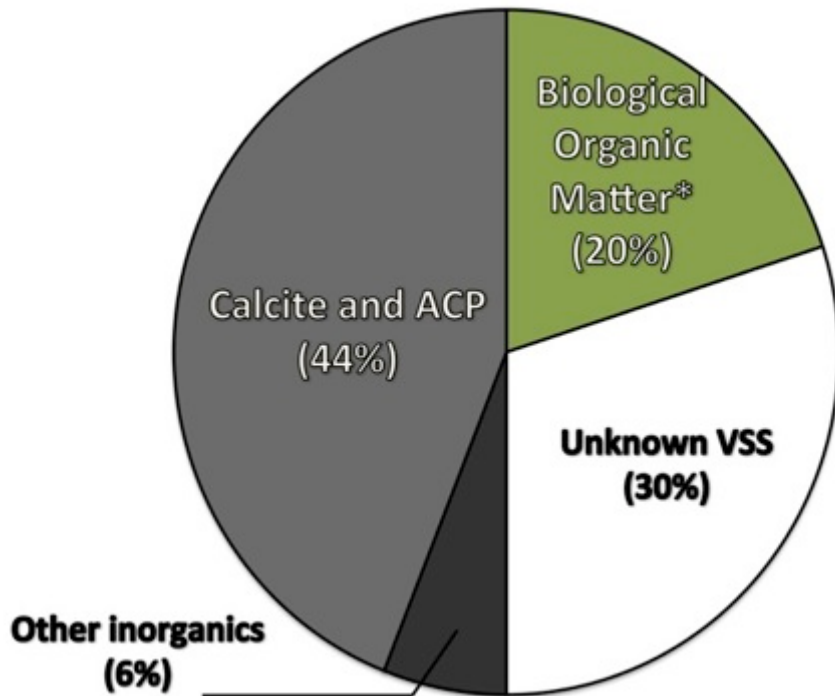


Other analyses

Solids Analysis  
1. TSS/VSS



# Solids Characterization



Data from September 2011

**Estimated composition of solids at County Line metering station**

**\*Note: Biological organic matter is assumed to be twice the concentration of the particulate organic carbon.**

# Solids Characterization

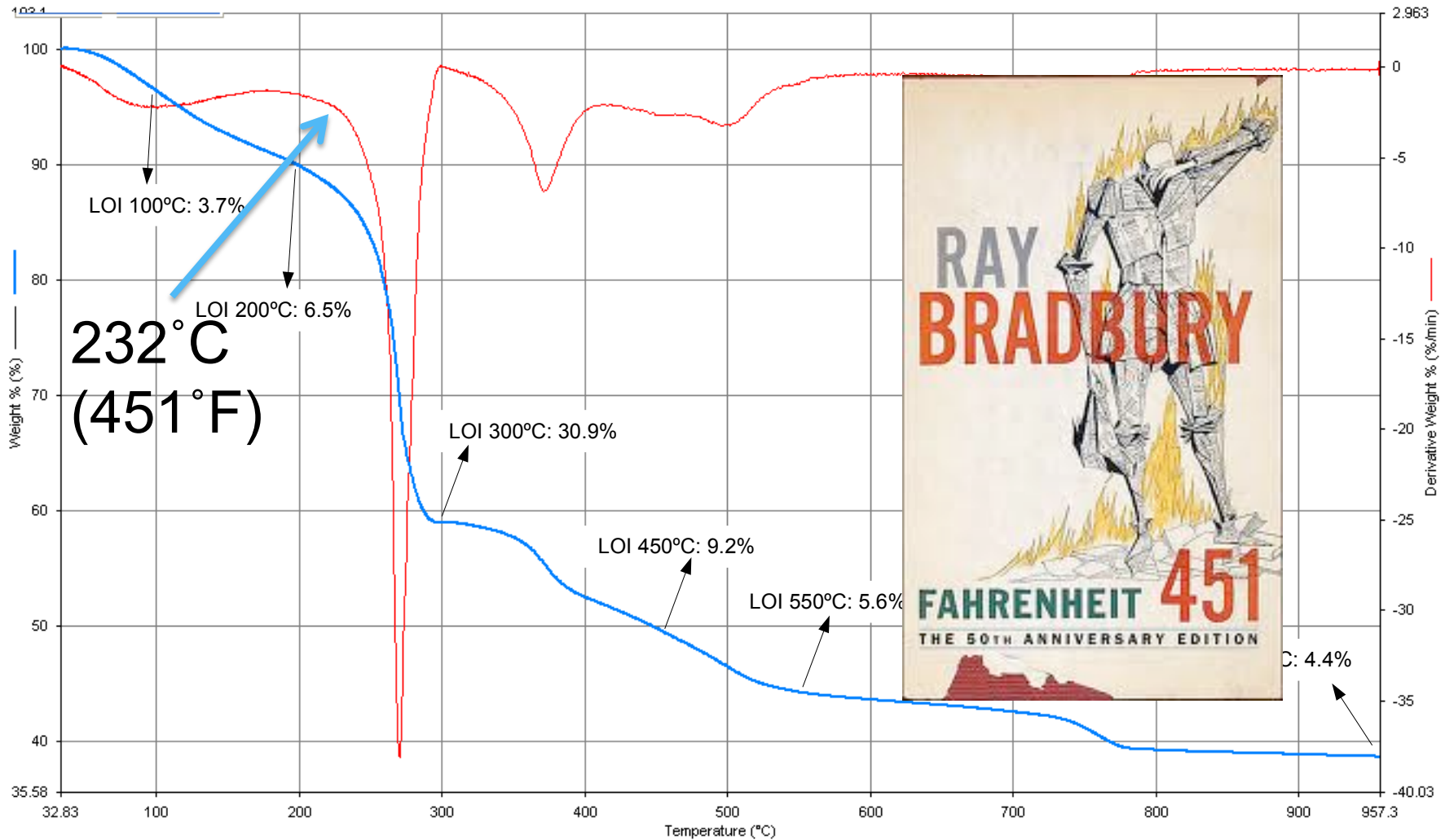


**macrophotography**



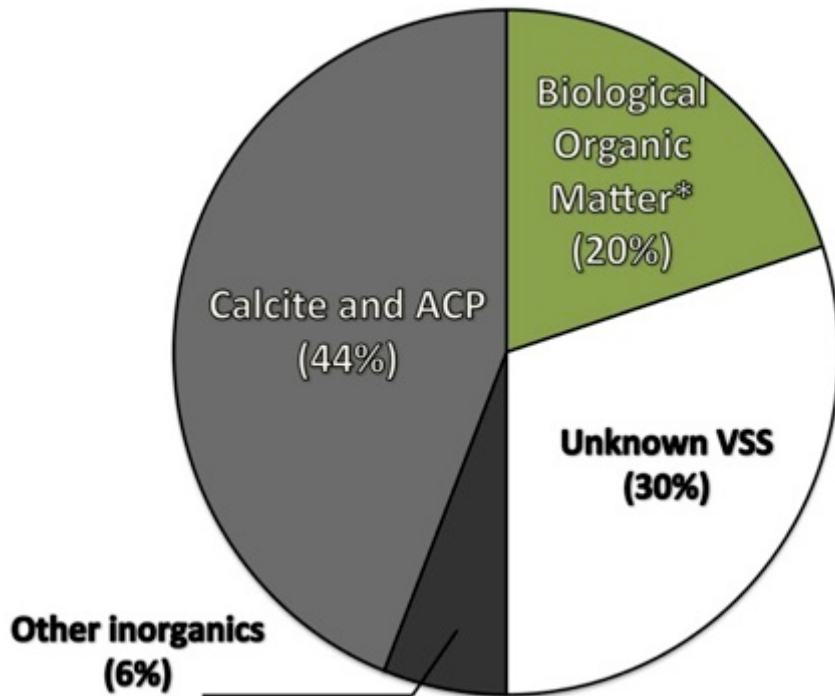
**Closer look at  
dried solids**

# Solids Characterization

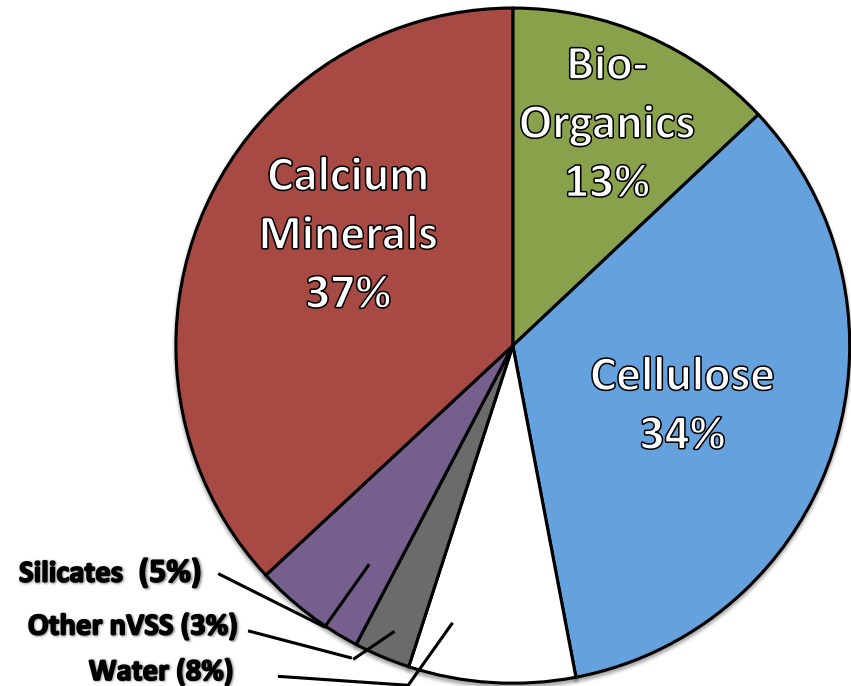


TGA suggests new organic candidate

# Solids Characterization



Data from September 2011



Data from October-December 2011

**Estimated composition of solids at County Line metering station**

\*Note: Biological organic matter is assumed to be twice the concentration of the particulate organic carbon.

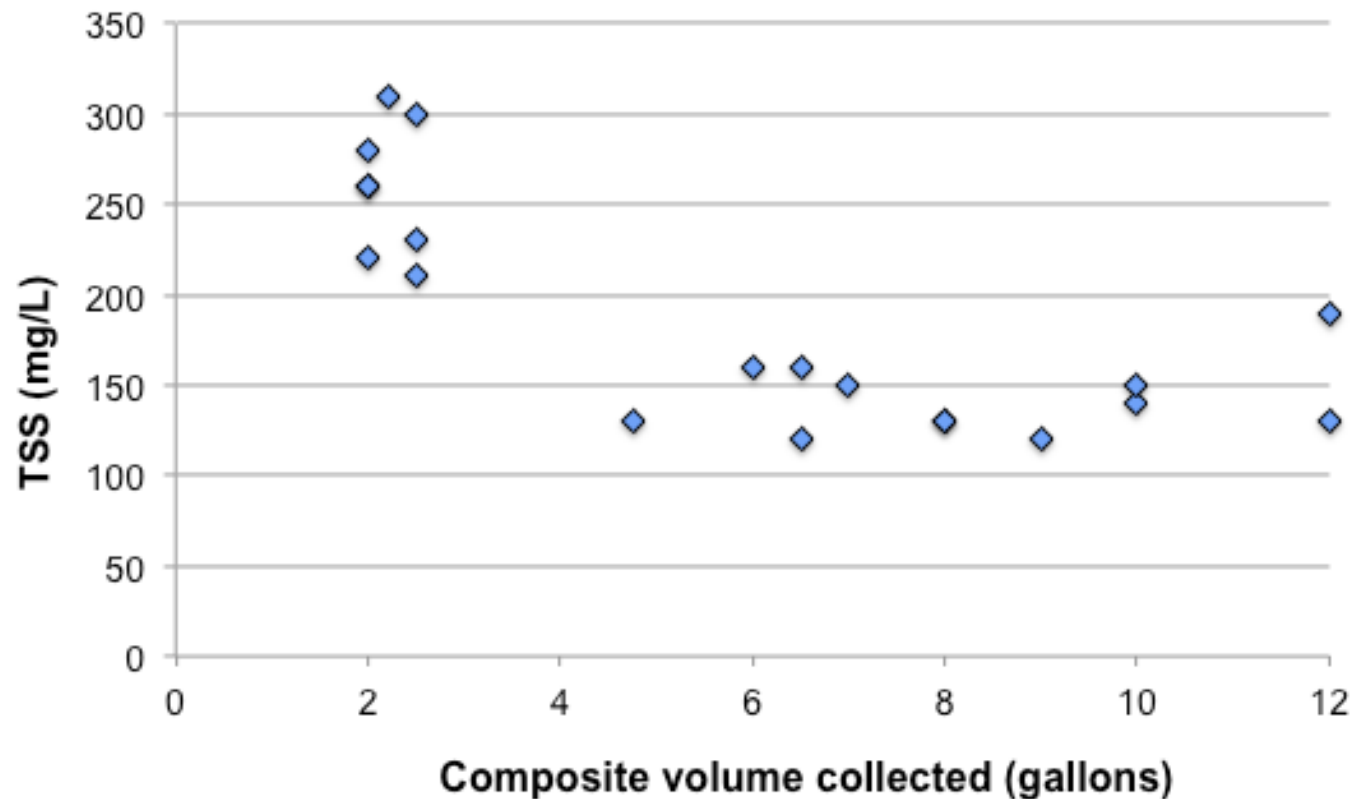
# Sampling Investigation

- Impact of sampling at old metering station
  - First noticed that TSS seemed to be lower whenever special sampling was done
  - Special sampling requires LARGER sample volume
  - Composite sampler collects a discrete sample every 15 minutes

