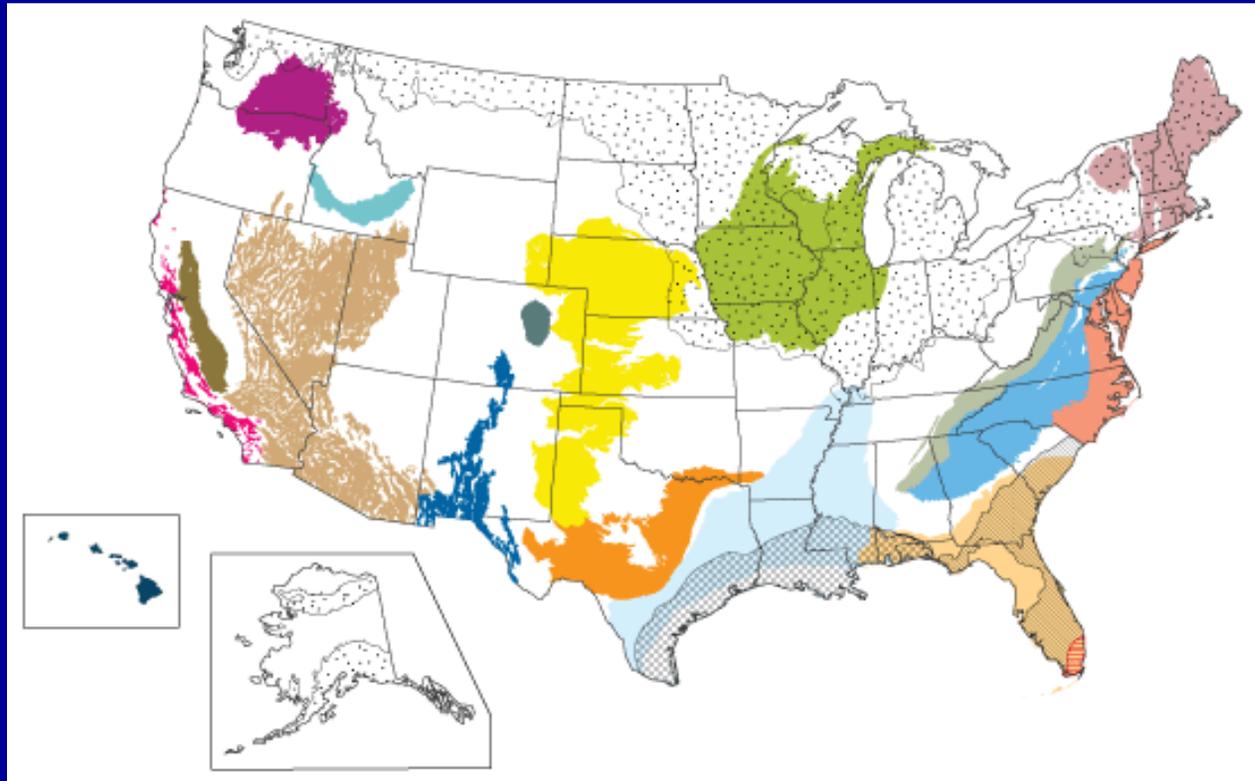


USGS National Water-Quality Assessment (NAWQA) Program

GW Monitoring Design & Approach

Wayne Lapham, NAWQA GW Status & Trends Coordinator



National Water-Quality Assessment (NAWQA) Program Brief Background

- (1) GW & SW pilot studies started in the late 80's.**
- (2) Full implementation in 60 study areas began in 1992 w/ river basins as the design framework.**
- (3) Nation-wide program: Assessments of quality of U.S. water resource w/r to SW, GW, Ecology.**
- (4) 3 Goals of the water-quality assessments:**
 - Occurrence**
 - Trends**
 - Understanding of Occurrence and Trends**
- (5) Redesign for GW in 2002 w/ Principal Aquifers as the GW design framework.**

