Summary of Annual Reports
from Terracon on the Midtown Service Station Site
(MPCA SITE ID#: LEAK 00000131)

October 13, 1998 – Subsurface Assessment and Feasibility Study

Background information:

Gasoline contamination was detected in ground water samples collected from a municipal water well (CW-4) in 1985 (LEAK 00000131). Ground water sampling activities performed during 1997 detected increasing concentrations of benzene and 1,2-dichloroethane in city well 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 (below ground surface). The horizontal ground water flow direction in the water table aquifer is reportedly to the north-northeast in the direction of the North Fork Crow River approximately 1,500 feet to the north of the site, but appears to be variable.

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 2, 1998 when CW-4 was operational are presented in Figures 6C and 6D. These data indicate that the horizontal groundwater 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 Analyses

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 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 is present at the water table in the vicinity of this site. Soil boring DB-1 was advanced near well CW-3 and encountered elevated organic vapor levels in soil samples collected neat the water table with a DRO (diesel range organics) concentration of 57,000 ug/L in a ground water sample.

Potable Well Sampling

Ground water samples have been collected from cit sells 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), American 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 the 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 a t 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 operate data reduced flow rate of approximately 100 gpm.

Ground Water Pumping Tests

Fluid level data collected at the end of the test indicated greater than 0.1feet 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. 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.

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 filer via a blower unit. The filer 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 these options to ensure clean drinking water.

February 28, 2000 – Annual Monitoring Report - 1999

From Fact Sheet 3.26

Section I. Discussion:
Discuss the results of the monitoring performed since the remedial investigation (RI) report or the last progress report has been submitted. Include any notable trends in the discussion.

Fluid levels were collected from wells (map unit number in parentheses) DW-1((1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson wells M-4(44) and MW-5(7); City of Paynesville monitoring wells identified as map units 42 and 43; test wells CTW-18(18) and TW-1 and Farmers Union Coop wells MW-7(8) on a monthly basis (Figures 1 and 2). The fluid level data is presented in Table 1. Well construction information is summarized in Table 2. The fluid level data from wells screened between 75 and 90 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A through 3E. The contour maps indicate that the horizontal ground water flow direction is to the southeast. A southeasterly flow direction is consistent with previously collected data.

Ground water samples were collected from recovery well DW-5, City Wells CW-3 and CW-4, and the water treatment plant influent and effluent on a monthly basis during 1999 for laboratory analysis, City Well CW-3 and the water treatment plant influent and effluent were sampled to monitoring drinking water quality. City Wells CW-5 and CW-6 were also sampled for laboratory analysis during January, 2000. Recovery well DW-5 and City Well CW-4 were monitored to assess their impact on containing the plume and for discharge permit requirements. The laboratory results are summarized on Table 3.

Laboratory results from City Well CW-3 (9) detected benzene concentrations during 1999 fluctuating from near the detection level of 0.30 ug/L to 1.6 ug/L. The fluctuations may be seasonal. Laboratory results from City Well CW-4(10) decreased during 1999 such that benzene concentrations were less then the Minnesota Department of Health's (MDH) Health Risk Limits (HRLs) and approaching the USEPA Maximum Contaminant Levels (MCLs). This decrease is likely in response to ground water pumping activities at recovery well DW-5 and reduction in the pumping rate for City Well CW-4 (Figure 4A).

The treatment plant effluent and storm discharge to the river laboratory analysis results indicated occasional low benzene and toluene concentrations. The concentrations did not exceed the MDH HRLs.

Laboratory results from monitoring wells DW-6 (46) and MW-17 (28) and recovery well DW-5 (45) indicated decreasing concentrations of petroleum constituents during 1999 apparently in response to ground water pumping activities as well DW-5 (Figure 4B).

If vapor impacts were reported during the RI, discuss the results of the vapor monitoring survey completed during this reporting period. Include in your discussion the sampling instrument and sampling method.

A limited vapor survey was conducted on the following days, March 17, 1999, July 19, 1999 and December 9, 1999. Storm sewer manholes and inlets were screened for the presence of organic vapors using a photo-ionization detector (PID). This device is calibrated to isobutylene and provides a direct reading in parts per million (ppm).

The March 17, 1999 vapor survey included the storm sewer manhole to which City Well #4 is pumped to in the intersection of Railroad Street and Washburne. A vapor survey was also conducted on two storm sewer inlets, west of the Railroad Street and Washburne intersection. The manhole vapor survey recorded a reading of 12 ppm and the storm sewer inlets recorded non-detectable concentrations.

The July 19, 1999 vapor survey recorded a reading of less than 1 ppm at the manhole and 2 ppm during the December 9, 1999 vapor survey. The storm sewer inlets were not checked during these months.

Recommendations

From Fact Sheet #3.31.

System Changes

City Well CW-4 is currently being pumped at approximately 100 gpm as a plume containment measure. The pumping rate has been stepped down several times since these activities were initiated in 1998. The effluent is discharge to a nearby storm sewer under an NPDES Permit. Ground water laboratory results from CW-4 indicate that the discharge has met the NPDES Permit requirements.

Recommendations

Decreased dissolved phase petroleum concentrations in ground water samples collected from City Well CW-3 indicated that ground water extraction activities utilizing recovery well DW-5 and City Well CW-4 appear to have resulted in containment of the petroleum plume. Benzene concentrations in the effluent from recovery well DW-5 appears to be approaching asymptotic levels. It is unclear whether the decreasing benzene concentrations in City Well CW-4 are the result of the reduced pumping rate or pumping activities at recovery well DW-5. The pending operation of the planned new municipal well(s) may result in further changes in the configuration of the plume. Terracon recommends that plume containment activities utilizing recovery well DW-5 and City Well CW-4 continue during the interim period before and when the new municipal well (s) come on line. The associated ground water monitoring activities should also be continued.

Specifically, Terracon recommends the following activities:

- Conduct monthly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-5(35) and MW-5(7); City of Paynesville monitoring wells identified as map units 42 and 43; test wells CTW-18(18) and TW-1 and Farmers Union Coop wells MW-7(8).

- Continue ground water extraction activities utilizing recovery well DW-5 and City Well CW-4 to contain the petroleum plume. Collect monthly ground water effluent samples from recovery well DW-5. The samples will be analyzed for the presence of BTEX (benzene, toluene, ethyl benzene, and xylene), MTBE (Methyl tertiary butyl ether), and GRO (gasoline range organics). Perform routine maintenance on the ground water extraction system on an as needed basis. Consider modifying the ground water pumping rate and schedule for City Well CW-4 to evaluate its impact on containing the petroleum plume.
- Collect monthly ground water samples from City Wells CW-3, CW-4 and the water treatment plant influent and effluent. The samples will be analyzed for the presence of volatile organic compounds (VOCs) using Minnesota Department of Health Method 465F and pH. Four samples from city well CW-4 will also be analyzed for total lead consistent with NPDES Permits requirements.
- Perform reporting and project management duties necessary for continued operation of the remediation system which includes permitting requirements, utility costs, and submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Fact Sheets #3.26 and #3.31.

From Fact Sheet #3.31

Ground Water Pump-Out Systems

Operating parameters

Pumping rate: ~10 gallons per minute

Amount of water table drawdown: ~30 feet

Contaminant mass removal

Estimated contaminant mass removal rate: 0.001 gallons/day

Estimated contaminant mass removal to date: 3.17 gallons

May 2, 2001 – Annual Monitoring Report – 2000/2001

From Fact Sheet 3.26

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted.

The fluid level data from wells screened between 75 and 90 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3D. The contour maps indicate that the horizontal ground water flow directions to the southeast. A southeasterly flow direction is consistent with previously collected data.

Ground water samples were collected from recovery wells DW-5, City Well CW-3, City Well CW-4 and the water treatment plant influent and effluent on a monthly basis during 2000 for laboratory analysis. City Well CW-3 and the water treatment plant influent and effluent were sampled to monitoring drinking water quality. The storm sewer outfall from CW-4 were also sampled for laboratory analysis during April 2000. Recovery well DW-5, DW-6(46), DW-3(3) and City Well CW-4 were monitored to assess their impact on containing the plume and for discharge permit requirements. The laboratory results are summarized in Table 3.

A sample from the water treatment plant was collected and analyzed by the Minnesota Department of Health (MDH). The City of Paynesville provided Terracon with the results of the MDH analysis. The MDH results showed a benzene concentration of 0.2 ug/L, which are below the detection level for the analysis performed for Terracon by Legend Technical Services.

Laboratory results from City Well CW-3(9) detected a benzene concentration of 0.35 ug/L for the February 2000 sampling. All successive laboratory results from City Well CW-3(9) were below the detection level for benzene. However, the laboratory detection level changed from 0.30 ug/L to 0.50 ug/L between the June and July sampling rounds. Benzene concentrations may have fluctuated above the 0.30 ug/L level while staying below the new laboratory detection level of 0.50 ug/L. Laboratory results from City Well CW-4 (10) continued to decrease during 2000 sampling to non-detectable concentrations. It appears that decreased pumping of CW-3 in conjunction with the pumping activity at the recovery well DW-5 has led to some degree of stabilization of the northward migration of the plume (Figure 4A).

DW-3(3) began to show the presence of hydrocarbons: benzene, toluene, and xylenes (Table 3). The presence of these organic chemicals may or may not be due to the changing groundwater dynamics brought on by remediation activities.

Laboratory analysis results for the river discharge from CW-4 indicated a low benzene concentration. The concentration did not exceed the MDH HRLs.

DW-5(45) and DW-6(46) continued to show fluctuating concentrations of petroleum constituents, indicating that the remediation system is successfully removing contaminated groundwater.

Section 2. Vapor Impact Monitoring

No new vapor surveys were conducted during the 2000 testing period.

Section 3. Recommendations

Decreased dissolved phase petroleum concentrations in ground water samples collected from City Well CW-3 and CW-4 indicted that ground water extraction activities utilizing recovery well DW-5 appear to be approaching asymptotic levels. It appears that the decreasing benzene concentrations in City Well CW-4 are mainly the result of the reduced pumping rate of City Well CW-4 and to a lesser extend, the pumping activities at recovery well DW-5. The appearance of Volatile Organic Compounds in DW-3 suggests that containment efforts and the utilization of the new municipal wells may have altered the plume/groundwater dynamics. Terracon recommends that plume containment activities utilizing recovery well DW-5 and City Well CW-4 continue until after the new monitoring well, between DW-3 and the new municipal wells, is installed. The associated ground water monitoring activities should also be continued.

Specifically, Terracon recommends the following activities:

- Conduct monthly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as map units 42 and 43. Fluid levels will also be collected from two new monitoring wells planned to install during May 2001 southeast of well DW-3.
- Continue ground water extraction activities utilizing recovery well DW-5 and City Well CW-4(10) to contain the petroleum plume. Collect quarterly ground water effluent samples from recovery well DW-5. The samples will be analyzed for the presence of BTEX, MTBE, and GRO. Perform routine maintenance on the ground water extraction system on an as needed basis. Redevelop recovery well DW-5 if the ground water pumping rate does not increase in response to the anticipated recharge of the aquifer this spring. Once both the new city wells have been active and the new monitoring have been install and sampled, consider suspending pumping activities at recovery well DW-5 and/or modifying the ground water pumping rate and schedule for City Well CW-4 to evaluate its impact on containing the petroleum plume.
- Collect monthly ground water samples from City Wells CW-4 and the water treatment plant influent and effluent. Collect annual ground water samples from City Wells CW-5, CW-6, CW-7 and CW-8. The samples will be analyzed for the presence of volatile organic compounds (VOCs) using Minnesota Department of Health Method 465F and pH. Four samples from city well CW-4 will also be analyzed for total lead consistent with NPDES Permits requirements.
- Perform reporting and project management duties necessary for continued operation of the remediation system which includes permitting requirements, utility costs, and submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Fact Sheets #3.26 and #3.31.

From Fact Sheet #3.31

Ground Water Pump-Out Systems

Operating parameters

Pumping rate: ~10 gallons per minute

Amount of water table drawdown: ~30 feet

Contaminant mass removal

Estimated contaminant mass removal rate: 0.004 gallons/day

Estimated contaminant mass removal to date: 4.4 gallons

Cumulative mass removal vs time (plot) Figure 6

System Changes

Describe in detail any changes in system operation or configuration made during this reporting period. Also explain any periods during which the system was not operating.

The system remained operating (pumping) for the entire reporting period. However, the counter for the system hours failed between the October 2000 and November 2000 visits. The system failure was repaired on January 31, 2001. Although the system hours were not automatically recorded, the total gallons of water pumped were consistently recorded with the flow rate and percent availability in Table 5 has been adjusted to reflect the actual conditions. During the January 31, 2001 site visit the pump controller was found to have charred contacts. The pump controller was replaced on March 16, 2001. The delay on the pump controller was increased from 5 to 10 minutes during February 2001 and from 10 to 15 minutes during March 2001.

May 2, 2002 – Annual Monitoring Report – 2001/2002

From Fact Sheet 3.26

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted.

The fluid level data from wells screened between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3D. The contour maps for the April 12, 2001 and October 9, 2001 site visits indicate that the horizontal ground water flow direction is to the southeast. A southeasterly flow direction is consistent with previously collected data. Ground water contour maps for the August 13, 2001 and January 29, 2002 site visits indicate a general southeasterly flow direction. However, the ground water elevation data suggest that during the two aforementioned site visits ground water flow may have been altered by pumping activities associated with City Well CW-4(10).

Ground water samples were collected from City Well-4(10), Water Treatment Plant Influent, and Water treatment Plant Effluent on a monthly basis for laboratory analysis. Two samples continued to be taken from the water treatment plant effluent as this is chlorinated water which occasionally reacts with the HCI. One water treatment plant effluent sample included HCI as a preservative; the other effluent sample did not contain the HCI preservative to allow the laboratory to analyze an unpreserved sampling if the holding time (7 days) permits. Groundwater samples were collected from monitoring wells DW-3(3), DW-6(46), DW-7S(48), DW-7D(49), recovery well DW-5(45), and City Well CW-3 on a quarterly basis during the current reporting period for laboratory analysis. Ground water samples were collected from City Wells CW-5 thorough CW-8 on an annual basis for laboratory analysis.

Ground water sample from City Wells CW-3, CW-5, CW-6, CW-7 and CW-8 exhibited non – detectable concentrations of target volatile organic compounds for the annual sampling event. Samples collected from the water treatment plant influent and effluent points showed periodic detectable concentrations of target volatile organic compounds. Volatile organic compounds detected in the water treatment plant influent and effluent samples did not reveal a pattern and the origin for the detected compounds could not be identified through analytical results from the city wells.

Ground water samples from City Well CW-4 have shown consistent detection of benzene and 1, 2 DCA during the last four monthly sampling events. The most notable trend in the City Well CW-4 analytical results is that the benzene concentrations have increased from a concentration between the Method Detection Limit (MDL) and the Practical Quantification Limit (PQL) to a concentration above the laboratory PQL. The increase in benzene concentrations from between laboratory MDL and PQL to above the laboratory PQL coincides with increased pumping activity of City Well CW-4. Before December 20, 2001 the pumping rate of City Well CW-4 was approximately 75 gallons per minute (gpm) for twelve hours followed by twelve hours of not pumping. On December 20, 2001, pumping activities of City Well CW-4 were increased to 125 gpm continuously for 24 hours. The increased pumping activity of City Well CW-4 appears

to be drawing the contamination plume further to the north than was occurring at the lower pumping rate.
Increased pumping of City Well CW-4 was initiated in response to rising benzene concentrations in ground water samples collected from monitoring well DW-3. Contaminant concentrations in ground water samples from monitoring well DW-3 have decreased since the increase in City Well CW-4 pumping activity. Monitoring wells DW-7S and DW-7D are located between monitoring well DW-3 and city wells CW-5 through CW-7. Monitoring wells DW-7S and DW-7D were installed as sentinel wells between the Midtown Auto site and City Wells CW-5, CW-6 and CW-7. Ground water samples collected from monitoring wells DW-7S and DW-7D exhibited non-detectable concentrations of target volatile organic compounds.

Pumping activities of recovery well DW-5 have continued during this monitoring period. Contaminant concentrations in effluent samples collected from recovery well DW-5 continue to decrease. The last quarterly sample collected from recovery well DW-5 exhibited benzene concentrations below MDH HRLs and a gasoline range organics (GRO) concentration below the laboratory PQL. The adjacent and shallower monitoring well DW-6 appears to be relatively unaffected by pumping activities in recovery well DW-5. Ground water samples from monitoring well DW-6 continue to exhibit elevated concentrations of petroleum products. However, the contaminant concentrations encountered in samples from monitoring well DW-6 appear to be stable with fluctuations due to seasonal variations in the ground water table.

Section 2. Vapor Impact Monitoring

No new vapor surveys were conducted during the 2001/2002 monitoring period.

Section 3. Recommendations

Ground water quality data collected from City Well CW-4 and monitoring well DW-3 suggests that the contamination plume is responsive to city well pumping activities and that plume migration may be influence by city well pumping rates. The increase pumping activity of City Well CW-4 on December 20, 2001 from approximately 75 gpm for 12 hours per day, to 125 gpm continuously for 24 hours per day appears to have contributed to decreased concentrations of contaminants in ground water samples from monitoring well DW-3. In addition, the higher pumping rate of city well CW-4 resulted in increased contaminant concentrations in CW-4. At this same time City Well CW-8 was placed on-line on a full time basis and City Well CW-5, CW-6 and CW-7 were used on an alternating basis.

Pumping rates of CW-4 may be used to control contamination plume migration in the direction of City Wells CW-5 through CW-7. However, pumping rates of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume further to the north or into the drinking water aquifer. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should continue in order to monitor the quality of the water supply and contaminant plume stability or migration.

Ground water quality data collected from wells DW-5, DW-6 and MW-17 suggest that although pumping activities at recovery well DW-5 have decreased petroleum concentrations at the location of the well, the impact from these activities is limited in extent. The pump in recovery

well failed during April 2002. Terracon recommends that pumping activities remained suspended and the ground water quality data be collected to assess whether there is substantial rebound of petroleum concentrations. An attempt was made to find an alternative location for the recovery well system near to the source area (Midtown site). However, the owner of a vacant residential property located south of the Casey's General Store not interested in allowing access for assessment or the installation of a recovery system.