Type	Composite Sample Size (gal)	Discrete Sample Volume (mL)
Typical Sample	2.5	100
Special Sample	10	400

# Sampling Investigation

- Impact of sampling at old metering station
  - TSS/VSS decreases with increasing sample volume

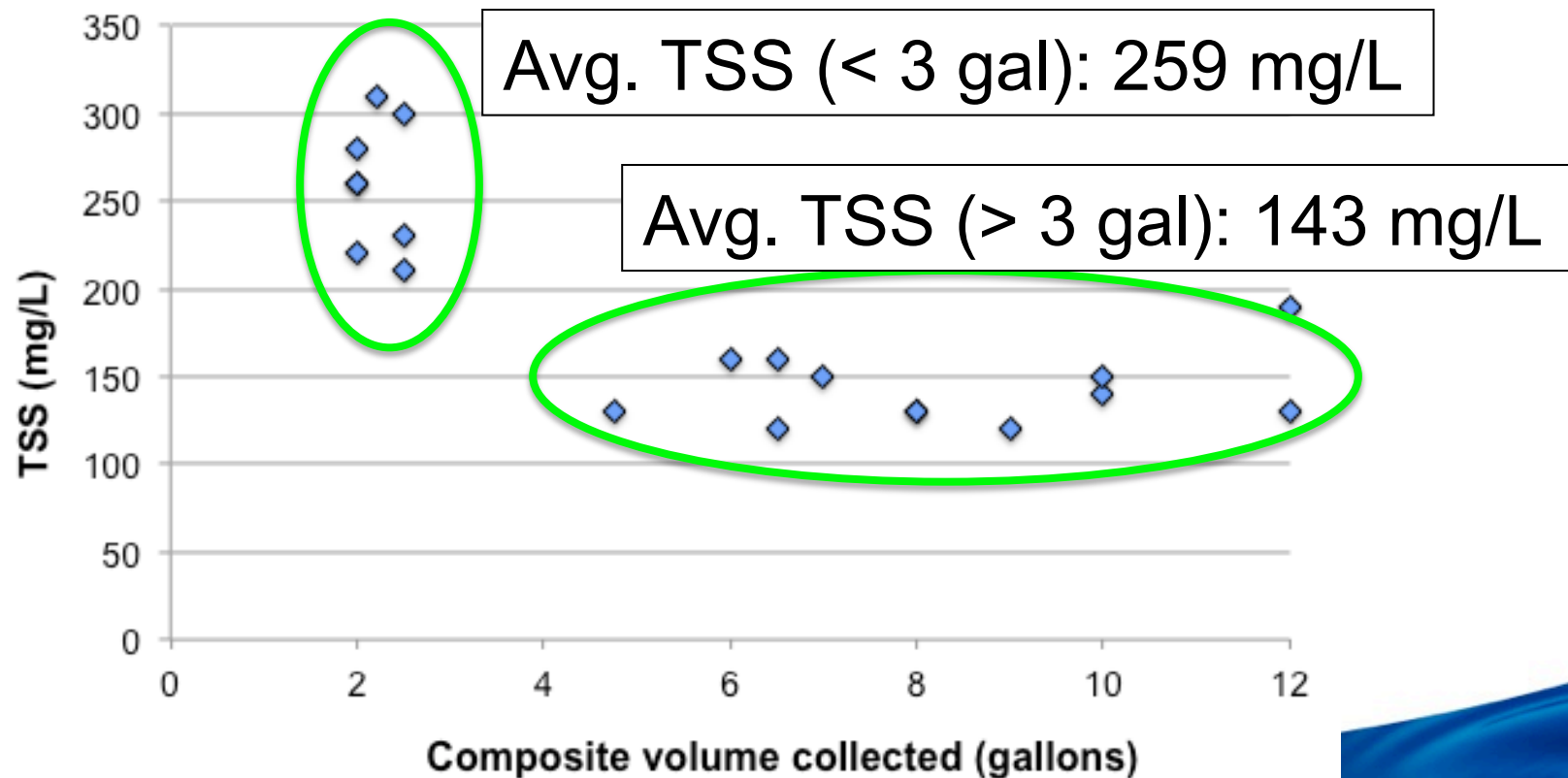


All data from 11/11 to 5/12 when sample volume recorded



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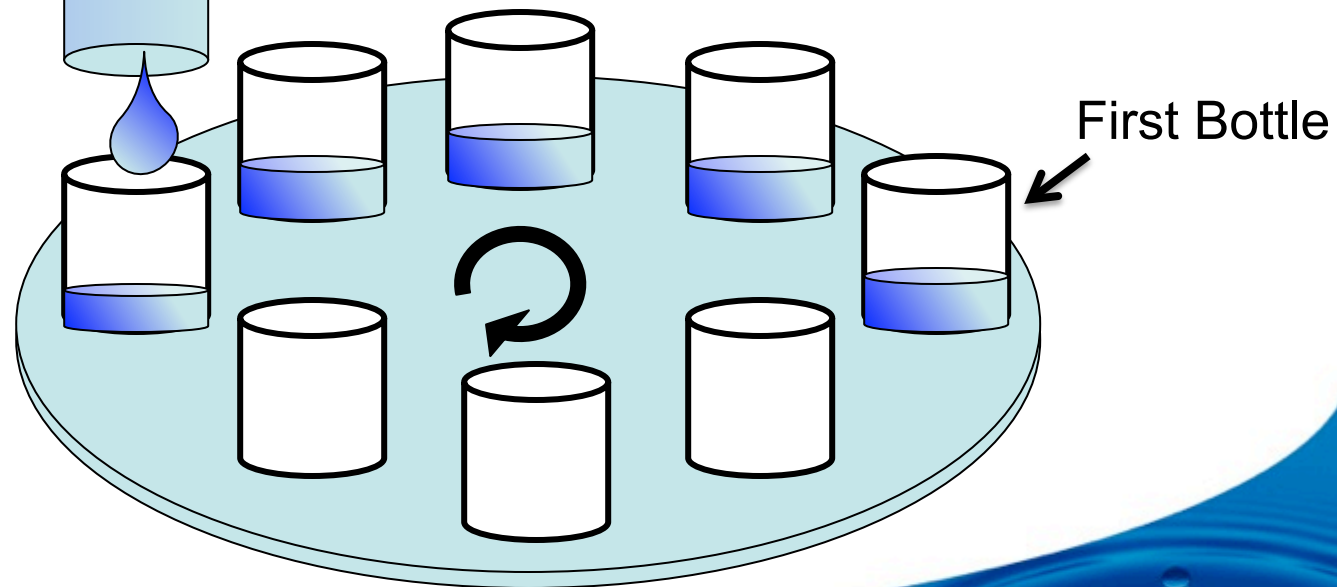


All data from 11/11 to 5/12 when sample volume recorded

# Sampling Investigation

- Impact of sampling at old metering station
  - Split composite sampling

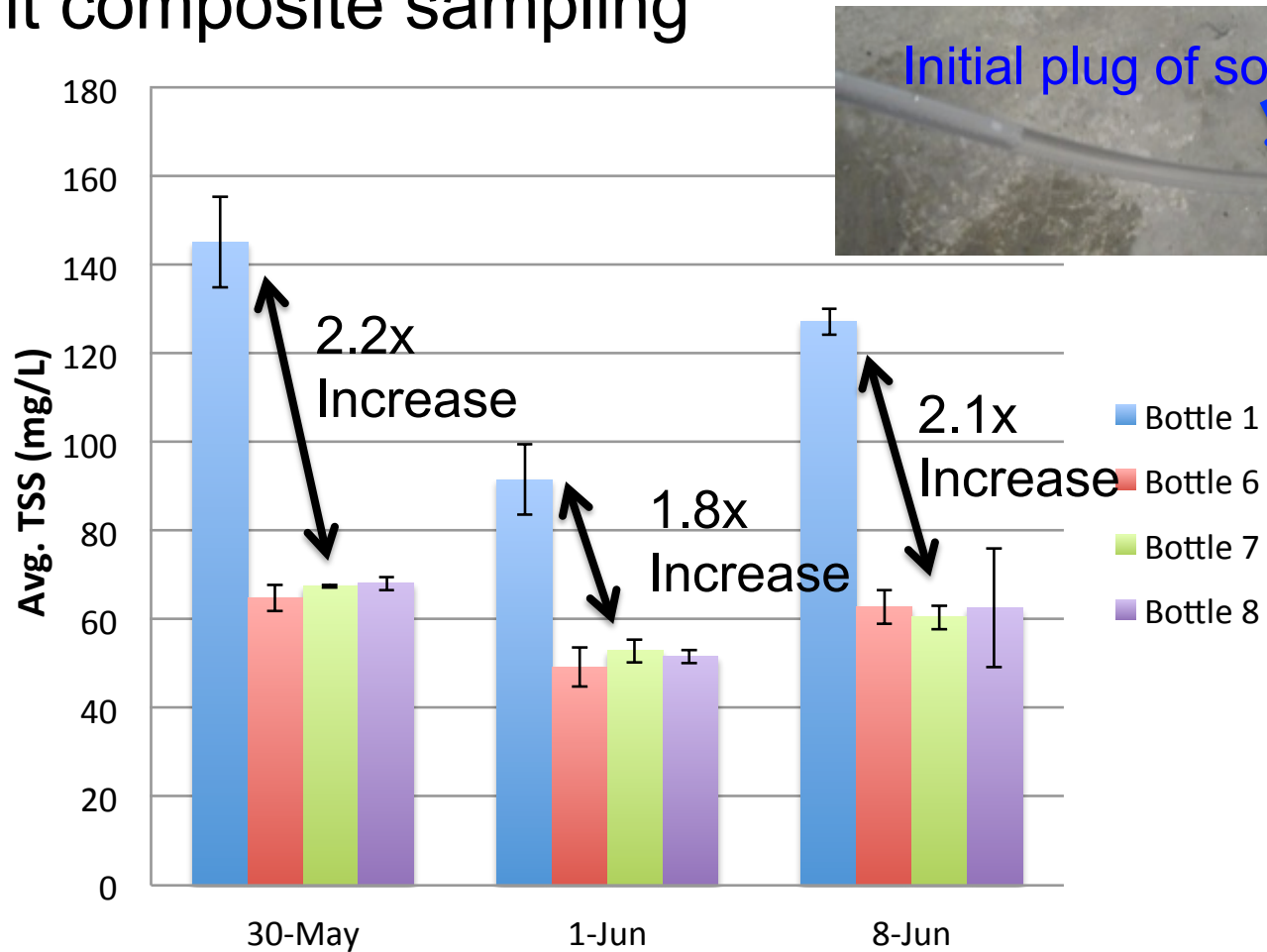
Sampler hose



- ~100 mL per bottle
- Full revolution every 15 min.

# Sampling Investigation

- Impact of sampling at old metering station
  - Split composite sampling



# Sample Port Replacement



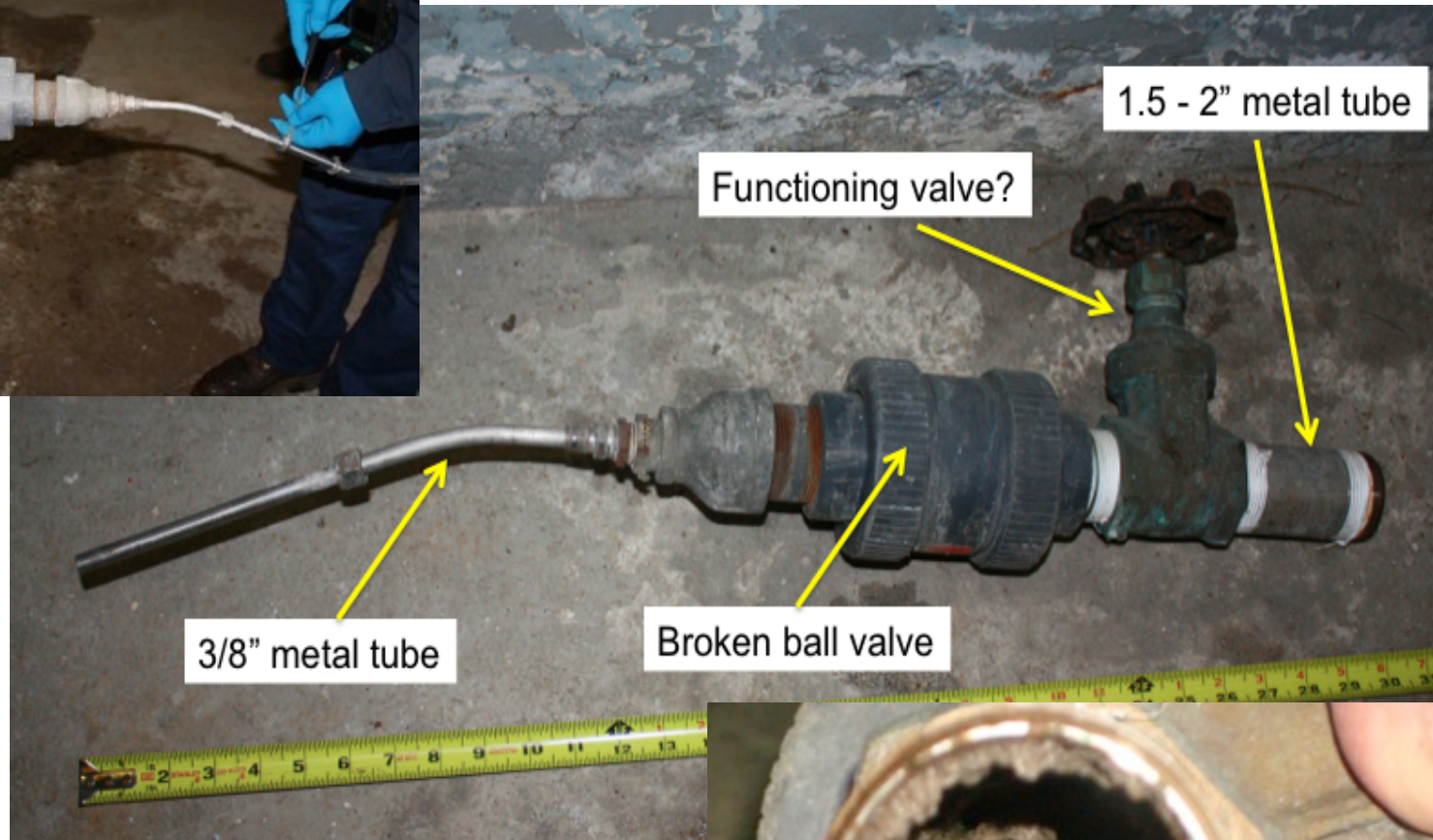
Old Port



New Port

**May 2013: Sample Port at Green River S-01 Replaced**

# Sample Port Replacement



# Sample Port Replacement

## Continuous Diameter Probe



## Maintenance Procedure and Nylon Brush

*Santa Ana Watershed Project Authority*  
Inland Empire Brine Line – Green River Monitoring Station (S-01)  
Sample Port Maintenance Procedure

To maintain sampling integrity, the sample port within the vault of the Green River monitoring station (S-01) will need to be cleaned prior to each composite sampling event using a nylon brush.

