

NATTS/PAMS VOC/Carbonyl Manifold Leaks (Identification, Corrective Actions, and Lessons Learned)

South Coast Air Quality Management District
Monitoring and Analysis Division



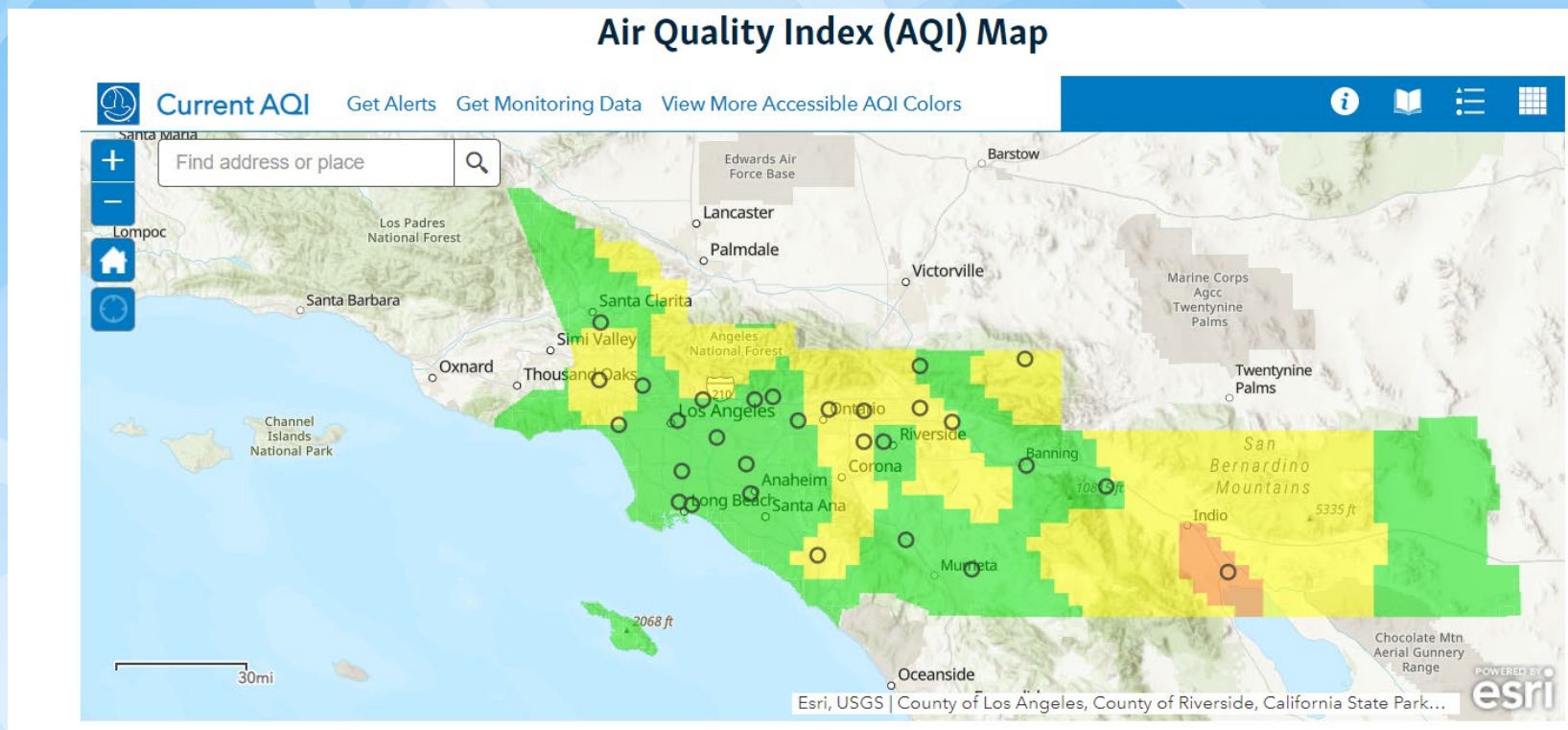
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Presented by Brandon Feenstra, QA Manager
on behalf of Raul Dominguez



South Coast Air Quality Management District

- Air pollution control agency for the four-county region:
 - Los Angeles and Orange counties
 - Portions of Riverside and San Bernardino counties.



Jurisdiction:

- > 12,000 square miles
- > 14 million people



Monitoring and Analysis Division

**Monitoring
Network**

**Laboratory
Services**

**Advanced
Monitoring**

**Special
Monitoring**

**Source Test
Engineering**

Quality Assurance Oversight



Identifying the Issue : Background

Multiple Air Toxics Exposure Study V (MATES) 2018-2019

- 1-year air toxics monitoring and exposure study
- Purpose to update air toxic emissions inventory and air toxics health risk estimates based on air toxics monitoring data and modeled exposures.

