The Woburn Toxics Case

A Civil Action

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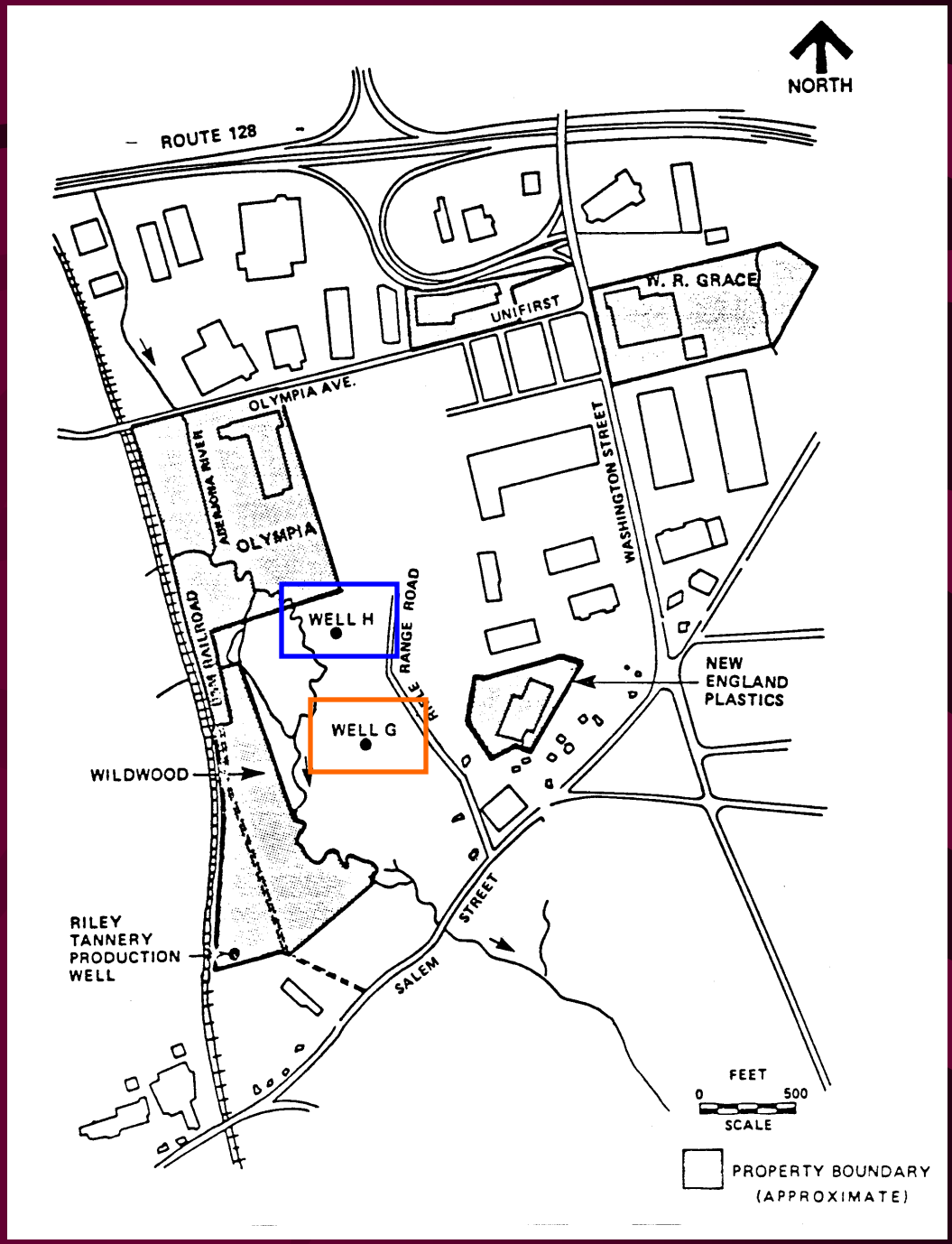
The Woburn toxics case

- In May 1982 a lawsuit was filed on behalf of eight Woburn families by Jan Schlichtmann.
- The suit alleged that serious health effects (childhood leukemia, cardiac arrhythmias, disorders of the immune and neurological systems) were caused by exposure to contaminated water from public supply wells G & H.
- The suit named W. R. Grace, Beatrice Foods, and subsequently UniFirst Corporation as the polluters.

