A Short History of Nutrient and Microbial trends in Ground Water in the Gallatin Valley -- Implications

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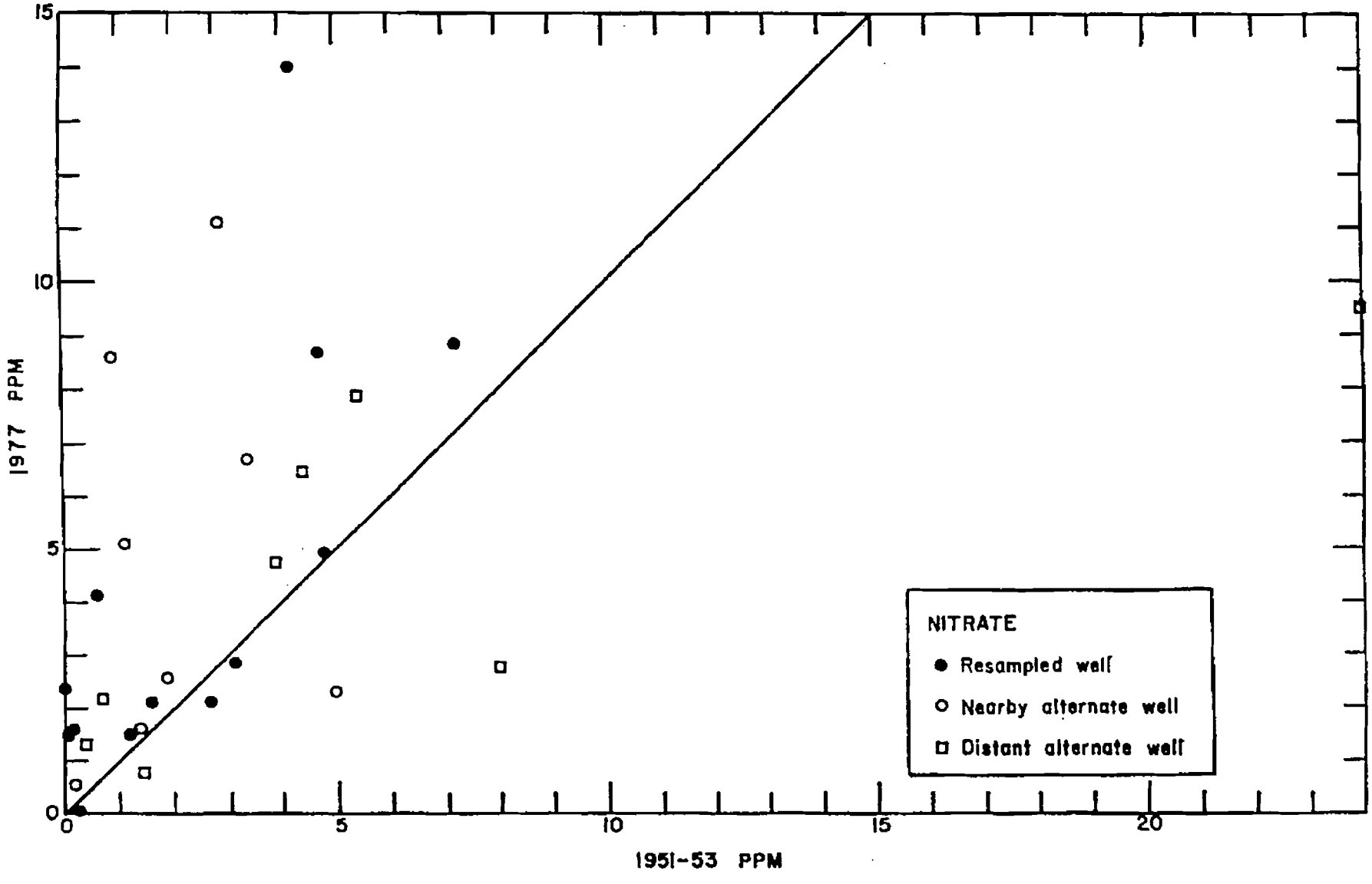
WATER POLICY INTERIM COMM.
AUGUST 16-17, 2007
EXHIBIT 11

Remember

U.S. EPA Standard for
Nitrate-Nitrogen is
10 mg/l

Dunn 1978 Follows Hackett et al. 1960



- Slagle 1991
- Most <3
- One 17 (higher than 10)

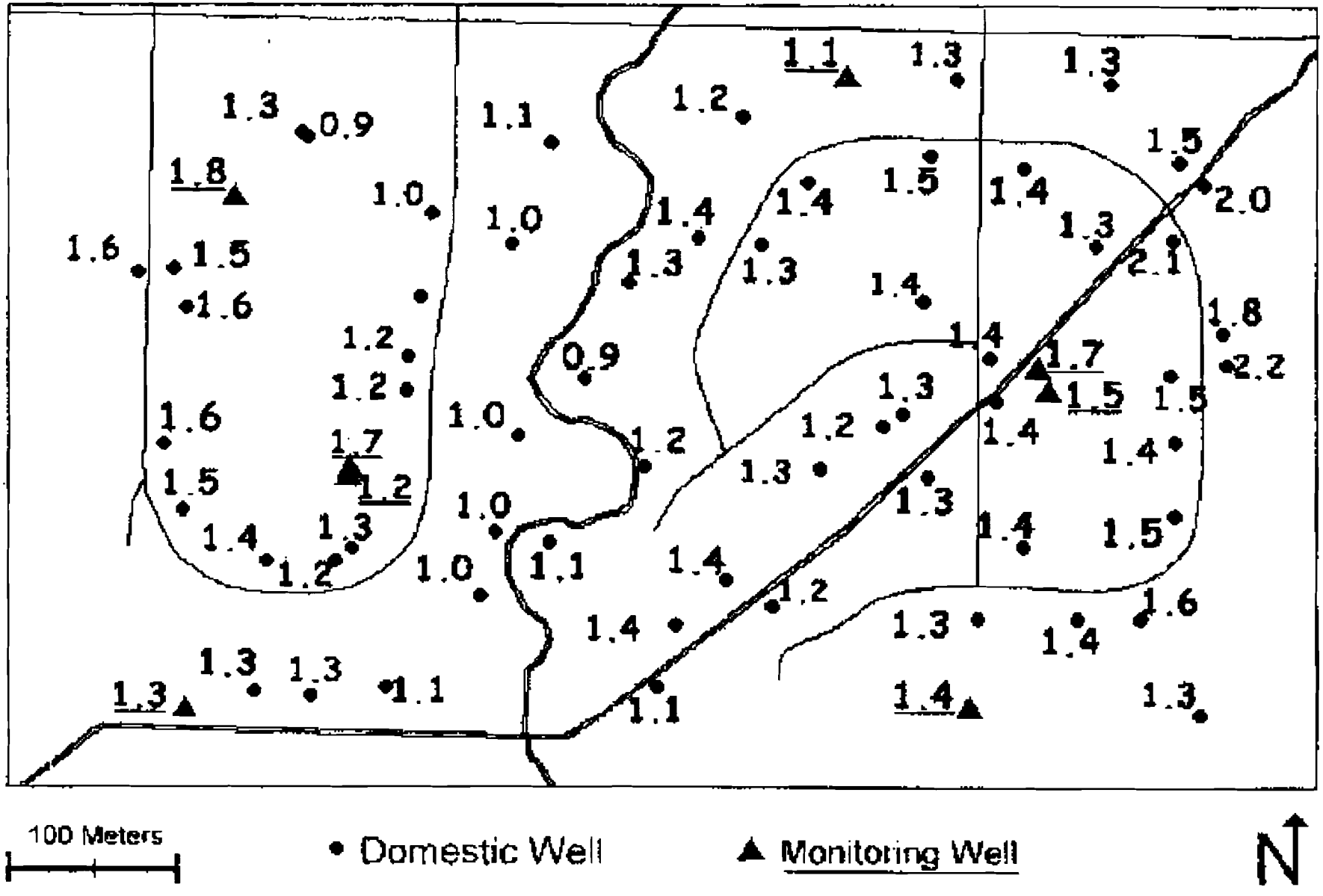
LOCAL NUMBER	DEPTH OF WELL (FEET)	DATE QUALITY PARAMETER MEASURED	NITRATE, FIELD (MG/L) (99900)
01N02E22BADD01	79	05-28-91	.7
01N04E17BAAA01	28	06-11-92	.6
01N04E18DBCC01	33	07-15-92	.9
01N04E28ABBB01	44	07-14-92	1.5
01N04E28ABBD01	10	07-14-92	.9
01N04E31CAAA01	--	06-18-92	.3
01N05E02AAAC01	78	07-22-92	.9
01N05E04DDAD02	68	07-17-92	1.3
01N05E14ACDD01	109	07-31-92	1.0
01N05E20DBAA01	33	07-15-92	1.6
01N05E28DCAD01	40	07-08-92	2.7
01N05E35ADBB01	81	07-22-92	3.1
01N06E30BCBB01	154	07-16-92	3.5
01S02E03DCCC02	404	05-28-91	5.1
01S02E22BCBC01	140	05-28-91	17.2
01S04E10DDDD01	107	07-30-92	.8
01S04E25ADDD01	34	07-29-92	1.0
01S04E26CDDD01	37	07-30-92	.6
01S05E05CCBB01	47	07-23-92	1.4
01S05E09ACCC01	28	07-09-92	1.8
01S05E12BCCC02	120	07-09-92	3.9
01S05E17CCDC01	42	07-31-92	1.0
01S05E22AADD01	52	07-23-92	2.8
01S05E24CACD01	37	07-28-92	4.5
01S05E27CBDC01	109	08-06-92	1.6
01S05E35CAAB01	67	08-18-92	3.3
01S06E06ABCB01	375	07-16-92	.3
02N04E35BDCC01	62	08-14-92	.8
02N05E18ABBB01	48	08-05-92	2.1
02N05E22DDAD01	110	07-31-92	.1
02N05E31DAAA01	--	08-04-92	.5
02N05E31DAAA02	110	08-04-92	.8
02S03E19ACBC01	45	05-28-91	2.4
02S03E19BDAB01	80	05-28-91	2.4