Analytes

- Carbonyls*
- VOCs*
- Hexavalent Chromium
- Metals*
- PM10 and PM2.5*
- PAHs*

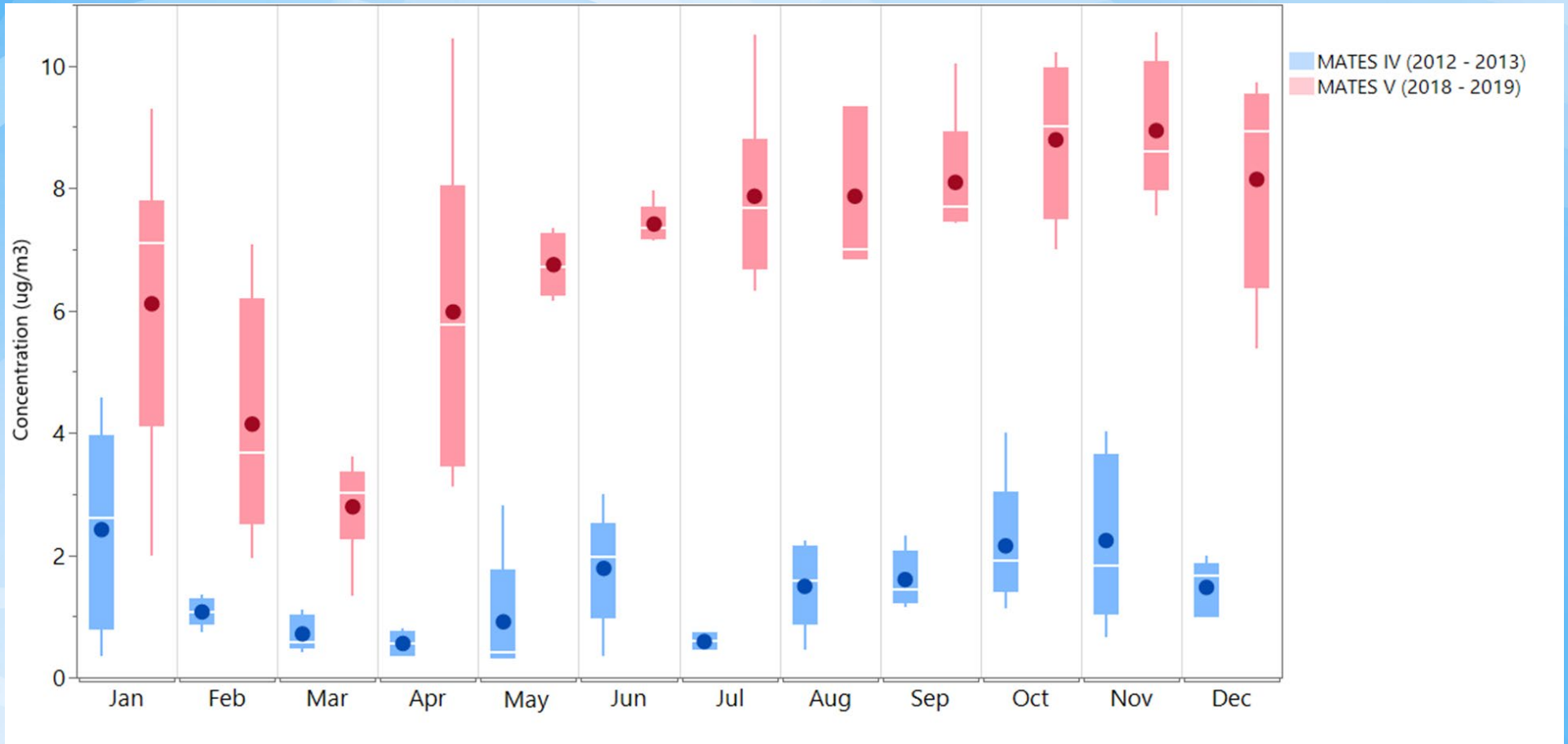
* NATTS Sampling and Analysis Methodology





Identifying the Issue

Anaheim Formaldehyde



Investigation

- What is going on?
- How widespread is the issue?
 - How many monitoring sites?
 - Data impacted?
 - Time span?
- Identify the root cause(s)