### Sample Port Cleaning

1. Switch the sample tap valve to the OFF position.

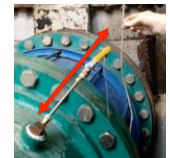
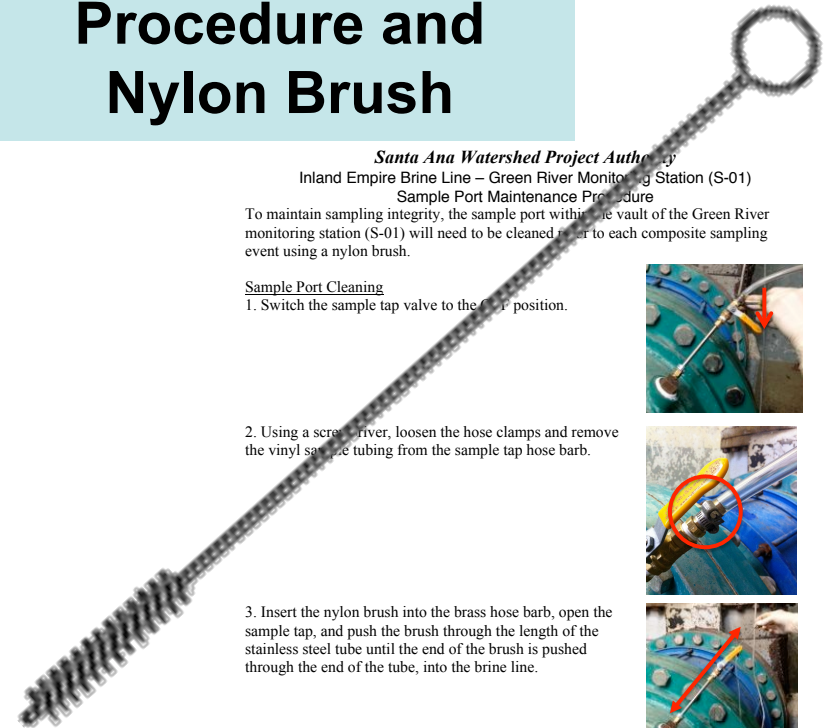
2. Using a screw driver, loosen the hose clamps and remove the vinyl sample tubing from the sample tap hose barb.

3. Insert the nylon brush into the brass hose barb, open the sample tap, and push the brush through the length of the stainless steel tube until the end of the brush is pushed through the end of the tube, into the brine line.

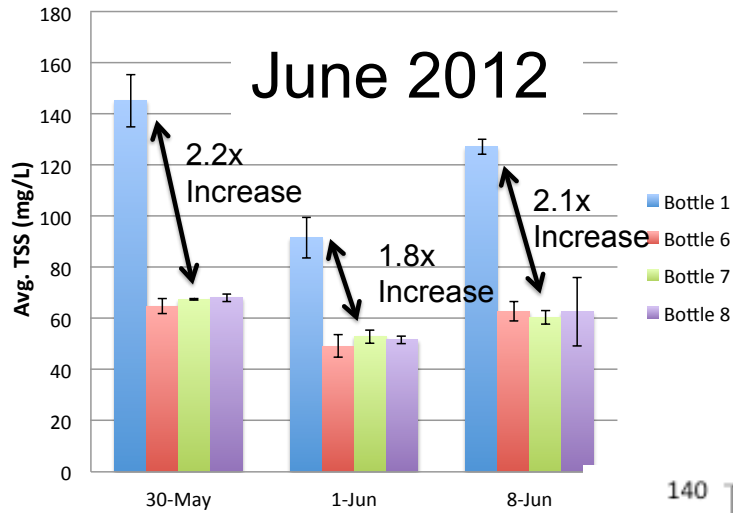
4. Pull the brush out, check for any accumulated debris, rinse in the stream of sample flowing out the sample port.

5. Repeat steps 3-4 at least 6 times.

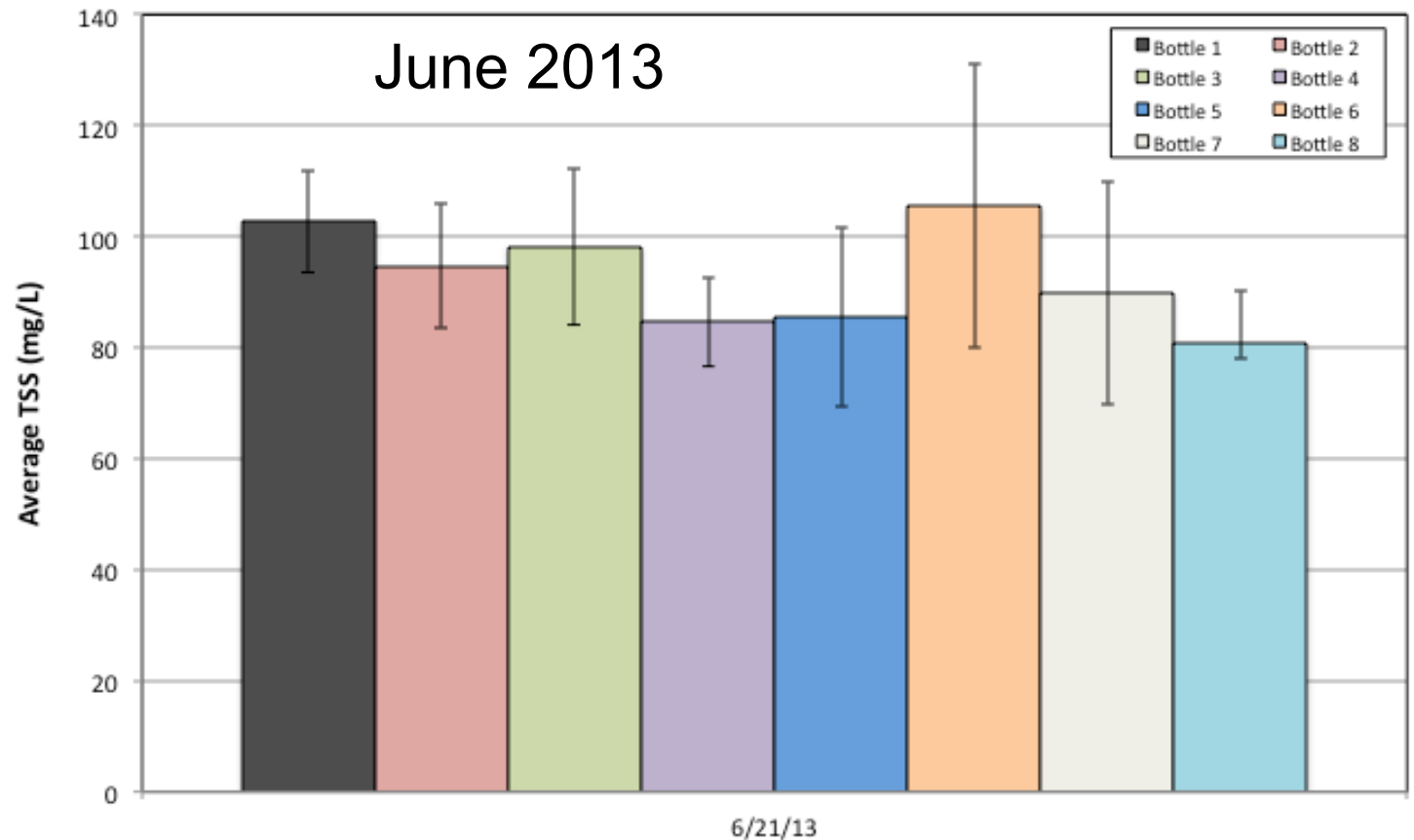
6. Switch off the sample tap valve to reattach the vinyl sample tubing and hose clamps.



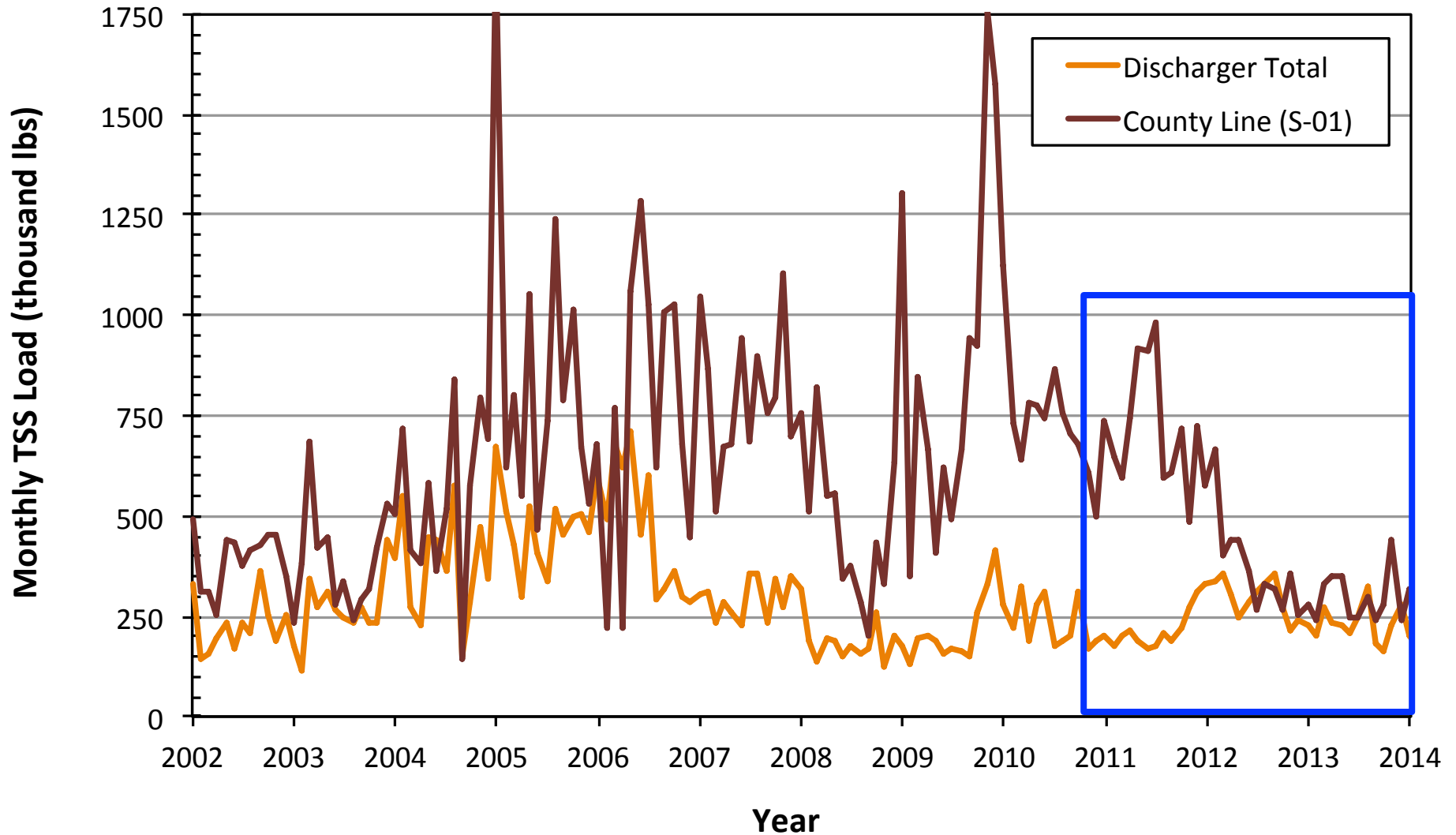
# Sample Port Replacement



- Split composite sampling (8 bottle)



