

GROUND-WATER MONITORING ACTIVITIES - Updated August, 2000

Ground water issues to be studied by the NECB study have been identified in meetings with Liaison Committee members, discussions with other State and Federal agencies, with NAWQA program specialists, and via retrospective analysis. As a result, the ground water monitoring activities during 1998-2001 will focus on the following issues:

- Occurrence and distribution of VOCs in water from in stratified drift and bedrock aquifers.
- Effects of recent urbanization on shallow ground water quality in stratified drift deposits.
- Occurrence and distribution of trace metals (with emphasis on arsenic) and radon in selected bedrock lithogeochemical groups or aquifers.

Three sub-unit surveys (SUS) and one land-use study (LUS) are proposed to address these issues. Sub-unit surveys are planned for the stratified-drift aquifer, for the calcareous metasedimentary bedrock lithogeochemical group, and for a combination of the felsic igneous and other metasedimentary groups. The urban land-use study in the Boston metropolitan area was completed in 1999 and a report summarizing results is being prepared. Tables 1 and 2 below define the proposed schedule of these activities and constituents to be analyzed.

Table 1: Schedule of groundwater monitoring studies, 1998 through 2001

Ground-water component	FY 98	1998-99				1999-2000				2000-01			
	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS
LUS-urban stratified drift													
SUS1-calc metaseds													
SUS2 - felsic igneous/other metasediments													
SUS3-stratified drift													