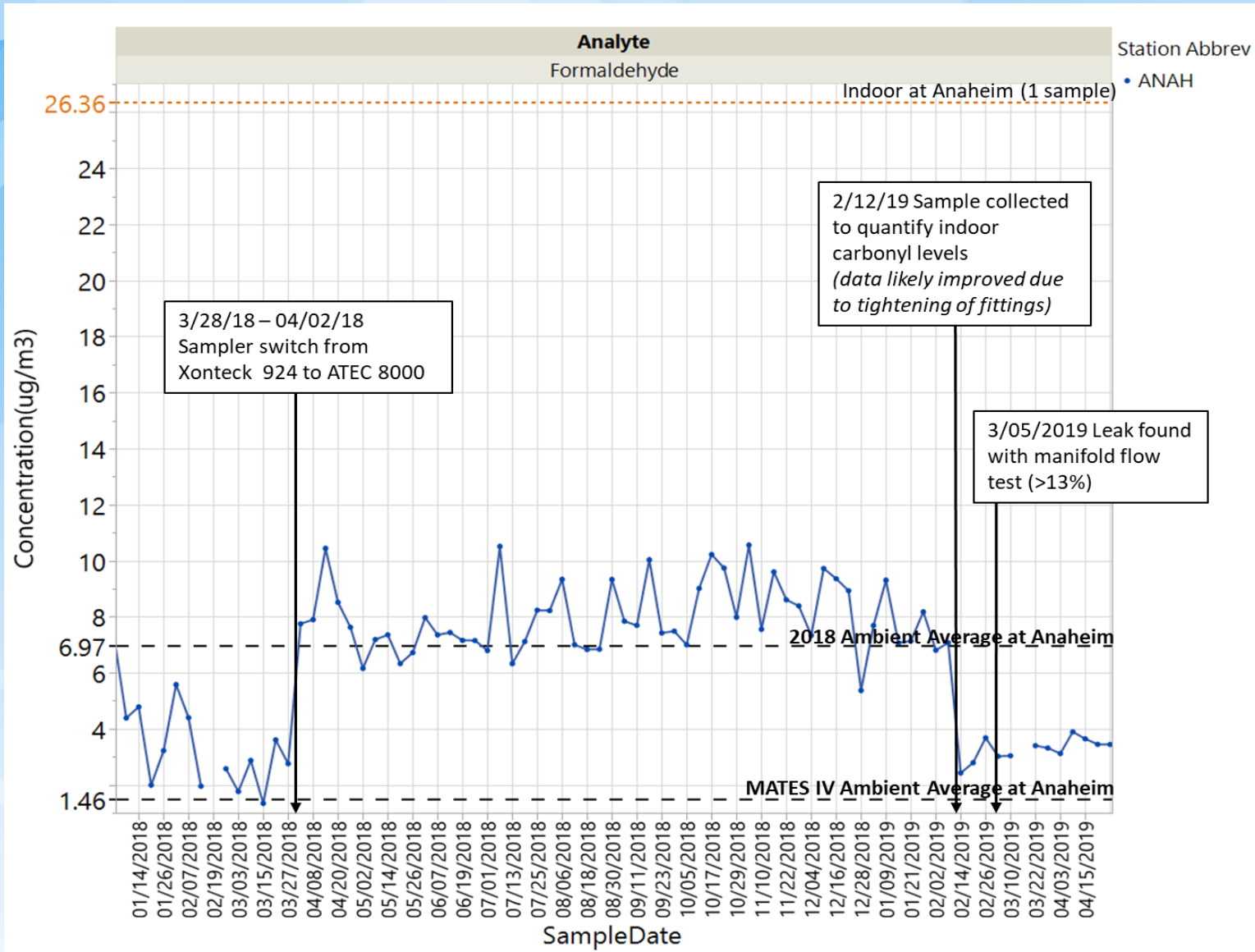


First Steps

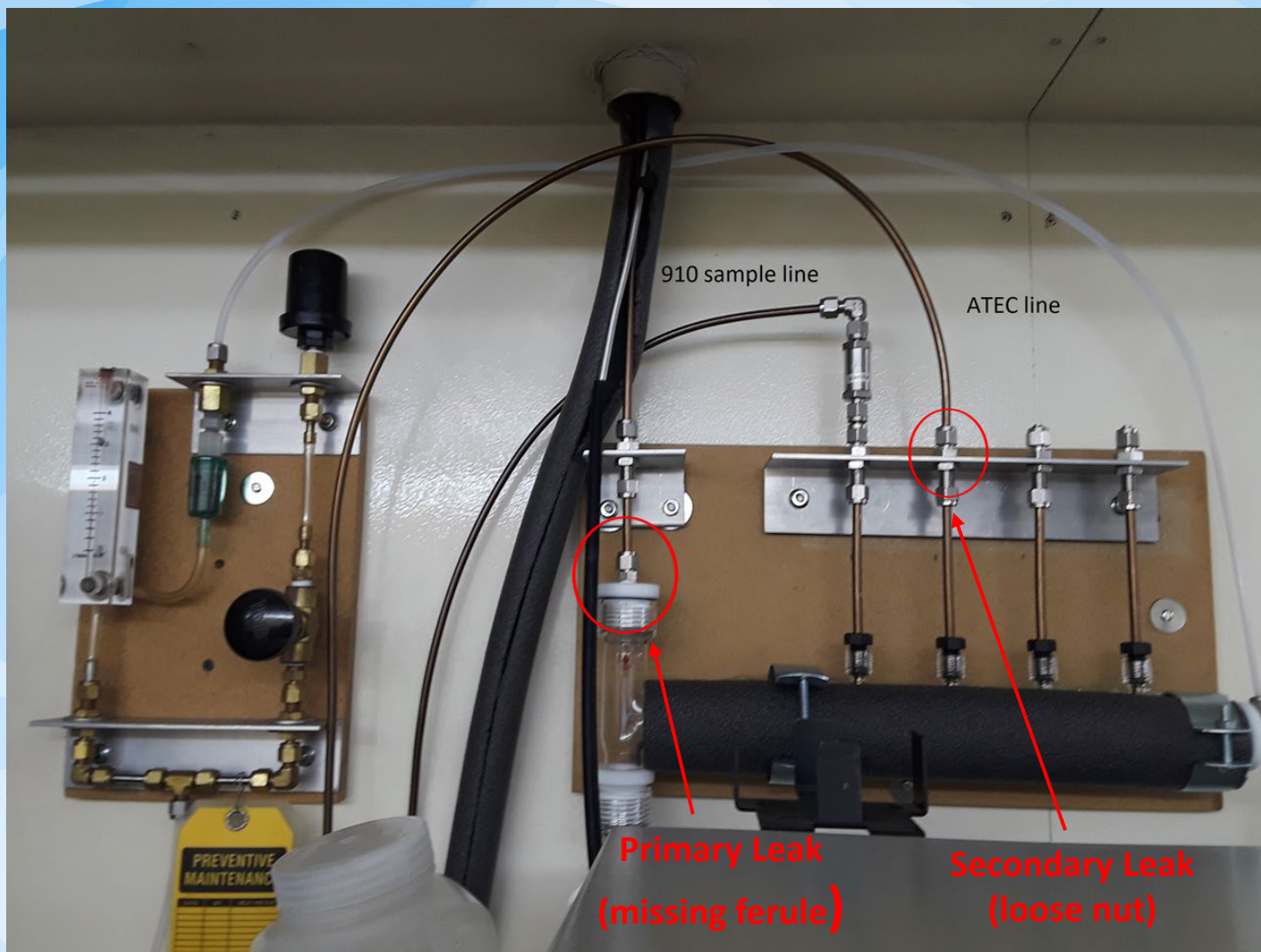
1. Visualize the Data
 - Concentration over time
2. Add monitoring site/manifold changes and time frame to the plot
 - Changes in sampler
 - Addition of instruments to the manifold
 - Other events
3. Visit the Monitoring Station and Investigate
 - Manifold configuration
 - Fittings
 - Overall condition
 - Add discovery date to plot