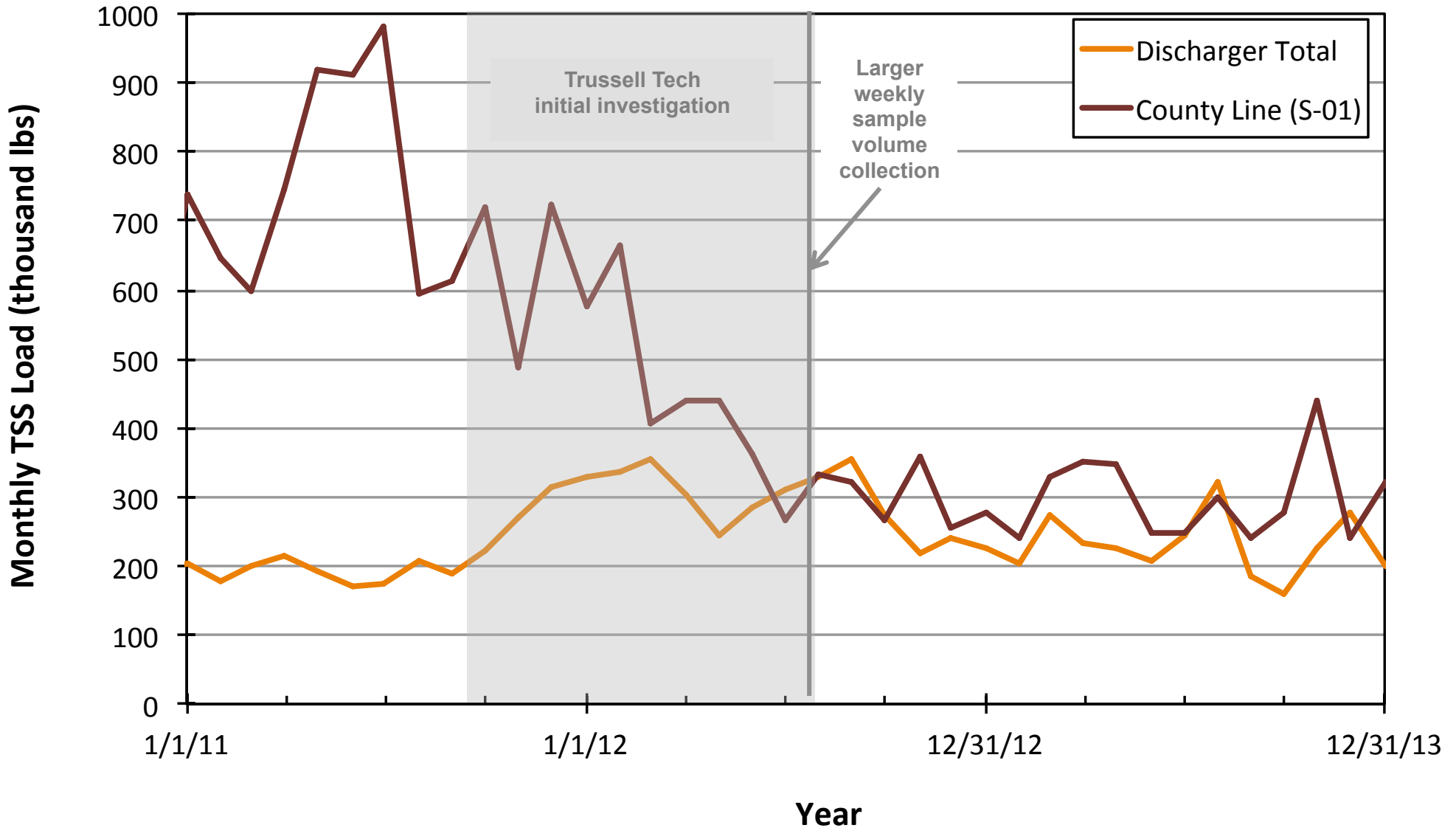
# Solids Difference in Brine Line



\*Values represent monthly average loading. When no monitoring occurred for an individual discharger in a given month, surrounding average measurements were substituted.



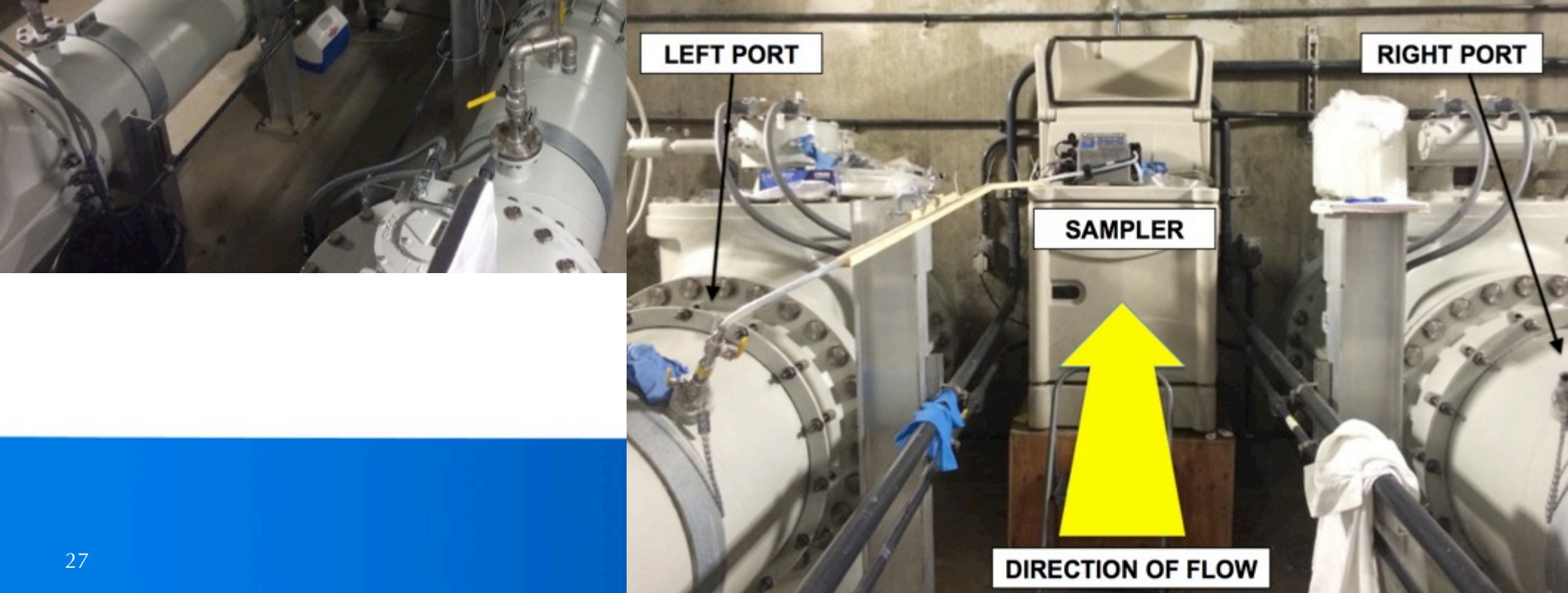
# Solids Difference in Brine Line



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# NEW METERING STATION

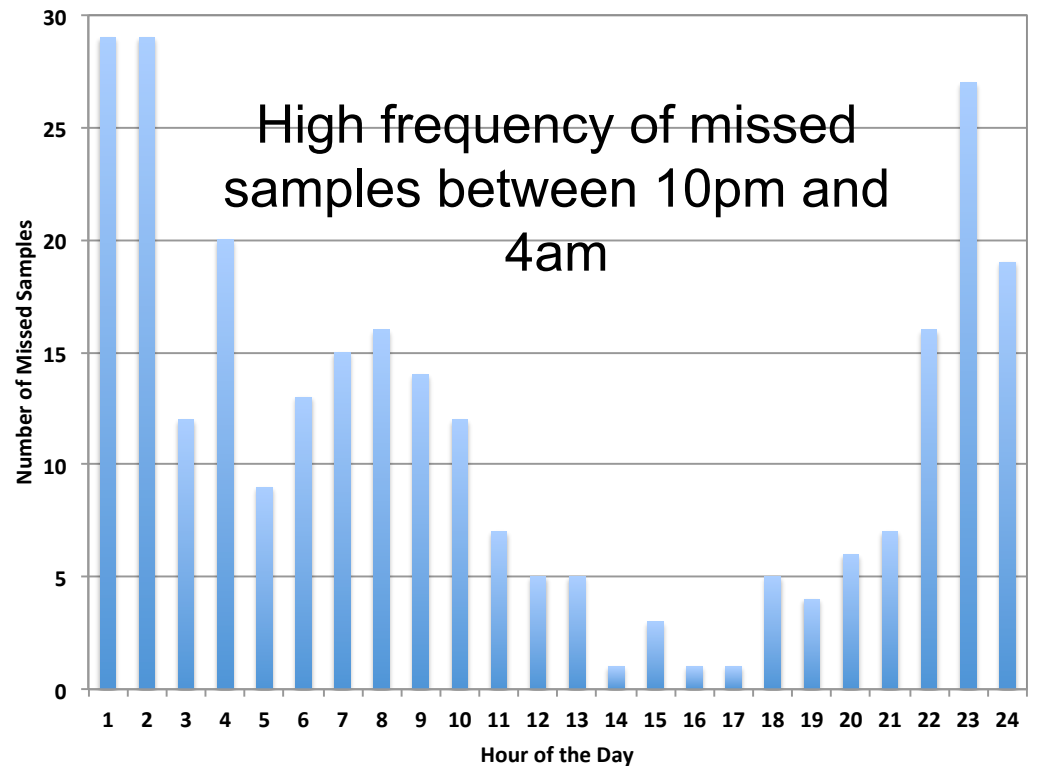
# Canyon RV Park Sampling Station



# Missed Samples

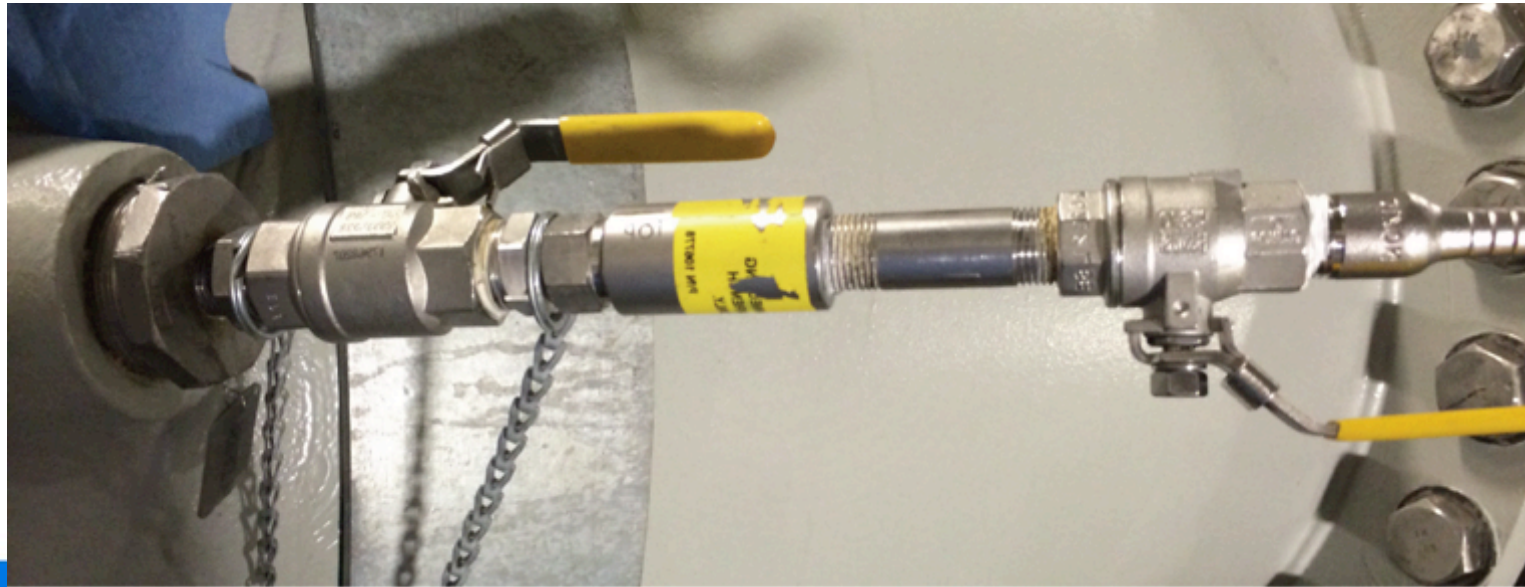
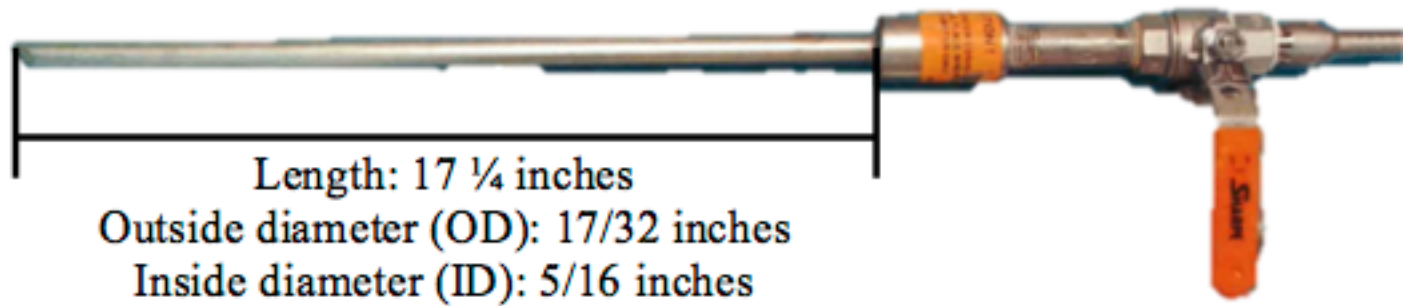
Initial 16 weeks of sampling at new metering station:  
missed samples every time

Sample Date	Number of Missed Samples
5/7/14	1
5/16/14	1
5/21/14	3
5/29/14	4
6/3/14	20
6/11/14	6
6/17/14	15
6/25/14	24
7/1/14	5
7/11/14	13
7/17/14	19
7/23/14	30
7/29/14	11
8/7/14	50
8/13/14	12
8/19/14	11



