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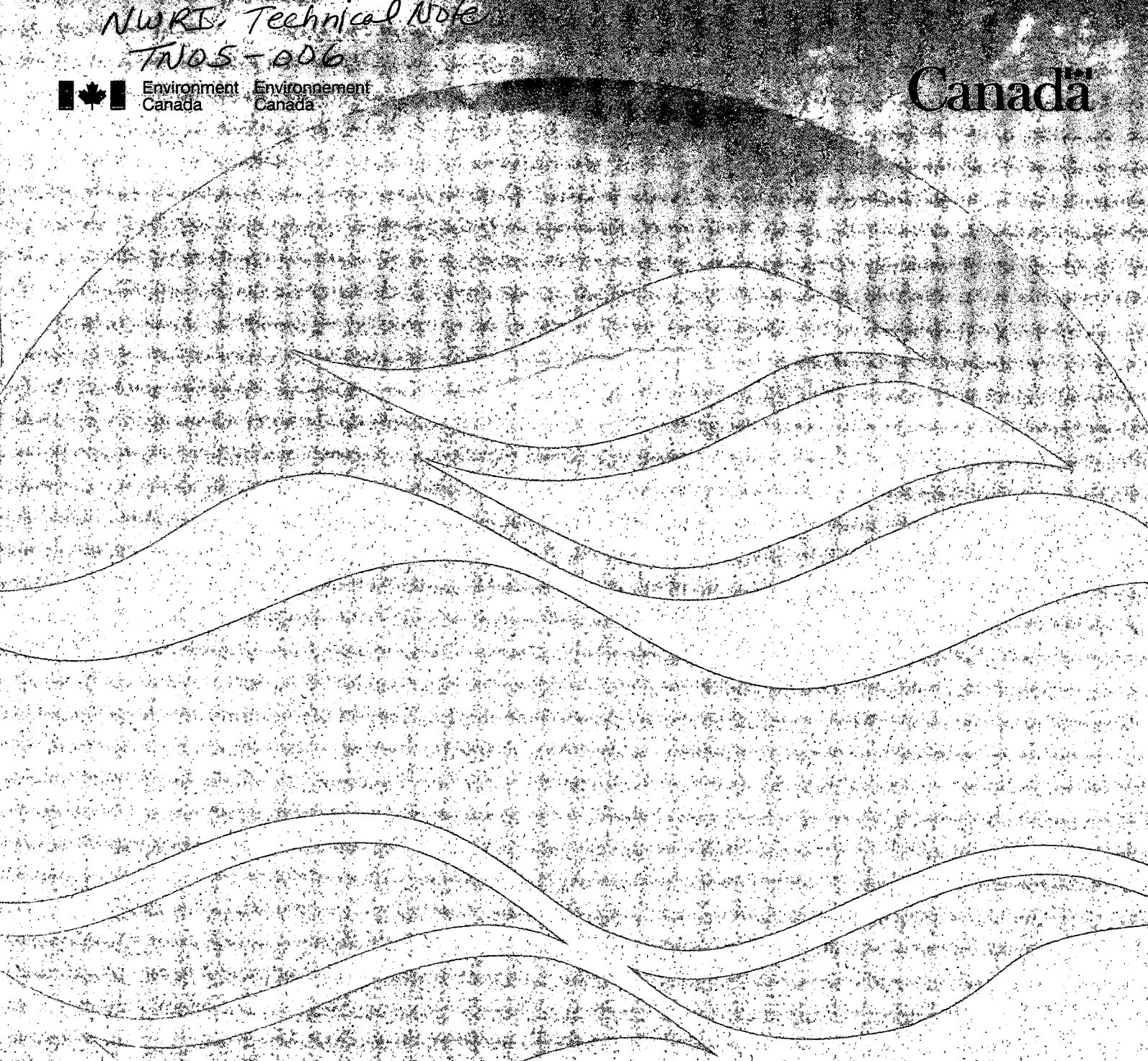

ASSESSMENT OF THE CURRENT EXTENT AND STABILITY OF THE PETROLEUM-HYDROCARBON PLUMES IN GROUNDWATER AT WEENEEBAYKO HOSPITAL, MOOSE FACTORY, ONTARIO

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Assessment of the Current Extent and Stability of the Petroleum-Hydrocarbon Plumes in Groundwater at Weeneebayko Hospital, Moose Factory, Ontario

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Preamble

The National Water Research Institute (NWRI) of Environment Canada was approached by Public Works and Government Service Canada (PWGSC) to expand NWRI's existing groundwater monitoring program at Weeneebayko Hospital in Moose Factory, Ontario. The purpose was to develop a site-wide assessment of the current status of groundwater contamination on Health Canada's property at Weeneebayko Hospital. Although NWRI had been performing continual groundwater monitoring since April 2002, their research studies focused exclusively on the hydrocarbon plume associated with previous fuel storage at the above-ground storage-tank farm area of the property. The status of the groundwater contamination associated with the water utility plant was less well documented. The information collected during this study was intended to begin addressing this gap and to assist Health Canada and PWGSC in making management and remediation decisions related the site.

Préambule

Travaux publics et Services gouvernementaux Canada (TPSGC) a demandé à l'Institut national de recherche sur les eaux (INRE), d'Environnement Canada, de développer le programme de surveillance des eaux souterraines déjà en place à l'Hôpital Weeneebayko, sur l'île de Moose Factory (Ontario). L'objectif était de procéder à un examen global du site pour déterminer l'état de la contamination des eaux souterraines de la propriété de Santé Canada, à l'Hôpital Weeneebayko. Depuis avril 2002, bien que l'INRE ait sans cesse surveillé ces eaux souterraines, la recherche n'a porté que sur le panache d'hydrocarbures associé à l'ancien parc de réservoirs de stockage de combustibles hors-sol qui était installé sur la propriété. De plus, l'état de la contamination des eaux souterraines dans le cas de l'usine de traitement des eaux est moins bien documenté. Les renseignements recueillis dans le cadre de l'étude visaient à pallier cette lacune et à aider Santé Canada et TPSGC à prendre les décisions qui s'imposent quant à la gestion et à l'assainissement du site.

Executive Summary

The National Water Research Institute (NWRI) of Environment Canada was approached by Public Works and Government Service Canada (PWGSC) to expand NWRI's existing groundwater monitoring program at Weeneebayko Hospital in Moose Factory, Ontario. The purpose was to develop a site-wide assessment of the current status of groundwater contamination on Health Canada's property at Weeneebayko Hospital. Although NWRI had been performing continual groundwater monitoring since April 2002, their research studies focused exclusively on the hydrocarbon plume associated with previous fuel storage at the above-ground storage-tank farm area of the property. The status of the groundwater contamination associated with the water utility plant was less well documented. The information collected during this study was intended to begin addressing this gap and to assist Health Canada and PWGSC in management and remediation decisions related to the site.

In terms of the groundwater flow system at the site, it appears that the lowest groundwater levels occur in early spring, prior to snow melt, and the highest groundwater levels occur between late May and early July. The documented seasonal groundwater fluctuations ranged from 0.28 m to 1.40 m, depending on the location. Despite these fluctuations, the direction of groundwater flow towards the river appears to be relatively constant; however significant seasonal and spatial variations in groundwater velocity are expected. As discussed in previous reports, the Moose River levels are not expected to have any significant influence on the groundwater flow system for most of the year.

It appears that most remaining fuel in the subsurface at the site is in a relatively immobile form and will likely be unrecoverable using conventional pumping technologies. The amounts measured in the monitoring wells appeared too small and the permeabilities of the geologic materials too low to provide a high probability of success. Successful recovery of the remaining fuel, or LNAPL (light non aqueous phase liquid), may require the use of other advanced technologies. Similarly, the available evidence also suggests that most of the remaining fuel would likely not move significantly if the Moose River were to flood; a concern that has been repeatedly expressed with regards to the site. A 2-dimensional multiphase modeling study is suggested as a possible option to further explore this issue if site management has remaining concerns surrounding contaminant mobilization during flooding.

In general, ethylbenzene and total petroleum hydrocarbons (TPH) were the only contaminants at the site found to exceed federal and provincial guidelines for potable groundwater. The regions of the site which contained contaminated groundwater that exceeded guidelines were typically more than 75 m from the Moose River. However, two locations of concern were identified within 15 m of the river where ethylbenzene concentrations slightly exceeded guideline values. The groundwater contaminant data also continues to provide support to NWRI's previous contention that preferential flow is occurring along an abandoned sewer alignment at the site. This provides a mechanism

that allows contaminants a quicker and more direct route to the shoreline of the Moose River.

An examination of contaminant concentrations in groundwater discharging through seeps in the banks of the Moose River was explored for the first time in this study. Detectable levels of benzene, ethlylbenzene, o-xylene and trimethylbenzene were found in the discharging groundwater at the 3 locations sampled. Although no concentration levels were found to exceed surface water guidelines. It currently appears that ethylbenzene and trimethylbenzene are the contaminants of greatest concern for discharging groundwater along the shoreline at the site. An examination of groundwater discharge along the shoreline should be considered to identify if any further problem areas exist.

A new and unresolved issue is whether a separate plume, which has not been previously identified, exists in the vicinity of the former transformer storage compound. It is suggested that the abandoned (and recently removed) underground storage tanks identified in the area could have provided a potential source for such a plume. Groundwater information obtained from this area is limited and contradictory; however it may justify further examination. Although the concentration levels of contaminants detected in this area do not exceed federal or provincial criteria, understanding the source of the contaminants in this area is the larger concern. Mistakenly attributing the contaminants to another source at the site would likely lead to gross misinterpretations of contaminant transport rates and processes at the site.

The addition of new groundwater data collected during this study has finally allowed a statistical evaluation of plume stability to be performed in the tank farm area. Unfortunately, similar statistical tests could not be conducted on the plume near the water utility plant due to insufficient data. In general, the available contaminant data suggests that the contaminant plume is currently stable. However some exceptions were noted. Due to the relatively limited historical data available, continued monitoring of plumes at the site is strongly suggested for providing more confidence to the stability analysis or to identify any new trends

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Acknowledgements

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1.0 Introduction

1.1 Background

The National Water Research Institute (NWRI) of Environment Canada was approached by Public Works and Government Service Canada (PWGSC) to expand NWRI's existing groundwater monitoring program at Weeneebayko Hospital in Moose Factory, Ontario. The purpose was to develop a site-wide assessment of the current status of groundwater contamination on Health Canada's property at Weeneebayko Hospital. Although NWRI had been performing continual groundwater monitoring since April 2002, their research studies (*Bickerton et al.*, 2005a & 2005b) focused exclusively on the plume associated with the above-ground storage-tank farm (ASTF) area of the property. The status of the groundwater plume associated with the water utility plant (WUP) was less well documented. The last monitoring event for the WUP plume was performed in August 2002 (*Franz Environmental*, 2003).

1.2 Scope of Investigation and Objectives

The specific objectives of the groundwater monitoring program identified by PWGSC in their April 2004 request for proposal were:

(i) *Measure groundwater impacts and provide additional information to assist in establishing trends and future remedial options.*
(ii) *Compare previous site data with new data to make conclusions on the effects of seasonal fluctuations and the stability/condition of the groundwater contamination.*

Excluding the incorporation of results obtained under NWRI's research program (*Bickerton et al.*, 2005a & 2005b), the activities requested under PWGSC's scope of work were:

(i) Collecting manual groundwater levels for 6 specified wells (see Figure 1.1) at a weekly interval for a period of five weeks in both the spring and fall of 2004.
(ii) Obtaining surface water elevations of the Moose River during the monitoring period.
(iii) Collecting groundwater samples from 14 specified wells (see Figure 1.1) and performing analyses (or have analyses performed) for benzene, toluene, ethylbenzene, xylene (collectively referred to as BTEX) and the gas and diesel fractions of total petroleum hydrocarbons (TPH).
(iv) Collecting manual measurements of LNAPL (light non-aqueous phase liquid) thickness in wells where a distinct layer of fuel is present in the well.

(v) Comparing analytical results to CCME's Canadian Environmental Quality Guidelines (*CCME*, 2003) and the Ontario Ministry of the Environment's Table A guidelines (*MOE*, 1997).

Administrative delays confounded the collection of data during the spring period identified in the scope of work. NWRI was instructed not to proceed with the activities for PWGSC until approval and funding from Health Canada were confirmed. NWRI had received approval for its research program prior to April, 2004; however, the confirmation for the PWGSC activities was not received until May 27, 2004. The approval to proceed was received after NWRI's on-site staff member began his prearranged leave which lasted until late June. Consequently, collecting groundwater levels from the WUP area and river level data did not begin until late June. Rather than forego the data from groundwater sampling in the WUP area, NWRI instructed on-site staff to collect the requested samples from the WUP area immediately after the sampling event was conducted in the ASTF area. In the event that approval for the PWGSC activities was denied, NWRI would have assumed responsibility for the sampling costs.

2.0 Seasonal Variability in Groundwater Elevations and LNAPL Thicknesses

2.1 Monitoring Well Positions and Elevations

Several different organizations have been responsible for collecting data on Weeneebayko Hospital property over the last decade; some have focused on specific locations (e.g. ASTF area) and others on a site-wide basis. In each case, the distribution of monitoring points (e.g. wells, boreholes and test pits) has been depicted graphically to show the relative positions of parameter values and allow for interpretation. However, different bench marks have been used for their spatial positioning and elevation determinations. For example, *CH2M Hill* (2002) used an unspecified arbitrary datum for showing relative positioning and the WUP floor as an elevation datum; *Franz Environmental* (2003) appears to have used a NAD27-based positioning system which was presumably referenced to a specific (but unspecified) monitoring well with a GPS-determined position; and NWRI used an arbitrary, but specified, datum for survey positioning and NAD83 for GPS-determined positions. The use of different bench marks does not diminish or invalidate the findings or value of the respective studies, but it does complicate the integration of the various positioning and elevation data for depicted site-wide features. For this compilation, all data were transformed to reference a common positioning and elevation datum before proceeding. The NAD27 (North American Datum 1927) was selected for all spatial positioning to agree with available local topographic maps and hydrographic charts. A local vertical control marker (BM15) was used as the elevation datum.