Bauder, 1993 (1989-1990)
Maybe summer fallow he suggests

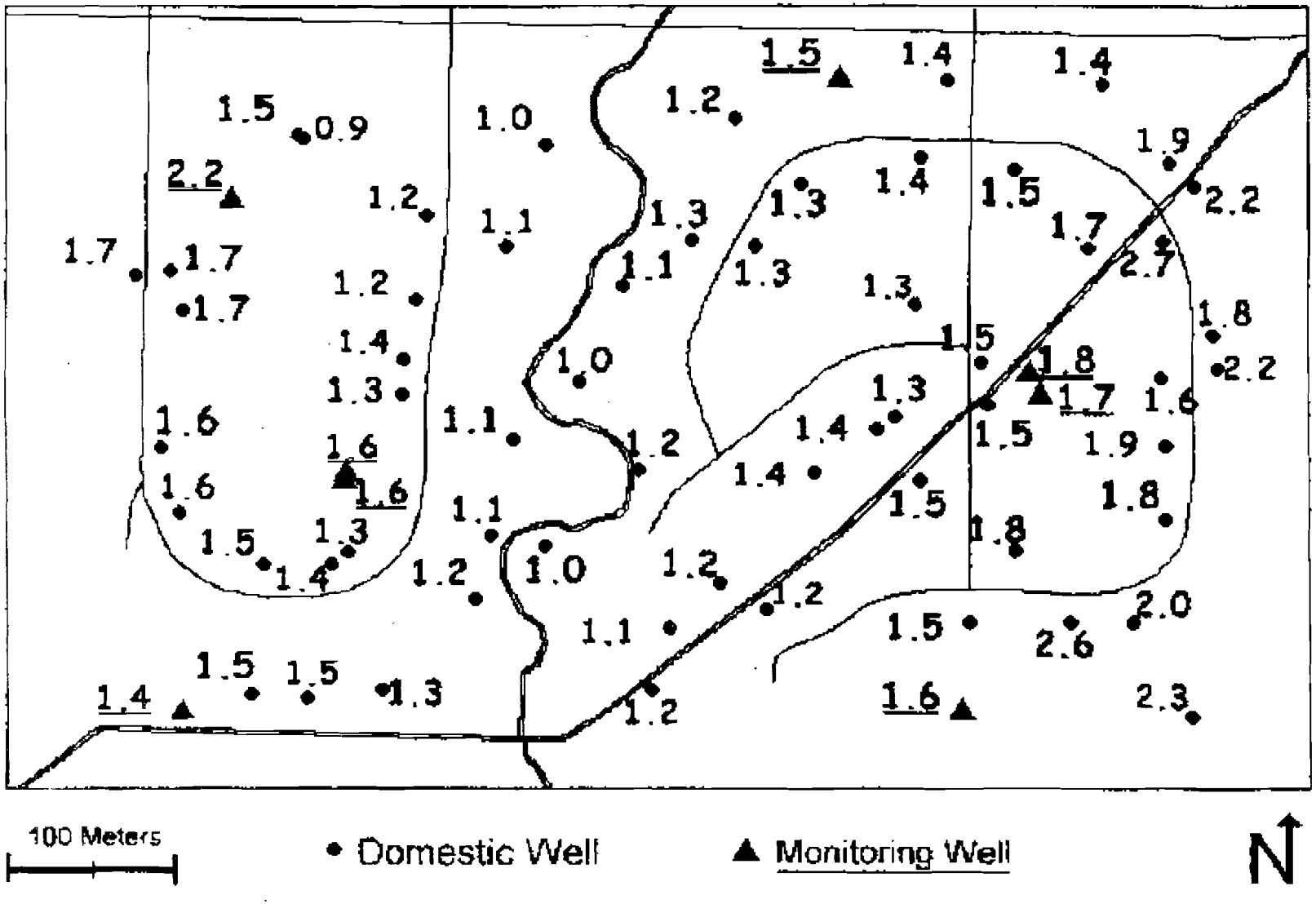
Month		Jun	May	Nov	Dec
Value		2.3	2.1	1.1	1.3
Number of Samples	23	57	29	65	

Of 175 Samples, Mean = 1.7
41 samples had nitrate-N less than 1 mg/l
33 samples had nitrate-N 1-2 mg/l
19 samples had nitrate-N 2-5 mg/l
5 samples had nitrate-N 5-10 mg/l
2 samples had nitrate-N 10-20 mg/l

Flemming Nitrate Low Water

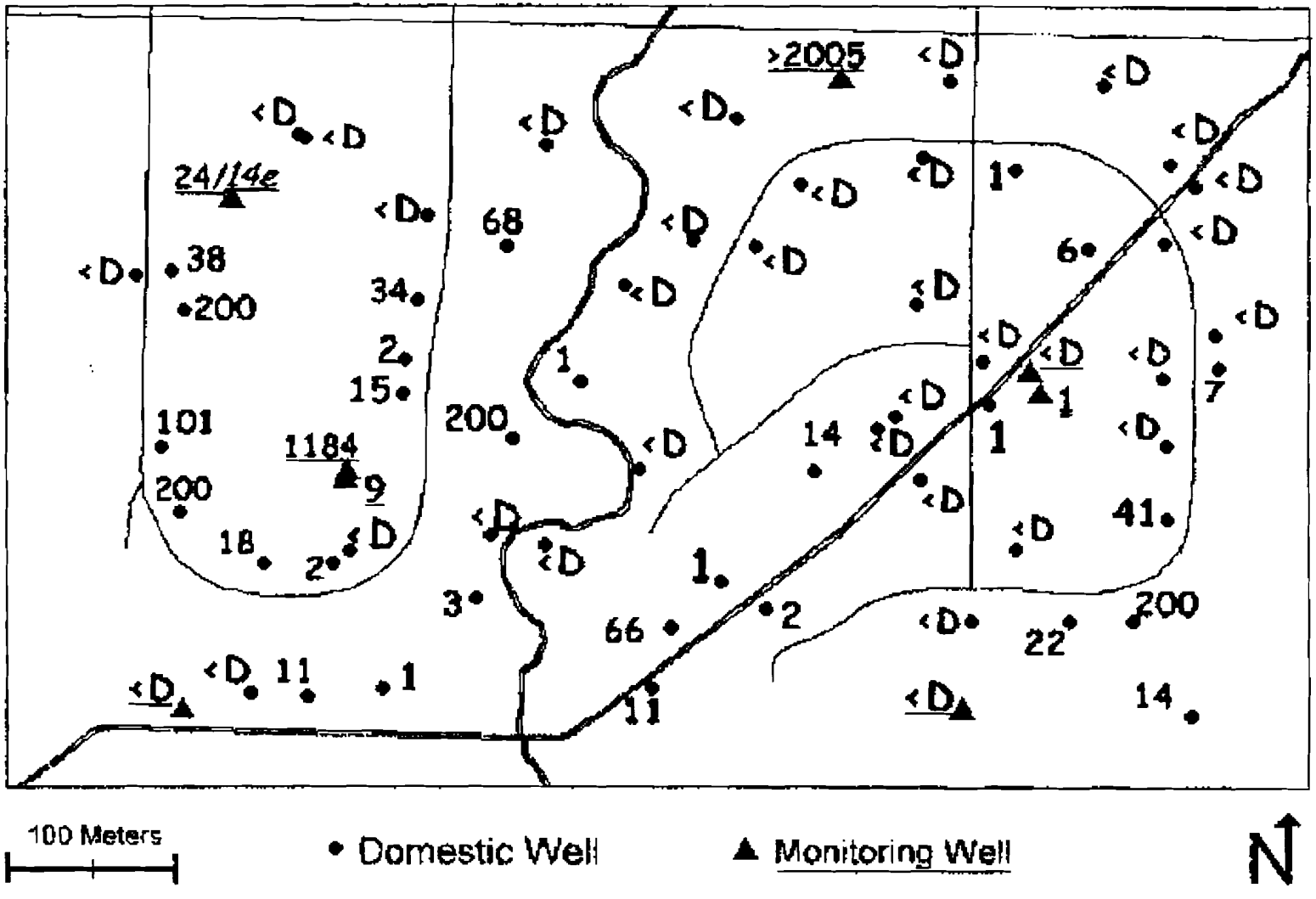


Flemming Nitrate High Water



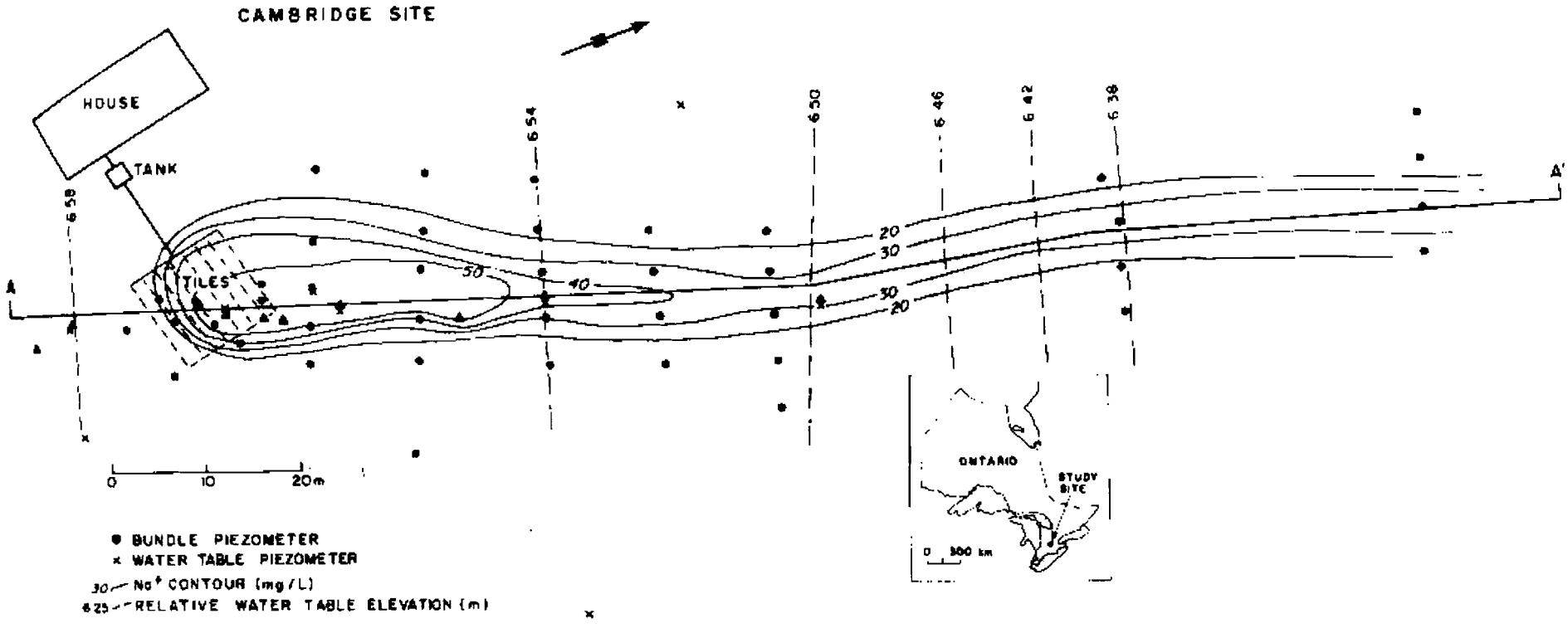
a) high water concentrations (July-August, 1999 and 2000)