Specifically, Terracon recommends the following activities:

- Evaluate performing a packer test on City Well CW-4 to the pumping rate and ground water quality. The packer test should isolate the intervals between 70 and 80 feet, 80 and 90 feet, 90 and 100 feet and 100 and 110 feet below ground surface. Ground water samples collected during the packer test should be analyzed for VOCs listed in MDH Method 456F and GRO. Location options for moving the recovery system closer to the Midtown site should also be continually assessed.
- Suspend continuous pumping activities for recovery well DW-5 and monitor the response of ground water quality wells DW-5, DW-6 and MW-17. The pump in well DW-5 should be repaired or replaced to facilitate sampling of the well. Pumping activities should resume if ground water quality data collected from wells DW-5, DW-6 and MW-17 indicates a significant rebound in petroleum concentrations. If ground water extraction activities resume, routine operation and maintenance of the system should be performed on a monthly basis.
- Continue ground water extraction activities utilizing City Well CW-4(10) to contain the petroleum plume. Adjust the pumping activity of city well CW-4(10) to 90 gpm for 24 hours per day, in order to establish an extraction rate that prevents the contaminant plume from migrating in the direction of either CW-4 or in the direction of wells DW-3, DW-7S, DW-7D, and CW-5 through CW-7. The flow rate may require additional adjustment to maximize the effectiveness of the well or it a portion of City Well CW-4 is closed off with packers.
- Collect monthly ground water samples from City Wells CW-4 and the water treatment plant influent and effluent. The ground water samples should be analyzed for the presence of VOCs listed in Minnesota Department of Health Method 465. This sample schedule should be changed to quarterly once the petroleum plume has stabilized. This may require submitting a request to the MPCA that the NPDES Permit be changed to quarterly sampling.
- Collect annual ground water samples form City Wells CW-5, CW-6, CW-7 and CW-8. The ground water samples should be analyzed for the presence of VOCs listed in Minnesota Department of Health Method 465F and pH. Four samples from city well CW-4 will also be analyzed for total lead consistent with NPDES Permit requirements.
- Conduct quarterly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46), DW-7S(48), and DW-7D(49); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells CMW-42 and CMW- 43.
- Collect quarterly ground water quality samples for laboratory analysis from monitoring wells DW-3, DW-6, DW-7S, DW-7D, and recovery well DW-5. Recovery well DW-5 should be sampled after purging with the recovery well pump. The samples should be

analyzed for BTEX, MTBE, and GRO. A duplicate sample or field blank should be *analyzed during each sampling event.*

- *Perform reporting and project management duties associated with the continued sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, and submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Fact Sheets #3.26 and #3.31.*

From Fact Sheet #3.31

Ground Water Pump-Out Systems

Operating parameters

Pumping rate: ~10 gallons per minute

Amount of water table drawdown: ~30 feet

Contaminant mass removal

Estimated contaminant mass removal rate: 0.003 gallons/day

Estimated contaminant mass removal to date: 4.5 gallons

Cumulative mass removal vs time (plot) Figure 6

System Changes

Describe in detail any changes in system operation or configuration made during this reporting period. Also explain any periods during which the system was not operating.

The system remained operating (pumping) for the entire reporting period until the April 2002 site visit when the well pump was found to be produce only a few gallons of water before tripping off. Prior to the site meeting on April 29, 2001 the system was check and found to not be pumping water. The pump controller repeatedly trips off suggesting that the motor has failed. Several minor operational problems also occurred during his monitoring period. The flow meter plugged during July/August 2001. The motor hour counter for the system hours failed between the September 2001 and November 2001 visits. The motor hour counter began operating again during December 2001. Although the system hours are not automatically recorded, the total gallons of water pumped were consistently recorded with the flow rate and percent availability in Table 5 had been adjusted to reflect the actual conditions.

May 23, 2003 – Annual Monitoring Report – 2002/2003

From Fact Sheet 3.26

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted. Indicate whether samples were purged or unpurged (see fact sheet 3.23). If purged, indicate purging method.

The fluid level data from wells screened between 75 and 90 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3D.

Ground water samples were collected from City Well-4(10), Water Treatment Plant Influent, and Water Treatment Plant Effluent on a monthly basis for laboratory analysis. Two samples continued to be taken from the water treatment plant effluent as this is chlorinated water which occasionally reacts with the HCI. One water treatment plant effluent sample included HCI as a preservative; the other effluent sample did not contain the HCI preservative to allow the laboratory to analyze an unpreserved sampling if the holding time (7 days) permits. Groundwater samples were collected from monitoring wells DW-3(3), DW-6(46), recovery well DW-5(45), and City Well CW-3 on a quarterly basis; from monitoring wells DW-7S(48), DW-7D(49) on a semi-annual basis and from City Wells CW-5 thorough CW-8 on an annual basis for laboratory analysis during this reporting period. The quarterly water sample was not collected from DW-5(46) during the August site visit because the pump would not start. Groundwater samples were collected from the city wells via sampling taps after minimal purging. Groundwater samples were collected from the monitoring wells after purging three to five well volumes using disposable bailers, dedicated plastic purge pumps with polyethylene tubing or a Grundfos Redi-Flow 2 sampling pump with dedicated polyethylene tubing as described in the attached sampling forms. The laboratory results are summarized in Table 3.

The quarterly groundwater samples from City Well CW-3 and the annual water samples from City Wells CW-5, CW-6, CW-7 and CW-8 exhibited non-detectable concentrations of target volatile organic compounds. Laboratory analysis of the water treatment plant influent samples detected 0.33 ug/L of benzene in the November 5, 2002 sample and 0.92 ug/L of chloroform in the February 6, 2003 sample. Laboratory analysis detected 0.24 ug/L and 0.43 ug/L of benzene in the November 5, 2002 and the February 6, 2003 samples collected from the water treatment plant effluent. Volatile organic compounds detected in the water treatment plant influent and effluent samples did not reveal a pattern and the origin for the detected compounds could not be identified through analytical results from the city wells. It is possible that the sand filter in the water treatment plant contains residual concentrations of benzene that are periodically detected in the effluent samples.

Water samples were collected on a quarterly basis from City Well CW-4 and analyzed for total lead. Laboratory analysis detected a lead concentration between the MDL and the PQL in two of the samples.

Groundwater samples from City Well CW-4 have shown consistent detection of benzene and periodic detection of 1,2-DCA over the last 12 months. The most notable trend in the City Well CW-4 analytical results is that the benzene concentration has increased from a concentration between the Method Detection Limit (MDL) and Practical Quantification Limit (PQL) to a concentration of 13 ug/L in the March 6, 2003 sample. The steady and ongoing increase in the benzene concentration coincides with increased pumping activity of City Well CW-4. Before December 20, 2001 the pumping rate of City Well CW-4 was approximately 75 gallons per minute (gpm) for twelve hours followed by twelve hours of not pumping. On December 20, 2001, pumping activities of City Well CW-4 were increased to 125 gpm continuously for 24 hours. The increased pumping activity of City Well CW-4 appeared to drawing the contamination plume further to the north than was occurring at the lower pumping rate. During early July 2002 the pumping rate was reduce to approximately 95 gpm.

Increased pumping of City Well CW-4 was initiated in response to a rising benzene concentration in groundwater samples collected from monitoring well DW-3. Contaminant concentrations in groundwater samples from monitoring well DW-3 have decreased since the pumping rate was increased at City Well CW-4. In fact, laboratory analysis has not detected the target volatile organic compounds in the samples from DW-3 since January 2002 and therefore the pumping rate of City Well CW-4 was reduced during July 2002. Monitoring wells DW-7S and DW-7D are located between monitoring well DW-3 and the city wells CW-5 through CW-7. Monitoring wells DW-7S and DW-7D were installed as sentinel wells between the Midtown Auto site and City Wells CW-5, CW-6 and CW-7. Groundwater samples collected from monitoring wells DW-7S and DW-7D exhibited non-detectable concentrations of target volatile organic compounds.

Pumping was discontinued at recovery well DW-5 on May 23, 2002 as proposed in the previous annual report. Water has not been pumped from DW-5 during this reporting period, other than to collect water samples for laboratory analysis. Contaminant concentrations at well DW-5 have generally increased since pumping was discontinued. The benzene concentration has increased from 98 ug/L in April 2002 to 350 ug/L in April 2003. The contaminant concentrations have generally been decreasing at nearby monitoring DW-6 since pumping was discontinued at recovery well DW-5. The benzene concentration has decreased to 23 ug/L and the remaining target analytes were not detected in the April 2003 sample. Groundwater analytical data from monitoring wells MW-16(27) and MW-17(28) obtained from the Cirrus Environmental Group, Inc (Cirrus) "Annual Monitoring Report" dated October 24, 2002 had been included in Table 3. Apparently Cirrus sampled the monitoring wells on occasion during March 2002 when 2.5 ug/L of benzene was detected in the sample from monitoring well MW-17(28).

Terracon coordinated the completion of a packer test at City Well CW-4 on September 23, 2002. Thein Well Company installed two packers in an attempt to isolate specific sampling intervals (70 to 80, 80 to 90, 90 to 100 and 100 to 110 feet). Water was purged from the specified intervals for approximately 15 minutes at rates of 10 to 11 gallons per minute and the samples were collected for laboratory analysis. Laboratory analysis detected benzene and toluene in each of the samples. The benzene concentration raged from 5.3 ug/L in the 70 to 80 foot sample to 8.2 ug/L in the 100 to 110 foot sample. Trichloroethene was detected at 0.61 ug/L in the 70 to 80 foot sample. GRO was not detected in the four water samples. The packer test did not isolate an interval which is more highly contaminated. Based on the consistency of the data, it is possible

that water short-circuited the packers by flowing through the filer pack or a large volume of water needed to be pumped before obtaining greater variations in the VOC concentrations. A 20 foot section of the drop pipe was found to have a hole just above the pump and was not reinstalled in City Well CW-4 resulting in the pump being raised up higher in the well screen. There is currently 40 feet drop pipe installed in the well.

Section 2. Vapor Impact Monitoring

No new vapor surveys were conducted during the 2002-2003 monitoring period.

Section 3. Recommendations

Groundwater quality data collected from City Well CW-4 and monitoring well DW-3 suggests that the contamination plume is responsive to city well pumping activities and that plume migration may be influence by city well pumping rates. The increased pumping activity of City Well CW-4 on December 20, 2001 from approximately 75 gpm for 12 hours per day, to 125 gpm continuously for 24 hours per day (reduced to approximately 95 gpm in during July 2002) appears to have contributed to decreased concentrations of contaminants in groundwater samples from monitoring well DW-3. In addition, the higher pumping rate of City Well CW-4 resulted in increased contaminant concentrations in the discharge water. Decreasing the depth of the pump in City Well CW-4 may have also resulted in increased contaminant concentrations in the discharge water. It is our understanding that City Well CW-8 is on-line on a full time basis and City Well CW-5, CW-6 and CW-7 are used on an alternating basis.

The current pumping rate of City Well CW-4 of approximately 95 gpm appears to be controlling contamination plume migration in the direction of City Wells SW-5 through CW-7. However, the pumping rate of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume further to the north or downward into the drinking water aquifer. The current pump installed in the well can not be operated at lower pumping rates. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and contaminant plume stability or migration.

Ground water quality data collected from wells DW-5, DW-6, and MW-17 suggest that although previous pumping activities at recovery well DW-5 have decreased petroleum concentrations at the location of the well, the impact from these activities was likely limited in extent. Terracon recommends that pumping activities remain suspended and that groundwater quality data be collected to assess whether there is substantial additional rebound of petroleum concentrations. Prior attempts to find an alternative location for recovery well system near to the source area (the Midtown site) have been unsuccessful.

Specifically, Terracon recommends the following activities:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the petroleum plume. Continue to adjust the pumping rate of City Well CW-4 in order to establish an extraction rate that prevents the excessive migration of the contaminant plume in the direction of either CW-4 or wells DW-3, DW-7S, DW-7D and CW-5

through CW-7. Evaluate the installation of a pump to can operate at between 75 gpm and 125 gpm, should the current pump fail.

- Collect quarterly groundwater samples from City Wells SW-4, water treatment plant influent, and water treatment effluent. The groundwater samples should be analyzed for the Minnesota Department of Health (MDH) list of VOCs and pH. This may require submitting a request to the MPCA that the NPDES Permit be changed to quarterly sampling and no longer test for lead four times per year. This sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct quarterly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46, DW-7S(48), and DW-7D(49); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect quarterly groundwater quality samples for laboratory analysis from monitoring wells DW-3, DW-6 and DW-5; and semi-annual samples from monitoring wells DW-7S and DW-7D. Quarterly groundwater samples should also be collected from monitoring well MW-17(28) if it is not being samples by Cirrus. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Fact Sheets #3.26 and #3.31.

From Fact Sheet #3.31

Ground Water Pump-Out Systems

Operating parameters

Pumping rate: ~2 to10 gallons per minute

Amount of water table drawdown: ~30 feet

Contaminant mass removal

Estimated contaminant mass removal rate: 0.001 gallons/day

Estimated contaminant mass removal to date: 4.6 gallons

Cumulative mass removal vs time (plot)

System Changes

Describe in detail any changes in system operation or configuration made during this reporting period. Also explain any periods during which the system was not operating.

The groundwater pump out system on well DW-5 remained operating (pumping) during this reporting period until the April 2002 site visit when the well pump was found to produce only a few gallons of water before tripping off. The pump controller repeatedly tripped off suggesting that the motor has failed. Prior to the site meeting on April 29, 2002 the system was checked and found to not be pumping water. MPCA and Terracon staff agreed the pumping activities at well DW-5 should be suspended and while groundwater sampling activities continued. The pump was checked by Thein Well Company on August 23, 2002 and found to be in good condition. The control system was rewired on September 18, 2002 by MRSI to allow well DW-5 to be sampled

using the pump. Apparently the pump controller had failed. Additional operational problems did not occur during this monitoring period.

May 24, 2004 – Annual Monitoring Report – 2003/2004

From Fact Sheet 3.26

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted. Indicate whether samples were purged or unpurged (see fact sheet 3.23). If purged, indicate purging method.

The fluid level data from wells screened between 75 and 90 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3D.

Ground water samples were collected from City Well-4(10) on a monthly basis for laboratory analysis. Groundwater samples were collected from City Well CW-3(9), Water Treatment Plant Influent, and Water Treatment Plant Effluent, monitoring wells DW-3(3), DW-6(46), and midtown well MW-17 and recovery well DW-5(45) on a quarterly basis; from monitoring wells DW-7S(48), DW-7D(49) on a semi-annual basis, and from City Wells CW-5 through CW-8 on a annual basis for laboratory analysis during this reporting period. Two samples continued to be taken from the water treatment plant effluent as this is chlorinated water which occasionally reacts with the HCI. One water treatment plant effluent sample included HCI as a preservative; the other effluent sample did not contain the HCI preservative to allow the laboratory to analyze an unpreserved sampling if the holding time (7 days) permits. Groundwater samples were collected from the city wells via sampling taps after minimal purging. Groundwater samples were collected for the monitoring wells after purging three to five well volumes using disposable bailers, dedicated plastic purge pumps with polyethylene tubing as described or a Grundfos Redi-Flow 2 sampling pump with dedicated polyethylene tubing as described in the attached sampling forms. The laboratory results are summarized in Table 3. Natural attenuation monitoring parameters are summarized in Table 4.

The bi-monthly groundwater samples from the city water treatment plant influent, the quarterly groundwater samples from City Well CW-3 and monitoring well DW-3, semi-annual groundwater samples from monitoring wells MW-17, DW-7S, and DW-7D, and annual groundwater samples from City Wells CW-7 and CW-8 exhibited non-detectable concentrations of target VOCs (volatile organic compounds). Laboratory analysis of groundwater samples from City Wells CW-5 and CW-6 detected 0.091 ug/L and 0.081 ug/L of benzene, respectively, during their annual sampling on October 28, 2003. Laboratory analysis of groundwater samples from the city water treatment plant effluent detected 0.55 ug/L of ethyl benzene and 3.9 ug/L of total xylenes during the May 19, 2003 bi-monthly sampling event. Volatile organic compounds detected in the water treatment plant effluent samples did not reveal a pattern and the origin for the detected compounds could not be identified through analytical results from the city wells (Figure 5A). It is possible that the sand filter in the water treatment plant contains residual concentrations of contaminant compounds that are periodically detected in the effluent samples.

Groundwater samples from monitoring well DW-6 have shown consistent significant concentrations of benzene, xylenes, and GRO along with less significant detection of ethyl

benzene. After contaminant concentration peaked in October 2003, concentrations of petroleum related VOCs have decreased for the remainder of this monitoring period (Figure 5B).

Groundwater samples from City Well CW-4 have shown consistent detection of benzene and 1,2 DCA in the last twelve months (May 2003 through April 2004). Benzene concentrations have been decreasing throughout the monitoring period and the 1,2 DCA concentrations have decreased overall as well (Figure 5A). The pumping rate of City Well CW-4 was increased on December 20, 2001 from approximately 75 gpm for 12 hours per day, to 125 gpm continuously for 24 hours per day. During July 2002 the pumping rated was reduced to approximately 95 gpm. The higher pumping rate of City Well CW-4 initially resulted in increased contaminant concentrations in the discharge water. Decreasing the depth of the pump in City Well CW-4 may have also resulted in increased contaminant concentrations in the discharge water. However, benzene concentrations in samples collected from City Well CW-4 have been decreasing since Spring 2004. It is our understanding that City Well SC-3 (~100 gpm) and CW-8 (~500 gpm) are on-line on a full time basis and City Well CW-5, CW-6 and CW-7 are pumped at approximately 400 gpm on an alternating basis to meet the water treatment plant processing rate of approximately 1,000 gpm.

The City of Paynesville is currently completing road construction and storm sewer modifications that required that the City Well CW-4 be shut down for the period of April 27, 2004 to May 17, 2004. The modifications were required such that a portion of the storm water within Paynesville could be re-routed to an infiltration pond. The discharge point for the effluent from City Well CW-4 has not changed. Copies of the plans are included in Appendix D.

Pumping was discontinued at recovery well DW-5 on May 23, 2002 as recommended in annual report 2001/2002 annual monitoring report. Water has not been pumped from DW-5 during this reporting period, other than to collect water samples for laboratory analysis. Contaminant concentrations in groundwater samples collected from well DW-5 have generally increased since pumping was discontinued. The benzene concentrations have increased from 350 ug/L in April 2003 to 400 ug/L in April 2004. The ethyl benzene, total xylenes and GRO (gasoline range organics) have also increased since pumping activities were suspended (Figure 5B and Table 3).

Section 2. Vapor Impact Monitoring

No new vapor surveys were conducted during the 2003-2004 monitoring period.

Section 3. Recommendations

Groundwater quality data collected from City Well CW-4 and monitoring well DW-3 suggests that the contamination plume is responsive to city well pumping activities and that plume migration may be influence by city well pumping rates. The increased pumping activity of City Well CW-4 appears to have contributed to decreased concentrations of petroleum contaminants in groundwater samples from monitoring well DW-3. However, benzene and 1,2-DCA concentrations in water samples collected from City Well CW-4 have been decreasing since Spring 2004. This decrease may be indicative of a reduction in the dissolved phase petroleum, an insufficient pumping rate or other unidentified well or pump issue. The current pumping rate at City Well CW-4 of approximately 95 gpm appears to be controlling contamination plume

migration in the direction of City Wells CW-5 through CW-7. The pumping rate of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume further to the north or downward into the drinking water aquifer. The current pump installed in the well can not be operated at a lower pumping rate. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and contaminant plume stability or migration.