In order to evaluate the direction and rate of groundwater flow at the site, all manually collected water levels had to be converted to elevations using known casing-top elevations. The casing top elevations in the ASTF area (i.e. grey-filled symbols in Figure 1.1) were determined by NWRI (*Bickerton et al.*, 2005a) using a Wild NA2000 laser level (accuracy and precision of approximately 1 mm) and were referenced to the vertical control marker BM15 (elevation 8.674 metres above sea level or masl) located near the north-west side of the hospital. More specific details related to the marker can be found in *Bickerton et al.* (2005a) or through the Canadian Geodetic Survey under station number 6033048. The elevations of the remaining monitoring wells with an FEI prefix where determined by *Franz Environmental* (2003). Although not explicitly stated, these elevations were also referenced to BM15; however, *Franz Environmental* (2003) incorrectly stated that a correction was required for the NWRI elevations that they were provided. The values they reported after applying a "correction" were identical to NWRI's calculated values. It is believed that this confusion resulted from the historical use of the WUP floor as a datum for elevation determinations (e.g. *CH2M Hill*, 2002). NWRI used the floor drain in the WUP as an equivalent to BM15 as they were determined to be at the exact same elevation (i.e. 8.674 masl). It is suspected that when *Franz Environmental* (2003) reduced NWRI's raw elevation data they assumed that the floor drain was identical to the floor elevation that they measured near the bay doors at

the north end of the WUP. The floor at this location was measured to be 5.3 cm higher than the floor drain; similar to the 4.1 cm correction suggested by *Franz Environmental* (2003). The elevations for the remaining monitoring wells were provided by *CH2M Hill* (2002) who did use the elevation of the WUP floor near the bay doors as their datum. As *Franz Environmental* (2003) suggested, a correction was necessary for these wells and 5.3 cm was added to the elevations provided by *CH2M Hill* (2002).

Unifying the various coordinate systems used at the site for spatial positioning was more complicated than obtaining consistency in the elevation data. The most accurate relative positions (+/- 1 cm) available were collected by NWRI (*Bickerton et al.*, 2005a) using a Wild T-1000 Theomat and Wild DIOR 3002 Distomat and were used as a basis for comparing relative positions. The relationships between the various coordinate systems were obtained by minimizing the error between the NWRI positions and the other coordinate systems, for common wells, by performing axis translations and rotations. This error analysis indicated that the relative positions provided by *Franz Environmental* (2003) were accurate to within 1.5 m and the positions provided by *CH2M Hill* (2002) to within 17 m. However, all the wells used in this study were either positioned separately by NWRI or *Franz Environmental* (2003) so the relative positions of the wells depicted in this study are accurate to at least 1.5 m (the only exception is WDA-2). In terms of absolute position accuracy, a similar error analysis using multiple GPS-determined positions for selected wells indicated that absolute positions are likely accurate to within 15 m.

2.2 Groundwater Elevations and Flow

Water levels (and LNAPL thicknesses where appropriate) were measured in the monitoring wells identified in Figure 1.1 using a Heron interface probe. The levels were converted to elevations using known casing-top elevations. Table 2.1 provides the tabulated groundwater elevations measured for the current monitoring period (April 9, 2004 to September 23, 2004). In Table 2.1, the current period minimum and maximum are also highlighted and a comparison to historical values (i.e. September 2001 to September 2004) is provided. It appears that the lowest groundwater levels for the current monitoring period occurred in early April 2004, prior to snow melt, and the highest period groundwater levels occurred between late May and early July 2004. The wells immediately north and west of the ASTF displayed annual highs earlier (i.e. mid-May) than at other locations. This was observed previously (*Bickerton and Voralek*, 2002) and has been attributed to depression-focused recharge of snow melt. Note that most of the historical maximums coincide with those recorded during the period of this monitoring study. However, the historical lows were generally observed prior to April 9, 2004. In terms of the historical range of seasonal groundwater fluctuations, the monitoring wells closest to the river appear to experience the lowest range (0.28 to 0.64 m) of variability, whereas the wells farther inland typically experienced a range between 0.80 and 1.40 m.

Contour plots of groundwater equipotentials collected during this monitoring study are shown for April 16 (Figure 2.1), May 13 (Figure 2.2), July 2 (Figure 2.3), and September

16 (Figure 2.4). These figures share a common colour scale (i.e. blue shading) to allow easy comparison of relative changes in groundwater elevation and gradients between monitoring dates. The direction of groundwater flow (i.e. perpendicular to equipotentials) towards the river was relatively constant between dates; however seasonal variations in the hydraulic gradient were observed. Calculated hydraulic gradients were generally lowest on April 16 and typically ranged between 0.004 and 0.009. The highest gradients were calculated for May 13 and July 2 which ranged between 0.006 and 0.016. The high gradients associated with groundwater pumping and water injection in the NWRI treatment area (immediately west of the ASTF) were excluded from these calculations. Using typical values of hydraulic conductivity (e.g. 2.1 x 10^{-5} m/s and 7.4 x 10^{-4} m/s) that were measured in the ASTF area (*Bickerton and Voralek*, 2002), and assuming a porosity range of 30%-40%, the local groundwater velocity would have typically ranged between 0.02 m/day to 3.4 m/day. This broad range illustrates that there is likely considerable seasonal and spatial variability in groundwater velocity at the site.

Figures 2.5 and 2.6 provide the time-series data collected automatically at an hourly interval for the groundwater elevations and local river levels, respectively. The river levels were collected near the end of the water-intake pier. Note that the river levels had no obvious influence on the groundwater responses for the period July 17 to September 23, 2004. As discussed in previous reports (*Franz Environmental*, 2003; *Bickerton et al.*, 2005a), the river was not expected to have any significant influence on the groundwater flow system for most of the year. With the exception of spring, the river levels are generally below the upper contact (approximately 1.80 masl) of the clay layer which underlies the local sand aquifer. During spring thaw the river has been observed to exceed 3.90 masl (NWRI observation in May 2002) and may have a transient impact on the groundwater system during this time until the levels recede to normal values. However, the impact of precipitation events is obvious in EC-02 and TW00-8 and indicates a strong connection to the surface in these locations. A good agreement between the electronic and corresponding manual measurements of groundwater elevation was also observed.

2.3 Apparent LNAPL Thicknesses and Distribution

Overview and Limitations

In addition to groundwater elevations, Figure 2.1 to Figure 2.4 also provide the distribution and apparent thickness of LNAPL (light non-aqueous phase liquid). LNAPLs are liquids (e.g. fuel hydrocarbons) that are less dense than water and exist as a separate immiscible phase when in contact with water. The presence of LNAPL in the subsurface provides a persistant source of contamination for groundwater as various components of the LNAPL are continuously dissolved by infiltrating precipitation or flowing groundwater.

Table 2.2 provides the tabulated apparent thicknesses (excluding wells in NWRI's treatment area) for all monitoring dates included in this study, including the current monitoring period (April 9, 2004 to September 23, 2004) minimum and maximum and a

comparison to historical values (i.e. September 2001 to September 2004). There are some inherent limitations to using apparent thickness as a meaningful measure of the true LNAPL thickness in geologic materials. LNAPL behaviour in monitoring wells reflects the complex nature of LNAPL transport in response to a fluctuating water table and the influence of the surrounding geology. The classical model for LNAPL distribution in soil holds that free-product LNAPL will accumulate along the top of the capillary fringe as a discrete layer. The apparent thickness measured in a well intercepting this layer would reflect the thickness of the capillary fringe and the true LNAPL thickness. Despite being shown to be generally erroneous, the use of this concept widely persists. Studies (e.g. *Lenhard and Parker*, 1990; *Huntley et al.*, 1994) have shown that LNAPL is generally distributed throughout, and above, the capillary fringe with the actual volume of residual LNAPL in the capillary fringe being relatively small. However, the monitoring wells intersecting the geologic material with LNAPL present will generally give the impression of a much greater volume of LNAPL. Further, *Huntley et al.* (1994) have shown that the low LNAPL saturation levels imply little mobility (i.e. residual levels) of the LNAPL, in contrast to the classical discrete-layer approach, and that often significant LNAPL remains trapped below the water table where fluctuations in the water table occur.

ASTF Area

The occurrence of LNAPL in the ASTF area was generally restricted to NWRI's treatment area where the pilot testing of a remediation technology was being conducted. Only four wells outside this immediate area showed any detectable LNAPL. The single occurrences of measurable LNAPL in TW99-3 and WDA-1 were considered suspect as no LNAPL has been detected in these wells either historically or since the isolated occurrences. Although EC-03 has shown measurable LNAPL in the past, LNAPL was only detected once during the monitoring period of this study. The only well outside NWRI's treatment area that consistently showed measurable LNAPL was TW00-9. Monitoring well TW00-9 has historically shown large apparent LNAPL thicknesses and had thicknesses between 55 cm and 102 cm for April to August 2004 inclusive. After September 13, the measured LNAPL thickness in TW00-9 declined to less than 10 cm. This dramatic decline in the apparent thickness is likely related to the cessation of active treatment (i.e. injection and pumping) operations on September 9, 2004. For the observation period of this study the estimated areal extent of the LNAPL plume remained relatively constant at between 700 m^2 and 1100 m^2.

WUP Area

LNAPL measurements for this study were not collected in the WUP area until June 28; however, the detectable LNAPL observed after this date was primarily limited to only three monitoring wells. On July 2, 2004 (Figure 2.3) no LNAPL was detected in the WUP area (although measurements at WUP-14 were not available) as was also the case in late September. The measured apparent thicknesses obtained between these dates typically ranged between 2.5 cm and 17 cm. Note that the historical maximums (i.e.

September 2001 to September 2004) for apparent thicknesses in the WUP area were recorded during the period June 28, 2004 to September 23, 2004. Although an estimated areal extent of between 4000 m^2 and 4200 m^2 was calculated for the LNAPL plume in the WUP area, this estimate has a high level of uncertainty associated with it. Based on the limited number of monitored locations available between the LNAPL-containing wells and those with no detectable levels, the contouring algorithm would be expected to generate an overestimate of the plume's areal extent. It is suspected that the actual extent of the LNAPL plume is much smaller and mainly restricted to the area in the vicinity of the northwest portion of the WUP. Several underground storage tanks were formally located in this area and provide a probable source for the LNAPL plume. Further refinement of the LNAPL distribution is unlikely given the existing monitoring well array.

Implications

In terms of implications for management of the site, the nature and extent of measurable LNAPL should influence remedial and risk management decisions. On the basis of theoretical performance studies (*Wilson and Conrad*, 1984; *Johnson et al.*, 2002), and considering the physical conditions at the site, it appears that most of the LNAPL plume will likely be unrecoverable in the absence of flushing agents or other non-conventional technologies. The apparent thicknesses appears too small and the hydraulic conductivities too low to provide a high probability of success. The issue of river flooding and the potential mobilization of LNAPL have also been raised in several meetings related to the site. It is suspected that this concern was based on the classical approach described above, where it was envisaged that the LNAPL layer would "float" to the surface if the site was inundated with flood waters. Based on the current understanding of multiphase flow in porous media discussed above, these concerns are not well supported by empirical and theoretical considerations. It is likely that much of the LNAPL would be in a residual phase and immobile under flood conditions; however, a 2-dimensional multiphase modeling study could be used to provide a more complete assessment of this issue if it is deemed a significant risk by site managers.

3.0 Nature and Extent of Groundwater Contamination

3.1 Dissolved-Phase Plumes

Sampling and Contaminant Parameters

Groundwater samples were collected from the monitoring wells identified in Figure 1.1 in late May 2004 and late September 2004. An additional sampling of a subset of wells in the ASTF area was also performed as part of NWRI's research program (*Bickerton et al.*, 2005a). In addition, several groundwater seeps were sampled along the banks of the Moose River (FEI-1 Seep, FEI-4 Seep and FEI-5 Seep). The seep samples were collected directly from the discharging groundwater by creating a small depression at the discharge point that allowed a sample bottle to be filled. The groundwater samples were analyzed for BTEX at NWRI's laboratories and TPH (gas and diesel fractions) at Paracel Laboratories as specified in the scope of work; however, the samples were also analyzed for trimethylbenzene (TMB) and tetramethylbenzene (TeMB). BTEX, TMB and TeMB analyses could be performed in the same analytical scan (purge and trap GC-MSD) on the same groundwater sample. Both TMB and TeMB had been regularly monitored in the ASTF area since October 2003 (*Bickerton et al.*, 2005a).

Including TMB and TeMB analyses allowed a better estimate of the actual footprint of the groundwater contamination to be assessed at the site and provided information on the presence and degree of intrinsic bioremediation occurring (see *Bickerton et al.*, 2005a). BTEX, TMB and TeMB have similar transport properties and are found at approximately the same concentration in fuels. However, TMB and TeMB have often been found to be relatively resistant to biodegradation in anaerobic environments (e.g. most petroleum hydrocarbon plumes). This property allows biodegradation of BTEX to be separated from the physical mechanisms of natural attenuation (e.g. sorption, dispersion, volatilization, etc.). TMB and TeMB actually do biodegrade slightly and are more prone to sorption to soils than BTEX. However, this does not detract from the utility of the compounds; it merely adds a degree of conservatism to the analysis

Graphical Depiction of Contaminant Data and Limitations

Contours of concentration were generated using kriging for various components of the dissolved-phase plume to illustrate the extent and degree of contamination based on the May 2004 and September 2004 sampling events. Figure 3.1 and Figure 3.2 illustrate the distribution of TMB in May 2004 and September 2004, respectively. Similarly, Figure 3.3 and Figure 3.4 illustrate ethylbenzene distributions and Figure 3.5 and Figure 3.6 illustrate TPH (gas and diesel fractions) distributions. For contours of contaminant data, the MDL (i.e. minimum detection limit) of the analytical method used is indicated on the concentration colour-scale. Also, where applicable, the CCME community water criteria (*CCME*, 2003), MOE Table A criteria (*MOE*, 1997) and MOEE provincial water quality

objectives (*MOEE*, 1994) are indicated in a similar fashion. Comparisons to provincial water quality objectives (PQWO) for surface water have not been addressed in the past; however, they have been included as they pertain to groundwater seepage occurring along the river banks at the site. More details on the various guidelines are presented in Table 3.2.

