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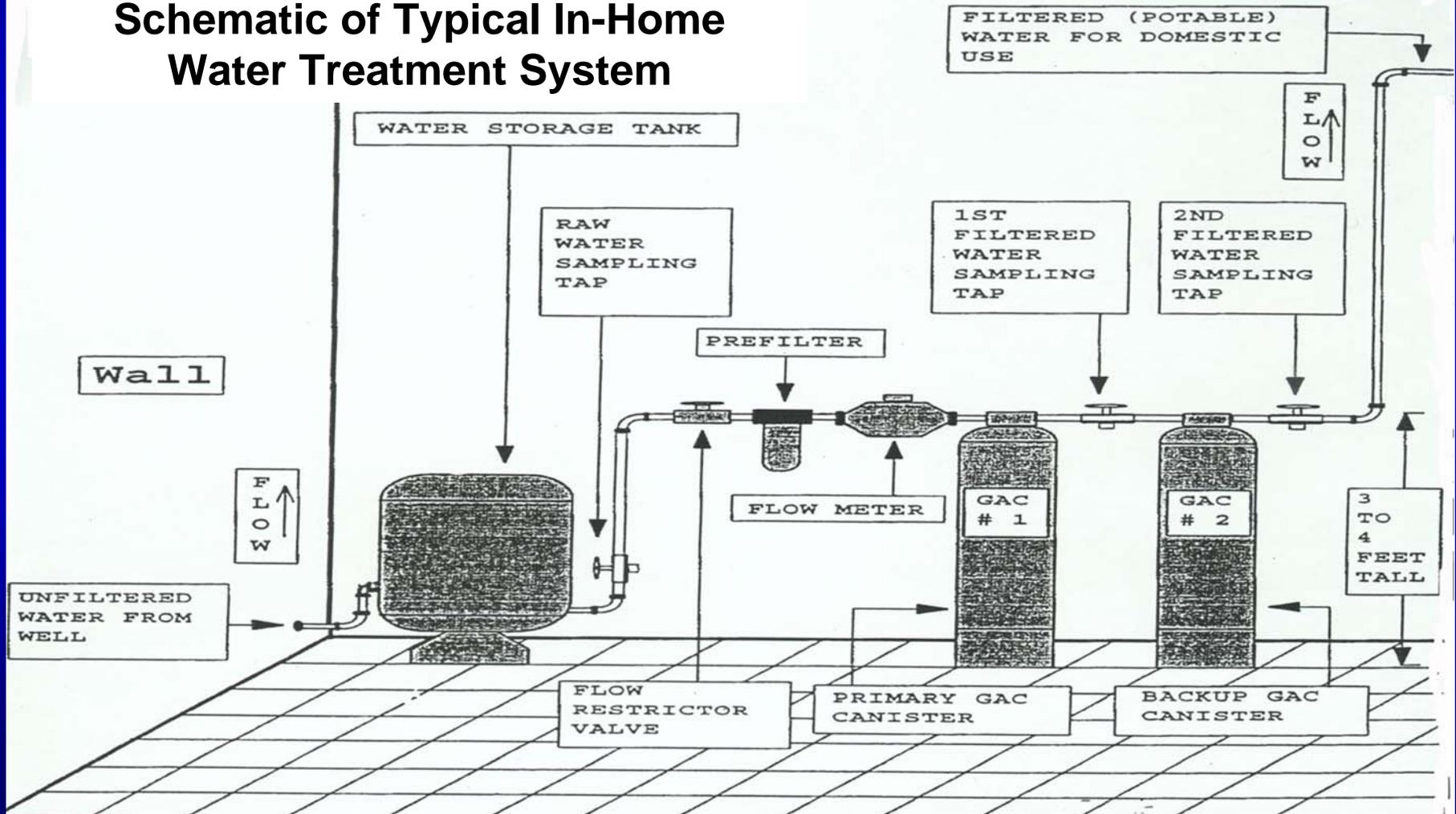
# 2002 – 2003: Site Discovery