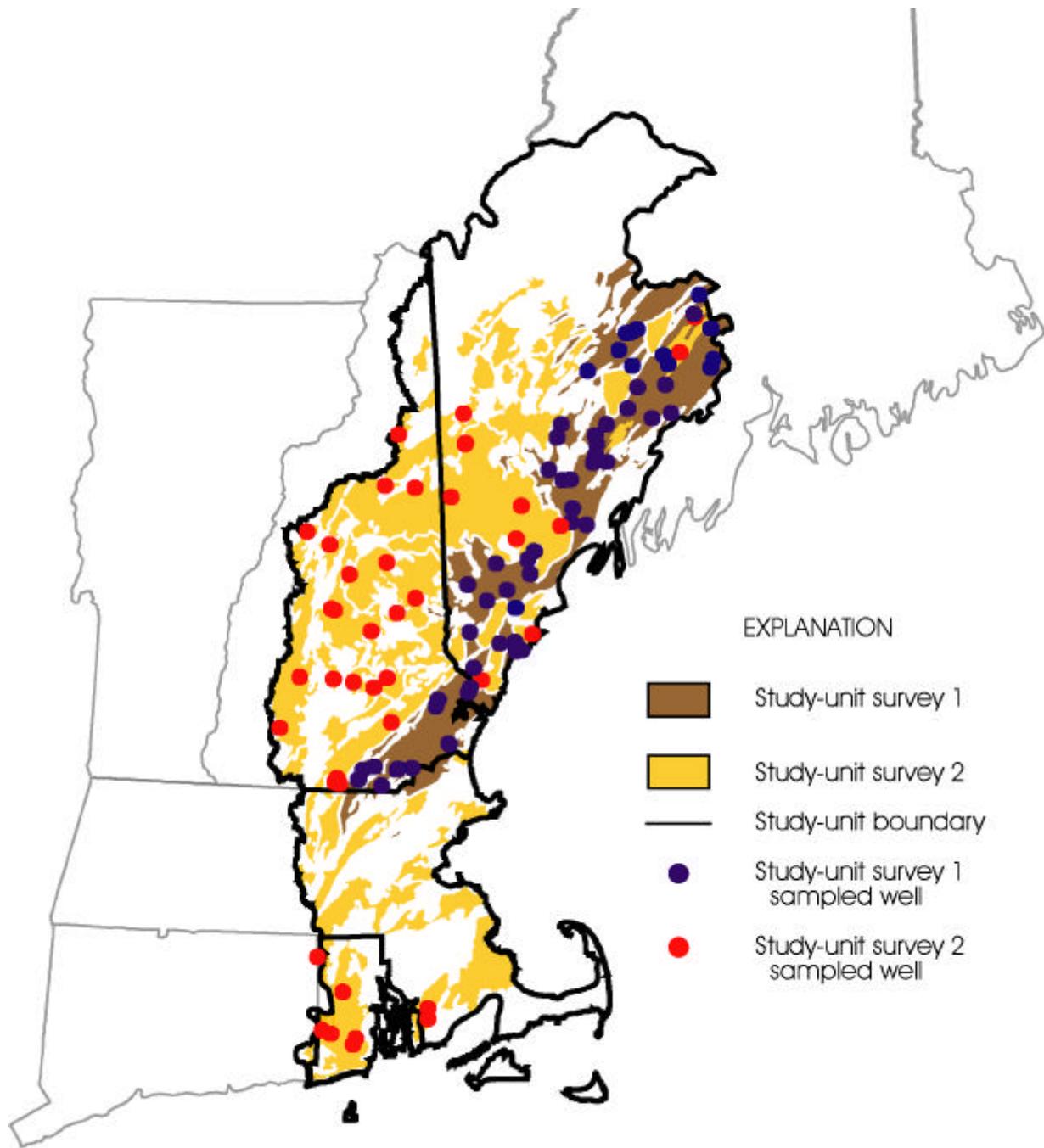


Figure 1. Location of study-unit survey 1, study-unit survey 2, and wells sampled.

Table 2: Proposed constituent schedule by ground water activity

Constituent	Ground-water Activity	
	SUS's	LUS
Major ions		
Nutrients		
DOC		
Pesticides		
VOCs		
Trace elements		
Minitan 10,000 Daltons for TE's		
Sulfur/Lead Isotopes (USGS-GD)		
Tritium/Helium		
CFCs		
Radon/Radium		

SUB UNIT SURVEYS

For more information on the subunit surveys contact Joe Ayotte

Sub-unit surveys (SUS) will assess 2 major aquifers (stratified drift and bedrock). The bedrock aquifer is further divided up into several lithochemical groups and two SUS's, totalling 60 wells, cover a combination of these groups (figure 2). The stratified-drift SUS, consisting of 30 wells, will cover stratified drift aquifer across the entire study unit and will be used as a comparison data set for the stratified-drift urban land-use study.

Sub-Unit Survey 1 -- Calcareous metasedimentary bedrock aquifer: NECB retrospective analysis of ground-water quality data has found that certain constituents show variation by lithochemical grouping (Ayotte and others, 1999, USGS WRIR 99-4162). Detectable concentrations of arsenic in the calcareous metasedimentary bedrock are nearly twice that found in other lithochemical groupings. Sub-unit survey 1 is underway for this group to better define arsenic concentrations in relation to other indicators of water quality and land uses. The full suite of sub-unit survey analytes (VOC's, nutrients, pesticides, inorganics, trace-elements, radium, CFC age-dating, and radon) would be done. Conducting this SUS would be beneficial to other potential work to better determine the sources of arsenic in New England ground water. Collaborative studies with the USGS Geologic Division and other researchers in New England are currently underway and follow-up studies are being pursued. The calcareous metasedimentary rocks are not as spatially extensive as other bedrock-aquifer groups, but account for significant water use in the bedrock systems of the study unit. The issue of arsenic in ground water is important in New England and this SUS will help address this issue.

While a striking relationship exists for arsenic in metasedimentary bedrock derived from calcareous sediments, there are very little ancillary data and other constituent data to begin to understand the geologic controls on arsenic occurrence and distribution. The lithochemical data generated for the NECB has

proven to be of significant value in this first phase of analysis of existing data and has resulted in a more defined study design and a clear hypothesis to be tested during the SUS monitoring. The combination of this SUS and other special studies in the bedrock will enable a first-cut geochemical analysis to be done on the waters of the carbonate-rich metasedimentary rocks. Arsenic can then be compared to iron, manganese, sulfate, pH, lead, among others, to better explain the cause of this finding.

Eleven of the 30 wells for SUS1 were sampled in 1999, and show promising results for the issues of interest. The rate of detection of arsenic in SUS1 domestic bedrock wells is similar to rates seen in bedrock public supply wells in the same lithochemical group (table 3). In addition, concentrations of arsenic from NAWQA protocol sampling (0.45 micron filter) are almost identical to concentrations in samples collected at the same time through the minitan and pelicon filters (10,000 and 30,000 Daltons) for all samples with detectable arsenic (these wells were sampled in conjunction with Alan Welch for the USGS Tangential Flow Filter Pilot Project).