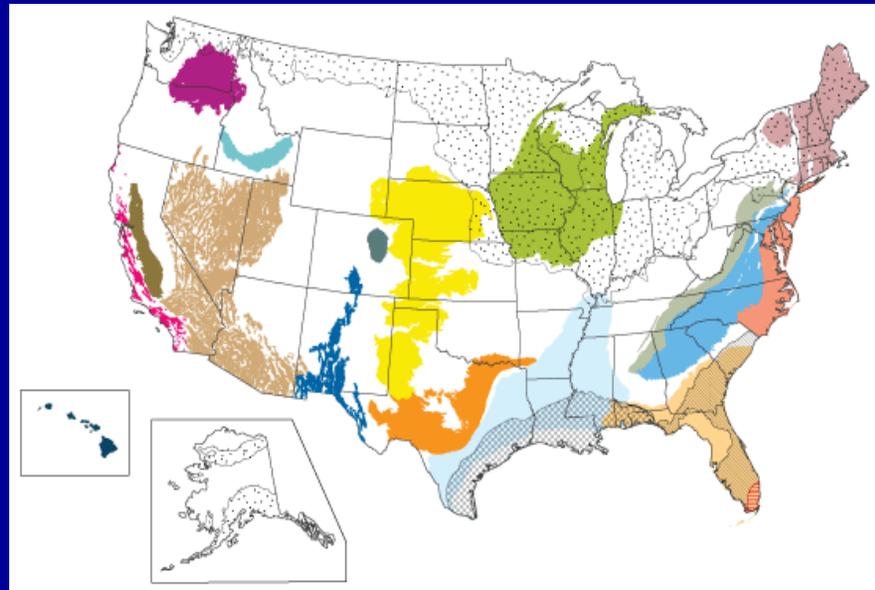
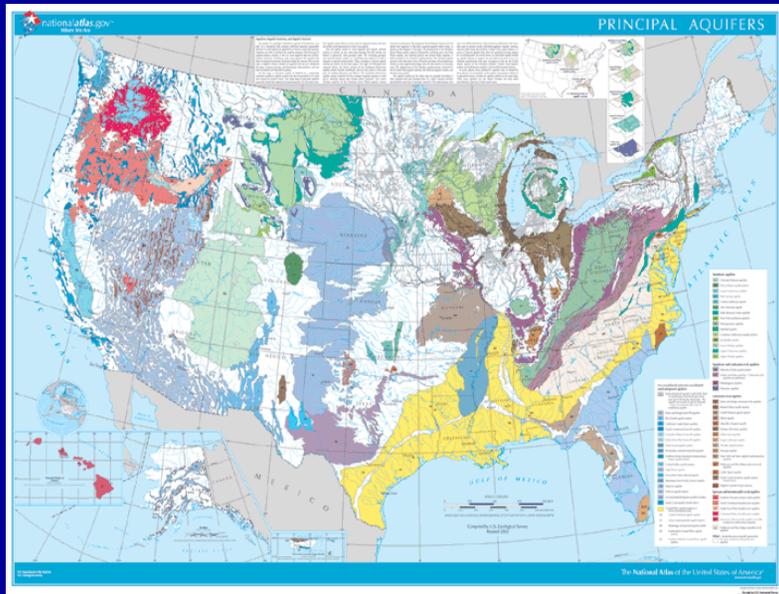
NAWQA Ground-Water Quality Program Brief Background (Cont.)

- Sampling costs (field + lab): ~\$5 m / yr.
- # of wells sampled: Av of ~750 / yr.
- Cost / well: \$5,000 of which \$2,500 is for laboratory analysis. Remaining \$ for field costs, equip & supplies, staff costs, QC checks, database input, etc.
- \$5 m / yr for analysis, interpretation & reporting of findings.