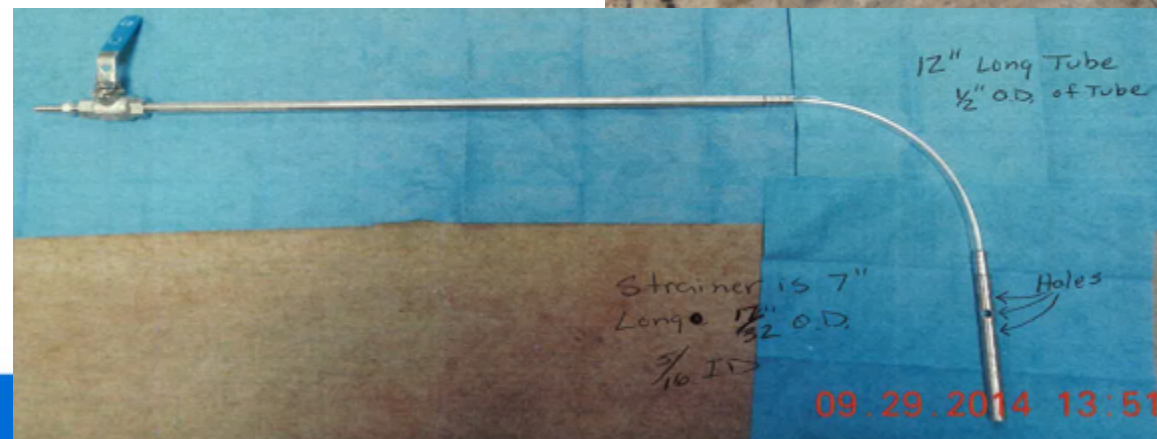
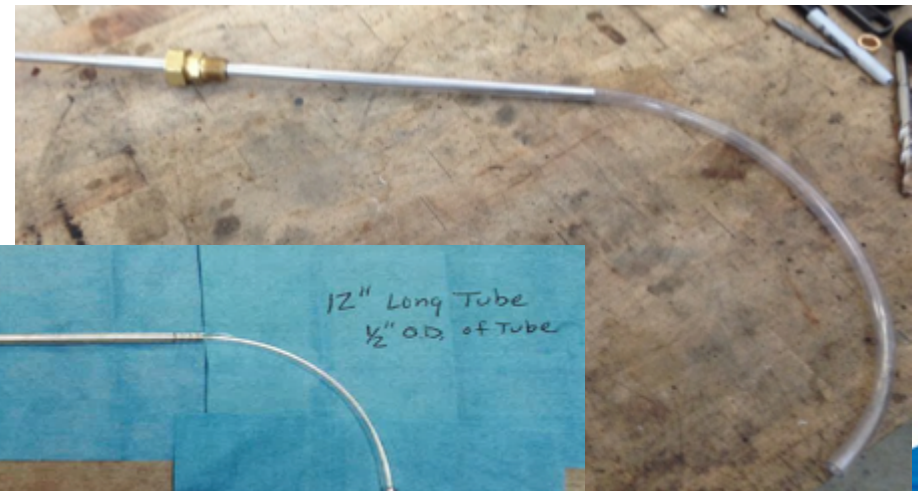
# Probe Investigation

- Original probe



# Probe Investigation

- Trial probes:
  - Drilled
  - Flexible tubing
  - Flexible tubing + strainer

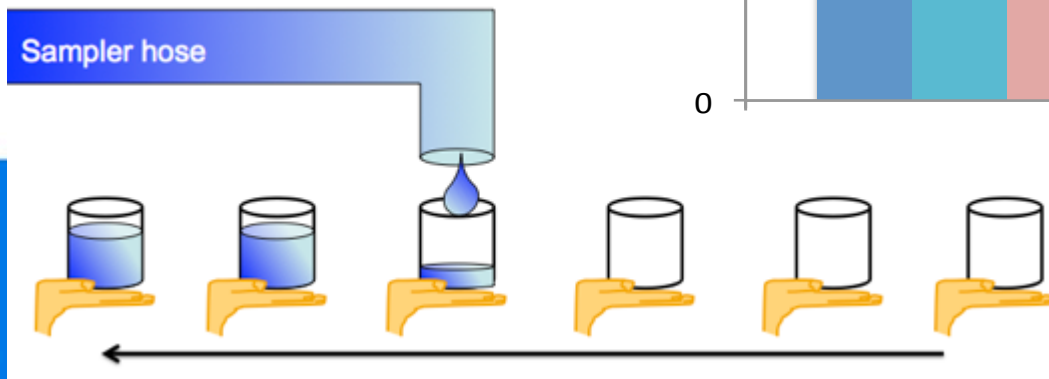
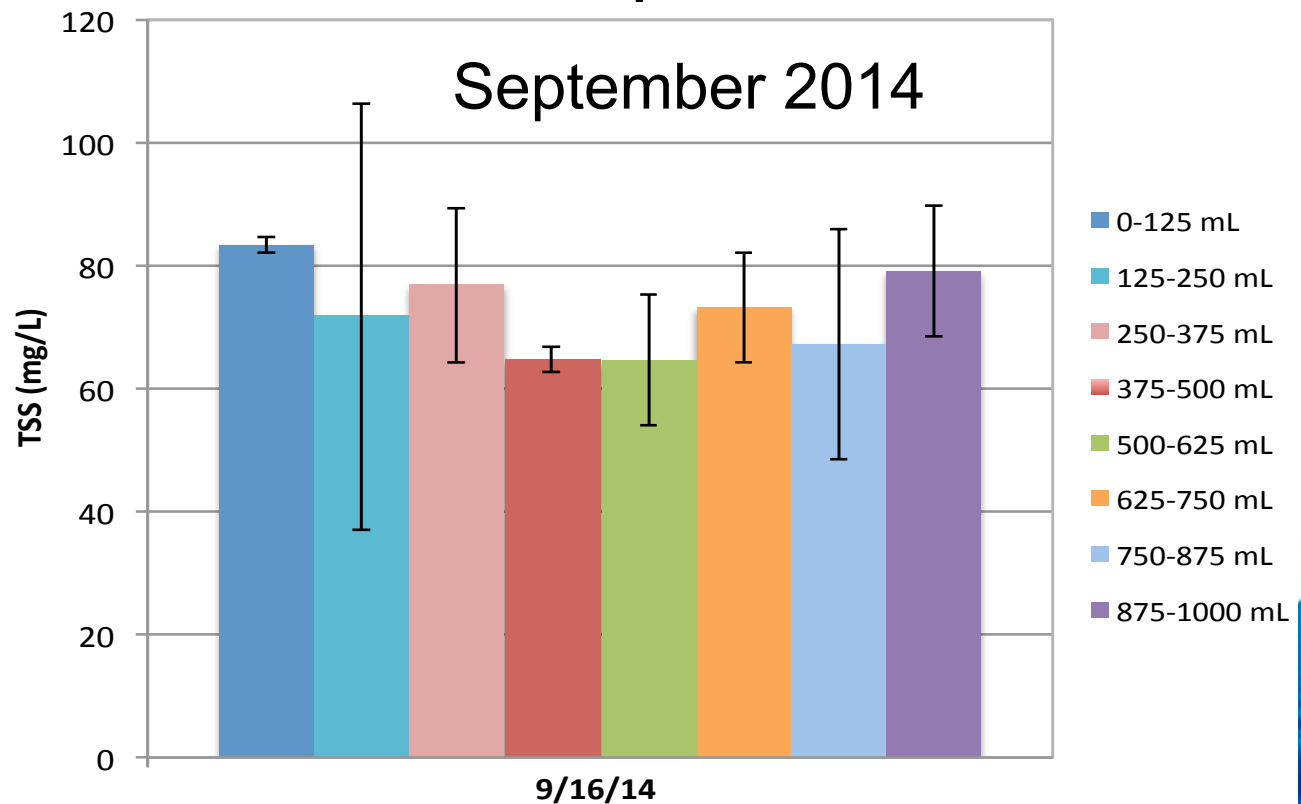
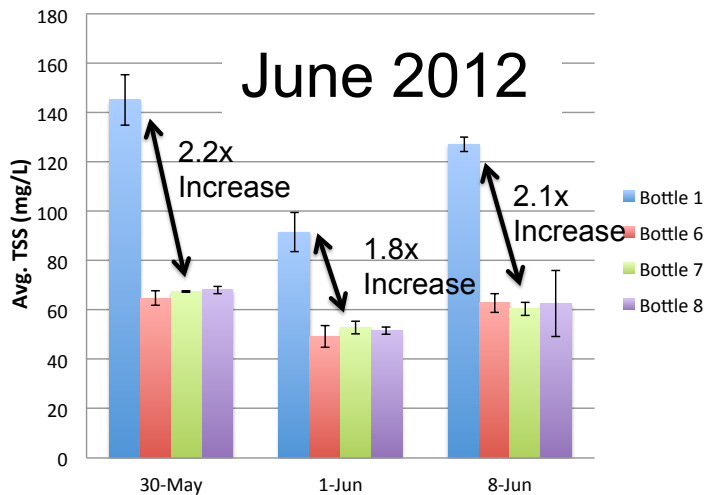


# Custom Sampling Modifications



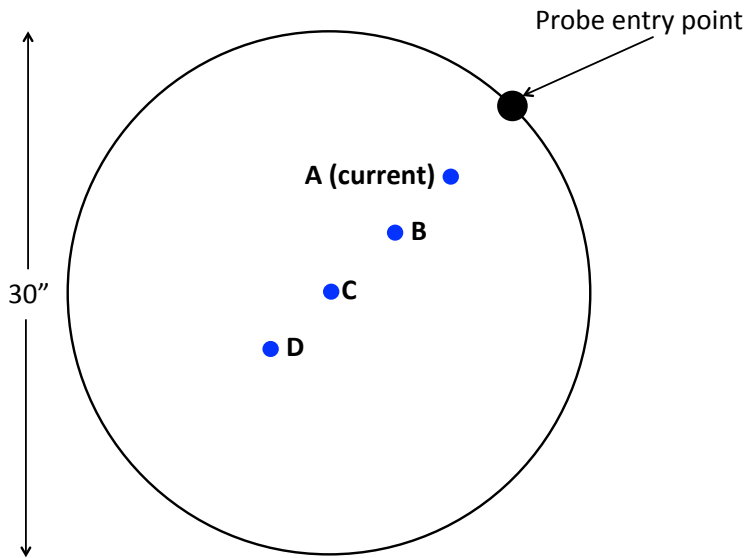
# Confirmation Testing

- Modified 8-bottle sampling using grabs
- Three consecutive 8-bottle samples





# Confirmation Testing

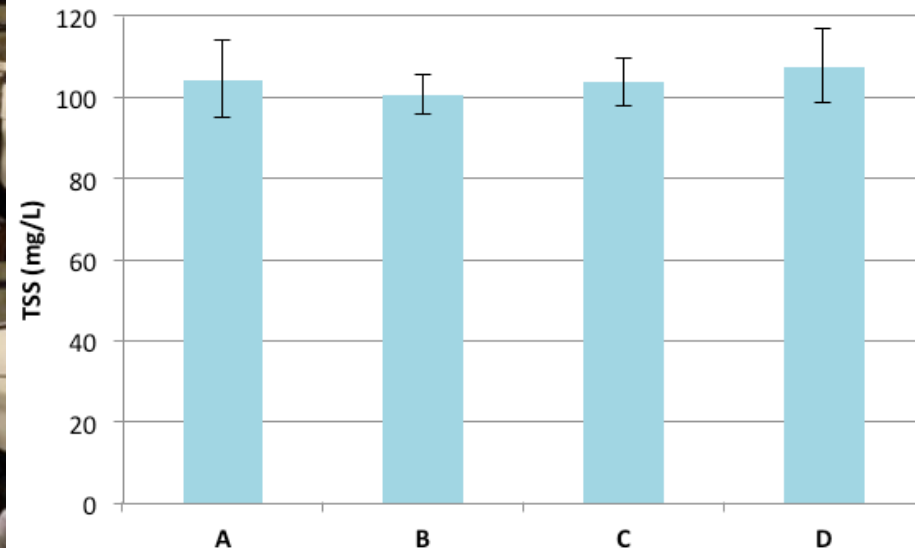
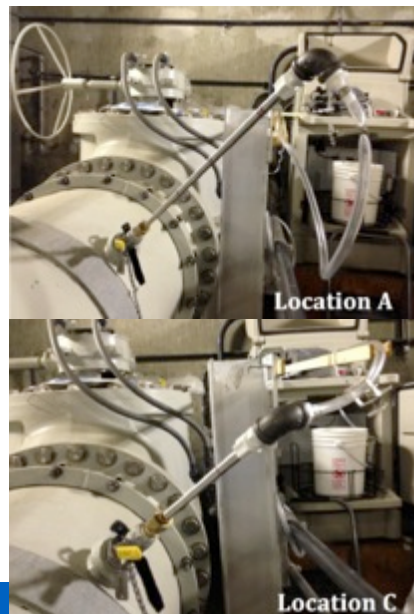


Sample point ID	Approximate % depth from crown of pipe	Approximate depth from crown of pipe (in)	Length of probe in Brine Line
A (current)	32%	9.5 in	6.75 in
B	40%	12 in	15.3 in
C	50%	15 in	21.2 in
D	60%	18 in	27.3 in

