Health Consultation

BAGLEY BANK

CITY OF BAGLEY, CLEARWATER COUNTY, MINNESOTA

JULY 13, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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HEALTH CONSULTATION

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Prepared by:

Minnesota Department of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

FOREWORD

This document summarizes public health concerns at a hazardous waste site in Minnesota. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary to do such an evaluation:

- Evaluating exposure: MDH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it's found on the site, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. We rely on information provided by the Minnesota Pollution Control Agency (MPCA), the U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the general public.

- Evaluating health effects: If there is evidence that people are being exposed - or could be exposed - to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health - the health impact on the community as a whole - and is based on existing scientific information.

- Developing recommendations: In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of MDH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies including EPA and MPCA. However, if there is an immediate health threat, MDH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the organizations responsible for cleaning up the site, and the community surrounding the site. Any conclusions about the site are shared with the groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us*.

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I. Background and History

The 1st National Bank of Bagley (referred to as Bagley Bank in this document) is located in the SE 1/4 of the NW 1/4 of Section 29, Township 147 North, Range 37 West, in Clearwater County, Minnesota. The Bagley Bank was founded in 1903, and has been at its current location since 1960. The bank property is a rectangle consisting of less than one acre of developed land located in the eastern portion of the City of Bagley. To the north of the property is an alley and a private residence; the southern boundary is Central Ave (Highway 2); the eastern boundary is Getchell Ave; the Christian Lending Library is across the alley to the west (see Figures 1, and 2). According to recorded title search documents, dry cleaning activities were also conducted on the property in 1947, 1972-75, and 1986. Figure 3 depicts the location of the drycleaner building on the west side of the Bagley Bank. The drycleaner building was demolished prior to the west side bank expansion with a slab on grade addition in 1997. There is little information regarding waste management practices at the dry cleaner or of any contamination found during the demolition of the building. However drycleaner impacts to the area are suspected because drycleaner solvent (tetrachloroethylene (PCE)) has been detected in air samples collected inside the bank.

During construction of the bank addition in 1997, a 3000-gallon Under Ground Storage Tank (UST) was ruptured during removal and spilled approximately 500 gallons of fuel oil mixed with water (see Figure 3). The release spilled onto the ground in and near the UST excavation along the west side of the former bank basement/foundation wall. The spillage of the UST contents was collected with absorbent pads. The impacted soil was not excavated. Petroleum related contaminants have also been detected in air samples collected inside the bank and in ground water. A smaller former fuel oil tank was also found in the northwest corner of the bank, but no additional information was located concerning removal (see Figure 3). A groundwater receptor survey confirmed by the City of Bagley's Public Utilities Department found no supply wells within 500 feet of the site (MPCA 1999). This health consultation was undertaken at the request of the Minnesota Pollution Control Agency (MPCA). The focus of this health consultation is the indoor air impacts from vapor migration of volatile organic compounds (VOCs) in soil and groundwater.

Geology/Hydrogeology

Regional surficial geology consists of Quaternary deposits overlying bedrock. Local Quaternary hydrogeology consists of interbedded sand and gravel with some silt and clay. The sustained yield rating from this unit is reported to be between 25-100 gallons per minute.

Onsite temporary monitoring wells show groundwater depth at approximately nine feet below ground surface. The regional direction of groundwater flow in the vicinity of the site is south toward Clearwater River and the surrounding wetlands.

Environmental Evaluation

1) Soil Contamination

Twenty-three individual soil samples were collected at the Bagley bank (see Table 1). Most of the samples were collected to evaluate petroleum impacts to the soil and groundwater. However many of the standard chemical constituents found in gasoline range organics (GRO), and diesel range organics (DRO) were either not analyzed in samples or were below detection limits in the samples collected. Most of the samples were analyzed for the petroleum constituents benzene, toluene, ethylbenzene, and xylenes (BTEX). Only a few soil samples were analyzed for the chlorinated dry cleaner solvent tetrachloroethylene (PCE) and its decay products trichloroethylene (TCE), and cis-1, 2-dichloroethylene (DCE). Soil samples SS-1 and SS-2 tested positive for PCE and cis-1, 2-DCE. PCE results are 162 and 95 µg/kg respectively (see Table 1). The PCE health based soil reference values (SRV) is 72,000 µg/kg. The cis-1, 2-DCE SRV is 8,000 µg/kg. MPCA SRVs are concentrations of contaminants in soil that are expected to pose minimal health risk. The soil samples were collected in the southwest corner of the basement where the tank was removed or from stock piled soils from the tank excavation. This location is now located under the bank addition. See Figures 3, 4, and 5 for former tanks, and soil sample locations.

2) Sump Samples

On July 9, 2003 untreated water was collected for laboratory analysis from each of the four on-site sumps (see Table 2 for Sump #1, Sump #2, Sump #3 and Sump #4 results). The sumps are utilized to help keep the basement dry by removing the water that collects near the foundation walls (see Figure 4 for sump locations). Each sump has a sealed top that helps prevent VOC from vaporizing into the bank basement air (see Figure 6). The water is pumped out of the sumps and treated in a carbon filtration system before being discharged to the storm sewer (NPDES permit #MN0065676). The GRO concentrations ranged from 130 - 720 µg/L with the highest concentration in sump #1 (see Table 2). The DRO concentrations ranged from 120 - 320 µg/L with the highest concentration in sump #1. The benzene concentrations ranged from 15 - 86 µg/L. Sump #1 had the highest benzene concentration. The PCE concentrations ranged from 1.1 - 110 µg/L. Sump #3 had the highest PCE concentration. Sumps 1and 3 had TCE concentrations of 1.2 and 5.6 µg/L respectively. TCE concentrations were not reported in the other sumps. It is not clear why sump 3 had the highest PCE concentration because it is across gradient to the expected source areas located near the demolished drycleaner building (see Figures 3 and 4).

3) Bagley Bank Indoor Air Samples

Air samples were collected to determine if site contamination was impacting indoor air at the bank. The following text describes the sample results and compares the indoor air concentrations to health screening criteria or to MDH chronic HRVs, adjusted for a 40 hour/week exposure (see MDH Discussion and Appendix A for description of these criteria).

The 24-hour ambient air samples were collected in SUMMA canisters. These are non-reactive, coated stainless steel canisters placed under a vacuum in order to pull air from the room into the canister. During five sampling events a total of 10 samples were collected. Samples were collected in the main floor, basement common area and south side of the basement. Both the main floor and basement are employee work areas although employees occupy the main floor most of the time. The air samples were analyzed using approved EPA analytical methods (EPA Method TO-15). Very low detection limits, generally less than 10 micrograms per cubic meter (µg/m^3) for most compounds, are possible using this method. However, even at these low detection limits, a non-detect can be above health-based screening levels.

