Terracon

# SUBSURFACE ASSESSMENT AND FEASIBILITY STUDY

**PAYNESVILLE PUBLIC WATER SUPPLY - MPCA**
**MINNESOTA STATE HIGHWAY 23**
**PAYNESVILLE, MINNESOTA**
**MPCA SITE ID #: LEAK00000131**

**Terracon Project No. 41987018**
**October 13, 1998**

*Prepared for:*

**MINNESOTA POLLUTION CONTROL AGENCY**
**Brainerd, Minnesota 56401**

*Prepared by:*

**TERRACON**
**White Bear Lake, Minnesota 55110**

October 13, 1998

Terracon
3535 Hoffman Road East
White Bear Lake, Minnesota 55110-5376
(612) 770-1500 Fax: (612) 770-1657

Mr. Don Milless
Minnesota Pollution Control Agency
Region II - North Central Office
1601 Minnesota Drive
Brainerd, Minnesota 56401

RE: Subsurface Assessment And Feasibility Study
Paynesville Public Water Supply - MPCA
Minnesota State Highway 23
Paynesville, Minnesota
MPCA Site ID #: LEAK00000131

Dear Mr. Milless:

This report presents the results of subsurface assessment and feasibility study activities coordinated by Terracon at the above referenced site (Figure 1). These activities were authorized by the Minnesota Pollution Control Agency (MPCA) under Work Orders TERRA-189 and LTE-9924.

**BACKGROUND INFORMATION**

Gasoline contamination was detected in ground water samples collected from a municipal water well (CW-4) in 1985 (LEAK00000131). Ground water sampling activities performed during 1997 detected increasing concentrations of benzene and 1,2-dichloroethane in city wells CW-3 and CW-4 (Figure 2). Several open and closed leaking underground storage tank (LUST) sites were known to exist within an approximately one-quarter mile radius of the impacted wells. Terracon was contracted in April 1998 to review historical information and complete a series of assessment tasks to attempt to locate the source(s) of petroleum contamination impacting the city wells.

Information obtained from the MPCA, City of Paynesville, and a Fire Underwriters Inspection Bureau Map prepared in 1961 identified twenty-one potential sources of petroleum contamination in the study area (Figure 2). The identified potential sources are summarized on Table 1.

Previous assessment activities completed in the area indicate that the subsurface generally consists of interbedded sand, sandy gravel and clay units. One or more clay units ranging in thickness from 5 to 30 feet was encountered between approximately 30 to 50 feet below ground surface (bgs) as noted on the logs from the city wells (Appendix D). The water table is typically encountered approximately 20 feet bgs. The horizontal ground water flow direction in the water

east edge of the Casey's facility located at the southeast corner of the intersection of Lake Avenue and Hoffman Street (State Highways 124 and 23).

The subsurface in the area north of Hoffman Street (CW-3, CW-4, DW-1, DB-1, and DB-2) generally consists of 10 to 20 feet of sand to sandy silt overlying a sandy silt and gravel till unit to a depth of from 30 to 50 feet below ground surface (bgs). The massive till unit is underlain by thin interbedded sand, silty sand, and sandy silt lenses which grade into a massive sand unit at a depth of 50 to 60 feet bgs. The sand unit generally consists of fine to coarse grained moderate to well sorted sand with some gravel lenses. The unit extends to a depth of from 90 to 110 feet bgs where a second massive till unit was encountered in wells CW-3, CW-5 and CW-6. The water table is typically encountered approximately 20 feet bgs. Geologic cross-sections of the site are depicted in Figures 4B through 4E. Copies of the soil boring logs, well construction logs and potable well logs are included in Appendix D.

Soil samples collected from the soil probes were screened for the presence of organic vapor in the field using a photoionization detector consistent with MPCA guidance. Organic vapors were not detected above background concentrations with the exception of borings DB-1, DW-5 and DW-6. Organic vapor concentrations ranging from 6 to 11 parts per million (ppm) were detected in the sand and gravel unit approximately 47 bgs and from 18 to 52 ppm in the sand unit encountered approximately 60 bgs. This sand unit appears to correspond to the top of the aquifer utilized for drink water. Soil samples were not submitted for laboratory analysis because of the low to non-detectable organic vapor concentrations. Organic vapor monitoring data is presented on the boring logs in Appendix D.

Methods utilized for the advancement of the soil probes and borings and the collection of soil and ground water samples are provided in Appendix C. The laboratory and Geoprobe analytical reports for the soil and ground water analyses are presented in Appendix E.

## HYDROGEOLOGIC CONDITIONS

Ground water elevations have been recorded from the monitoring wells and select potable wells on seven occasions. Ground water elevation data are presented in Table 3. Ground water contour maps prepared using data collected from water table monitoring wells on May 20, 1998 and August 20, 1998 are presented in Figures 6A and 6B. These data indicate that the horizontal ground water flow direction in the water table aquifer is to the northeast towards the North Fork of the Crow River. A northeasterly ground water flow direction in the water table aquifer is generally consistent with that calculated by others.

Ground water contour maps prepared using data collected from monitoring wells screened from approximately 80 to 90 feet bgs on April 22, 1998 when well CW-4 was not operational and on

August 20, 1998 when CW-4 was operational are presented in Figures 6C and 6D. These data indicate that the horizontal ground water flow direction within drinking water aquifer is influenced significantly by ground water pumping activities. Similar effects were observed between fluid levels collected from wells completed in the drinking water on May 20, 1999 prior to a ground water pumping test utilizing well CW-4 and those collected near the end of the test on May 21, 1998. The ground water flow regime is likely being influence by the complex geology, unique boundary conditions and variable pumping activities at the city wells.

Ground water elevation data from the wells indicate that the water table gradient is relatively flat. The horizontal hydraulic gradient on August 20, 1998 was calculated to be approximately 1.5 x $10^3$. Data collected from wells MW-16, MW-17, DW-5 and DW-6 indicate that there is a downward vertical component to ground water flow. A downward vertical gradient would be anticipated in a geologic setting where the drinking water aquifer appears to be at least semi-confined in most of the area and being utilized as the primary source of water.

## GROUND WATER ANALYSES

Select ground water samples were collected from the soil probes and borings from the water table to assess potential sources, and at discrete intervals to develop a vertical profile of dissolved phase contamination within the water bearing units. In addition, ground water samples were collected from monitoring wells DW-1, DW-2, DW-3, and DW-4 on two occasions. The ground water samples collected from the soil probes and borings were analyzed in the field using a gas chromatograph (GC) located in the Geoprobe for the presence of benzene, toluene, ethyl benzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), naphthalene and 1,2-dichloroethane. Select ground water samples from the probes/borings and those from the monitoring wells were submitted for laboratory analysis for the presence of volatile organic compounds (VOCs) using MDH Method 465E, BTEX, MTBE and gasoline range organics (GRO). The cumulative ground water analytical data are summarized in Tables 4 and 5.

