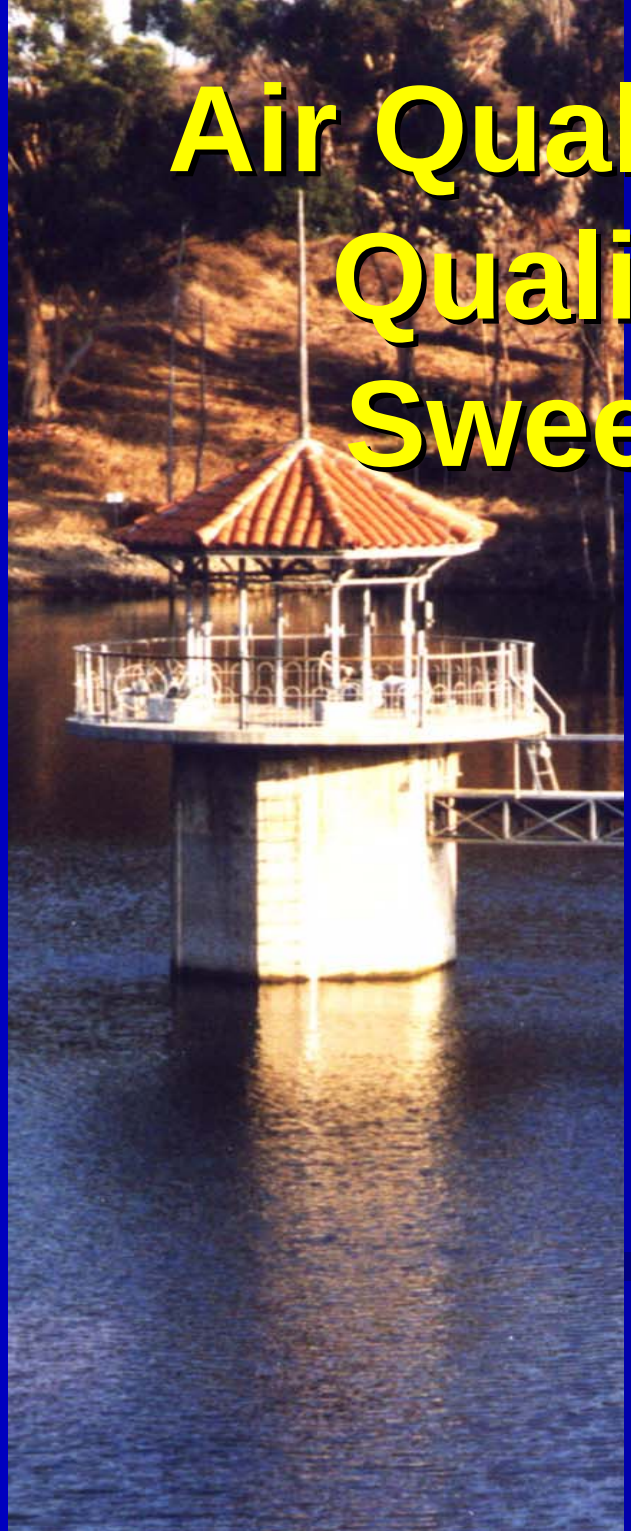

Air Quality Affects on Water Quality - Monitoring at Sweetwater Reservoir

US Geological Survey

Sacramento, CA

Sweetwater Authority

Spring Valley, CA

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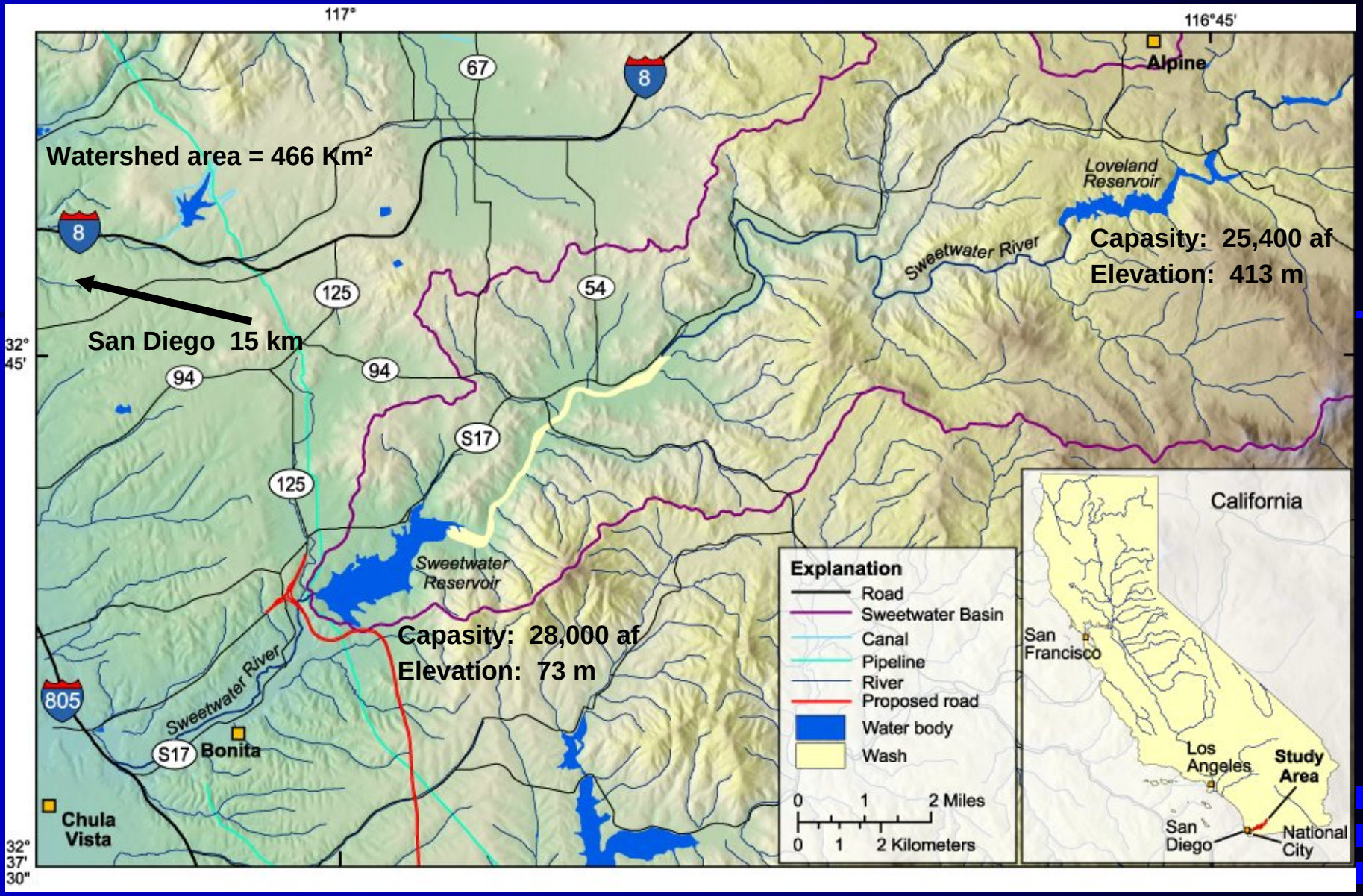

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Air/Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- **Objectives and Scope**
  - **Determine Impact on WQ in SWR from the Construction and Operation of a Specific Highway Project (SR-125)**
  - **Distinguish Local from Regional Ambient Levels of Contaminants**
    - Measuring long-term concentration trends of select VOCs, PAHs, and TMs in water and air and comparing them to measured baseline levels.
  - **General Health of the Watershed**
    - To Better Understand Land Use Impacts on WQ Through Monitoring