Flemming Coliform High Water

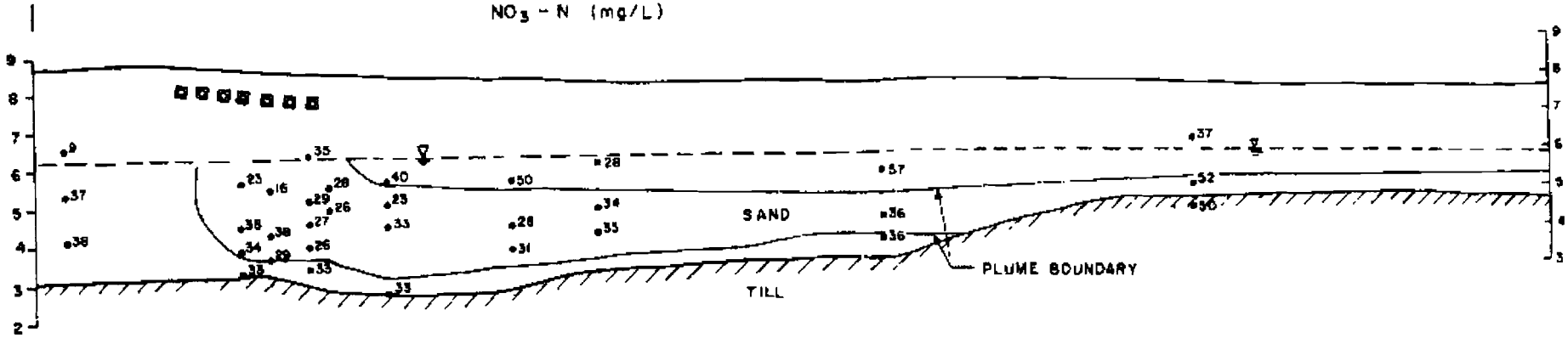


a) high water numbers (italics 14e represent the only *E. coli* detection number) (July-August, 1999 and 2000)

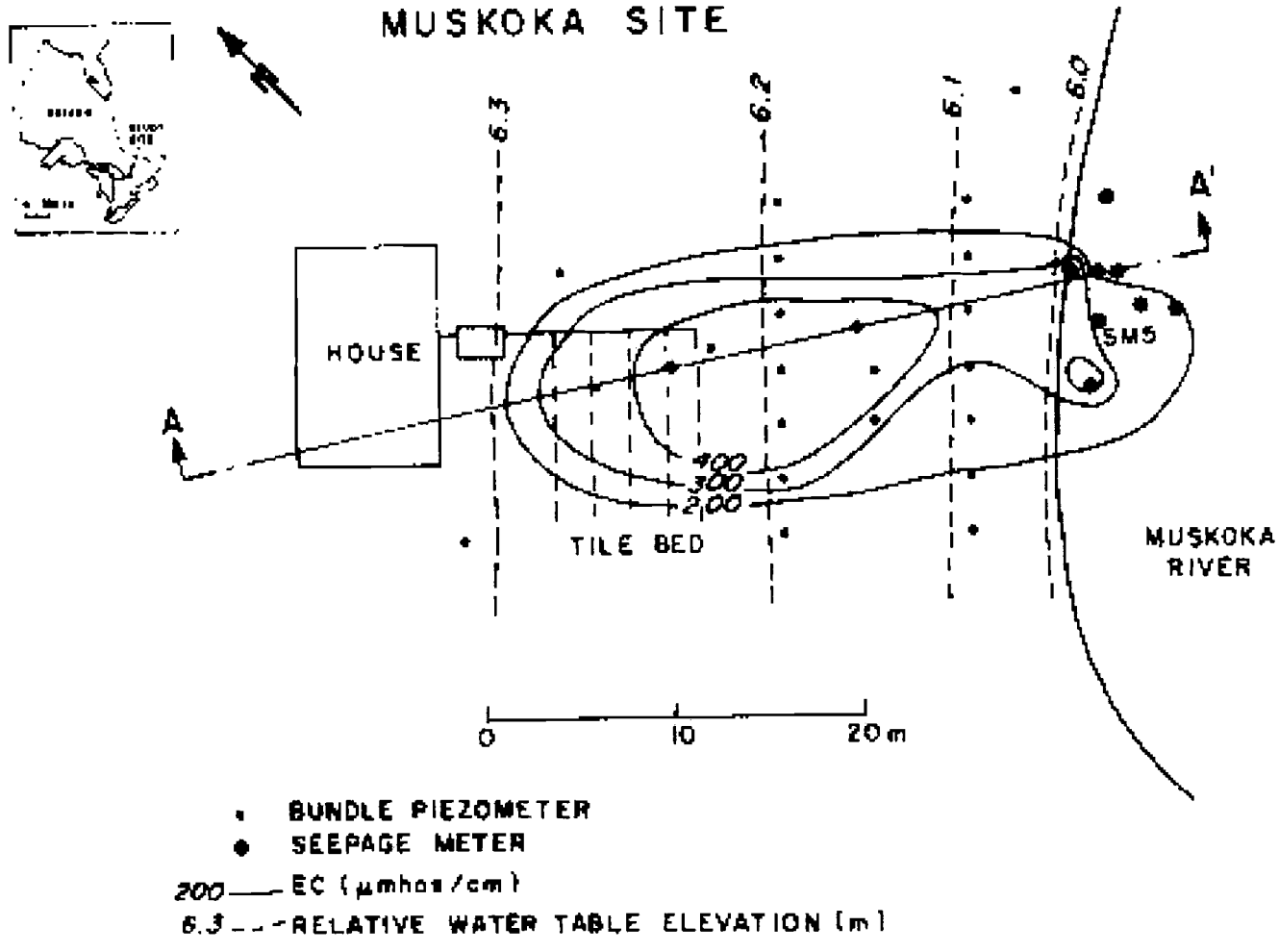
Cambridge, Ontario – Sodium Map View



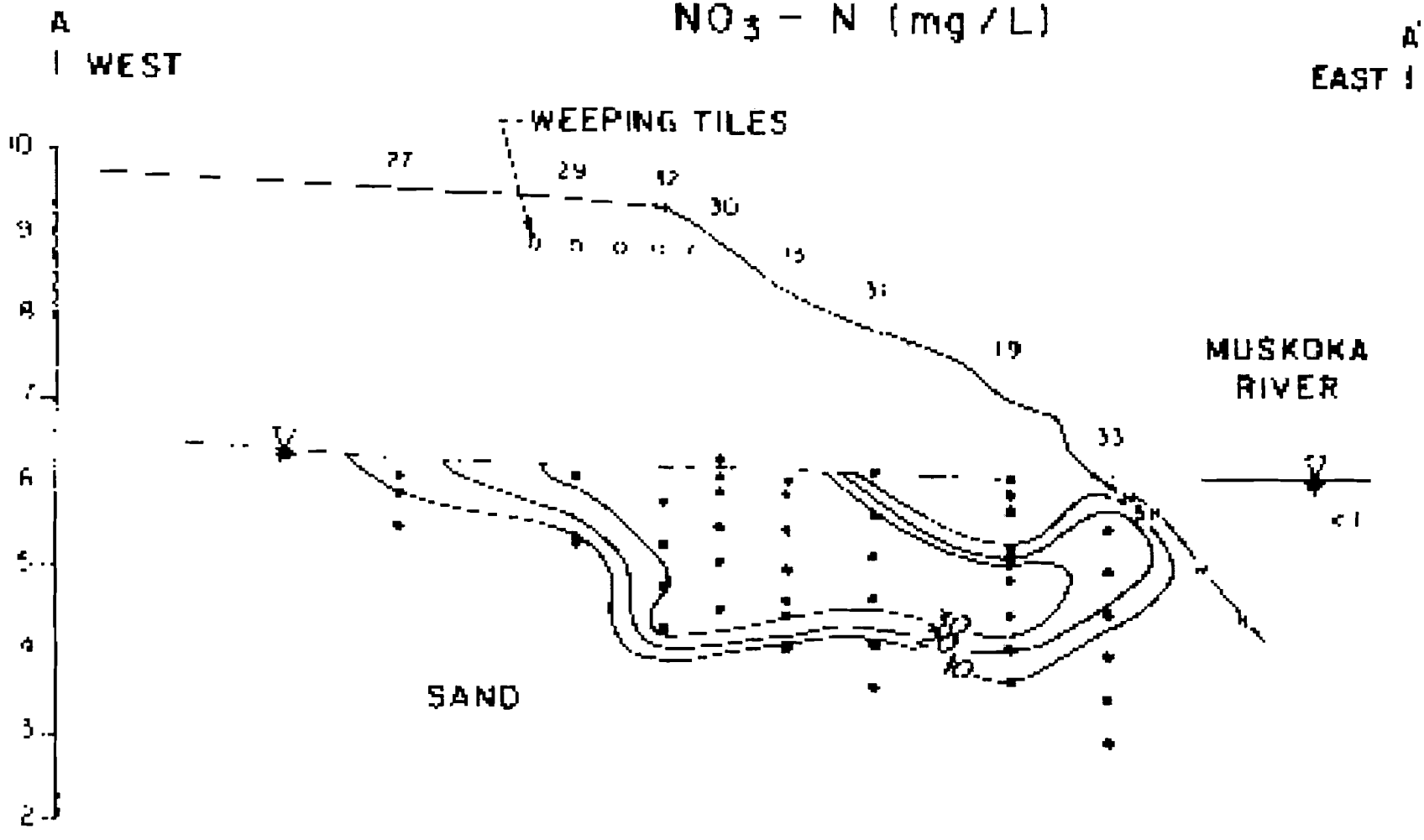
Cambridge, Ontario Nitrate-N (Subsurface Cross Section)