Organic vapor monitoring of soil samples collected from boring DB-1 and ground water analytical results indicate that four petroleum related water table plumes are present in the project area. Soil probe P-29 was advanced near northeast of the former Midtown Service Station and encountered elevated concentrations of gasoline related compounds in the ground water sample collected near the water table (Figure 7). This facility is an open leak site with a history of free phase product on the site. MPCA files indicate that approximately 1,500 cubic yards of impacted soil were excavated and removed from the site. A remediation system is currently being installed which will consist of a series of small diameter product recovery wells. Ground water analytical data collected from probes P-29 through P-33 and assessment activities performed by others indicate that contamination originating from this site had migrated horizontally approximately 800 feet to the northeast in the water table aquifer. The analytical results from discrete ground water

samples collected from probes advanced beneath the water table and from monitoring well MW-17 indicate that benzene concentrations were detected in excess of 1,000 micrograms per liter (ug/L) at depths from 40 to 60 feet bgs. The inferred extend of benzene contamination in the ground water at a depth of 44 feet bgs is depicted in Figure 7. The available information suggests that the absence or limited thickness of the till unit in area south of Hoffman Street is the conduit by which contamination is reaching the drinking water aquifer and then migrating to wells CW-3 and CW-4. Benzene contamination in the drinking water aquifer appears to extend from this area towards wells CW-3 and CW-4. ROST data collected by Dakota Technologies, Inc. indicates that free phase product is present at the water table in the vicinity of this site. The ROST data also suggest that the product may consist of both gasoline and diesel fuel (Appendix G).

Soil probe P-17 was advanced in the road right-of-way adjacent to the abandoned Gottwald Oil Company facility and encountered elevated concentrations of diesel range organics (DRO) in the ground water sample collected at the water table. This facility was previously operated as a bulk fuel storage plant and service station (Figure 2). Underground storage tanks and fuel dispensers are currently on-site.

Soil boring DB-1 was advanced near well CW-3 and encountered elevated organic vapor levels in soil samples collected near the water table with a DRO concentration of 57,000 ug/L in a ground water sample. Subsequent sampling of monitoring well BEI MW-1 installed at the Farmers Union Cooperative facility north of well CW-3 as part of a pesticide assessment detected 170 ug/L of DRO. The available information suggests the contamination originating from a current or former bulk petroleum facility located north of well CW-3 has impacted the water table aquifer. The analysis of discrete ground water samples collected from soil boring DB-1 at depths below the water table detected low concentrations of petroleum related compounds, but did not appear to be indicative of this contamination having impacted well CW-4.

Soil boring DB-3 was advanced near the intersection of Hoffman Street and Washburne Avenue and encountered naphthalene at a concentration of 400 ug/L. The analysis of additional discrete ground water samples collected from soil boring DB-3 at depths below the water table did not detect the target parameters above the method detection limits (Figure 5).

## POTABLE WELL SAMPLING

Ground water samples have been collected from city wells CW-3 and CW-4 on five occasions and from the treatment plant influent and effluent (filtered) on four occasions. Active and inactive potable wells located at the Paynesville Nursery (Nursery), America Milk Producers, Inc. (AMPI), and the south well at the Paynesville Bus Garage were also sampled. The ground water samples from the wells were analyzed for the presence of VOCs (MDH Method 465E). The analytical results are summarized in Table 5 and the laboratory reports are included in Appendix E. The

target parameters were not detected above laboratory method detection limits in samples collected from the Nursery, AMPI, and Bus Garage wells with the exception of 0.35 ug/L of toluene in the sample from the Bus Garage.

The analysis of ground water samples collected from city wells CW-3 and CW-4 during 1998 typically detected concentrations of benzene ranging between 5 and 10 ug/L. Concentrations of 1,2-dichloroethane below the MDH Health Risk Limits (HRLs) were also detected in samples from well CW-4. Benzene concentrations in samples collected from well CW-4 have been increasing since the city began pumping the well. The effluent from the well was at first intermittently pumped to the sanitary sewer starting in June 1998 and then to the storm sewer in July 1998 at a continuous flow rate of approximately 50 gallons per minute (gpm). Once an NPDES Permit was obtained by the City of Paynesville (MN0064238), underground piping was installed between the wellhead and the storm sewer to allow year round pumping. A smaller pump has also been installed in well CW-4 to decrease the electrical cost of these activities. Benzene concentrations in well CW-3 appear to be decreasing in response to this pumping strategy. City well CW-3 is currently being operated at a reduced flow rate of approximately 100 gpm.

## GROUND WATER PUMPING TESTS

A ground water pumping test was performed on city well CW-3, on May 20,1998 at a rate of approximately 200 gallons per minute over a 24 hour period. The test utilizing the existing pump in the well with ground water being discharged to the storm sewer. The goal of the test was to evaluate the hydrogeologic setting with respect to communication between the water table drinking water aquifers, provide aquifer parameter with which the MPCA could prepare a ground water model, establish a pumping rate at which the well could be operated to contain the contaminant plume and drinking water aquifers and assess whether the well seal could have failed.

Fluid level data collected at the end of the test indicated greater than 0.1 feet drawdown in monitoring wells through most of the study area with almost one foot of drawdown observed in monitoring well DW-4 more than 1,700 feet to the southeast. In addition, the influence of pumping activities at wells CW-5 and CW-6 can be seen in the plot of drawdown versus elapsed time. Ground water samples collected from the discharge of well CW-4 were analyzed for VOCs, BTEX, MTBE and GRO (Table 5). Low concentrations of benzene and 1,2-dichoroethane were detected in the sample collected before the end of the test suggesting that pumping activities were responsible for the movement of the plume to the well and additional pumping of the well may limit contaminant migration towards the other city wells.

Fluid level data collected during the ground water pumping test was used to calculate hydraulic conductivity, transmissivity, and storativity values for the aquifer using the Cooper-Jacob Straight

Line Method (Cooper & Jacob, 1946). Recovery data from the pumping well was analyzed using a method after Theis & Jacob for confined aquifers in the ground water analytical software package Aquifer Test Version 2.0. The results of these tests indicate a mean hydraulic conductivity using the Cooper-Jacob and Theis & Jacob methods of 1,760 gallons per day per square foot (gpd/ft$^2$). The mean transmissivity using the Cooper-Jacob and Theis & Jacob methods was 52,798 gpd/ft. Storativity values using the Cooper-Jacob method ranged from 0.0002 to 0.0003, respectively.

A ground water pumping test was performed using well DW-5 on August 20,1998 at a rate of approximately 10 gallons per minute over a six hour period. Well DW-5 is screened from 58 to 68 feet bgs at the top of the drinking water aquifer where the high organic vapor concentrations were observed during drilling activities. The test was conducted utilizing a electric submersible pump with ground water being discharged to the sanitary sewer. The goal of the test was to evaluate the hydrogeologic setting with respect to communication between the water table and drinking water aquifers and provide aquifer parameters to allow for the design of a ground water pump out system to attempt to limit migration of contaminant plume.

Fluid level data collected at the end of the test indicated greater than 0.1 feet drawdown in monitoring wells DW-6 and MW-17. Drawdown was not observed in Midtown wells MW-1, MW-10, MW-16 or RW. The influence of pumping activities at the city wells appears to be the cause of the fluctuations observed in the plot of drawdown versus elapsed time. Ground water samples collected from the discharge of well DW-5 were analyzed for the VOCs, GRO, polynuclear aromatic hydrocarbons (PAHs), RCRA metals, iron, calcium, manganese, magnesium, hardness, chemical oxygen demand, and total suspended solids (see laboratory report of complete summary). Benzene and 1,2-dichoroethane were detected in a sample collected two hours in to the test at concentrations of 2,300 ug/L and 110 ug/L, respectively. The PAH's naphthalene, acenaphthylene, and pyrene were detected at concentrations less than 2 ug/L.