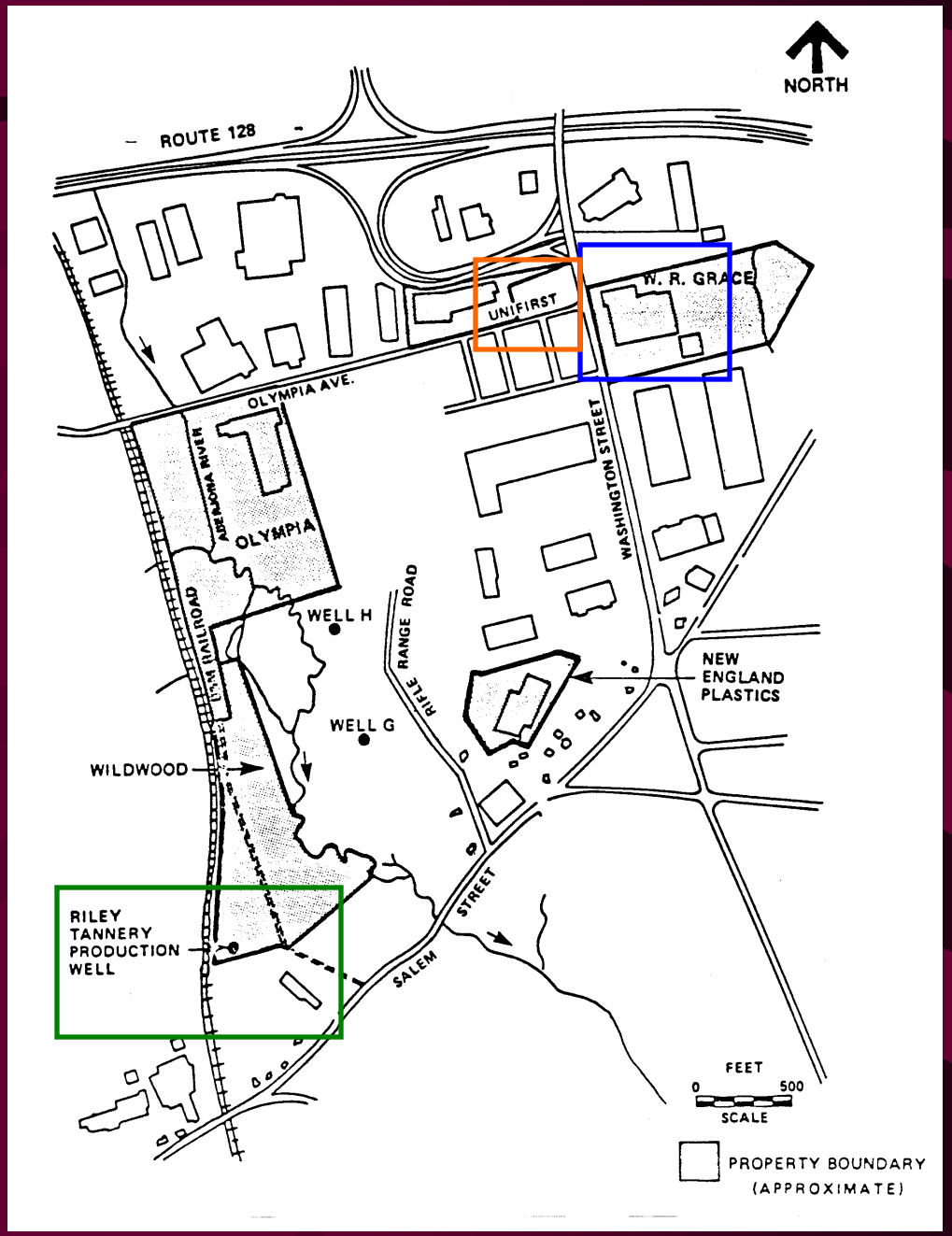
History of the wells

- G was drilled in 1964
- H was drilled in 1966
- Residents complained the water smelled and tasted bad, but no significant contamination was found.
- In May 1979 DEQE (now DEP) found several chlorinated compounds in the wells (TCE & PCE).
- Both wells were closed May 22, 1979



Three defendants were named in the lawsuit

- W. R. Grace
- Beatrice Food Company
- UniFirst Corporation (UniFirst settled for $1.05 million before the trial began)

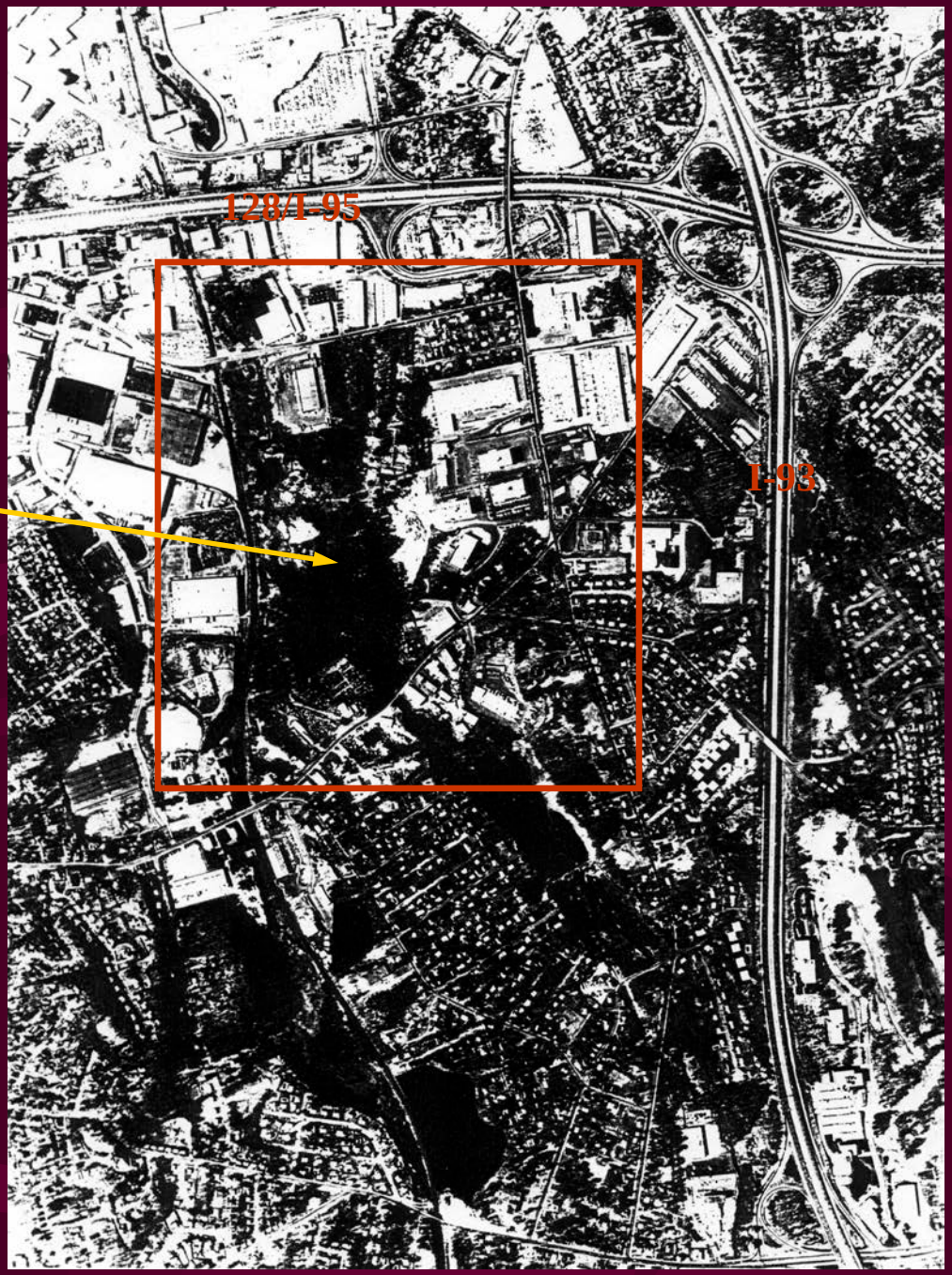


Business Activities of the three defendants

- W. R. Grace (Cryovac plant) manufactured equipment for the food-packaging industry. Solvents were used to clean and cool tools, degreasing, and paint thinner.
- Beatrice Foods Company purchased the Riley Tannery in 1978 and sold it back to Riley in 1983. It was alleged that activities at the cannery and dumping of chemicals on an adjacent undeveloped 15 acre tract had contaminated the groundwater.
- UniFirst Corporation operated an industrial dry-cleaning business and used PCE in its business.

Two EPA superfund sites are located in Woburn. One north of I-95 and the other the Civil Action site. Woburn's athletic teams are called the tanners.

Civil Action site



The trial started in 1986. US District Court Judge Walter Jay Skinner presided. He divided the trial into three phases. At each stage the jury had to rule in favor of the plaintiffs in order for the trial to proceed to the next phase. The first phase of the trial ran 78 days.

- The plaintiffs would attempt to show that wells G and H had become contaminated as a result of actions by Grace and Beatrice, and that the contamination had occurred before the wells were closed in 1979
- The plaintiffs would attempt to show that exposure to contaminated well water resulted in the leukemia cases and the other illnesses alleged in the lawsuit
- Setting of damages

The Key Players

For the defense:

Lawyers - Jerome Facher (Beatrice) and Michael Keating (Grace)

Technical expert - Jack Guzwa (GeoTrans, Inc.)