Map of Muskoka, Ontario EC Note linkage to the river



Cross Section of Muskoka, Ontario Ground-Water-Surface-Water Interaction Nitrate



Flemming Nitrate Isotopes

GS=domestic GW=Monitor MC=domestic MW=Monitor

- Middle Creek +4.5-+5.7 Five Samples
- Gardiner Park Sourdough +1.1-+2.5
  - Animal >+9 or 10
  - Septic waste +7 to +15
  - Soil Organic Matter +4 to +9
  - Fertilizer -3 to +6
  - Atmosphere +4.5 to +5.9
  - Precipitation -7 to +2.5
  - Black Shale (not in this area) +3.5 to +9

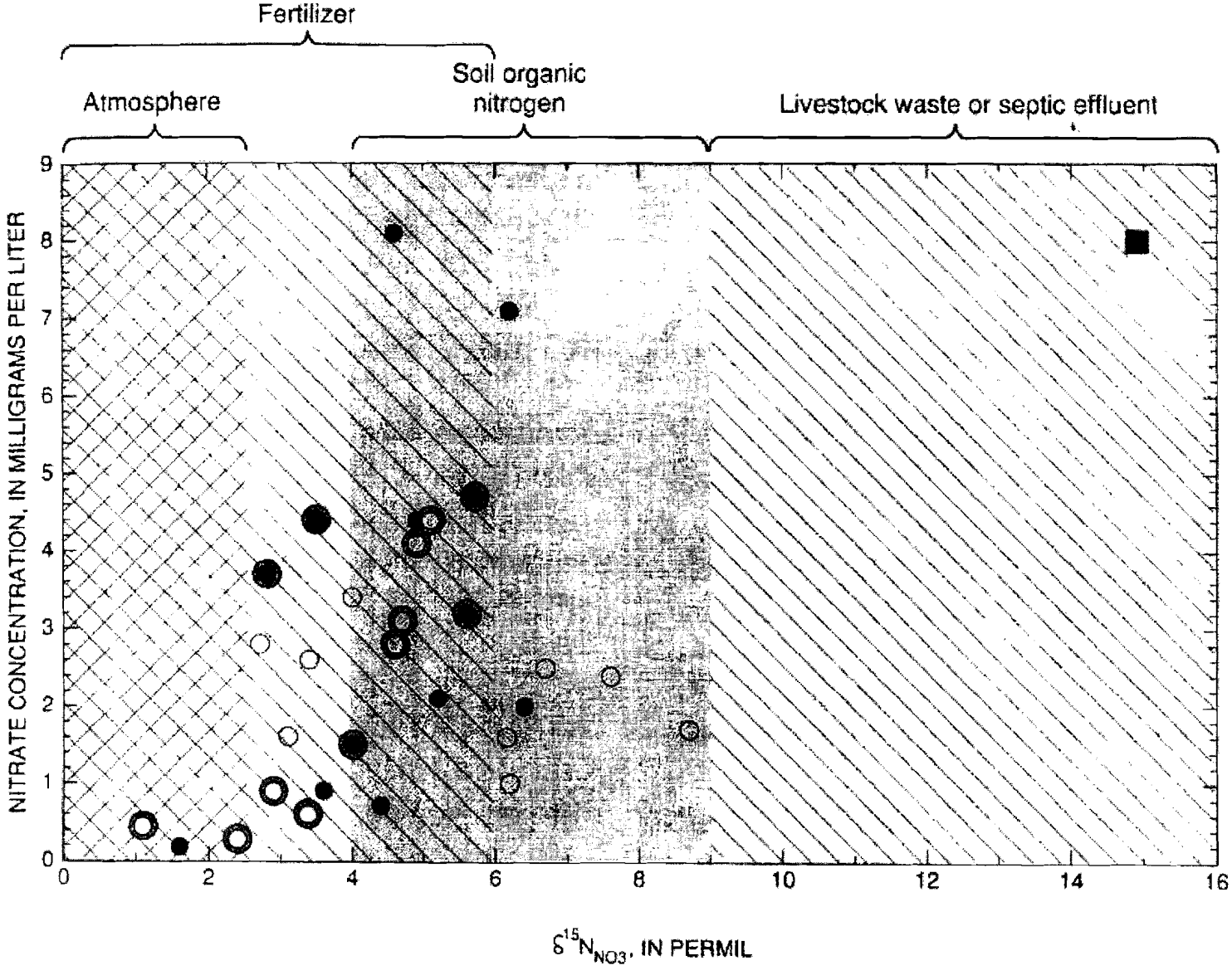
Kendy U.S.G.S. WRI 014307

A study of contamination from septic systems in the Gallatin Local Water Quality District

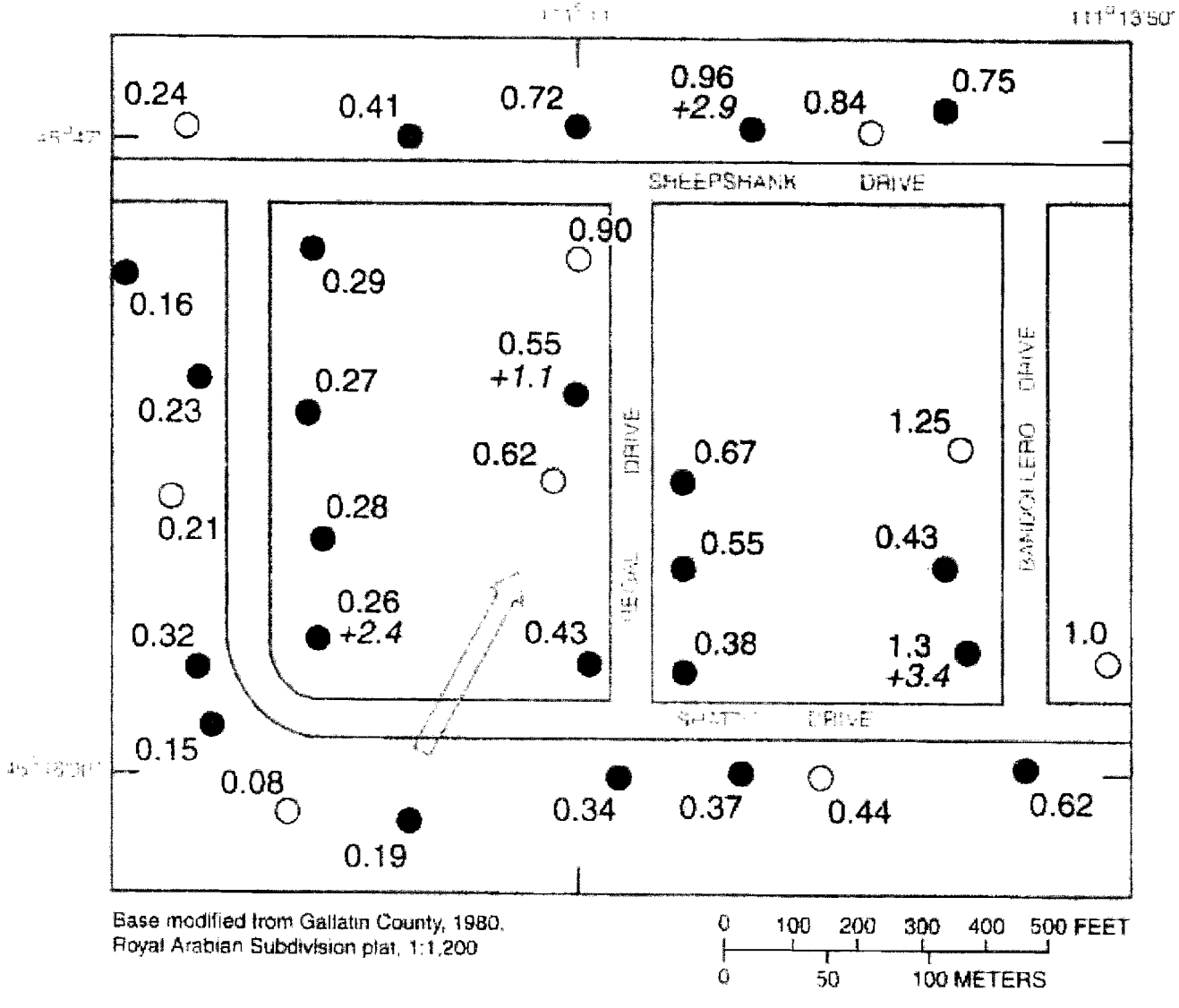
Kendy Nitrate-N Range in Study

- Study: 0.05 (Detection limit) to 13 mg/l
- Two out of 96 Samples ≥ 10 mg/l

Kendy Nitrogen Isotopes



Kendy: Royal Arabian Nitrate-N/Del15N



Kendy Nitrogen Isotopes p. 37

- "… fertilizers and soil organic nitrogen probably contribute most of the nitrate to ground water…"

Greenup Thesis

Used data from
Montana Microbiological.