Ground water quality data collected from wells DW-5, DW-6, and MW-17 suggest that although previous pumping activities at recovery well DW-5 have decreased petroleum concentrations at the location of the well, the impact from these activities was likely limited in extent. Terracon recommends that pumping activities remain suspended and that groundwater quality data be collected to assess whether there is substantial additional rebound of petroleum concentrations. Prior attempts to find an alternative location for recovery well system near to the source area (the Midtown site) have been unsuccessful.

Specifically, Terracon recommends the following activities:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the petroleum plume. Continue to adjust the pumping rate of City Well CW-4 in order to establish an extraction rate that prevents the excessive migration of the contaminant plume in the direction of either CW-4 or wells DW-3, DW-7S, DW-7D and CW-5 through CW-7.
- Collect quarterly groundwater samples from City Wells CW-3, CW-4, CW-5, CW-6, water treatment plant influent, and water treatment effluent. The groundwater samples should be analyzed for the Minnesota Department of Health (MDH) list of VOCs and pH. A request was submitted to the MPCA on October 22, 2003 to reduce the sampling frequency within the NPDES Permit for City Well CW-4 from monthly to quarterly and no longer test for lead four times per year. The sampling frequency for City Well CS-4 should remain monthly until the NPDES Permit is modified. This sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct quarterly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46), DW-7S(48), and DW-7D(49); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect annual groundwater samples form City Wells CW-7 and CW-8. The ground water samples should be analyzed for the MDH list of VOCs.
- Collect quarterly groundwater quality samples for laboratory analysis from monitoring wells DW-3, DW-6 and DW-5; and semi-annual samples from monitoring wells MW-17, DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Fact Sheets #3.26.

June 29, 2005 – Annual Monitoring Report – 2004/2005

From Guidance Document 4-08

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted. Include all cumulative data in the tables. Indicate whether samples were purged or unpurged (see Guidance Document 4-05). If purged, indicate purging method.

Based on available information and previous assessment work conducted by Terracon, the site has soil, soil vapor and groundwater impacts. The fluid level data from wells screened between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B.

The estimated groundwater contours for groundwater levels measured on August 24, 2004 and February 16, 2005 show the regional groundwater flow is generally down to the east-southeast. Available information indicates the water table aquifer flows north at the near the source area. However, local fluctuations and variations due to seasonal infiltration/exfiltration, geologic formations, groundwater pump-out and/or other site features can affect the groundwater flow.

Municipal well CW-4 was previously sampled during monthly intervals until March 2005 and at quarterly intervals thereafter beginning in May 2005. The other sample locations were sampled at the intervals indicated in the table above, except for wells CW-5, CW-6, CW-7 and CW-8 were not sampled during a planned semi-annual event conducted in February 2005. These four wells were not sampled in February 2005 because the wells could not be accessed due to excessive snow cover blocking access to the wells. Therefore, the four wells were sampled in May 2005.

Groundwater samples were collected from the city wells via sampling taps after purging. Groundwater samples were collected for the monitoring wells after purging three to five well volumes using disposable bailers, dedicated plastic purge pumps with polyethylene tubing or a Grundfos Redi-Flow 2 sampling pump with dedicated polyethylene tubing as described in the attached sampling forms. The laboratory results are summarized in Table 3. Natural attenuation monitoring parameters are summarized in Table 3 and 4.

The most recent monitoring event was conducted in February 2005 and included collecting groundwater samples from DW-3, DW-5, DW-6, DW-7S, DW-7D, MW-17, CW-3, CW-4, CW-7, CW-8, WTP influent and WTP effluent. The laboratory analytical results for the groundwater samples from these monitoring locations were below laboratory reporting limits for VOCs, except for concentrations detected in samples collected from wells DW-5, DW-6 and CW-4. In addition, wells CW-5 and CW-6 were last sampled in August 2004 and the laboratory analytical results of these samples were below the laboratory reporting limits for VOCs. The VOCs detected in the sample collected from well DW-5 included benzene (180 ug/L), toluene (2.1 ug/L0, ethyl benzene (31 ug/L), total xylenes (39 ug/L) and GRO (400 ug/L). The VOCs detected in the sample from DW-6 include benzene (33 ug/L0, ethyl benzene (2.4 ug/L0, MTNE

(5.3 ug/L) and GRO (170 ug/L). The VOC detected in the sample collected from well CW-4 include 1,2-dichloroethane (0.46 ug/L). The detected VOCs are consistent with laboratory analytical results conducted on groundwater samples collected during previous monitoring events.

Section 2. Vapor Impact Monitoring

If vapor impacts were detected during previous assessments, discuss the results of follow-up vapor monitoring. Include in your discussion the sampling instrument and sampling method.

Vapor monitoring of the subsurface soil vapors was conducted at four locations (VP-7 through VP-10) adjacent to nearby and/or down-gradient receptors. Initially, Terracon planned to conduct sub-slab vapor monitoring by installing sub-slab sampling points within the basements of buildings at the site. However, access to install the sampling points was denied by the property/building owners. Therefore, Terracon proceeded with gaining access arrangements to conduct temporary solid vapor monitoring points outside the buildings. In addition, previous vapor monitoring activities were conducted at the site and included six soil probes (VP-1 through VP-6) completed in the right-of-way of Lake Avenue. The results of the initial vapor monitoring work are discussed in Terracon's "VIA Pilot – Midtown Station" letter report dated January 21, 2005. The previous monitoring work noted elevated organic vapors, using a photo ionization detector (PID), at depths corresponding to the soil/groundwater interface at and near the source area. Furthermore, soil probe VP-3 encountered a pocket of soil gas under pressure at about 22 feet below ground surface that exhibited elevated concentrations of organic vapors. Pressurized soil gas was also encountered in a previously completed probe (P-32). The vapor samples collected from the probes each had laboratory analytical results showing elevated concentrations of VOCs and total hydrocarbons (THCs) as gas (Table 7 and 8, Figure 3).

The additional vapor monitoring work included four hand-driven probe sample points (VP-7 through VP-10), Figure 3). The sample points were selected to assess the vapor migration potential to receptors (i.e., building) located near the previously identified source area. Terracon attempted to assess several other properties/buildings at the site. However, access to those properties was denied by the owners. The probes were conducted by Terracon on April 21, 2005. The soil gas sampling methods using a manual push-probe monitor point are described in Appendix B. The vapor samples collected from the probes each had laboratory analytical results showing elevated concentrations of VOCs and total hydrocarbons (THCs) as gas (Table 7 and 8, Figure 3).

Various petroleum related VOCs were detected in the soil gas samples collected from the ten soil-gas vapor points (VP-1 through VP-10). The vapor points exhibiting higher concentrations of VOCs were located at and/or down-gradient of the source area in regards to the inferred horizontal groundwater flow direction. Therefore, the source of the VOCs detected appears to be from the petroleum release and associated dissolved/free phase contaminant plume at the site. Many of the VOC concentrations detected were above their respective soil gas action levels [i.e., Minnesota Department of Health (MDH Health Risk Value (HRV), Environmental Protection Agency (EPA) Reference concentrations (Rfes) or MDH Interim Screening Concentrations (ISCs)].

Section 3. Recommendations

Groundwater quality data indicates the contamination plume is responsive to groundwater pumping activities. In comparing data from similar time periods, the city well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates from well CW-4, a corresponding decrease in dissolved phase petroleum hydrocarbon concentrations were noted for samples collected from well CW-4 and nearby monitoring wells DW-3, DW-5 and DW-6. In addition, a stoppage of groundwater pumping from well CW-4 showed a corresponding increase in dissolved phase petroleum hydrocarbons in well CW-4.

The groundwater pumping rate for well CW-4 has been about 102 to 103 gallons per minute (gpm) since October 2004. Prior to October 2004 the pumping rate was about 95 gpm. The laboratory analytical results from samples collected from well CW-4 have been decreasing steadily from March 2003 (13 ug/L benzene) to the present (below laboratory reporting limits for benzene). This decrease may be indicative of a reduction in the dissolved phase petroleum, a decreased pumping rate or other unidentified well or pump issue. The current pumping rate at city well CW-4 of approximately 103 gpm appears to be controlling contamination plume migration in the direction of city wells CW-5, CW-6 and CW-7. The pumping rate of city well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward into the drinking water aquifer. The current pump installed in the well can not be operated at a lower pumping rate. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and contaminant plume stability or migration.

If additional corrective action is recommended, please provide your justification.
Terracon understands the MPCA plans to request Terracon to evaluate the Midtown Auto site for possible corrective actions.

Pending the results of an evaluation of assessment and cleanup actions conducted at the Midtown Auto site, Terracon recommends the following activities:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the petroleum plume. Continue to adjust the pumping rate of City Well CW-4 in order to establish an extraction rate that prevents the excessive migration of the contaminant plume in the direction of either CW-4 or wells DW-3, DW-7S, DW-7D and CW-, CW-6 and CW-7.
- Collect semi-annual groundwater samples from City Wells CW-3, CW-5, CW-6, water treatment plant influent, and water treatment effluent. The groundwater samples should be analyzed for the Minnesota Department of Health (MDH) list of VOCs and pH. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct quarterly site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3(3), DW-4(4), DW-5(45), DW-6(46), DW-7S(48), and DW-7D(49); Midtown wells MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-16(27), and MW-17(28); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect annual groundwater samples form City Wells CW-7 and CW-8. The ground water samples should be analyzed for the MDH list of VOCs.

- Collect quarterly groundwater quality samples for laboratory analysis from monitoring wells DW-3, DW-6 and DW-5; and semi-annual samples from monitoring wells MW-17, DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.
- Conduct additional vapor risk assessment work to assess the identified soil-gas VOCs potential for vapor intrusion (i.e., migrating and /or accumulating into buildings). The additional vapor risk assessment activities should include: an expanded soil gas survey to assess the horizontal extent of the vapor cloud, attaining access to buildings to perform additional assessment work, collection of indoor air samples of buildings that have been identified as being at risk of vapor intrusion, and perform the work in general accordance with MPCA Guidance Document 4-01a, "Vapor Intrusion Assessments Performed During Site Investigations". The possibility of encountering pockets of petroleum impacted gas should be considered during future assessment activities.

June 30, 2006 – Annual Monitoring Report – 2005/2006

From Guidance Document 4-08

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the remedial investigation (RI) report or the last progress report submitted. Include all cumulative data in the tables. Indicate whether samples were purged or unpurged (see Guidance Document 4-05). If purged, indicate purging method.

Based on available information and previous assessment work conducted by Terracon, the site has soil, soil vapor and groundwater impacts. Soil gas impacts appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for this issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Various petroleum related VOCs were detected in the soil gas samples collected from the two soil-gas probes. One or more petroleum related VOCs were detected at concentrations that exceeded one of the soil gas action levels [i.e., Minnesota Department of Health (MDH Health Risk Value (HRV), Environmental Protection Agency (EPA) Reference concentrations (Rfcs) or MDH Interim Screening Concentrations (ISCs, or MPCA residential Intrusion Screening Values (ISVs)].

In addition to the activities described in this document, Terracon completed a review of the Minnesota Pollution Control Agency (MPCA) file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15, 2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, excavation, bioslurping (multi-phase extraction), soil excavation and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The fluid level data from wells screened in the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B.

The estimated groundwater contours for groundwater levels measured on November 2, 2005 and May 4, 2006 show the regional groundwater flow is generally down to the east-southeast. Available information indicates the local horizontal groundwater flow direction in the water able aquifer near the source area is to the north, towards the North Fork of the Crow River. However,

local fluctuations and variations due to seasonal infiltration/exfiltration, geologic formations, groundwater pump-out and/or other site features can affect the groundwater flow.
The VOCs detected in the sample collected from well DW-5 included benzene (180 ug/L), toluene (1.5 ug/L), ethyl benzene (32 ug/L), total xylenes (32 ug/L), MTBE (1.3 ug/L) and GRO (440 ug/L). The VOCs detected in the sample from well DW-6 included benzene (27 ug/L), ethyl benzene (1.7 ug/L) and GRO (71 ug/L). The detected VOCs are consistent with laboratory analytical results conducted on groundwater samples collected during previous monitoring events. Monitoring well DW-3 was abandoned on May 5, 2006 following the annual sampling event because Pomeroy Avenue was being realigned in the well would be within the road surface.

Plume Containment Activities (CW-4)

The groundwater pumping rate for CW-4 decreased from approximately 103 gallons per minute (gpm) during Summer 2005 until it was shutdown on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2004 and the maximum pumping rate was approximately 90 gpm. The pump in well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump rate was set to approximately 90 gpm. Monitoring well DW-3 was abandoned on May 5, 2006 because Pomeroy Avenue was being realigned in the well would be within the road surface.

The laboratory analytical results for samples collected from well CW-4 have been decreasing steadily from March 2003 (13 ug/L benzene) to the present (below laboratory reporting limits for benzene). This decrease may be indicative of a reduction in the dissolved phase petroleum, a decrease pumping rate or other unidentified well or pump issue. The current pumping rate at city well CW-4 of approximately 90 gpm appears to be controlling dissolved phase petroleum plume migration in the direction of city wells CW-3, CW-5, CW-6 and CW-7. The pumping rate of city well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward to the drinking water aquifer. The pump installed in the well during May/June 2006 may operate at lower pumping rates then the previous pump.

Section 2. Vapor Impact Monitoring

If vapor impacts were detected during previous assessments, discuss the results of follow-up vapor monitoring. Include in your discussion the sampling instrument and sampling method.

Soil gas sampling was conducted during October 2005 at two locations, soil gas probes VP-1A and VP-11, near the "source area" and "fringe" of the soil gas associated with the site VIA Pilot Study activities being performed for the MPCA. A copy of the VIA Pilot – Midtown Station report dated December 14, 2005 is included in Appendix D. Refer to Figure 2A for soil gas probe locations. Additional VIA activities planned for the site were postponed until MPCA staff could review the FFS dated March 15, 2006 such that assessment activities could be integrated and locations selected.

Various petroleum related VOCs were detected in the soil gas samples collected from the two soil-gas points (VP-1A through VP-11). One or more petroleum related VOCs were detected in samples from soil gas probes VP-1A and VP-11 at concentrations that exceeded their respective soil gas action levels (i.e., MDH HRVs, EPA Rfcs, MDH ISCs or MPCA residential ISVs).The

soil-gas sample collected from soil gas probe VP-1A exhibited higher concentrations of VOCs due to its location near the source area. The concentrations of VOCs detected in the sample collected from soil gas probe VP-11 were several orders of magnitude lower than those detected in vapor probe VP-1A.

Section 3. Recommendations

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the water table aquifer and underlying drinking water aquifer at the site and to the north and northeast. The primary source of the dissolved phase petroleum plume appears to be light non-aqueous phase liquid (LNAPL) which as consistently been observed in several monitoring wells on the former Midtown Service Station property. Groundwater quality data indicates that dissolved phase petroleum plume is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-four pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at well CW-4, dissolved phase petroleum hydrocarbon concentrations for samples collected from well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3 have remained below laboratory reporting limits or at levels below their respective MDH Health Risk Limits (HRLs), Health Based Values (HBVs) and EPA Maximum Contaminant Levels (MCLs). However, benzene concentrations in samples from monitoring wells DW-5 and DW-6 consistently exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the drinking water aquifer and poses a continuing risk of once again impacting one of the city well if pumping activities at City Well CW-4 cease. Continued analysis of samples form the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the Quality of the water supply and plume stability or migration. In addition, the recommendations in the FFS dated March 15, 2006 for additional assessment and remediation of the source area on and near the former Midtown Service station should be implemented.

If additional corrective action is recommended, please provide your justification.

As discussed above, Terracon's FFS dated March 15, 2006 identifies a list of potentially effective corrective actions for the former Midtown Service Station site that would address source area petroleum contamination; decrease dissolved phase petroleum concentrations in the drinking water aquifer; and potential mitigate vapor migration into nearby buildings. Additional assessment of the extent and magnitude of petroleum contamination in and near the source area is needed before a useful evaluation of the feasibility and potential effectiveness of implementing the identified corrective actions (CAs).

Terracon recommends that assessment activities in and near the source area include the following:

- Laser induced fluorescence (LIF) and conductive probes should be advanced on-site and along the Mill Street, Lake Avenue and Koronis Avenue road right-of-way to attempt to delineate the horizontal and vertical extent of free product impacts. Terracon estimates that a total of 24 LIF probes locations will be utilized for the off-site assessment. An additional 18 LIF probes will be utilized for the on-site assessment. An estimated 50 percent of these locations would include an additional conductivity probe evaluation.

Also, approximately 20 percent of the probe locations will require confirmatory sampling.

- Based upon the results of the source area assessment additional monitoring wells should be installed to provide fixed sampling points for collecting fluid levels and groundwater quality data. It is anticipated that monitoring well clusters may be installed at several locations with a variety of screened intervals. Water able monitoring wells should be constructed using 15 to 20 foot screens to compensate for fluctuations in the water table. Test well(s) could also be installed at this time should pilot testing be required.
- Based upon the result of the source area assessment activities, a potential corrective action alternative will be determined. Pilot testing may be required before full scale implementation. Additionally, a Corrective Action Design report should be prepared consistent with the requirements of MPCA Guidance Document 4-11. The results of the assessment activities and pilot testing, if applicable, would be summarized in the report.

If additional monitoring is recommended, indicate the proposed monitoring schedule and frequency.

On going semi-annual groundwater monitoring activities should continue with the addition of monitoring wells at the Midtown Service Station. In addition, the monitoring activities should be integrated with the source area assessment activities at the Midtown Service Station discussed above. Terracon recommends the following:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the contaminant plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.
- Collect semi-annual groundwater samples from City Wells CW-3, CW-5, CW-6, water treatment plant influent, and water treatment effluent. The groundwater samples should be analyzed for the Minnesota Department of Health (MDH) list of VOCs. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-4(4), DW-5(45), DW-6(46), DW-7S(48), and DW-7D(49); Midtown wells Mw-1(20), MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-15(26), MW-16(27), and MW-17(28), MW-18-(29), MW-19(30), MW-20(31), MW-21, MW-22, MW-23, MW-24, Mw-25, and RW-1(32); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect annual groundwater samples form City Wells CW-7 and CW-8. The ground water samples should be analyzed for the MDH list of VOCs.
- Collect semi-annual sample groundwater quality samples for laboratory analysis from monitoring wells DW-5, DW-6, MW-16 and MW-17; and annual samples from monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.

- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.
- Conduct additional vapor risk assessment work to assess the identified soil-gas VOCs potential for vapor intrusion (i.e., migrating and /or accumulating into buildings). The additional vapor risk assessment activities should include: an expanded soil gas survey to assess the horizontal extent of the soil gas cloud, attaining access to buildings to perform additional assessment work, collection of indoor air samples of buildings that have been identified as being at risk of vapor intrusion, and perform the work in general accordance with MPCA Guidance Document 4-01a, Vapor Intrusion Assessments Performed During Site Investigations. The possibility of encountering pockets of petroleum impacted gas should be considered during future assessment activities and if encountered an effort will be made to collect samples for laboratory analysis.