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Reservoir Characteristics:

- **Established in 1888**
- **Uniqueness**
  - **Water supplied from watershed**
  - **Management Program**
    - Controlled environment
    - URDS Program
    - Proactive Educational and Monitoring Programs
    - Air Quality Impacts on Water Quality

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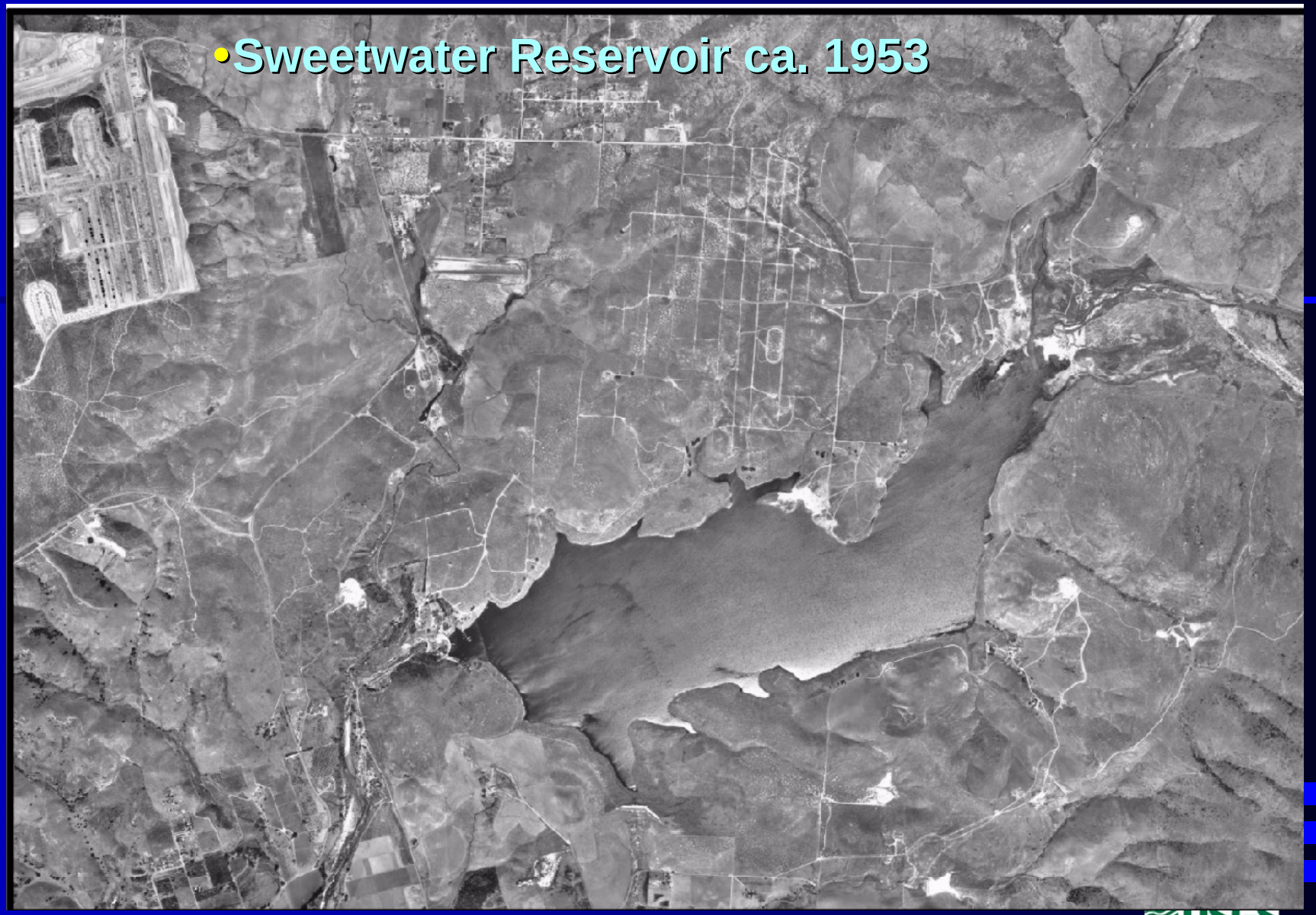

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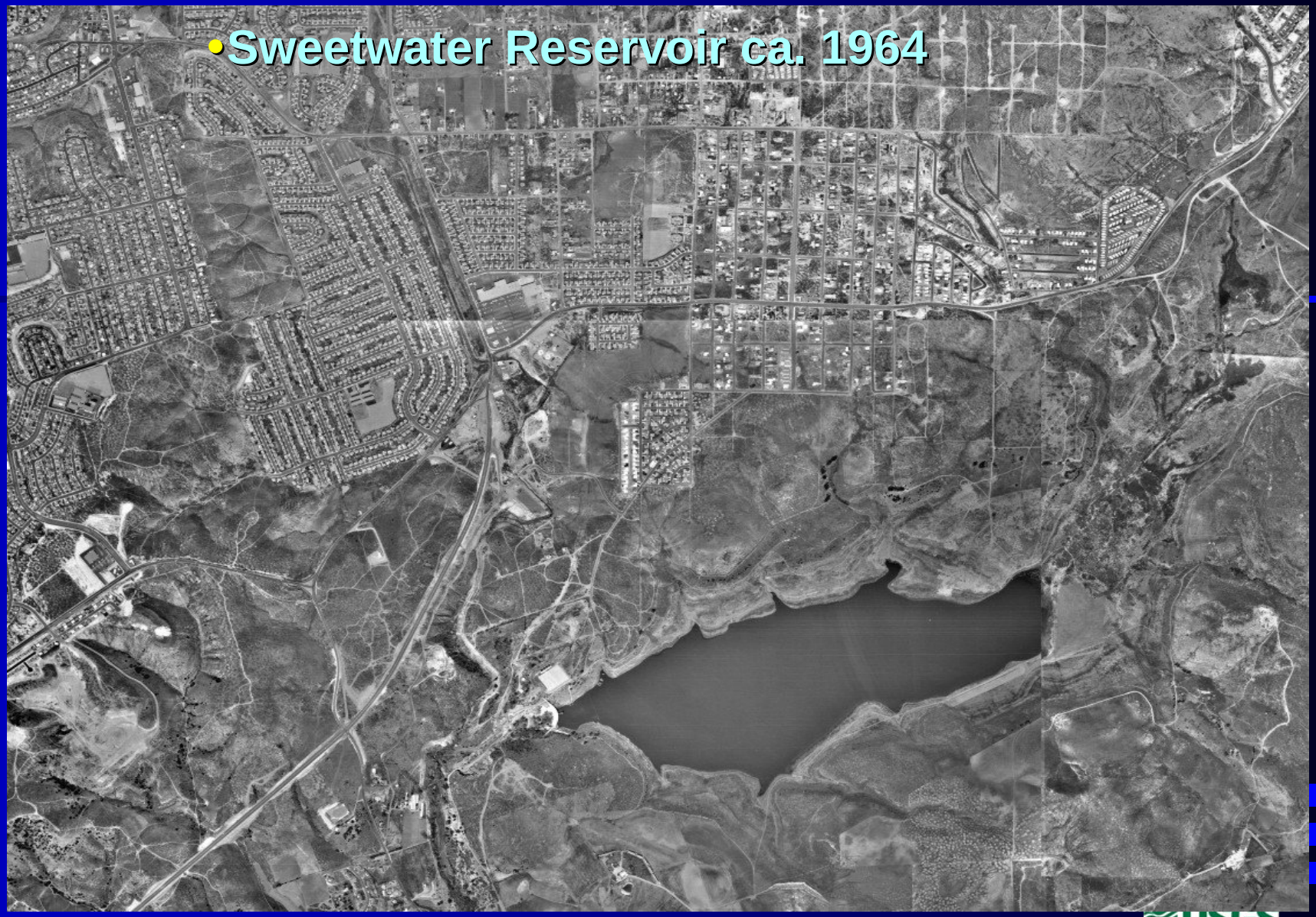
- Sweetwater Reservoir ca. 1964