Table 3: Arsenic Detection Rates Comparing Data from Public Water Suppliers with Initial SUS1 Results

Lithochemical Group	Arsenic detection rate (at or above 0.005 mg/L, in percent)	
	Public Supply	Domestic (SUS1)
Mc (calcareous metasediments)	44	36
	n = 200	n = 11

Collection of well water samples as part of SUS1 was completed in August 2000.

Sub-Unit Survey 2: Sub-unit survey 2 will include the noncalcareous metasedimentary and the felsic igneous lithochemical groups. Retrospective analysis found that radon concentrations are greatest in the felsic igneous rock group, but are even greater in the 2-mica granite lithologies within this group. These findings are consistent with previous work in New England, which indicates 2-mica granite can be a major source rock for radon in ground water. Wells in SUS2 will target trace elements and radon along with major inorganic constituents, VOC's, pesticides and field parameters to further evaluate constituent occurrence and distribution in the study unit. The felsic igneous rocks are found about 36 percent of the study unit and have significant water use. Urban lands comprise 8 percent of this group, while agriculture is found on 4 percent of this bedrock group.

The metasedimentary rocks in this lithochemical group have been found to have the greatest iron and manganese concentrations of all the lithochemical groups in the study unit based on retrospective analysis. This group is also extensive in the study unit (found in 32% of the study unit) and accounts for a significant amount of water use. About 8 and 6 percent of this group are urban and agricultural lands, respectively. SUS2 field sampling is scheduled to be completed in the Fall, 2000.

Sub-Unit Survey 3: Stratified-drift aquifers will be assessed in both as sub-unit survey 3 and in the urban land-use study. This aquifer is found over 22 percent of the study unit and is the dominant aquifer for total ground water withdrawals (293 MGD) and public supply uses (184 MGD). Stratified drift is found discontinuously across the entire New England Physiographic Province, but is most extensive in the populated metropolitan areas and becomes progressively less extensive to the north. Existing water-quality data for this stratified drift are extensive spatially but are limited in terms of constituents sampled. Data



Hydrologist collecting a ground-water sample for dating the age of the water.

largely include major ions and some metals. Readily-available VOC data is very limited but may be obtainable from a targeted selection of public-supply wells--similar to that done for the retrospective analysis. A 30-well subunit survey of this aquifer would be completed in 2001

Potential Reports from the SUSs: One or more USGS reports will be produced to describe the results of the two bedrock aquifer sub-unit surveys. Work on these reports will be started in 2001.



Mapping detailed land-use data around urban land-use wells.

URBAN LAND USE STUDY

For more information on the urban land use study, contact Sarah Flanagan

One land-use study will be conducted for the NECB study; this study is in the Boston Metropolitan area. The study, which began in 1998, was completed in 1999. Its focus is on assessing shallow ground-water quality in newly developed urbanized lands (development of 0-30 years old) that overlie the stratified-drift aquifer. While Boston proper is served by surface water sources (Quabbin Reservoir from outside the NECB SU), most of the water supplied to the surrounding 'new urban' areas is from ground water in stratified drift. Many of these cities and towns have master plans that detail the need for future development of ground water supplies.

Drilling and installation of monitoring wells for the urban land use study began in 1998 and concluded, along with sampling, in 1999. By the end of June 1999, 29 wells had been installed (figure 2). Sampling of wells occurred in the summer of 1999, as was the detailed land use/land cover delineations around the wells required by the NAWQA program.

Some Draft Results from Land Use Study in FY99:

-Concentrations of MTBE were generally low -- four wells had water with concentrations above 1 µg/L and less than 10 µg/L; one well had water with a concentration of 267 µg/L (figure 3).

-Pesticides were not frequently detected in wells in from the study. The most common pesticides are shown in figure 4. All values for atrazine, diazinon, and tebuthiuron were above the lowest reporting level; all values for deethylatrazine were below the lowest reporting level). None were above USEPA maximum contaminant levels.

-Nutrients were generally found in low concentration in LUS1 wells (figure 5); the highest concentrations were nitrate/nitrite. Several wells had concentrations above 5 mg/L; one was above the USEPA MCL of 10 mg/L.

Potential Reports from the Land Use Study: Presently, results of the study are being analyzed and a USGS report is being prepared. The reports will compare NECB study results to results from other NAWQA study results in New England.