Fluid level data collected from monitoring well MW-17 during the ground water pumping test was used to calculate hydraulic conductivity, transmissivity, and storativity values for the aquifer using the Cooper-Jacob Straight Line Method (Cooper & Jacob, 1946). The results of these analysis indicates a hydraulic conductivity 143 gpd/ft$^2$, transmissivity 7,135 gpd/ft, and storativity of 0.008. Results from the pilot test indicated that well DW-5 appears to be able sustain a pumping rate of approximately 10 gpm with approximately 30 feet of drawdown and should influence an area of the drinking water aquifer with benzene concentrations in excess of 1,000 ug/L. The absence of drawdown in the shallow monitoring well (MW-16) nearest well DW-5 suggests that the till unit observed in the boring extends laterally for some distance.

The methods used to perform the pilot tests and analyze the data are described in Appendix C. Data collected during the tests is included in Appendix F. The analytical results from ground water

samples collected from the discharge during the tests are summarized in Table 5 and in the laboratory report in Appendix E.

## FEASIBILITY STUDY

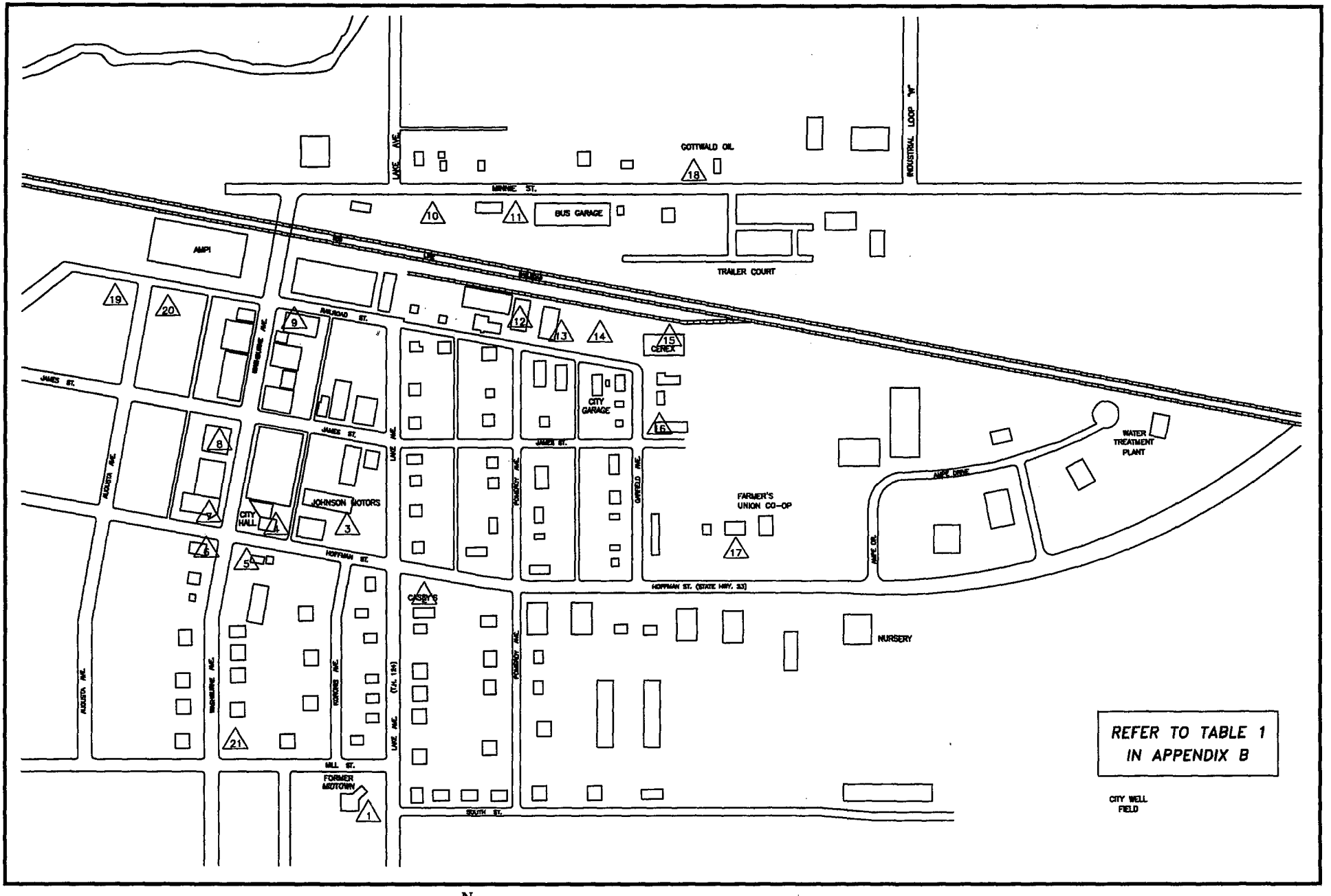
Terracon met with representatives from the City of Paynesville on September 9, 1998 to review the water supply and treatment system. The water supply system consists of four water supply wells, a treatment plant, and an underground holding tank (Figure 3). Wells CW-3 and CW-4 are located within historically developed areas of the city. Wells CW-5 and CW-6 are located on land southeast of town for which the city has an easement. The city wells are connected to a water treatment plant located on the east edge of town via underground piping (Figure 3). The water treatment plant consists of chemical feed pumps which add fluorine and chlorine to the influent prior to it entering a filter composed of gravel, sand and anthracite coal designed to removed iron and manganese. The water enters four filter cells via spray nozzles. The spray chamber is vent out of the top of the filter via a blower unit. The filter is designed to operate at 1,000 gpm and is back flushed approximately every two days with the back-flush effluent routed to the sanitary. Treated water is then pumped to an underground storage tank for distribution.

Assessment data gathered to date suggest there are three principle remedial courses of action to provide a clean source of drinking water to the City of Paynesville. One course of action would be to attempt to remediate or contain the contaminant plume. This course of action would likely involve one or more ground water extraction wells. A second course of action would be to continue to use the existing water supply wells and treat the impacted water to remove the petroleum hydrocarbons. This course of action would involve the use of water treatment technologies either at the treatment plant or at each impacted wellhead. The third course of action would be to provide an alternative source of clean drinking water from outside of the impacted area. This course of action would likely involve the installation of two new municipal wells, transmission lines, and possibly a second water treatment plant. It may be necessary to use a combination of two of this options to ensure clean drinking water.

Each of the principle courses of action may include a variety of permutations which will influence the cost, effectiveness (long term impact), timeliness, and less tangible factors such as future needs, unanticipated contaminants or disruption to the residence/businesses in the area (overall practicality). Each of these principle courses of action are discussed in more detail in the following sections with the advantages and disadvantages of options summarized in the options analysis section. A cost breakdown for these actions will be provided under a separate cover.