For the plantiffs:

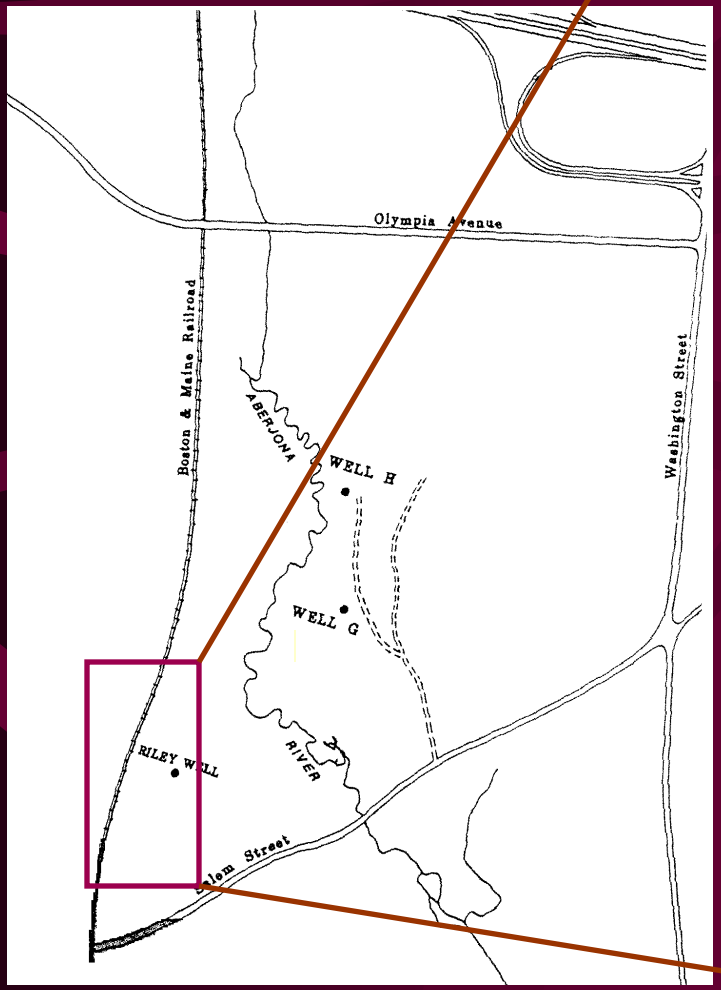
Lawyers - Jan Schlichtmann and Charles Nesson

Technical experts -

John Drobinski (Weston Geophysical)

George Pinder (Princeton, Chair Civil Engineering Department)

Drobinski - barrels on Beatrice site. Contaminants found in groundwater and soils under debris pile.



The “Great Debate” and the USGS pump test (December 1985-January 1986)

Pinder:

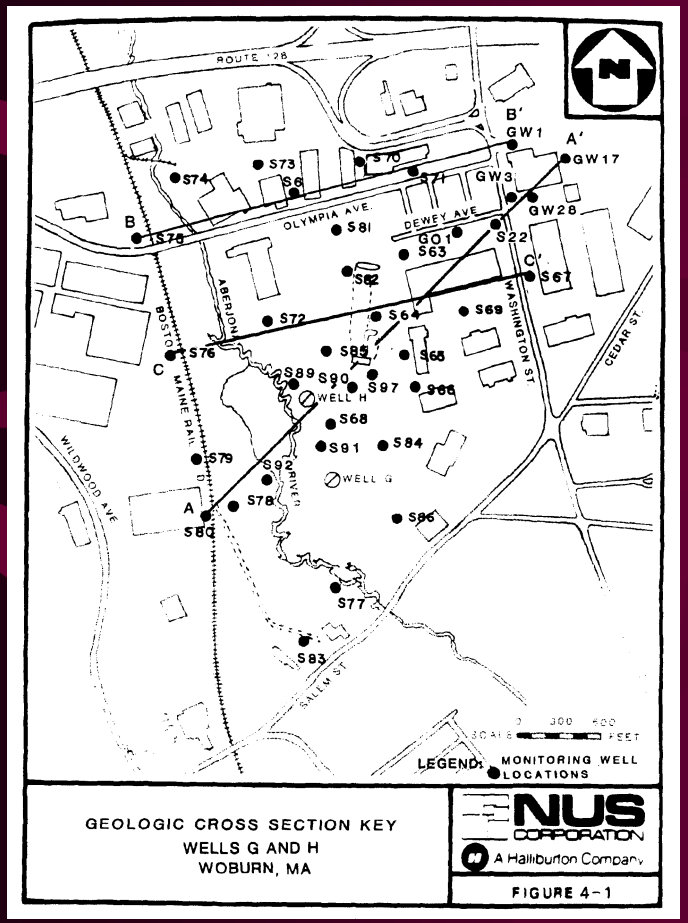
- TCE in groundwater from the Beatrice site would get to the wells in 6 months.
- TCE in groundwater from the Grace site would get to the wells in 3 years.
- The Aberjona River was not a source of water for the wells

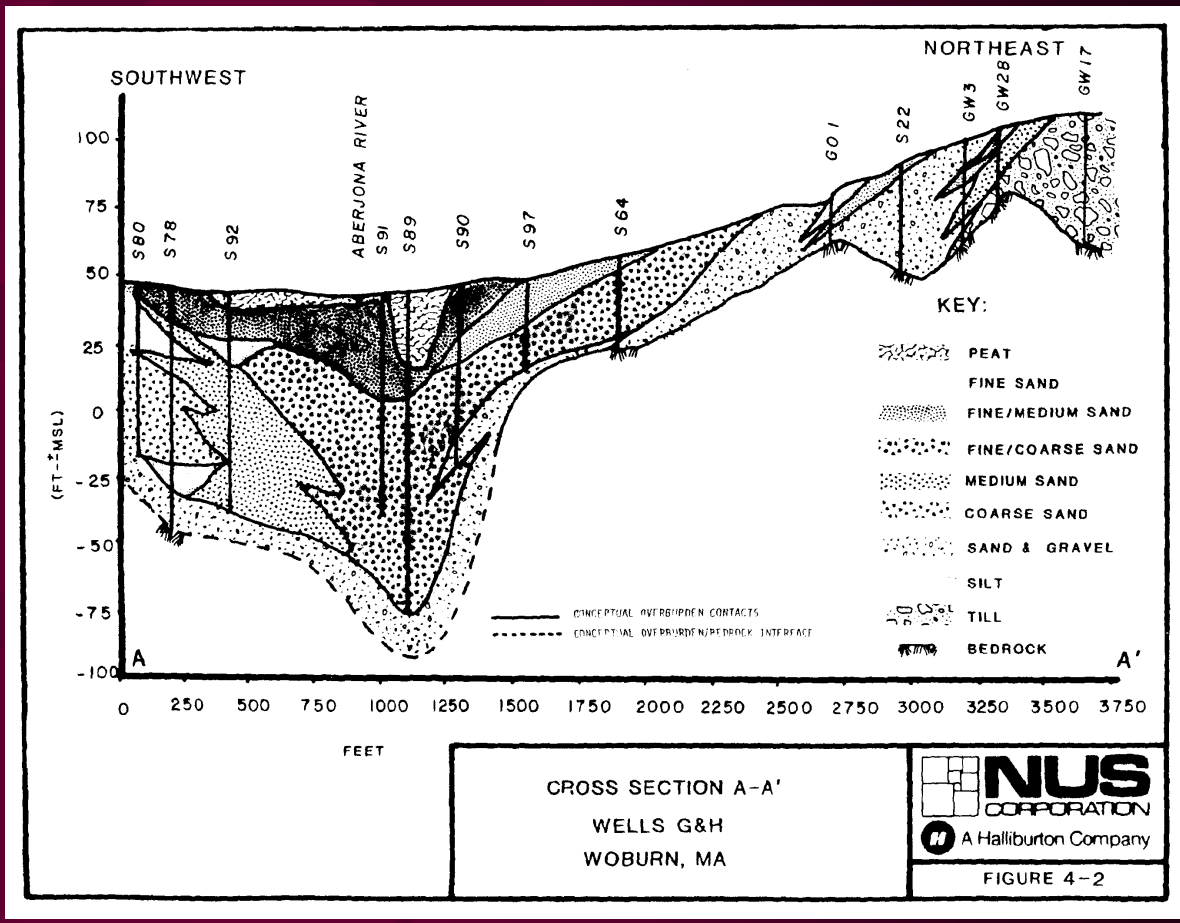
Guswa:

- TCE dumped on the Grace site would not reach the wells by the time they were closed in 1979. This was due to low hydraulic conductivity.
- The Aberjona River was a major source of water to the wells.

Geologic Cross-section A-A’

Gravel-filled glacial valley. Common aquifer type in Massachusetts. The gravel and sands have high permeability, the tills have a very low permeability.





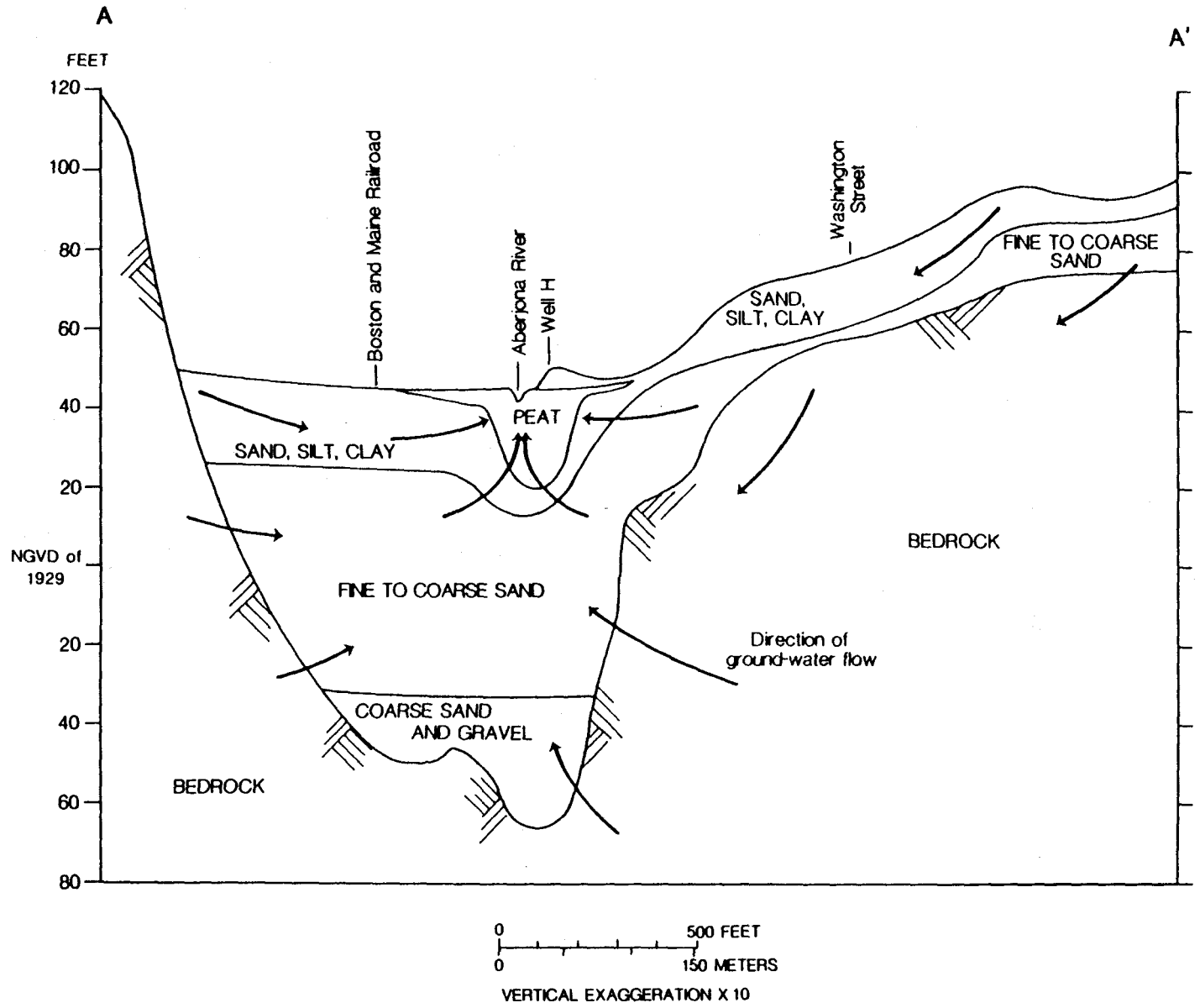


Figure 4.--Representative geologic section and generalized direction of ground-water flow along section A-A'.