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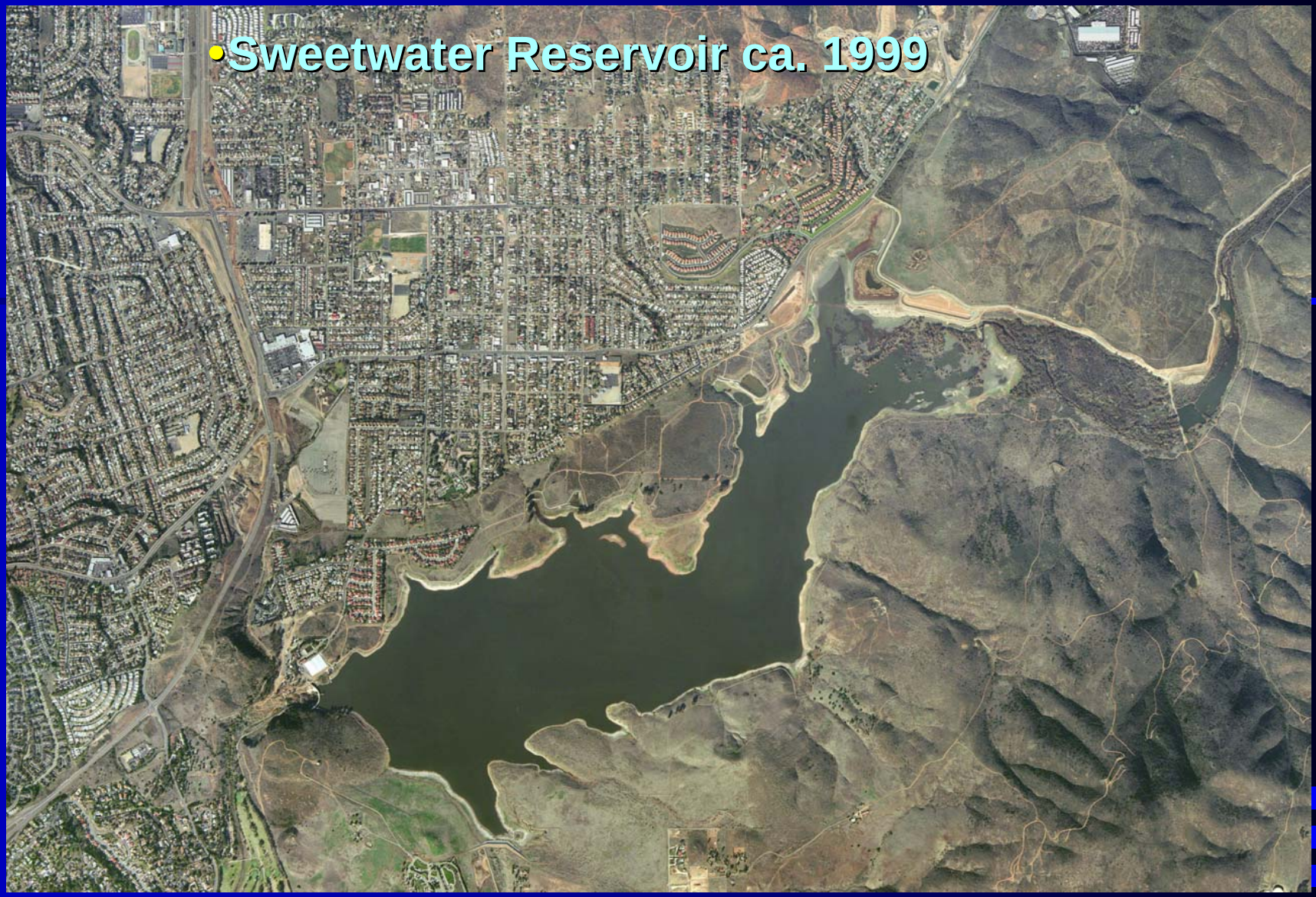

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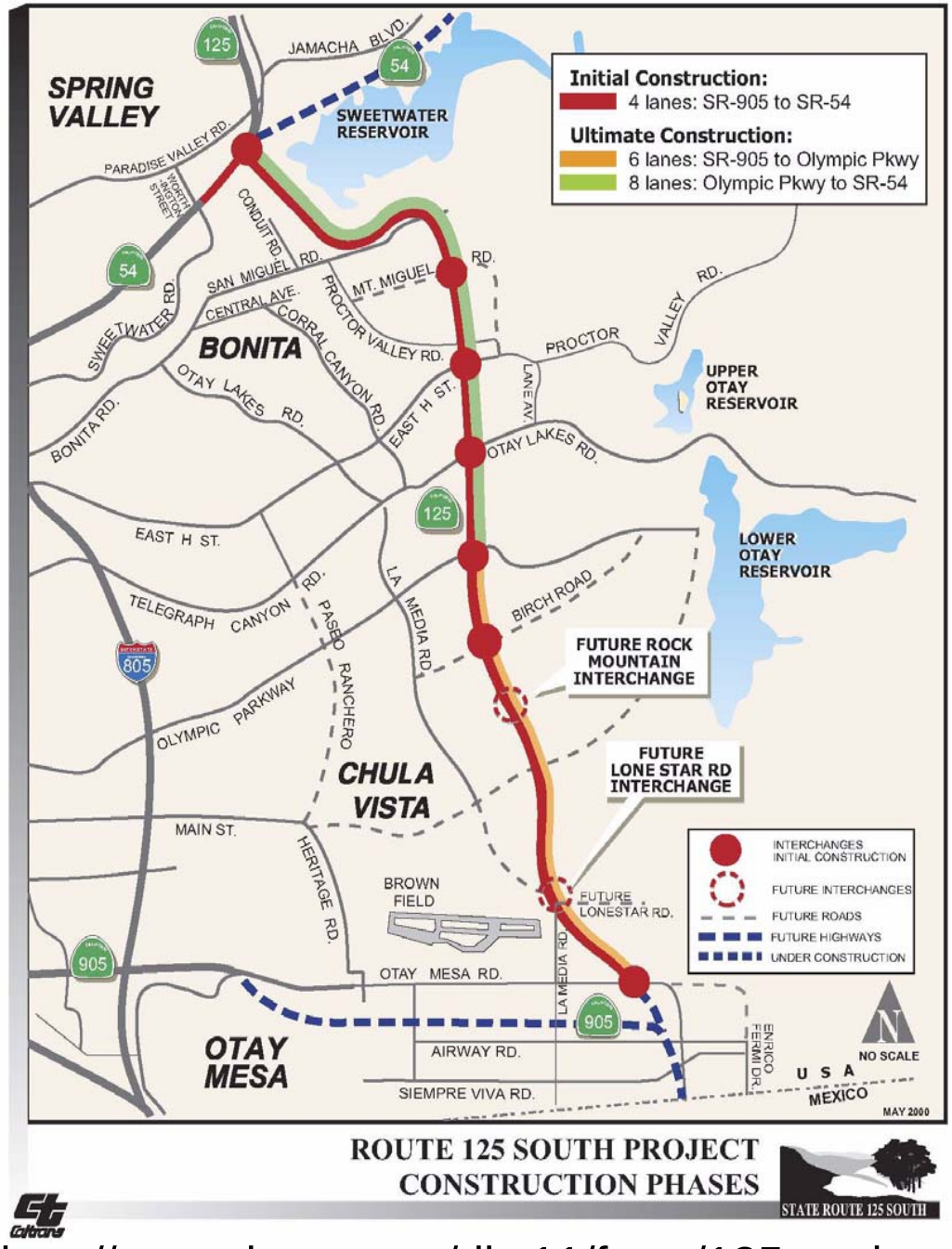
- **SR-125**
  - **Elevated Tollway (~30m)**
  - **Upwind of Reservoir (within ~100m)**
  - **Major NAFTA Route to and from Mexico**



http://www.dot.ca.gov/dist11/facts/125south.pdf

Program Timeline

- 1998 - Start of Program
  - High intensity sampling (every 2 months)
- 1999 - Sediment coring of Sweetwater Reservoir
  - Low intensity sampling begins (every 3 months)
- 2003 - Construction on SR-125 began
  - Added sampling for TMs in whole water
- 2004 - Added sampling
  - PAHs in whole water
  - TMs in air