### Active Remediation

This course of action would involve the installation of active remedial systems to attempt to remediate and/or contain the contaminant plume which has impacted city wells CW-3 and CW-4. The goal of this course of action may range from temporary containment of the plume to




Terracon
3535 HOFFMAN ROAD EAST
WHITE BEAR LAKE, MN 55110
(612) 770-1500 FAX (612) 770-1657

0 400
Approximate Scale (Feet)

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MPCA – PAYNESVILLE
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

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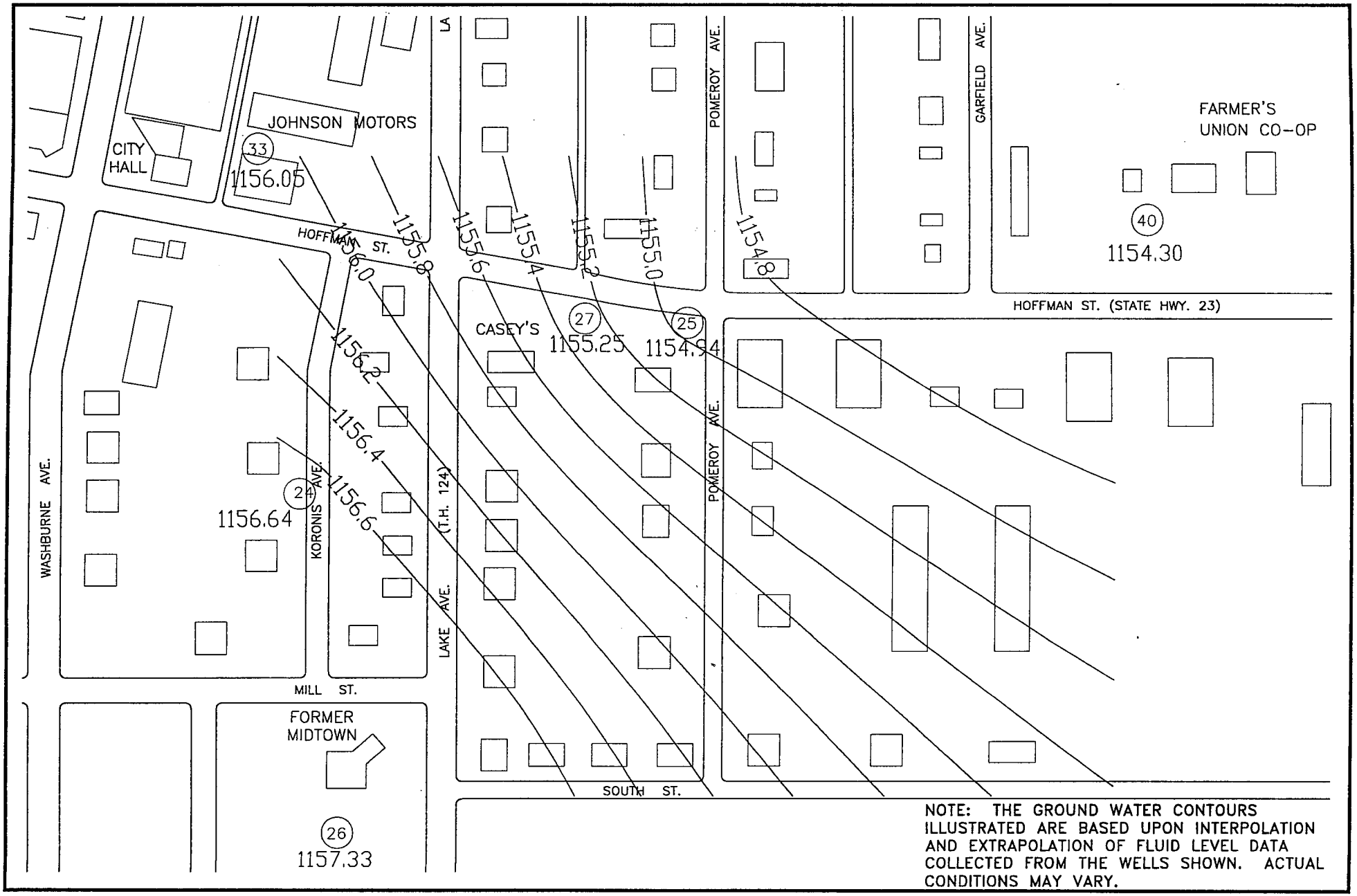
POTENTIAL CONTAMINATION SOURCES

FIGURE 2




NOTE: THE GROUND WATER CONTOURS ILLUSTRATED ARE BASED UPON INTERPOLATION AND EXTRAPOLATION OF FLUID LEVEL DATA COLLECTED FROM THE WELLS SHOWN. ACTUAL CONDITIONS MAY VARY.

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(612) 770-1500 FAX (612) 770-1657

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Approximate Scale (Feet)

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TERRACON PROJECT NO. 41987018

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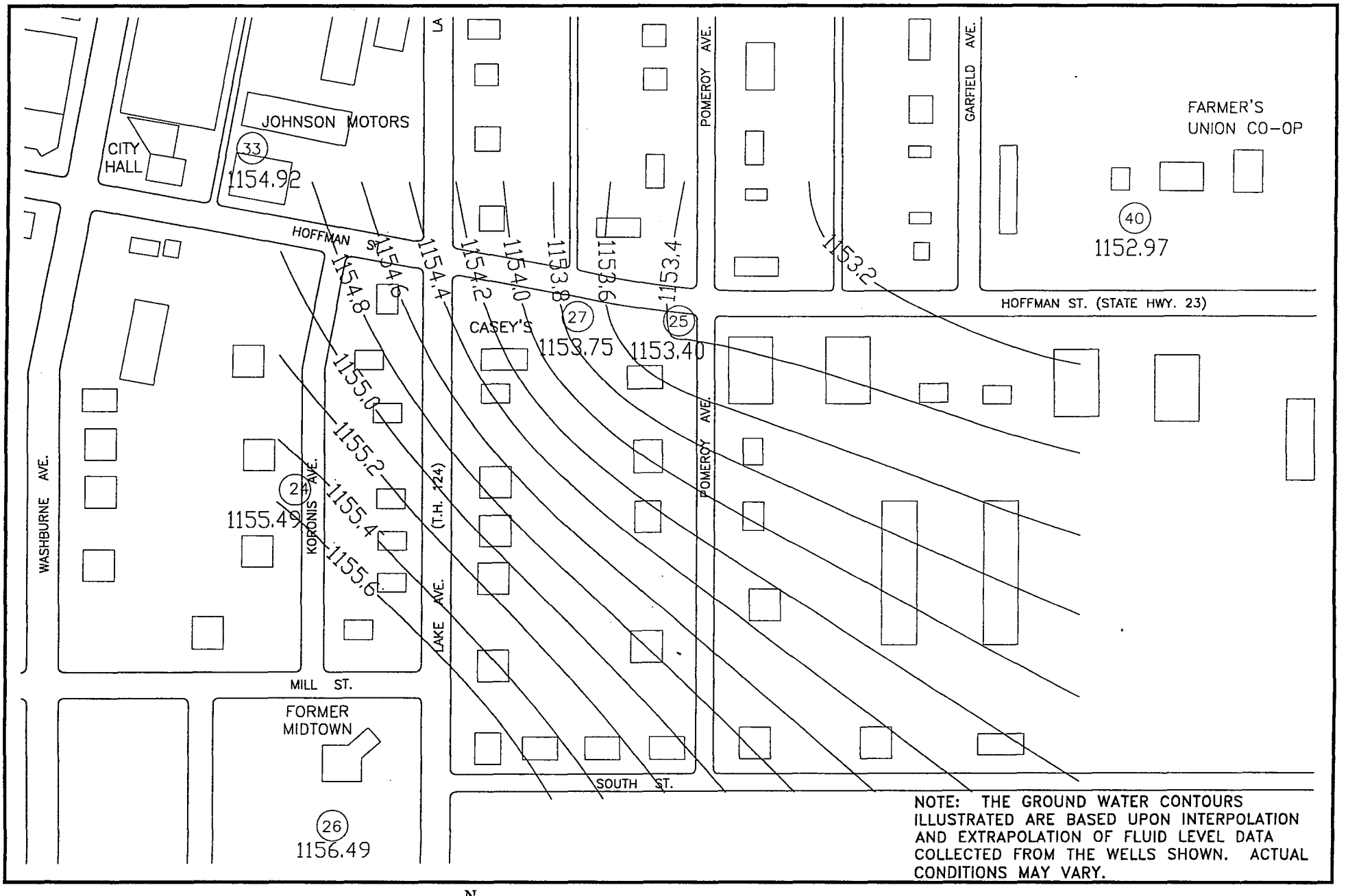
GROUND WATER ELEVATIONS
25' TO 30' MONITORING WELLS
MEASURED 5/20/98

FIGURE 6A




NOTE: THE GROUND WATER CONTOURS ILLUSTRATED ARE BASED UPON INTERPOLATION AND EXTRAPOLATION OF FLUID LEVEL DATA COLLECTED FROM THE WELLS SHOWN. ACTUAL CONDITIONS MAY VARY.