Could not use data from Montana
Department of Health Laboratory

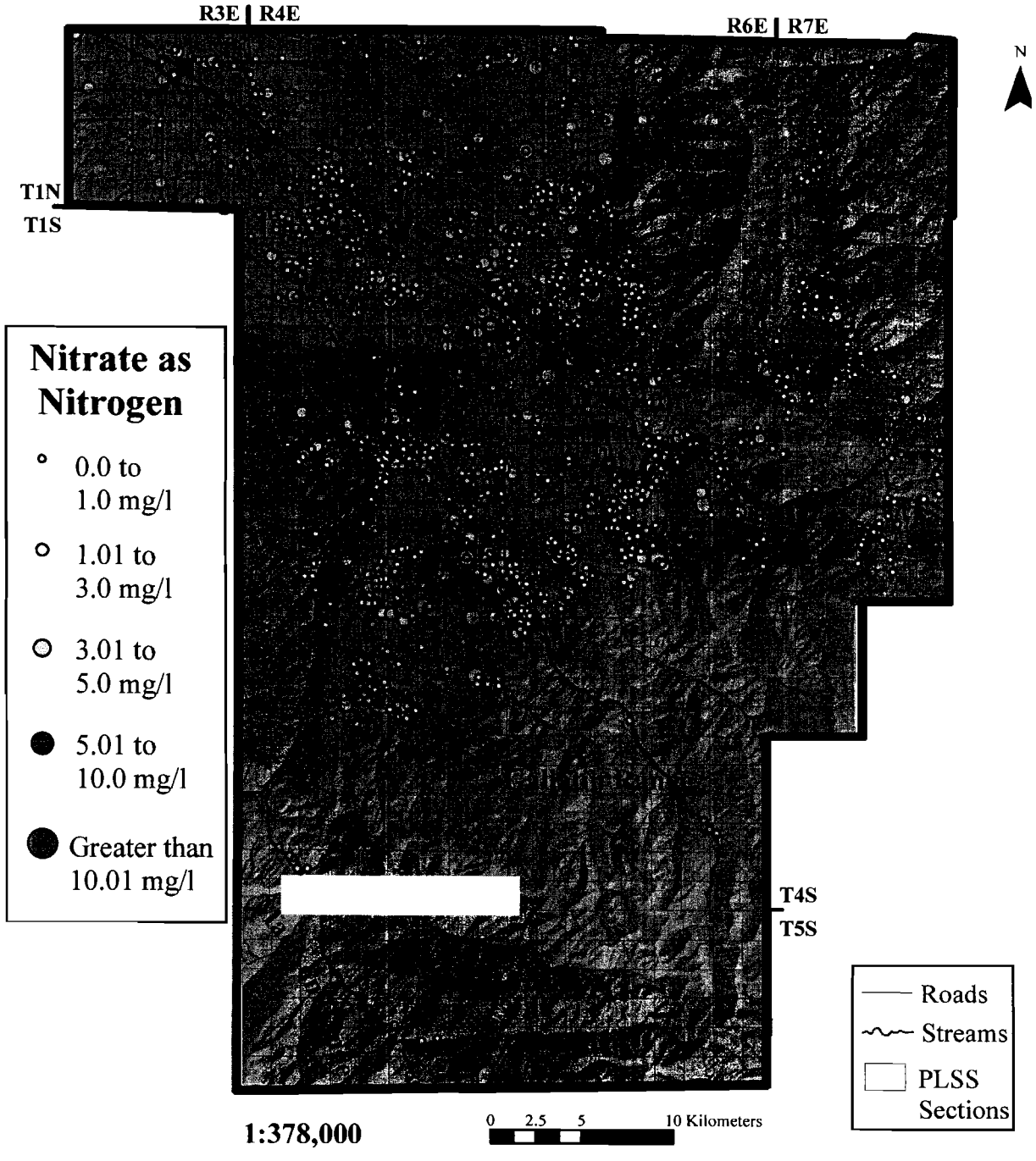
MDH provides Owner Address
Not Location of Well

Methods

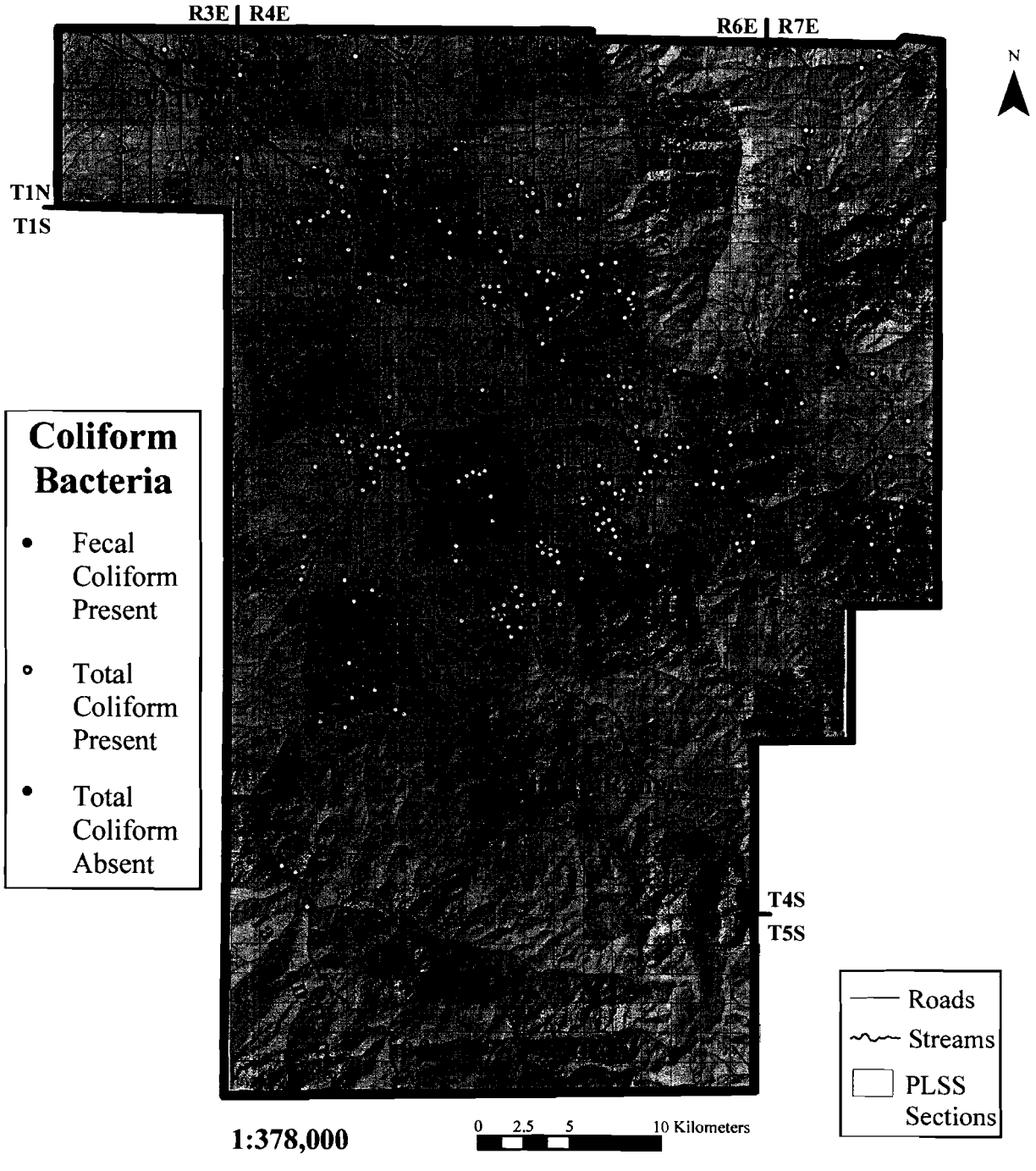
- water quality database assembly: **- 72 Historic**
  - 4,542 Current

- **Nitrate-Nitrogen**
  - **Mean=1.89, Median 1.40, Mode 0.50, Max 25, Min 0.01**