3 NAWQA Program Ground-Water Quality Study Objectives

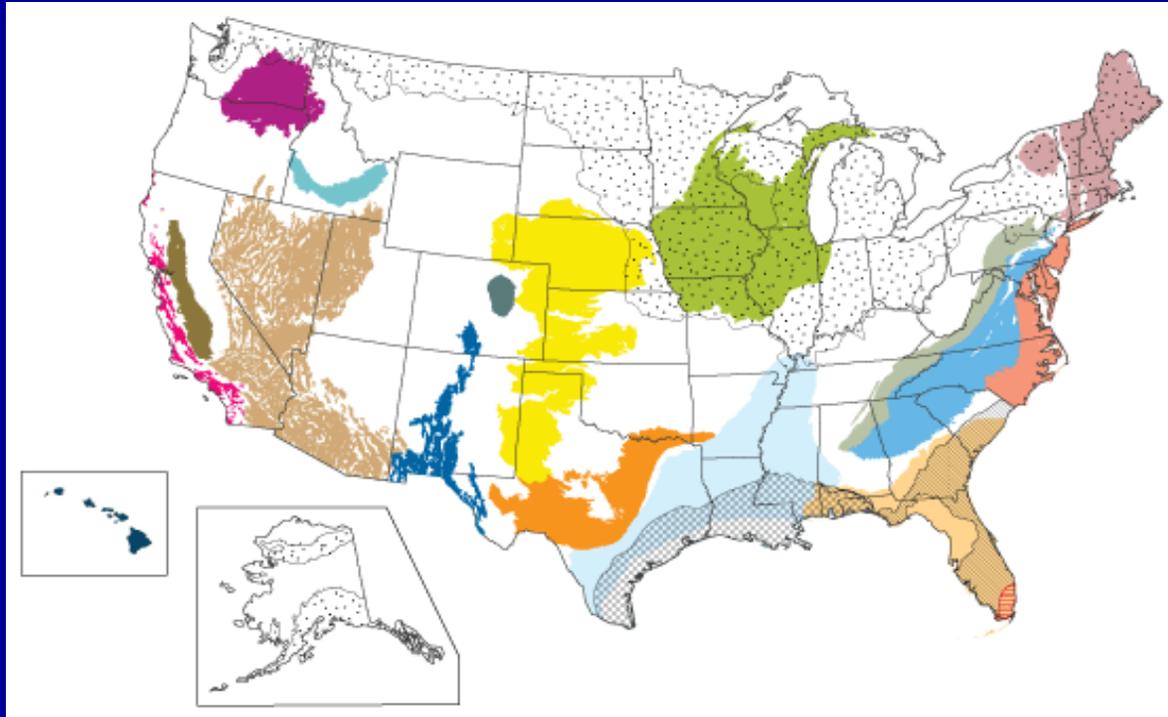
- (1) Ground-Water Quality: Occurrence and Distribution.**
- (2) Trends in Ground-Water Quality (Generally decadal scale).**
- (3) Understanding of Occurrence & Distribution and of Trends in Ground-Water Quality.**

Aquifers Studied – NAWQA Selection Criteria



- **Select from 62 U.S. Principal Aquifers.**
- **Select Principal Aquifers with largest withdrawals for drinking-water.**
- **Include representation of all major aquifer lithologies.**
- **Ensure geographic distribution across the U.S.**
- **Include Principal Aquifers with largest areal extents.**