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Approximate Scale (Feet)

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TERRACON PROJECT NO. 41987018

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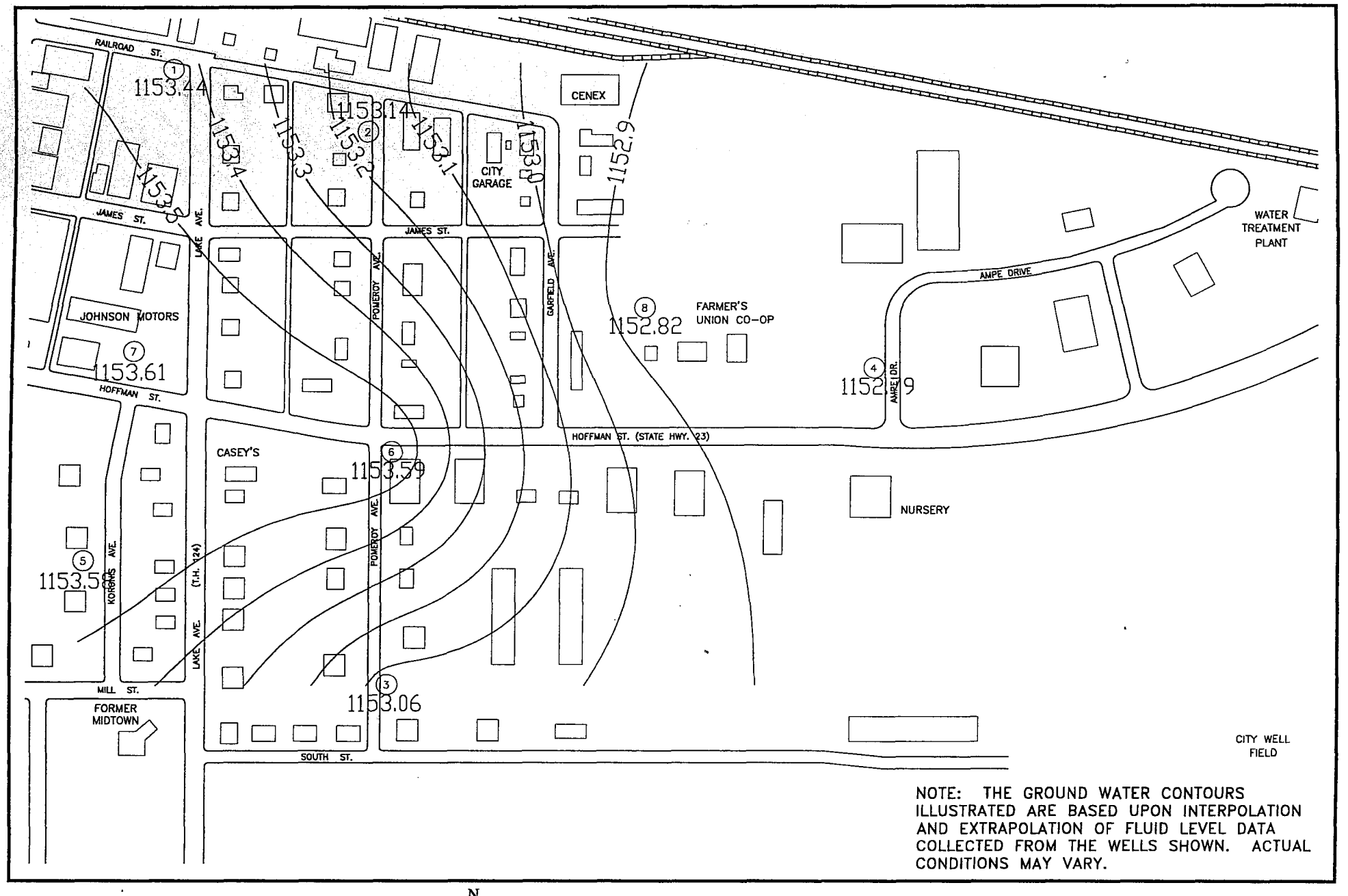
GROUND WATER ELEVATIONS
25' TO 30' MONITORING WELLS
MEASURED 8/20/98

FIGURE 6B




NOTE: THE GROUND WATER CONTOURS ILLUSTRATED ARE BASED UPON INTERPOLATION AND EXTRAPOLATION OF FLUID LEVEL DATA COLLECTED FROM THE WELLS SHOWN. ACTUAL CONDITIONS MAY VARY.

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3535 HOFFMAN ROAD EAST
WHITE BEAR LAKE, MN 55110
(612) 770-1500 FAX (612) 770-1657

0 300
Approximate Scale (Feet)