Anaheim – Data Review



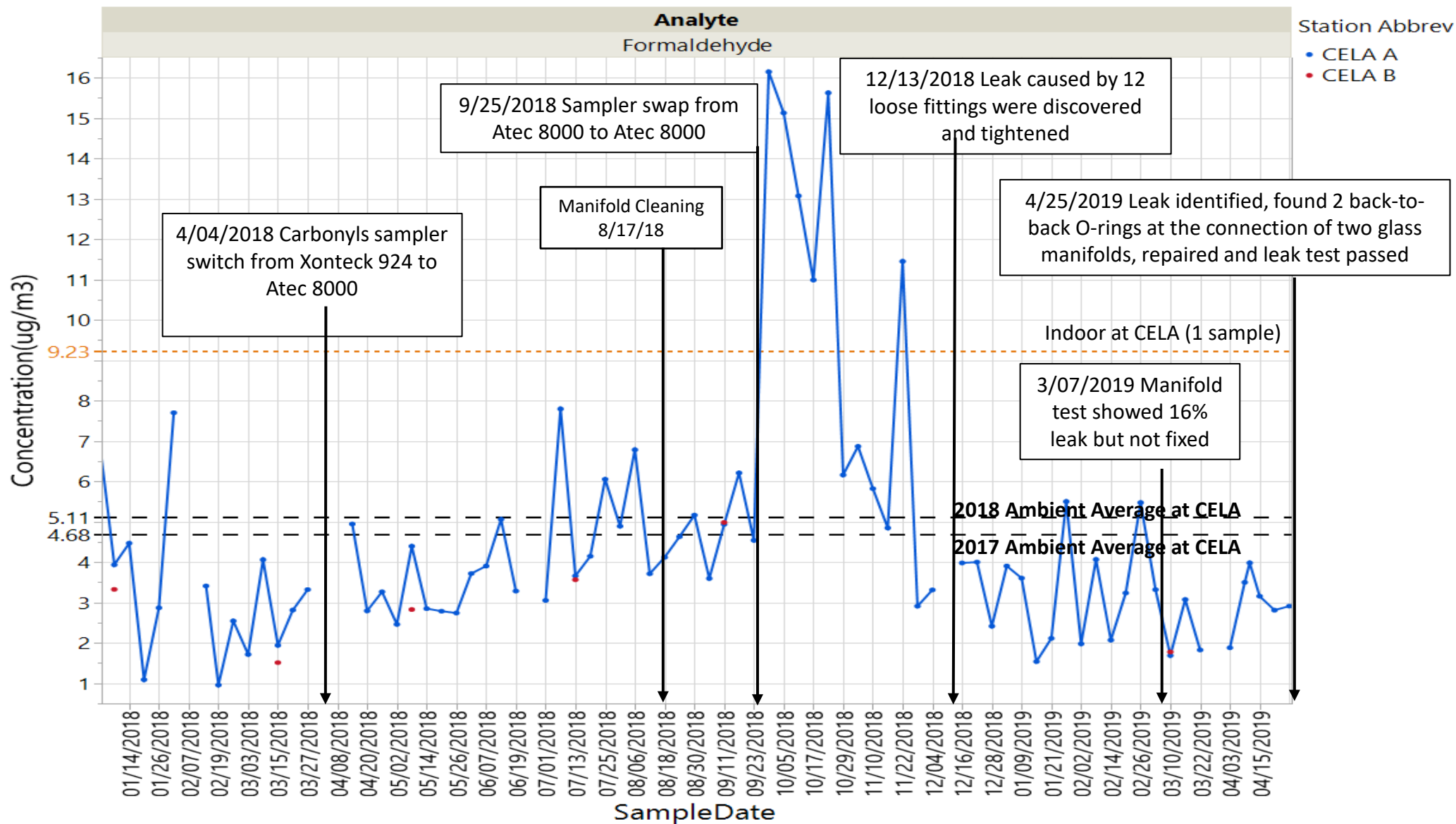
Anaheim – Site Visit



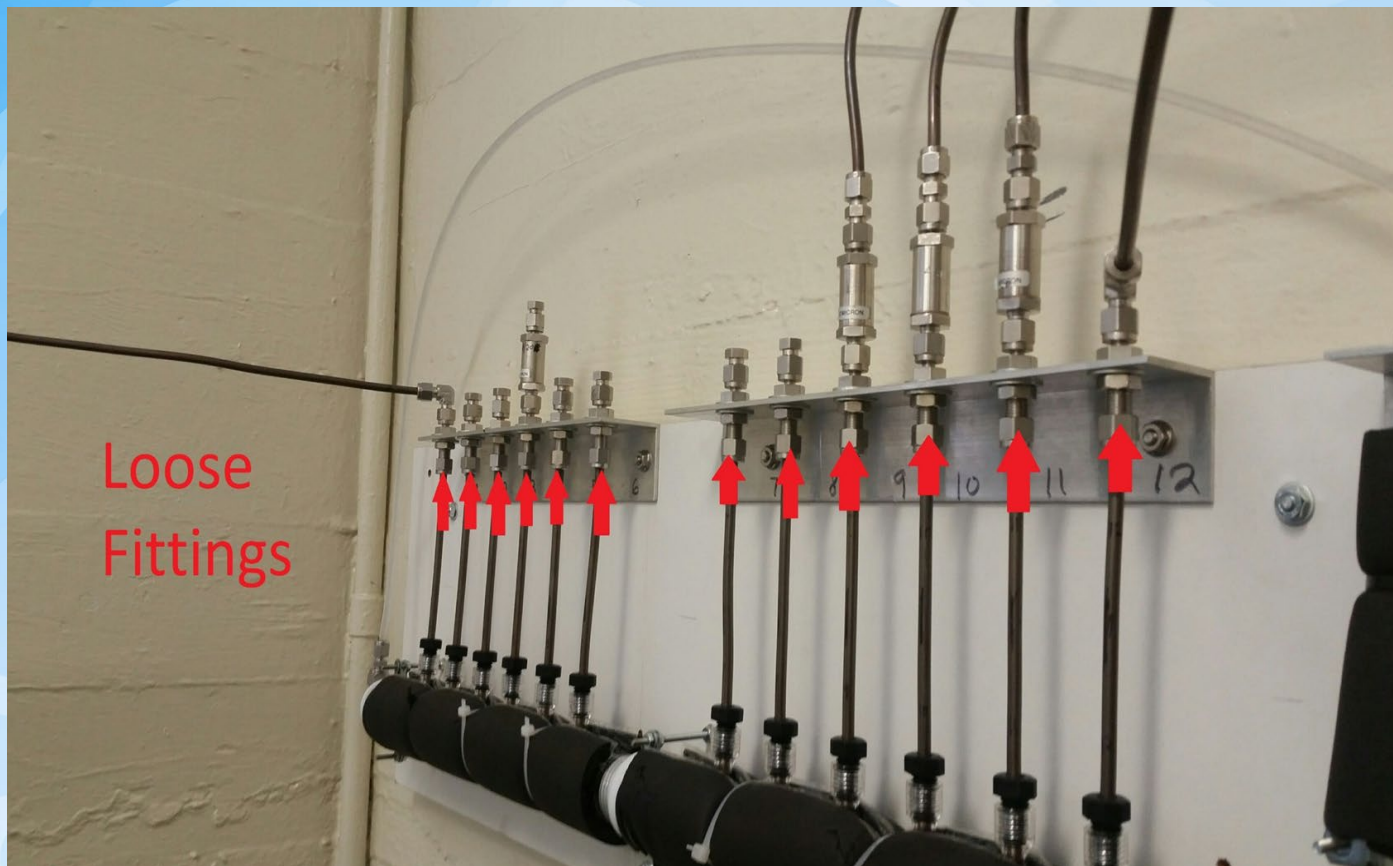
Manifold testing after MATES-V indicated root cause was a missing ferule on the manifold inlet during installation. Recommend invalidating all Anaheim MATES-V VOC and ATEC Carbonyl data.