The analysis of the SUMMA canister air samples indicated detectable levels of VOCs in ambient air of the main floor and basement. VOCs detected include the following:

Acetone	Ethylbenzene	Toluene
Benzene	N-hexane	TCE
2-Butanone	Methylene chloride	Trichlorofluoromethane
Cyclohexane	Propylene	1,2,4-Trimethylbenzene
Dichlorodifluoromethane	Styrene	1,3,5-Trimethylbenzene
Dichlorotetrafluoromethane	PCE	Vinyl Acetate
1,1-DCE	Tetrahydrofuran	Xylenes
Cis-1, 2-DCE	Total Hydrocarbons as gas	trans-1, 2-DCE

The results of the indoor air sampling are summarized in Table 3. The PCE, TCE, and benzene indoor air concentrations exceeded screening criteria. PCE concentrations were above the modified PCE Interim Screening Concentration (9.2 µg/m^3) in all 10 samples collected in the basement and main floor (see Table 3). PCE concentrations ranged from 19.3 - 600 µg/m^3. The PCE concentrations are approximately 2- 60 times the screening level. The modified TCE ISC concentration (1.1 µg/m^3) was exceeded in all 10 samples. The TCE concentrations ranged from 60.1 - 819 µg/m^3. The TCE concentrations are approximately 60-800 times the screening level. The lower end of the modified benzene chronic Health Risk Value (3.6 – 12.6 µg/m^3) was exceeded in 2 samples.

Total petroleum hydrocarbons as gas (TPHG) results ranged from 343 – 2560 µg/m^3. MDH not currently have a TPHG interim screen concentration criteria. The TPHG concentration is a total mass value for numerous gasoline constituents (complex mixture) detected within a given retention time on a gas chromatograph. Chemical constituents found within the TPHG chromatographic window are not well defined in the current analytical method. In an effort to better characterize the risks associated with exposure to petroleum mixtures, TPHG analyses will need to identify and quantitate more compounds of interest. Tables 4 and 5 list some of the possible chemical constituents found in gasoline and #2 fuel oil. It is important to note that many of the compounds do not have sufficient toxicological information for assessing risk. However, it is not necessary to quantify all compounds found in TPH in order to assess potential risks associated with inhalation exposure.

II. <u>Discussion</u>

1) Indoor Air Samples

VOCs in soil and groundwater can migrate into nearby structures in the vapor phase, especially in permeable soil or fill such as gravel. PCE, in particular, has been found to travel longer distances through soil gas relative to other VOCs (Hodgson et al 1992). Sewer and utility lines run beneath the streets surrounding the site, to which businesses and homes are connected. Gravel or other permeable fill is often used as a base beneath and around utility lines to facilitate drainage and avoid frost damage. VOCs in the vapor state can migrate along utility lines and enter building basements through foundation cracks, pipe entries, sumps, or floor drains. Unsealed foundation drain systems or sumps may also provide a route for VOCs to volatilize from contaminated groundwater into buildings.

Individuals are potentially exposed to petroleum vapors and other VOCs from numerous sources on a daily basis; the additional involuntary exposure to the PCE and TCE levels observed at the bank could result in an increased cancer risk, as well as increased risk of other toxic effects of these agents (see below). For these reasons, MDH recommends minimizing exposure to potential cancer-causing agents wherever possible.

2) Common Sources of Indoor Air Contaminants

The use of many common commercial products can introduce PCE, TCE, BTEX, or other VOCs into the indoor environment. The following is a list of common sources of indoor VOC emissions:

- Paints
- Varnishes
- Printers
- Solvents
- Gasoline
- Newspaper
- Cooking
- Cleaning Chemicals
- Vinyl floors
- Carpets
- Burning Candles
- Upholstery Fabrics
- Adhesives
- Sealing Caulks
- Air Fresheners
- Fuel Oil
- Vehicle Exhaust
- Pressed wood furniture
- Dry Cleaned items
- Pesticides
- Tobacco Smoke

Indoor air in most structures will contain measurable levels of VOCs. However, each building will have varying VOC levels based upon the use of these and other products. The construction date of the building and the type of building materials used can also contribute to indoor air VOCs levels. Newer buildings tend to have more VOCs than older ones because VOCs in aged construction materials would have already evaporated. It is also possible that environmental media (groundwater, soil and air) contaminated with PCE, TCE, BTEX, and can influence indoor air quality as vapors migrate into buildings.

3) Environmental Fate and Transport of Contaminants

When contaminants are released into environmental media (soil, water, and air), they partition into other media. For example when dry cleaner solvent and gasoline are released to soil, individual compounds found in the mixture can partition into air and water. This partitioning is partly based upon chemical properties such as water solubility, and volatility (quantified by Henry's constant). Compounds that have a high water solubility will dissolve into, and migrate with water. If a compound has a low water solubility, it will tend to stay in soil.

Other environmental factors such as oxygen levels, moisture, and pH can play an important role in establishing an environment for microorganisms to metabolize or degrade contaminants in soil or water. For example, PCE is relatively water-soluble and will often leach from soils into groundwater. If the environmental conditions are favorable in soil, microorganisms will degrade PCE in a step-by-step process (de-chlorination) removing one chlorine atom at a time. This is one reason why weathered PCE plumes may have decay products such as TCE. Gasoline can also leach from soil and dissolve into groundwater. Gasoline consists of potentially hundreds of different compounds including BTEX. If environmental conditions are right microorganisms will selectively metabolize or degrade only certain gasoline constituents such as BTEX while other chemical constituents will remain in the plume.

4) Contaminant Toxicity

Tetrachloroethylene (PCE) is a synthetic solvent widely used for fabric cleaning and degreasing of metal. It has been the solvent of choice for dry cleaning operators because it is nonflammable and volatilizes (evaporates) quickly. In dry cleaning operations, PCE is used as a scouring solvent to remove oils, greases, waxes, and fats from both natural and man-made fabrics (ATSDR 1997). PCE is also used in water repellents, silicone lubricants, spot removers, adhesives, and wood cleaners.

Although it has not been demonstrated to cause cancer in people, the U.S. Department of Health and Human Services has determined that PCE may reasonably be considered a potential human carcinogen, or cancer causing agent, based on animal studies (ATSDR 1997). Once it enters the body, PCE is rapidly metabolized by the liver and eliminated from the body (Bogen and McKone 1988). The MDH Interim Screening Concentration (ISC) for PCE is based on cancer risk (see below).

Trichloroethylene (TCE) is also a widely used solvent, and is as a breakdown product of PCE. TCE is a nonflammable, colorless liquid with a slightly sweet odor and taste (ATSDR 1997). TCE is extremely volatile, and most TCE released into the environment will evaporate into the air. Exposure to high concentrations of TCE in air can affect the central nervous system, producing headaches, dizziness or even unconsciousness. These concentrations have only been found in occupational settings, or cases of intentional exposure (i.e. intoxication or suicide attempts). The MDH ISC for TCE is based on cancer risk (see below).