Aquifers Studied – Results of Selection Given Funds Available

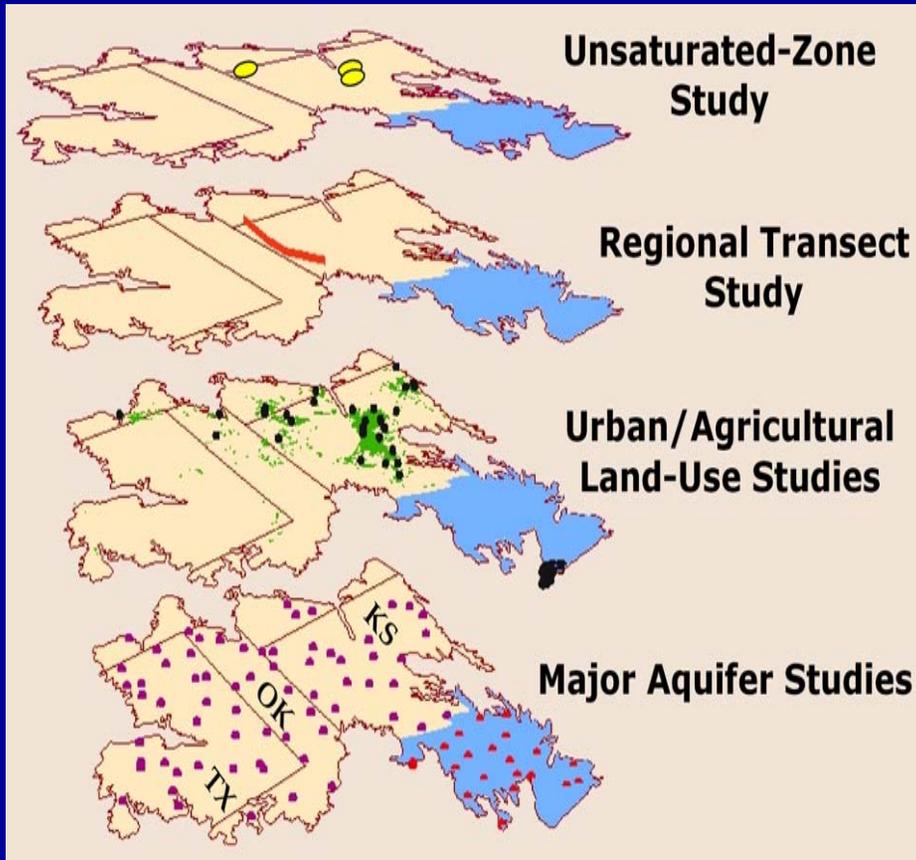


- About 1/3 of the 62 Principal Aquifers currently being studied.
- Provides a framework for regional studies.
- Each regional assessment focuses on specific issue(s) of concern.
- Local multi-scale, nested studies in each Principal Aquifer.

3 Design Concepts Applied to NAWQA Water-Quality Assessments

- 1. Local multiple-scale, nested studies.**
- 2. Consistent design of all local-scale studies.**
- 3. Consistent approaches to conducting local-scale studies.**

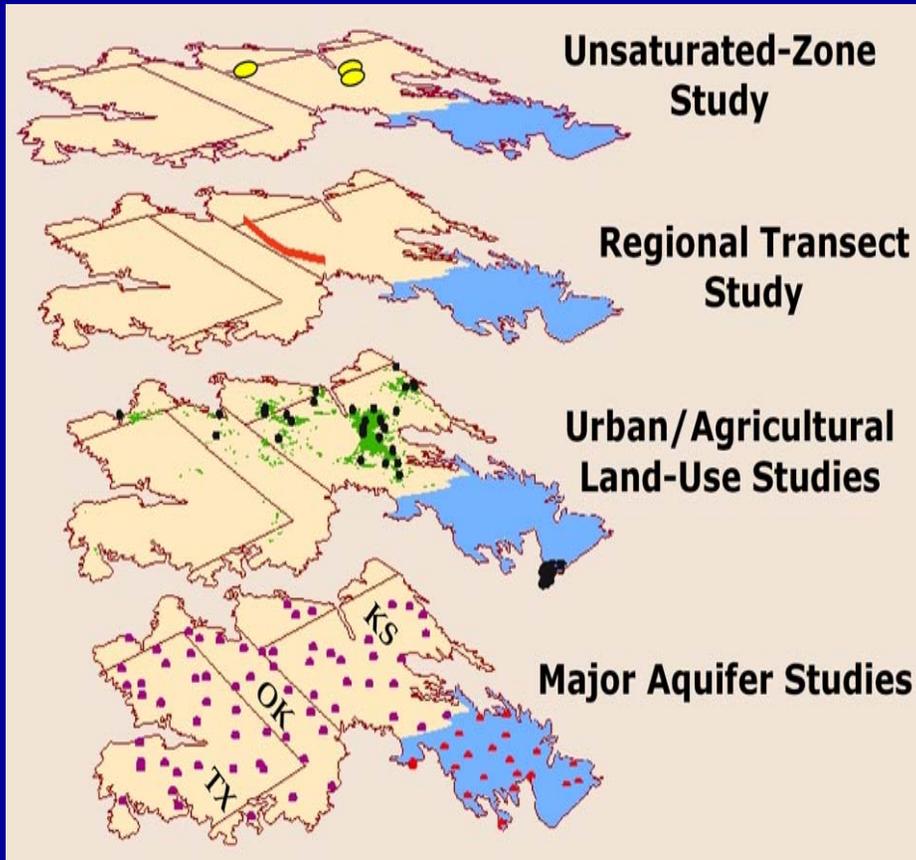
#1 - Key Design Element: Nested, Multiple-Scale Studies – Example: High Plains aquifer



Each scale of study has a different objective.

Multiple, nested studies in an aquifer provide findings that can be collectively used to characterize and understand Ground-Water Quality in an aquifer.

