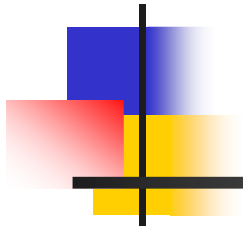


# Water Analysis by GCWW for Water Security Initiative



**I. Introduction**

**II. Purpose**

**III. Objectives**

**IV. GCWW Lab Analysis**





# Water Analysis by GCWW for Water Security Initiative

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- The WSi is a program developed by USEPA in close partnership with Drinking Water utilities and other key stakeholders in response to Homeland Security Presidential Directive 9 (HSPD 9).
- A Contamination Warning System (CWS) is a systematic approach to the collection of information from a variety of sources.
- USEPA entered into a three-year Cooperative Research and Development Agreement (CRADA) with the Greater Cincinnati Water Works (GCWW).
- The ultimate goal is to develop WSi-CWS guidance that can be applied to drinking water utilities nationwide.
- Sampling and Analysis of Water samples from the distribution system plays a critical role in the WSi-CWS.
- GCWW will analyze samples from across the distribution system to establish a baseline of contaminant occurrence.



# Water Analysis by GCWW for Water Security Initiative

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- GCWW has two water treatment facilities:
- The Richard Miller Treatment Plant (RMTP) which draws water from Ohio River (Surface Water).
- Charles M. Bolton Treatment Plant (CMBP) which draws water from the Great Miami River (Ground Water).
- GCWW provided 53 billion gallons of water with an average daily pumpage of 146 million gallons of water.
- GCWW maintained over 3,000 miles of water mains to provide a reliable supply of water to our customers.



# Water Analysis by GCWW for Water Security Initiative

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- To determine background levels of targeted and non-targeted contaminants in the distribution system.
- Samples that are routinely collected and analyzed as part of WS baseline monitoring are called baseline samples.
- Triggered samples are those collected and analyzed in response to "triggers" from any WS monitoring and surveillance component
- The purpose is to describe the approach that will be used to collect baseline data for the first year of the WS-CWS pilot at GCWW and to present Sampling and Analysis Plans (SAPs)



# Water Analysis by GCWW for Water Security Initiative

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- Establish lab preparedness to respond during a triggered sampling event.
- Determine contaminant occurrence and method performance in finished water from the distribution system.
- Establish the best data management and analysis tools to analyze, store, retrieve and interpret the data in a manner that supports credibility determination in the event of a suspected contamination incident
- Develop recommendations for a long term baseline monitoring program



# Water Analysis by GCWW for Water Security Initiative

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- Collect and analyze samples for **volatiles, semi-volatiles**, free cyanide, free chlorine, pH, conductivity, turbidity, metals, radioactivity and toxicity.
- Review internal data and apply appropriate QC standards as per Quality Assurance Plan
- Collaborate in the design of distribution system baseline monitoring studies
- Maintain control charts for baseline monitoring
- Provide the recommendations for long term baseline monitoring



# Water Analysis by GCWW for Water Security Initiative

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- Baseline monitoring for the first year is divided into six phases of activity.
- The first five phases are designed to establish lab capabilities and QC practices.
- Determine if distribution system variability influences contaminant occurrence or method performance.
- In phase 6, the results from the first five phases will be analyzed to establish control charts and tools for use during a triggered sampling and analysis event.
- Provide the recommendations for long term baseline monitoring.

# Water Analysis by GCWW for Water Security Initiative

- Laboratory-Based Chemical Methods:

EPA Method	Method Title
524.2 (VOCs)	Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry
525.2 (SVOCs)	Determination of Organic Compounds in Drinking Water by LSE and Capillary Column Gas Chromatography/Mass Spectrometry



# Water Analysis by GCWW for Water Security Initiative

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- Phase 1: SOPs for sample collection and lab analysis are developed. Initial demonstration of capability will be performed to establish analyst proficiency, method performance and MRLs for each method.
- Phase 2: Water samples from the two treatment plants are collected and analyzed over one month period using the EPA methods 524.2 and 525.2.
- 8-10 samples are collected over two week period and analyzed as per the EPA method and two levels of spiking also performed.
- Phase 3: Regular surveillance monitoring of 18 strategic locations will be initiated and conducted at regular intervals for one year to establish baseline