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- Several property owners contacted DES for assistance
- DES sampling found 4 water supplies over standard for 2 VOCs:
  - 1,1-Dichloroethene (a chlorinated VOC) detected at max of 9 ppb (AGQS = 7 ppb)
  - MtBE detected at max of 17 ppb (AGQS = 13 ppb)
- DES surveyed area for VOC source but none identified

# In 2002 & 2003, DES funded installation of 4 water treatment systems

## Schematic of Typical In-Home Water Treatment System



# Representative Water Quality History

## Emery Drive Untreated Drinking Water Well

Date Sampled	1,1-Dichloroethene ppb	MtBE ppb
AGQS	7	13
<b>2/11/03</b>	<b>8.1</b>	<b>17</b>
5/3/03	Water Treatment System Installed by DES Contractor	
<b>5/26/04</b>	<b>8.5</b>	<b>14</b>
5/15/06	5.6	7.5
4/25/07	5.4	7.1
5/13/08	4.3	5.7
5/13/09	3.5	5.7
5/15/10	2.9	5.4
5/9/11	2.8	4.8
1/23/12	2.1	3.9
3/6/12	3.4	4.5

# Initial 1,4-Dioxane Detections at Emery Drive

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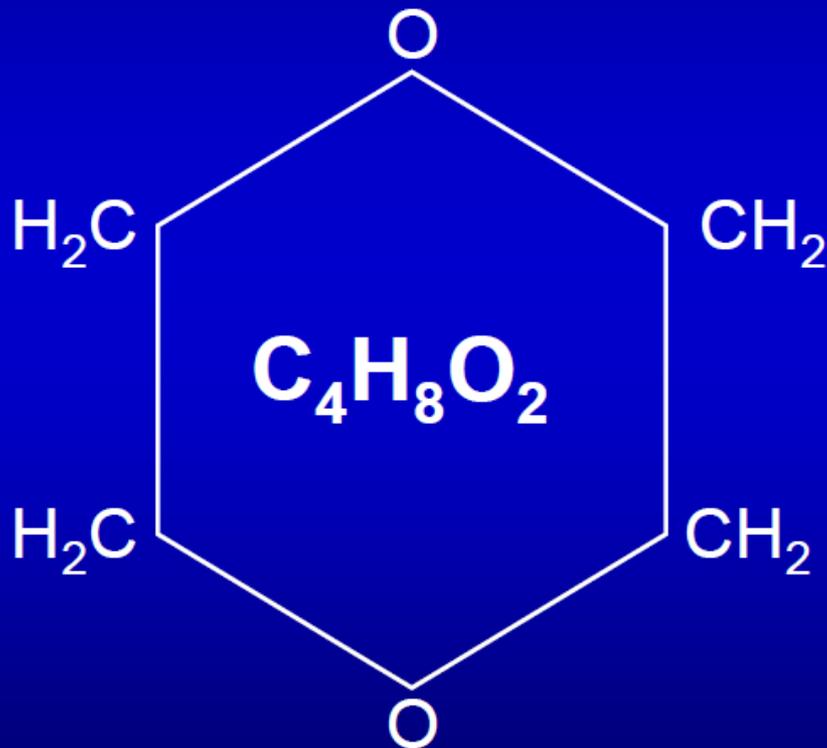
- Nov. 2011 DES sampled 4 water supplies where chlorinated VOC (1,1-Dichloroethene) detected over standard
- All 4 found to contain 1,4-Dioxane over AGQS of 3 ppb
- Conventional water treatment systems unreliable for 1,4-Dioxane removal
- All properties where standard exceeded provided bottled water

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# Overview 1,4-Dioxane as Emerging Contaminant



# Topics to Be Covered – 1,4-Dioxane

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- Sources
- Regulatory background
- Fate and transport
- Presence at contaminated sites
- Presence at public water systems
- Presence in wastewater
- Treatment/removal