Once released into the environment, PCE, TCE, and gasoline constituents readily volatilize from soil and water. Factors that affect the rate of volatilization from soil include the soil type, organic matter content of the soil, moisture content of the soil, and the nature of the release. Volatilization will tend to be higher in sandy soils and lower in denser, more organic soils such as clays where VOCs may be adsorbed onto organic carbon particles. PCE, TCE, and gasoline readily leach through soil, contaminating shallow groundwater. PCE and TCE are denser than water, and if present in sufficient concentrations in groundwater, they sink to form a pool at the base of the groundwater aquifer. This pool of dense, non-aqueous phase liquid (or DNAPL) can serve as a continuing source of groundwater contamination that can also impact indoor air.

Gasoline consists of potentially hundreds of chemical constituents with varying chemical properties; some of the chemical constituents will dissolve into the groundwater (BTEX) and others (naphthalene) will have more of an affinity for soil. Although it is possible to chemically characterize most of the chemical constituents found in a gasoline plume, it is very expensive and of little use because toxicological data for most of the chemical constituents will not be sufficient to aid in assessing health implications of inhalation exposure.

Inhalation is the primary route of exposure to benzene due to its high volatility (ATSDR 1993). Inhalation exposure to benzene can result in non-cancer health effects that impact the tissues involved in the formation of the blood cells and the immune system (EPA 2004). Studies involving chronic human occupational or environmental inhalation exposures have established benzene to be a human carcinogen (class A). Human pre-cancer and cancer effects have been reported in the literature from exposures (1- 40 years) to high benzene concentrations ranging from 1000 – 479,000 $\mu g/m^3$ (ATSDR 1993). The modified MDH chronic benzene HRV is 3.6 – 12.6 $\mu g/m^3$.

Chronic inhalation exposure to moderate to high concentrations of toluene is associated with central nervous system disturbances involving subtle behavioral and neurological effects at concentrations >376,800 µg/m^3 (ATSDR 1994). The modified MDH chronic toluene HRV is 1120 µg/m^3.

Individuals exposed to high levels of ethylbenzene for short periods of time have complained of eye and throat irritation, and dizziness (ATSDR 1999). It is not known if long-term exposure to low levels of ethyl-benzene affects humans (ATSDR 1999). Acute exposures to high levels (> 615 mg/m^3) in animal studies resulted in reproductive and developmental effects (ATSDR 1999). The MDH acute ethylbenzene HRV is 10,000 µg/m^3. MDH also has an acute HRV for benzene of 1,000 µg/m^3. Both of these are based on developmental effects.

Studies involving human acute exposures to xylene (868.4 mg/m^3) resulted in eye, nose, and throat irritation (ATSDR 1995). Neurological effects (dizziness) were reported at 2,995,900 µg/m^3 (ASTDR 1995). Occupational studies have reported irritant effects of xylene at concentrations as low as 60,800 µg/m^3 (ATSDR 1995). The MDH acute xylene HRV is 43,000 µg/m^3.

5) Indoor Air Criteria

MDH utilizes promulgated Health Risk Values (HRVs) for evaluating ambient air and indoor air quality for excess cancer risk and non-cancer effects. HRVs are concentrations of contaminants in air that MDH considers to be safe for the general public, including sensitive sub-populations. For site related carcinogenic compounds that do not have HRVs, MDH staff developed a set of screening criterion known as Interim Screening Concentrations (ISC). The ISCs were developed using common risk assessment parameters including adult body weight (70kg), adult inhalation rate (20 m^3/day) and USEPA cancer slope factors. HRVs and ISCs for carcinogens are air concentrations that are associated with an incremental cancer risk of no more than 1 case per 100,000 people exposed for a lifetime. Estimated cancer risks below this level are considered to be negligible. Toxicological data for the VOCs of concern were obtained from standard reference sources, including the U.S. Environmental Protection Agency (EPA) Superfund Technical Support Center, and EPA's Integrated Risk Information System (IRIS) and Health Effects Summary Tables (HEAST). Oral slope factors were used in the calculation of several ISCs due to a lack of available inhalation toxicity values. Their use, therefore, should be limited to simple screening for the identification of potential problem situations and not for determining an actual, long-term air standard. Note that PCE and TCE slope factors are EPA values (see Appendix A for ISC derivation. It is also important to recognize that exposures to contaminants at the ISCs levels pose a negligible cancer risk (1 case per 100,000 people exposed for a lifetime) and are an upper bound estimates that likely overestimate risk. When exceedances of ISCs are small and/or people experience elevated air contaminant concentrations for short periods of time, the exceedance of an ISC will not result in a health hazard for people. However, continual exposure to contaminants well above the TCE, and PCE ISC criteria may increase a person's theoretical cancer risk.

Child Health Concerns

ATSDR recognizes that the unique vulnerabilities of infants and children make them of special concern to communities faced with contamination of their water, soil, air, or food. Children may be at greater risk than adults from certain kinds of exposures to hazardous substances at waste disposal sites. They may be more likely to be exposed because they play outdoors and they often bring food into contaminated areas. Because they are shorter than adults, they breathe dust, soil, and heavy vapors closer to the ground. Children also weigh less, resulting in higher doses of chemical exposure per body weight. The developing body systems of children may sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

III. Conclusions

- At present the health hazard is indeterminate because only one sample is available for the first floor. More samples are needed to determine if levels in the bank remain generally high enough to be a public health hazard.
- Indoor air levels of PCE and TCE measured at Bagley Bank in both the basement and first floor work areas are above the state health screening criteria . Measured levels of PCE in the basement and of TCE in the basement and main floor were two orders of magnitude or more above state screening criteria, and therefore may pose a health concern if additional sample analyses determine that the levels continue to increase. Based on state policy, this site is considered by MDH to pose a health concern. This is not ATSDR policy.
- Uncharacterized petroleum hydrocarbons were also measured inside the bank.
- Based on the information reviewed for this report, source areas have not been identified.
- The site contaminant source area(s) extent and magnitude have not been fully characterized.
- Better petroleum analytical methods are needed to implement better risk assessment methodologies for TPH inhalation exposures.

IV. Recommendations

1. A thorough site investigation to identify the PCE and TCE source areas is warranted.

2. As part of prudent public health practice, measures to reduce the indoor levels of PCE and TCE should be implemented.

V. Public Health Action Plan

MDH’s Public Health Action Plan for the site consists of continued consultation with MPCA staff to ensure collection of additional soil and indoor air samples, and to evaluate the data.

MDH and the Pollution Control Agency should collaborate in developing a more thorough petroleum inhalation risk assessment methodology with a complimentary analytical method.