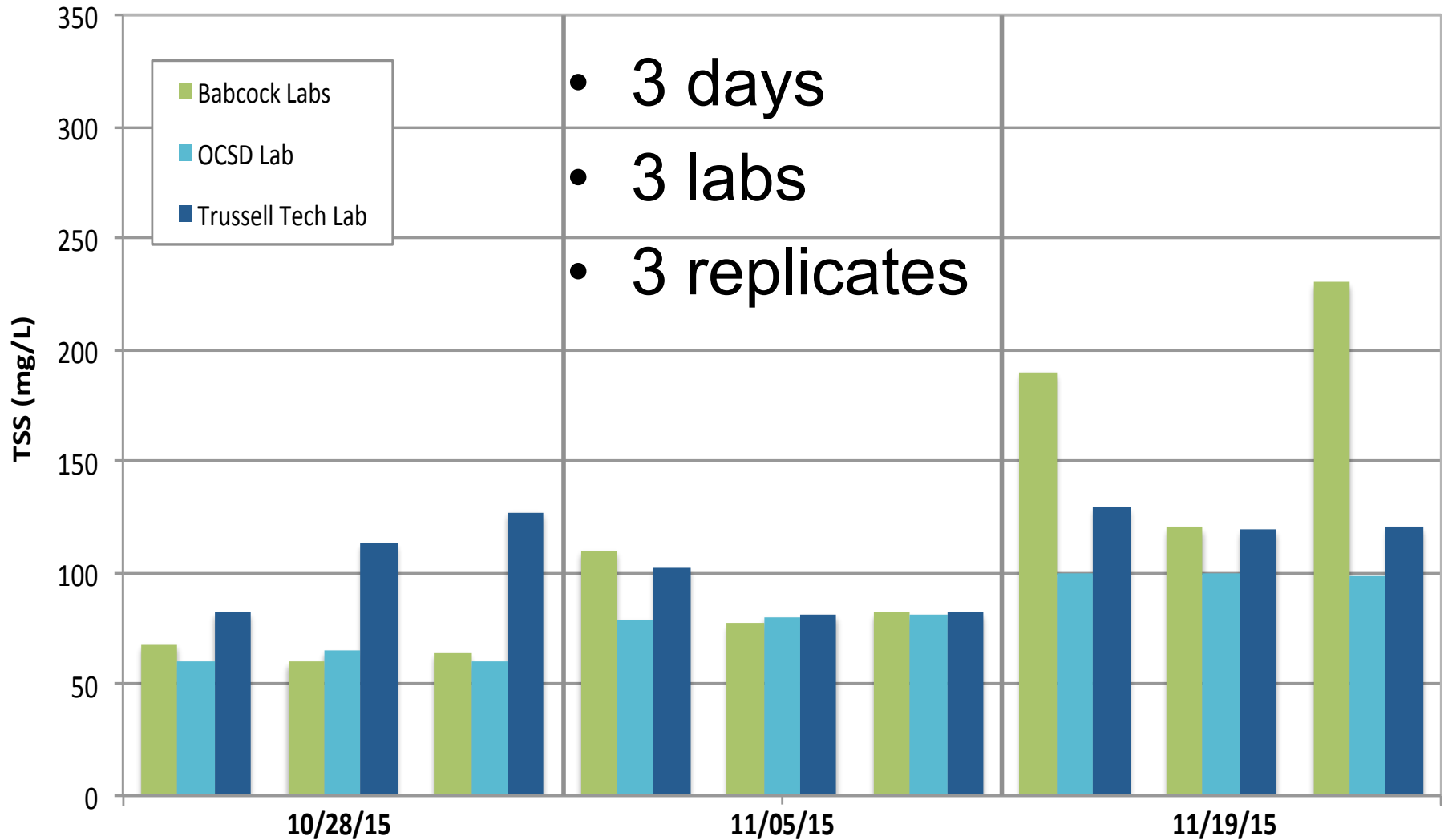
**Test:** 3 samples from 4 depths, repeated 3 times

**Goal:** Test impact of sampling depth on TSS concentration

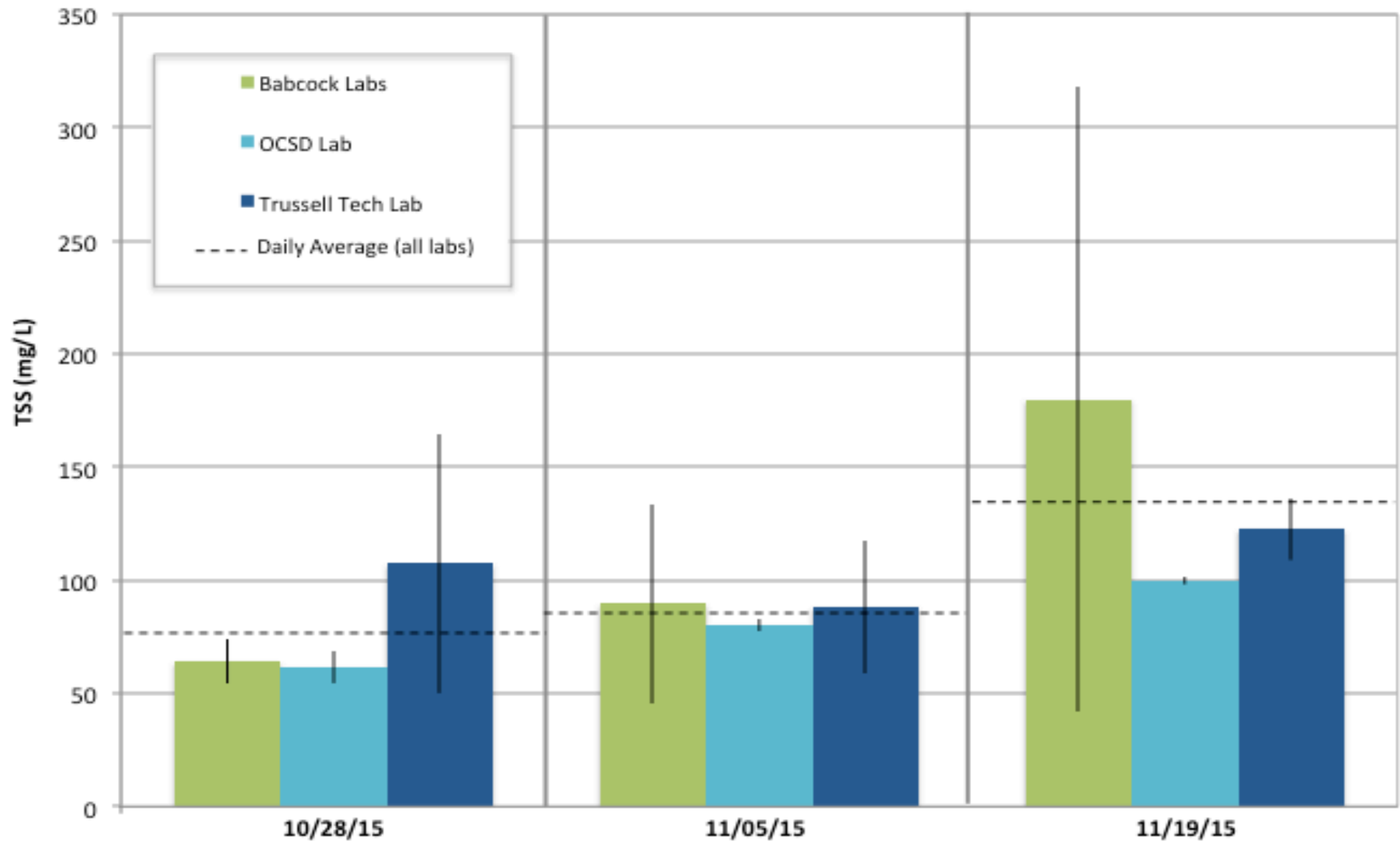
**Results:** No significant differences between sample depths