Some caution should be used to avoid interpreting contour maps too literally; especially in regions that represent concentrations near detection limits and areas with a low density of sample locations. These areas are particularly prone to contouring artifacts, where single point measurement can bias the resulting contours. The monitoring wells FEI-5 and FEI-8 (not shown on figures) were excluded from the contouring because they were too far removed from the remaining data set to provide any meaningful results. Despite the power of contour plots to provide a strong visual impression of spatial data, contoured data generally give the impression that field data is less variable than it actually is. Some of the variability observed in the plumes presented likely result from this feature. However, the broad and persistent features of the plumes shown in the contour plots should be treated as significant.

In examining Figure 3.1 to Figure 3.6, there appears to be considerable variability in the plume shape and concentration levels observed between sampling events. Although it may be tempting to conclude from the figures that the concentration levels are dramatically changing between sampling events, this conclusion currently has little statistical support (outside of the active treatment area). The observed changes likely reflect the influence of natural seasonal variations at the site which are only now beginning to be documented. Some of the changes in the plume, particularly in the spring, are likely linked to the influx of snow-melt. However, it is speculated that much of the seasonal changes observed in the concentration levels are not "true" changes in the ambient concentration of groundwater contaminants, but rather are artifacts of sampling from monitoring wells in a dynamic and shallow groundwater system. Samples collected from wells provide an integrated (i.e. averaged) concentration for the groundwater zones intercepted by the well screen. Because the water table fluctuates significantly over the year, the actual groundwater zones being sampled and the relative contribution of each zone to the sample will generally be different for each sampling event. Even if the "true" ambient groundwater conditions did not change seasonally; variations in sample concentration would generally be expected in situations where the water table had significant seasonal fluctuations. Therefore, the apparent seasonality may merely be an artifact of what portion of the geologic profile can be sampled at a given date. In research applications, vertically-distributed (or nested) arrays of discrete sample points are commonly used to address this problem. However, the sampling and analytical costs for this approach are considerably higher for the same level of areal coverage. NWRI included one nested array (EC-31, EC32, and EC33) at the site to provide some indication of the importance of these issues. Results from these nested monitoring wells showed pronounced vertical differences in concentration for each sampling event; with the highest BTEX levels detected at the intermediate depth (i.e. 2.0 m to 2.5 m below ground surface). The vertical location of the lowest concentrations appeared to depend on the season during which the sample were collected.

Comparison to Federal and Provincial Water Quality Guidelines and Criteria

In terms of exceeding appropriate federal and provincial guidelines, during the monitoring period of this study there were no toluene or styrene concentrations detected which exceeded the guideline values. A single minor benzene exceedence was found at the site during each sampling event: benzene concentrations in ASTF-10 (May 2004) and EC-33 (September 2004) were 6 µg/L and 10 µg/L, respectively. In general no measured concentrations for xylene exceeded the guidelines, with the exception of TW00-9 which was located near the centre of the ASTF plume. For the TPH (Figure 3.5 and Figure 3.6) and ethylbenzene (Figure 3.3 and Figure 3.4) data, the regions of the site for which concentrations exceeded guidelines are shown in the corresponding figures. Table 3.2 also provides the maximum concentrations for each measured compound detected in various portions of the site.

An examination of contaminant concentrations in groundwater discharging through seeps in the banks of the Moose River was not explored in previous studies of the site; however samples from 3 major seeps were collected for this study after NWRI staff noticed what appeared to be an oily sheen on groundwater discharging from the banks near FEI-4. This feature is commonly observed in advance of hydrocarbon plumes, but is not necessarily an indication of petroleum contamination in the discharging water. The "oily sheen" is often the result of elevated iron concentrations (influenced by microbial activity) associated with intrinsic bioremediation of the hydrocarbon plume (see *Bickerton et al.*, 2005a for further details). Iron concentrations in the discharging groundwater were found to be 15.2 mg/L; above the typical background (e.g. 0 mg/L to 6 mg/L) concentrations measured at the site. However, detectable levels of benzene, ethlylbenzene, o-xylene and TMB were also found in the discharging groundwater. In Ontario surface water criteria (e.g. PWQO) should be applied to groundwater discharging to surface. Provincial guidelines (*MOEE*, 1994) state that *"Provincial Water Quality Objectives (PWQO)... serve as chemical and physical indicators representing a satisfactory level for surface waters (i.e. lakes and rivers) and,* ***where it discharges to the surface, the ground water of the Province"***. Although no BTEX, TMB or TPH concentration levels were found to exceed PWQO for the samples obtained from the groundwater seeps, the presence of detectable BTEX and TMB at these locations suggests that there is the potential for discharging groundwater along the shoreline to locally exceed PQWO (particularly with respect to ethylbenzene as shown in Figure 3.4 in the vicinity of FEI-3). This assessment is suggested from the data interpolations and extrapolations presented in the figures provided (e.g. Figure 3.2 and Figure 3.4). Although, far from certain, these extrapolations help identify possible areas of concern given the known distributions of concentrations at the site (and knowledge of the general groundwater flow direction). Considering that FEI-1-Seep and FEI-4-Seep represent the current northern and southern extents of detectable concentrations along the shoreline, it appears prudent that some intermediate locations down-gradient of the plumes' centre lines should be investigated. An examination of groundwater discharge along the Moose River should be considered to identify if any further problem areas exist or to alleviate concerns regarding the potential for discharging contaminated groundwater along the shoreline.

Quality Control and Sample Preservation

All groundwater samples collected for BTEX, TMB and TeMB analyses were preserved at the time of collection using hydrochloric acid or sodium bisulfate. It was found (*Bickerton et al.*, 2005a) that the conventional practice of storing groundwater samples at 4°C and not preserving them prior to shipping generally lead to significantly lower BTEX concentrations for samples collected at the site. Samples obtained in August 2002 and post-October 2003 were preserved. Samples collected in October 2003 and those reported by *CH2M Hill* (2002) and Franz Environmental (2003) were not. As it appears to have been the common practice, it was assumed that all groundwater samples reported in *Jacques Whitford Environmental* (1997) and *CH2M Gore and Storrie* (2000) were also not preserved prior to shipping. One of the implications of this finding is that all BTEX samples collected prior to August 2002 may significantly underestimate the actual concentrations. A complete listing of all groundwater analyses at the site (excluding NWRI's treatment area) for BTEX, TMB, TeMB and TPH (gas and diesel fractions) from October 1996 to September 2004 are tabulated in Table A.1, A.2 and A.3, respectively. Notes on the annotations in these tables are provided in Table A.4. A detailed listing of the sources for the various data sets used in these tables is provided in Table 3.1, along with the minimum detection limit (MDL) associated with each parameter.

To assess the level of uncertainty associated with the analytical results, several samples were also collected for quality control purposes. A total of 8 blind field-duplicates (i.e. the laboratory was not informed of the sampling location) and 3 field duplicates were analyzed to gauge the level of natural variability in the monitoring wells. For samples with concentration levels above MDLs, the duplicates were found to be between 22% and 155% of the original concentrations observed for BTEX, TMB and TeMB and between 50% and 150% for TPH. The complete listing of field duplicates is provided in Table 3.3. For comparison, a field duplicate from 2002 (*CH2M Hill*, 2002) showed BTEX values to be between 53% and 114% and TPH between 73% and 100% of the original concentrations; the remaining 3 field duplicates and originals collected during this time could not be compared as they had only concentrations below MDLs. As part of the quality control for this study, 2 field/trip blanks (i.e. deionized water carried through the sampling and shipping process) were collected and found to contain no BTEX, TMB, TeMB or TPH above their MDLs. Consequently, cross contamination or sample contamination during shipment are not suspected. Further, spiked samples for BTEX, TMB and TeMB were regularly analyzed as part of NWRI's analytical protocol to describe the accuracy and precision of the analytical procedure. All analyses of the spiked samples were found to fall between 80% and 120% of the known standard concentrations. Similarly, spiked sample results provided by Paracel Laboratories for their TPH analyses were found to fall between 92% and 119% of their known standards. Data provided by Paracel Laboratories from the 2002 sampling (*CH2M Hill*, 2002) showed similar results with spike analyses between 75% and 118% for BTEX standards and 77% and 103% for TPH standards. Based on the results of the quality control sampling, it is suggested that only about 20% of the observed variability in the field duplicates can be associated with analytical procedures and that the remainder is

associated with natural variability and/or the limitations of monitoring wells and conventional sampling practices.

Interpretations Associated with the Dissolved-Phase Plumes

Several other features associated with the contours of concentration, particularly for the ASTF plume, also warrant further comment. The apparent local depression of concentration in the ASTF plume, immediately west of the ASTF compound, is attributed to NWRI's pilot-scale remediation activities in this area. Also, in several of the figures (i.e. Figures 3.1, 3.3, 3.5 and 3.6) the western portion of the ASTF plume appears detached from the main body of the plume. This is likely a contouring artifact resulting from the limited number of monitoring locations in the region.

The anomalously high concentrations found in the vicinity of FEI-2 have been attributed (e.g. *Bickerton et al.*, 2005) to preferential transport of contaminants along the existing storm sewer alignment between MH2 and MH3. It is suspected that the transport occurs along the backfill associated with the sewer line and not necessarily within the sewer itself, as MH2 was sealed with concrete prior to spring 2001 (*personal communication with PWGSC*). The impact on contouring is to gives the impression that the plume veers to the west or to create an isolated region of high concentration. Which of these occur depends on the concentrations observed in nearby wells. Previous NWRI reports (e.g. *Bickerton et al.*, 2005a) have expressed concern over this impact of the sewer alignment and suggest that it should be examined more carefully. If preferential flow is occurring along the alignment, even seasonally, it provides a mechanism that allows contaminants a quicker and more direct route to the shoreline of the Moose River. The second implication is that it diminishes the time that intrinsic bioremediation and other natural attenuation processes would have had to influence the affected portion of the plume. If the impact of the sewer alignment can be reliably determined, then its negative impacts can be mitigated. Successful mitigation would allow the remaining plume more residence time for intrinsic bioremediation. We recognize that this interpretation of the impact of the sewer alignment is contrary to the previous assessment of this issue by *Franz Environmental* (2003). What remains unclear is what portion of the ASTF plume is diverted along the sewer alignment.

Another unresolved issue related to the ASTF plume, is whether a portion of the plume extends to FEI-3 as shown in Figure 3.2 and Figure 3.4. The absence of monitoring wells between EC-08 and FEI-3 make this issue difficult to resolve. Although an extension of the ASTF or WUP plume to FEI-3 is possible, it currently appears more probable that the elevated concentrations in the vicinity of FEI-3 may have originated from fuel storage facilities in former transformer storage compound (FTSC). If this source can be confirmed, it would represent a third separate plume at the site which has not been previously considered. It is suggested that the abandoned underground storage tanks (USTs) identified in the FTSC (e.g. *CH2M Hill*, 2002) could have provided a potential source for such a plume. Contaminant information from the vicinity of these USTs is limited and often appears contradictory. Although the suspect USTs were removed in

November 2003 with little soil impacts detected (*personal communication with PWGSC*), previous soil sampling in test pits down gradient of the UST have showed both non-detectable and significantly elevated levels of BTEX and TPH (*Jacques Whitford Environmental*, 1997). The BTEX analyses recently collected from wells near the FTSC show some evidence of compositional differences (BTEX composition with elevated ethylbenzene and depleted m-p xylene and benzene) compared to much of the WUP and ASTF plumes, suggesting the possibility of a different hydrocarbon source (the USTs in the FTSC stored gasoline, unlike the fuel oil found in the ASTF and WUP plumes). This evidence is relative weak and may only provide a working hypothesis for further source identification. Although the concentration levels of contaminants detected in the FTSC during this study did not exceed MOE or CCME criteria, understanding the source of the contaminants in this area is still important. Mistakenly attributing the contaminants in the FTSC to either the WUP or ASTF plumes would likely lead to gross misinterpretations of contaminant transport rates and processes at the site.

3.2 Plume Stability

The stability of the plumes on the Weeneebayko Hospital property is of great importance from the perspective of managing the site and ensuring the public's safety. The nature, cost and aggressiveness of selected remedial approaches for the site will be highly influenced by whether the plume is static, contracting or expanding. The availability of long-term monitoring data for a plume is usually sufficient to address these questions of stability.

Until 2001 the nature of the dissolved-phase plume and its down-gradient extent and proximity to the Moose River was not addressed. By the summer of 2002, NWRI (*Bickerton et al.*, 2005a) had installed additional monitoring wells in the ASTF area approaching the Moose River, which provided an indication of the full extent of the ASTF plume. Similarly, several monitoring wells were installed down gradient of the WUP in August 2002 (*Franz Environmental*, 2003). Excluding the monitoring conducted in this study, no complete monitoring events have been performed in the WUP area since the 2002 sampling. However, the ASTF plume has been monitored more closely than the WUP plume as it has been a component of an NWRI research program since April 2002 (*Bickerton et al.*, 2005a). The finding of NWRI that conventional BTEX preservation practices were inadequate for groundwater samples collected at the site effectively rendered all BTEX results prior to August 2002 as suspect; eliminating a large source of comparative data. At best, the suspect BTEX concentration may serve as lower-bound values.