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Certification

This Bagley Bank Public Health consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR

Tables

Indoor Air Sample and Soil Boring Data

Table 1. Bagley Bank
Soil Analysis Results ug/kg

Sample ID	Date Conducted	Depth (ft)	PID (ppm)	Cis-1,2-DCE	Tetra-chloro ethylene (PCE)	Trichloro ethylene (TCE)	Gasoline Range Organics (GRO)	Diesel Range Organics (DRO)	Methyl Tert Butyl Ether (MTBE)	Benzene	Ethyl benzene	Toluene	total Xylenes
SS-1	8/5/1997	6	817	**95**	**162**	NA	**223000**	**446000**	ND	ND	ND	ND	ND
SS-2	8/5/1997	5	195	ND	**282**	NA	ND	**23900**	ND	ND	ND	ND	ND
SW-7	8/5/1997	6	435	ND	ND	NA	ND	**86500**	ND	ND	ND	ND	ND
B-1	8/14/1997	6	85	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B-2	8/14/1997	6	120	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B-3	8/14/1997	6	75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B-4	8/14/1997	6	3.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B-5	8/14/1997	9	240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-1	8/12/1997	16 - 18	1.4	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND
SB-2	8/12/1997	14 - 16	4.3	NA	NA	NA	**17.3**	**13**	ND	**208**	ND	ND	ND
SB-3	8/12/1997	14 - 16	0.5	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND
GP-1	3/24/1998	18 - 20	0	ND	ND	NA	ND	ND	ND	ND	ND	**12**	ND
GP-2	3/24/1998	18 - 20	0	ND	ND	NA	ND	ND	ND	ND	ND	**12**	ND
GP-3	3/24/1998	18 - 20	0	ND	ND	NA	ND	ND	ND	ND	ND	**14**	ND
GP-4	3/24/1998	18 - 20	0	ND	ND	NA	ND	ND	ND	ND	ND	**15**	ND
GP-5	3/24/1998	18 - 20	0	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
GP-6	4/25/2002	6 - 8	4.1	ND	ND	NA	ND	**5100**	ND	ND	ND	ND	ND
GP-7	4/25/2002	4 - 6	2	ND	ND	NA	ND	**4100**	ND	ND	ND	ND	ND
		18 - 20	2.4	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
GP-8	4/25/2002	8 - 10	3.1	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
GP-9	4/25/2002	6 - 8	2.5	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND
GP-7*	unknown	2 - 4	unknown	NR	NR	NR	**22000**	ND	NR	NR	ND	ND	ND
GP-8*	unknown	4 - 6	unknown	NR	NR	NR	ND	ND	NR	NR	ND	ND	ND
Residential SRV (ug/kg)				8000	72000	29000	NP	NP	NP	1500	200000	107000	110000

NR = not reported
ND = not detected
NA = not analyzed
NP= Not Published

Reference: Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG) Volume 2

Table 1. Bagley Bank
Soil Analysis Results ug/kg

Naphthalene	methylene chloride	Methyl Isobutyl Ketone	Isopropyl benzene	n-propyl benzene	1,3,5-trimethyl benzene	1,2,4-trimethyl benzene	tert-butyl benzene	Sec-butyl benzene	p-isopropyl toluene	n-butyl benzene
1565	**136**	**146**	**460**	**202**	**533**	**1704**	**899**	**2125**	**5411**	**6120**
176	ND	ND	ND	ND	**21**	**147**	**71**	**123**	**353**	**422**
1117	**30**	**88**	**319**	**142**	**359**	**311**	**769**	**1622**	**3896**	**4680**
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
10000	NP	140000	NP	NP	NP	NP	NP	NP	NP	NP

NR = not reported
ND = not detected
NA = not analyzed
NP= Not Published

Reference: Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG) Volume 2

Table 2. Bagley Bank Sump Data Collected On July 9, 2003

Sample ID	DRO	GRO	Acetone	Benzene	Cis-1,2-DCE	Ethylbenzene	Isopropyl benzene	n-Propylbenzene	PCE	Toluene	TCE	total Xylenes
	ug/L											
Sump #1	320	720	13	86	4.7	55	6.4	3.8	5.8	4.6	1.2	5.8
Sump #2	NR	NR	NR	8.3	1.5	NR	NR	NR	3.4	NR	NR	NR
Sump #3	120	130	NR	15	7.1	3.1	NR	NR	110	NR	5.6	NR
Sump #4	230	160	NR	71	NR	5.2	NR	NR	1.1	NR	NR	NR

NR = Not Reported
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
DCE = Dicholoroethylene
PCE = Tetrachloroethylene
TCE = Trichloroethylene

Table 3 Summa Canister Air Sample (ug/m^3) Results
1st National Bank of Bagley, Bagley, Minnesota

Location	Date Sampled	Acetone	Benzene	2-Butanone (MEK)	Chloro-methane	Cyclo-hexane	Dichlorodi-fluoro-methene	Dichloro-tetrafluoro-methane	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	Ethyl-benzene	n-Hexane	Dichloromethane	Pro-pylene	Styrene	PCE	Tetrahydro-furan	Total Hydrocarbons as gas	Toluene	TCE	Trichloro-flurомethane	1,2,4-Trimethyl-benzene	1,3,5 -Trimethyl-benzene	Vinyl Acetate	Xylenes
Basement (central area)	12/5/2003	**17.40**	**2.5**	**2.70**	ND	ND	**3.77**	ND	ND	**117**	**5.64**	ND	ND	ND	3.15	ND	**53.1**	ND	**2560**	**6.9**	**208**	ND	**4.75**	ND	ND	ND
	1/8/2004	**26.60**	**3.57**	**5.10**	ND	**9.10**	**7.04**	ND	ND	**5.24**	ND	ND	ND	**5.65**	**11.50**	ND	**46.2**	**9.29**	**781**	**7.28**	**126**	ND	ND	ND	ND	ND
	4/14/2004	NA	ND	NA	NA	NA	**12.1**	**12.10**	ND	ND	NA	ND	NA	**7.06**	NA	ND	**20.7**	NA	**343**	**4.6**	**104**	ND	ND	ND	NA	ND
	7/21/2004	NA	**2.44**	NA	NA	NA	**4.52**	ND	ND	ND	NA	**2.60**	NA	ND	NA	**4.24**	**558**	NA	**1560**	**17.6**	**546**	ND	**7**	**3.4**	NA	**5.74**
	10/20/2004	**12.60**	ND	**2.91**	ND	ND	ND	ND	**3**	ND	ND	ND	ND	ND	ND	ND	**9.65**	ND	**673**	**3.18**	**60.1**	ND	ND	ND	ND	ND
Basement (southern area)	12/5/2003	**29.00**	**3.9**	**3.90**	ND	**3.39**	**6.03**	ND	ND	**5.64**	ND	ND	ND	**3.88**	**3.85**	**3.68**	**40.7**	ND	**694**	**8.04**	**153**	**4.91**	ND	ND	ND	ND
	1/8/2004	**38.60**	**3.57**	**6.90**	ND	**10.10**	**8.04**	ND	ND	**5.24**	ND	ND	**3.19**	**7.42**	**11.90**	ND	**52.4**	**9.59**	**738**	**8.81**	**98.3**	**4.68**	ND	ND	**7.16**	ND
	4/14/2004	NA	ND	NA	NA	NA	ND	ND	ND	ND	NA	ND	NA	**6.36**	NA	ND	**19.3**	NA	**425**	**3.83**	**109**	ND	ND	ND	NA	ND
	7/21/2004	NA	**3.18**	NA	NA	NA	**6.03**	ND	**3.3**	ND	NA	**3.49**	NA	ND	NA	**6.06**	**600**	NA	**1350**	**24.1**	**819**	ND	**7**	ND	NA	**9.93**
Main Floor	10/20/2004	**20.50**	ND	**10.20**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**26.40**	ND	**22.8**	**6.00**	**829**	**5.75**	**121**	ND	ND	ND	ND	ND
MDH Chronic Health Risk Value (HRV) x 2.8 (ug/m^3)			3.5-12.6											60.00						1120					560	
HRV Toxicological endpoint			cancer											cancer						nervous system					Respiratory system	
MDH Modified Interim Screening Concentration (ISC)* (ISC multiplied by 2.8) ug/m^3		NPS	NPS	NPS	1.62 (3.24)	NPS	NPS	NPS	NPS	1.1	NPS	NPS	NPS	NPS	NPS	NPS	9.2	NPS	NPS	NPS	1.1	NPS	NPS	NPS	NPS	NPS
ISC Toxicological endpoint			cancer														cancer				cancer					