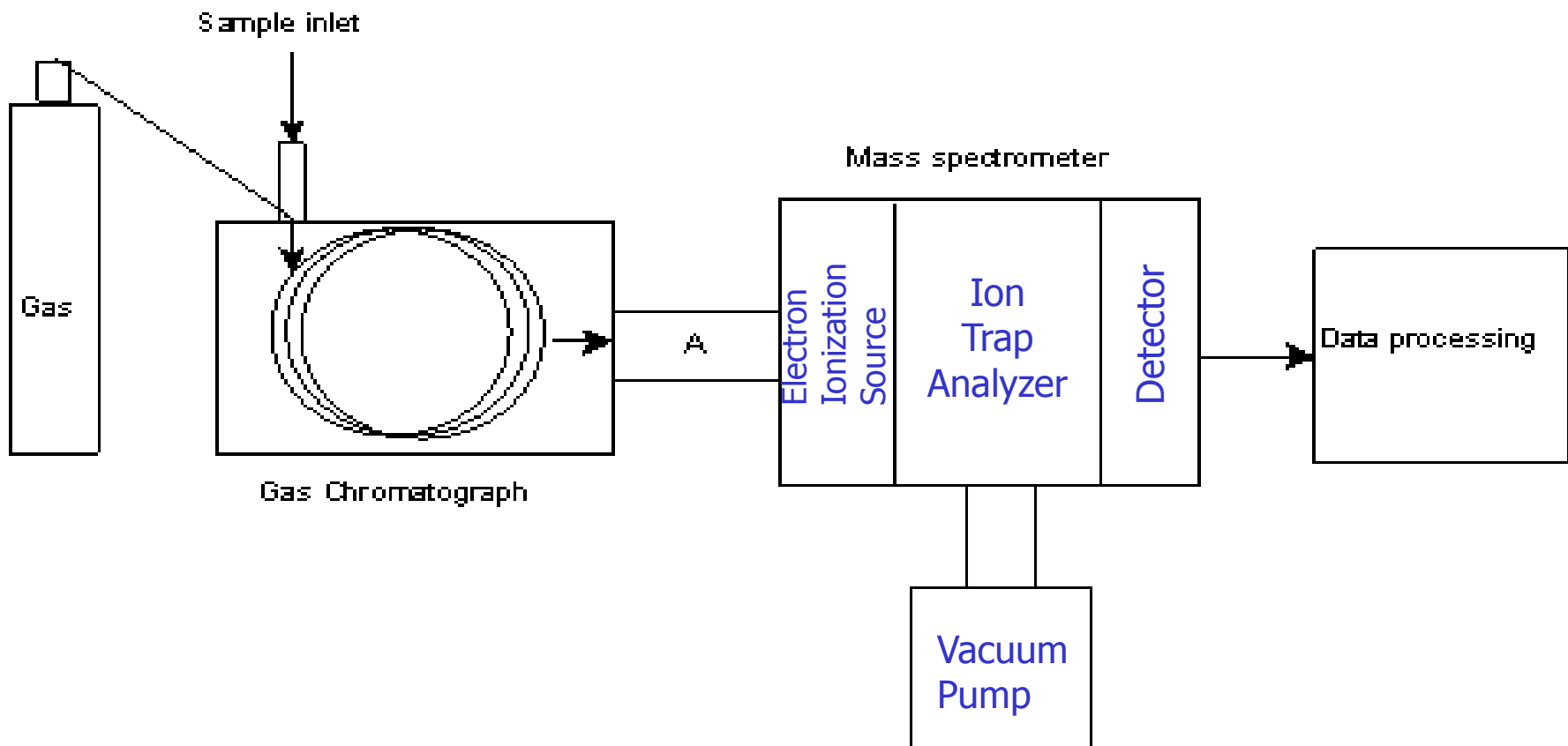


# Water Analysis by GCWW for Water Security Initiative

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- Phase 4: A survey study will be performed to determine the chemical contaminant occurrence and method performance. Contaminant data will be compared to the treatment plant data from Phase 2.
- Phase 5: Based on the results of Phases 2-4, short term focused studies may be conducted.
- Phase 6: The final phase is the analysis of results from Phases 1-5 to establish a maintenance monitoring program.

# The GC-MS System





# How does GC/MS Works?

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- The heated transfer line keeps compounds in the gas phase as they leave the GC column. GC column is directly connected to the ionization source or chamber.
- We are using EI (Electron Ionization or impact). In EI, a beam of electrons impact the compound, molecules of compound causing the loss of electron from the molecule and is called the molecular ion  
(positively charged particle).