Central Los Angeles (CELA)



Central Los Angeles (CELA)



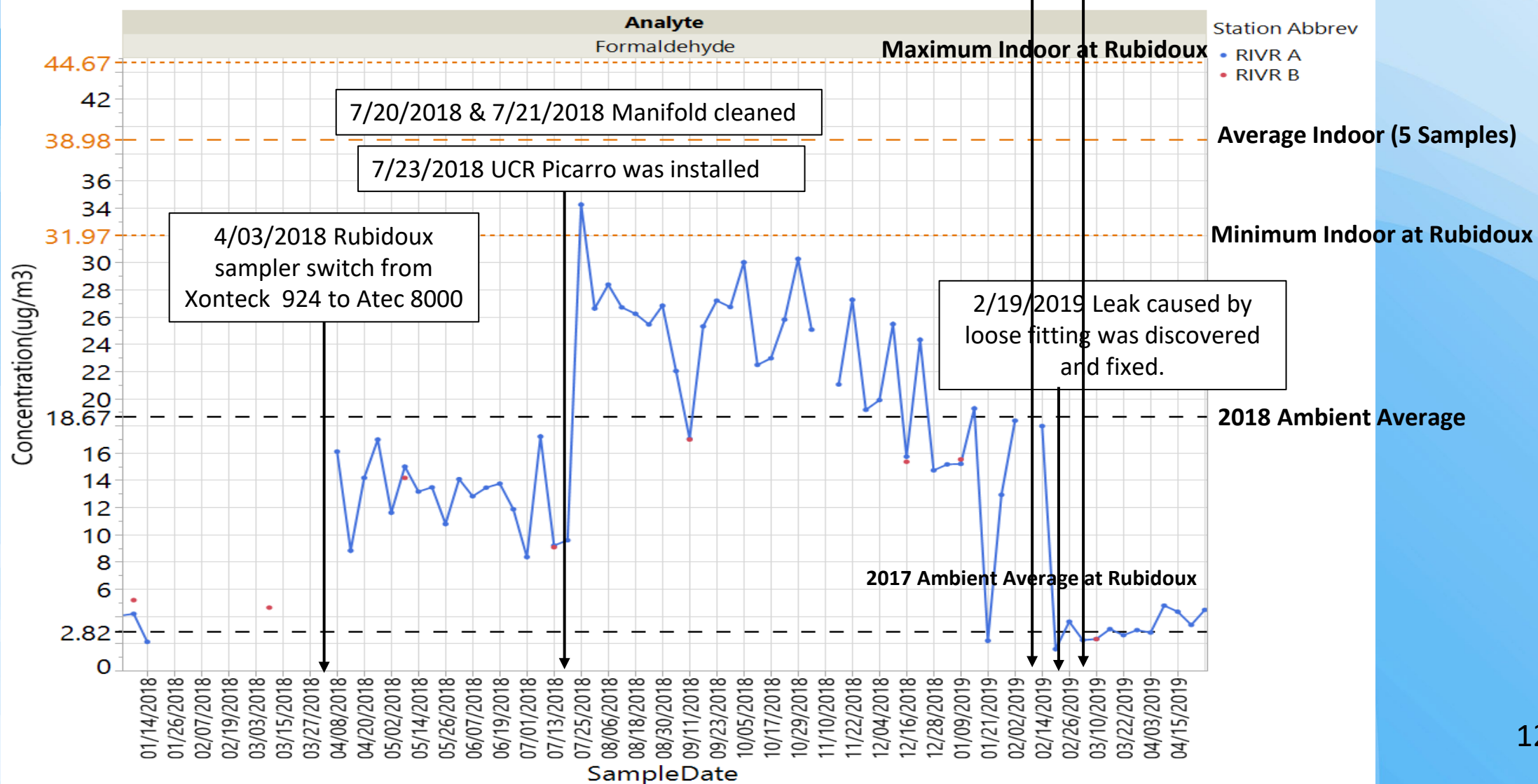
12/13/2018 Leak caused by 12 loose fittings were discovered and tightened.