#2 - Consistent Design of Nested, Multiple-Scale Studies in Each Principal Aquifer



Similar studies are done in each of the ~20 Principal Aquifers across the U.S.

Consistent Study Designs



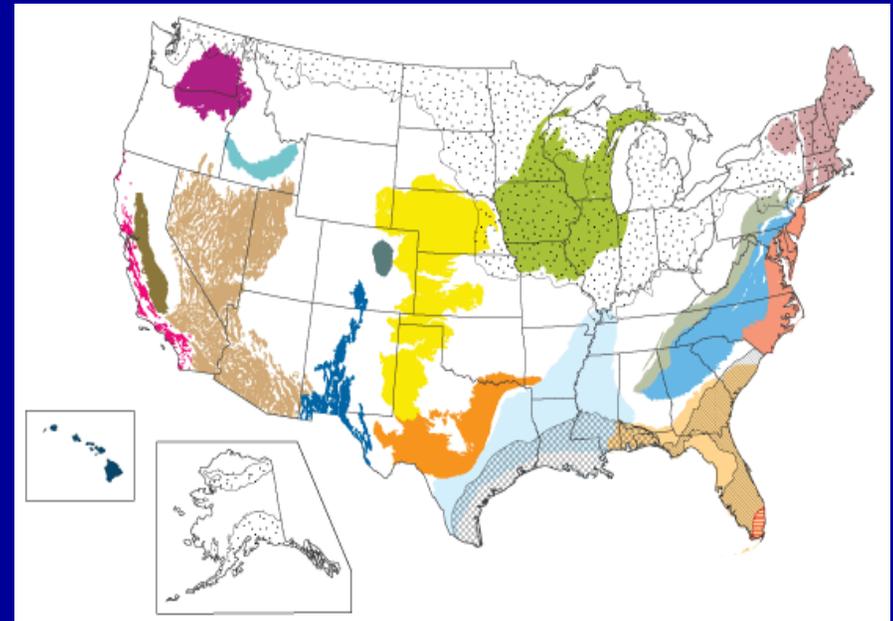
Local scale: Aquifer studies in about 40 areas (called “study units”).



Regional scale: Summaries in ~20 principal aquifers.



National scale: National summaries using all studies / data from all Principal Aquifers.



A Main Message

These 3 design concepts (multi-scale, nested studies, consistent designs, consistent approaches) **enable**



(1) Local assessments of Ground-Water Quality.

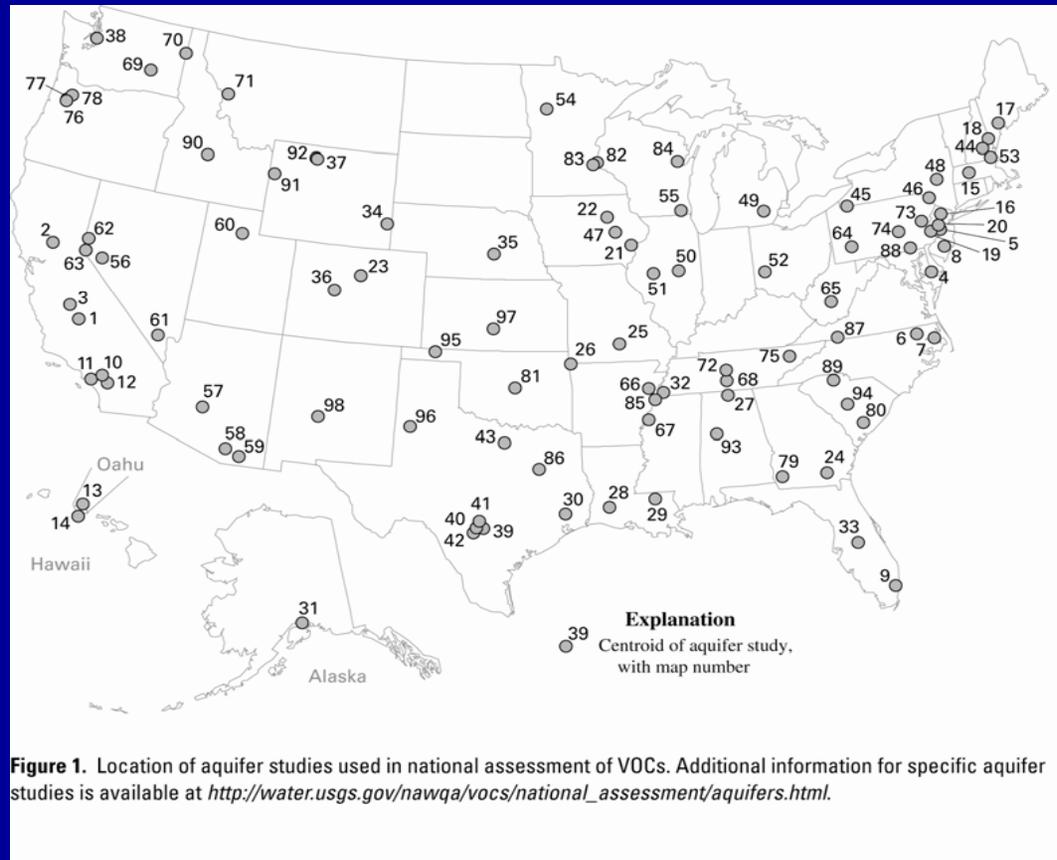
(2) Aggregation of local findings (or data) into Regional & National Water-Quality Assessments.