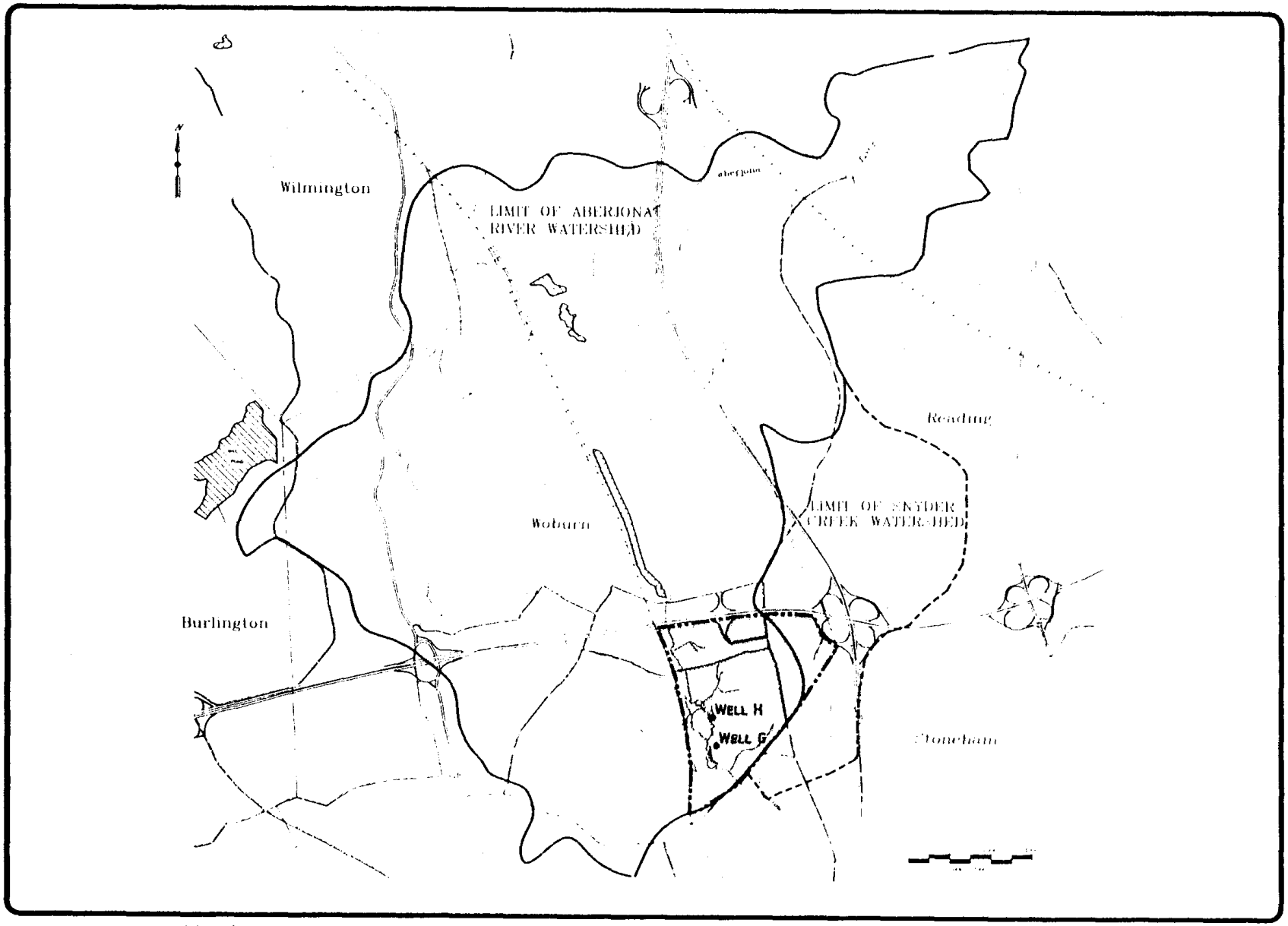


Fig. 3. Aberjona River watershed boundary.

U. S. Geological Survey pump test - Dec 1985 - Jan 1986

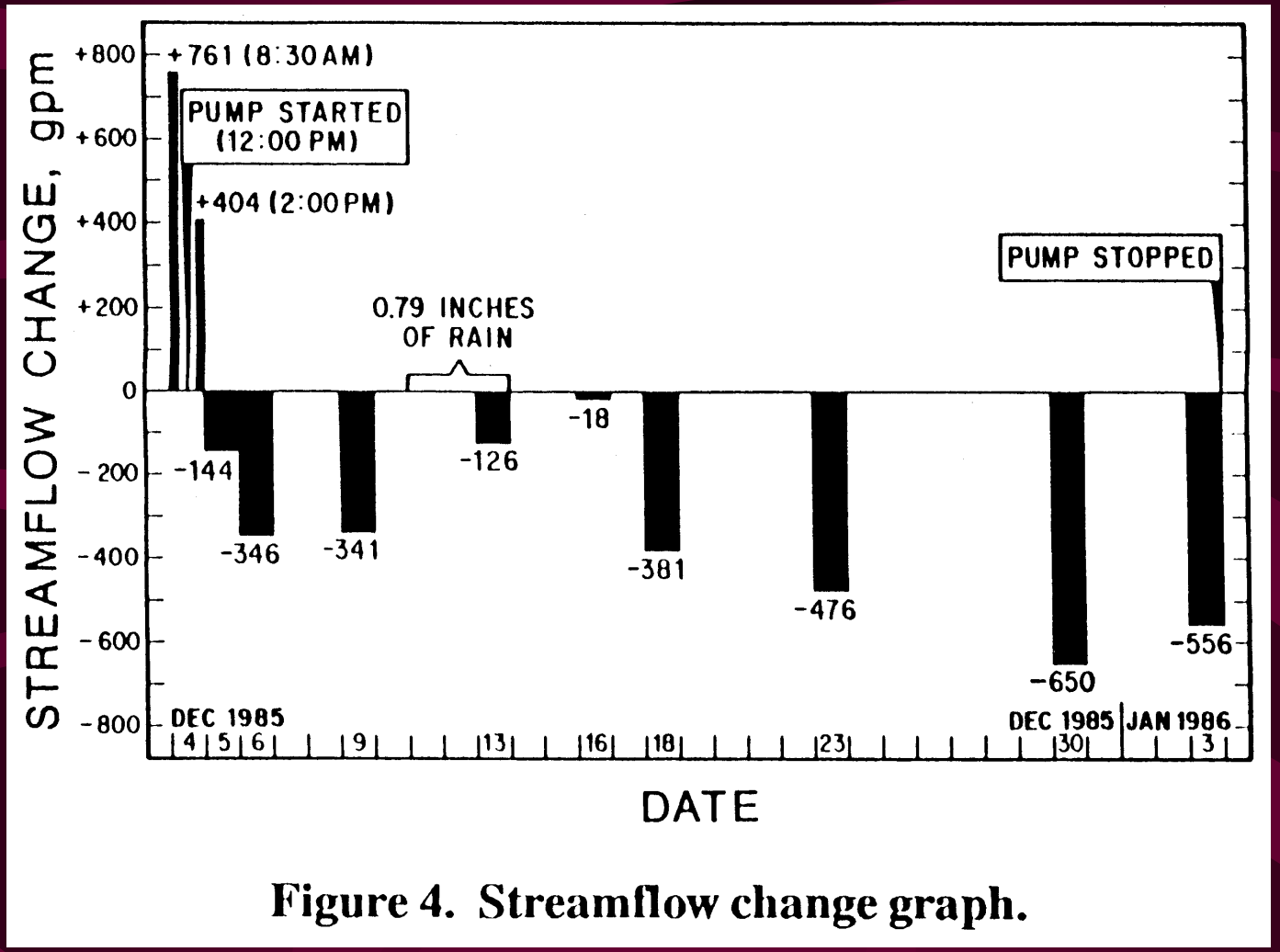


Figure 4. Streamflow change graph.

Pumped water from wells G & H. Graph measures difference between stream flow at upstream end of study area and the stream flow exiting the study area. Net decrease in stream flow.