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Program Timeline

- 2005 - Continue sampling during SR-125 construction
- 2006 +
  - Sample for 2 to 3 years during full operation of SR-125

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Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- Study Design
  - Water
  - Air
  - Bed Sediments

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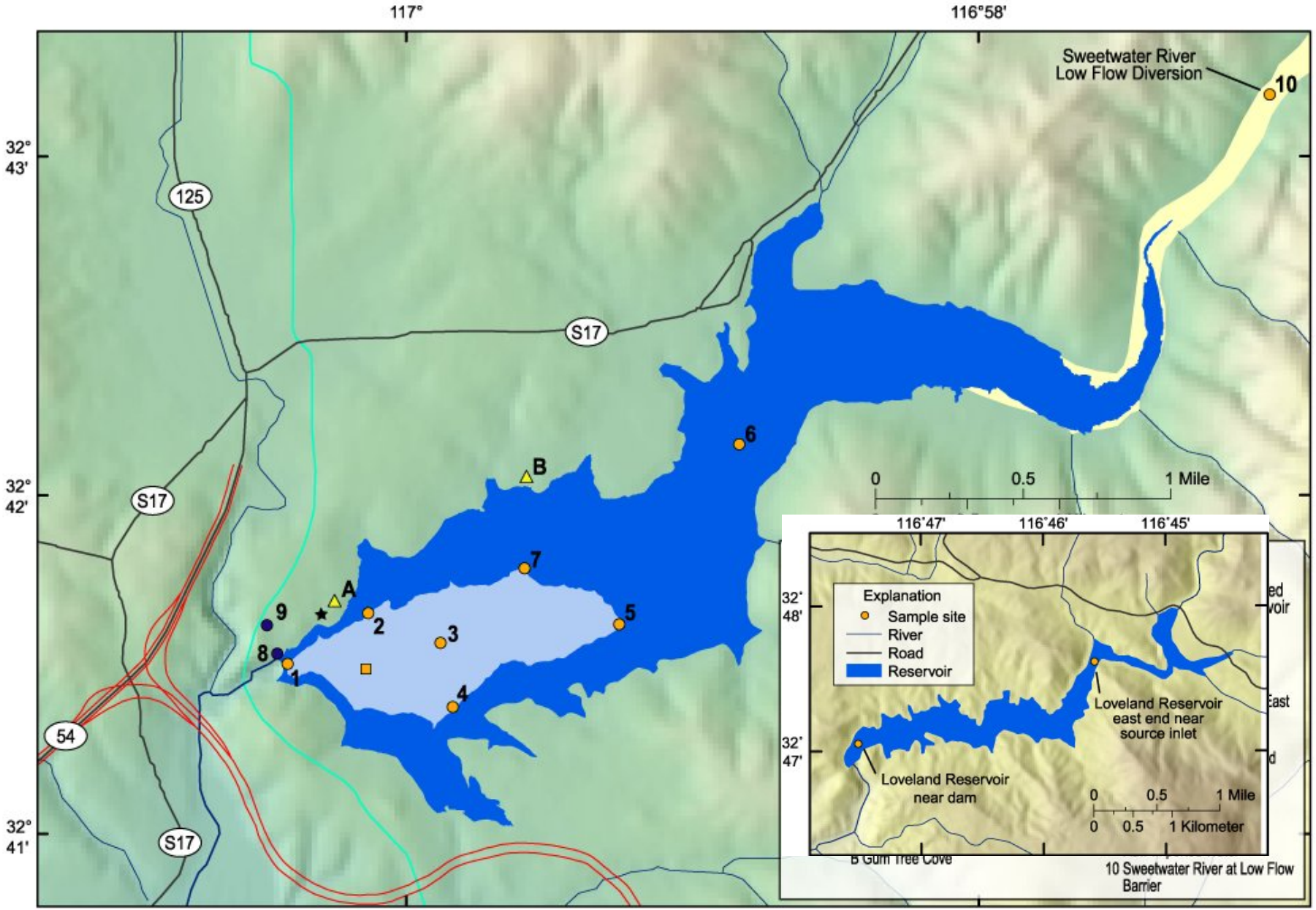
117°
116°58'
Sweetwater River
Low Flow Diversion
10
32°
43'
125
S17
32°
42'
S17
54
32°
41'
S17
A
B
1
2
3
4
5
6
7
8
9
0
0.5
1 Mile
116°47'
116°46'
116°45'
32°
48'
32°
47'
Explanation
Sample site
River
Road
Reservoir
Loveland Reservoir
east end near
source inlet
Loveland Reservoir
near dam
0
0.5
1 Mile
0
0.5
1 Kilometer
B Gum Tree Cove
10 Sweetwater River at Low Flow
Barrier

Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- Reservoir Depth Profiles of:
  - Temperature
  - pH
  - Dissolved Oxygen
  - Specific Conductance
- Thermocline
  - mid-Epilimnion
  - mid-Hypolimnion

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USGS National Water Quality Assessment (NAWQA) Program

- **Water Sampling Methods**
  - **Point Sampling**
- **Water Analytical Methods**
  - **Water - All Sites**
    - VOCs
    - Trace Metals
  - **Water - Select Sites**
    - PAHs
    - *Waste water compounds*
    - *Pharmaceuticals*
    - *Pesticides and transformation products*

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- Air Monitoring at Sweetwater Reservoir

- Meteorological Measurements
  - Air Temperature (2 & 10 m)
  - Relative Humidity (2 & 10 m)
  - Wind Speed (10 m)
  - Wind Direction (10 m)
  - Solar Radiation (2 m)
  - Barometric Pressure