Until recently, a statistical evaluation of the stability of the plume could not be generally applied at the site due to the limited monitoring data available. However, with the addition of new data collected under NWRI's research program in the ASTF area (*Bickerton et al.*, 2005a), adequate data had become available to permit the use of statistical tests to evaluate the ASTF plume stability. With the exception of TPH data in wells FEI-3 and FEI-7, a similar treatment could not be conducted in the WUP area due

to insufficient data. The Mann-Kendall Test (Gilbert, 1987) was applied to each well and for each contaminant with at least 4 independent measurement events available. All pre-August 2002 measurements of BTEX parameters were treated as suspect and excluded from the analyses. The Mann-Kendall test is considered a low power test (i.e. difficult to resolve subtle trends) but it does provide an objective method for determining whether a plume is expanding, decreasing or stable. The results of the Mann-Kendall analyses are tabulated in Table 3.4. In general, the available contaminant data at the ASTF site suggest that the plume is currently stable (i.e. no statistically significant trend could be established) with the exception of wells near NWRI's treatment area (i.e. locations undergoing active remediation). However several exceptions were noted: EC-09 had evidence suggesting decreasing concentrations at that location with the support of three of seven contaminant indicators (the remaining 4 contaminants indicated no trend), and TW00-9 and ASTF-10 both had one indicator suggesting increasing concentration and one suggesting decreasing concentration (the remaining 5 contaminant indicators suggested no trend). The two wells in the WUP that were also analyzed indicated no trend in one and a probable declining trend in the other (i.e. for the only available indicator). Generally, the results suggest that the plume in the ASTF area is currently stable, with allowance made for seasonal variability. Presumably the WUP plume would display similar behaviour, but this should be confirmed. These statistical tests should continue to be applied after each monitoring event in the future to either add further support or to document new trends in the groundwater contaminant data. In particular, wells ASTF-10, EC-05 and EC-06 should be closely watched to establish if the increasing trends detected for specific indicators will persist.

The evidence of plume stability is consistent with recent research (*Rice et al.*, 1995; *Mace et al.*, 1997) that indicates that most petroleum plumes of this age are stable. These earlier studies demonstrated that petroleum plumes typically change slowly and stabilize at relatively short distance from their source (typically less than 100 m). *Rice et al.* (1995) further indicated that of the 271 plumes examined, only 8% were found to be expanding. The plume observed at the ASTF site appears to be displaying typical behaviour. However, due to the relatively limited historical data available, continued monitoring of plumes at the site is strongly suggested for providing more confidence to the stability analysis.

The suggestion that the plume is stable is contrary to the finding and opinions expressed in previous assessment of the site (*CH2M Hill*, 2002; *Franz Environmental*, 2003). Previous efforts, with varying degrees of complexity, attempted to estimate the rate of advance of the hydrocarbon plume and to determine how long it will take to impact the Moose River. Based on the results of this and other (*Bickerton et al.*, 2005a) investigations, plumes at the site have already reached the Moose River, albeit at concentrations below regulatory guidelines. If the ASTF plume has developed as a typical petroleum hydrocarbon plume, which the weight of evidence suggests it has; its current down-gradient extent likely occurred well before site investigations began at the site. As discussed in *Bickerton et al.* (2005a), considering that the major fuel release associated with the plume occurred in the mid-1970's, the fact that the detectable BTEX and TPH plume has not advance farther is attributable to the processes of natural attenuation.

4.0 Summary of Findings

4.1 Seasonal Variability in Groundwater Flow

In general, the lowest groundwater levels occurred in early spring, prior to snow melt, and the highest groundwater levels occurred between late May and early July. In terms of the historical range of seasonal groundwater fluctuations, the monitoring wells closest to the river appear to experience the lowest range (0.28 to 0.64 m) of variability, whereas the wells farther inland typically experienced a seasonal range between 0.80 and 1.40 m.

The direction of groundwater flow towards the river appears to be relatively constant; however seasonal variations in the hydraulic gradient (and therefore groundwater flow rates) were observed. Calculated hydraulic gradients were generally lowest prior to snow melt and highest between May and July. There is also likely considerable seasonal and spatial variability in groundwater velocity at the site.

As discussed in previous reports, the Moose River levels are not expected to have any significant influence on the groundwater flow system for most of the year.

4.2 LNAPL Plumes

It appears that most remaining LNAPL in the subsurface at the site is in a residual phase and will likely be unrecoverable using conventional pumping technologies. The apparent thicknesses appear too small and the hydraulic conductivities too low to provide a high probability of success at both the ASTF and WUP sites. Successful recovery of the remaining LNAPL may require the addition of flushing agents or the use of other advanced technologies. The extent of the LNAPL plume in the WUP area is also highly uncertain based on the limited number of monitored locations available between the LNAPL-containing wells and those with no detectable levels. It is suspected that the actual extent of the LNAPL plume is much smaller than estimated (based on contouring algorithms) and mainly restricted to the area in the vicinity of the northwest portion of the WUP.

The issues of river flooding and the potential mobilization of LNAPL have been previously discussed in relation to the site. Based on the current understanding of multiphase flow in porous media, it is suggested that these concerns are not well supported by empirical and theoretical considerations. It is likely that much of the LNAPL would be in a residual phase and immobile under flood conditions. A 2-dimensional multiphase modeling study could be used to provide a more complete assessment of this issue if it is deemed a significant risk by site managers.

4.3 Dissolved-Phase Plumes

In terms of exceeding federal and provincial guidelines, during the monitoring period of this study there were no toluene or styrene concentrations detected which exceeded the guideline values. Localized (i.e. a single monitoring well) concentration levels of xylene and benzene were found to exceed guidelines; however, these were proximate to the ASTF proper. In general, the regions of the site which contained groundwater concentrations of ethylbenzene and TPH that exceeded guidelines were more than 75 m from the river. However, two locations were identified within 15 m of the river where ethylbenzene concentration slightly exceeded guideline values. One of these locations was near the outfall of the abandoned sewer alignment mentioned below.

An examination of contaminant concentrations in groundwater discharging through seeps in the banks of the Moose River was explored for the first time at the site. Detectable levels of benzene, ethlylbenzene, o-xylene and TMB were found in the discharging groundwater at the three locations sampled. Although no concentration levels were found to exceed surface water guidelines, at one location (i.e. FEI-4-Seep) the concentration of TMB was found to be at the PWQO limit and ethylbenzene occurred at a concentration near the PQWO guideline (but exceeded the MOE potable groundwater criteria). Consequently, it currently appears that ethylbenzene and TMB are the contaminants of greatest concern for discharging groundwater along the shoreline at the site. An examination of groundwater discharge along the Moose River should be considered to identify if any further problem areas exist or to alleviate concerns regarding the potential for discharging contaminated groundwater along the shoreline.

The groundwater contaminant data collected continues to provide support to NWRI's previous contention that preferential flow is occurring along the abandoned sewer alignment in the ASTF area. This provides a mechanism that allows contaminants a quicker and more direct route to the shoreline of the Moose River. A second implication is that it diminishes the time that intrinsic bioremediation and other natural attenuation processes would have had to influence the affected portion of the plume. If the impact of the sewer alignment can be reliably determined, then its negative impacts can be mitigated. Successful mitigation would allow the remaining plume more residence time for intrinsic bioremediation.

A new and unresolved issue is whether a separate plume, which has not been previously identified, exists in the vicinity of the former transformer storage compound (FTSC). It is suggested that the abandoned (and recently removed) underground storage tanks (USTs) in the FTSC could have provided a potential source for such a plume. The BTEX analyses collected from wells near the FTSC show some evidence of compositional differences compared to much of the WUP and ASTF plumes. This suggests the possibility of a different hydrocarbon source (the USTs in the FTSC stored gasoline, unlike the fuel oil found in the ASTF and WUP plumes). However, this evidence is relative weak but still may justify further examination. Contaminant information from the vicinity of these USTs is also limited and often appears contradictory. Although the concentration levels of contaminants detected in the FTSC during this study did not

exceed MOE or CCME criteria, understanding the source of the contaminants in this area is the larger concern. Mistakenly attributing the contaminants in the FTSC to either the WUP or ASTF plumes would likely lead to gross misinterpretations of contaminant transport rates and processes at the site.

With the addition of new data collected in 2004, a statistical evaluation of the plume stability became viable and was performed on data from the ASTF site. Unfortunately, a similar treatment could not be conducted in the WUP area due to insufficient data. In general, the available contaminant data suggests that the plume is currently stable (i.e. no statistically significant trend could be established) with the exception of wells near NWRI's treatment area (i.e. locations undergoing active remediation). However some exceptions were noted. Due to the relatively limited historical data available, continued monitoring of plumes at the site is strongly suggested for providing more confidence to the stability analysis or to identify any new trends. In particular, wells ASTF-10, EC-05 and EC-06 should be closely watched to establish if the increasing trends detected for specific indicators will persist.

5.0 Limitations

All findings and conclusion provided in this report were based on available facts and circumstances that were present at the time of writing. The interpretations provided were based on professional scientific/engineering judgment and existing knowledge. Any future additions of new information may change the views, opinions, findings and conclusions expressed in this report.

This report was prepared for the use of Public Works and Government Services Canada, Health Canada and Moose-Cree First Nations. Any reliance on this report by third parties is the responsibility of such third parties. Environment Canada and NWRI accept no responsibility for any damages incurred as a result of decisions made or actions taken based on this report.

6.0 References

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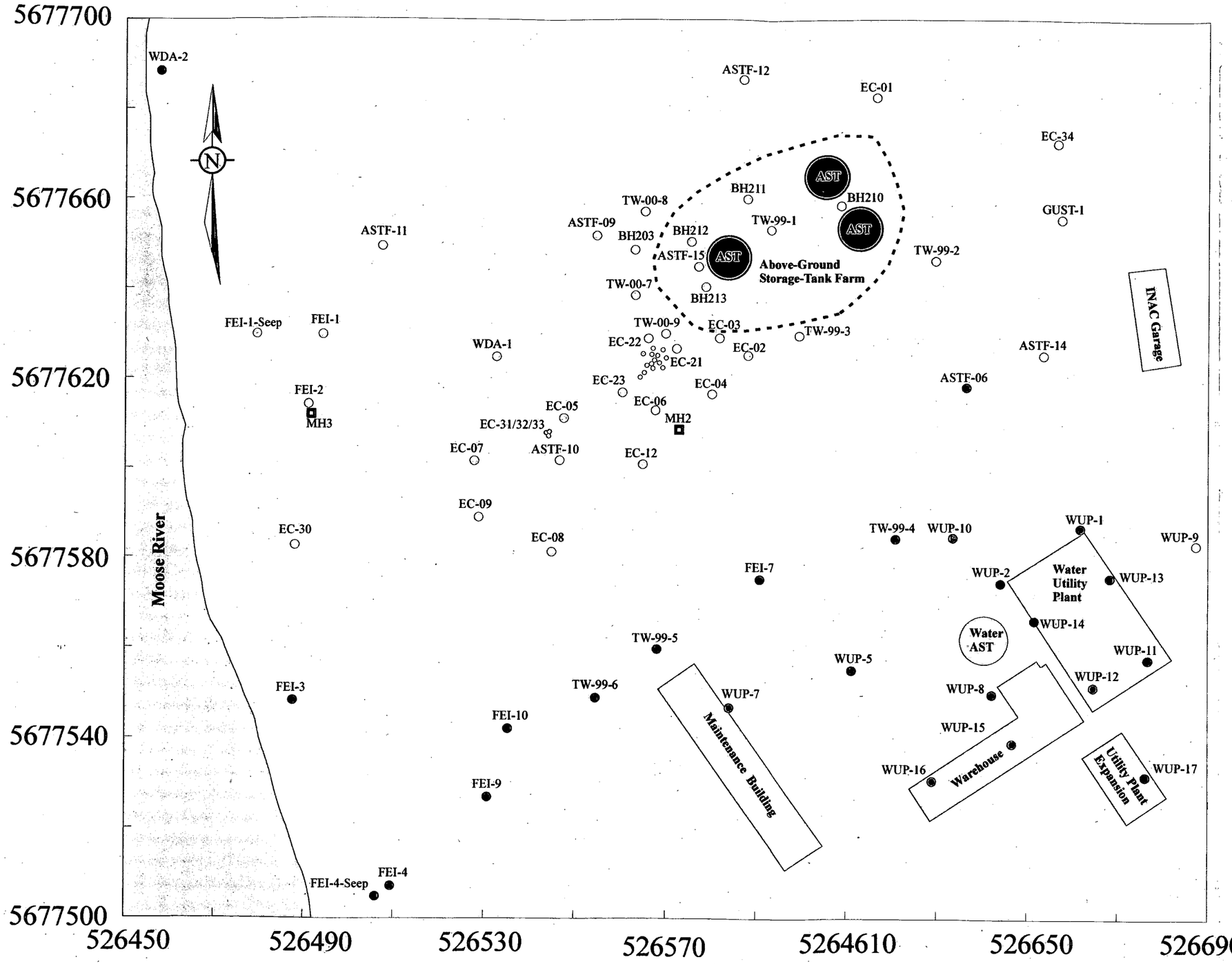
Figures