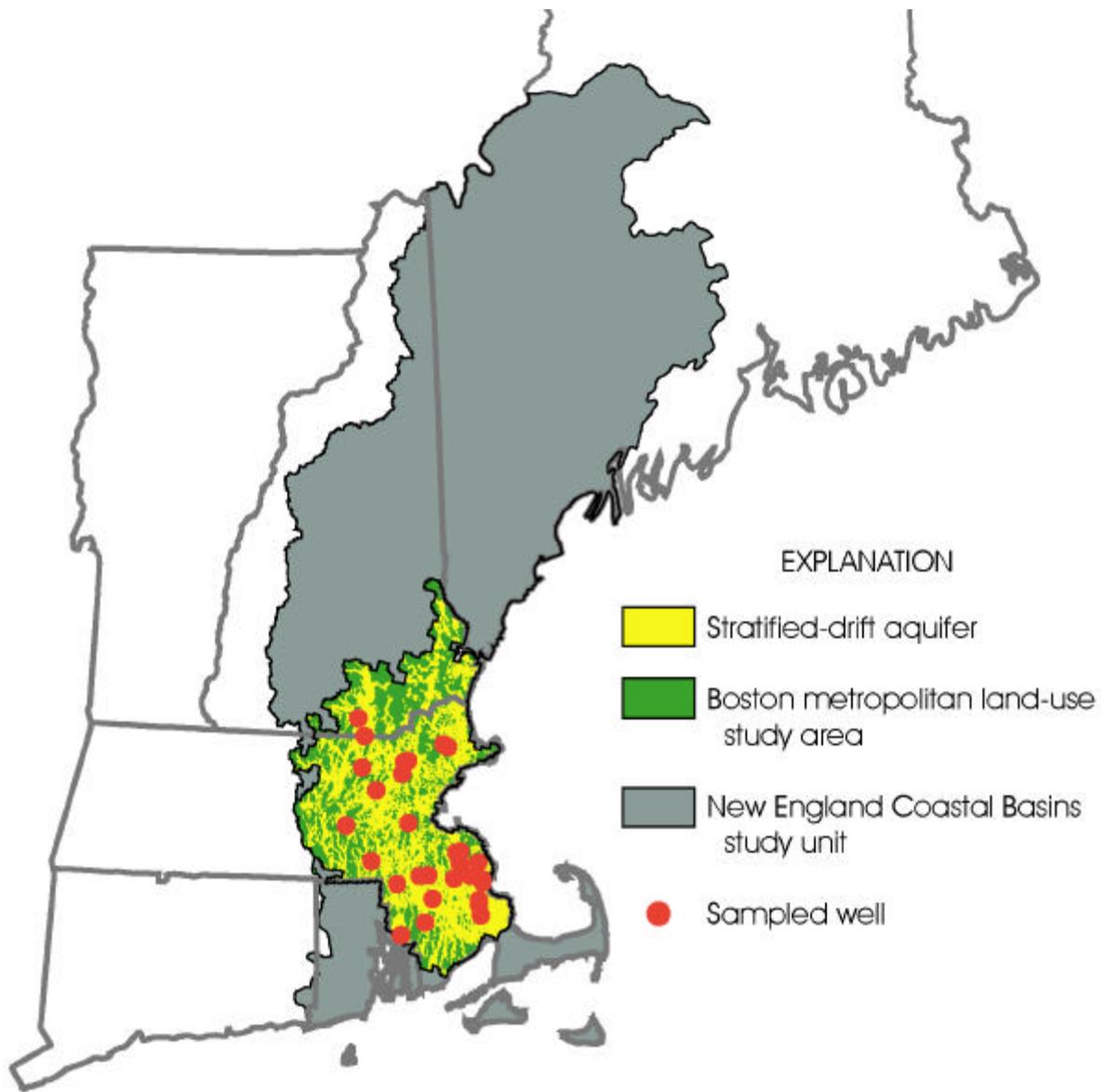


Figure 2. Location of wells installed and sampled for the New England Coastal Basins urban land-use study.