June 30, 2007 – Annual Monitoring Report – 2006/2007

From Guidance Document 4-08

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the investigation report or the last progress report submitted. Include all cumulative data in the tables. Indicate whether samples were purged or unpurged (see Guidance Document 4-05). If purged, indicate purging method.

This Annual Monitoring Report (AMR) includes groundwater monitoring results for monitoring events conducted since Terracon's Annual Monitoring Report dated June 30, 2006. In addition, this AMR includes the results of source area assessment activities, the installation of additional groundwater monitoring wells, and additional soil gas sampling activities performed in February, March and April 2007.

Based on available information and previous assessment work conducted by Terracon, the site has petroleum impacted soil, soil gas and groundwater in addition to a significant source mass of light non-aqueous phase liquid (LNAPL) which appears to consist primarily of gasoline. Soil gas impact appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for this issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Various petroleum related VOCs were detected in the soil gas samples collected from soil-gas probes. Soil vapor probes VP-7, VP-8, VP-9, VP-10, VP-12 and VP-13 were completed near residences. In these and other soil gas samples, one or more petroleum related VOCs were detected at concentrations that exceeded one of the MPCA soil gas action levels [i.e., Minnesota Department of Health (MDH) Health Risk Value (HRVs) or Environmental Protection Agency (EPA) Reference concentrations (RfCs)] (Tables10A through 10C).

In addition to the activities described in this document, Terracon completed a review of the Minnesota Pollution Control Agency (MPCA) file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15, 2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, excavation, bioslurping (multi-phase extraction), soil excavation and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The fluid level data from wells screened in the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B. The estimated groundwater contours for groundwater levels measured on November 29, 2006 and March 20, 2007 show the regional groundwater flow is generally down to the east-southeast. Available information indicates the local horizontal groundwater flow direction in the water able aquifer near the source area is to the north, towards the North Fork of the Crow River. However, local fluctuations and variations due to seasonal infiltration/exfiltration, geologic formations, groundwater pump-out and/or other site features can affect the groundwater flow.

The VOCs detected in the groundwater samples collected from well DW-5 included benzene (64-74 ug/L), ethyl benzene (42-55 ug/L), total xylenes (19 ug/L), MTBE (1.6-1.8 ug/L) and GRO (260-280 ug/L). The VOCs detected in the groundwater samples from well DW-6 include benzene (22-24 ug/L), ethyl benzene (2.5-2.8 ug/L), xylenes (2.4-2.7 ug/L), MTBE (1.1-1.2 ug/L) and GRO (80-100 ug/L). The VOCs detected in the groundwater sample from CW-4 include benzene (0.66-0.78 ug/L). The detected VOCs are consistent with laboratory analytical results from groundwater samples collected during previous monitoring events. Monitoring well DW-3 was abandoned on May 5, 2006 following the annual sampling event because Pomeroy Avenue was being realigned and the well would be within the road surface. Monitoring well DW-3 was replaced with well DW-3R in April 2007. Attempts to access to the Nursery well to collect a groundwater sample were not successful.

Plume Containment Activities (CW-4)

City Well CW-4 is continually pumped to contain the dissolved phase petroleum plume. Water from the well is discharged to the City of Paynesville storm sewer without needing treatment under an NPDES Permit. Groundwater samples were collected from the discharge from City Well CW-4 on a quarterly basis for laboratory analysis as required in the NPDES Permit. The groundwater samples were analyzed for the MDH list of VOCs. The target VOCs were not detected in the discharge samples, except for benzene in the September and November 2006 samples at concentrations between the laboratory reporting limit (RL) and method detection limit (MDL). The groundwater analytical results are summarized in Table 3.

The laboratory analytical results for samples collected from well CW-4 have been decreasing steadily from March 2003 (13 ug/L benzene) to the present. However, there were estimated ("J-flagged") results reported for the August 2006 and November 2006 samples (0.66 and 0.78 ug/L, respectively). This decrease may be indicative of a reduction in the dissolved phase petroleum, a decrease pumping rate or other unidentified well or pump issue.

The groundwater pumping rate for CW-4 decreased from approximately 103 gallons per minute (gpm) during Summer 2005 until it was shutdown on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2005 and the maximum pumping rate was approximately 90 gpm. The pump in well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump was reinstalled in City Well CW-4 on June 1, 2006 and started the next day. The pump rate was set to approximately 90 gpm. The current pumping rate at City Well CW-4 of approximately 90-105 gpm appears to be controlling dissolved phase petroleum plume migration in the direction of City Wells CW-3, CW-5, CW-6 and CW-7. The pumping rate of city well CW-4 should be limited so that it does not promote excessive migration of the

contaminant plume to the north or downward to the drinking water aquifer. The pump installed in the well during May/June 2006 may operate at lower pumping rates then the previous pump.

Laser-Induced Fluorescence (LIF) and Soil Probes

Based on interpretation of LIF data, extents of LNAPL (light non-aqueous phase liquid) were estimated. The estimated extent of LNAPL is approximately within a 160-foot radius of the former tank basin. There are four areas where the horizontal extent of LNAPL is not defined by LIF data: on the northwest (LIF-54 and LIF-55), northeast (LIF-45 and LIF-46), southeast (LIF-36 and LIF-42) and southwest (LIF-13 and LIF-18) of the extent drawn on Figure 9A. Considering the significant thickness of LNAPRL near the source area (18.5 feet) and the transition to low thickness in these four areas (0.5- to 3.5 feet) it is likely that the extent of LNAPL ends close to these areas. The interpreted depth to the top of the LNAPL ranges from 5 feet to 24 feet bgs. The interpreted depth to the bottom of the LNAPL is generally near 25 feet bgs, but ranges from approximately 6 to 26 feet.

A total of 13 soil probes (P-38 through P-50) were completed in February/March 2007 to collect soil, soil-gas and groundwater samples to confirm the LIF probes and assess other aspects of petroleum impacts near the source area. Soil probes (P-38 through P-44 and P-47 through P50) were advanced to collect data to confirm the LIF probes. Soil probe (P-50) was completed as a discrete sample corresponding to a depth of an elevated response in probe LIF-42. Two of the soil probes (P-45 and P-46) were advanced north-northeast of the site to aid in locating a monitoring well down gradient of the source area and attempt to collect a sample of soil-gas from pocket of pressurized soil-gas previously encountered in soil probes P-32 and VP-3. Soil-gas under pressure was not encountered during the assessment activities performed during February /March 2007.

Soil headspace analysis indicates impacts in confirmation soil probes that generally coincide with impacts noted in the LIF probes (Table 6). Headspace screening and analytical results of the two soil samples form soil probe P-38 suggest that petroleum impacts are primarily limited to depths shallower than approximately 25 feet. Laboratory analytical results of soil and groundwater samples indicate that elevated concentrations of petroleum impacted soil and groundwater are present within the source area at the site (Tables 7 and 9). GRO concentrations in soil samples collected from soil probes P-38 through P-43 exceeding 100 milligrams per kilogram (mg/kg). GRO concentrations in groundwater samples collected from soil probes P-48 and P-49 exceeded 10,000 micrograms per liter (ug/L). A soil analytical sample was not collected at P-50 confirms the suspected petroleum saturated soil based on a review of LIF-42. Groundwater analytical results collected from soil borings indicate significant petroleum impacts to groundwater.

The results of the LIF and soil probe assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay and clay to 17 to 24 feet bgs. The fine grained alluvium unit overlies a water bearing coarse grain alluvium unit consisting of fine to coarse grain sand and even gravel which extends to at least 35 feet bgs in some areas. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area approximately 18 feet bgs. Data from the LIF probes indicated that the LNAPL

migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The LNAPL also migrated laterally in the water bearing coarse grained alluvium unit.

Monitoring Wells

Three monitoring wells (W-3R, DW-8 and DW-9) were installed April 23 to 25, 2007 to the east-northeast and northeast of the source area. Monitoring well DW-3R was installed to replace monitoring well DW-3 which was sealed during May 2006 as part of the reconstruction on Pomeroy Avenue. Monitoring well DW-8 was located approximately 700 feet east-northeast of the source area as a sentinel well between the site and City Wells CW-5 and CW-6. Monitoring wells DW-3R and DW-8 were installed at a depth of 90 feet bgs and instrumented with wire wrapped stainless steel well screen set from a depth of 85 feet to 90 feet bgs within the drinking water aquifer. Monitoring well DW-9 was located approximately 400 feet northeast of the source as a down-gradient monitoring well. Monitoring well DW-9 was installed at a depth of 31 feet bgs and instrumented with wire wrapped Schedule 40 PVC well screen set from a depth of 26 feet to 31 feet bgs in the petroleum impacted sand and gravel unit. The monitoring wells were installed using a hollow stem auger drilling method as described in Appendix B.

Soil samples collected from the soil borings DW-3R, DW-8 and DW-9 were screed in the field with a PID. One sample from each boring was collected at the depth of the water table and submitted for laboratory analysis for the presence of BTEX, MTBE and GRO. Laboratory analyses of the soil samples did not detect the target compounds at concentrations at or above the laboratory reporting limits.

Soil samples collected from soil probes P-38 through P-43 were not analyzed within the 14 day hold time. The soil and groundwater samples collected from soil probes P-38 through P-49 were received by the laboratory at 10 degrees Celsius and no longer on ice. In addition, groundwater samples collected from soil probes P-39 and P-41 through P-43 were not analyzed within the 14 day hold time. The soil and groundwater samples from soil probes P-38 through P-49 were received by the laboratory late because the cooler was couriered from Minneapolis to Green Bay and then returned to Minneapolis by the courier. A review of the data indicated that the analytical data is viable for its intended use.

Section 2. Vapor Impact Monitoring

If vapor impacts were detected during previous assessments, discuss the results of follow-up vapor monitoring. Include in your discussion the sampling instrument and sampling method.

Two additional soil gas probes (VP-12 and VP-13) were advanced in conjunction with the February/March 2007 LIF probes and soil probes to further assess the risk of vapor intrusion to nearby residences (347 Lake Avenue and 410 Lake Avenue). Laboratory analytical results from both of the soil gas samples (VP-12 at 8 feet and VP-13 at 8 feet) detected a variety of petroleum related and non–petroleum related VOCs (Tables 10A-C). Benzene concentrations in the soil-gas samples from VP-12 [ug/cubic meter of air (18.0 ug/m^3) and VP-13 (30.4 ug/m^3) exceeded the MPCA action level [Minnesota Department of Health's (MDH) Health Base Values of 1.3 to 4.5 ug/m^3]. Therefore, there is a risk for petroleum vapors to potentially intrude into living spaces of the residences located at 347 Lake Avenue and 410 Lake Avenue.

Section 3. Recommendations

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the water table aquifer at the site and off-site to the north and northeast. In addition, the petroleum impacts groundwater appear to migrate downward into the underlying drinking water aquifer to the north and northeast of the site. The primary source of the dissolved phase petroleum plume appears to be light non-aqueous phase liquid (LNAPL) which as consistently been observed in several monitoring wells on the former Midtown Service Station property (MW-1, MW-20, MW-21, MW-22, MW-24 5 and MW-25). Groundwater quality data indicates that dissolved phase petroleum plume within the drinking water aquifer is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at well CW-4, dissolved phase petroleum concentrations for samples collected from well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3 have remained below laboratory reporting limits or at levels below their respective MDH Health Risk Limits (HRLs) or MDH Health Based Values (HBVs). However, benzene concentrations in groundwater samples from monitoring wells DW-5 and DW-6, which appear to be completed near the top of the drinking aquifer, consistently exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the drinking water aquifer and poses a continuing risk of once again impacting one of the city well if pumping activities at City Well CW-4 cease. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and plume stability or migration.

The results from vapor intrusion assessment activities completed to date have detected concentrations of benzene and 1,2,4-trimethylbenzene in soil-gas samples adjacent to several residences that exceed MPCA action levels. The available data indicate that petroleum vapor poses a risk of potentially intruding into living spaces of the residences located at 330 Lake Avenue, 400 Lake Avenue, 410 Lake Avenue and 154 Mill Street. Additional assessment is needed to further quantify the risk posed to the residential properties.

If additional corrective action is recommended, please provide your justification.

As discussed above, Terracon's FFS dated March 15, 2006 identifies a list of potentially effective corrective actions for the former Midtown Service Station site that would address source area petroleum impacts; decrease dissolved phase petroleum concentrations in the drinking water aquifer; and mitigate vapor migration into nearby buildings. The list of potentially effective corrective actions included: soil excavation and multi-phase extraction. In-situ soil washing was judged as having a moderate potential for long term effectiveness, but the presence of the clay and sandy clay unit in the source area would limited the ability of this technology to remediate a significant mass of LNAPL in the unsaturated zone.

Based on the data generated during the LIF and soil probe assessment activities in the source area described above cross-sections (Figures 5A through 5G) and an isopach map (Figures 9A) of the approximate LNAPL impacted area and soil thickness have been developed. Based on the same LIF data, LNAPL contour maps were prepared of the approximate elevation of the top and bottom of the LNAPL impacted soil. For soil excavation to remove a sufficient portion of the

LNAPL it would likely involve the removal of the non-impacted overburden, petroleum vapor impacted overburden and then excavating the LNAPL impacted soil from an area as depicted on Figures 9A. The proposed area is roughly bounded by the north side of Mill Street, the center of Lake Avenue, the southern site property boundary, and the western site property boundary. The proposed excavation area depicted on Figure 9A was developed with the goal of removing the greatest possible volume of LNAPL impacted soil without requiring the removal or extensive shoring of buildings other than those on the site. It is anticipated that approximately 75 percent of the know LNAPL impacted soil could be removed given the proposed area on Figure 9A. The impacted soil would be removed from the site for disposal or treated near the site and returned to the excavation. Soil excavation would be a very effective method of rapidly removing LNAPL impacted soil. The excavation process will need to reach a depth of approximately 25 feet such that LNAPL impacted soil as much as 7 feet below the water table could be removed which will require dewatering and treatment. Portions of Mill Street and Lake Avenue would need to be removed and then replaced. Since the excavation will go as deep as 25 feet which will require at least a 25 foot set back from the edge of the excavation for sloping and access. It is estimated that approximately 8,500 cubic yards of overburden would need to be removed to excavate approximately 6,000 cubic yards of LNAPL impacted soil. The estimated volume of overburden does not include sloping required for safety and access. It is anticipated that a significant portion of the overburden would be heavily impacted by petroleum vapors and should also be removed for disposal as it could act as a continuing source of vapor that could migrate into the living spaces of nearby residences. The estimated cost for the soil excavation alternative discussed above is approximately $1,400,000 with significant portions of this cost associated with the removal of the buildings on the site, dewatering/treatment, and reconstruction of Mill Street and Lake Avenue. The cost of the soil excavation alternative could be significantly reduced if innovative methods or site conditions allowed for the removal of LNAPL impacted soil from the water bearing sand unit without dewatering and treatment.

The typical multi-phase extraction (MPE) approach would involve: installing two extraction wells and several monitoring points for pilot testing; performing an MPE pilot test; and implementing a system consisting of several conventional extraction wells. An MPE system would likely have the advantage of recovering LNAPL from under the existing building, streets and landscaped / paved areas. A significant disadvantage of MPE using vertical extraction wells would be that the underground piping and operation of the system would require a significant disruption of the site and surrounding properties and likely take several years to complete. In addition, in areas near the former tank basins extraction well clusters would be needed to remediate the shallow LNPLP impacted areas. There is also a possible issue as to whether vertical extraction wells could produce sufficient drawdown in the coarse grained alluvium unit to dewater it sufficiently to allow for a significant volume of LNAPL to be removed in the vapor phase. However, an MPE system using a combination of vertical extraction wells on site and horizontal extraction wells extending off-site and targeting the LNAPL coarse grained alluvium unit may provide a more effective means removing the LNAPL. In addition, the larger surface area of a horizontal extraction well would probably achieve a greater radius of influence in the coarser grained units than the typical vertical extraction well design. Installation of horizontal extraction wells using a directional bore would have the advantage of minimizing the need for site restoration and disruption of activities on and near the site. The estimated cost for the MPE alternatives discussed above is approximately $950,000 with significant portions of this cost associated with installation and operation/maintenance of the remedial equipment. Unfortunately

the potential effectiveness of MPE using a horizontal extraction well(s) can not be pilot tested for without installing the well which would be a significant portion of the cost. It is also unfortunate that it is difficult to quantify how much LNAPL impact soil or what magnitude of the LNAPL impact would need to be remediated to have the net result of the dissolved phase petroleum plume attenuating before it reaches the drinking water aquifer.

Terracon recommends additional assessment of the extent and magnitude of the LNAPL impacts in and near the source area and the risk to potential vapor receptor, then possibly performing a MPE pilot test, before further evaluation of the feasibility and potential effectiveness of implementing the identified corrective actions. The results of the additional assessment and pilot testing may indicate that one technology will be more effective than other at addressing risk(s) or that a combination of technologies (i.e. on-site soil excavation and down-gradient (MPE) may the most effective corrective action. After completion of the additional assessment activities, Terracon recommends that a Conceptual Corrective Action Design (CCAD) be completed, if appropriate, that recommends a corrective action technology for addressing the LNAPL impacts to the source area. Specifically, Terracon recommends the following:

- Indoor air or sub-slab soil-gas samples should be collected from the residences near the source area that have been identified as being at risk of intrusion of petroleum vapors (330 Lake Avenue, 347 Lake Avenue, 400 Lake Avenue, 410 Lake Avenue and 154 Mill Street).
- Additional LIF and soil probes should advanced along the northern, western and east edge of the proposed area for soil excavation shown on Figure 9A. Additional LIF and soil probes should also be advanced in the four areas where the horizontal extent of LNAPL is not fully defined by LIF data: on the northwest (LIF-54 and LIF-55), northeast (LIF-45 and LIF-46), southeast (LIF-36 and LIF-42) and southwest (LIF-13 and LIF-18) of the extent drawn on Figure 9A.
- Based upon the results of the source area assessment activities, a CCAD report should be prepare that evaluates potential corrective action alternatives and recommends a CAD. The results of the assessment activities and pilot testing, if applicable, would be summarized in the CCAD report. Pilot testing or test pits may be required prior to the CCAD or before full scale implementation. Additionally, a Corrective Action Design report should be prepared consistent with the requirement of MPCA Guidance Document 4-11.

If additional monitoring is recommended, indicate the proposed monitoring schedule and frequency.

On going semi-annual groundwater monitoring activities should continue at the Midtown Service Station. Terracon recommends the following:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the dissolved phase petroleum plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.