Notes:

Cells shaded green indicate concentrations exceeding the doubled ISC.

Air samples collected on 4/14/2004, 7/21/2004 were analyzed for Method TO14.

Air Samples collected on 12/5/2003, 1/8/2004, and 10/20/004 were analyzed for Method TO15.

DCE = 1,1-Dichloroethene, TCE = Trichloroethene and PCE = Tetrachloroethene

NA = Not Analyzed

ND = Not Detected

NPS = No published Standard.
* see Appendix A for ISC details

TABLE 4

SUMMARY OF COMPOSITION DATA FOR GASOLINE FUEL

COMPOUND CLASS	CARBON #	COMPOUND
		Total Alkenes
	4	
	4	1,3-Butadiene
	4	cis-2-Butene
Alkenes	5	trans-2-Butene
	5	2-Methyl-1-butene
	5	2-Methyl-2-butene
	5	cis-2-Pentene
	6	Benzene
	7	Toluene
	8	Ethylbenzene
	8	m-Xylene
	8	o-Xylene
Alkyl-Monoaromatics	8	p-Xylene
	9	1,2,4-Trimethylbenzene
	9	1,3,5-Trimethylbenzene
	9	1-Methyl-2-ethylbenzene
	9	1-Methyl-3-ethylbenzene
	9	1-Methyl-4-ethylbenzene
	4	Isobutane
	5	Isopentane
	6	2,2-Dimethylbutane
	6	2,3-Dimethylbutane
	6	2-Methylpentane
	6	3-Methylpentane
	7	2,4-Dimethylpentane
Branched Alkanes	7	2-Methylhexane
	7	3-Methylhexane
	8	2,2,4-Trimethylpentane
	8	2,3,3-Trimethylpentane
	8	2,3,4-Trimethylpentane
	8	2,3-Dimethylhexane
	8	2,4-Dimethylhexane
	8	3-Methylheptane
Cycloalkanes	5	Cyclopentane
	6	Cyclohexane
	6	Methylcyclopentane
	7	Methycyclohexane
n-Alkanes	4	n-Butane
	5	n-Pentane
	6	n-Hexane
	7	n-Heptane
		Total Naphthalenes
Naphthalenes	10	Naphthalene
	11	1-Methylnaphthalene
	11	2-Methylnaphthalene
Oxygenates	5	Methyl-tert-butylether
Total Aromatics		Total Aromatics
Total Monoaromatics		Total Benzene, Toluene and Xylenes
Total Straight-Chain and Branched Alkanes		Total Straight-Chain and Branched Alkanes
Gasoline Blending Agents and Additives		
		2,2,4-trimethylpentane
Anti-knock		tetraethyl lead
		tetramethyl lead
		tert-butyl alcohol
		methyl-tert-butyl-p-cresol
		ortho-alkylated phenols
		p-phenylenediamine
anti-oxidants		aminophenols
		2,6-di-ter-butyl-p-cresol
Metal Activators		N,N-disalicylidene-1,2-diaminopropane
Lead Scavengers		1,2-dibromoethane=(ethylene dibromide)
		1,2-dichloroethane=(ethylene dichloride)
Anti-rusting Agents		fatty acid amines
		sulfonated
		Alcohols
		gycols
Anti-icing Agents		amides
		amines
		organophospate salts
Upper Cylinder Lubricants		Cycloalkane distillates
detergents		aminohydroxy amide
		alkyl derivatives of azobenzen-4-azo-2-naphthol
Dyes		benzene-azo-2-naphthol
		p-diethylaminoazobenzene
		1,4-di-isopropylaminanthraquinone

Reference: Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG) Volumes 1-5 (1999)

Table 5

SUMMARY OF COMPOSITION DATA FOR NO. 2 FUEL OIL		
Family	Carbons	Compound
	13	Total
Methyldibenzothiophenes		
	14	Total
Tetramethylnaphthalenes		
	15	Total
Tremethyldibenzothiophenes		
Polynuclear Aromatics		Total Acenaphthalenes
		Total Acenaphthenes
		Total Biphenyls and
Acenaphthenes		
Polynuclear Aromatics (cont.)		
		Total Methylfluoranthenes
and Pyrenes		
		Total Phenanthrenes
		Total Tricyclicaromatics
	12	Acenaphthene
	12	Acenaphthylene
	14	Anthracene
	14	Phenanthrene
	15	1-Methylphenanthrene
	15	2-Methylanthracene
	15	2-Methylphenanthrene
	15	Methylanthracene
	15	Total Methylphenanthrenes
	16	9,10-Dimethylanthracene
	16	Fluoranthene
	16	Pyrene
	16	Total Dimethylphenanthrenes
	17	Total
Trimethylphenanthrenes		
	18	Benz(a)anthracene
	18	Chrysene
	18	Total
Tetramethylphenanthrenes		
	18	Triphenylene
	19	Total Methylchrysenes
	20	Benzo(a)pyrene
	20	Benzo(e)pyrene
	20	Benzo(g,h,i)pyrene
	20	Total Dimethylchrysenes
	21	Total Trimethylchrysenes
	22	Benzo(g,h,i)perylene
Total Aromatics		Total Aromatics
Total Branched Alkanes		Total Branched Alkanes
Total n-Alkanes		Total n-Alkanes
Total Straight-Chain and Branched Alkanes		Total Straight-Chain and Branched Alkanes