# Replicate Sampling for TSS



# Replicate Sampling for TSS



# Canyon RV Park Sampling Station Line Switch

Line 2: active  
May 2014 –  
Feb. 9, 2016

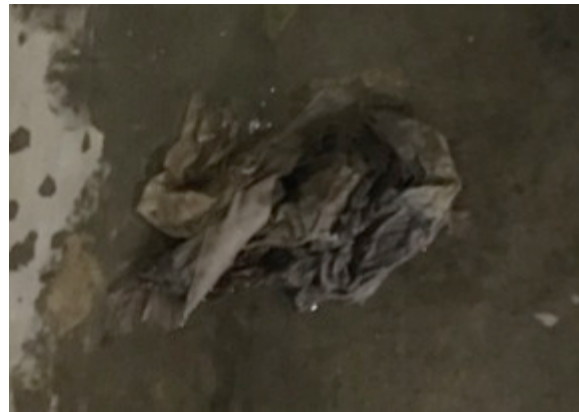


Line 1: active  
Feb. 9, 2016  
– present

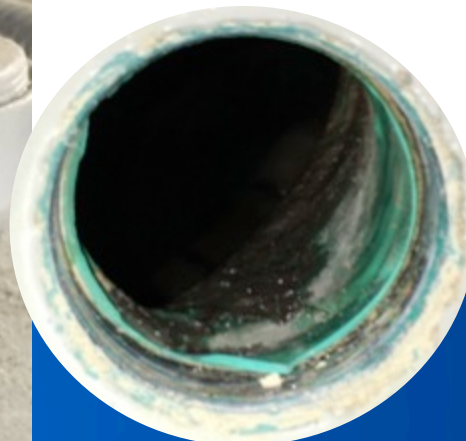


# S-01 Line Switch

- Debris, large dispersibles clogging drain

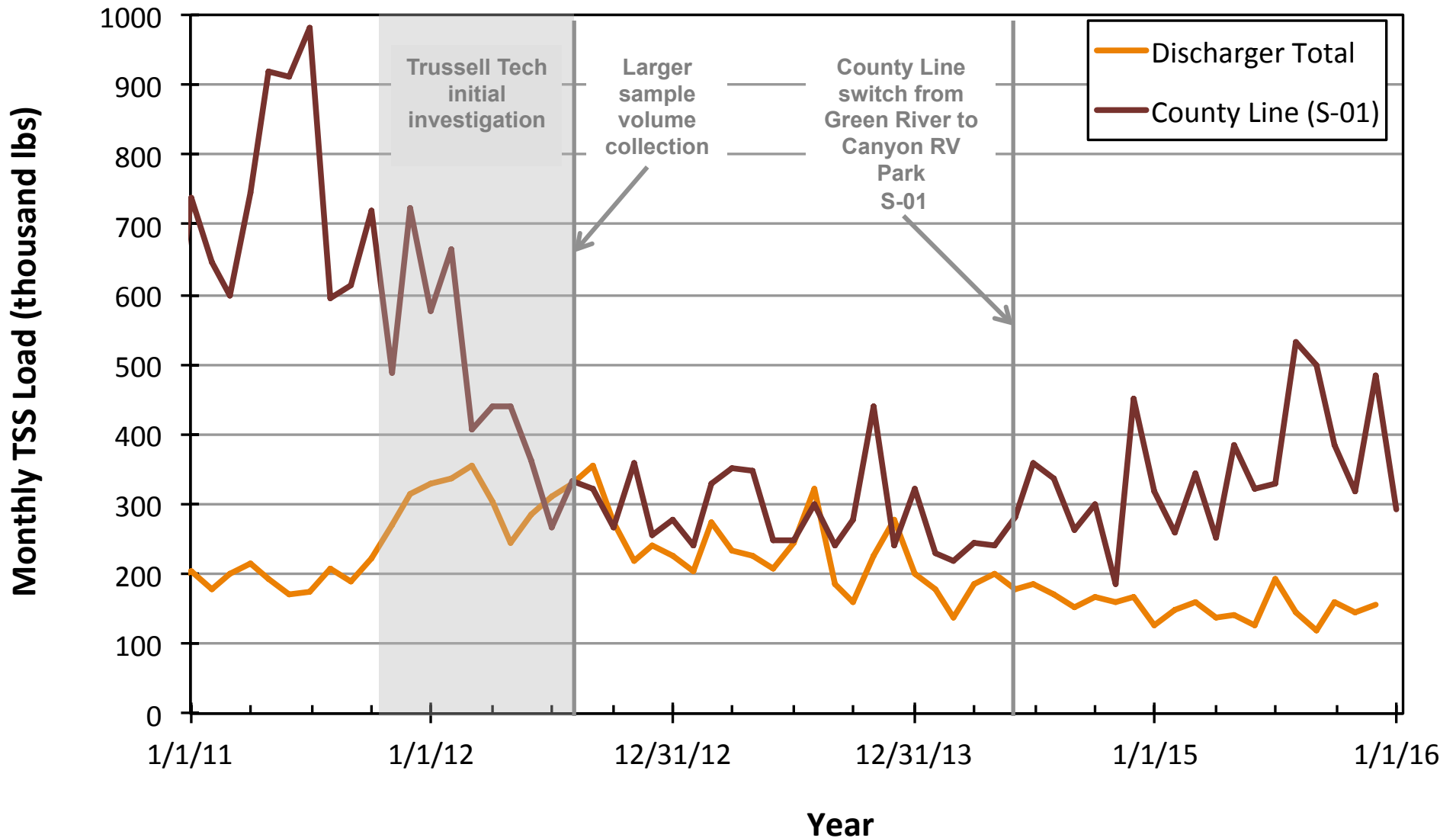


- Sample port
  - Large opening
  - Cracked epoxy liner



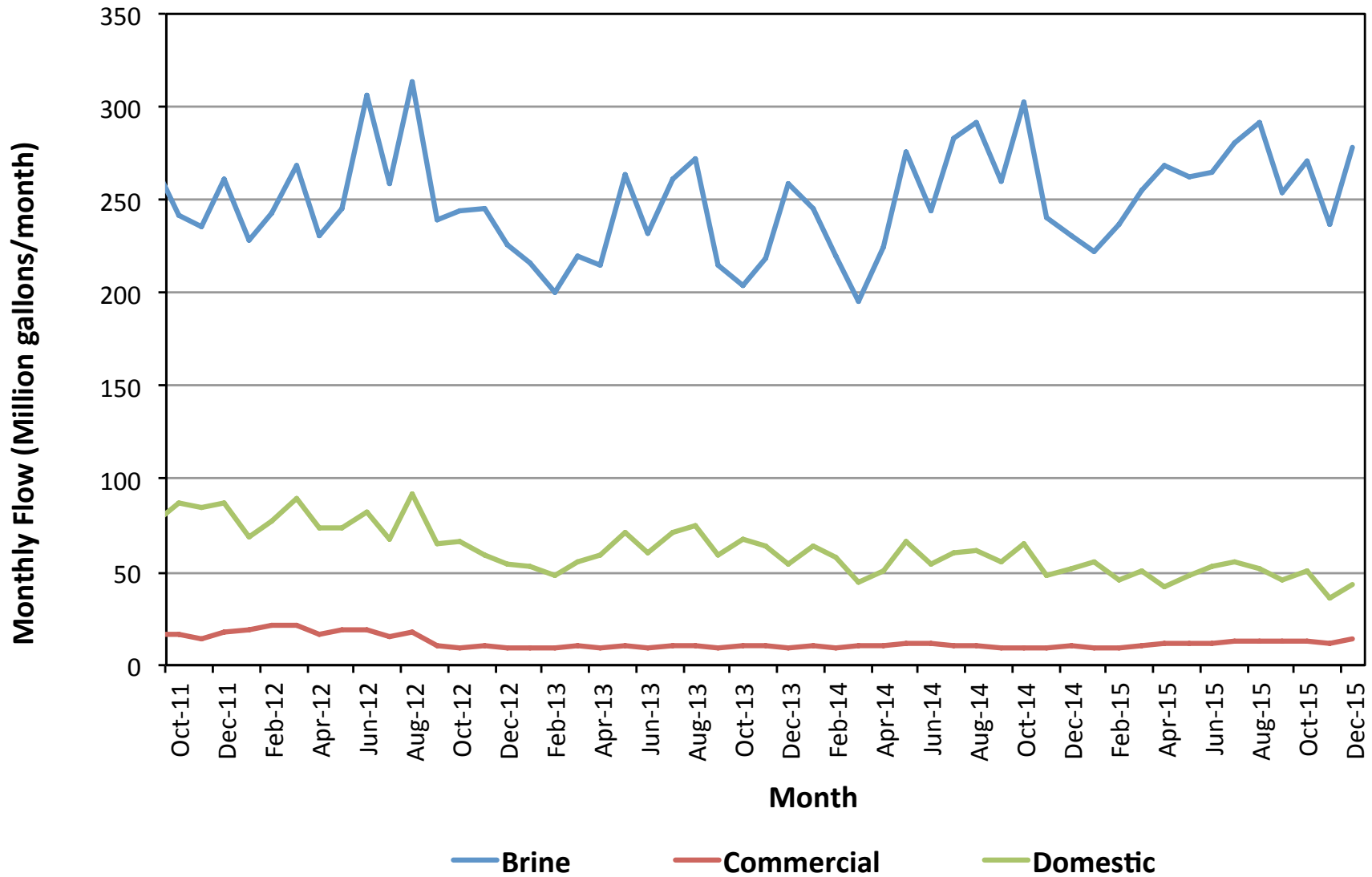
# UPDATE OF SOLIDS FORMATION

# Solids Difference in Brine Line



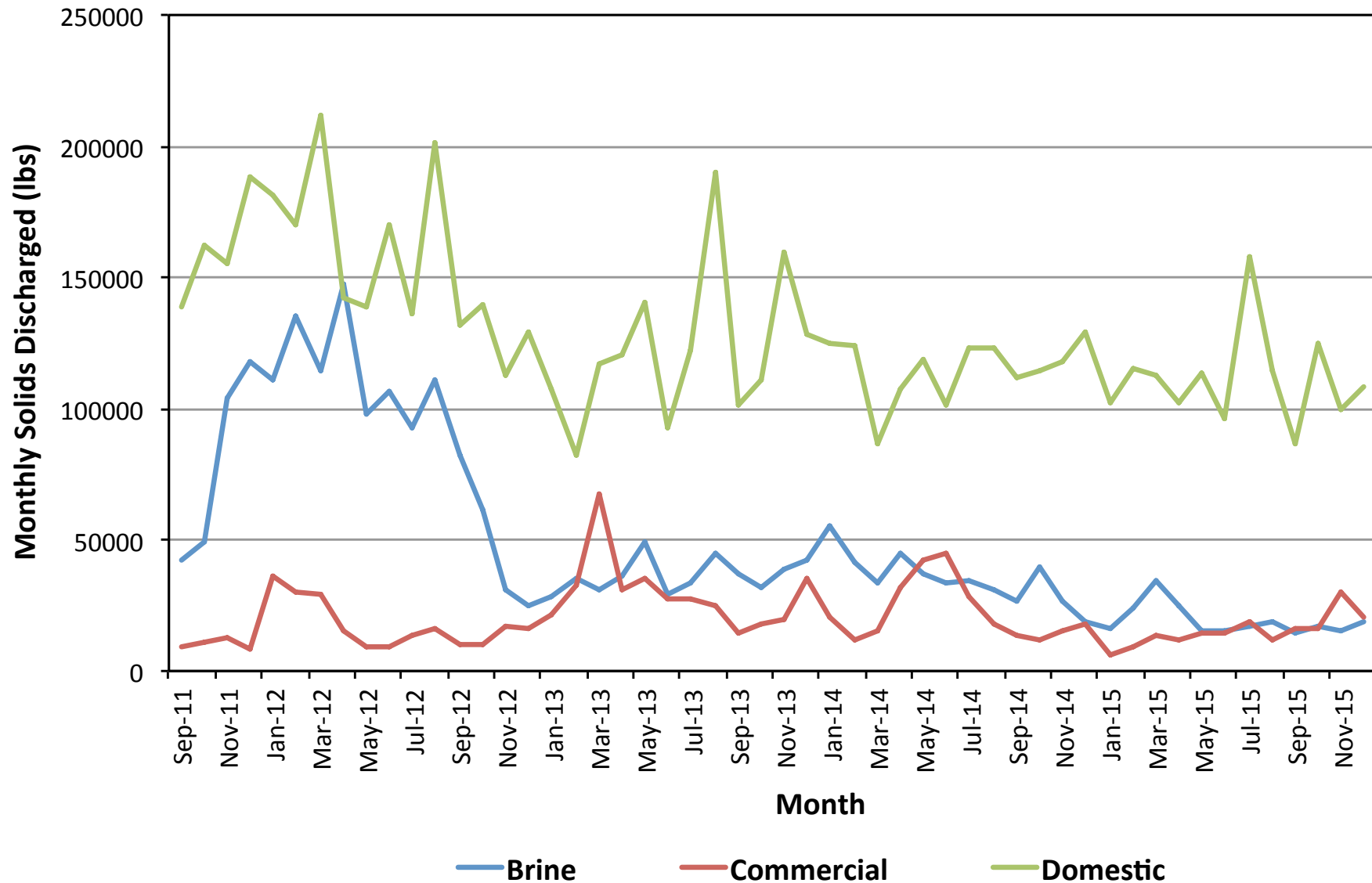
\*Values represent monthly average loading. When no monitoring occurred for an individual discharger in a given month, surrounding average measurements were substituted.

# Discharger Flows





# Discharger Solids Loading



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# Pretreatment Survey

- Goal: Identify chemical addition and treatment practices prior to discharge to Brine Line
- Method: Distribute survey to all Brine Line dischargers, compile information about pretreatment practices

SAWPA Pretreatment Survey 2016

1. Please provide the following information about your facility.

Name

Company

Facility name

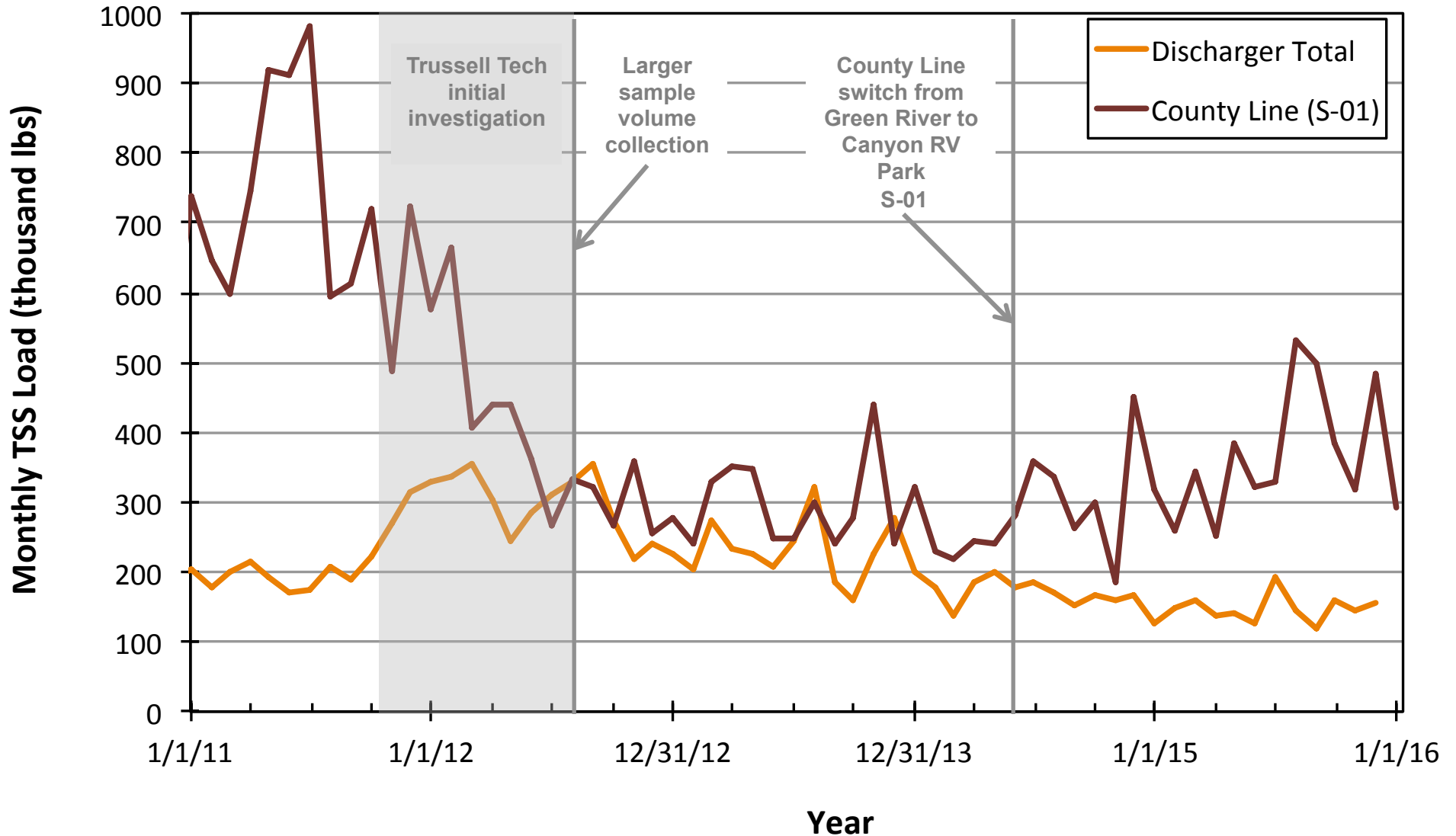
Email address

Phone number

Next

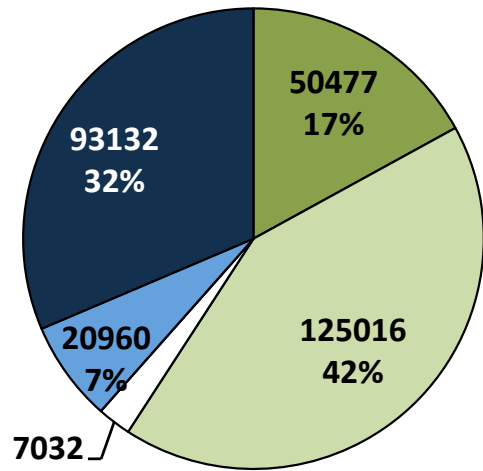
Powered by  
 SurveyMonkey®  
See how easy it is to [create a survey](#).