- Collect semi-annual groundwater samples from City Wells CW-3, CW-5, CW-6, water treatment plant influent, and water treatment effluent. The groundwater samples should be analyzed for the MDH list of VOCs. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1(1), DW-2(2), DW-3R, DW-4(4), DW-5(45), DW-6(46), DW-7S(48), and DW-7D(49), DW-8 and DW-9; Midtown wells MW-1(20), MW-10(24), MW-10D(5), MW-14(25), MW-14D(6), MW-15(26), MW-16(27), and MW-17(28), MW-18-(29), MW-19(30), MW-20(31), MW-21, MW-22, MW-23, MW-24, MW-25, and RW-1(32); Johnson Motors wells MW-4(44) and MW-5(7); City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect annual groundwater samples from the nursery well, City Wells CW-7 and CW-8. The ground water samples should be analyzed for the MDH list of VOCs.
- Collect semi-annual sample groundwater quality samples for laboratory analysis from monitoring wells DW-3R, DW-5, DW-6, DW-8, DW-9, MW-16 and MW-17; and annual samples from monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. The samples from monitoring wells MW-8 and MW-9 should also be analyzed for the MDH list of VOCs. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. Update the groundwater analytical results table for the monitoring and municipal wells to include other petroleum and non-petroleum related VOCs detected during the sampling activities. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.

June 12, 2008 – Annual Monitoring Report – 2007/2008

From Guidance Document 4-08

Section I. Ground Water Monitoring

Discuss the groundwater monitoring results, including water level measurements and analytical results, performed since the investigation report or the last progress report submitted. Include all cumulative data in the tables. Indicate whether samples were purged or unpurged (see Guidance Document 4-05). If purged, indicate purging method.

This Annual Monitoring Report (AMR) includes groundwater monitoring results for monitoring events conducted since Terracon's Annual Monitoring Report dated June 30, 2007. In addition, this AMR includes the results of additional source area assessment activities performed during January 2008 and soil-gas sampling activities performed during November 2007, January 2008 and April 2008.

Based on available information and previous assessment work conducted by Terracon, the site has petroleum impacted soil, soil gas and groundwater in addition to a significant source mass of light non-aqueous phase liquid (NAPL) which appears to consist primarily of gasoline. Soil gas impacts appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in groundwater samples from City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for his issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Various petroleum related volatile organic compounds (VOCs) have been detected in the soil gas samples collected from soil-gas probes advanced at the site. Soil gas probes VP-7, VP-8, VP-9, VP-10, VP-12 and VP-13 were completed near residences. In these and other soil gas samples, one or more petroleum related VOCs were detected at concentrations that exceeded one of the MPCA soil gas action levels [i.e., Minnesota Department of Health (MDH) Health Risk Value (HRVs) or Environmental Protection Agency (EPA) Reference concentrations (RfCs)] (Tables10A through 10C).

Terracon completed a review of the MPCA file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15, 2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, excavation, bioslurping (multi-phase extraction), soil excavation and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The water table was encountered within the source area approximately 18 feet bgs. Data from the LIF probe indicated that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. The estimated horizontal extent of NAPL was approximately within a 160 foot radius of the former tank basins. The interpreted depth to the top of the NAPL ranged from 5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL was generally near 25 feet bgs, but ranged from approximately 6 to 26 feet. Several areas were identified which required additional assessment to delineate the horizontal extent of the NAPL and better understand the vertical extent of NAPL. The results of the source area assessment activities are summarized in Terracon's Annual Monitoring Report dated June 30, 2007.

The fluid level data from wells screened in the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B. The ground water contour maps developed using groundwater elevation data collected on September 25, 2007 and February 12, 2008 indicated the local horizontal groundwater flow direction in the drinking water aquifer is generally to the east-southeast which is consistent with previous collected data and the reported regional groundwater flow direction.

Semi-annual and annual groundwater monitoring events occurred during September 2007 and February 2008. The annual groundwater monitoring event occurred in September 2007. While the semi-annual events occurred in September 2007 and February 2008. The most recent monitoring event was conducted in February 2008 and included collecting groundwater samples from wells DW-3R, DW-5, DW-6, DW-8, DW-9, MW-14D, MW-16, MW-17, CW-4 and the Paynesville water treatment plant (WTP) influent and effluent. The VOCs detected in the groundwater samples collected from well DW-5 included benzene 79 microgram per liter (ug/L), ethyl benzene at 32 ug/L, total xylenes at 28 ug/L, and gasoline range organics (GRO) at 270 ug/L. The VOCs detected in the groundwater samples from monitoring well DW-6 include benzene at concentration of 11 ug/L. The VOCs detected in the groundwater sample from monitoring well DW-9 include benzene at 1,200 ug/L, ethyl benzene at 200 ug/L, and GRO at 4,300 ug/L. The absence of benzene in the groundwater sample collected from monitoring well MW-8 during the February 2008 sampling event suggests that its presence during the initial two sampling events may be the result of contaminants introduced during the installation of the well. Attempts to access the Nursery well to collect a groundwater sample were not successful as the property owner did not want the well sampled.

Plume Containment Activities (CW-4)

City Well CW-4 is continually pumped to contain the dissolved phase petroleum plume. Water from the well is discharged to the City of Paynesville storm sewer without needing treatment under an National Pollutant Discharge Elimination System (NPDES) Permit. Groundwater samples were collected from the discharge from City Well CW-4 on a quarterly basis for laboratory analysis as required in the NPDES Permit. The groundwater samples were analyzed for the MDH list of VOCs. The target VOCs were not detected in the discharge samples collected during September and November 2007, and February and May 2008. The groundwater analytical results are summarized in Tables 3A and 3B.

The groundwater pumping rate for CW-4 was observed to be decreased during the summer 2005 from approximately 103 gallons per minute (gpm) until it was shutdown on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2005 and the maximum pumping rate was approximately 90 gpm. The pump installed in the well during May/June 2006 may operate at lower pumping rates then the previous pump.

The pump in well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump was reinstalled in City Well CW-4 on June 1, 2006 and started the next day. The pump rate was set to approximately 90 gpm. The current pumping rate at City Well CW-4 of approximately 90-105 gpm appears to be controlling dissolved phase petroleum plume migration in the direction of City Wells CW-3, CW-5, CW-6 and CW-7. The pumping rate of city well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward to the drinking water aquifer. The pump installed in the well during May/June 2006 may operate at lower pumping rates then the previous pump. Water coming from the well was observed to be steaming when the sampling point was opened on May 20, 2008. The well was shutdown for investigation after it was allowed to pump at approximately 25 gpm for approximately one hour before as sample was collected. Further investigation by the City of Paynesville found the discharge line between the well and storm sewer was apparently blocked at a valve or the valve had somehow become closed. The pump would not restart. Thein Well Company (Thein) was contracted to remove and inspect the well pump to determine if it could be repaired or needed to be replaced. Thein found the pump and motor to be in good condition, but there was a hole in the drop pipe which apparently caused the pump to circulate water within the well until it overheated. Terracon plans to contract with Thein to install the pump in City Well CW-4.

The groundwater pumping rate for City Well CW-4 during the period from July 2006 to June 2007 was approximately 100 gpm. The groundwater pumping rate for City Well CW-4 during the current reporting period from July 2007 to May 2008 ranged from 80 to 100 gpm and appears to be controlling dissolved phase petroleum plume migration in the direction of City Wells CW-3, CW-5, CW-6, and CW-7. The pumping rate of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward into the drinking water aquifer.

Laser-Induced Fluorescence (LIF) and Soil Probes

The goal of the source area assessment was to develop a sufficient understanding of the source area hydrogeology, extent and magnitude of NAPL, migration pathways, and contaminant fate and transport mechanisms such that a Conceptual Corrective Action Design (CCAD) could be developed to address the risk to identified receptors. The goal of the additional source area assessment activities include: additional assessment along the north, west and east edge of the proposed area for soil excavation; and further delineation of the horizontal extent along the northeast, northwest, southwest and southeast edges assessed during March 2007. In general, the LIF probes were advanced to 5 feet beyond significant LIF response. Refer to Figures 5A through 5G for cross-sections based on LIF probes and soil borings / probe logs. See Figures 9A, 9B and 9C for maps illustrating the inferred horizontal and vertical extent of NAPL.

Based on interpretation of LIF data the horizontal and vertical extent of NAPL was estimated.

The inferred horizontal extent of NAPL consists of an approximately 320 feet by 200 feet oval shape with NAPL extending approximately 200 feet northwest of the former tank basins (Figure 9A). The interpreted depth to the top of the NAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted NAPL thickness is as much as 18.5 feet.

Groundwater samples were collected form the five soil probes (P-51 through P-55) and submitted to Pace for BTEX, MTBE, and GRO analyses. Low concentrations of one or more BTEX compounds were detected in groundwater samples collected from soil probes P-51, P-53 and P-54. MTBE was detected in the groundwater sample collected from soil probe P-51 at a concentration of 1.3 ug/L. The concentration for BTEX and MTBE detected in the groundwater samples from the soil probes P-51, P-53 and P-54 do not exceed the MDH HRLs or HBVs. GRO concentrations in groundwater samples collected from soil probes P-51 and P-53 were reported at 1,100 ug/L and 850 ug/L respectively, exceeding the MDH HRV of 200 ug/L. BTEX, MTBE and GRO were not detected above laboratory reporting limits in the groundwater samples collected from soil probes P-52 and P-55. The groundwater sampling information and analytical results from the soil probes are summarized in Tables 8 and 9.

The results of the LIF and soil probe assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay, sandy silt, and clay to 17 to 30 feet below ground surface (bgs). The fine grained alluvium unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to at least 35 feet bgs. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area approximately 18 feet bgs. Data from the LIF probes indicted that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit.

Section 2. Vapor Impact Monitoring

If vapor impacts were detected during previous assessments, discuss the results of follow-up vapor monitoring. Include in your discussion the sampling instrument and sampling method.

Past VIA activities near the source area have included soil gas probes advanced both as part of the MPCA VIA Pilot Study and site risk assessment activities. Various petroleum-related VOCs were detected in the soil gas samples collected from the soil gas probes (VP-1A through VP-13). One or more petroleum related VOCs were detected in samples from soil gas probes VP-1A and VP-13 at concentrations that exceeded their respective soil-gas MPCA action levels (i.e., MDH HRVs and EPA RfCs) (Tables 10A-C).

Three sub-slab monitoring points were installed through the basement floors of residences surrounding the source area to collect sub-slab gas samples to further assess the risk of petroleum vapors intruding into the buildings. A sub-slab monitoring point (SSMP-1) was installed in basement at 154 Mill Street in November 2007 and then sampled on November 7, 2007 and April 8, 2008. A sub-slab monitoring point (SSMP-2) was installed in the basement at 347 Lake

Avenue in January 2008 and then sampled on January 11, 2008 and April 8, 2008. A sub-slab monitoring point (SSMP-3) was installed in the basement at 410 Lake Avenue in January 2008 and then sampled on January 11, 2008 and May 20, 2008. Air samples were collected from the crawl space under the residence at 400 Lake Avenue on January 11, 2008 and April 8, 2008. The sub-slab soil gas and crawl space air samples were collected in laboratory certified Summa canisters using the method described in Appendix B. The Summa canisters were be submitted to Pace to be analyzed for MPCA list of VOCs using EPA Method TO-15 in general accordance with MPCA Guidance Document 4-01a Vapor Intrusion Assessment Performed during Site Investigations. Sub-slab soil gas samples and a crawl space air were also collected from each location during February 2008, but the samples were not analyzed when it was determined they were not collected in laboratory certified Summa canisters.

Information on soil vapor intrusion included in the USEPA OSWER Draft Guidance for Evaluating the Vapor Intrusion to indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) dated November 2002 indicates that building components and dilution from air exchange may attenuate soil gas concentrations entering a building by a factor of 10. Since the naphthalene and/or 1,2,4-trimethylbenzene concentrations detected in the sub-slab soil gas samples collected from the residences at 154 Mill Street, 347 Lake Avenue and 410 Lake Avenue do not exceed 10 times the MPCA limits, the petroleum vapors should not pose a significant threat to the indoor air quality in the buildings, However, the residence at 154 Mill Street has a crawl space with a dirt floor under the addition on the eastside of the building such that petroleum vapors may move directly from the sub-surface into the basement. In addition, the residence is used as a daycare.

Section 3. Recommendations

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the water table aquifer at the site and off-site to the north and northeast. In addition, the petroleum impacts groundwater appear to migrate downward into the underlying drinking water aquifer to the north and northeast of the site. The primary source of the dissolved phase petroleum plume appears to be non-aqueous phase liquid (NAPL) which as consistently been observed in several monitoring wells on the former Midtown Service Station property (MW-1, MW-20, MW-21, MW-22, MW-24 and MW-25). Groundwater quality data indicates that dissolved phase petroleum plume within the drinking water aquifer is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at well CW-4, dissolved phase petroleum concentrations for samples collected from well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3 have remained below laboratory reporting limits or at concentration below their respective MDH HRLs or HBVs. However, benzene concentrations in groundwater samples from monitoring wells that appear to be completed near the top of the drinking aquifer (DW-5, DW-6 and possibly DW-9), consistently exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the drinking water aquifer and poses a continuing risk of once again impacting one of the city well if pumping activities at City Well CW-4 cease. Continued analysis of samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and plume stability or migration.

The results from vapor intrusion assessment activities completed to date have detected concentrations of 1,2,4-trimethylbenzene and naphthalene in sub-slab soil-gas samples collected from beneath the residences located at 154 Mill Street, 347 Lake Avenue, and 410 Lake Avenue that exceed MPCA action levels, but by less than a factor of 10 (Tables 10A through 10G). Therefore, the 1,2,4-trimethylbenzene and /or naphthalene should not pose a significant threat to the indoor air quality in the buildings assuming sub-slab soil gas concentrations need to be more than 10 times the MPCA action level to result in an indoor air impact. However, the residence at 154 Mill Street, which is also used as a daycare, has a crawl space with a dirt floor under the addition on the east side of the building such that petroleum vapors may move directly from the sub-surface into the basement. Additional sampling during warm weather months is needed to further quantify the risk posed to the residential properties. Attempt by Terracon and the City of Paynesville to gain access to the property at 330 Lake Avenue have been unsuccessful.

Based upon the result from the groundwater monitoring and source area assessment activities, Terracon recommends that correction actions be taken to address the NAPL impacted soil in the source area at the site.

If additional corrective action is recommended, please provide you justification.
Please refer to MPCA Guidance Document 4-19 Conceptual Corrective Action Design which is included in Appendix E.

If additional corrective action is recommended, please provide your justification.

On going groundwater monitoring activities should continue at the former Midtown Service Station. Terracon recommends the following:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the dissolved phase petroleum plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.
- Collect annual groundwater samples from City Wells CW-3, CW-5, CW-6, CW-7 and CW-8; and semi-annual samples from the water treatment plant influent and effluent. The groundwater samples should be analyzed for the MDH list of VOCs. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1, DW-2, DW-3R, DW-4, DW-5, DW-6, DW-7S, and DW-7D, DW-8 and DW-9; Midtown wells MW-1, MW-10, MW-10D, MW-14, MW-14D, MW-15, MW-16, and MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, MW-25, and RW-1; Johnson Motors wells MW-4 and MW-5; City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect one additional set of sub-slab soil gas samples during warm weather from the sub-slab monitoring points at 347 Lake Avenue, 410 Lake Avenue and 154 Mill Street to further assess the risk of vapor intrusion. Indoor air samples should also be collected

from the basement, crawl space and main level of the residence located at 154 Mill Street to assess whether the petroleum vapors are entering the building through the crawl space. The indoor air samples should be collected with Summa canisters equipped with 24 hour flow controllers. The soil gas and indoor air samples should be analyzed for the MPCA List of VOCs using EPA Method TO-15. Additional sampling at 400 Lake Avenue is not recommended.

- Collect semi-annual groundwater quality samples for laboratory analysis from monitoring wells DW-3R, DW-5, DW-6, DW-8, DW-9, MW-16 and MW-17; and annual samples from monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.

May 13, 2009 – Annual Monitoring Report – 2008/2009

From Guidance Document 4-08

Section I. Work Completed

Discuss all site work completed since the Investigation Report Form or the last Monitoring Report was submitted. This should include both field and non-field related activities.

This Annual Monitoring Report (AMR) includes groundwater monitoring results for monitoring events conducted since Terracon's Annual Monitoring Report dated June 12, 2008. In addition, this AMR includes the results of soil gas sampling activities performed during November 2008, the replacement of monitoring well DW-8 during December 2008, and the results of indoor air sampling activities performed during February 2009.

Based on available information and previous assessment work conducted by Terracon, the site has petroleum impacted soil, soil gas and groundwater in addition to a significant source mass of light non-aqueous phase liquid (NAPL) which appears to consist primarily of gasoline. Soil gas impacts appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in groundwater samples from City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for this issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Two additional soil-gas probes (VP-12 and VP-13) were advanced in conjunction with source area assessment during February /March 2007 to further assess the risk of vapor intrusion to nearby residences (347 Lake Avenue and 410 Lake Avenue). The results from soil gas probes VP-12 and VP-13 were discussed in Terracon's Annual Monitoring Report dated June 30, 2007.

Various petroleum related volatile organic compounds (VOCs) have been detected in the soil gas samples collected from soil-gas probes advanced at the site. Soil gas probes VP-7, VP-8, VP-9, VP-10, VP-12 and VP-13 were completed near residences. In these and other soil gas samples, one or more petroleum related VOCs were detected at concentrations that exceeded one of the MPCA soil gas action levels (Tables 20A through 20C). Various petroleum related VOCs have been detected in the air samples and soil-gas collected from the crawl space under the on-site residence and sub-slab soil gas samples were collected from the three homes located near the site during 2007/2008. However, the petroleum-related VOCs concentrations detected in air and soil gas samples collected from the crawl space, soil gas probe and sub-slab monitoring points do not exceed 10 times the MPCA residential Intrusion Screening Values (ISVs) established in February 2009 indication the building should not be at risk of vapor intrusion resulting in VOCs concentration that exceed the MPCA ISVs. The results from crawl space and sub-slab soil gas sampling activities were discussed in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008.

Terracon completed a review of the MPCA file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15,

2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, excavation, bioslurping (multi-phase extraction), soil excavation and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The results of the source area assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay, sandy silt, and clay to 17 to 24 feet (bgs). The fine grained alluvium unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to at least 35 feet bgs. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area approximately 18 feet bgs. Data from the LIF probes indicted that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. The estimated horizontal extent of NAPL was approximately within a 160 foot radius of the former tank basins. The interpreted depth to the top of the NAPL ranged from 5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL was generally near 25 feet bgs, but ranged from approximately 6 to 26 feet.