Groundwater table prior to pump test. Note that water flows towards the SW corner of the site. Riley well downgradient

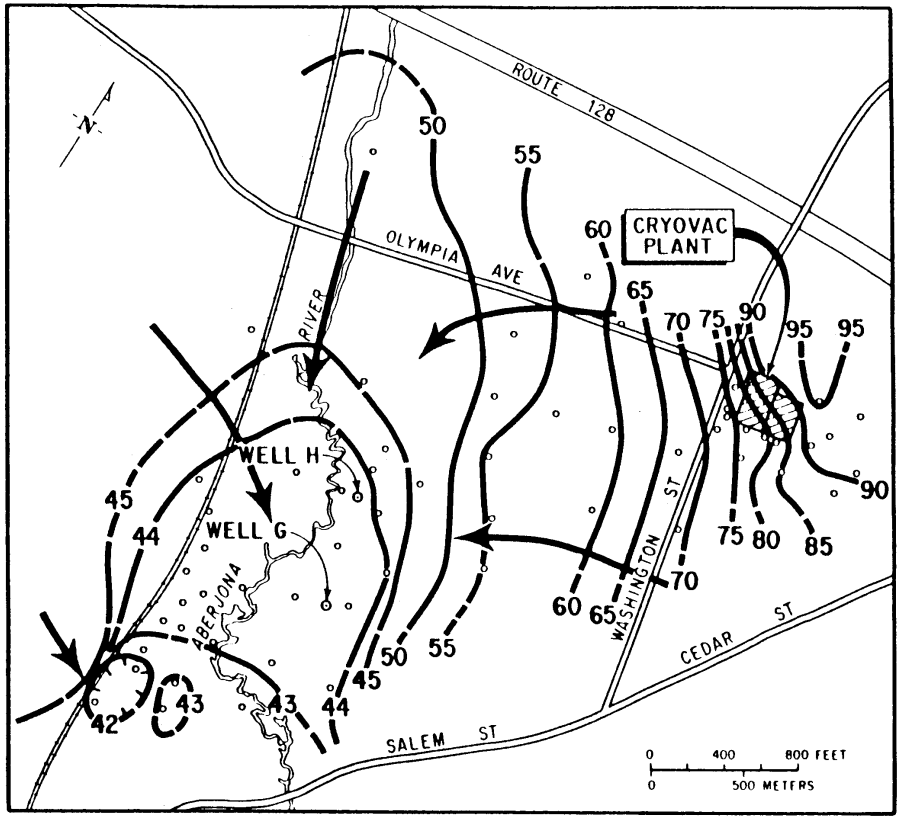


Figure 2. December 1985 water level map (ft above msl).

Groundwater table after pump test. Note cones-of-depression around wells and direction of groundwater flow. The USGS estimated that 40% of the well water came from the Aberjona.

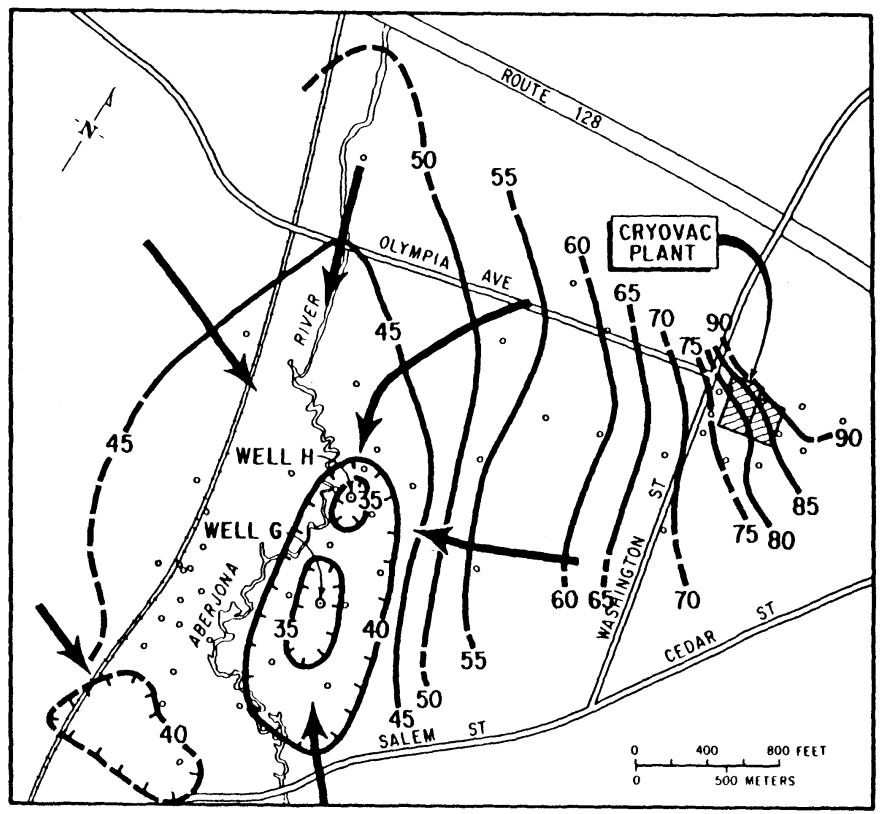
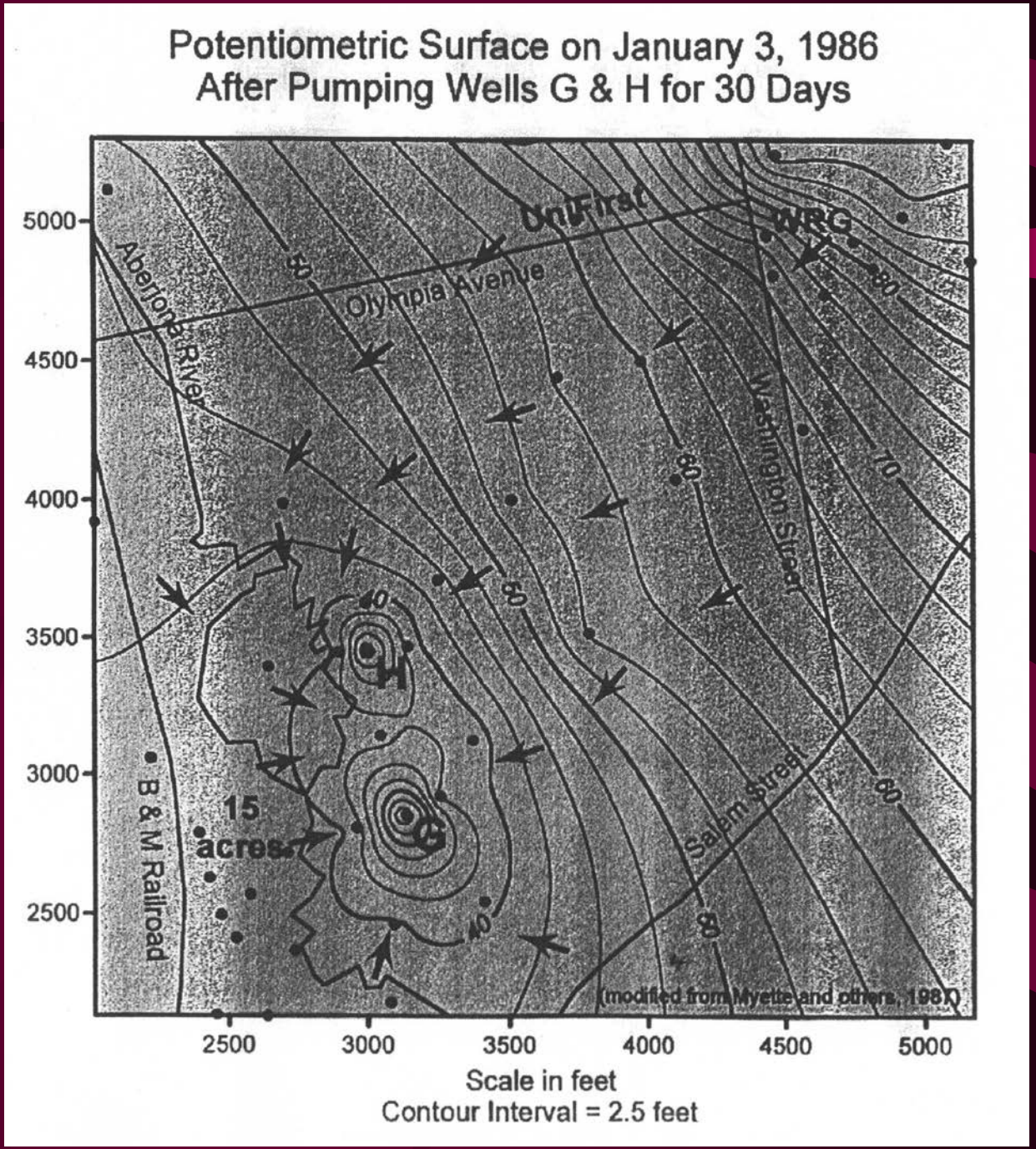