# Sources of 1,4-Dioxane

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- Stabilizer for chlorinated solvents (TCA) added 2-8% by volume
- Paint strippers
- Dyes
- Degreasers
- Varnishes
- Impurity in antifreeze and deicing fluids (ethylene glycol)
- Deodorants, shampoos, & cosmetics
  - 23 ppm in Clairol Herbal Essence shampoo
  - 12 ppm in Hello Kitty Bubble Bath
  - 50 ppm in Tide

More results at  
[www.1-4dioxane.com](http://www.1-4dioxane.com)

# 1,4-Dioxane in Personal Care Products

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- Not a purposefully added ingredient
- Forms as part of a secondary reaction or present as contamination
- Not listed as an ingredient
- Steps being taken to reduce levels

See

<http://www.sasoltechdata.com/MarketingBrochures/14Dioxane.pdf>

for more information

# Background

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## 1) Emerging contaminant

- a. No federal standard
- b. Variability in state standards (1-85 ppb)
  - a. Low standard for groundwater and drinking water when established
- c. Historically not analyzed (contaminated sites or drinking water)
- d. Analytical capability of laboratories to detect low concentration needed to be developed

# History 1,4-Dioxane

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- 2003 EPA directed analysis @ Keefe Superfund site.
- 2005 established groundwater standard of 3 ppb (enforceable as Drinking Water Standard).
- 2009 required use of laboratory methods that could detect low concentrations at haz. waste sites, landfills, junkyards and groundwater discharge sites.

# History of 1,4-Dioxane (cont.)

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- **2010 – USEPA includes 1,4-Dioxane list of contaminants to monitor at drinking water systems**
- **2010 – USEPA toxicity review – reduced health based value**
- **2011 – DES comparison of laboratory methods**
- **2011 – DES required reporting limit of 0.3 ppb**
  - Spring 2011 State Laboratory reduced its reporting limit (2 ppb to 0.2 ppb)
- **2011 - Requested nontransient water systems to voluntarily sample**

# 1,4-Dioxane Properties

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- Chemically stable – persistent and long lasting
- Mobile in water - groundwater plumes expand rapidly
- Does not readily volatilize (evaporate)
- Is not significantly adsorbed by aquifer sediments
- Dioxane could be contaminant above standards that will require action
- May be present with TCA breakdown products

# Presence of 1,4-Dioxane in NH

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- Present at approx. 70 sites to date
  - Superfund sites, chlorinated sites and landfills
- Sites with public water supplies affected – 6
- Private wells impacted by 1,4-dioxane
- Reassessing sites for 1,4-dioxane

# Survey of 1,4-Dioxane - Public Water

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- Spring 2011
  - Requested systems to voluntarily sample sources for 1,4-dioxane
  - Recommended that analytical methods with a reporting limit of at least 0.3 ppb
- Approximately 215 sources were sampled
  - 4 sources with water sources exceeding 3 ppb
  - 7 sources with water sources exceeding 0.35 ppb
  - 10 sources with detectable levels

# 1,4-Dioxane in Wastewater

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- International research estimated 1,4-dioxane would be present at 1 ppb in treated wastewater
- NHDES confirmed this estimate by sampling treated effluent from two wastewater treatment plants
- Detected above 3 ppb in effluent from one car wash
- To date, 1,4-dioxane detected in a few groundwater discharge systems (4 out of 30) at low concentrations (1-2 ppb)

# Treatment Options for 1,4-Dioxane

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- Carbon system is very expensive and not reliable
- Reverse osmosis reduces 1,4-dioxane by approx 75% but only point of use
- Air stripping poor performance
- Advanced oxidation process appears best (not practical for home units)
  - Ozone/peroxide
  - Peroxide and UV light

# 1,4 Dioxane Summary

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- Emerging contaminant - we are gaining experience
- Low standard
- Mobile and persistent contaminant
- Many potential sources
  - Present in wide range of products
  - Present at contaminated waste sites
  - Present at some groundwater discharges
- Difficult to treat or remove from drinking water