During 2008, additional source area assessment activities were conducted including advancing 23 LIF probes (LIF-62 through LIF-84) and five additional soil probes (P-51 through P-55) to confirm previous LIF data. The goal of the source area assessment was to develop a sufficient understanding of the source area hydrogeology, extent and magnitude of NAPL, migration pathways, and contaminant fate and transport mechanisms such that a Detailed Corrective Action Design (DCAD) could be developed to address the risk to identified receptors. The additional source area assessment activities included: additional assessment along the north, west and east edge of the proposed area for soil excavation; and further delineation of the horizontal extent along the northeast, northwest, southwest and southeast edges assessed during March 2007.

Based on interpretation of LIF data the inferred horizontal extent of NAPL consists of an approximately 320 feet by 200 feet oval shape with NAPL extending approximately 200 feet northwest of the former tank basins. The interpreted depth to the top of the NAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted NAPL thickness is as much as 18.5 feet.

Data from the LIF probes indicated that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. The results of the

additional source area assessment activities are summarized in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008.

Section 2. Monitoring Results

Section 2.1 Ground Water

The fluid level data from wells screened in the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B. The ground water contour maps developed using groundwater elevation data collected on November 10, 2008 and February 11, 2009 indicated the local horizontal groundwater flow direction in the drinking water aquifer is generally to the east-southeast which is consistent with previous collected data and the reported regional groundwater flow direction.

Semi-annual and annual groundwater monitoring events occurred during November 2008 and February 2009. The annual groundwater monitoring event occurred in November 2008, while the semi-annual events occurred in November 2008 and February 2009. The most recent monitoring event was conducted in February 2009 and included collecting groundwater samples from wells DW-3R, DW-5, DW-6, DW-8, DW-8S, DW-9, MW-10D, MW-16, MW-17, CW-4 and the Paynesville water treatment plant (WTP) influent and effluent. The laboratory analytical results for the groundwater samples from these monitoring locations were reported below laboratory reporting limits for target VOCs, except for concentrations of various petroleum related compounds detected in samples collected from wells DW-5, DW-6, DW-8 and DW-9 and CW-4. The VOCs detected in the groundwater samples collected from well DW-5 included benzene 58.8 microgram per liter (ug/L), ethyl benzene at 11.5 ug/L, total xylenes at 16.8 ug/L, and gasoline range organics (GRO) at 186 ug/L. The VOCs detected in the groundwater samples from monitoring well DW-6 include benzene at concentration of 10 ug/L and ethyl benzene at a concentration of 1.0 ug/L. The VOCs detected in the groundwater sample from monitoring well DW-8 include benzene at 2.0 ug/L. The VOCs detected in the groundwater sample from monitoring well DW-9 included benzene at 1,330 ug/L, ethyl benzene at 256 ug/L, and GRO at 3,920 ug/L. The VOCs detected in city well CW-4 include benzene at a concentration of 0.73 ug/L.

Plume Containment Activities (CW-4)

City Well CW-4 is continually pumped to contain the dissolved phase petroleum plume. Water from the well is discharged to the City of Paynesville storm sewer without needing treatment under a National Pollutant Discharge Elimination System (NPDES) Permit. Groundwater samples were collected from the discharge from City Well CW-4 on a quarterly basis for laboratory analysis as required in the NPDES Permit. The groundwater samples were analyzed for the MDH list of VOCs. The target VOCs were not detected in the discharge samples collected during November 2008 and February 2009, with the exception of benzene detected at a concentration of 0.73 ug/L during the February 2009 sample event. The groundwater analytical results are summarized in Tables 3A and 3B.

The groundwater pumping rate for CW-4 was observed to be decreased during the summer 2005 from approximately 103 gallons per minute (gpm) until it was shutdown on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2005 and the maximum pumping rate was approximately 90 gpm. The pump in

well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump was reinstalled in City Well CW-4 on June 1, 2006 and started the next day. The pump rate was set to approximately 90 gpm. The pump installed in the well during May/June 2006 may operate at lower pumping rates then the previous pump. Water coming from the well was observed to be steaming when the sampling point was opened on May 20, 2008. The well was shutdown for investigation after it was allowed to pump at approximately 25 gpm for approximately one hour before as sample was collected. Further investigation by the City of Paynesville found the discharge line between the well and storm sewer was apparently blocked at a valve or the valve had somehow become closed. The pump would not restart. Thein Well Company (Thein) was contracted to remove and inspect the well pump to determine if it could be repaired or needed to be replaced. Thein found the pump and motor to be in good condition, but there was a hole in the drop pipe which apparently caused the pump to circulate water within the well until it overheated. The drop pipe and fittings were replaced on CW-4 and the pump was reinstalled and restarted by Thein Well on June 27, 2008.

The groundwater pumping rate for City Well CW-4 during the period from July 2006 to June 2007 was approximately 100 gpm. The groundwater pumping rate for City Well CW-4 during the current reporting period from July 2008 to February 2009 was approximately 100 gpm and appears to be controlling dissolved phase petroleum plume migration in the direction of City Wells CW-3, CW-5, CW-6, and CW-7. The pumping rate of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward into the drinking water aquifer.

Section 2.3 Vapor Intrusion (soil gas, sub-slab, indoor, ambient)

Discuss the results of any follow-up vapor intrusion assessment (VIA) activities including a description of each VIA sampling location and an interpretation of the results with respect to receptors. A third set of soil gas samples were collected during November 2008 from the sub-slab monitoring points. The soil-gas samples were collected in Certified Summa canisters equipped with a flow controller as described in Appendix C. The soil gas samples were analyzed for the MPCA list of VOCs using EPA Method TO-15. The soil gas samples were also analyzed for carbon dioxide, methane and oxygen. The sub-slab soil-gas analytical results are summarized in Tables 20E-20G.

A variety of petroleum and non-petroleum related volatile organic compounds (VOCs) were detected in the soil gas samples collected from sub-slab monitoring points SSMP-1 through SSMP-3 at concentrations less than MPCA residential Intrusion Screening Values (ISVs) (Tables 20E – 20G). The soil gas samples collected from sub-slab monitoring point SSMP-1 (154 Mill Street) contained trichloroethene (TCE) at concentration of 15.1 micrograms per cubic meters of air (ug/m^3) which exceeds the MPCA residential ISV of factor of 10.

Indoor air samples were collected at the residence located at 154 Mill Street to assess whether vapors associated with the source area were intruding through the dirt crawl space and intruding into occupied space of the residence. TCE was detected at a concentration of 1.6 ug/m^3 in the air sample collected from the crawl space, 3.6 ug/m^3 in the air sample collected from the basement, 29.6 ug/m^3 in the air sample collected from the main living space and 127 ug/m^3 in the air sample collected from ambient air sample collected from outside the residence (Tables 20H-20K). The TCE concentrations detected in the air samples collected from the basement, main

level and ambient air samples exceeded the MPCA acute ISV of 3 ug/m^3, however it is unclear from the limited amount of data whether the source of the TCE is in the subsurface, the home or outside ambient air.

Section 2.4 Free Product

If free product is present, discuss what activities are being completed to measure and recover it. Describe the effectiveness of the recovery efforts and free product trends over the course of the investigation. Complete Table 14 and discuss the data complied to date.
Fluid level data collected during this reporting period detected measurable free product in monitoring wells MW-1, MW-18, MW-20, MW-22, MW-24 and MW-25 (Table 10).
Product recovery activities were not performed.

Section 2.5 Other

Discuss the results of any additional monitoring or subsurface investigation conducted during this reporting period. Identify all monitoring locations on an attached site map by labeling each location. A description of sampling methods, including the instruments used, must be included in Section 6.

In December 2008, an additional monitoring well (MW-8S) was installed adjacent to monitoring well MW-8 to provide a fixed down-gradient shallow monitoring point. The well was advanced to a depth of 35 feet bgs. Groundwater was encountered at approximately 20 feet bgs. Soil samples recovered from the soil boring in the field were screened for the presence of organic vapors using a photo-ionization detector (PID) equipped with a 10.6 eV Lamp using a polyethylene bag headspace screening method consistent with MPCA guidelines. Based on field headspace screening results and factory and visual observation of soil samples collected from the soil boring, petroleum impacts were not detected.

The subsurface consists of approximately 15 feet of gravelly sand overlying clay sand and sand to a depth of 22 feet bgs where water bearing sand was encountered to a depth of 35 feet bgs. A 5 foot screen was set between 25 and 30 feet bgs to monitor groundwater quality near what appears to be the top of the drinking water aquifer.

Section 2.6 Site Conceptual Model

The results of source area assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay, and clay to 17 to 24 feet below ground surface (bgs). The fine grained alluvium unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to at least 35 feet bgs and may be the top of the drinking water aquifer. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area and down-gradient at approximately 18 to 20 feet bgs. Data from the LIF probes indicted that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. Based on interpretation of LIF data the inferred horizontal extent of NAPL consists of an approximately 320 feet by 200 feet oval shape with NAPL extending approximately 200 feet northwest of the former tank basins. The

interpreted depth to the top of the NAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted NAPL thickness is as much as 18.5 feet.

The NAPL is the apparent source of a dissolved phase petroleum plume that extends 900 feet to the north-northwest (CW-4) and to the east-northeast (DW-8), and to a depth of at least 90 feet bgs. It is anticipated that the dissolved phase petroleum plume extends to a similar distance and depth to the north and northeast of the source area. City Well CW-4 is being pumped to contain the dissolved phase plume. Impacts to potential vapor receptors have not been identified although a substantial petroleum vapor cloud is present at the site and to the north along Lake Avenue.

Section 3 Site Management Decision

Section 3.1 Recommendation for Site: additional ground water monitoring and corrective action

If additional monitoring or subsurface investigation is recommended, provide details of all proposed activities (e.g., monitoring locations, sampling frequency, target analytes, additional monitoring wells, and soil borings). Continue ground water monitoring and sampling in accordance with the previously approved schedule until the MPCA responds to this report.

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the water table aquifer at the site and off-site to the north and northeast. In addition, the petroleum impacts groundwater appear to migrate downward into the underlying drinking water aquifer to the north-northwest and east-northeast of the site. The primary source of the dissolved phase petroleum plume appears to be NAPL which as consistently been observed in several monitoring wells on the former Midtown Service Station property (MW-1, MW-20, MW-21, MW-22, MW-24 and MW-25). Groundwater quality data indicates that dissolved phase petroleum plume within the drinking water aquifer is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at well CW-4, dissolved phase petroleum concentrations for samples collected from well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3/3R have remained below laboratory reporting limits or at concentration below their respective MDH HRLs or HBVs. However, benzene concentrations in groundwater samples from monitoring wells that appear to be completed near the top of the drinking aquifer (DW-5, DW-6 and possibly DW-9), consistently exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the drinking water aquifer and poses a continuing risk of once again impacting one of the city well if pumping activities at City Well CW-4 cease. Continued analysis of groundwater samples from the water treatment plant, city wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and plume stability or migration.

The results from vapor intrusion assessment activities completed to date have detected concentrations of 1,2,4-trimethylbenzene and naphthalene in sub-slab soil-gas samples collected

from beneath the residences located at 154 Mill Street, 347 Lake Avenue, and 410 Lake Avenue. Concentrations of 1,2,4-trimethylbenzene and TCE have also been detected in indoor air samples collected the residence located at 154 Mill Street. The concentrations of petroleum related VOCs detected in the soil gas samples collected from the sub-slab monitoring points have been less than 10 times the MPCA residential ISVs suggesting the residences are not at risk of vapors intruding into the structures exceeding the residential ISVs. However, the chlorinated solvent TCE was detected in the most recent soil gas sample from monitoring point SSMP-1 (154 Mill Street) at a concentration of 15.1 ug/m^3 which exceeds the MPCA residential ISV of 3 ug/m^3. TCE was also detected in air samples collected from the crawl space (1.6 ug/m^3), basement (3.6 ug/m^3) main level (29.6 ug/m^3) and outside ambient air (127 ug/m^3) suggesting the source may not be in the subsurface.

Based upon the result from the groundwater monitoring and source area assessment activities, Terracon recommends that correction actions be taken to address the NAPL impacted soil in the source area at the site. On going groundwater monitoring activities should continue at the former Midtown Service Station. Terracon recommends the following:

- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the dissolved phase petroleum plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.
- Collect annual groundwater samples from City Wells CW-3, CW-5, CW-6, CW-7 and CW-8; and semi-annual samples from the water treatment plant influent and effluent. The groundwater samples should be analyzed for the MDH list of VOCs. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1, DW-2, DW-3R, DW-4, DW-5, DW-6, DW-7S, and DW-7D, DW-8 and DW-9; Midtown wells MW-1, MW-10, MW-10D, MW-14, MW-14D, MW-15, MW-16, and MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, MW-25, and RW-1; Johnson Motors wells MW-4 and MW-5; City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect semi-annual groundwater quality samples for laboratory analysis from monitoring wells DW-3R, DW-5, DW-6, DW-8, DW-9, MW-16 and MW-17; and annual samples from monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.

Section 3.5

If corrective action is recommended, provide a conceptual approach by completing Guidance Document 4-19 Conceptual Corrective Action Design Worksheet and include in Section 6. See Guidance Document 4-10 Elements of the Corrective Action Design for more information on the corrective action design process and other requirements.

See Terracon's Detailed Corrective Action Design, Dated May 13, 2009.

May 17, 2010 – Annual Monitoring Report – 2009/2010

From Guidance Document 4-08

Section I. Work Completed
Discuss all site work completed since the Investigation Report Form or the last Monitoring Report was submitted. This should include both field and non-field related activities.

This Annual Monitoring Report (AMR) includes groundwater monitoring results for monitoring events conducted since Terracon's Annual Monitoring Report – 2008/2009 dated May 13, 2009. In addition, this AMR includes a discussion of the installation of a piezometer in August 2009.

Based on available information and previous assessment work conducted by Terracon, the site has petroleum impacted soil, soil gas and groundwater in addition to a significant source mass of light non-aqueous phase liquid (NAPL) which appears to consist primarily of gasoline. Soil gas impacts appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in groundwater samples from City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for this issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Two additional soil-gas probes (VP-12 and VP-13) were advanced in conjunction with source area assessment during February /March 2007 to further assess the risk of vapor intrusion to nearby residences (347 Lake Avenue and 410 Lake Avenue). The results from soil gas probes VP-12 and VP-13 were discussed in Terracon's Annual Monitoring Report dated June 30, 2007.

Various petroleum related volatile organic compounds (VOCs) have been detected in the soil gas samples collected from soil-gas probes advanced at the site. Soil gas probes VP-7, VP-8, VP-9, VP-10, VP-12 and VP-13 were completed near residences. In these and other soil gas samples, one or more petroleum related VOCs were detected at concentrations that exceeded one of the MPCA soil gas action levels (Tables 20A through 20C). Various petroleum related VOCs have been detected in the air samples and soil-gas collected from the crawl space under the on-site residence and sub-slab soil gas samples were collected from the three homes located near the site during 2007/2008. However, the petroleum-related VOCs concentrations detected in air and soil gas samples collected from the crawl space, soil gas probe and sub-slab monitoring points do not exceed 10 times the MPCA residential Intrusion Screening Values (ISVs) established in February 2009 indication the building should not be at risk of vapor intrusion resulting in VOCs concentration that exceed the MPCA ISVs. The results from crawl space and sub-slab soil gas sampling activities were discussed in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008 and Terracon's Annual Monitoring Report – 2008/2009 dated May 13, 2009.

Terracon completed a review of the MPCA file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15, 2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The

FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, excavation, bioslurping (multi-phase extraction), soil excavation and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The results of the source area assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay, sandy silt, and clay to 17 to 24 feet (bgs). The fine grained alluvium unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to at least 35 feet bgs. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area approximately 18 feet bgs. Data from the LIF probes indicted that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. The estimated horizontal extent of NAPL was approximately within a 160 foot radius of the former tank basins. The interpreted depth to the top of the NAPL ranged from 5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL was generally near 25 feet bgs, but ranged from approximately 6 to 26 feet. Several areas wee identified which required additional assessment to delineate the horizontal extend of the NAPL and better understand the vertical extent of NAPL. Monitoring wells DW-8 and DW-9 were installed during May 2007 to better delineate the dissolved phase petroleum plume to the northeast of the source area. Monitoring wells DW-8 and DW-9 were installed during May 2007 to better delineate the dissolved phase petroleum plume to the northeast of the source area. Monitoring well DW-8 was completed in the drinking water aquifer approximately 90 feet bgs. Monitoring well DW-9 was completed in what appears to be the top of the drinking water aquifer approximately 30 feet bgs. The results of the source area assessment activities are summarized in Terracon's Annual Monitoring Report dated June 30, 2007.

During January 2008, additional source area assessment activities were conducted including advancing 23 LIF probes (LIF-62 through LIF-84) and five additional soil probes (P-51 through P-55) to confirm previous LIF data. The goal of the source area assessment was to develop a sufficient understanding of the source area hydrogeology, extent and magnitude of NAPL, migration pathways, and contaminant fate and transport mechanisms such that a Detailed Corrective Action Design (DCAD) could be developed to address the risk to identified receptors. The additional source area assessment activities included: additional assessment along the north, west and east edge of the proposed area for soil excavation; and further delineation of the horizontal extent along the northeast, northwest, southwest and southeast edges assessed during March 2007.

Based on interpretation of LIF data the inferred horizontal extent of NAPL consists of an approximately 320 feet by 200 feet oval shape with NAPL extending approximately 200 feet northwest of the former tank basins. The interpreted depth to the top of the NAPL ranges from

7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted NAPL thickness is as much as 18.5 feet.

Data from the LIF probes indicated that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. The results of the additional source area assessment activities are summarized in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008.

Monitoring well DW-8S was installed during December 2008 to provide a fixed monitoring point near the top of the drinking water aquifer at the location of monitoring well DW-8 where benzene has consistently been detected at a depth of 85 to 90 feet bgs. The results of the additional assessment and groundwater monitoring activities during 2008/2009 are summarized in Terracon's Annual Monitoring Report - 2008/2009 dated May 13, 2009. A DCAD recommending the excavation and off-site disposal of the NAPL impacted soil was also prepared during 2009. The DCAD included options for a large excavation which would likely require access to the residential property north of the site and a small excavation limited to the site that would include a rainey well and associated remedial equipment to attempt to recover the off-site NAPL. The two source area remedial options are summarized in Detailed Corrective Action Design dated May 13, 2009. More recently the MPCA is considering the use of mechanical remedial methods to recover the NAPL such that the costs and potential effectiveness of the various remedial options can be compared. The MPCA is currently reviewing Terracon's Pilot Test Work Plan dated February 10, 2010.

Section 2. Monitoring Results

Section 2.1 Ground Water

The fluid level data from wells screened in the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B. The ground water contour maps developed using groundwater elevation data collected on August 11, 2009 and February 3, 2010 indicated the local horizontal groundwater flow direction in the drinking water aquifer is generally to the east-southeast which is consistent with previous collected data and the reported regional groundwater flow direction.