Figure 3. January 1986 water level map (ft above msl).

Note the direction of groundwater flow. It is towards wells G & H from all directions, including the Riley Tannery property. Groundwater flows under the Aberjona River to the wells. Hence, the Riley Tannery is a potential source of the contaminants.



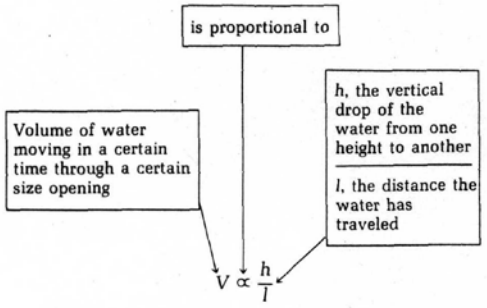
Nesson's Epiphany

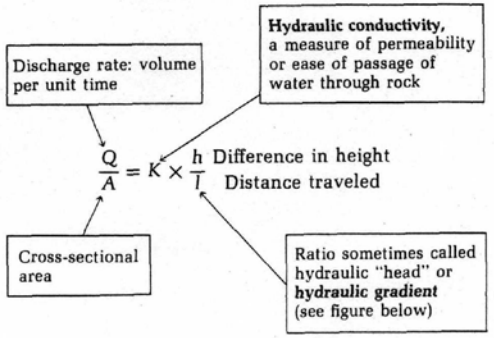
Or why you shouldn't let a Harvard Law professor loose.

Using Darcy's Law Nesson concluded that Guzwa's analysis must be wrong, otherwise there would be a 6 foot wall of water coming down the valley, a complete misunderstanding of Darcy's Law. A little tweaking of the hydraulic conductivity solves the problem.

Box 6–1 Darcy's Law of Groundwater Motion

The law formulated by Darcy is given in terms of the volume of water moving through any opening in a given amount of time, essentially a velocity term, and the geometry of the general flow, or the ratio of the vertical to the horizontal distance.

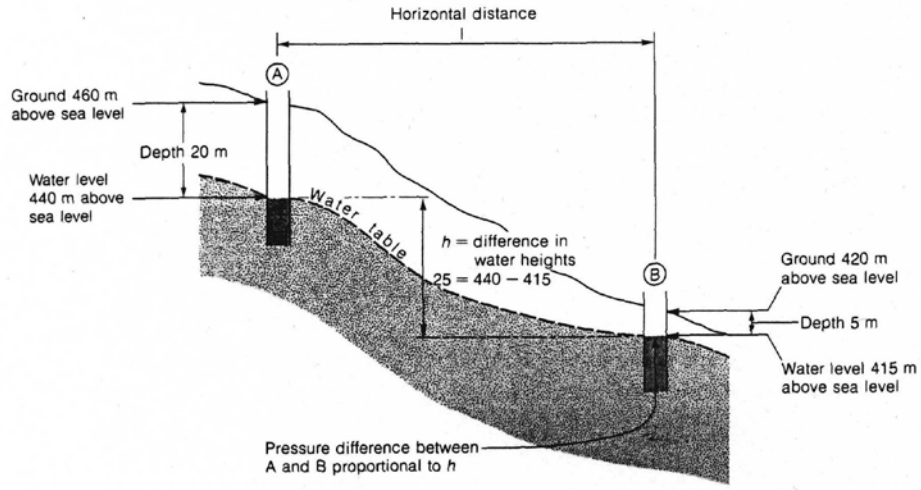




equation by multiplying the right-hand side by a proportionality factor, K. Darcy identified K as a measure of the permeability of the rock, or in other words, how easily it transmits water.

Darcy reasoned that the permeability of a rock is what slows down the flow for a given drop of height *h* in a certain distance *l*. So he made this proportion into an

From this equation, we can either determine the velocity of flow or, knowing the velocity, the hydraulic conductivity.



Darcy's Law

What can we conclude from the hydrologic studies?

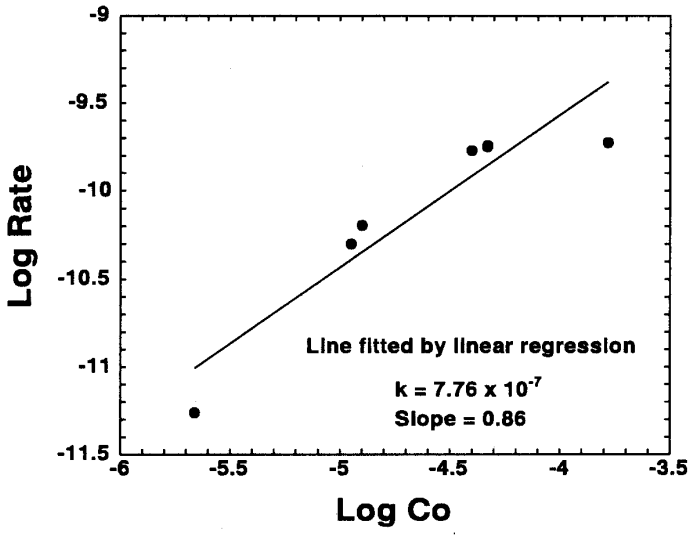
- When the wells were operating, the Aberjona River was a significant water source (40%). Contaminants could have come from the river, but TCE and PCE were not found in the river water or sediments.
- When the wells were operating groundwater flowed to the wells from all directions, including under the river from the Riley tannery.
- Due to the low hydraulic conductivity of glacial till, groundwater flow in the immediate vicinity of the Grace site would be slow, but we do know, based on testimony, that TCE's were definitely dumped at the Grace site.