Example of networks of wells & analysis options

(Each Dot is a network of ~ 20 - 30 wells)

- Analysis Options are ...

- by Network
- Well
- Aquifer
- State
- Region
- Nat'l
- etc



#3 - Consistent approaches to conducting these studies

- Water-quality constituents measured.
- Sample collection procedures and laboratory analyses.
- Laboratory & field quality assurance.
- Ancillary data collected.
- Data in one common data base.
- Analysis procedures.

Consistent approaches

- **Example: Sample collection procedures are the same for all wells.**
 - All sampling crews receive training in QW sampling.
 - All sampling crews are taught the same sampling procedures, which are documented in the USGS National Field Manual.
 - QC samples collected when sampling.

Consistent approaches

- **Sampling at the well head.**
- **The same water-quality constituents measured**
- **Example: NAWQA measures the following in its studies . . .**
 - Temp, Specific Conductance, Dissolved Oxygen, pH, Turbidity
 - Major inorganics
 - Nutrients
 - Pesticides
 - Volatile Organic Compounds
 - Trace Elements
 - Microbial indicators (coliform, E coli)

Consistent approaches

- **For Example: Common Laboratory & Field Quality Assurance are applied**
 - **One laboratory used for analyses.**
 - **Same laboratory methods applied.**
 - **Standard laboratory Quality Assurance - Quality Control procedures.**
 - **etc.**

Need a minimum of 7 pieces of information before selecting a well for NAWQA sampling

- 1. Well depth.**
- 2. Water level (preferably at time of sampling).**
- 3. Casing material(s).**
- 4. Depths to tops & bottoms of open intervals.**
- 5. Lithologies of contributing intervals.**
- 6. Primary aquifer contributing water to the well.**
- 7. Lithology of primary aquifer.**

Some challenges w/ using data from existing monitoring programs for a Nat'l monitoring network

Differences among and/or Lack of Information about each Monitoring Program, including:

Monitoring objectives.

Network design.

QW measures.