Annual groundwater samples were collected from monitoring wells DW-3R(3), DW-5(45), DW-6(46), DW-7S(48), DW-7D(49), DW-8S(57), DW-8(55), DW-9(56), MW-16(27), MW-17(28), City Wells CW-1 through CW-8; and the water treatment plant (WTP) influent and effluent during August 2009. Semi-annual groundwater samples were collected from monitoring wells DW-3R(3), DW-5(45), DW-6(46), DW-8S(57), DW-8(55), DW-9(56), MW-16(27), MW-17(28), City Wells CW-4; and the WTP influent and effluent during February 2010. The laboratory analytical results for the groundwater samples from these monitoring locations were reported below laboratory reporting limits for target VOCs, except for concentrations of various petroleum related compounds detected in samples collected from wells DW-5, DW-6, DW-8 and DW-9 (Table 11). The benzene concentrations in the groundwater samples collected from monitoring wells DW-5, DW-6, DW-8 and DW-9 exceeded the MDH HRL of 2 ug/L. The GRO

concentration in the groundwater samples collected from monitoring well DW-9 exceeded the MDH HBV of 200 ug/L.

Plume Containment Activities (CW-4)

City Well CW-4 is continually pumped to contain the dissolved phase petroleum plume. Water from the well is discharged to the City of Paynesville storm sewer without needing treatment under a National Pollutant Discharge Elimination System (NPDES) Permit. Groundwater samples were collected from the discharge from City Well CW-4 on a quarterly basis for laboratory analysis as required in the NPDES Permit (Table 11). The groundwater samples were analyzed for the MDH list of VOCs. The target VOCs were not detected in the discharge samples collected during April 2009, August 2009, December 2009 and February 2010. The groundwater analytical results are summarized in Tables 11 and 12.

The groundwater pumping rate for CW-4 was observed to be decreased during the summer 2005 from approximately 103 gallons per minute (gpm) until it was shutdown on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2005 and the maximum pumping rate was approximately 90 gpm. The pump in well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump was reinstalled in City Well CW-4 on June 1, 2006 and started the next day. The pump rate was set to approximately 90 gpm. The pump installed in the well during May/June 2006 can operate at lower pumping rates then the previous pump. The groundwater pumping rate for City Well CW-4 during the period form July 2006 to June 2007 was approximately 100 gpm. Water coming from the well was observed to be steaming when the sampling point was opened on May 20, 2008. The well was shutdown for investigation after it was allowed to pump at approximately 25 gpm for approximately one hour before as sample was collected. Further investigation by the City of Paynesville found the discharge line between the well and storm sewer was apparently blocked at a valve or the valve had somehow become closed. The pump would not restart. Thein Well Company (Thein) was contracted to remove and inspect the well pump to determine if it could be repaired or needed to be replaced. Thein found the pump and motor to be in good condition, but there was a hole in the drop pipe which apparently caused the pump to circulate water within the well until it overheated. The drop pipe and fittings were replaced on CW-4 and the pump was reinstalled and restarted by Thein Well on June 27, 2008.

The groundwater pumping rate during the current reporting period from March 2009 to May 2010 varied from approximately 100 gpm to 20 gpm when it was shut down in March 2010. The groundwater pumping rate for City Well CW-4 was approximately 90 to 100 gpm during the first half of the reporting period. The groundwater pumping rate decreased during the second half of the reporting period to a point where it was operating at 20 gpm when it was shut down on March 31, 2010. Thein removed the drop pipe and submersible pump on April 8, 2010 and found the drop pipe near the pump had holes and pump should be replaced. Thein also indicated that the well spool was in poor condition and would likely need to be replaced within the next two years. Thein installed a new pump and drop pipe on May 11, 2010 and the pumping rate was set at approximately 100 gpm. A pumping rate of 100 appears to be controlling dissolved phase petroleum plume migration in the direction of City Wells CW-3, CW-5, CW-6, and CW-7. The groundwater pumping rate of City Well CW-4 should be limited so that it does not promote

excessive migration of the contaminant plume to the north or downward into the drinking water aquifer.

Section 2.3 Vapor Intrusion (soil gas, sub-slab, indoor, ambient)
Discuss the results of any follow-up vapor intrusion assessment (VIA) activities including a description of each VIA sampling location and an interpretation of the results with respect to receptors. Not Applicable

Section 2.4 Free Product
If free product is present, discuss what activities are being completed to measure and recover it. Describe the effectiveness of the recovery efforts and free product trends over the course of the investigation. Complete Table 14 and discuss the data complied to date.
Fluid level data collected during this reporting period detected measurable free product in monitoring wells MW-1, MW-18, MW-20, MW-22, MW-24 and MW-25 (Table 10).
Product recovery activities were not performed.

Section 2.5 Other
Discuss the results of any additional monitoring or subsurface investigation conducted during this reporting period. Identify all monitoring locations on an attached site map by labeling each location. A description of sampling methods, including the instruments used, must be included in Section 6.

In August 2009, a piezometer well (PZ-1) was installed adjacent to Paynesville City Well CW-4 to provide a fixed groundwater elevation monitoring point since CW-4 is inaccessible for the collection of water elevations. The well was advanced to a depth of 110 feet bgs using a Rota-Sonic drilling method. Groundwater was encountered at approximately 20 feet bgs. Soil samples recovered from the soil boring in the field were screened for the presence of organic vapors using a photo-ionization detector (PID) equipped with a 10.6 eV lamp using a polyethylene bag headspace screening method consistent with MPCA guidelines. Based on field headspace screening results and olfactory and visual observation of soil samples collected from the soil boring, petroleum impacts were not detected.

The subsurface consists of approximately 19 feet of gravelly sand overlying water bearing silty sand and clayey sand to a depth of 43 feet bgs. Water-bearing sand, sandy gravel, and gravelly sand was encountered from 43 to 101 feet bgs. Lean clay was encountered from 101 to 110 feet bgs. A 5 foot screen was set between 95 and 100 feet bgs to monitor groundwater elevations.

Section 2.6 Site Conceptual Model
Discuss any changes to the overall site conceptual model that has altered the current site management decision based upon the information presented in this report.

The results of source area assessment activities indicated that in and near the source area that the subsurface generally consists of up to 13 feet of fine to coarse grained sand with gravel and fill overlying a fine grained alluvium unit composed of sandy clay, and clay to 17 to 24 feet (bgs). The fine grained alluvium unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to at least 35 feet bgs and may be the top of the drinking water aquifer. Perched

water was occasionally encountered within the upper sand / fill unit and in sand lenses within the fine grained alluvium unit. The water table was encountered within the source area and down-gradient at approximately 18 to 20 feet bgs. Data from the LIF probes indicted that the NAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The NAPL also migrated laterally in the water bearing coarse grained alluvium unit. Based on interpretation of LIF data the inferred horizontal extent of NAPL consists of an approximately 320 feet by 200 feet oval shape with NAPL extending approximately 200 feet northwest of the former tank basins. The interpreted depth to the top of the NAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the NAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted NAPL thickness is as much as 18.5 feet.

The NAPL is the apparent source of a dissolved phase petroleum plume that extends 900 feet to the north-northwest (CW-4) and to the east-northeast (DW-8), and to a depth of at least 90 feet bgs. It is anticipated that the dissolved phase petroleum plume extends to a similar distance and depth to the north and northeast of the source area. City Well CW-4 is being pumped to contain the dissolved phase plume. Impacts to potential vapor receptors have not been identified although a substantial petroleum vapor cloud is present at the site and to the north along Lake Avenue.

Section 3 Site Management Decision

Section 3.1 Recommendation for Site: additional ground water monitoring and corrective action

If additional monitoring or subsurface investigation is recommended, provide details of all proposed activities (e.g., monitoring locations, sampling frequency, target analytes, additional monitoring wells, and soil borings). Continue ground water monitoring and sampling in accordance with the previously approved schedule until the MPCA responds to this report.

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the water table aquifer at the site and off-site to the north and northeast. In addition, the petroleum impacts groundwater appear to migrate downward into the underlying drinking water aquifer to the north-northwest and east-northeast of the site. The primary source of the dissolved phase petroleum plume appears to be NAPL which as consistently been observed in several monitoring wells on the former Midtown Service Station property (MW-1, MW-20, MW-21, MW-22, MW-24 and MW-25). Groundwater quality data indicates that dissolved phase petroleum plume within the drinking water aquifer is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at well CW-4, dissolved phase petroleum concentrations for samples collected from well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3/3R have remained below laboratory reporting limits or at concentration below their respective MDH HRLs or HBVs. However, benzene concentrations in groundwater samples from monitoring wells that appear to be completed near the top of the drinking aquifer (DW-5, DW-6 and DW-9), consistently exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the

drinking water aquifer and poses a continuing risk of once again impacting one of the city well if pumping activities at City Well CW-4 cease. Continued analysis of groundwater samples from the water treatment plant, City Wells, and select monitoring wells should be performed in order to monitor the quality of the water supply and plume stability or migration.

Based upon the result from the groundwater monitoring and source area assessment activities, Terracon recommends that correction actions be taken to address the NAPL impacted soil in the source area at the site. On going groundwater monitoring activities should continue at the former Midtown Service Station. Terracon recommends the following:

- Meet with MPCA staff to discuss the Pilot Test Work Plan dated February 10, 2010 which is currently being reviewed.
- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the dissolved phase petroleum plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.
- Collect annual groundwater samples from City Wells CW-3, CW-5, CW-6, CW-7 and CW-8; and semi-annual samples from the water treatment plant influent and effluent. The groundwater samples should be analyzed for the MDH list of VOCs. The sampling schedule should be adjusted to monthly if the dissolved phase petroleum plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1, DW-2, DW-3R, DW-4, DW-5, DW-6, DW-7S, and DW-7D, DW-8, DW-8S and DW-9; Midtown wells MW-1, MW-10, MW-10D, MW-14, MW-14D, MW-15, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, MW-25, and RW-1; Johnson Motors wells MW-4 and MW-5; City of Paynesville monitoring wells identified as CMW-42 and CMW-43.
- Collect semi-annual groundwater quality samples for laboratory analysis from monitoring wells DW-3R, DW-5, DW-6, DW-8, DW-8S, DW-9, MW-16 and MW-17; and annual samples from monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.
- The drop pipe and submersible pump should be removed from City Well CW-4 in spring 2011 and the conditions of the well inspected using a downhole camera. If the pump spool in City Well CW-4 needs to be replaced the City of Paynesville should be contacted to discuss modifying the well to use a pitless adapter which may be less costly than replacing the spool and would allow for the collection of water levels. The MPCA may also wish to consider looking at an alternative means of monitoring the water level in City well CW-4 such as a pressure transducer.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of

Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.

Section 3.5

If corrective action is recommended, provide a conceptual approach by completing Guidance Document 4-19 Conceptual Corrective Action Design Worksheet and include in Section 6. See Guidance Document 4-10 Elements of the Corrective Action Design for more information on the corrective action design process and other requirements.

See Terracon's Detailed Pilot Test Work Plan dated May 13, 2009.

May 17, 2011 – Annual Monitoring Report – 2010/2011

From Guidance Document 4-08

Section I. Work Completed

Discuss all site work completed since the Investigation Report Form or the last Monitoring Report was submitted. This should include both field and non-field related activities.

This Annual Monitoring Report (AMR) summarizes the results of groundwater monitoring activities and the operation/maintenance activities associated with City Well CW-4 coordinated by Terracon Consultants, Inc. (Terracon) at the site during period of May 2010 through March 2011. The AMR also includes information regarding the installation of monitoring wells, test wells and vapor monitoring points installed in preparation for dual-phase extraction (DPE) pilot test.

Based on available information and previous assessment work conducted by Terracon, the site has petroleum impacted soil, soil gas and groundwater in addition to a significant source mass of light non-aqueous phase liquid (NAPL) which appears to consist primarily of gasoline. Soil gas impacts appear to be concentrated along Lake Avenue between the former Midtown Service Station and State Highway 23. Benzene and 1,2-dichloroethane have been detected in groundwater samples from City Wells CW-3 and CW-4 on several occasions in the past. The most recent corrective action for this issue involved assisting the City of Paynesville with the installation of new municipal water supply wells (CW-7 and CW-8) and utilizing City Well CW-4 as a plume containment well.

Two additional soil-gas probes (VP-12 and VP-13) were advanced in conjunction with source area assessment during February /March 2007 to further assess the risk of vapor intrusion to nearby residences (347 Lake Avenue and 410 Lake Avenue). The results from soil gas probes VP-12 and VP-13 were discussed in Terracon's Annual Monitoring Report dated June 30, 2007.

Various petroleum related volatile organic compounds (VOCs) have been detected in the soil gas samples collected from soil-gas probes advanced at the site. Soil gas probes VP-7, VP-8, VP-9, VP-10, VP-12 and VP-13 were completed near residences. In these and other soil gas samples, one or more petroleum related VOCs were detected at concentrations that exceeded one of the MPCA residential Intrusion Screening Values (ISVs) (Tables 20A through 20C). Various petroleum related VOCs have been detected in the air samples and soil-gas collected from the crawl space under the on-site residence and sub-slab soil gas samples were collected from the three residences located near the site during 2007/2008. However, the petroleum-related VOCs concentrations detected in air and soil gas samples collected from the crawl space, soil gas probe and sub-slab monitoring points do not exceed 10 times the MPCA residential Intrusion Screening Values (ISVs) established in February 2009 indication the building should not be at risk of vapor intrusion resulting. The results from crawl space and sub-slab soil gas sampling activities were discussed in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008 and Terracon's Annual Monitoring Report – 2008/2009 dated May 13, 2009.

Terracon completed a review of the MPCA file for the former Midtown Service Station (LEAK00002181) in order to develop a limited focused feasibility study (FFS). The results of the FFS were submitted to the MPCA in Terracon's Focused Feasibility study dated March 15, 2006. The FFS included a summary of the historic activities on site and assessment of the effectiveness of corrective actions that have previously targeted the source area at the site. The FFS also included recommendations for further definition of the source area to be remediated; proposed a plan for developing cleanup objectives for the site; and provided a summary of potential corrective actions. Corrective action alternatives evaluated in the FFS included: free product recovery, soil excavation, bioslurping (multi-phase extraction), and in situ soil flushing. The FFS did not include a recommendation for implementing a specific corrective action to address the current extent and magnitude of the petroleum impacts in and near the source area.

The results of the source area assessment activities indicated that in and near the source area the subsurface generally consists of 7 to as much as 17 feet of fine to coarse grained sand with gravel and fill overlaying a till unit composed of clay, sandy clay and clayey sand to 17 to 24 feet below ground surface (bgs). The clay unit overlies a water bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to 27 to 31 feet bgs and is underlain by a silt to sandy silt unit that extend to at least 40 feet bgs. Perched water was occasionally encountered within the upper sand / fill unit and in sand lenses within the clay unit. The water table was encountered within the source area and down-gradient at approximately 15 to 20 feet bgs. Data from the LIF probes indicted that the LNAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The LNAPL also migrated laterally in the water bearing coarse grained alluvium unit. The estimated horizontal extent of LNAPL was approximately within a 160 foot radius of the former tank basins. The interpreted depth to the top of the LNAPL ranged from 5 feet to 24 feet bgs. The interpreted depth to the bottom of the LNAPL was generally near 25 feet bgs, but ranged from approximately 6 to 26 feet. Several areas were identified which required additional assessment to delineate the horizontal extend of the LNAPL and better understand the vertical extent of LNAPL. Monitoring wells DW-8 and DW-9 were installed during May 2007 to better delineate the dissolved phase petroleum plume to the northeast of the source area. Monitoring wells DW-8 was completed in the drinking water aquifer approximately 90 feet bgs. Monitoring well DW-9 was completed in what appears to be the top of the drinking aquifer, approximately 30 feet bgs. The results of the source area assessment activities are summarized in Terracon's Annual Monitoring Report dated June 30, 2007.

During January 2008, additional source area assessment activities were conducted including advancing 23 LIF probes (LIF-62 through LIF-84) and five additional soil probes (P-51 through P-55) to confirm previous LIF data. The goal of the source area assessment was to develop a sufficient understanding of the source area hydrogeology, extent and magnitude of LNAPL, migration pathways, and contaminant fate and transport mechanisms such that a Detailed Corrective Action Design (DCAD) could be developed to address the risk to identified receptors. The additional source area assessment activities included: additional assessment along the north, west and east edge of the proposed area for soil excavation; and further delineation of the horizontal extent along the northeast, northwest, southwest and southeast edges assessed during March 2007.

Based on interpretation of LIF data the inferred horizontal extent of LNAPL consists of an approximately 320 feet by 200 feet oval shape with LNAPL extending approximately 200 feet northwest of the former tank basins. The interpreted depth to the top of the LNAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the LNAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted LNAPL thickness is as much as 18.5 feet. Data from the LIF probes indicated that the LNAPL migrated laterally on top of the fine grained alluvium unit as well as downward to the water bearing coarse grained alluvium unit. The LNAPL also migrated laterally in the water bearing coarse grained alluvium unit. The results of the additional source area assessment activities are summarized in Terracon's Annual Monitoring Report – 2007/2008 dated June 12, 2008.

Monitoring well DW-8S was installed during December 2008 to provide a fixed monitoring point near the top of the drinking water aquifer at the location of monitoring well DW-8 where benzene has consistently been detected at a depth of 85 to 90 feet bgs. The results of the additional assessment and groundwater monitoring activities during 2008/2009 are summarized in Terracon's Annual Monitoring Report - 2008/2009 dated May 13, 2009. A DCAD recommending the excavation and off-site disposal of the LNAPL impacted soil was also prepared during 2009. The DCAD included options for a large excavation which would likely require access to the residential property north of the site and a small excavation limited to the site that would include a rainey well and associated remedial equipment to attempt to recover the off-site LNAPL. The two source area remedial options are summarized in Terracon's Detailed Corrective Action Design dated May 13, 2009. More recently the MPCA is considering the use of mechanical remedial methods to recover the LNAPL such that the costs and potential effectiveness of the various remedial options can be compared. The results of a dual-phase extraction (DPE) pilot test performed during April 2011 will be summarized in a Pilot Test Report scheduled to be completed during June 2011.

Recently Performed Activities

Work performed on the project since the last report has included the following:

- Effluent samples were collected from City Well CW-4 during June 2010, September 2010 and March 2011 as part of operation/monitoring activities associate with City Well CW-4.
- Fluid levels were collected from select monitoring wells and piezometer PZ-1 during October/November 2010 and March 2011.
- Ground water samples were collected from select monitoring wells, City wells and the water treatment plant during October/November 2010 and March 2011.
- Remedial well RW-1 and monitoring wells MW-20, MW-21, MW-22, MW-23, MW-24, and MW-25 were abandoned during October 2010 in preparation of DPE pilot test.
- Five new monitoring wells (MW-26 through MW-30), two DPE wells (DPE-1 and DPE-2) and three vapor monitoring points (VPM-1 through VMP-3) were installed during October/November 2011 in preparation for a DPE pilot test.