Reference: Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG) Volumes 1-5 (1999)

Table 6 ATSDR Total Petroleum Hydrocarbon (TPH) Fractions*

Fraction	Carbon Number	Chemical	Inhalation Minimal Risk Level (exposure duration) ug/m^3	U.S. Environmental Protection Agency Cancer Classification	Critical Effect (exposure duration)
Aromatic C5 - C9 (Indicator Compounds)	6	Benzene	160 (Acute) 12.8 (Intermediate)	Group A (known human carcinogen)	(Acute) Immunological/Lymphoreticular (Intermediate) Neurological
	7	Toluene	11,304 (Acute) 3,768 (Chronic)	Group D (not classifiable to its carcinogenicity to humans)	(Acute) Neurological (Intermediate) Neurological
	8	Ethylbenzene	868 (Intermediate)	Group D (not classifiable to its carcinogenicity to humans)	(Intermediate) Neurological
	8	Xylenes (mixed)	4,342 (Acute) 3,039 (Intermediate) 434 (Chronic)	Group D (not classifiable to its carcinogenicity to humans)	(Acute) Neurological (Intermediate) Developmental Neurological (Chronic) Neurological
Aromatic C9 - C16	9	Napthalene	10.5 (Chronic)	Group D (not classifiable to its carcinogenicity to humans)	(Chronic) Respiratory
Aliphatic C5 -C8	6	n-Hexane	211 (Chronic)	Group D (not classifiable to its carcinogenicity to humans)	(Chronic) Neurological
Aliphatic C9 -C16	9 -16	JP-4 (Jet Fuel)	9,000 (Intermediate)	NA	(Intermediate) Hepatic

NA = Not Available

Reference: Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Total Petroleum Hydrocarbons.(1999)

Figures

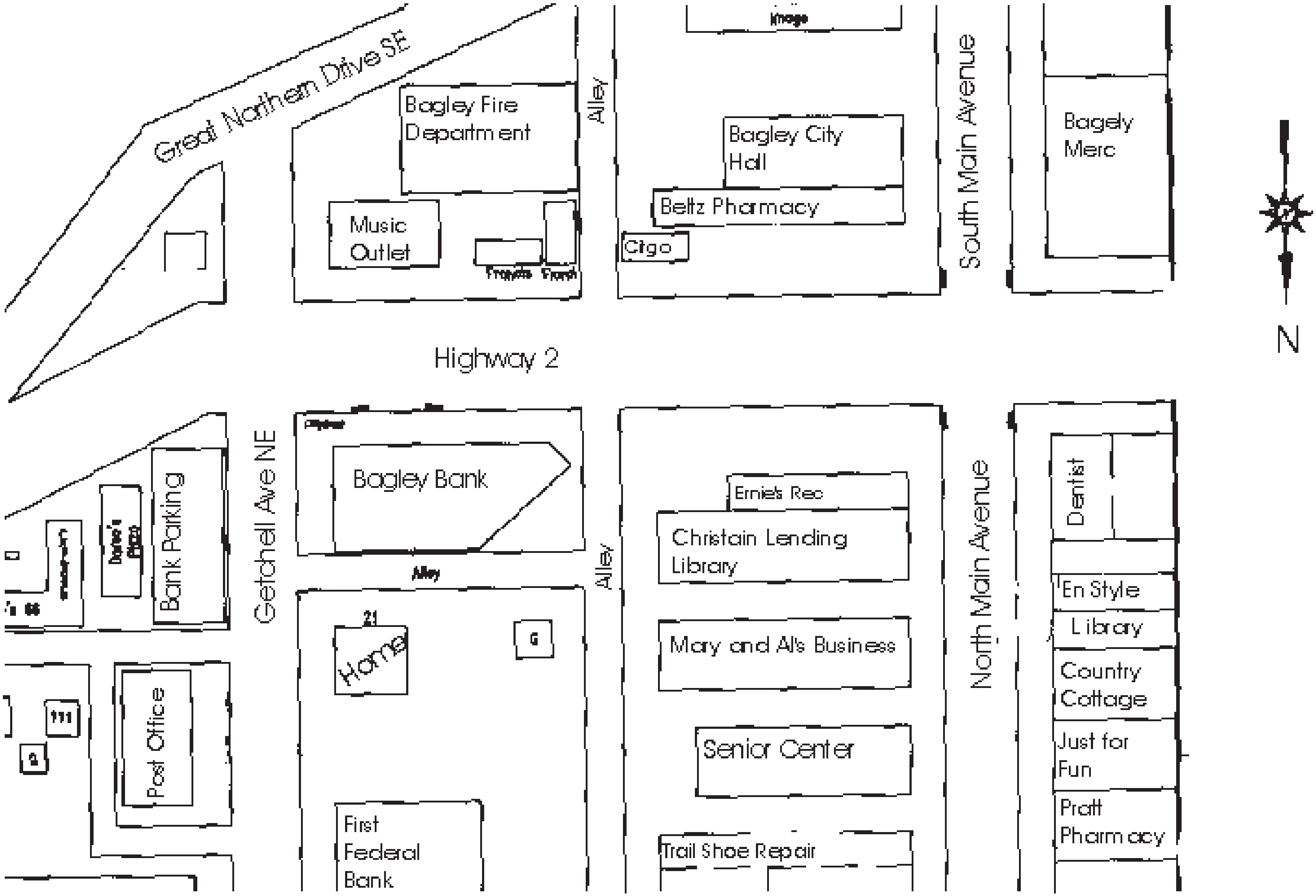
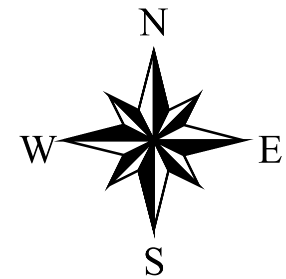
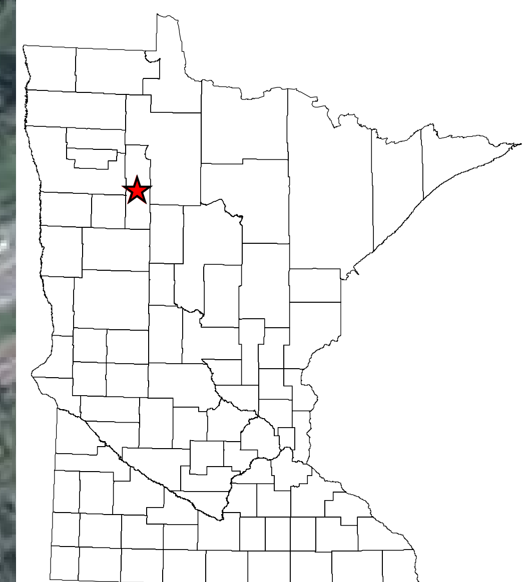