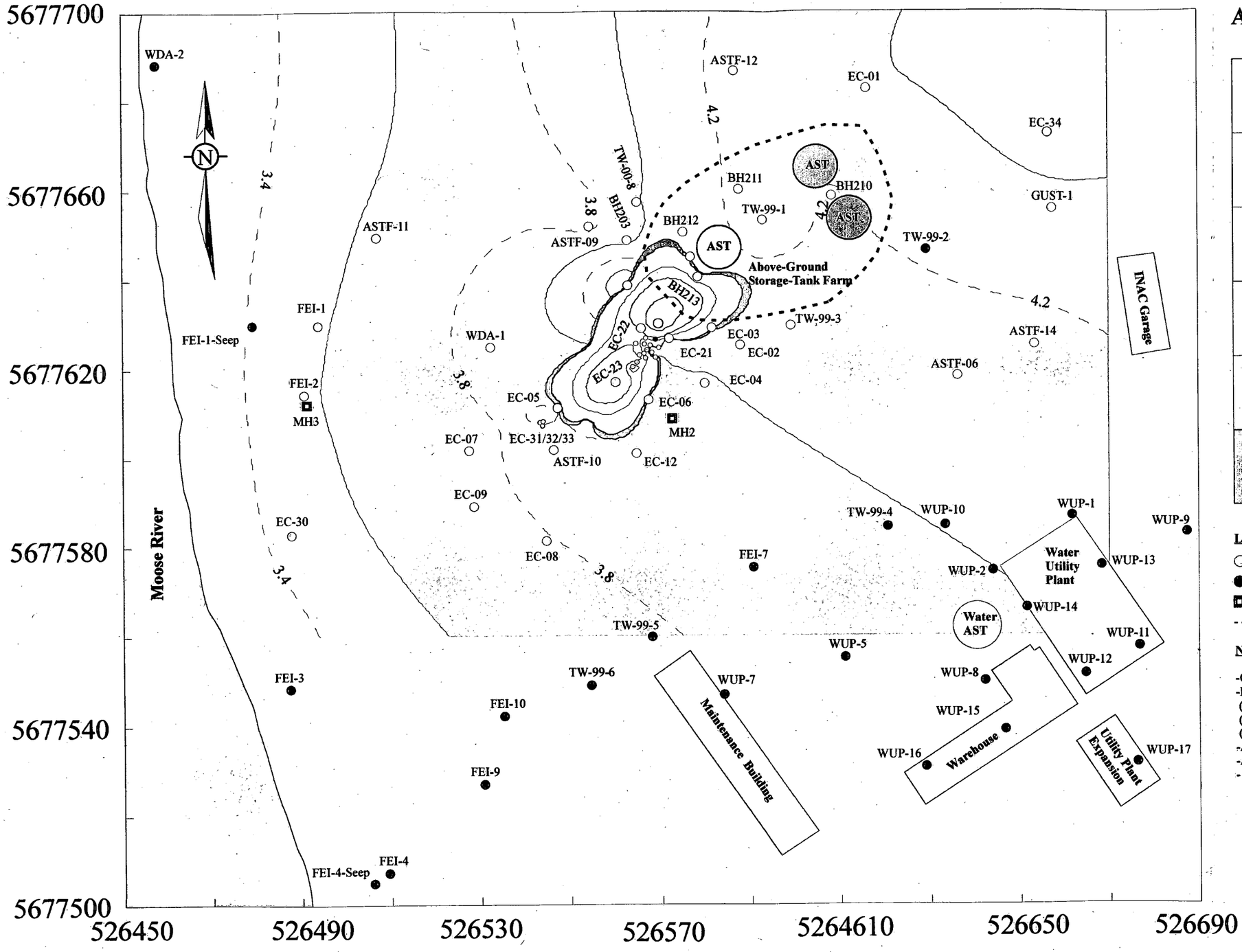
Legend

- NWRI water level and sampling location
- NWRI water level location
- PWGSC-requested water level and sampling location
- PWGSC-requested sampling location
- PWGSC-requested water level location
- NWRI expanded water level location
- NWRI expanded/substitution sample location
- Damaged or excluded monitoring well
- Manhole access to abandoned storm sewer

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm
(FEI-prefix wells accurate to within 1.5 m)
(WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
-NWRI - National Water Research Institute
-PWGSC - Public Works and Government Services Canada
-Monitoring wells FEI-MW5 and FEI-MW8 were monitored but are not shown (located ~ 65 m south of southern limit of figure)

Figure 1.1
Site Map



Apparent LNAPL (cm)

50
25
10
5
1
0.5

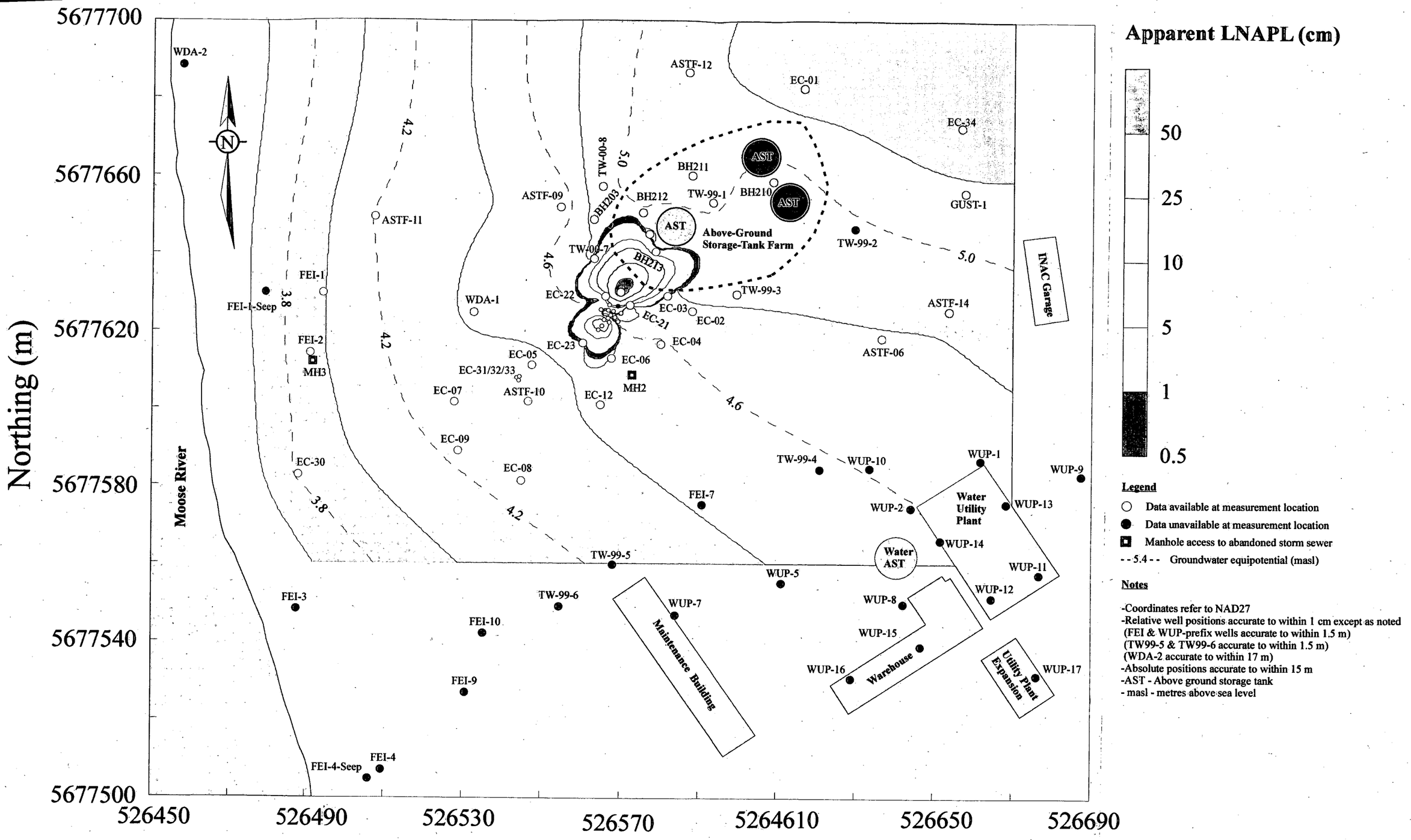
Legend

- ○ Data available at measurement location
- ● Data unavailable at measurement location
- ▣ Manhole access to abandoned storm sewer
- - - 5.4 - - Groundwater equipotential (masl)

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm except as noted
(FEI & WUP-prefix wells accurate to within 1.5 m)
(TW99-5 & TW99-6 accurate to within 1.5 m)
(WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
- masl - metres above sea level

Figure 2.1
Groundwater Equipotentials &
LNAPL Apparent Thicknesses
April 16, 2004



Apparent LNAPL (cm)

50
25
10
5
1
0.5

Legend

- ○ Data available at measurement location
- ● Data unavailable at measurement location
- ■ Manhole access to abandoned storm sewer
- - - 5.4 - - Groundwater equipotential (masl)

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm except as noted (FEI & WUP-prefix wells accurate to within 1.5 m) (TW99-5 & TW99-6 accurate to within 1.5 m) (WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
- masl - metres above sea level

Figure 2.2
Groundwater Equipotentials & LNAPL Apparent Thicknesses
May 13, 2004

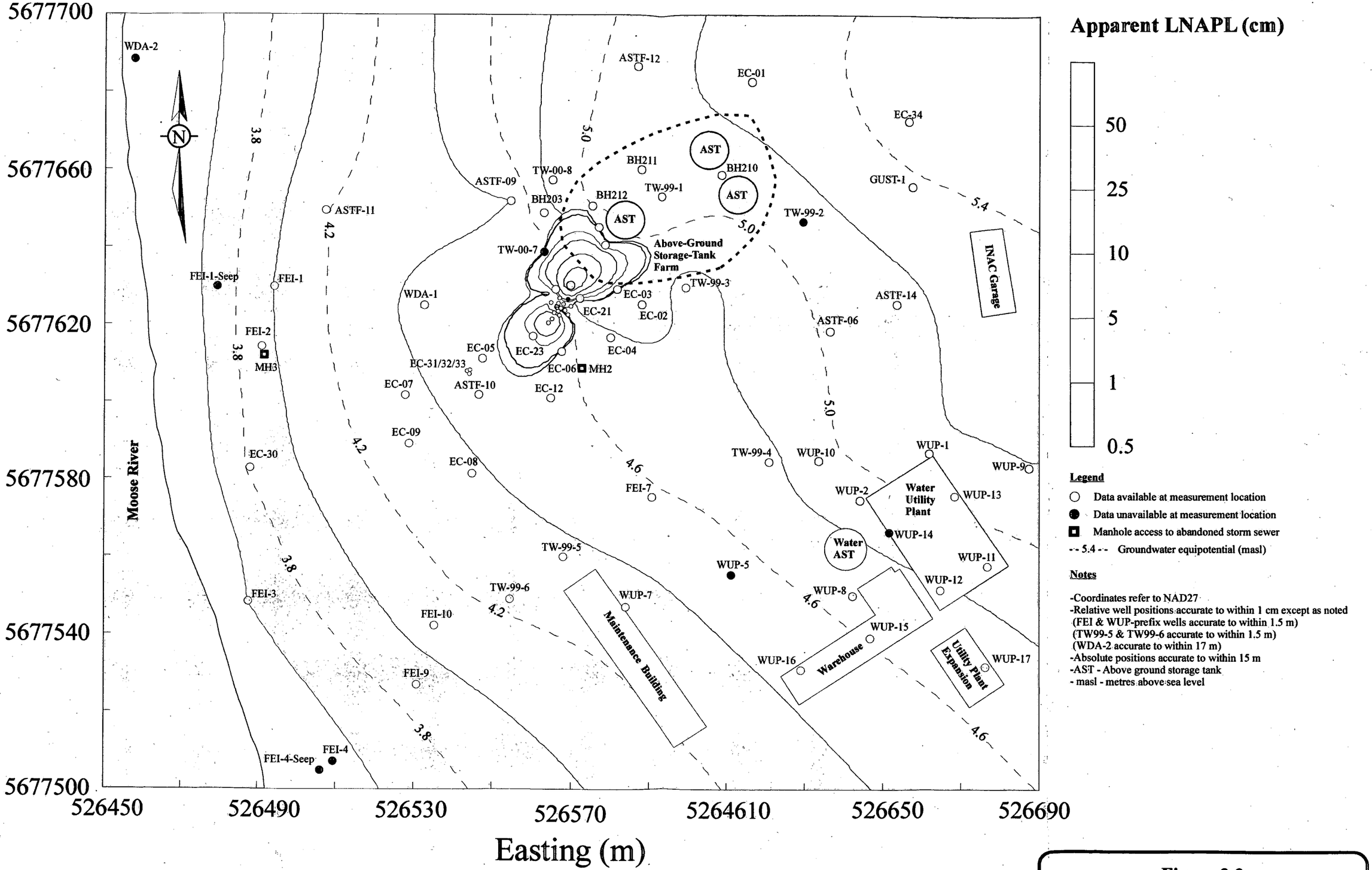
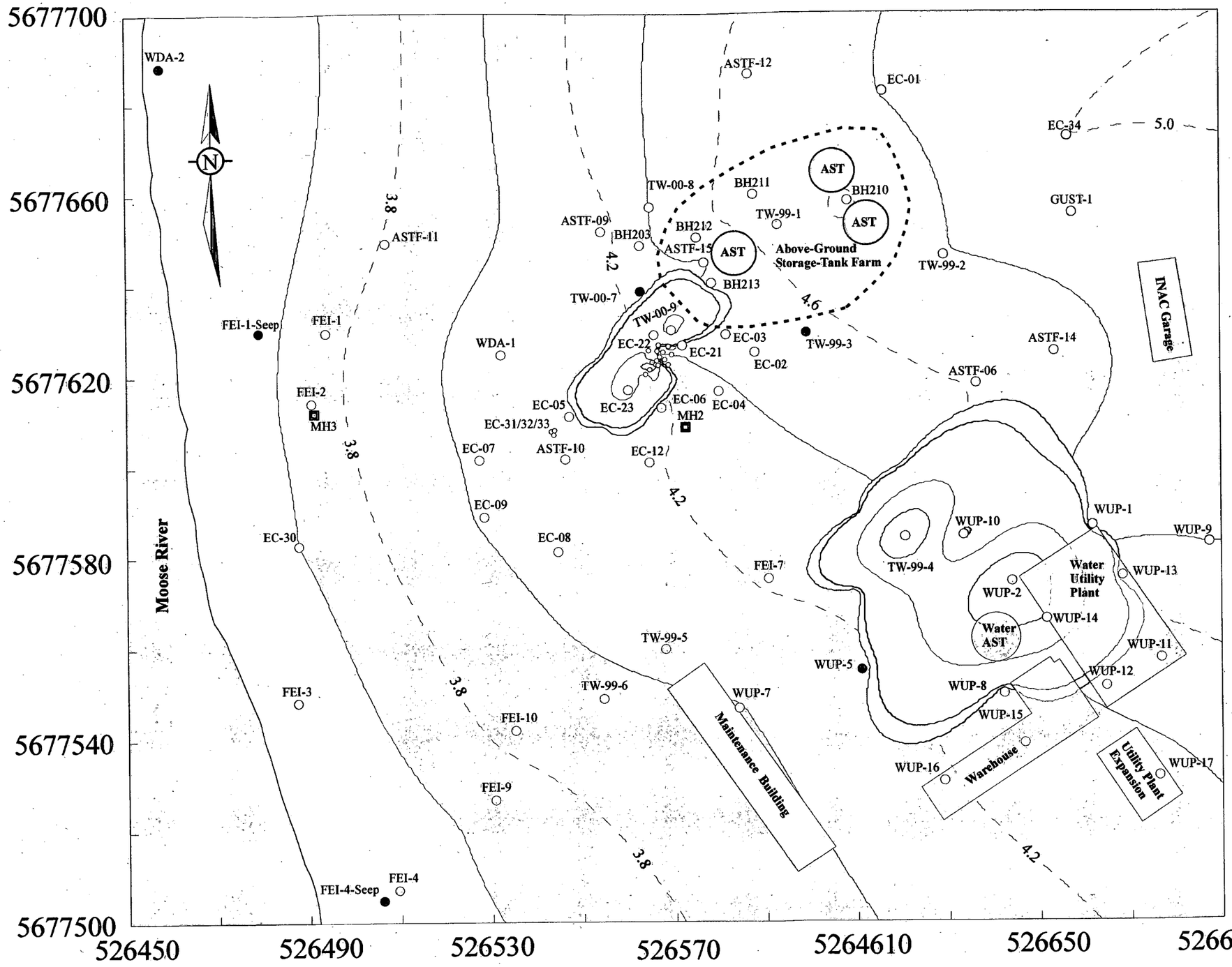