Figure 3 - VOC detections in the NECB and CONN urban land-use wells

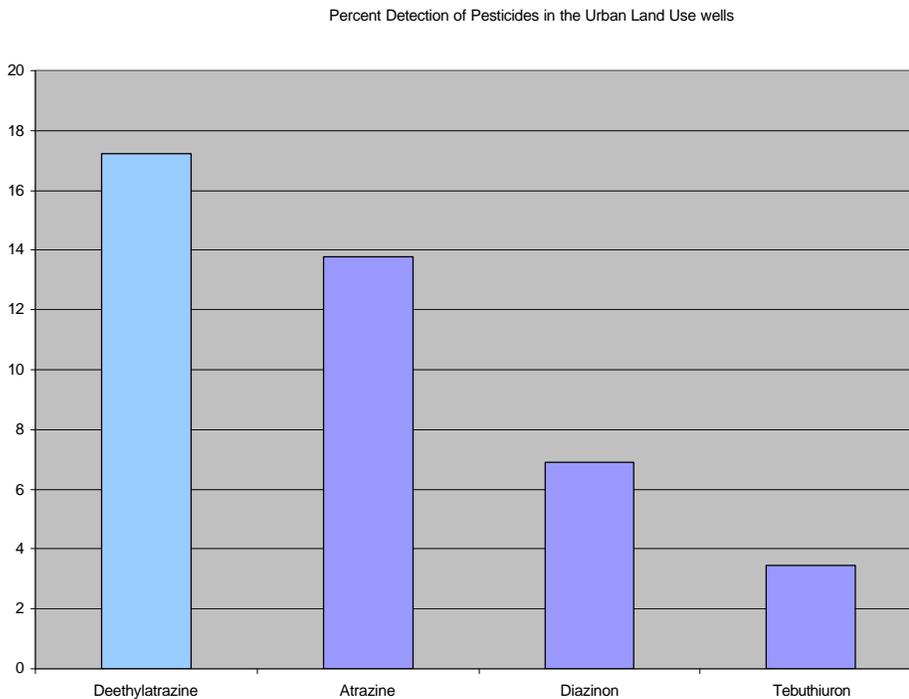
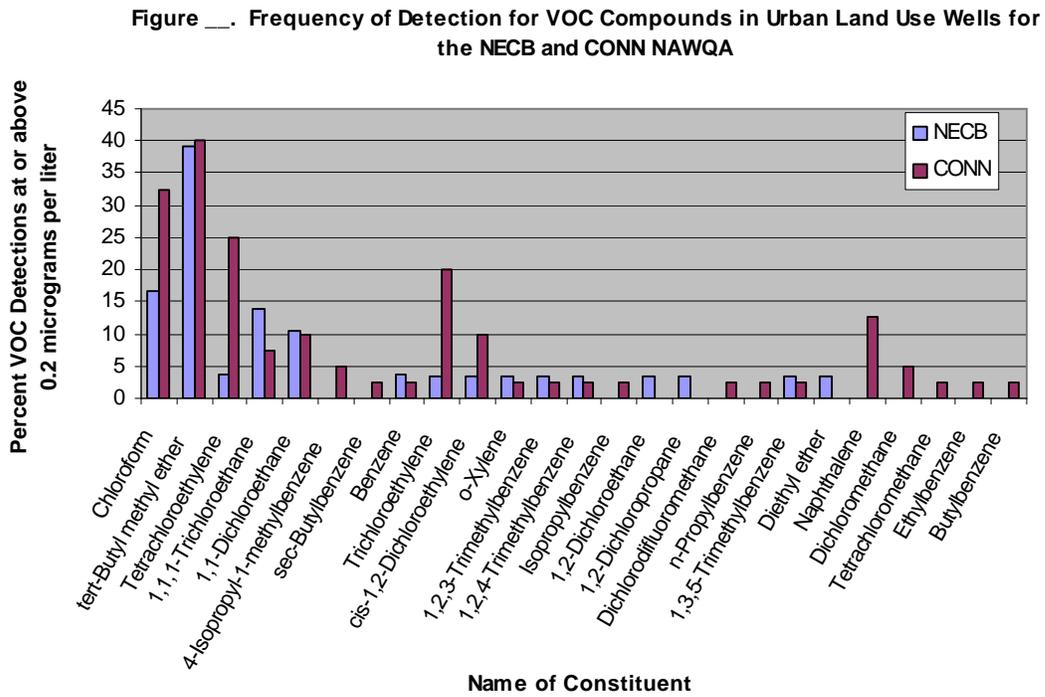


Figure 4 - Pesticides detections in the NECB urban land-use study wells

Figure 5 - Nutrient Concentrations in the NECB urban land-use wells