- Greenup: Nitrate N

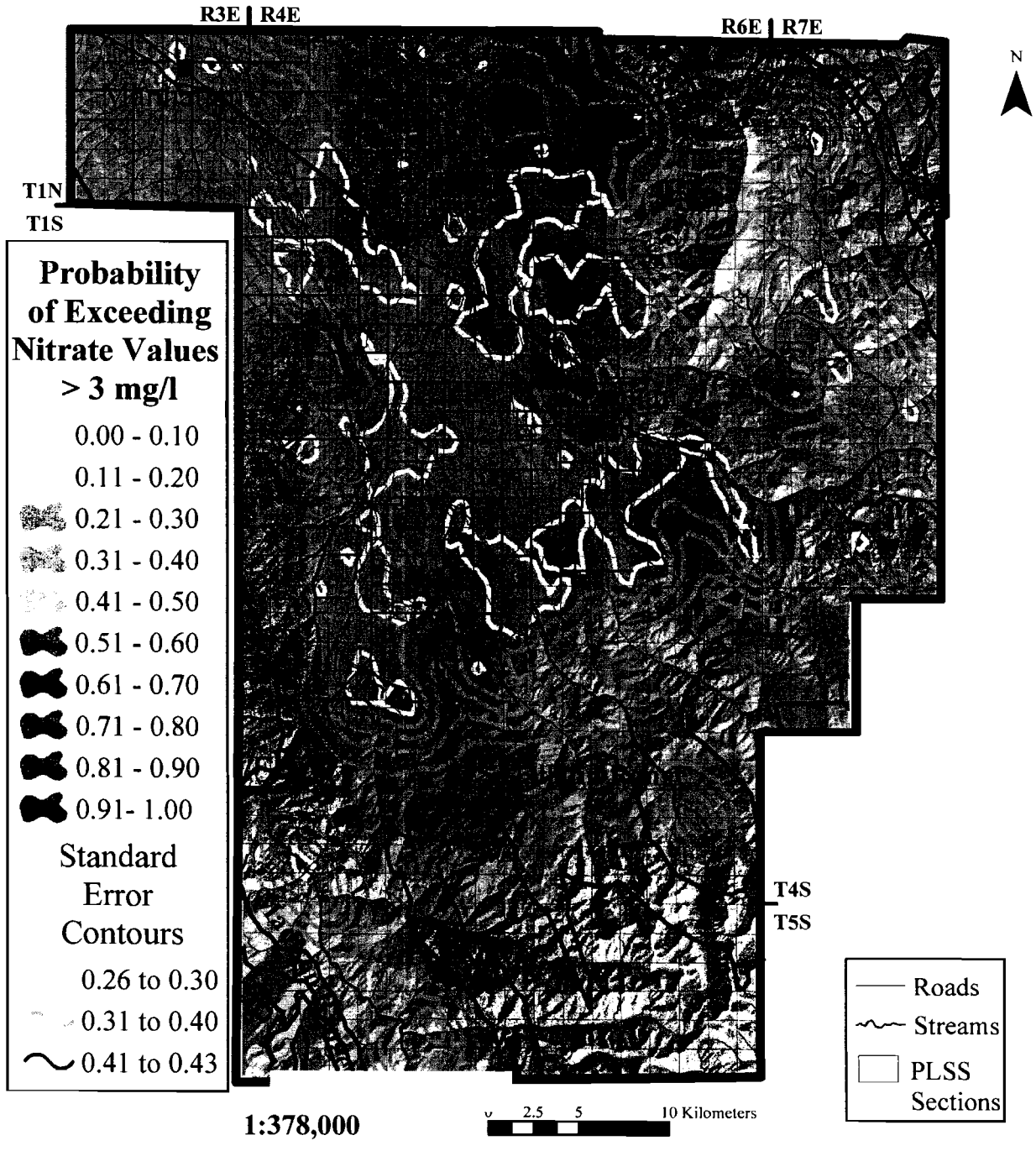


Greenup: Coliform



Modeling Results : Indicator Kriging for Possible Contamination

Probability Nitrate-N >3 mg/l



Discussion: Water Quality in the GLWQD

- Overall low values:

NO_3-N > 10 mg/l in less than 1% of samples

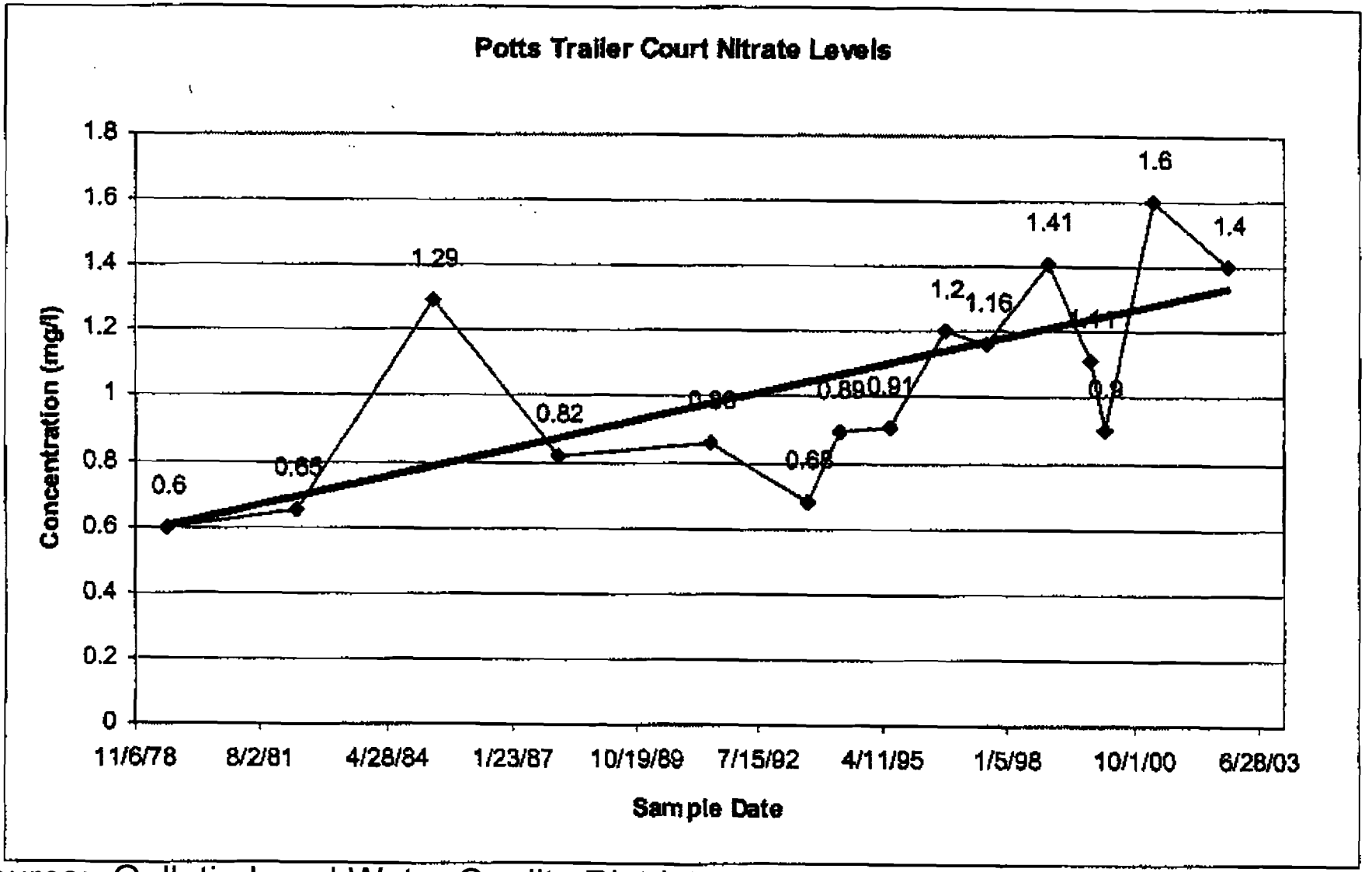
Fecal coliform present in less than 1% of samples

- Results probably indicative of point source contamination

- Flemming and Kendy suggest probable origin of highest nitrate is organic mater or fertilizer in the recharge areas of Gallatin Valley.
  - I suspect tillage more than fertilizer but have no data to demonstrate this
  - Bauder independently concurrs

But possible trends at some sites

Chart 1.
Nitrate trend in Potts Trailer Court PWS samples



Source: Gallatin Local Water Quality District

A subdivision near Bozeman showed contamination of 30 mg/l nitrate-nitrogen after an intense rain storm.

(Source: Gallatin Local Water Quality District)

Some Take-Home Messages

- Detection of trends is difficult
- The whole valley is not contaminated
- Select wells do show high contamination levels.
- Some of those contamination levels are above the US health standard.
- Most high level contamination potential appears to occur in recharge areas
- The contamination is not from animals in most cases
- **My opinion: Focus study on areas with high contamination more than whole valley studies**

Action is needed in some areas

- Department of Health Lab processes many samples each year
- But they do not ask the land owner to record the location of the well.
- Rather they record owners address (some other state).
- How can we learn about and study locations of high nitrate or coliform if we do not have data on location?
- Mandate location information for all water quality samples.

What is the obstacle to recordation of this information?

- Land owners do not want people to know where the contaminated water is. (Land Sales).
- BUT it seems to me that the buyer has a right to know such information.
- This is a matter of public health.