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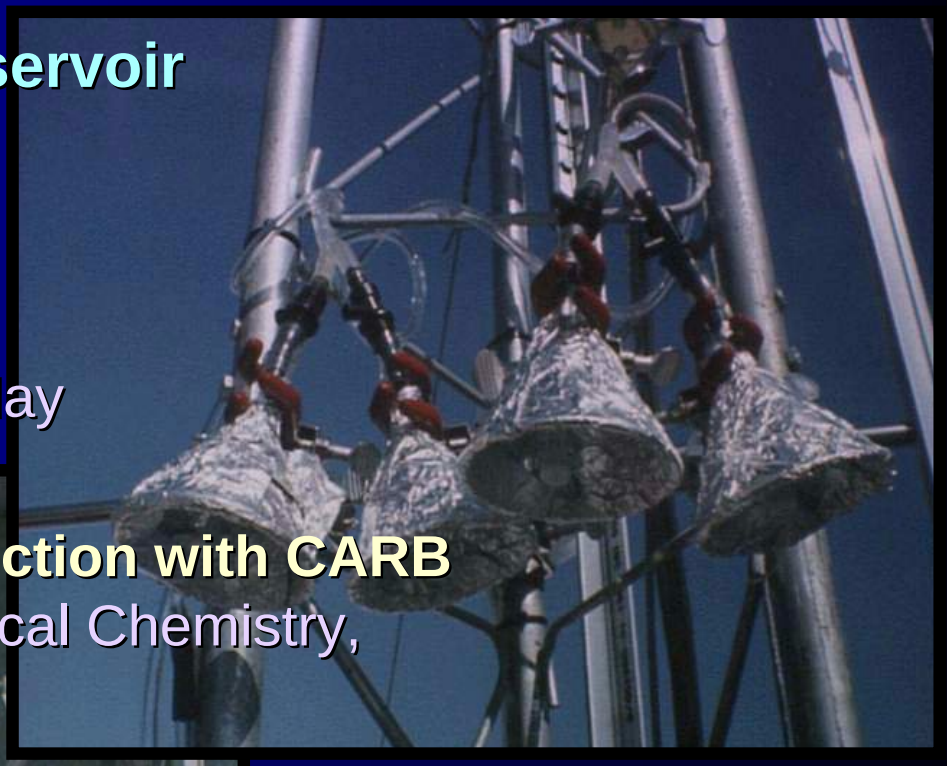
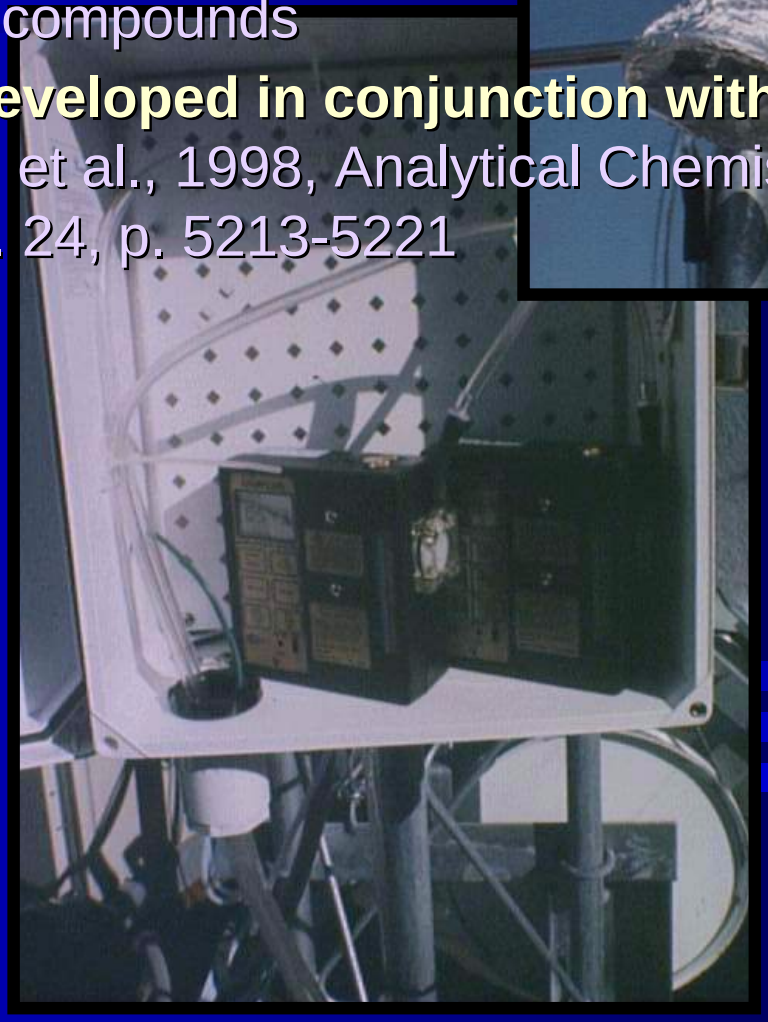
- **Air Monitoring at Sweetwater Reservoir**



  - **Air Sampling**
    - **VOCs (gas phase)**
      - 24 h composite, every 12th day
      - 88 VOC compounds
    - **Method developed in conjunction with CARB**
      - Pankow, et al., 1998, Analytical Chemistry, v. 70, no. 24, p. 5213-5221



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- **Air Monitoring at Sweetwater Reservoir**

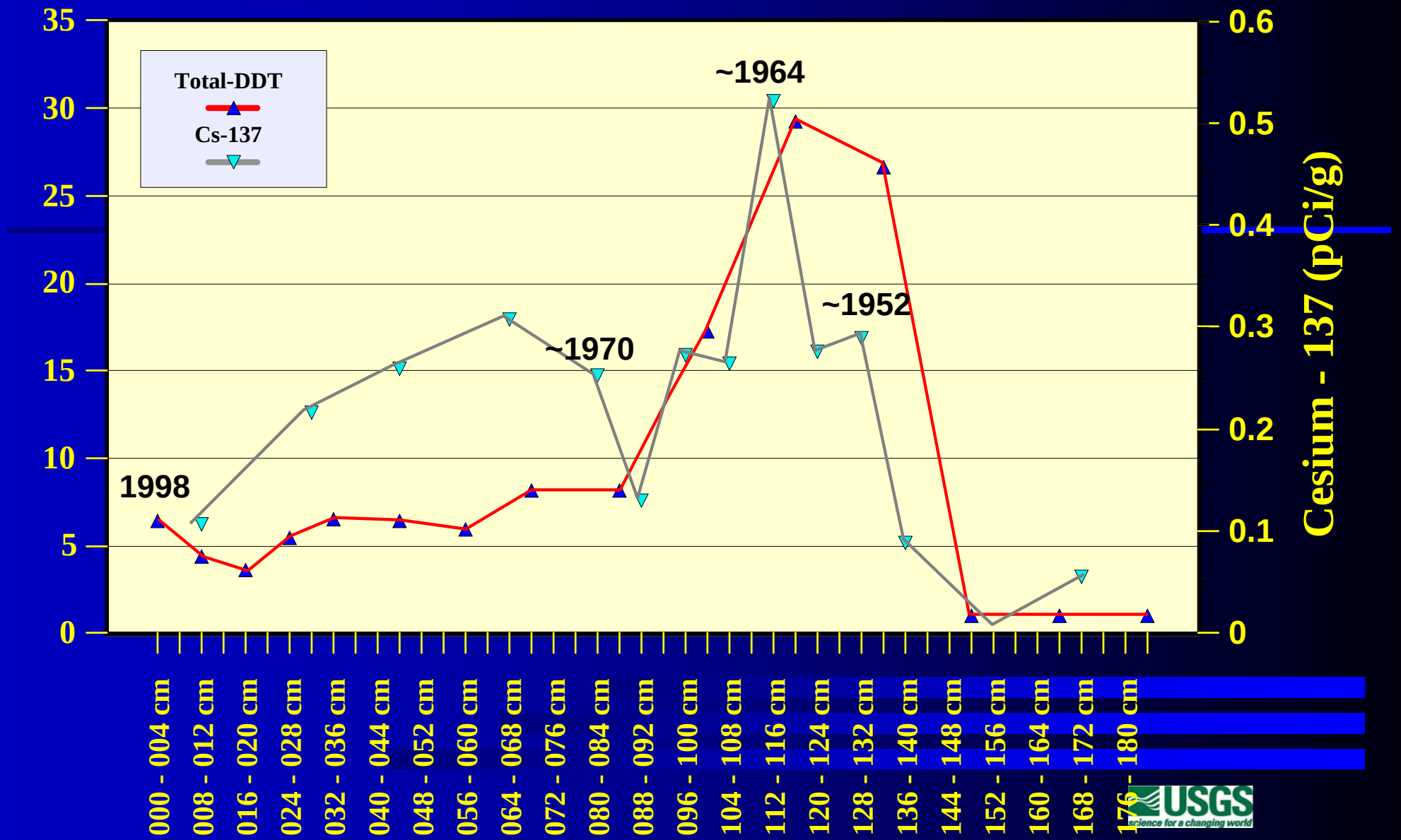
- **Air Sampling - 24 h composite, every 12th day**
  - **PAHs (gas & particle phases)**
    - Custom Methods at NWQL
    - 32 PAHs and related isomers
  - **Trace Metals (particle phase)**
    - 32 TMs

Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- **Bed Sediments**
  - Cores and Surficial
    - 32 PAH and related isomers
    - Total PCBs
    - 14 OC pesticides
    - Major and Trace Metals

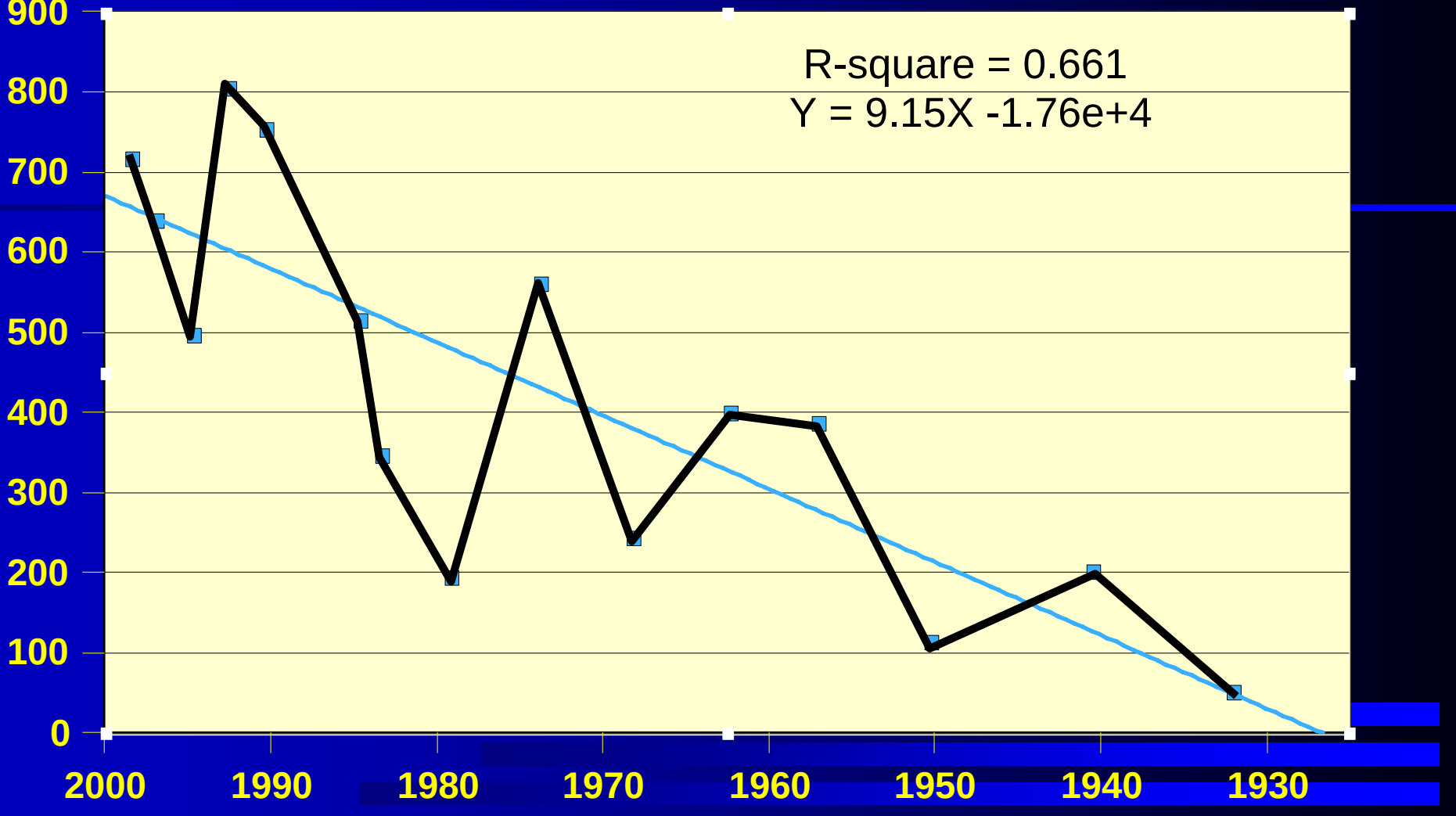
Sweetwater Reservoir Sediment Core

Total - DDT



Core Segment Depth (cm)

PAH Concentration in Sweetwater Reservoir Sediment Core



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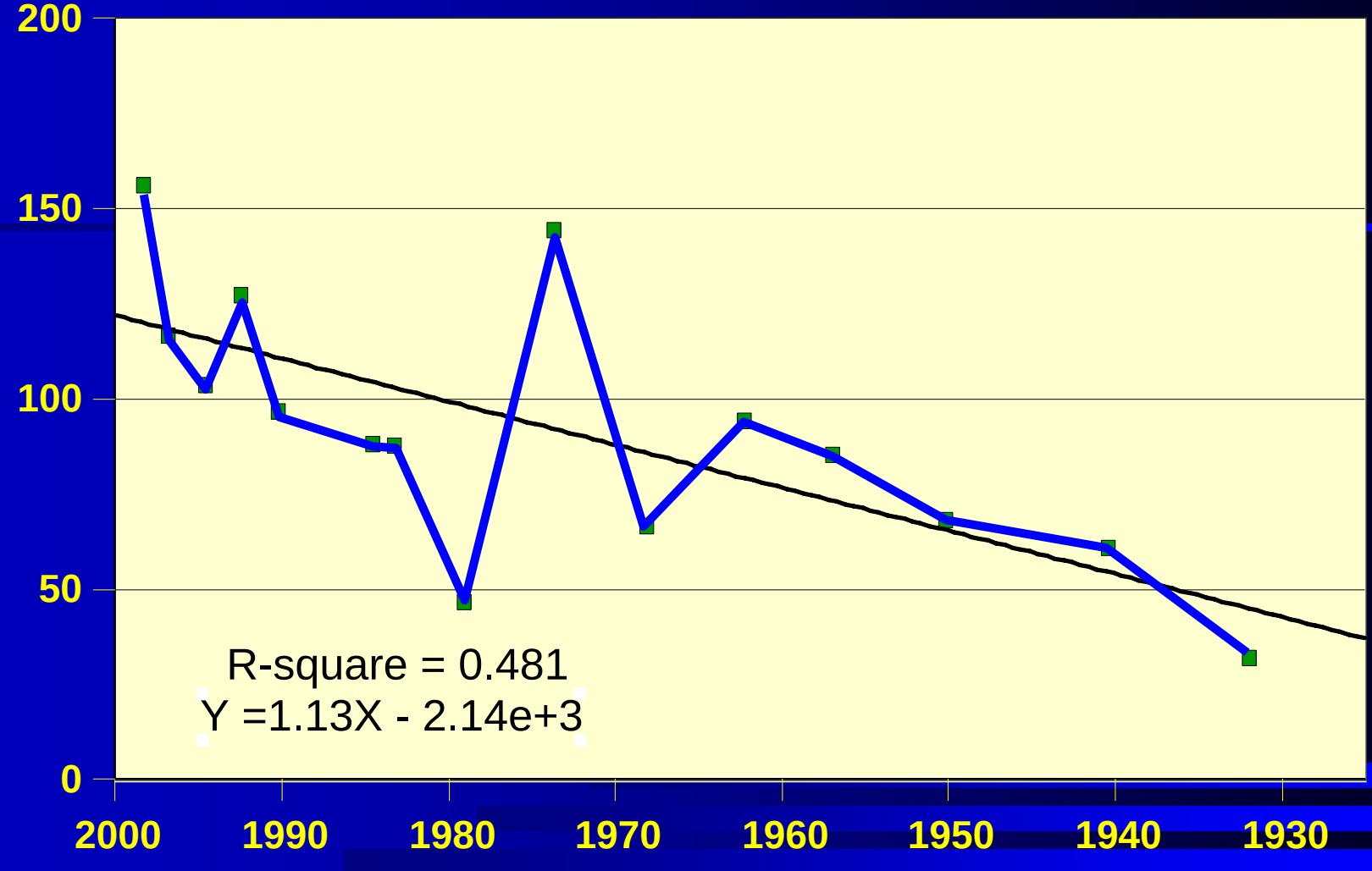
Total Combustion PAH Concentration in Sweetwater Reservoir Sediment Core