Figure 2.3
Groundwater Equipotentials &
LNAPL Apparent Thicknesses
July 2, 2004



Apparent LNAPL (cm)

50
25
10
5
1
0.5

Legend

- Data available at measurement location
- Data unavailable at measurement location
- Manhole access to abandoned storm sewer
- - 5.4 - - Groundwater equipotential (masl)

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm except as noted
(FEI & WUP-prefix wells accurate to within 1.5 m)
(TW99-5 & TW99-6 accurate to within 1.5 m)
(WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
- masl - metres above sea level

Figure 2.4
Groundwater Equipotentials &
LNAPL Apparent Thicknesses
September 13, 2004

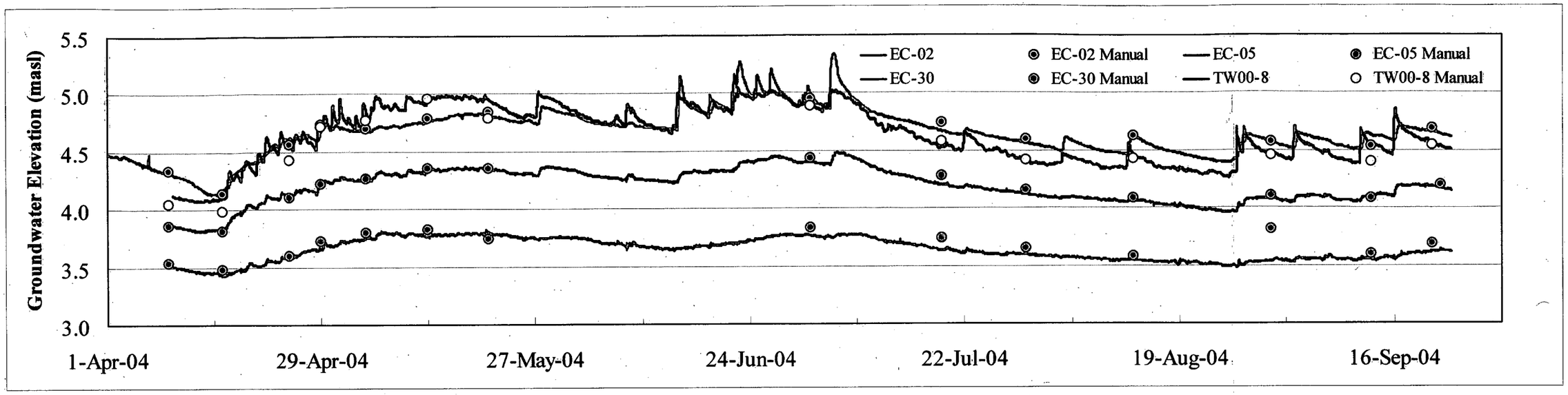


Figure 2.5 Automated groundwater levels from selected monitoring wells

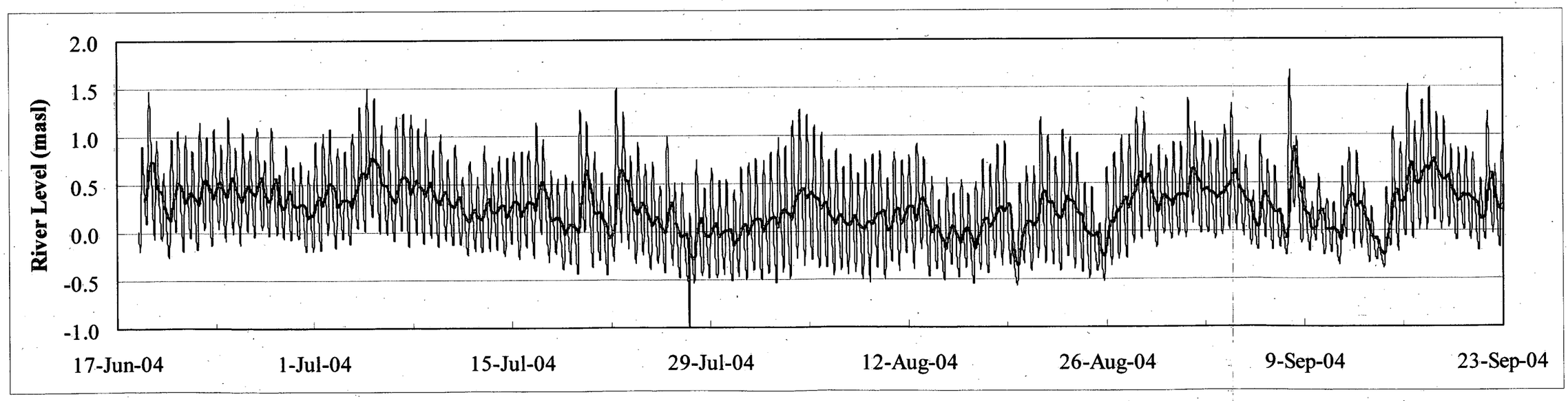
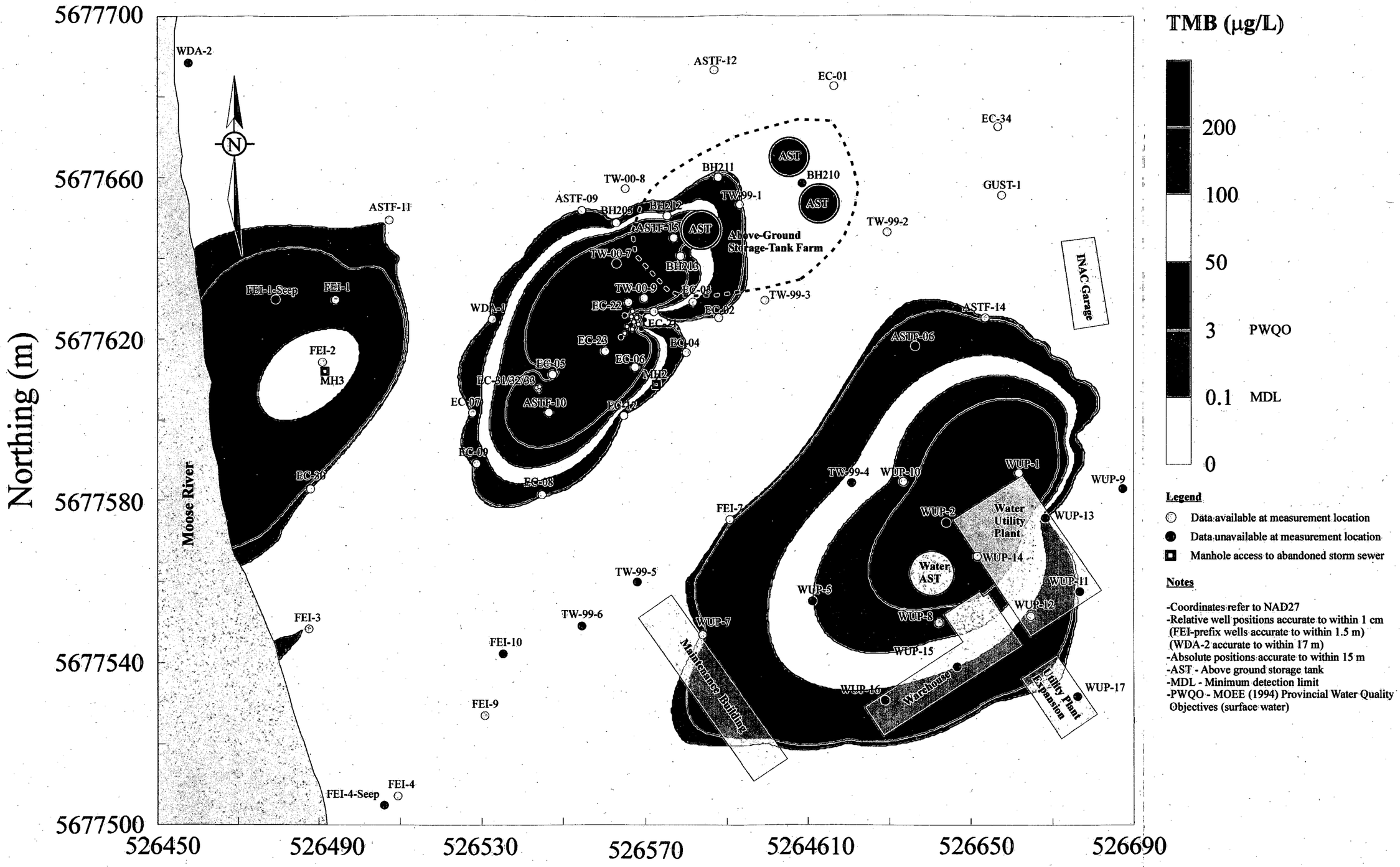


Figure 2.6 Automated river levels and 24-hour moving average (red line)



TMB (µg/L)

200

100

50

3 PWQO

0.1 MDL

0

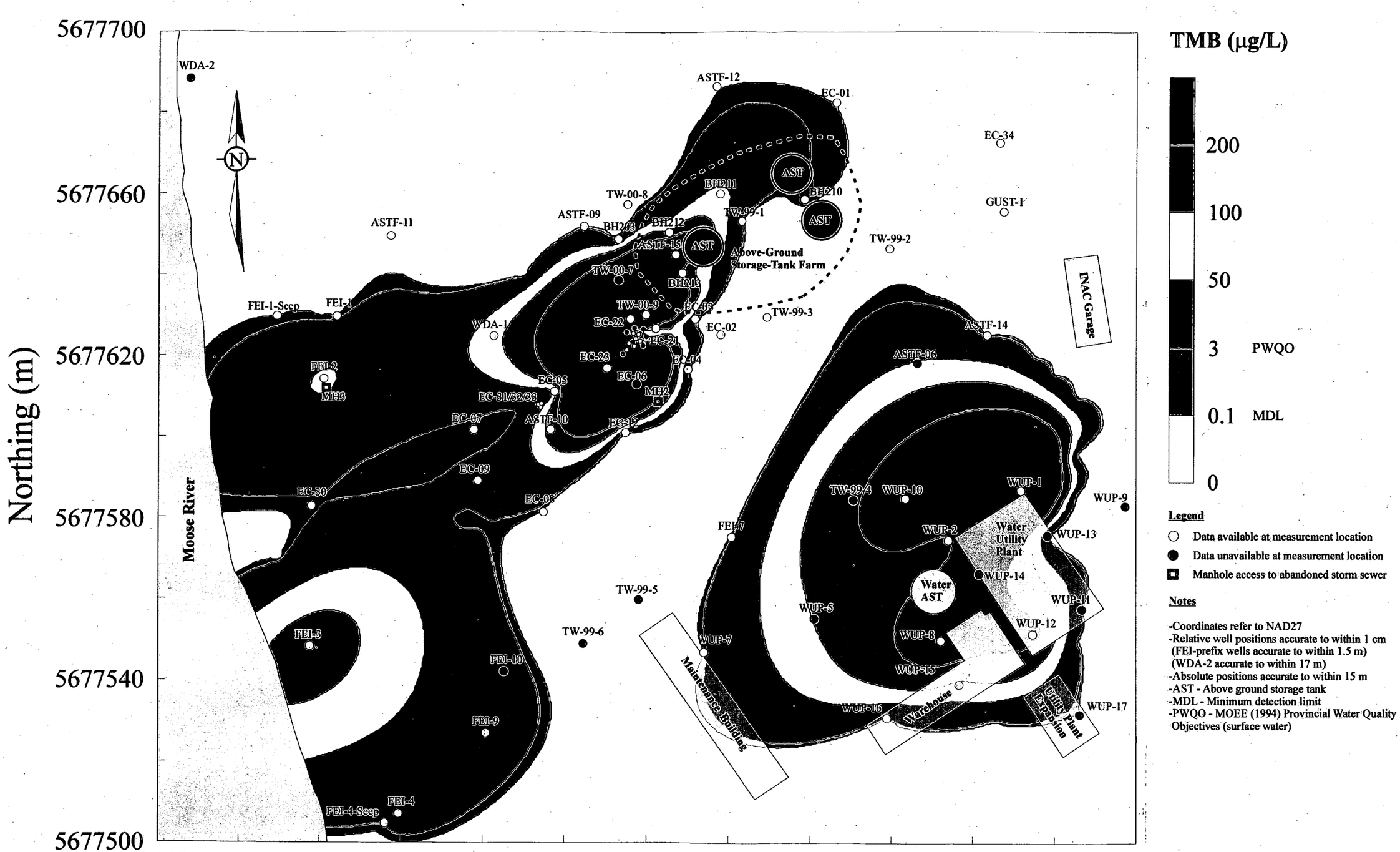
Legend

- Data available at measurement location
- Data unavailable at measurement location
- Manhole access to abandoned storm sewer