4/25/2019 Leak identified, found 2 back-to-back O-rings at the connection of two glass manifolds, repaired and leak test passed



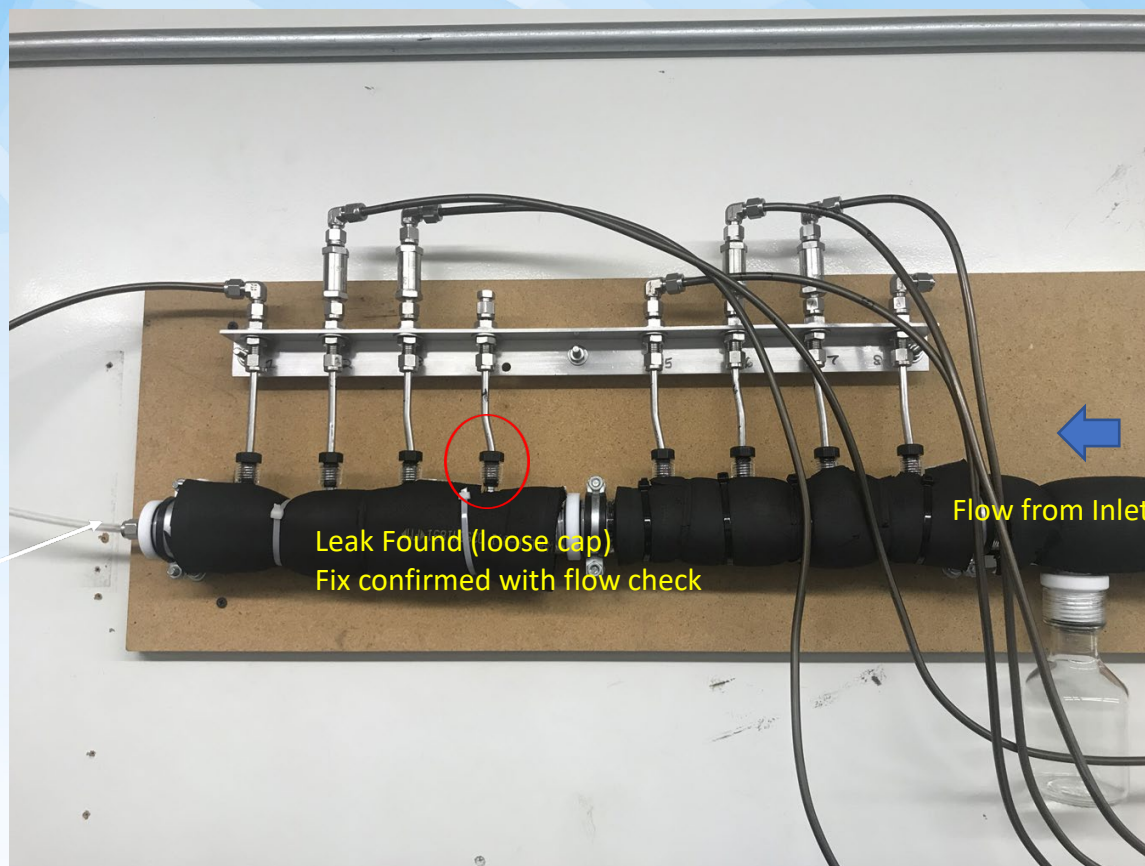
Rubidoux (RIVR)

2/12/2019 to 3/04/2019 Samples (5) collected to quantify indoor carbonyl levels



Rubidoux (RIVR)

Exhaust – to RTI Pump



Leak Found (loose cap)
Fix confirmed with flow check

Flow from Inlet



Issue Summary – Manifold Leaks/Carbonyls

- Changes made to manifold introduced leaks
 - Outdoor Xonteck 924 samplers were changed to indoor ATEC 8000 samplers affixed to gas manifolds in April 2018
 - University research equipment added to manifold
 - Manifold cleaning
- Manifold leaks were found at Rubidoux, Central L.A., & Anaheim)
 - Data review identified elevated formaldehyde, acetaldehyde, benzaldehyde, and propionaldehyde
 - Hypothesis was elevated due to leakage of indoor air into manifold
 - Hypothesis supported by indoor carbonyl sampling
 - Confirmed by observation of loose fittings/connections



CAR 20190012 Issued

AQMD CORRECTIVE ACTION REQUEST

To:	Staff	Date:	5/14/2019	Assessor:	J. Simone
Location:	CELA, RIVR, and ANH	Assessment Date:	5/14/2019	CAR #:	20190012
Expected Deadline:	5/28/2019	Instrument:	GMW SSI	S/N:	4935
FINDINGS:	<p>1. QAA20190527 reported a CELA manifold that potentially compromised data for PAMS VOC, NATTS VOC, NATTS Carbonyls, CARB VOC Canisters (12 Day), and Ammonium by Picarro Analyzer.</p> <p>2. QAA20190528 reported an analogous leak for the VOC manifold at the Rubidoux monitoring station and the MATES IV Anaheim special purpose station.</p>				
RECOMMENDATIONS:	<ol style="list-style-type: none"> 1. Investigate to determine the length of time leakage occurred. 2. Recommend whether data requires flagging or invalidation. 3. Develop reoccurrence minimization plan which may include: <ul style="list-style-type: none"> - enhanced communication process between manifold users. - enhanced communication process between field and lab staff. - policy statement or SOP better defining manifold leak testing and staff assigned to perform manifold modification. 				