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PAH Compounds in Water

Phenol	%	Mean (µg/L)	Max (µg/L)	Median (µg/L)
LLR (3)	33.3%	1.6	1.6	1.6
Finished (5)	0.0%	0.0	0.0	0.0
Imported (3)	66.7%	0.4	0.4	0.4
LFB (5)	80.0%	0.6	1.5	0.3
SWR01 (5)	80.0%	0.3	0.7	0.3
SWR03 (5)	40.0%	0.5	0.6	0.5

- **Benzyl n-butyl phthalate**
- **Bis(2-ethylhexyl) phthalate**
- **Di-n-butyl phthalate**

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PAHs in Air

Compound	Particle Phase (ng/m^3)	Gas Phase (ng/m^3)
Acenaphthylene	0.003	0.23
Acenaphthene	0.139	0.73
Anthracene	0.008	0.117
Chrysene	0.068	0.091
Fluoranthene	0.057	1.03
Phenanthrene	0.047	5.75
Pyrene	0.060	0.70
Benz (a) anthracene	0.044	0.029
Benzo (a) pyrene	0.054	0.008
Benzo (e) pyrene	0.096	0.014

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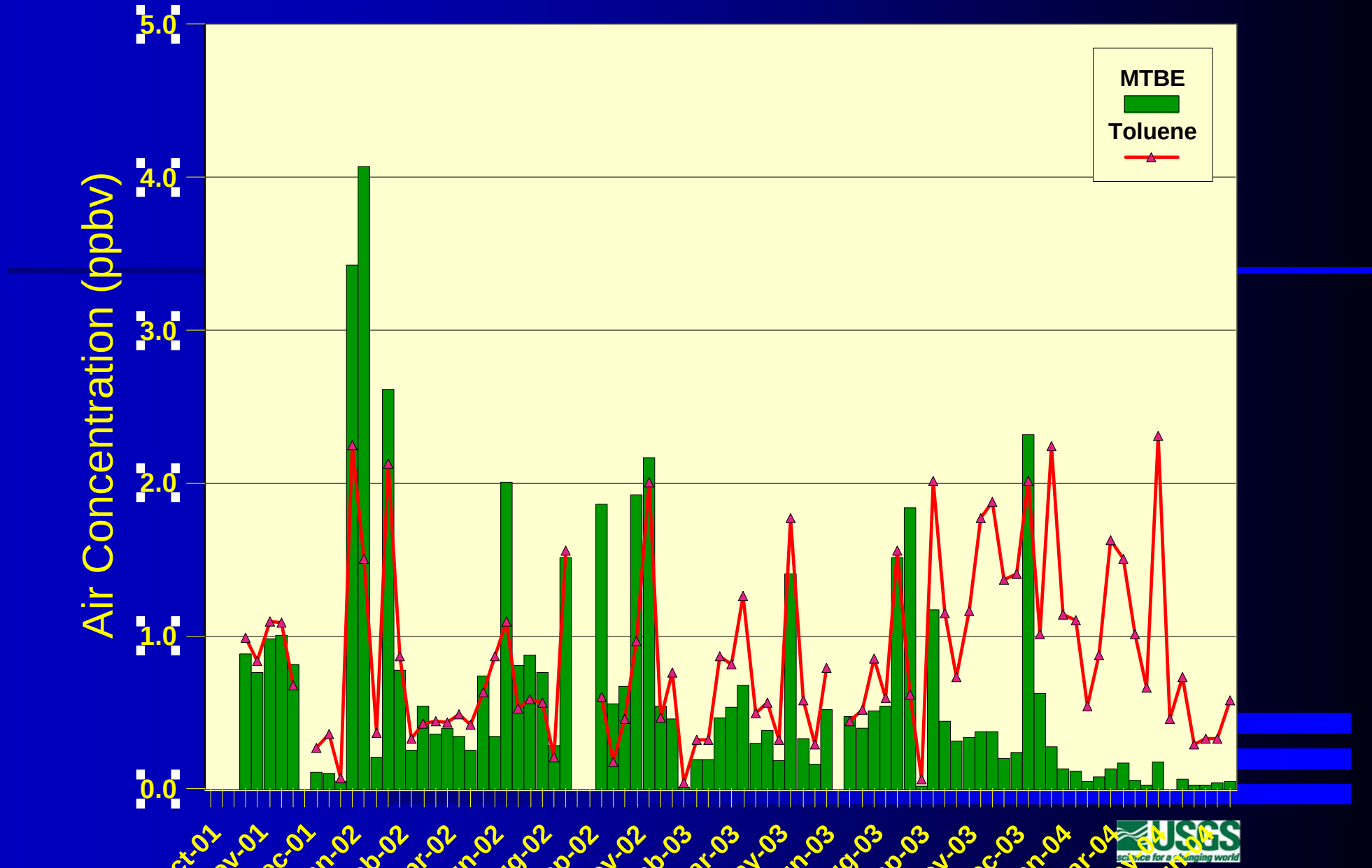
VOC Compounds in Water