Gallatin County Water Task Force

http://www.gallatinwatertaskforce.net/pdf/TF_FinalReport.pdf

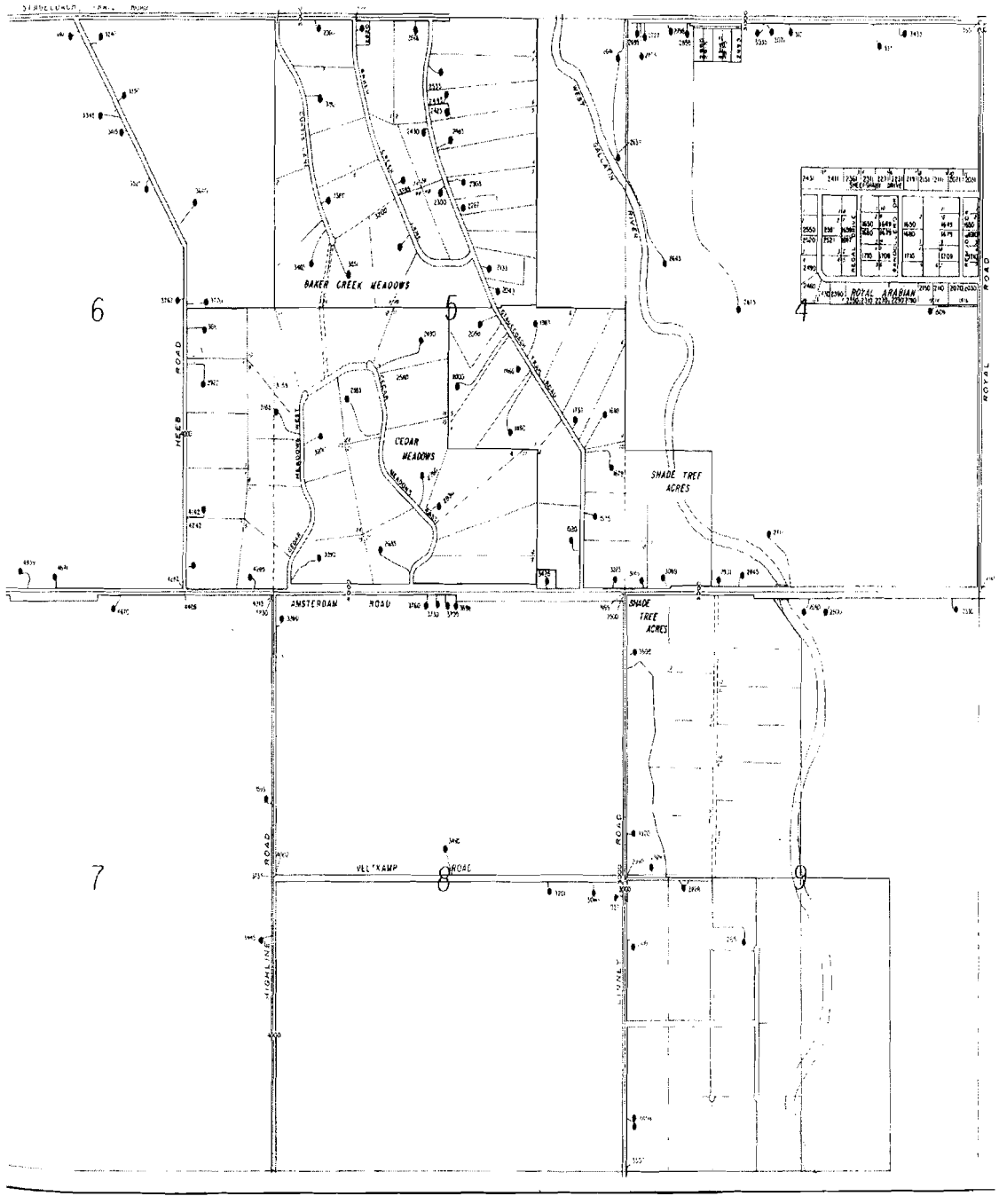
Gallatin LWQD Web Site

- If the restricted plume idea is correct, then placement of septic systems and wells is critical.
- Current regulation requires 100 feet well to drain field
  - But no direction
- How would a person siting a well know where up-gradient septic systems are?
- BUT there are no accurate records of the location of septic drain fields and tanks are that are easily accessible to the public.
- Section 3.5 Issue 4 Water Task Force Report.
- Shouldn't well sites be selected so they are not directly down gradient from a septic system where possible?

Approach Is Problematic

- Need to know gradient
- Assume Gradient does not change with time
- Not probably necessary for isolated subdivisions in low population areas
- Is helpful where data is know and density high.

- An example of three existing subdivisions in Gallatin County that might benefit from knowledge of septic drain field location



Other Issues

- Drain fields for community treatment systems not monitored (DEQ at AWRA 2006)
- We have little data on trends in water quality and water level in response to subdivision due to weak data before subdivision.
  - Many subdivisions require water level monitoring before
  - Should at least two monitoring wells be left in for monitoring in each new subdivision? (one up flow, one down flow).
    - Water Quality
    - Water Level
- Greenup investigated contamination from land disposal of sewage solids. Connection not clear, focused investigation may be warranted.
- To my knowledge, road salt has not been examined as a ground-water contaminant. (It is a known contaminant elsewhere in the US) (LWQD interest).

Septic Systems are not the only Source of Contamination, but we are out of time

- Pharmaceuticals
- Agricultural Contamination
- Super fund sites
- Leaking Underground Storage Tanks
- Land Fills
- Septage Disposal

Pharmaceuticals

Pharmaceuticals

- Missoula County has done a study
  - Ground Water V.45, No. 3, p. 263-271
  - Sources
    - Human Waste
    - Land Fills
    - Disposal of Expired or Unused into Sewers, On-Site Septic Systems or Land Fills
- Found:
  - Eryhromycin-1, carbamazepine, sulfamethoxazole, nicotine, caffeine, cotenine, codeine, parxenanthine, ranitidine, rimethoprim, warfarin.

Gallatin Local Water Quality District has a study slated

Agriculture

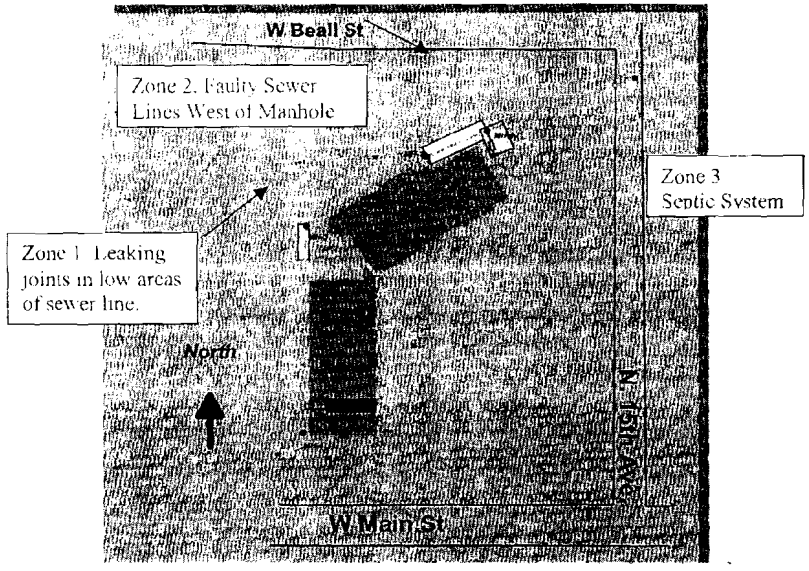
Available from the Montana Department of Agriculture on the Web

MT Department of Ag Results

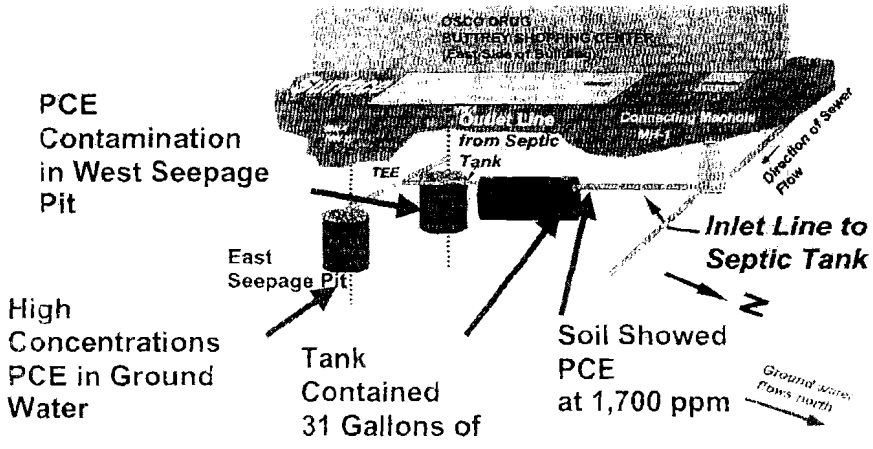
- 56 samples from 26 wells and 6 surface water bodies
  - 102 pesticide compounds were analyzed
- Pesticides in 29 of the 51 ground water samples
  - 12 compounds; 3 degradates
  - 80 detections; 48 below analytic reporting limits
- Pesticides in 5 surface water samples
  - 7 Pesticides
  - 14 Detections

- Most Common Atrazine and degradate deethyl atrazine (27 of 80)
- Next most common imazamethabenz methyl ester and metabolite imazamethabenzmethyl ester (19 of 80)
- Others include
  - prometon (12 detections)
  - 2,4-D (5 detections)
  - Imazapyr (4 detections)
  - Imidacloprid (3 detections)
  - Clopyralid (2 detections)
  - MCP (2 detections
  - Metolachlor ESA (Degradate) (2 detections)
  - Hexazinone (1 detection)
  - MCPA (1 detection)
  - Picloram (1 detection)
  - Tebuthiuron (1 detection)
- None exceeded or approached human health drinking water standards **where such standards exist**.
- None were above 0.1 ppb (parts per billion).

Bozeman Solvent Site



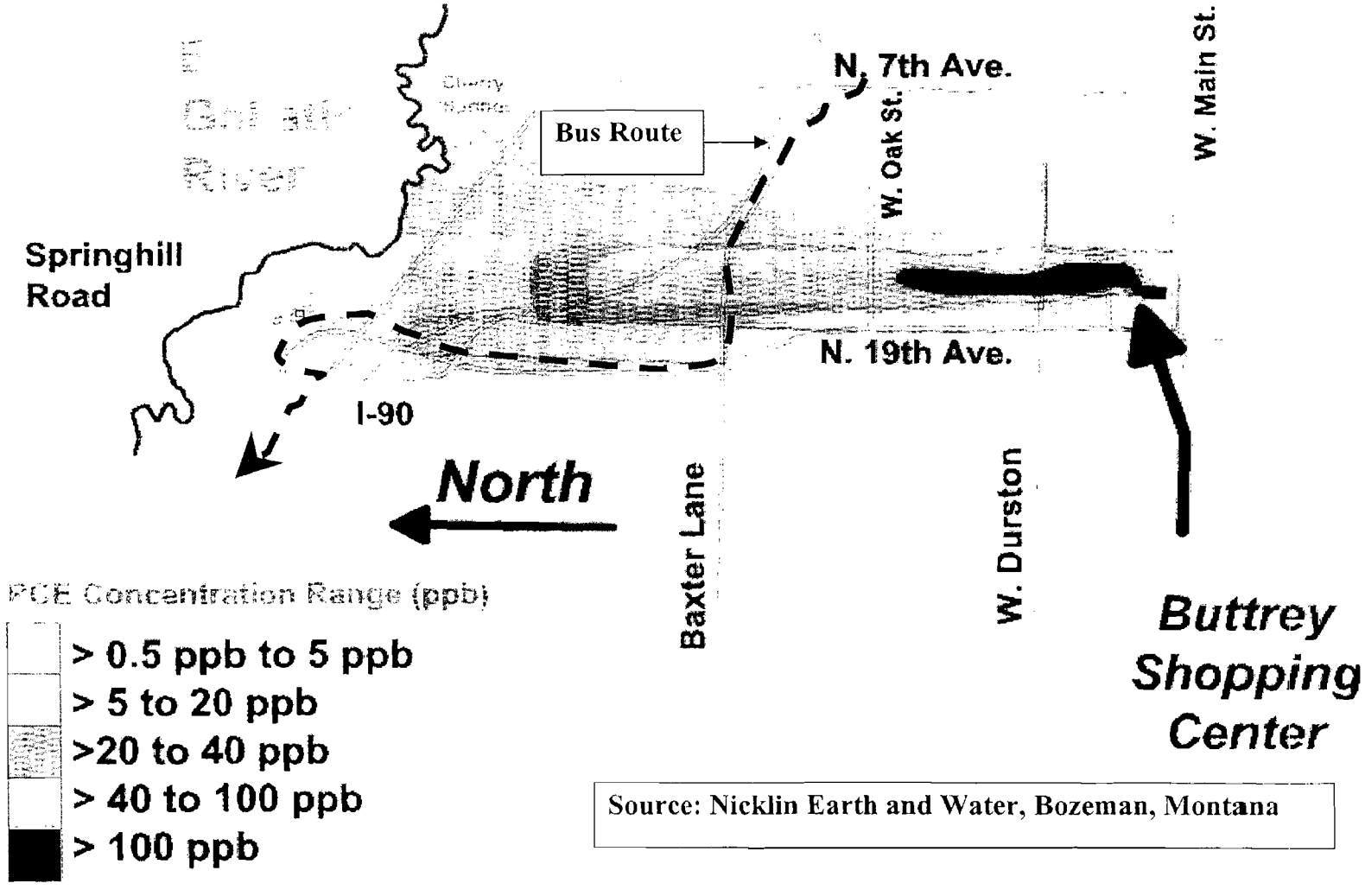
BSS Figure 1. Source areas for PCE migration into the aquifer around the shopping center. (Figure modified from Nicklin Earth and Water)