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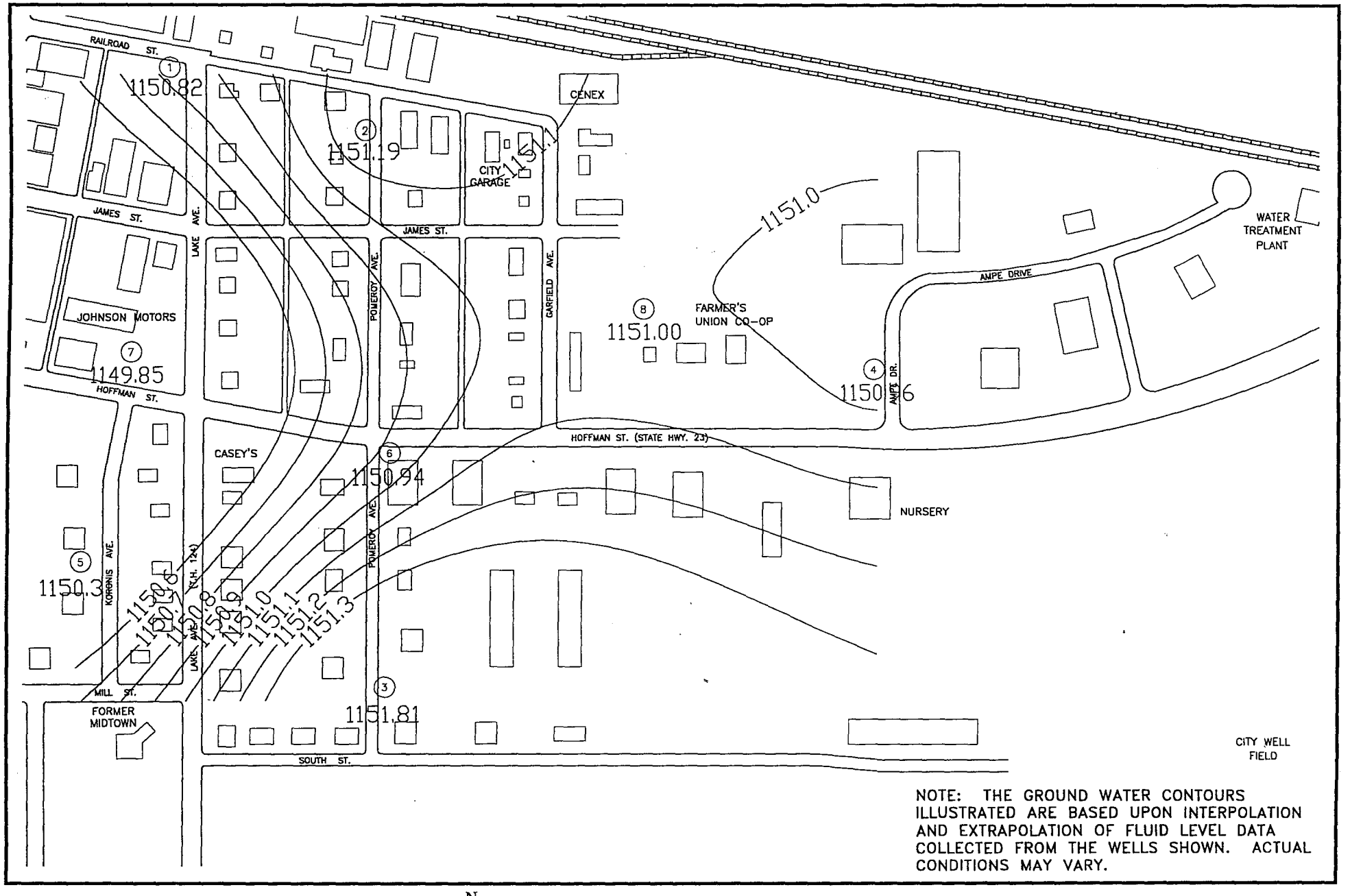
GROUND WATER ELEVATIONS
90' MONITORING WELLS
MEASURED 4/22/98

FIGURE 6C




NOTE: THE GROUND WATER CONTOURS ILLUSTRATED ARE BASED UPON INTERPOLATION AND EXTRAPOLATION OF FLUID LEVEL DATA COLLECTED FROM THE WELLS SHOWN. ACTUAL CONDITIONS MAY VARY.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3535 HOFFMAN ROAD EAST
WHITE BEAR LAKE, MN 55110
(612) 770-1500 FAX (612) 770-1657


0 300
Approximate Scale (Feet)

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TERRACON PROJECT NO. 41987018

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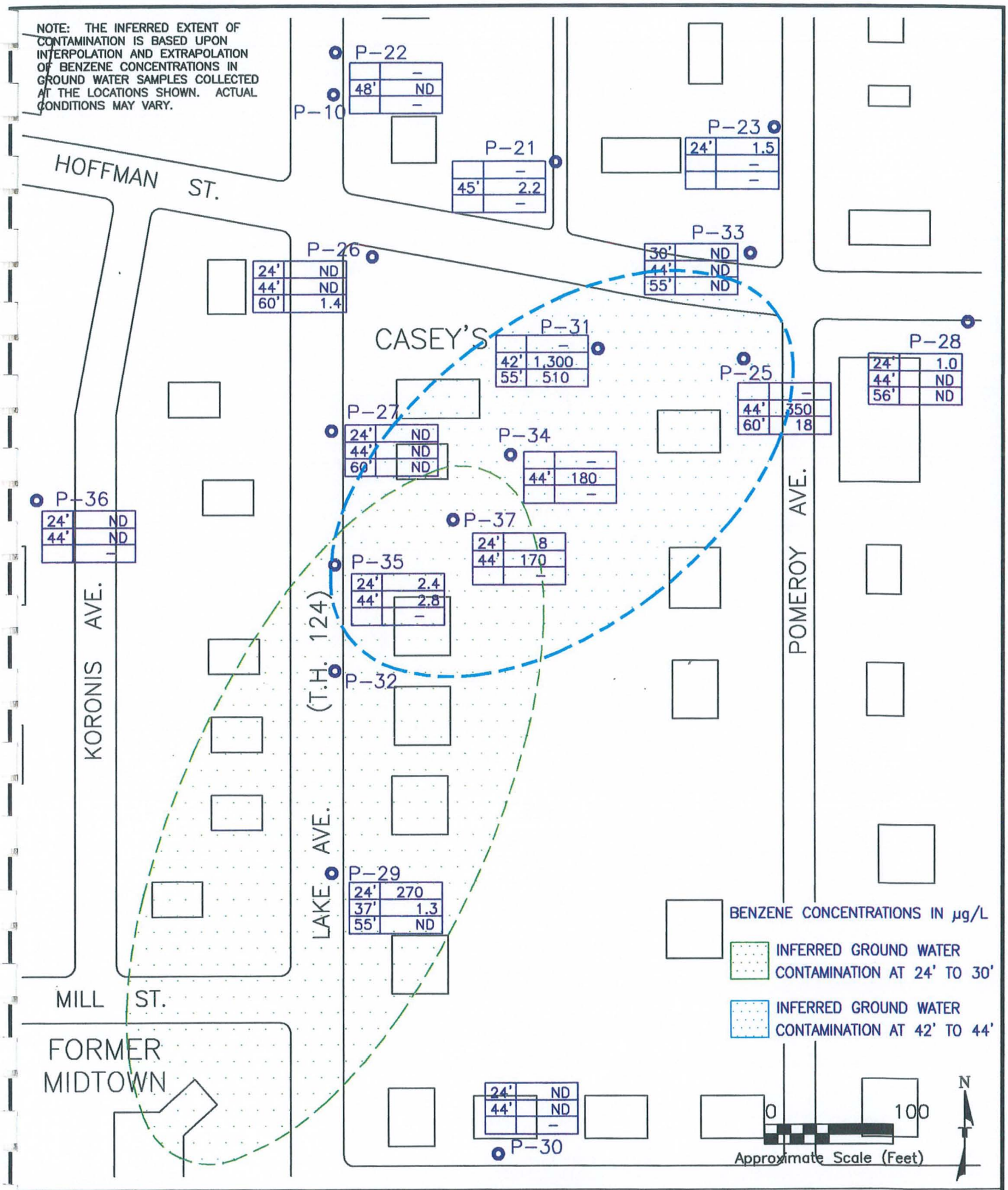
GROUND WATER ELEVATIONS
90' MONITORING WELLS
MEASURED 8/20/98