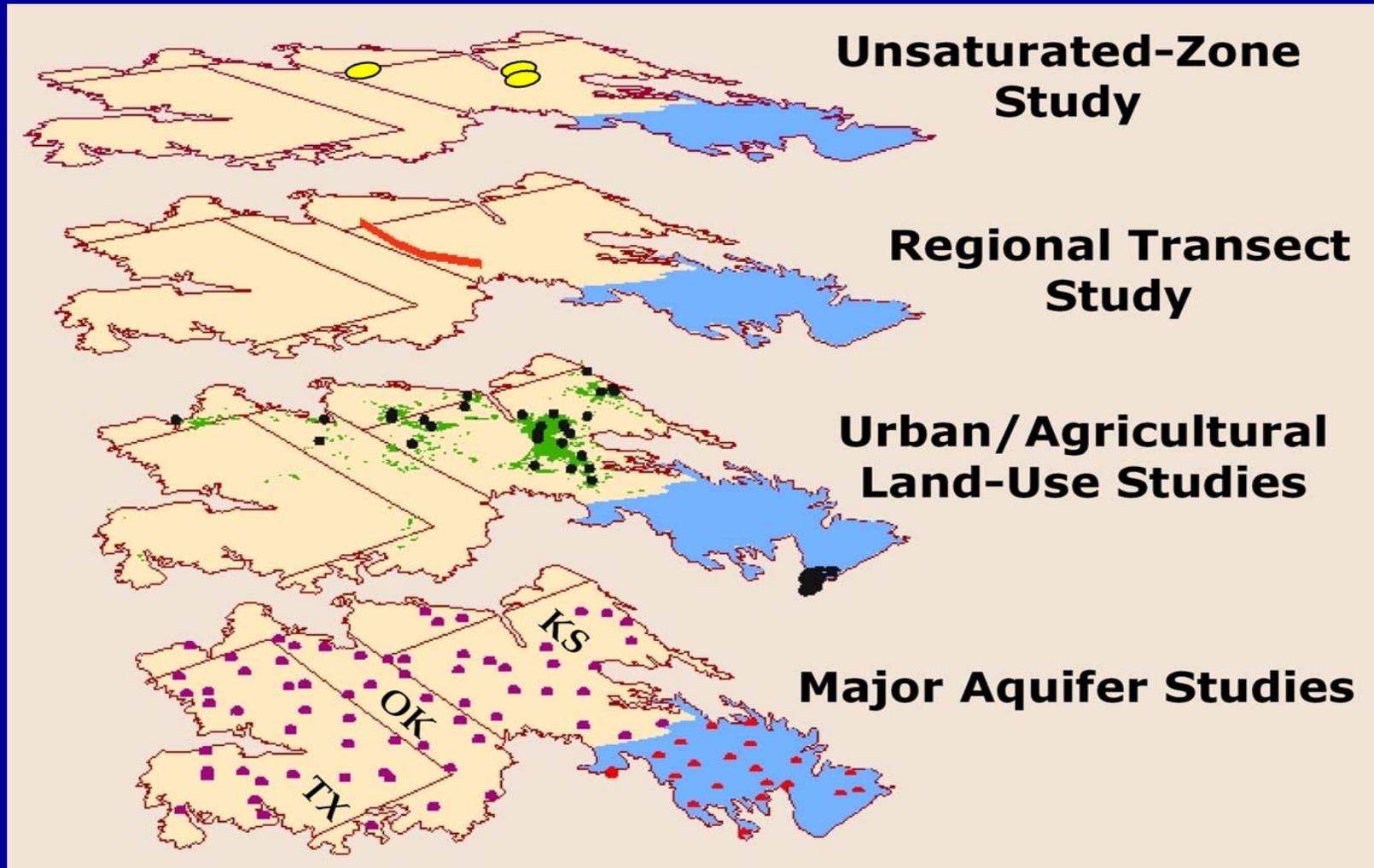
Lab methods & reporting levels.

Sampling periods.

Basic information available about each

well.

Developing “Aquifer Occurrence” Studies Using Existing Data



Example of using existing data for an Occurrence & Distribution objective

- Inventoried existing Fed, State, Local monitoring programs to determine objectives, design, QW measures, lab methods, sampling period, etc.
- Selected programs with a common objective and other specified common design elements.
- Mined those data.
- Used subset of those data to develop data sets that duplicated NAWQA design.

Example Monitoring Program Approach of Assembling Data from Multiple, Independent Monitoring Programs



- **Guidance: USGS open-file report 96-199: Plan for assessment of the occurrence, status, and distribution of VOCs in aquifers of the U.S.**
- **Report online at <http://pubs.er.usgs.gov/usgspubs/ofr96199>**

SUMMARY: Main Message

3 design concepts -> multi-scale, nested studies; consistent designs; & consistent approaches



(1) Local assessments of Ground-Water Quality.

(2) Ability to combine local findings (or data) into Regional & National Assessments.