1.2

If additional work requested in the most recent MPCA correspondence has not been completed, explain why.

The following activities associated with the operation/maintenance of City Well CW-4 and groundwater monitoring activities were not performed:

- An effluent sample was not collected from City Well CW-4 during the fourth quarter of 2010 as the sample was planned to be collected in conjunction with DPE pilot testing activities which were postpone until April 2011.
- Fluid levels were not collected from piezometer PZ-1 during June 2010 and September 2010 because of oversights.

Section 2. Monitoring Results

Section 2.1 Ground Water

The fluid level data from wells screened within the drinking water aquifer between 75 and 95 feet below ground surface was used to prepare the ground water contour maps depicted in Figures 3A and 3B. The ground water contour maps developed using groundwater elevation data collected on October 28, 2010 and March 1 and 3, 2011 indicated the local horizontal groundwater flow direction in the drinking water aquifer is generally to the east-southeast which is consistent with previous collected data and the reported regional groundwater flow direction.

Benzene concentrations from monitoring wells completed in the drinking water aquifer and water supply wells and the inferred extent of the dissolved phase benzene plume are shown of Figures 7A and 7B.

Annual groundwater samples were collected from City wells CW-3, and CW-5 through CW-8 during October 2010. The laboratory analytical results from the groundwater samples collected from these monitoring locations indicate that the target VOCs were not detected at concentrations at or above the laboratory reporting limits. Semi-annual groundwater samples were collected from monitoring wells DW-3R, DW-5, DW-6, DW-7S, DW-7D, DW-8S, DW-8), DW-9, MW-16, MW-17, MW-19, MW-27, MW-28, MW-29, MW-30; City Wells CW-4; and the Water Treatment Plant (WTP) influent and effluent during October 2010 and March 2011. The laboratory analytical results for the groundwater samples from monitoring wells DW-3R, DW-7S, DW-7D, MW-16 and MW-17 indicate that the benzene, toluene, ethyl benzene, xylenes (BTEX) and gasoline range organics (GRO) were not detected at concentrations at or above the laboratory reporting limits. Concentrations of various petroleum related compounds were detected in the groundwater samples collected from monitoring wells DW-5, DW-6, DW-8, DW-9, MW-19, and MW-26 through MW-30 (Table 11). The benzene concentrations in the groundwater samples collected from monitoring wells DW-5, DW-6, DW-8, MW-19, MW-26, MW-27, and MW-30 during each sampling event exceeded the MDH HRL of 2 ug/L. The benzene concentrations in the groundwater samples collected from monitoring wells DW-9 and MW-28 during the October 2010 sampling event exceeded the MDH HRL of 2 ug/L. The GRO concentration in the groundwater samples collected from monitoring well DW-9, MW-19, and MW-26 through MW-30 exceeded the MDH HBV of 200 ug/L. The diesel range organics (DRO) concentrations in the groundwater samples collected from monitoring wells MW-19, and MW-26 through WM-30 exceeded the MDH HBV of 200 ug/L

Plume Containment Activities (CW-4)

City Well CW-4 is continually pumped to contain the dissolved phase petroleum plume. Water from the well is discharged to the City of Paynesville storm sewer without needing treatment

under a National Pollutant Discharge Elimination System (NPDES) Permit. Groundwater samples were collected from the discharge from City Well CW-4 on a quarterly basis for laboratory analysis as required in the NPDES Permit (Table 11). The groundwater samples were analyzed for the MDH list of VOCs. The target VOCs were not detected in the discharge samples collected during June 2010, September 2010, or March 2011, with the exception of benzene at a concentration of 0.74 ug/L in the sample collected in March 2011. The groundwater analytical results are summarized in Tables 11 and 12.

The operational and maintenance history for City Well CW-4 is summarized in Table 21. Significant maintenance activities associated with City Well CW-4 are summarized below.

- The groundwater pumping rate for City Well CW-4 was observed to be decreasing during the summer of 2005 form approximately 103 gallons per minutes (gpm) until it was shut down on August 31, 2005 to replace the RPZ backflow preventer on the well that had failed. The pump was restarted on September 14, 2005 and the maximum pumping rate was approximately 90 gpm.
- The pump in City Well CW-4 failed during March 2006. A new pump was installed in the well CW-4 on May 5, 2006, but it had the wrong voltage motor. The pump was reinstalled in City Well CW-4 on June 1, 2006 and started the next day. The pump rate was set to approximately 90 gpm. The pump installed in the well during May/June 2006 can operate at lower pumping rates than the previous pump.
- Water coming from the well was observed to be steaming when the sampling point was opened on May 20, 2008. The well was shutdown for investigation after it was allowed to pump at approximately 25 gpm for approximately one hour before as sample was collected. Further investigation by the City of Paynesville found the discharge line between the well and storm sewer was apparently blocked at a valve or the valve had somehow become closed. The pump would not restart. Thein Well Company (Thein) was contracted to remove and inspect the well pump to determine if it could be repaired or needed to be replaced. Thein found the pump and motor to be in good condition, but there was a hole in the drop pipe which apparently caused the pump to circulate water within the well until it overheated. The drop pipe and fittings were replaced and the pump was reinstalled and restarted by Thein Well on June 27, 2008.
- The flow rate of water being pumped form City Well CW-4 was observed to be 20 gmp on March 31, 2010 and the pump was shut down for service. Thein removed the drop pipe and submersible pump on April 8, 2010 and found the drop pipe near the pump had holes and pump should be replaced. Thein also indicated that the well spool was in poor condition and would likely need to be replaced within the next two years. Thein installed a new pump and drop pipe on May 11, 2010 and the pumping rate was set at approximately 100 gpm.

The groundwater pumping rate during the current reporting period from May 2010 to March 2011 varied from approximately 80 to 95 gpm. Groundwater analytical data from monitoring wells completed within the drinking water aqifer suggests that a pumping rate of approximately 100 appears too control dissolved phase petroleum plume migration to the direction of City Wells CW-3, CW-5, CW-6, and CW-7. The groundwater pumping rate of City Well CW-4 should be limited so that it does not promote excessive migration of the contaminant plume to the north or downward into the drinking water aquifer.

Section 2.3 Vapor Intrusion (soil gas, sub-slab, indoor, ambient)
Discuss the results of any follow-up vapor intrusion assessment (VIA) activities including a description of each VIA sampling location and an interpretation of the results with respect to receptors. Not Applicable.

Section 2.4 Free Product
If free product is present, discuss what activities are being completed to measure and recover it. Describe the effectiveness of the recovery efforts and free product trends over the course of the investigation. Complete Table 14 and discuss the data complied to date.

Fluid level data collected during this reporting period detected measurable free product in monitoring wells MW-1, MW-18, MW-26, and MW-30 (Table 10). Product recovery at monitoring wells MW-1 and MW-18 was completed using a bailer to remove the product into a product can during the October 2010 and March 2011 sampling events to attempt to reduce the amount of product in the wells prior to the DPE pilot test. Product recovery activities were not performed on monitoring wells MW-26 and MW-30 as product was not detected or a recoverable volume was not present in these monitoring wells during this reporting period. Table 14 has not been prepared because corrective actions currently being evaluated for the site will address the LNAPL.

Section 2.5 Other
Discuss the results of any additional monitoring or subsurface investigation conducted during this reporting period. Identify all monitoring locations on an attached site map by labeling each location. A description of sampling methods, including the instruments used, must be included in Section 6.

Test Well Installation Activities
Terracon coordinated the advancement of ten soil borings, two of which were completed on DPE test wells (DPE-1 and DPE-2), five of which were completed as monitoring wells (MW-26 through MW-30), and there of which were completed as vapor monitoring points (VMP-1 through VMP-3) during October/November 2011 using hollow stem auger (HAS) and dual rotary drilling methods. The test wells and monitoring points were installed in preparation for a DPE pilot test that was performed during April 2011.

The soil borings for DPE wells DPE-1 and DPE-2 were advanced to 40 feet and 32 feet bgs respectively. A silt or sandy silt unit was encountered in both borings such that the length of the test well screens were reduced and the wells were equipped with solid sumps below the screens to attempt to maximize the removal of fluids form lower sand unit. DPE wells DPE-1 and DPE-2 were constructed using 8 inch diameter black steel well casing instrumented with 6 and 9 foot lengths of 8 inch diameter wire wrapped stainless steel well screens, respectively. Each of the DPE wells were equipped with a 5 foot long solid black steel sump below the screed interval. The initial attempt to install each of the DPE wells using hollow stem augers were unsuccessful and the well casing and screens were removed, the boreholes redrilled in approximately the same locations using a dual rotary drilling method and the wells reinstalled.

The soil borings for monitoring wells MW-26 through MW-30 were advanced to 30 feet bgs to allow for the completion of monitoring points within the lower sand unit. The monitoring wells were constructed using 10 foot lengths of 2 inch diameter flush threaded Schedule 40 PVC wll screens and casing set 29 to 30 feet bgs.

The soil borings for vapor monitoring points VMP-1 through VMP-3 were advanced to 8 to 10 feet bgs to allow for the completion of monitoring point within the sand and fill over the clay unit. The vapor monitoring wells were constructed using 2 to 5 foot lengths of 1 inch diameter flush threaded Schedule 40 PVC well screens and casing. Additional information regarding the well installation activities and the results of the DPE pilot test will be summarized in a separate report.

The results of the well installation activities indicated that the subsurface within the source area consist of 7 to 17 feet of fine to coarse grained sand with gravel and fill overlying a clayey sand till (clay unit) that extends to depths of 17 to 24 feet bgs. The clay unit overlies a water bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to 27 to 31 feet bgs and is underlain by a silt to sandy silt unit that extends to at least 40 feet bgs. Perched water is occasionally encountered within the upper sand/fill unit and in sand lenses within the clay unit. The water table was encountered within the source area and down gradient at approximately 15 to 20 feet bgs. Cross sections have been developed using soil boring logs and LIF probe logs for the site (Figures 9A-9I). The monitoring wells construction information is summarized in Table 9B.

Soil Analytical Results

Soil samples collected from the borings were screened in the field for organic vapors using a photo-ionization detector (PID) (Table 2). Elevated organic vapor concentrations were detected in one or more soil samples collected from borings DPE-, DPE-2, VMP-3, and MW-26 through MW-30. Based upon soil organic vapor concentrations and visual / olfactory evidence the soil drill cuttings ere containerized for off-site disposal. The petroleum impacted fluids and well development water was containerized and treated with a potable treatment system prior to being discharged to the storm sewer. The petroleum impacted soil drill cuttings were disposed of by Veolia ES Technical Solutions LLC.

Select soil samples collected from the soil borings were submitted to a laboratory and analyzed for BTEX, MTBE, GRO and DRO. Elevated concentrations of ethyl benzene, xylenes and GRO were detected in each of the soil samples collected from soil borings (Table 3). Select soils samples from soil borings DPE-1 and DPE-2 were also analyzed for RCRA metals and VOCs plus lead using the Toxic Characterization Leaching Procedure (CLP) to characterize the soil drill cuttings for off-site disposal (Table 4). Grain size analyses were also performed on select samples collected from soil borings DPE-1 and DPE-2 to size the well screen.

Soil organic vapor readings are summarized in Table 2 and on the boring logs in Appendix C. Laboratory analytical results for soils samples are summarized in Table 3 and 4.

Section 2.6 Site Conceptual Model

Discuss any changes to the overall site conceptual model that has altered the current site management decision based upon the information presented in this report.

The results of source area assessment activities indicated that in and near the source area that the subsurface generally consists of up to 7 to 17 feet of fine to coarse grained sand with gravel and fill overlying a clay to clayey sand till that extends to depths of 17 to 24 feet (bgs). The clay unit overlies a water-bearing coarse grained alluvium unit consisting of fine to coarse grained sand that grades to gravel in some areas. The coarse grained alluvium unit extends to 27 to 31 feet bgs and is underlain by a silt to sandy silt unit that extends to at least 40 feet bgs. Perched water is occasionally encountered within the upper sand / fill unit and in sand lenses within the clay unit. The water table was encountered within the source area and down-gradient at approximately 15 to 20 feet bgs. Data from the LIF probes indicted that the LNAPL migrated laterally on top of the clay unit as well as downward to the water bearing coarse grained alluvium unit. The LNAPL also migrated laterally in the water bearing coarse grained alluvium unit. Based on interpretation of LIF data the inferred horizontal extent of LNAPL consists of an approximately 320 feet by 200 feet oval shape with LNAPL extending approximately 200 feet northwest of the former tank basins. The interpreted depth to the top of the lNAPL ranges from 7.5 feet to 24 feet bgs. The interpreted depth to the bottom of the LNAPL is generally near 25 feet bgs, but ranges from approximately 12.5 to 27 feet. The interpreted LNAPL thickness is as much as 18.5 feet.

The LNAPL is the apparent source of a dissolved phase petroleum plume that extends 900 feet to the north-northwest (CW-4) and to the east-northeast (DW-8), and to a depth of at least 90 feet bgs. The occasional presence of benzene (CW-4, DW-3, DW-8) and sometimes 1,2-dichloroethane (CW-4) in groundwater samples from the drinking water aquifer is indicative of the leading edge of the dissolved phase petroleum plume. It is anticipated that the dissolved phase petroleum plume extends to a similar distance and depth to the north and northeast of the source area. City Well CW-4 is being pumped to contain the dissolved phase plume. Impacts to potential vapor receptors have not been identified although a substantial petroleum vapor cloud is present at the site and to the north along Lake Avenue.

Section 3 Site Management Decision

Section 3.1 Recommendation for Site: additional ground water monitoring and corrective action

Section 3.3

If additional monitoring or subsurface investigation is recommended, provide details of all proposed activities (e.g., monitoring locations, sampling frequency, target analytes, additional monitoring wells, and soil borings). Continue ground water monitoring and sampling in accordance with the previously approved schedule until the MPCA responds to this report.

The dissolved phase petroleum plume emanating from the former Midtown Service Station continues to impact the water quality in the aquifer at the site and off-site to the north and northeast. In addition, the petroleum impacted groundwater appears to migrate downward into the underlying drinking water aquifer to the north-northwest and east-northeast of the site. The primary source of the dissolved phase petroleum plume appears to be LNAPL which has consistently been observed in monitoring wells MW-1 and MW-18 on the former Midtown Service Station property as wells as in many of the LIF probes advanced on the former service station property and adjacent streets and properties. Groundwater quality data indicates the

dissolved phase petroleum plume within the drinking water aquifer is responsive to groundwater pumping activities. In comparing data from similar time periods, the City Well CW-4 pumping rates and laboratory analytical data for groundwater samples collected from wells at the site appear to correlate well. During increased groundwater pumping rates at City Well CW-4, dissolved phase petroleum concentrations for samples collected from City Well CW-4 at times increase while those in nearby monitoring wells MW-17 and DW-3/3R have remained below laboratory reporting limits or at concentrations below their respective MDH HRLs or HBVs. However, benzene concentrations in groundwater sample from monitoring wells that appear to be completed near the top of the drinking water aquifer (DW-5, DW-6 and DW-9) typically exceed the MDH HRL indicating that the dissolved phase petroleum plume continues to impact the drinking water aquifer and poses a continuing risk of once again impacting one of the City Wells if pumping activities at City Well CW-4 cease. Continued analysis of groundwater samples from water treatment plant, City Wells and select monitoring wells should be performed in order to monitor the quality of the water supply and plume stability or migration.

Based upon the result from the groundwater monitoring, Terracon recommends that correction actions be taken to address the LNAPL impacted soil in the source area at the site. On going groundwater monitoring activities should continue at the former Midtown Service Station. Terracon recommends the following:

- Prepare a report documenting the results from the DPE pilot test.
- Determine the current status of the monitoring wells associated with other sites in Paynesville and determine the ground surface and top of riser elevations for monitoring wells being used for assessment and monitoring activities at the site. Ground surface elevations for select soil boring, soil probes and LIF borings should be determined.
- Continue groundwater extraction activities utilizing City Well CW-4 to contain the dissolved phase petroleum plume. Continue to adjust the pumping rate of City Well CW-4 to establish an extraction rate that helps prevent excessive migration of the dissolved phase petroleum plume in the direction of either well CW-4 or wells DW-7S, DW-7D, CW-3, CW-5, CW-6, and CW-7. Continue to collect quarterly discharge samples from City Well CW-4 for laboratory analysis. The discharges samples should be analyzed for the MDH list of VOCs per the requirement of the NPDES Permit.
- Collect annual groundwater samples from City Wells CW-3, CW-5, CW-6, CW-7 and CW-8; and semi-annual samples from the water treatment plant influent and effluent. The groundwater samples should be analyzed for the MDH list of VOCs. The sampling schedule should be adjusted to monthly if the contaminant plume appears to become unstable.
- Conduct semi-annual site visits to collect fluid level data from wells DW-1, DW-2, DW-3R, DW-4, DW-5, DW-6, DW-7S, and DW-7D, DW-8, DW-8S and DW-9; Midtown wells MW-1, MW-10, MW-10D, MW-14, MW-14D, MW-15, MW-16, and MW-17, MW-18, MW-19, MW-26, MW-27, MW-28, MW-29, and MW-30; Johnson Motors wells MW-4 and MW-5; City of Paynesville monitoring wells identified as CMW-42 and CMW-43. Monitoring wells containing measurable free product should not be sampled.
- Collect semi-annual groundwater quality samples for laboratory analysis from monitoring wells DW-3R, DW-5, DW-6, DW-8, DW-8S and DW-9, MW-16, MW-17, MW-19, MW-26, MW-27, MW-28, MW-29 and MW-30; and annual samples from

monitoring wells DW-7S and DW-7D. Well DW-5 should be sampled after purging with the recovery well pump. The samples should be analyzed for BTEX, MTBE, and GRO. A duplicate sample and field blank should be analyzed during each sampling event.

- The drop pipe and submersible pump should be removed from City Well CW-4 in the summer 2011 and the conditions of the well inspected using a downhole camera. If the pump spool in City Well CW-4 needs to be replaced the City of Paynesville should be contacted to discuss modifying the well to use a pitless adapter which may be less costly than replacing the spool and would allow for the collection of water levels. The MPCA may also wish to consider looking at an alternative means of monitoring the water level in City Well CW-4 such as a pressure transducer.
- Perform reporting and project management duties associated with the continue sampling of the municipal water supply and plume containment which includes permitting requirements, utility costs, submission of data to MPCA Staff and the City of Paynesville, and the preparation of an annual monitoring report. The annual report will fulfill the requirements of MPCA Guidance Document 4-08.

Section 3.5

If corrective action is recommended, provide a conceptual approach by completing Guidance Document 4-19 Conceptual Corrective Action Design Worksheet and include in Section 6. See Guidance Document 4-10 Elements of the Corrective Action Design for more information on the corrective action design process and other requirements.

See Terracon's pending Pilot Test Report.