# Solids Difference in Brine Line

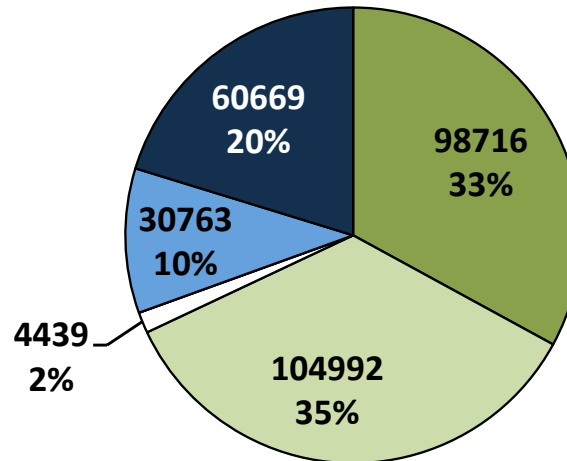


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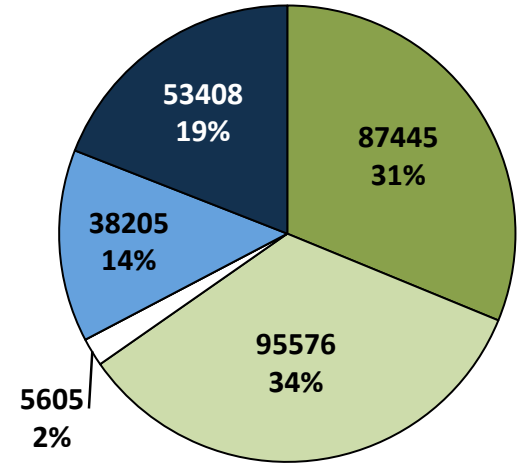
# County Line Solids Characterization



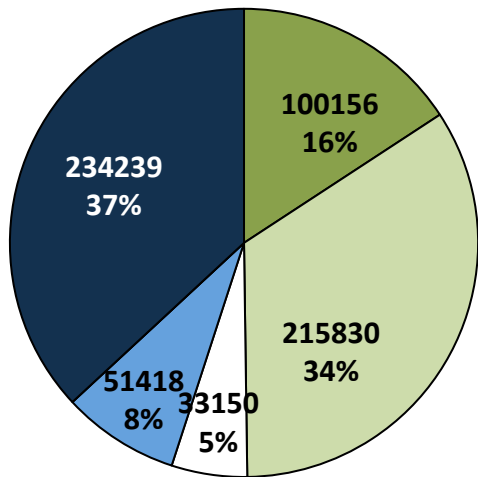
July-Oct 2012  
296,618 lbs/month



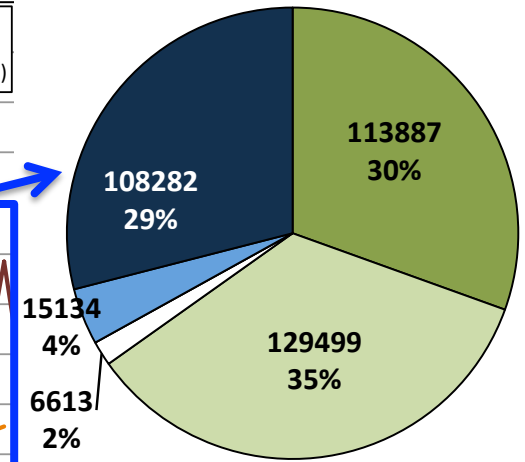
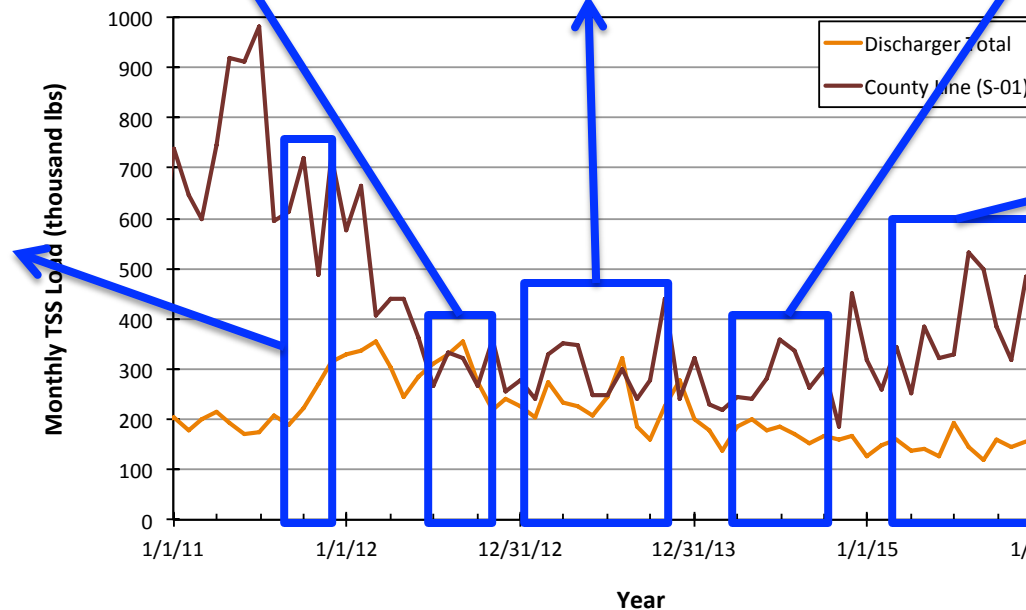
Jan-Nov 2013  
299,579 lbs/month



Mar-Oct 2014  
280,239 lbs/month



Sept-Dec 2011  
634,794 lbs/month



Feb-Dec 2015  
373,415 lbs/month

# CONCLUSIONS AND RECOMMENDATIONS

# Variability Mitigation

- Conclusion:
  - Brine Line solids are a heterogeneous mixture
  - Leads to sampling and analytical variability
- Recommendation:
  - Measure weekly TSS in triplicate
  - Perform 10 replicate TSS test with entire sample volume
    - Define the number of samples required to determine representative TSS with a 95% confidence interval
  - Review quarterly ‘solids characterization’ sampling procedure

# Discharger Loading

- Conclusion:
  - Discharger solids loading has decreased over time
- Recommendation:
  - Perform 3 month water quality analysis on dischargers
  - Determine top loading dischargers
  - Review/revise sampling frequency

# County Line Loading

- Conclusion:
  - Solids at the County Line has increased since 2014
- Recommendation:
  - Monitor solids load from new sampling line
  - Repeat sampling confirmation testing
    - First plug analysis
    - Sample depth analysis



# Other Recommendations

- Work with Independent Advisor
  - Dr. David Jenkins, UC Berkeley professor emeritus
  - Review work plan, results, and next steps with SAWPA staff and Dr. Jenkins
- Review current billing equation
  - Constituents of solids formation
  - Allocation of constituents

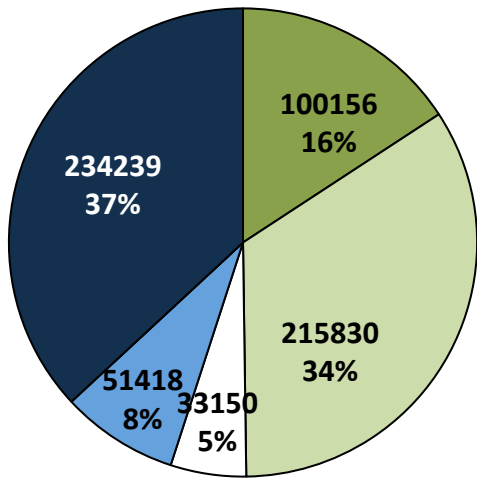
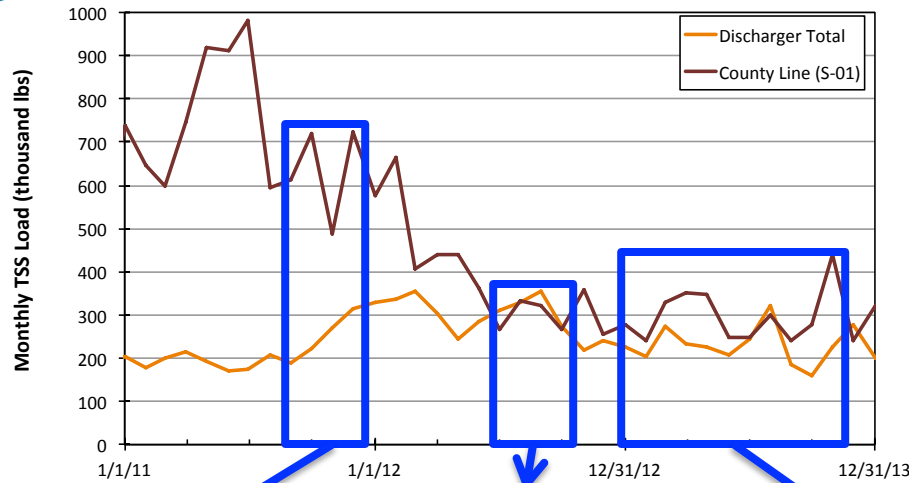
# Questions?

[bryant@trusselltech.com](mailto:bryant@trusselltech.com)

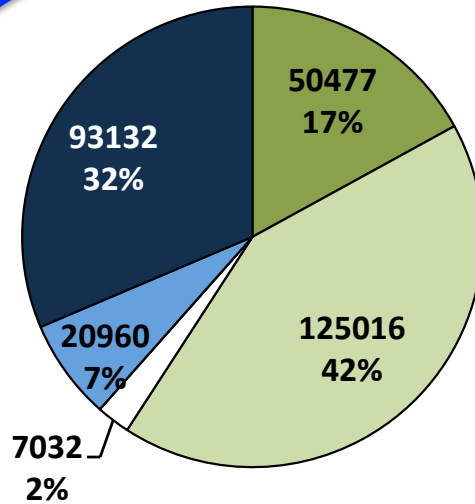
[emilyo@trusselltech.com](mailto:emilyo@trusselltech.com)

# BONUS SLIDES

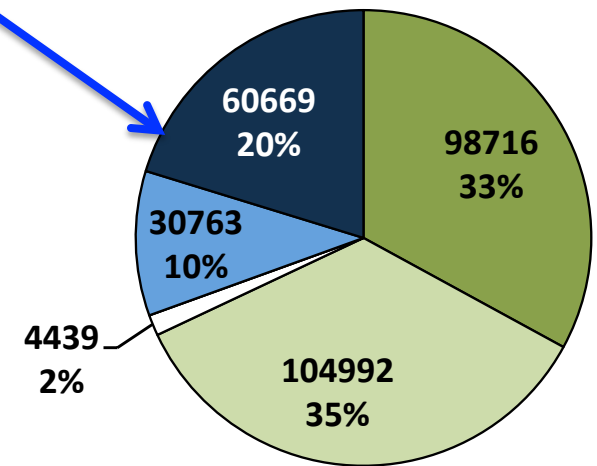
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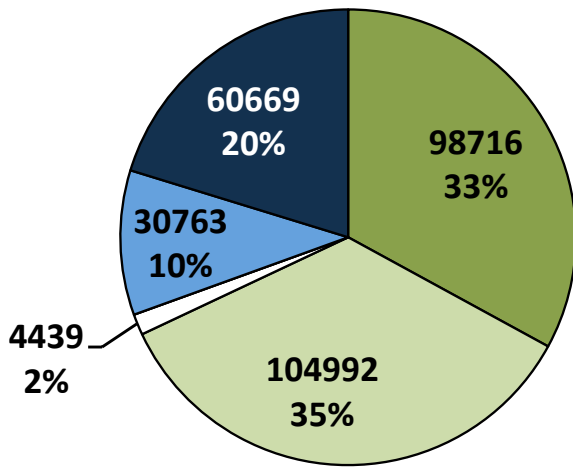
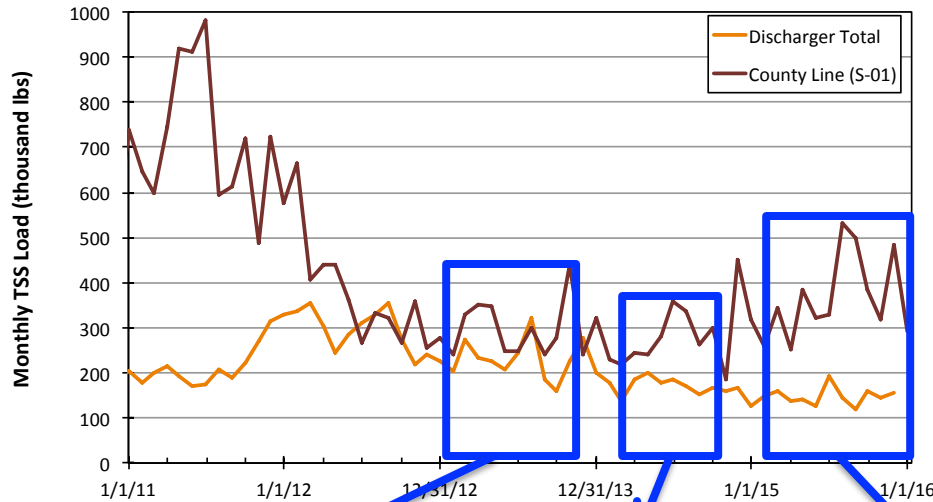


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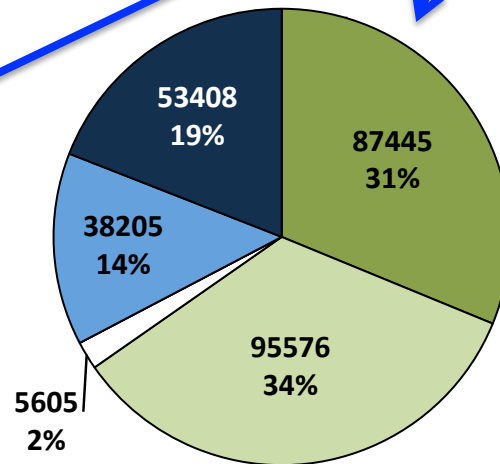
Calcium Minerals
  Other nVSS
  Water
  Cellulose
  Bio-Organic Matter

\*Solids composition values presented in units of lbs of suspended solids per month, based TSS loading averages

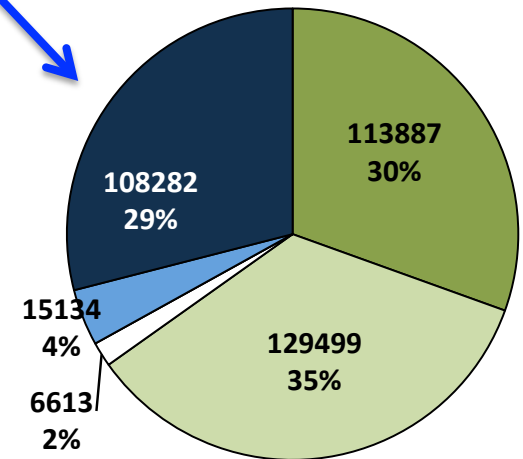
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# Missed Samples