Figure 1. City of Bagley

Figure 2 Bagley Bank





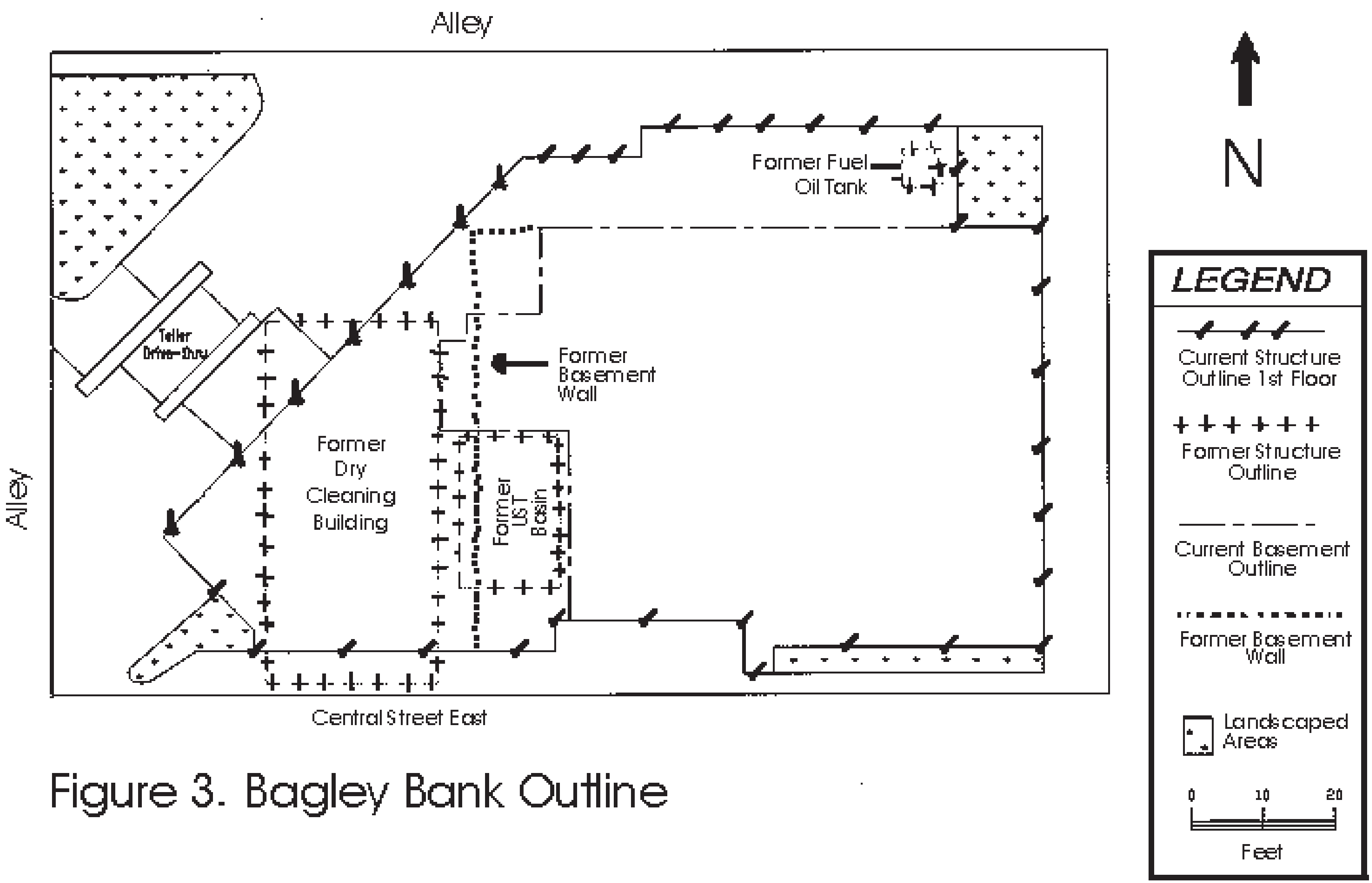


Figure 3. Bagley Bank Outline

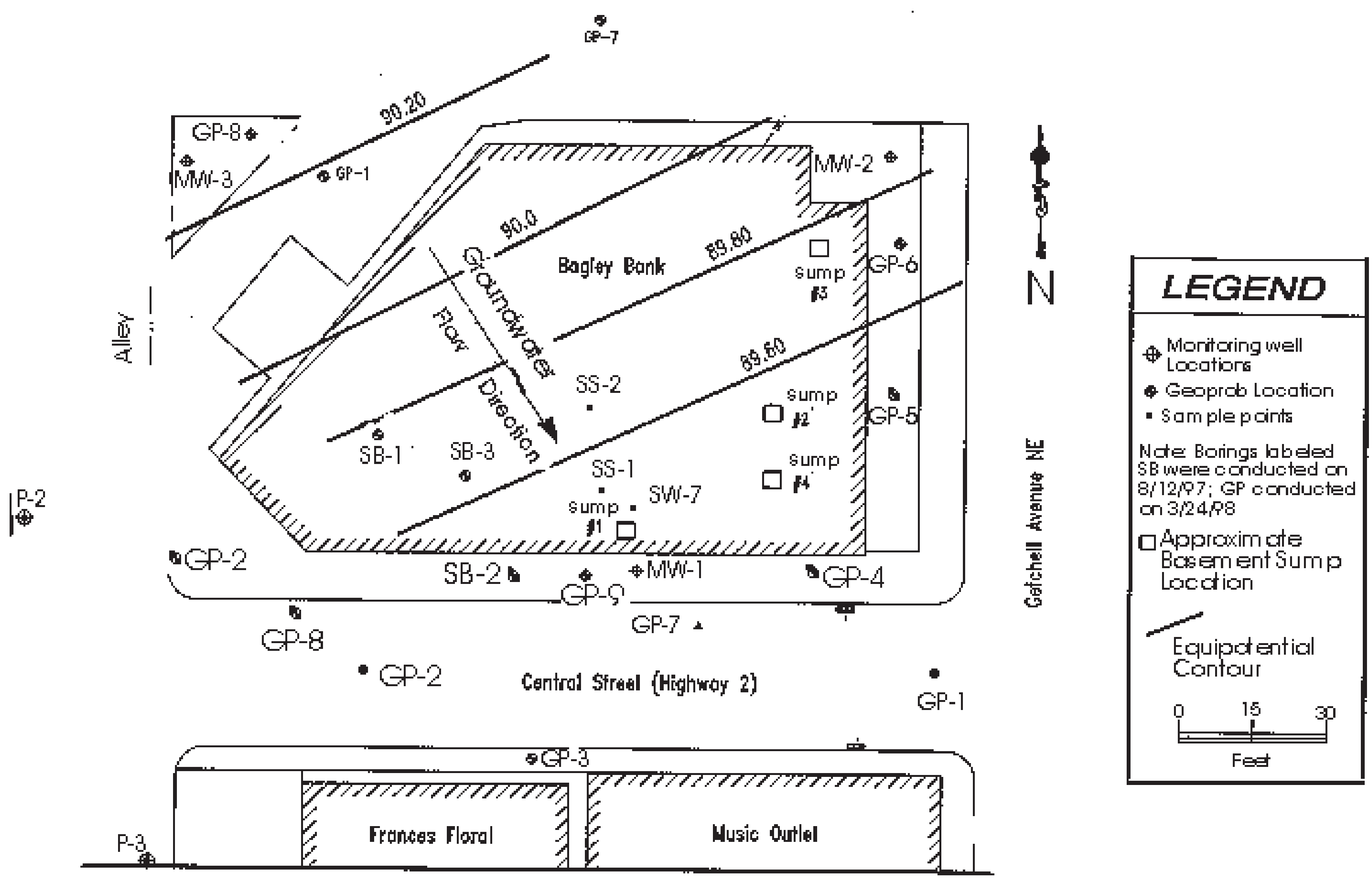


Figure 4. Sumps and Soil Sample Locations, and Groundwater Flow Direction

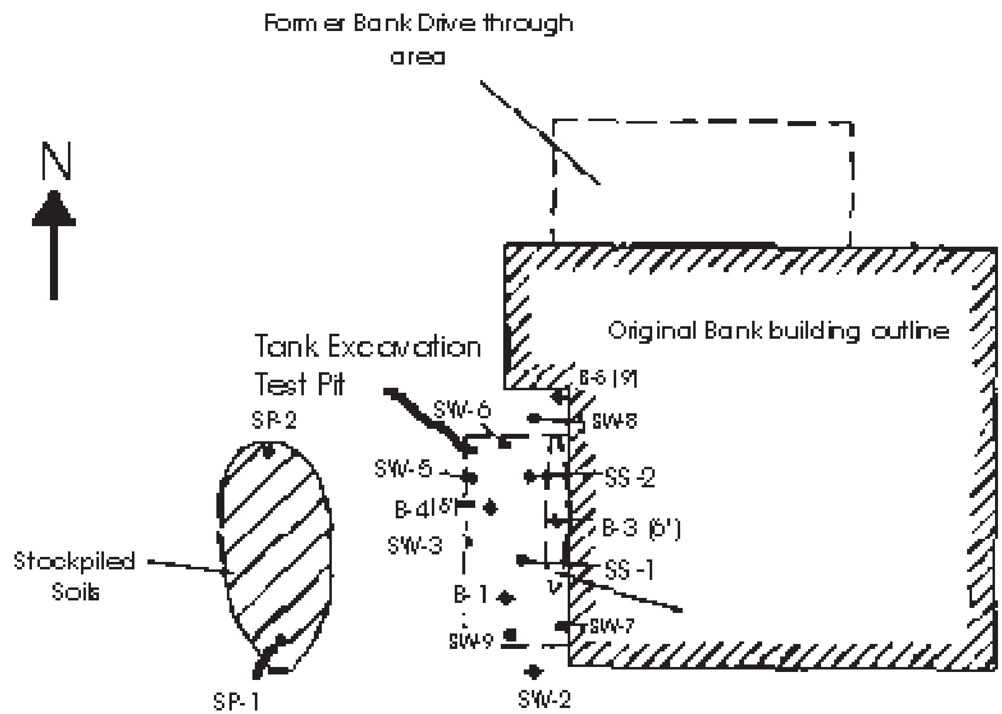


Figure 5. Tank Excavation Soil Sample Locations

Figure 6 Bagley Bank Sump # 4

Appendix A

Interim Screening Concentrations for Carcinogens

Screening Criteria and Standards for Contaminants in Indoor Air (in ug/m^3)

Compound	MDH Acute HRV	MDH Chronic HRV	EPA Reference Concentration (RfC)	MDH modified Interim Screening Concentration (ISC)	Conversion Factor*
Acetone			350		2.42
Benzene	1,000	1.3 - 4.5			3.19
Bromomethane		5			3.88
Carbon tetrachloride				5.3	6.89
Chloromethane			90		2.06
1,2-Dichlorobenzene			200		6.11
1,3-Dichlorobenzene			110		6.11
1,4-Dichlorobenzene			800		6.11
Dichlorodifluoromethane			200		4.95
1,1-Dichloroethane			500		4.05
1,2-Dichloroethane				3.1	4.05
Ethylbenzene	10,000		1,000		4.34
Methylene chloride	10,000	20			3.53
Styrene	21,000	1000			4.26