Breakdown of TCE

An Environmental Geochemistry problem

An experimental study on the breakdown of TCE: In aerobic (oxygen-rich) groundwater, TCE decomposes relatively rapidly. In 4 years approximately 98% of the TCE would decompose. Given groundwater flow velocities from the Grace site, TCE would probably decompose before reaching the wells

BREAKDOWN OF TCE IN AEROBIC GROUND WATER



Given a slope of 0.86 this can be considered a pseudo-first order reaction.

At 5°C: $\log k = \log A - \frac{E_a}{2.303RT} = 12.80 - \frac{108.0}{(2.303)(8.314\times10^{-3})(278.15)} = -7.48$

$k = 3.32 \times 10^{-8}\ s^{-1}$

$t_{1/2} = 0.693/3.32\times10^{-8} = 20{,}877{,}927\ s =$ **242 days**

Given the 242 day half-life for the decomposition of TCE, one would expect TCE to persist in the ground water system for several years, i.e. at the end of 4 years approximately 1.5% of the amount of TCE added to the system would still be present.

Judge Skinner's Interrogatories

SPECIAL INTERROGATORIES TO THE JURY AS TO BEATRICE FOODS

1. Have the plaintiffs established by a preponderance of the evidence that any of the following chemicals were disposed of at the Beatrice site after August 27, 1968 and substantially contributed to the contamination of Wells G and H by these chemicals prior to May 22, 1979?

(a) Trichloroethylene	Yes_____	No ✓
(b) Tetrachloroethylene	Yes_____	No ✓
(c) 1,2 Transdichloroethylene	Yes_____	No ✓
(d) 1,1,1 Trichloroethane	Yes_____	No ✓

If you have answered "No" to all these chemicals, you need not proceed further.

2. If you have answered "Yes" in question 1 as to any chemical(s), what, according to the preponderance of the evidence, was the earliest time after August 27, 1968 that such chemical(s) disposed of on the Beatrice site made a substantial contribution to the contamination of Wells G and H?

	Month	Year
(a) Trichloroethylene	_____	____
(b) Tetrachloroethylene	_____	____
(c) 1,2 Transdichloroethylene	_____	____
(d) 1,1,1 Trichloroethane	_____	____

(If, on the evidence before you, you are unable to determine by a preponderance of the evidence the appropriate date, write "ND" for Not Determined.)

3. If you have answered "Yes" in question 1 as to any chemical(s), please answer the following question:
Have the plaintiffs established by a preponderance of the evidence that the substantial contribution to the contamination of Wells G and H by chemicals disposed of on the Beatrice site after August 27, 1968 was caused by negligence of Beatrice, that is, the failure of Beatrice to fulfill any duty of due care to the plaintiffs -- with respect to

(a) Trichloroethylene	Yes_____	No_____
(b) Tetrachloroethylene	Yes_____	No_____
(c) 1,2 Transdichloroethylene	Yes_____	No_____
(d) 1,1,1 Trichloroethane	Yes_____	No_____

(Only answer with respect to a chemical as to which you answered "Yes" on question 1.)

4. If you have answered "Yes" to any part of question 3, what, according to a preponderance of the evidence, was the earliest time at which the substantial contribution referred to in question 3 was caused by the negligent conduct of this defendant -- with respect to

	Month	Year
(a) Trichloroethylene	_____	____
(b) Tetrachloroethylene	_____	____
(c) 1,2 Transdichloroethylene	_____	____
(d) 1,1,1 Trichloroethane	_____	____

JUDGE SKINNER'S QUESTIONNAIRE

SPECIAL INTERROGATORIES TO THE JURY AS TO W.R. GRACE

1. Have the plaintiffs established by a preponderance of the evidence that any of the following chemicals were disposed at the Grace site after October 1, 1964 and substantially contributed to the contamination of Wells G and H by these chemicals prior to May 22, 1979?

(a) Trichloroethylene	Yes ✓	No_____
(b) Tetrachloroethylene	Yes ✓	No_____
(c) 1,2 Transdichloroethylene	Yes_____	No ✓

If you answered "No" to all these chemicals, you need not proceed further.

2. If you have answered "Yes" in question 1 as to any chemical(s), what, according to the preponderance of the evidence, was the earliest time that such chemical(s) disposed of on the Grace site after October 1, 1964 made a substantial contribution to the contamination of Wells G and H?

	Month	Year
(a) Trichloroethylene	ND	____
(b) Tetrachloroethylene	ND	____
(c) 1,2 Transdichloroethylene	_____	____

(If, on the evidence before you, you are unable to determine by a preponderance of the evidence the appropriate date, write "ND" for Not Determined.)

3. If you have answered "Yes" in question 1 as to any chemical(s), please answer the following question:
Have the plaintiffs established by a preponderance of the evidence that the substantial contribution to the contamination of Wells G and H by chemicals disposed of on the Grace site after October 1, 1964 was caused by negligence of Grace, that is, the failure of Grace to fulfill any duty of due care to the plaintiffs -- with respect to

(a) Trichloroethylene	Yes ✓	No_____
(b) Tetrachloroethylene	Yes ✓	No_____
(c) 1,2 Transdichloroethylene	Yes_____	No_____

(Only answer with respect to a chemical as to which you answered "Yes" on question 1.)

4. If you have answered "Yes" to any part of question 3, what, according to a preponderance of the evidence, was the earliest time at which the substantial contribution referred to in question 3 was caused by the negligent conduct of this defendant -- with respect to

	Month	Year
(a) Trichloroethylene	SEPT.	1973
(b) Tetrachloroethylene	ND	____
(c) 1,2 Transdichloroethylene	_____	____

The EPA - Analysis and Cleanup

Property Owners Responsible for the Contamination

- W. R. Grace
- UniFirst Corporation
- New England Plastics
- Olympia Nominee Trust
- Wildwood Conservation Trust (Beatrice Foods)

Types of Contamination:

- Groundwater contaminated with VOCs (minor BTEX compounds)
- Sediments in the Aberjona River contaminated with PAHs and heavy metals (Cr, Zn, Hg, As)
- Soils contaminated with PAHs, PCBs, VOCs, and Pb.

Remediation:

- VOC contaminated soil cleaned by air injection and vacuum extraction. One set of wells injects the air into the ground to bubble contaminants to the surface and a second set of wells pulls contaminants to the surface with a vacuum. A cap covers the entire area to trap gases at the surface.
- PCB, PAH, and pesticide contaminated soil excavated and incinerated.
- Groundwater pumped and treated at separate treatment plants. UV light and H_2O_2 used to destroy contaminants.