FIGURE 6D




Terracon
3535 HOFFMAN ROAD EAST
WHITE BEAR LAKE, MN 55110
(612) 770-1500 FAX (612) 770-1657

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INFERRED EXTENT OF CONTAMINATION
GROUND WATER SAMPLES – BORINGS

FIGURE 7

TABLE 3

PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 1 | DW-1 | 03/16/98 | 18.97 | 1,170.73 | 90 | 1,151.76 |
| 1 | DW-1 | 03/25/98 | 19.37 | 1,170.73 | 90 | 1,151.36 |
| 1 | DW-1 | 04/22/98 | 17.29 | 1,170.73 | 90 | 1,153.44 |
| 1 | DW-1 | 05/20/98 | 18.04 | 1,170.73 | 90 | 1,152.69 |
| 1 | DW-1 | 05/21/98 | 19.30 | 1,170.73 | 90 | 1,151.43 |
| 1 | DW-1 | 06/13/98 | 18.61 | 1,170.73 | 90 | 1,152.12 |
| 1 | DW-1 | 08/20/98 | 19.91 | 1,170.73 | 90 | 1,150.82 |
| 2 | DW-2 | 03/16/98 | 17.68 | 1,170.44 | 85 | 1,152.76 |
| 2 | DW-2 | 03/25/98 | 20.12 | 1,170.44 | 85 | 1,150.32 |
| 2 | DW-2 | 04/22/98 | 17.30 | 1,170.44 | 85 | 1,153.14 |
| 2 | DW-2 | 05/20/98 | 18.09 | 1,170.44 | 85 | 1,152.35 |
| 2 | DW-2 | 05/21/98 | 18.88 | 1,170.44 | 85 | 1,151.56 |
| 2 | DW-2 | 06/13/98 | 18.64 | 1,170.44 | 85 | 1,151.80 |
| 2 | DW-2 | 08/20/98 | 19.25 | 1,170.44 | 85 | 1,151.19 |
| 3 | DW-3 | 03/16/98 | 24.08 | 1,176.29 | 90 | 1,152.21 |
| 3 | DW-3 | 03/25/98 | 24.44 | 1,176.29 | 90 | 1,151.85 |
| 3 | DW-3 | 04/22/98 | 23.23 | 1,176.29 | 90 | 1,153.06 |
| 3 | DW-3 | 05/20/98 | 24.00 | 1,176.29 | 90 | 1,152.29 |
| 3 | DW-3 | 05/21/98 | 25.25 | 1,176.29 | 90 | 1,151.04 |
| 3 | DW-3 | 06/13/98 | 24.46 | 1,176.29 | 90 | 1,151.83 |
| 3 | DW-3 | 08/20/98 | 24.48 | 1,176.29 | 90 | 1,151.81 |
| 3 | DW-3 | 09/08/98 | 26.38 | 1,176.29 | 90 | 1,149.91 |
| 4 | DW-4 | 03/16/98 | 19.17 | 1,171.74 | 90 | 1,152.57 |
| 4 | DW-4 | 03/25/98 | 20.08 | 1,171.74 | 90 | 1,151.66 |
| 4 | DW-4 | 04/22/98 | 18.95 | 1,171.74 | 90 | 1,152.79 |
| 4 | DW-4 | 05/20/98 | 19.78 | 1,171.74 | 90 | 1,151.96 |
| 4 | DW-4 | 05/21/98 | 20.77 | 1,171.74 | 90 | 1,150.97 |
| 4 | DW-4 | 06/13/98 | 19.77 | 1,171.74 | 90 | 1,151.97 |

TABLE 3

PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 4 | DW-4 | 08/20/98 | 20.78 | 1,171.74 | 90 | 1,150.96 |
| 4 | DW-4 | 09/08/98 | 21.80 | 1,171.74 | 90 | 1,149.94 |
| 5 | MW-10D | 04/22/98 | 18.67 | 1,172.25 | 90 | 1,153.58 |
| 5 | MW-10D | 05/20/98 | 19.55 | 1,172.25 | 90 | 1,152.70 |
| 5 | MW-10D | 05/21/98 | 21.78 | 1,172.25 | 90 | 1,150.47 |
| 5 | MW-10D | 06/13/98 | 20.82 | 1,172.25 | 90 | 1,151.43 |
| 5 | MW-10D | 08/20/98 | 21.94 | 1,172.25 | 90 | 1,150.31 |
| 5 | MW-10D | 09/08/98 | 23.10 | 1,172.25 | 90 | 1,149.15 |
| 6 | MW-14D | 04/22/98 | 21.89 | 1,175.48 | 90 | 1,153.59 |
| 6 | MW-14D | 05/20/98 | 23.00 | 1,175.48 | 90 | 1,152.48 |
| 6 | MW-14D | 05/21/98 | 24.35 | 1,175.48 | 90 | 1,151.13 |
| 6 | MW-14D | 06/13/98 | 23.99 | 1,175.48 | 90 | 1,151.49 |
| 6 | MW-14D | 08/20/98 | 24.54 | 1,175.48 | 90 | 1,150.94 |
| 6 | MW-14D | 09/08/98 | 26.02 | 1,175.48 | 90 | 1,149.46 |
| 7 | MW-5 | 04/22/98 | 16.80 | 1,170.41 | 89 | 1,153.61 |
| 7 | MW-5 | 05/20/98 | 17.70 | 1,170.41 | 89 | 1,152.71 |
| 7 | MW-5 | 05/21/98 | 20.55 | 1,170.41 | 89 | 1,149.86 |
| 7 | MW-5 | 06/13/98 | 18.79 | 1,170.41 | 89 | 1,151.62 |
| 7 | MW-5 | 08/20/98 | 20.56 | 1,170.41 | 89 | 1,149.85 |
| 8 | MW-7 | 04/22/98 | 19.38 | 1,172.20 | 80 | 1,152.82 |
| 8 | MW-7 | 05/20/98 | 19.64 | 1,172.20 | 80 | 1,152.56 |
| 8 | MW-7 | 05/21/98 | 20.85 | 1,172.20 | 80 | 1,151.35 |
| 8 | MW-7 | 06/13/98 | 20.74 | 1,172.20 | 80 | 1,151.46 |
| 8 | MW-7 | 08/20/98 | 21.20 | 1,172.20 | 80 | 1,151.00 |
| 8 | MW-7 | 09/08/98 | 22.47 | 1,172.20 | 80 | 1,149.73 |
| 10 | CW-4 | 03/16/98 | 21.60 | 1,173.38 | 110 | 1,151.78 |

TABLE 3

PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 10 | CW-4 | 03/25/98 | 21.30 | 1,173.38 | 110 | 1,152.08 |
| 10 | CW-4 | 04/22/98 | 20.32 | 1,173.38 | 110 | 1,153.06 |
| 10 | CW-4 | 05/20/98 | 20.83 | 1,173.38 | 110 | 1,152.55 |
| 10 | CW-4 | 06/13/98 | 23.65 | 1,173.38 | 110 | 1,149.73 |
| 10 | CW-4 | 05/21/98 | 23.85 | 1,173.38 | 110 | 1,149.53 |
| 11 | CW-5 | 04/22/98 | 39.03 | 1,168.49 | 90 | 1,129.46 |
| 11 | CW-5 | 05/21/98 | 40.25 | 1,168.49 | 90 | 1,128.24 |
| 12 | CW-6 | 04/22/98 | 42.25 | 1,171.55 | 97 | 1,129.30 |
| 12 | CW-6 | 05/21/98 | 42.74 | 1,171.55 | 97 | 1,128.81 |
| 17 | Bus Garage | 04/22/98 | 15.67 | 1,169.05 | 50 | 1,153.38 |
| 17 | Bus Garage | 05/21/98 | 16.87 | 1,169.05 | 50 | 1,152.18 |
| 17 | Bus Garage | 08/20/98 | 17.58 | 1,169.05 | 50 | 1,151.47 |
| 18 | CMW | 04/22/98 | 21.18 | 1,171.42 | 120 | 1,150.24 |
| 18 | CMW | 05/21/98 | 21.56 | 1,171.42 | 120 | 1,149.86 |
| 18 | CMW | 08/20/98 | 23.24 | 1,171.42 | 120 | 1,148.18 |
| 20 | MW-1 | 04/22/98 | 16.94 | 1,170.87 | 43 | 1,153.93 |
| 20 | MW-1 | 05/21/98 | 17.76 | 1,170.87 | 43 | 1,153.11 |
| 20 | MW-1 | 08/20/98 | 19.19 | 1,170.87 | 43 | 1,151.68 |
| 21 | MW-2 | 04/22/98 | 17.71 | 1,171.20 | 38 | 1,153.49 |
| 21 | MW-2 | 05/21/98 | 17.83 | 1,171.20 | 38 | 1,153.37 |
| 21 | MW-2 | 08/20/98 | 19.29 | 1,171.20 | 38 | 1,151.91 |
| 23 | MW-1 | 04/22/98 | 16.79 | 1,173.74 | 27 | 1,156.95 |
| 23 | MW-1 | 08/20/98 | 18.38 | 1,173.74 | 27 | 1,155.36 |