*Please indicate the corrective action taken below, save, and return this form to:
Quality Assurance Senior AQ Chemist or Instrument Specialist
and also copy this CAR electronically to your supervisor and manager*



Treatment of Impacted Data

Invalidate All Carbonyls

- Carbonyl do not meet PAMS/NATTS Data Quality Objectives (DQOs)
- Indoor/Outdoor samples indicate indoor air bias
- **AQS Invalidation Code BJ (operator error)**

Flag VOC Compound Data Without False Positives

- Many VOC compounds do not meet PAMS/NATTS DQOs
- Indoor/Outdoor sampling indicate small but measurable indoor air bias for some measurements
- **AQS Qualifier Code 3 (field issue) – User Beware**

Invalidate VOC Compound Data Points with False Positives

Three conditions

- Indoor/Outdoor samples suggests indoor bias
- Data points are inconsistent with 5- to 10-year trends
- Data fails an interquartile outlier 98th percentile statistical test, (seasonal variation considered)
- **Result: AQS Null Code BJ (operator error)**

Notify CA Air Resources Board and UC Riverside since their operations were impacted as well.



Reoccurrence Minimization

Manifold Testing

- Manifold Leak Test after every cleaning or significant change
- Manifold Flow Test
 - QA audit twice-yearly and after manifold changes
 - If flow test differential $\geq 7.1\%$, perform full leak test
- Add a magnehelic gauge, or similar, to each manifold for routine monthly check by station operators

Manifold Design & Handling

- Use single-piece glass or stainless-steel manifolds
- Control addition of instruments and test for leakage added to manifold
- Replace O-Rings after each cleaning
- Logbook for each manifold
- Enhanced training for staff involved in manifold use, handling, design, cleaning, testing & repair

General Considerations

- Only trained staff perform routine activities under federal programs
- Train all field and laboratory staff on usage and importance of the Corrective Action Process
- Increase oversight by field Senior and QA staff on manifold related procedures and adherence to SOPs
- Perform timely analyses and evaluation of data to identify and communicate potential issues to impacted staff

Lessons Learned



- Communication/Training is critical
 - Especially important with different groups working on single probe
 - Ensure same training between Monitoring Network and Special Monitoring teams
 - Ensure research staff adding equipment work with a trained technician
- Carefully inspect sample collection equipment
 - Leaks, unexpected “new” instruments, do not make assumption that everything is ok!
 - Leak check after cleaning
- Staff collecting data carefully verify and staff performing first level validation carefully examine data
 - Is it consistent with what has been seen before?
- Senior staff reviewing data (second and third level validation) plot data against historical data and not just look for outliers
 - Time series plots

Questions?



Contact Us

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Brandon Feenstra, bfeenstra@aqmd.gov

Extra slides



Quality Assurance Branch - Functions

- Prepare and maintain the Quality Management Plan (QMP)
- Maintain and Track QA Documents: OAGS, SOPS, QAPPS, Etc.
- Oversee quality system assessments (audits) and address issues
- Document and track QA assessment findings and resolutions
- Evaluate the effectiveness of QC procedures
- Issue Corrective Action Requests (CARS)
- Communicate findings with impacted personnel
- Discuss reasonable resolutions and deadlines
- Verify resolutions



Corrective Action Request (CAR) Process



- System Wide
- Random / Limited

- Audit Results
- Photos
- Data

- Formal document

- System Review
- Reoccurrence minimization

Quality Assurance Oversight



Significance of Impact on Data

- Assessment of magnitude of impact
 - Analysis of indoor station air
 - Statistical analysis compared to historical data
 - Are programmatic DQO Satisfied?
 - Carbonyls - no for all three sites all programs
 - VOCs - mixed with many failing PAMS and NATTs criteria, but still reportable with flagging



Issue Summary – Manifold Leaks/VOCs

- Marker for leaked indoor air in canister-sampled VOC data or with the indoor air testing not found
 - Indoor air VOCs are generally similar to outdoor air in concentration at Anaheim and sporadically elevated Methylene Chloride concentration at Central Los Angeles and Rubidoux



Summary of Data Impact by Manifold Leaks

Station	Impacted Program	Time Span	Analytes
Anaheim	MATES V	1/1/18 - 4/30/19	VOCs Carbonyls
Central LA (CELA)	MATES V NATTS PAMS	8/17/18 – 4/25/19	VOCs Carbonyls
	CARB	8/17/18 – 4/25/19	VOCs
Rubidoux (RIVR)	MATES V NATTS PAMS	9/22/17 - 2/19/19 4/8/18 - 2/19/19	VOCS Carbonyls
	CARB UC Riverside	9/22/17 - 2/19/19 ~7/23/18 - 2/19/19	VOCS Continuous Ammonia (Picarro)