BSS Figure 2. Detail of source area around septic tank and manhole connection to sewer main, Zone 3. (Figure modified from Nicklin Earth and Water)

- Cause:
  - PCE Dry Cleaner
  - Release to Septic
  - Septic still connected after city sewer connected

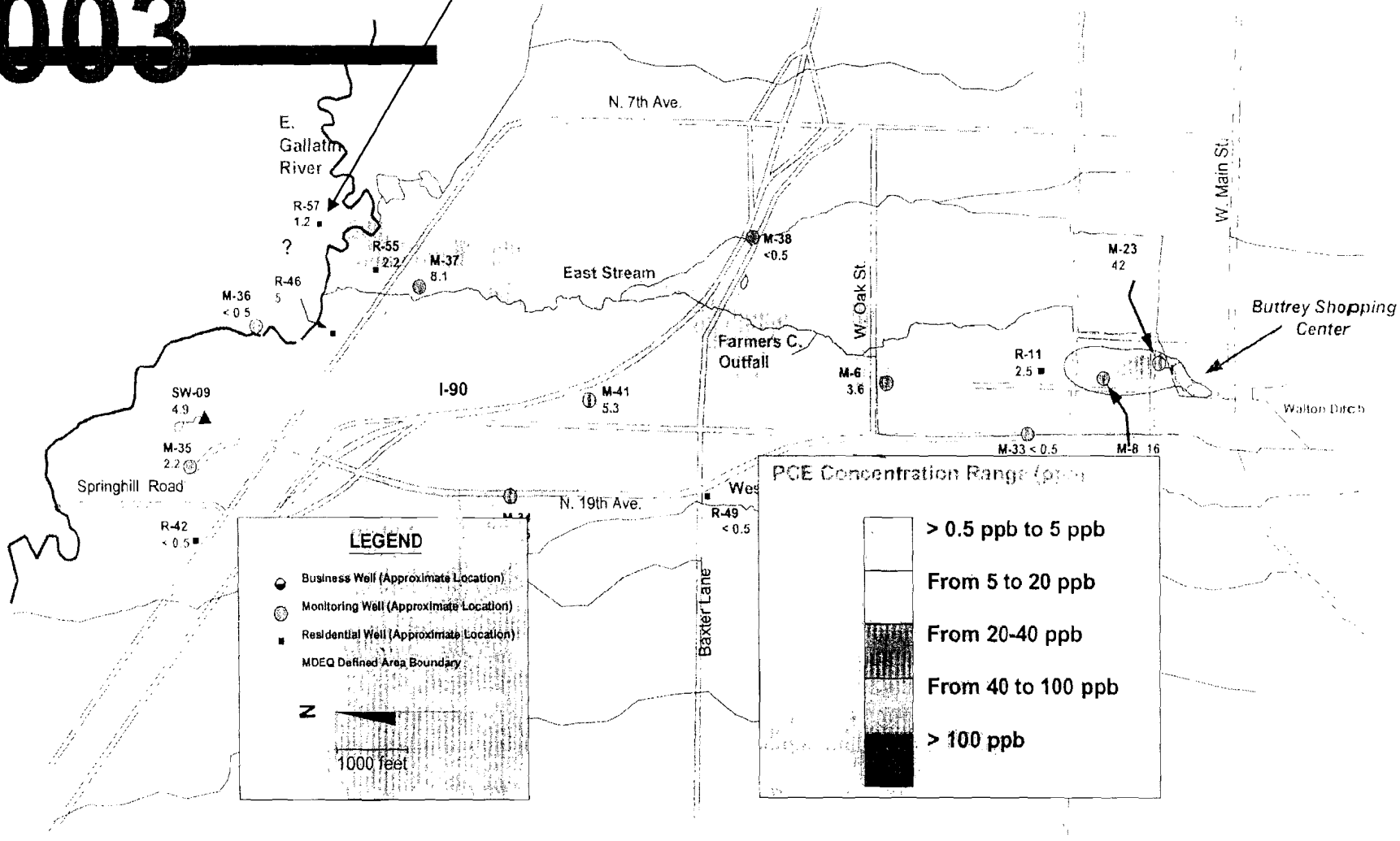
Plume Extent Shallow Ground Water Early 1990s



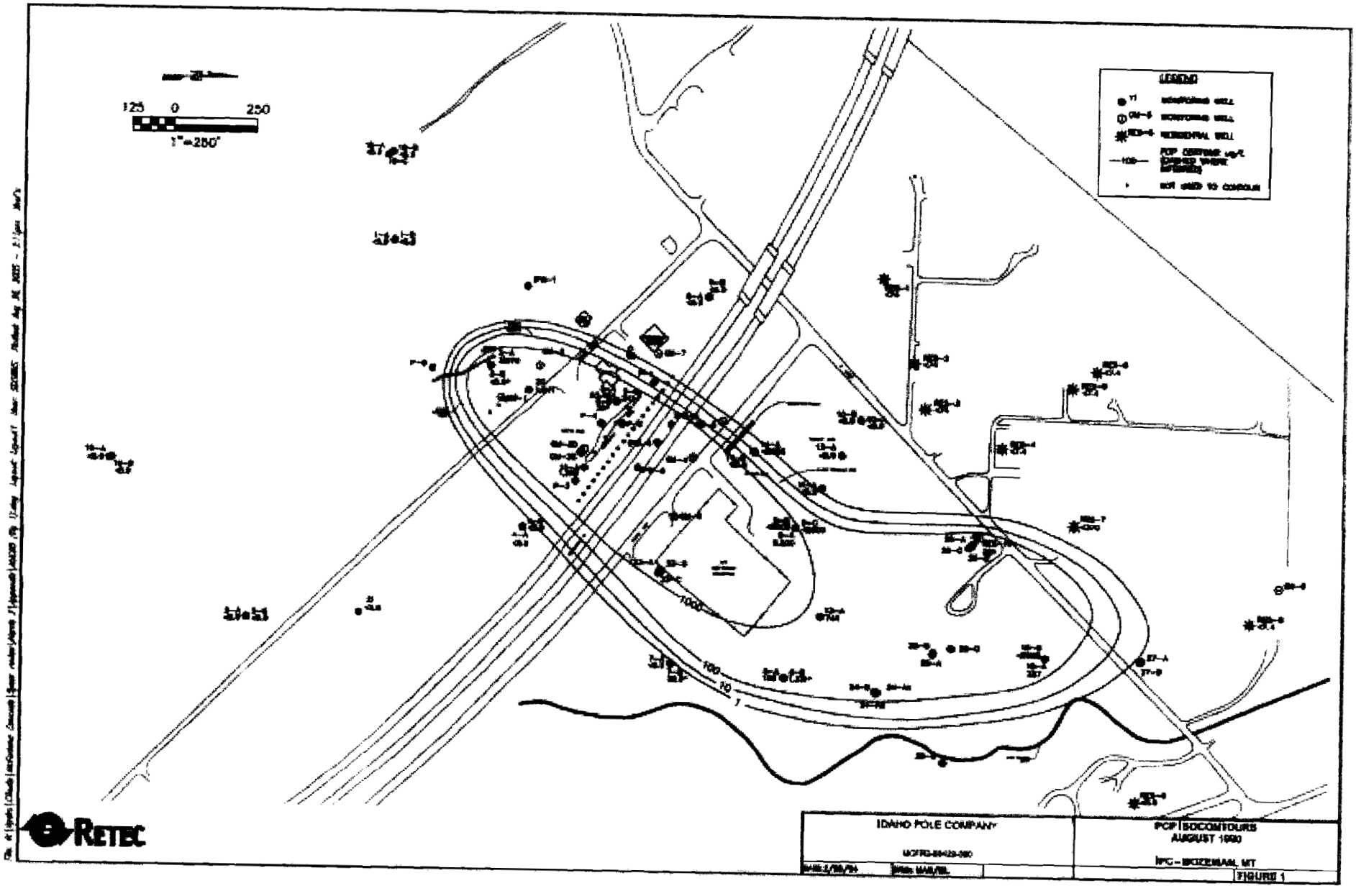
Source: Nicklin Earth and Water, Bozeman, Montana

Note contamination across River

~~2003~~



Idaho Pole Site


125 0 250
1"=250'
LEGEND
1000
100
10
1
RETEC
IDAHO POLE COMPANY
PCP ISOCONTOURS
AUGUST 1990
BPC – BOZEMAN, MT
FIGURE 1

Idaho Pole Main Points

- 1945 Creosote
- 1952 Pentachlorophenol in carrier oil
- 1977 Ceased wood treatment
- 1986 Added to National Priorities List
- 1992 Record of Decision
- 1998 Construction completion for the site
  - Interception Trench
  - Absorbent Pad
  - Soil Removal and Treatment
- 2002 Land Treatment closed
- Currently -- 15 Wells Monitored

Leaking Underground Storage Tanks in DEQ Data Base (2007)

- Belgrade (27 Tanks)
- Bozeman (100 Tanks)
- Manhattan (15 Tanks)
- Three Forks (17 Tanks)