TABLE 3

PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 24 | MW-10 | 04/22/98 | 15.01 | 1,171.69 | 27 | 1,156.68 |
| 24 | MW-10 | 05/20/98 | 15.05 | 1,171.69 | 27 | 1,156.64 |
| 24 | MW-10 | 05/21/98 | 15.22 | 1,171.69 | 27 | 1,156.47 |
| 24 | MW-10 | 06/13/98 | 15.44 | 1,171.69 | 27 | 1,156.25 |
| 24 | MW-10 | 08/20/98 | 16.20 | 1,171.69 | 27 | 1,155.49 |
| 25 | MW-14 | 04/22/98 | 17.92 | 1,173.20 | 29 | 1,155.28 |
| 25 | MW-14 | 05/20/98 | 18.26 | 1,173.20 | 29 | 1,154.94 |
| 25 | MW-14 | 05/21/98 | 18.61 | 1,173.20 | 29 | 1,154.59 |
| 25 | MW-14 | 06/13/98 | 18.90 | 1,173.20 | 29 | 1,154.30 |
| 25 | MW-14 | 08/20/98 | 19.80 | 1,173.20 | 29 | 1,153.40 |
| 26 | MW-15 | 04/22/98 | 17.67 | 1,175.09 | 25 | 1,157.42 |
| 26 | MW-15 | 05/21/98 | 17.76 | 1,175.09 | 25 | 1,157.33 |
| 26 | MW-15 | 06/13/98 | 18.01 | 1,175.09 | 25 | 1,157.08 |
| 26 | MW-15 | 08/20/98 | 18.60 | 1,175.09 | 25 | 1,156.49 |
| 27 | MW-16 | 04/22/98 | 15.67 | 1,171.10 | 26 | 1,155.43 |
| 27 | MW-16 | 05/20/98 | 15.85 | 1,171.10 | 26 | 1,155.25 |
| 27 | MW-16 | 05/21/98 | 16.18 | 1,171.10 | 26 | 1,154.92 |
| 27 | MW-16 | 06/13/98 | 16.48 | 1,171.10 | 26 | 1,154.62 |
| 27 | MW-16 | 08/20/98 | 17.35 | 1,171.10 | 26 | 1,153.75 |
| 28 | MW-17 | 04/22/98 | 18.10 | 1,171.53 | 62 | 1,153.43 |
| 28 | MW-17 | 05/20/98 | 19.03 | 1,171.53 | 62 | 1,152.50 |
| 28 | MW-17 | 05/21/98 | 20.66 | 1,171.53 | 62 | 1,150.87 |
| 28 | MW-17 | 06/13/98 | 19.98 | 1,171.53 | 62 | 1,151.55 |
| 28 | MW-17 | 08/20/98 | 21.02 | 1,171.53 | 62 | 1,150.51 |
| 28 | MW-17 | 09/08/98 | 22.28 | 1,171.53 | 62 | 1,149.25 |
| 33 | MW-1 | 04/22/98 | 13.66 | 1,169.35 | | 1,155.69 |

TABLE 3

PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
PAYNESVILLE, MINNESOTA
TERRACON PROJECT NO. 41987018

GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 33 | MW-1 | 05/20/98 | 13.30 | 1,169.35 | | 1,156.05 |
| 33 | MW-1 | 05/21/98 | 13.44 | 1,169.35 | | 1,155.91 |
| 33 | MW-1 | 08/20/98 | 14.43 | 1,169.35 | | 1,154.92 |
| 34 | MW-2 | 04/22/98 | 14.02 | 1,169.75 | | 1,155.73 |
| 34 | MW-2 | 05/20/98 | 13.83 | 1,169.75 | | 1,155.92 |
| 34 | MW-2 | 05/21/98 | 13.94 | 1,169.75 | | 1,155.81 |
| 35 | MW-3 | 04/22/98 | 13.74 | 1,169.60 | | 1,155.86 |
| 35 | MW-3 | 05/20/98 | 13.61 | 1,169.60 | | 1,155.99 |
| 35 | MW-3 | 05/21/98 | 13.76 | 1,169.60 | | 1,155.84 |
| 40 | MW-5 | 05/20/98 | 19.10 | 1,173.40 | | 1,154.30 |
| 40 | MW-5 | 05/21/98 | 18.76 | 1,173.40 | | 1,154.64 |
| 40 | MW-5 | 08/20/98 | 20.43 | 1,173.40 | | 1,152.97 |
| 41 | MW-6 | 05/21/98 | 9.97 | 1,170.81 | | 1,160.84 |
| 42 | CMW | 04/22/98 | 29.54 | 1,168.67 | 95 | 1,139.13 |
| 42 | CMW | 05/21/98 | 30.62 | 1,168.67 | 95 | 1,138.05 |
| 42 | CMW | 08/20/98 | 21.82 | 1,168.67 | 95 | 1,146.85 |
| 43 | CMW | 04/22/98 | 27.37 | 1,167.91 | 95 | 1,140.54 |
| 43 | CMW | 05/21/98 | 28.55 | 1,167.91 | 95 | 1,139.36 |
| 43 | CMW | 08/20/98 | 20.82 | 1,167.91 | 95 | 1,147.09 |
| 44 | MW-4 | 04/22/98 | 14.82 | 1,170.58 | | 1,155.76 |
| 44 | MW-4 | 05/20/98 | 14.72 | 1,170.58 | | 1,155.86 |
| 44 | MW-4 | 05/21/98 | 14.89 | 1,170.58 | | 1,155.69 |
| 45 | DW-5 | 08/20/98 | 22.27 | 1,172.76 | 67 | 1,150.49 |

## TABLE 3

## PAYNESVILLE PUBLIC WATER SUPPLY - MPCA
## PAYNESVILLE, MINNESOTA
## TERRACON PROJECT NO. 41987018

## GROUND WATER ELEVATION DATA

| Well | | Date | Depth to Water | Reference Elevation | Well Depth | Water Table Elevation |
|---|---|---|---|---|---|---|
| 46 | DW-6 | 08/20/98 | 21.28 | 1,172.32 | 45 | 1,151.04 |

Elevations are measured in feet.

Note: Riser pipe elevations are referenced to the top nut of the fire hydrant at the intersection of Hoffman and Augusta with an elevation of 1,173.14 feet AMSL per information provide by SEH.

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