# How does GC/MS works?

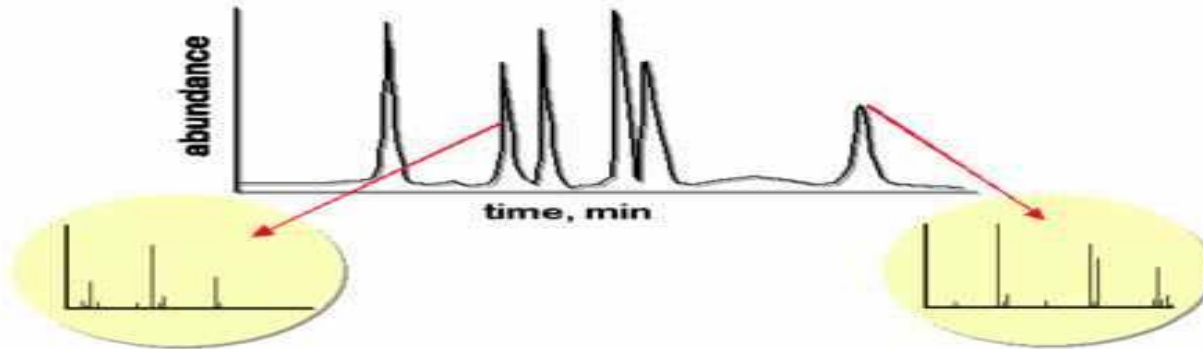
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- The next component is a mass analyzer (filter), which separates the positively charged particles according to their mass.
- We are using Ion Trap as a separating technique.
- After the ions are separated according to their masses, they enter a detector. The detector sends information to the computer which acts as a "clearing house". It records all the data produced.

# How does GC/MS works?

## Total ion chromatogram

Each point in a total ion chromatogram consists of an entire mass spectrum. Response for that point is determined by simply summing the abundances.



# GCWW Setup & Applications.

- The Saturn System (Varian) is the Combination of a GC, a MS, and a Data System. These are the hardware requirements of component as it relates to the technique of GC/MS.



# Velocity XPT Purge and Trap Sample Concentrator and AQUATek 70 Vial Autosampler.



# GC/MS With CombiPAL AutoSampler





# Current Uses of GC/MS

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- Routine VOC's and SVOCs and MIB and GSM
- 100% passed Performance Evaluation (PE)
- Better Identification of Unknown Peaks in the Sample
- More accurate results
- Spills
- Unknown contaminants



# Performance Evaluation Results by GC/MS

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- **Study WS-109 Complete Final Report**  
**Regulated Compounds**

■ <b><u>Benzene</u></b>	9.90 µg/L	Acceptable
■ <b><u>Carbon tetrachloride</u></b>	5.68 µg/L	Acceptable
■ <b><u>Chlorobenzene</u></b>	20.7 µg/L	Acceptable
■ <b><u>1,2-Dichlorobenzene</u></b>	6.76 µg/L	Acceptable
■ <b><u>1,4-Dichlorobenzene</u></b>	17.8 µg/L	Acceptable
■ <b><u>1,2-Dichloroethane</u></b>	15.7 µg/L	Acceptable
■ <b><u>1,1-Dichloroethylene</u></b>	2.96 µg/L	Acceptable
■ <b><u>cis-1,2-Dichloroethylene</u></b>	5.66 µg/L	Acceptable
■ <b><u>trans-1,2-Dichloroethylene</u></b>	16.0 µg/L	Acceptable
■ <b><u>1,2-Dichloropropane</u></b>	12.5 µg/L	Acceptable

# Performance Evaluation Results by GC/MS

▪ <u>Ethylbenzene</u>	13.0 µg/L	Acceptable
▪ <u>Methylene chloride (Dichloromethane)</u>	11.2 µg/L	Acceptable
▪ <u>Styrene</u>	15.8 µg/L	Acceptable
▪ <u>Tetrachloroethylene</u>	3.69 µg/L	Acceptable
▪ <u>Toluene</u>	8.39 µg/L	Acceptable
▪ <u>1,2,4-Trichlorobenzene</u>	6.25 µg/L	Acceptable
▪ <u>1,1,1-Trichloroethane</u>	9.02 µg/L	Acceptable
▪ <u>1,1,2-Trichloroethane</u>	12.9 µg/L	Acceptable
▪ <u>Trichloroethylene</u>	15.7 µg/L	Acceptable
▪ <u>Vinyl chloride</u>	22.0 µg/L	Acceptable
▪ <u>Xylenes, total</u>	23.4 µg/L	Acceptable



# Performance Evaluation Results by GC/MS

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- **Halomethanes**
- **Bromodichloromethane**      12.1 µg/L    Acceptable
- **Bromoform**                      23.2 µg/L    Acceptable
- **Chlorodibromomethane**      37.7 µg/L    Acceptable
- **Chloroform**                      11.6 µg/L    Acceptable
  
- **Total Trihalomethanes**      84.6 µg/L    Acceptable



# Acknowledgements

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- I would like to Thank

David Hartman

Yeongho Lee

Mike Tyree