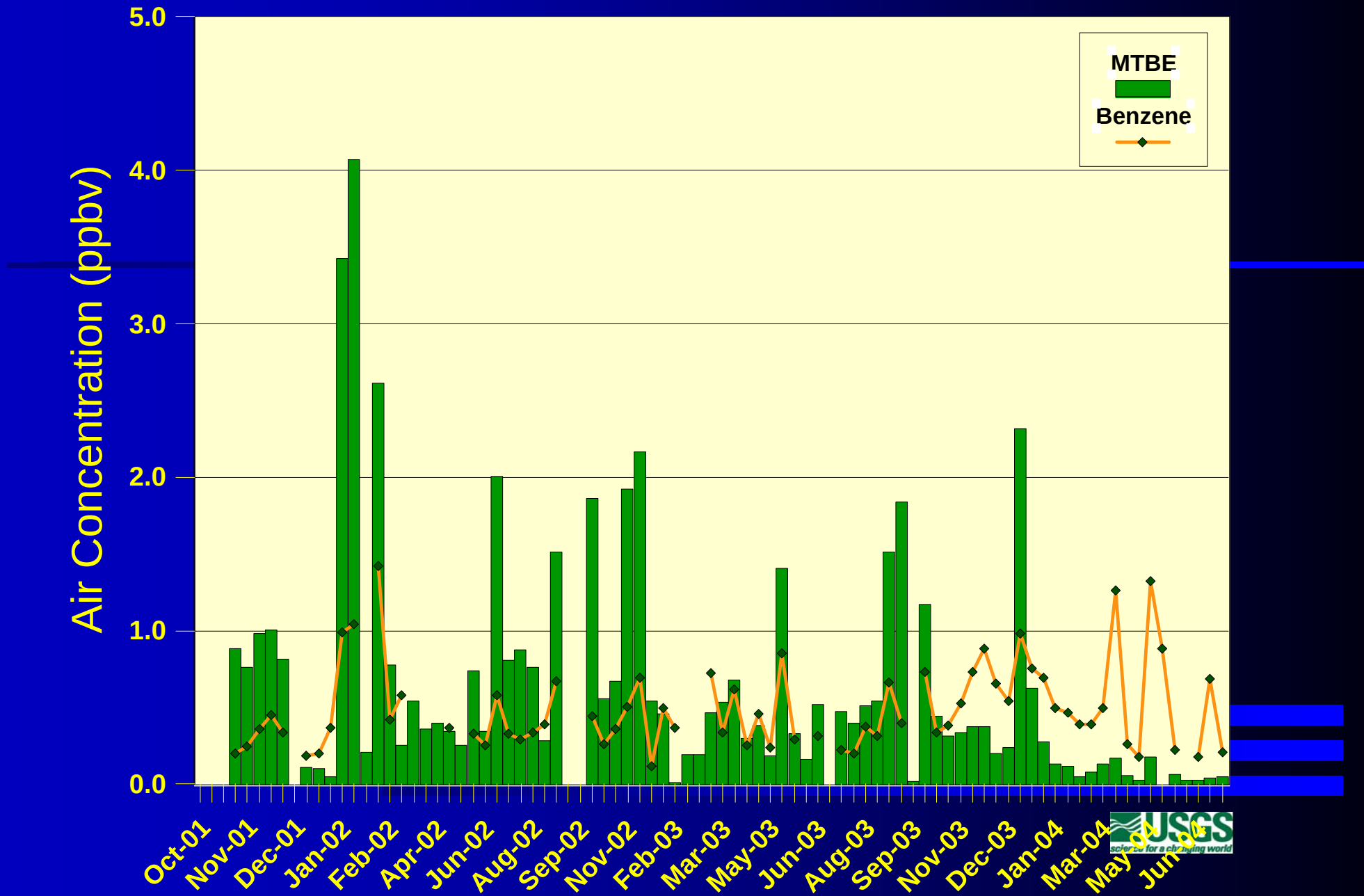
Percent Detections

	LLR	SWR01	SWR03	SWR06	LFB	Finished	Imported
Trichloromethane	2.5	100	100	96.0	11.1	100	100
Bromodichloromethane	0.0	94.7	88.2	92.0	0.0	100	92.9
Dibromochloromethane	0.0	84.2	76.5	52.0	0.0	100	42.9
Tribromomethane	0.0	42.1	8.8	4.0	0.0	96.2	0.0
Chloromethane	0.0	2.6	2.9	0.0	3.7	84.6	0.0
Tetrachloromethane	0.0	0.0	0.0	0.0	0.0	80.8	0.0
Methyl tert-butyl ether	57.5	57.9	50.0	60.0	59.3	69.2	78.6
Acetone	2.5	5.3	2.9	8.0	0.0	65.4	0.0
Carbon disulfide	12.5	18.4	14.7	24.0	59.3	34.6	7.1
Toluene	47.5	50.0	38.2	52.0	48.1	34.6	28.6
Dichloromethane	0.0	5.3	5.9	0.0	3.7	30.8	0.0
Benzene	17.5	15.8	8.8	20.0	7.4	19.2	0.0
Chloroethane	0.0	0.0	0.0	0.0	0.0	15.4	0.0
1,1,1-Trichloroethane	0.0	0.0	0.0	0.0	0.0	11.5	28.6
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	7.7	0.0
Styrene	0.0	5.3	2.9	4.0	51.9	7.7	0.0

VOC Compounds in Water

	Finished Water (µg/L)				SW01 (µg/L)		
	%	max	mean		%	max	mean
Trichloromethane (26/38)	100	44.8	14.18		100	1.34	0.360
Bromodichloromethane (26/36)	100	66.6	24.65		94.7	2.07	0.424
Dibromochloromethane (26/32)	100	61.1	24.10		84.2	2.10	0.406
Tribromomethane (25/16)	96.2	11.5	5.15		42.1	0.47	0.131
Chloromethane (22/1)	84.6	0.40	0.186		2.60	0.10	0.100
Tetrachloromethane (21/0)	80.8	0.20	0.065		0.00	0.00	0.000
Methyl tert-butyl ether (18/22)	69.2	0.80	0.306		57.9	0.30	0.155
Acetone (17/2)	65.4	13.0	7.18		5.30	2.00	2.000
Carbon disulfide (9/7)	34.6	0.15	0.049		18.4	0.26	0.063
Toluene (9/19)	34.6	0.03	0.018		50.0	0.08	0.030
Dichloromethane (8/2)	30.8	0.30	0.138		5.30	0.10	0.100
Benzene (5/6)	19.2	0.02	0.014		15.8	0.01	0.010
Chloroethane (4/0)	15.4	0.10	0.100		0.00	0.00	0.000
1,1,1-Trichloroethane (3/0)	11.5	0.03	0.023		0.00	0.00	0.000


Air Concentration (ppbv)
5.0
4.0
3.0
2.0
1.0
0.0
MTBE
Toluene
Oct-01
Nov-01
Dec-01
Jan-02
Feb-02
Apr-02
Jun-02
Aug-02
Sep-02
Nov-02
Feb-03
Mar-03
May-03
Jun-03
Aug-03
Sep-03
Nov-03
Dec-03
Jan-04
Mar-04
May-04
Jun-04


Air Concentration (ppbv)
5.0
4.0
3.0
2.0
1.0
0.0
MTBE
Benzene
Oct-01
Nov-01
Dec-01
Jan-02
Feb-02
Apr-02
Jun-02
Aug-02
Sep-02
Nov-02
Feb-03
Mar-03
May-03
Jun-03
Aug-03
Sep-03
Nov-03
Dec-03
Jan-04
Mar-04
May-04
Jun-04
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Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- **Summary**
  - **Monitoring of Sweetwater and Loveland Res.**
    - Detecting wide variety of organic and inorganic chemicals in the source and finished waters
    - Water treatment removes contaminants to various degrees and adds others (THMs)
    - Concentrations of most compounds are very low
    - Imported water contains additional chemicals not detected Sweetwater Reservoir

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Water Quality Monitoring of Sweetwater and Loveland Reservoirs

- **Summary**
  - **Many of the same chemicals found in the water are also found in the air**
    - Because of the climate, the atmosphere may be a possible source in water for some compounds
  - **Distinguish Local from Regional Ambient Levels**
    - SR-125 Construction is ongoing

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Recommended Follow-up Actions

- **Gaps in Regulatory Structure**
  - **Primary focus of the Safe Drinking Water Act source protection is on pathogens (*cryptosporidium & giardia*)**
    - SDWA does address other contaminants, but post treatment
  - **A general lack of information and research on other risks to WQ such as the impact of air quality of water quality, i.e., risks from airborne vehicle emissions**
  - **Informed decisions and sensible regulations can only be made based on quality research results**

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Recommended Follow-up Actions

- **Partnerships**
  - How does one answer the question: “Will the emissions from a proposed or existing roadway alignment near a drinking water source have any impact on that source?”
  - State and local regulatory and supply agencies and reliable, unbiased research organizations
  - Open mindedness is needed to address the concerns of local water supply agencies

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Recommended Follow-up Actions

- **Research Needs**
  - **Long-term, effective research focused on identifying all risks to source waters in a variety of environmental settings**
  - **An integrated approach incorporating causes, effects, and solutions**

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