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm (FEI-prefix wells accurate to within 1.5 m) (WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
-MDL - Minimum detection limit
-PWQO - MOEE (1994) Provincial Water Quality Objectives (surface water)

Figure 3.1
Estimated Distribution of TMB Concentrations in Groundwater May 2004



TMB (µg/L)

200

100

50

3 PWQO

0.1 MDL

0

Legend

- ○ Data available at measurement location
- ● Data unavailable at measurement location
- ▣ Manhole access to abandoned storm sewer

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm
(FEI-prefix wells accurate to within 1.5 m)
(WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
-MDL - Minimum detection limit
-PWQO - MOEE (1994) Provincial Water Quality Objectives (surface water)

Figure 3.2
Estimated Distribution of TMB Concentrations in Groundwater September 2004

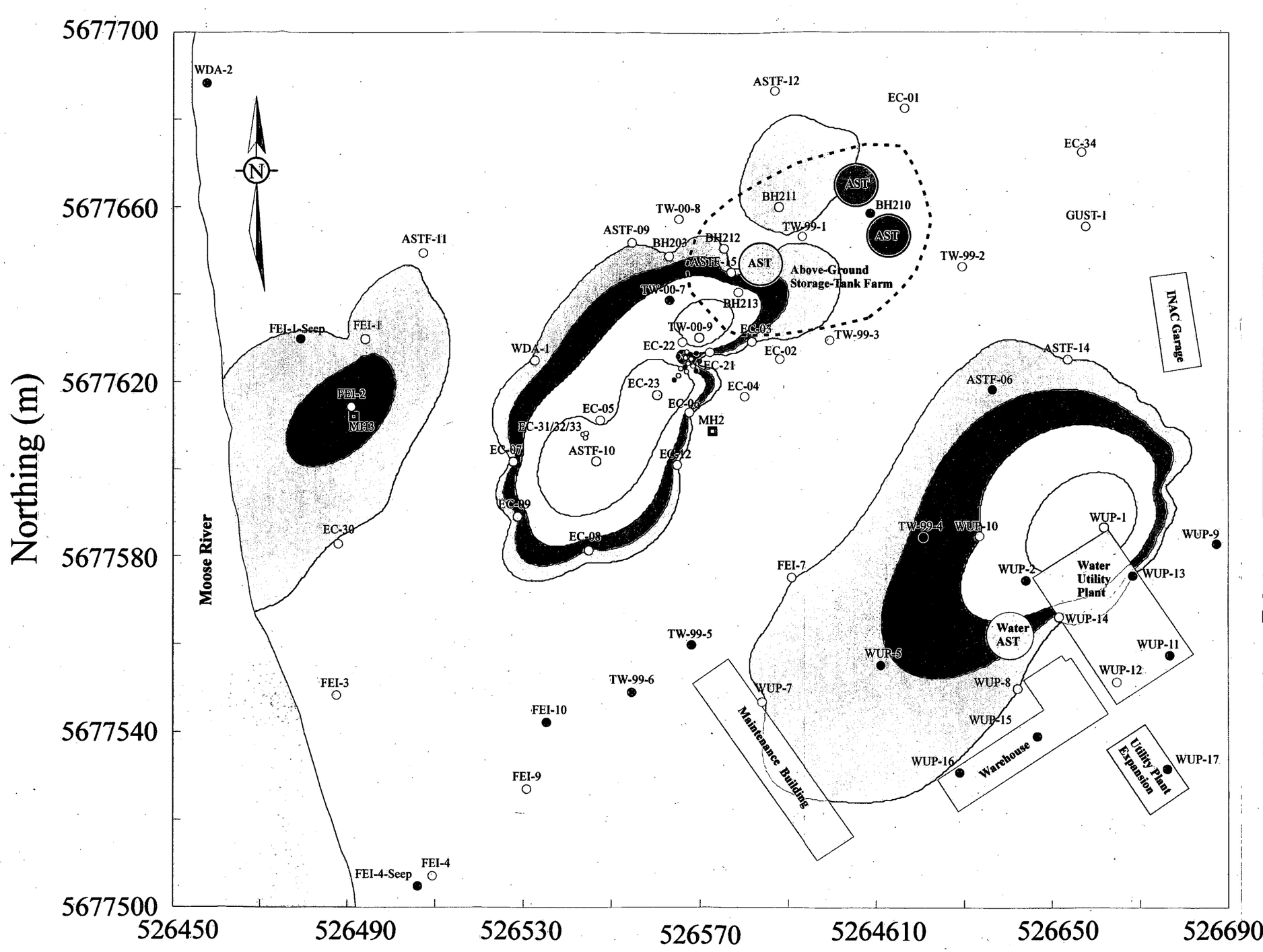


Figure 3.3
Estimated Distribution of Ethylbenzene Concentrations in Groundwater
May 2004

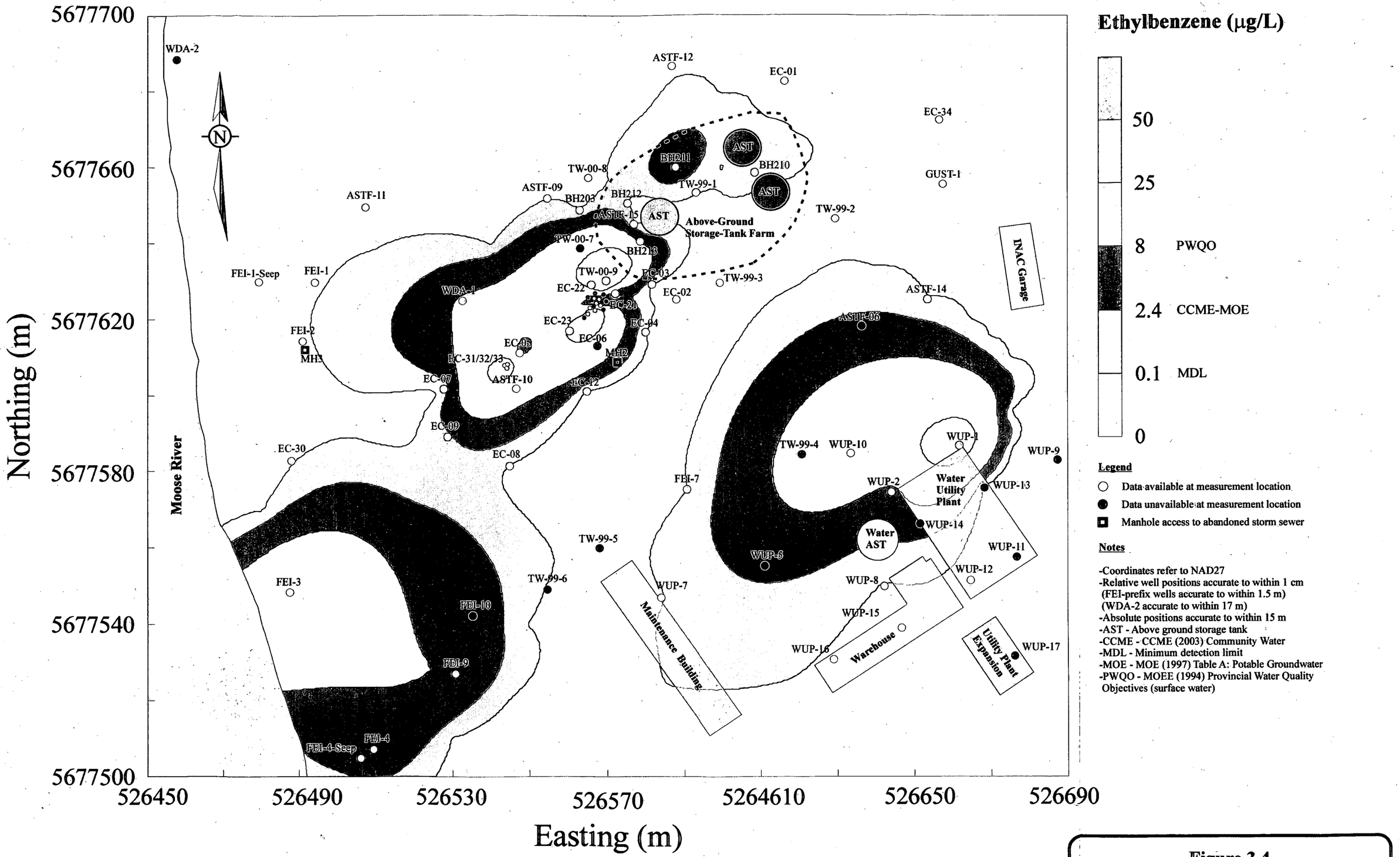


Figure 3.4
Estimated Distribution of Ethylbenzene Concentrations in Groundwater September 2004

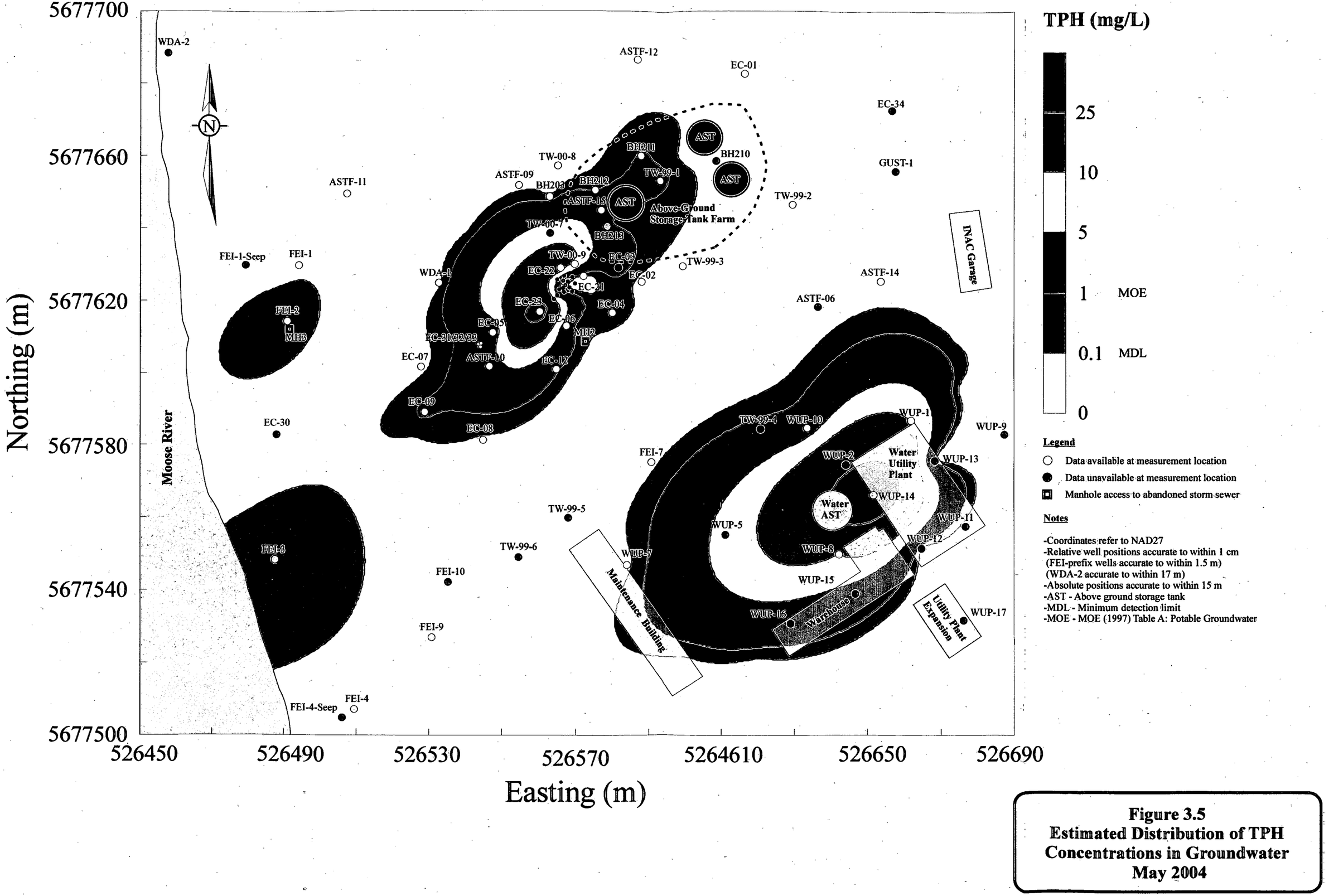
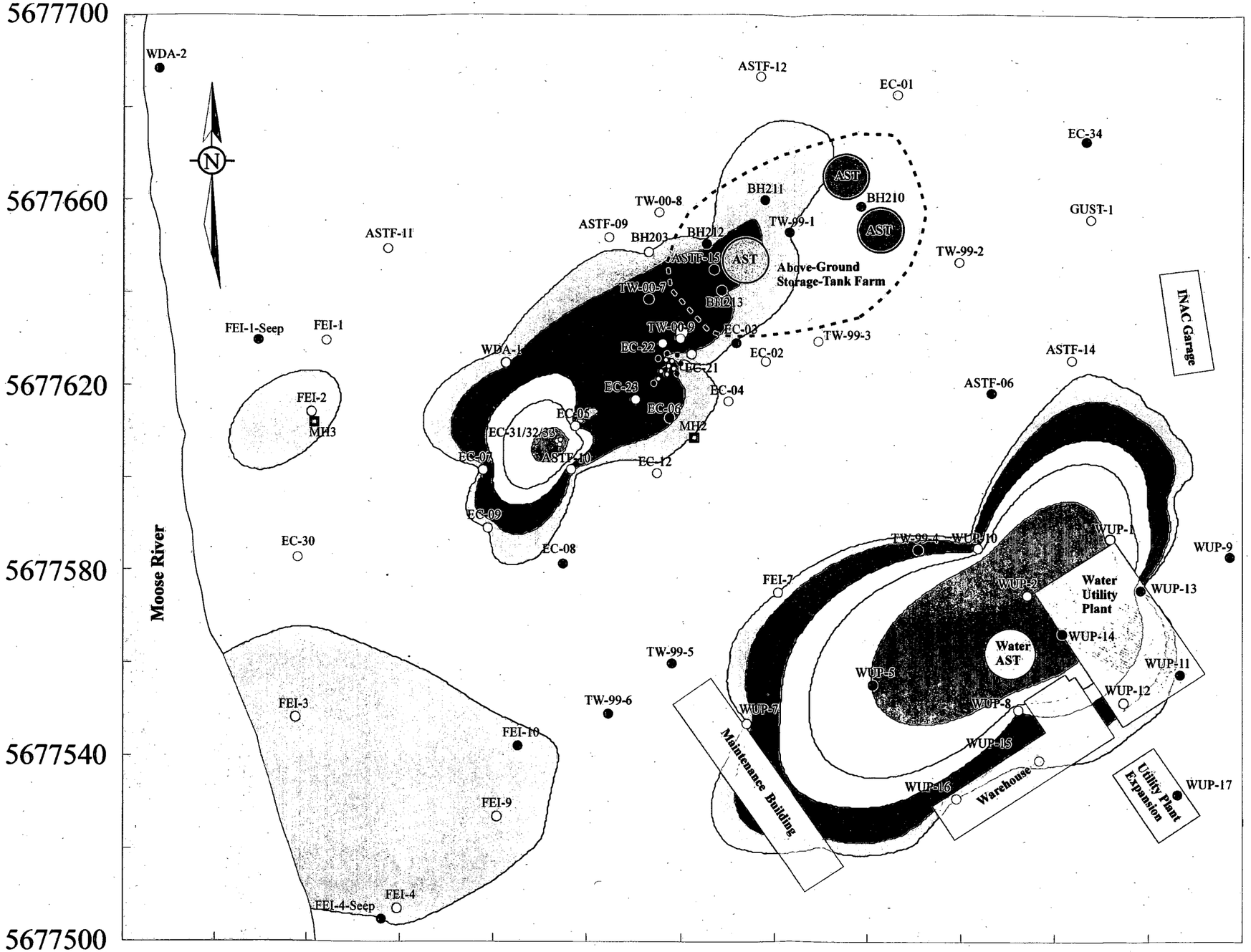