Tetrachlorethylene	20,000			9.2	6.89
Toluene	37,000	400			3.77
1,2,4-Trichlorobenzene			200		7.42
1,1,1-Trichloroethane			2,200		5.46
Trichloroethylene	2,000			1.1	5.46
Trichlorofluoromethane			700		5.62
1,2,4-Trimethylbenzene			6		4.92
1,3,5-Trimethylbenzene			6		4.92
Vinyl chloride		1		3.2	2.6
Xylenes	43,000		700		4.34

*(Air concentration in parts per billion x Conversion Factor = ug/m^3)

Calculation of Interim Screening Concentrations for Potential Carcinogens

Inhalation Unit Risk (risk per ug/m^3) = Slope Factor x 1 / BW x IR x 10^{-3} (mg/ug)

where: BW = Body Weight, Adult (70 kg)
IR = Inhalation Rate, Adult (20 m^3/day)
Slope Factor = Cancer Slope Factor, (mg/kg/day)$^{-1}$

Interim Screening Concentration (ISC, in ug/m^3) = $\frac{\text{TR}}{\text{Unit Risk}}$

where: TR = Target Risk (1 x 10^{-5})

Modifying Factor Calculation for Bank Worker Scenario

Residential Exposure Rate:

20 m^3/day x 7 days/week = 140 m^3/week

Bank Work Expsorure Rate:

10 m^3/day x 5 days/week = 50 m^3/week

Modifying Factor = $\frac{140 \text{ m}^3\text{/week}}{50 \text{ m}^3\text{/week}}$ = 2.8