Additional Slides

NAWQA Program Ground-Water Study Approach



**3 design concepts used to meet
the 3 objectives at multiple
scales (Local, Regional &
National)**

Example of occurrence results

(Each point is a well showing total concentrations of VOC in the sample)

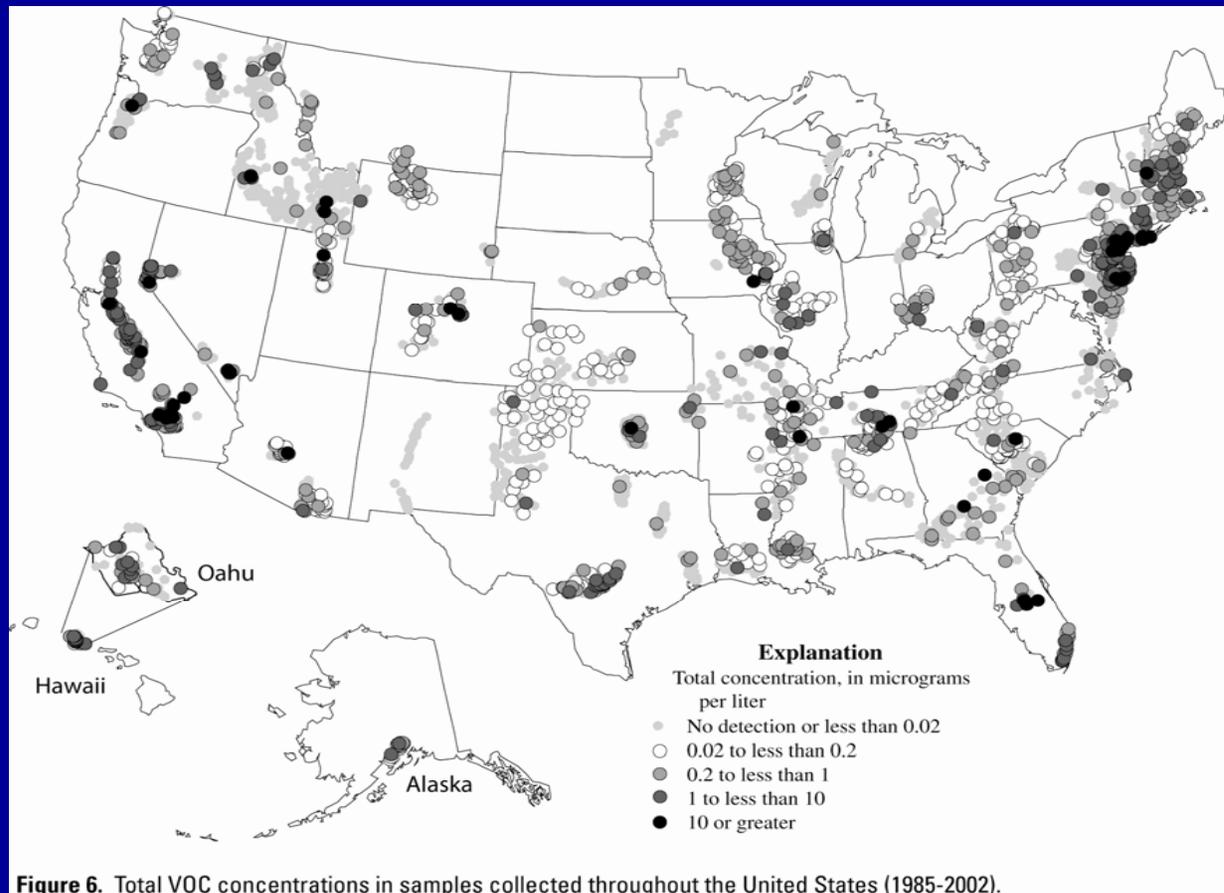


Figure 6. Total VOC concentrations in samples collected throughout the United States (1985-2002).

4 Examples of Occurrence & Distribution Questions

- **What compounds are present & not present in ground water?**
- **Where are compounds found & not found?**
- **At what concentrations & frequencies of detection?**
- **What types of mixtures of compounds are found?**

3 Examples of Trends Questions

- **What are the long-term changes and trends in ground-water quality and why?**
 - **What have been the historic trends?**
 - **What are the current trends?**
 - **What will be future trends under various management scenarios ?**

1 Example of Understanding Questions

- **What are the factors that govern groundwater quality?**

- **E.G.**

- **Hydrogeologic.**
- **Land-use.**
- **Geochemical conditions.**
- **Climatic factors.**
- **Etc.**

#1 - Key Design Element: Nested, Multiple-Scale Studies – Example: High Plains aquifer