**David Bowen**, Project Manager,  
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Recent Actions - Sampling

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# Samples Collected to Date

- 72 Residential wells
- 29 Commercial wells
- 6 Water supply wells
- 2 Surface water samples
- 1 Community water system

# Residential Results

- 12 Residential wells over AGQS for 1,4-Dioxane
- 15 Residential wells with detectable quantities of 1,4-Dioxane
- 24 Residential wells with no 1,4-Dioxane detected
- 21 Results pending

# Commercial Results

- 1 Well contains detectable quantities of 1,4-Dioxane
- 2 Wells exceed AGQS for non 1,4-Dioxane contaminants (MTBE, Methylene Chloride)
- 10 Wells had detectable levels of non 1,4-Dioxane contaminants
- 15 Wells were non detect for VOC/Dioxane
- 1 well need resampling

# Community Water Supply Results

- 6 Water supply wells (HAWC)
  - Non detect for VOCs/1,4-Dioxane
- 1 Community water system (Waterwheel)
  - 1 well non detect for VOCs/1,4-Dioxane
  - 1 well non detect for VOCs, 1,4-Dioxane detected

# Pending Action

- Awaiting results for 25 samples
  - 21 residential samples
  - 2 commercial samples
  - 2 surface water samples
- Continue Sampling to complete delineation
- Resample water supply wells with detectable levels of 1,4-Dioxane

# Other Recent Actions

- Several meetings with Town officials
- Initiated contact with EPA regarding potential assistance (2 site visits)
- Initial meeting with HAWC
- Sampling of 6 HAWC water supply wells
- Survey of over 50 businesses and collection of water supply samples

***Dave Gordon, Health Risk Assessor,  
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**1,4-Dioxane: Health Effects & Risk Information**

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# NH Ambient Groundwater Quality Standard (AGQS) for 1,4-Dioxane

- 3 micrograms per liter (ug/L) equivalent to: parts per billion (ppb)
- At 3 ppb, cancer risk is about 1-in 1-million for each 10 yrs. of exposure - assumes 2 liters/day ingestion (= 0.53 gal.)
- Risk proportional to contaminant concentration, amount of water consumed, and length of exposure

# Cancer

- EPA classification: “likely human carcinogen”
- 8 animal studies found increase in liver cancer
- Two studies of worker exposure found no increase in cancer or non-cancer effects

# Non-Cancer Health Effects

- Toxic to liver & kidneys
- Lesions, death of cells
- EPA Lifetime Health Advisory for non-cancer effects of 1,4-dioxane in drinking water = 200 ppb

# Routes of Exposure

- Most important is ingestion (drinking, cooking):  
90% of total risk = 1 in million risk for 10 yr.  
period
- Remaining 10% (1 in 10 million risk at 3 ppb for 10 yr. period):
  - Breathe in 1,4-dioxane as a gas – 9%
  - Pass through skin – 1%

# Biological and Health Effect Testing

- 1,4-Dioxane and its breakdown products can be detected in blood and urine
- Quickly metabolized and eliminated within 24-48 hrs.
- Testing for 1,4-dioxane exposure not recommended
- If have concerns about health effects:
  - ❖ Discuss exposure with doctor?
  - ❖ Would additional testing beyond what occurs during a routine physical be beneficial for you?

# To Reduce Exposure

- Use bottled water-eliminate 90% of exposure
- If want to reduce some of remaining 10% from bathing exposure:
  - Shorter bathing times - reduce both inhalation & skin absorption
  - Ventilation (bath exhaust fan)- reduce inhalation exposure

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# Water Supply Alternatives

- Short term
  - Bottled water (exceeding AGQS of 3 ppb)
  - Maintain existing POEs
  - Interim monitoring plan (to be developed)
- Long term (priority)
  - Bring clean, safe drinking water to impacted area
    - Unreliability of treatment systems
    - Number of impacted wells

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# Future Actions

- Sampling to refine impacted area
- Continue to work with EPA and Town
- Evaluate water supply alternatives
- Continue bottled water and monitoring
- Ongoing communication with community
  - Provide information
  - Updates on progress and developments