Figure 3.5
Estimated Distribution of TPH Concentrations in Groundwater May 2004



TPH (mg/L)

25
10
5
1 MOE
0.1 MDL
0

Legend

- ○ Data available at measurement location
- ● Data unavailable at measurement location
- ▣ Manhole access to abandoned storm sewer

Notes

-Coordinates refer to NAD27
-Relative well positions accurate to within 1 cm
(FEI-prefix wells accurate to within 1.5 m)
(WDA-2 accurate to within 17 m)
-Absolute positions accurate to within 15 m
-AST - Above ground storage tank
-MDL - Minimum detection limit
-MOE - MOE (1997) Table A: Potable Groundwater

Figure 3.6
Estimated Distribution of TPH Concentrations in Groundwater September 2004

Tables

Table 2.1 Manual Groundwater Elevations

Well	9-Apr-04 (masl)	16-Apr-04 (masl)	25-Apr-04 (masl)	29-Apr-04 (masl)	5-May-04 (masl)	13-May-04 (masl)	21-May-04 (masl)	28-Jun-04 (masl)	2-Jul-04 (masl)	19-Jul-04 (masl)	30-Jul-04 (masl)	13-Aug-04 (masl)	31-Aug-04 (masl)	13-Sep-04 (masl)	21-Sep-04 (masl)	22-Sep-04 (masl)	Maximum 2004 (masl)	Minimum 2004 (masl)	Range 2004 (m)	Maximum 2001-2004[1] (masl)	Minimum 2001-2004[1] (masl)	Range 2001-2004[1] (m)
ASTF-06-MW	4.105	4.115	4.305	4.450	4.600	4.785	4.925		5.025	5.135	4.715	4.595	4.595	4.605	4.734		5.135	4.105	1.030	5.135	3.895	1.240
ASTF-09-MW	3.769	3.739	4.174	4.349	4.344	4.414	4.324		4.394	4.204	4.154	4.254	4.114	4.109	4.358		4.414	3.739	0.675	4.714	3.434	1.280
ASTF-10-MW	3.875	3.830	4.100	4.210	4.250	4.330	4.360		4.440	4.300	4.175	4.100	4.070	4.100		4.215	4.440	3.830	0.610	4.440	3.590	0.850
ASTF-11-MW	3.728	3.643	3.963	4.083	4.143	4.213	4.123		4.193	4.023	3.883	3.803	4.123	3.813	3.896		4.213	3.643	0.570	4.563	3.442	1.121
ASTF-12-MW	4.307	4.272	4.567	4.817	5.017	5.157	5.047		5.097	4.857	4.647	4.667	4.697	4.657	4.821		5.157	4.272	0.885	5.157	4.002	1.155
ASTF-14-MW	4.112	4.132	4.382	4.467	4.632	4.832	5.012		5.122	5.072	4.922	4.792	4.672	4.687		4.937	5.122	4.112	1.010	5.122	3.922	1.200
ASTF-15-RW	4.071	4.051	4.351	4.516	4.611	4.731			4.831	4.621	4.441	4.381	4.391	4.371		4.510	4.831	4.051	0.780	4.831	3.868	0.963
BH203	3.918	3.943	4.398	4.688	4.588	4.848	4.728		4.738	4.503	4.388	4.388	4.408	4.358	4.502		4.848	3.918	0.930	5.148	3.620	1.528
BH210	4.185	4.180	4.435	4.575	4.720	4.905	5.035		5.055	4.620	4.605	4.565	4.565	4.575		4.795	5.055	4.180	0.875	5.055	3.925	1.130
BH211	4.290	4.230	4.590	4.695	4.885	5.060	5.030		5.115	5.195	4.720	4.660	4.700	4.660		4.793	5.195	4.230	0.965	5.195	3.810	1.385
BH212	4.235	4.115	4.565	4.675	4.755	4.990	4.915		5.015	4.380	4.625	4.605	4.610	4.575		4.689	5.015	4.115	0.900	5.015	3.670	1.345
BH213	4.243	4.183	4.488	4.663	4.688	4.843			4.943	4.793	4.528	4.503	4.503	4.453		4.607	4.943	4.183	0.760	4.943	3.720	1.223
EC-01	4.395	4.385	4.630	4.865	5.075	5.285	5.230		5.295	5.045	4.845	4.825	4.845	4.805	4.980		5.295	4.385	0.910	5.295	4.115	1.180
EC-02	4.333	4.135	4.563	4.733	4.693	4.783	4.843		4.953	4.743	4.593	4.623	4.573	4.533	4.688		4.953	4.135	0.818	4.953	3.783	1.170
EC-03	4.391	4.076	4.626	4.726	4.691	4.776	4.856		4.946	4.716	4.596	4.636	4.591	4.546		4.666	4.946	4.076	0.870	4.946	3.676	1.270
EC-04	3.989	3.959	4.214	4.379	4.469	4.569	4.659		4.759	4.574	4.429	4.344	4.379	4.349		4.489	4.759	3.959	0.800	4.759	3.679	1.080
EC-05	3.861	3.811	4.101	4.221	4.261	4.351	4.351		4.431	4.281	4.156	4.081	4.101	4.081		4.201	4.431	3.811	0.620	4.431	3.571	0.860
EC-06	3.902	3.867	4.137	4.262	4.292	4.402	4.447		4.522	4.367	4.237	4.167	4.162	4.162		4.285	4.522	3.867	0.655	4.522	3.702	0.820
EC-07	3.861	3.776	4.071	4.226	4.236	4.306	4.271		4.356	4.216	4.096	4.046	3.796	4.026		4.144	4.356	3.776	0.580	4.356	3.546	0.810
EC-08	3.826	3.796	4.046	4.166	4.196	4.266	4.156		4.376	4.251	4.126	4.056	4.066	4.056	4.182		4.376	3.796	0.580	4.376	3.556	0.820
EC-09	3.818	3.768	4.013	4.148	4.178	4.238	4.383		4.328	4.208		4.008	4.158	4.018		4.125	4.383	3.768	0.615	4.383	3.538	0.845
EC-12	3.906	3.866	4.106	4.196	4.316	4.441	4.446		4.546	4.431	4.286	4.196	4.201	4.186	4.321		4.546	3.866	0.680	4.546	3.626	0.920
EC-30	3.528	3.478	3.598	3.718	3.798	3.823	3.743		3.828	3.738	3.648	3.578	3.808	3.598	3.685		3.828	3.478	0.350	3.828	3.278	0.550
EC-31	3.832	3.792	4.052	4.192	4.232	4.332	4.382		4.462	4.312	4.192	4.112	4.132	4.122		4.228	4.462	3.792	0.670	4.462	3.542	0.920
EC-32	3.822	3.772	4.062	4.182	4.222	4.312	4.377		4.447	4.302	4.172	4.102	4.112	4.102		4.222	4.447	3.772	0.675	4.447	3.532	0.915
EC-33	3.867	3.817	4.107	4.227	4.267	4.357	4.367		4.437	4.287	4.167	4.097	4.112	4.107		4.212	4.437	3.817	0.620	4.437	3.572	0.865
EC-34	4.441	4.461	4.691	4.941	5.121	5.336	5.401		5.481	5.281	5.081	4.961	5.001	5.001	5.181		5.481	4.441	1.040	5.481	4.231	1.250
FEI-MW1	3.639	3.579	3.769	3.879	3.939	3.989	3.919		4.009	3.899	3.794	3.729	3.700	3.749	3.837		4.009	3.579	0.430	4.009	3.369	0.640
FEI-MW10								4.093	4.113	4.033	3.933	3.888	3.893	3.883	3.984		4.113	3.883	0.230	4.113	2.858	1.255
FEI-MW2	3.633	3.573	3.733	3.843	3.913	3.938	3.863		3.943	3.843	3.753	3.703	3.908	3.723	3.792		3.943	3.573	0.370	3.943	3.373	0.570
FEI-MW3								3.563	3.603	3.543	3.453	3.443	3.453	3.423	3.503		3.603	3.423	0.180	3.603	3.157	0.446
FEI-MW4								3.683		3.643	3.568	3.538	3.483	3.523	3.608		3.683	3.483	0.200	3.683	3.294	0.389
FEI-MW5								1.943	1.953	1.793	1.723	1.833		1.743	1.805		1.953	1.723	0.230	1.953	1.667	0.286
FEI-MW7								4.603	4.583	4.443	4.303	4.423	4.353	4.223	4.438		4.603	4.223	0.380	4.603	3.901	0.702
FEI-MW8								3.063	3.103	3.093	3.063	3.033	3.023	3.013	3.054		3.103	3.013	0.090	3.103	1.895	1.208
FEI-MW9								3.833	3.883	3.823	3.823	3.663	3.643	3.643	3.730		3.883	3.643	0.240	3.883	3.403	0.480
GUST-1-MW	4.342	4.362	4.562	4.772	4.972	5.162	5.282		5.372	5.192	4.997	4.867	4.902	4.902	5.079		5.372	4.342	1.030	5.372	4.142	1.230
TW-00-7	4.473	4.663	4.873	4.853	4.683	4.833											4.873	4.473	0.400	4.873	3.540	1.333
TW-00-8	4.046	3.986	4.426	4.716	4.766	4.956	4.791		4.886	4.576	4.416	4.426	4.456	4.396	4.540		4.956	3.986	0.970	4.956	3.640	1.316
TW-00-9	3.549	3.499	3.709	3.779	3.814	3.889	3.869		3.850	3.729	3.629	3.609	3.829	4.249		4.349	4.349	3.499	0.850	4.446	3.329	1.117
TW-99-1	4.324	4.269	4.549	4.704	4.864	5.029	5.009		5.114	4.879	4.709	4.659	4.689	4.649		4.796	5.114	4.269	0.845	5.114	3.820	1.294
TW-99-2							5.185				4.885	4.815	4.795	4.795	4.955		5.185	4.795	0.390	5.185	3.970	1.215
TW-99-3	4.181	4.086	4.246		4.706	4.826	4.866		4.706	4.776	4.626	4.636			4.736		4.866	4.086	0.780	4.866	3.740	1.126
TW-99-4								4.862	4.742	4.622	4.332	4.302	4.292	4.312			4.862	4.292	0.570	4.862	3.980	0.882
WDA-1-MW	3.902	3.862	4.162	4.307	4.352	4.432	4.377		4.462	4.287	4.152	4.092	4.022	4.107		4.212	4.462	3.862	0.600	4.462	3.590	0.872
WUP-01-MW								5.082	5.172	5.072	4.932	4.812	4.872	4.892	4.972		5.172	4.812	0.360	5.172	3.950	1.222
WUP-02-MW								4.843	4.893	4.823	4.643	4.483	4.523	4.373	4.649		4.893	4.373	0.520	4.893	3.953	0.940
WUP-07-MW								4.293	4.293	4.193	4.073	4.003	4.003	3.993	4.123		4.293	3.993	0.300	4.293	3.516	0.777
WUP-08-MW								4.613	4.663	4.613	4.483	4.373	4.318	4.303	4.456		4.663	4.303	0.360	4.663	3.857	0.806
WUP-09-MW								5.163	5.193	5.113	4.963	4.793	4.773	4.803	4.946		5.193	4.773	0.420	5.193	4.176	1.017
WUP-10-RW								4.902	4.962	4.872	4.732	4.592	4.552	4.587	4.709		4.962	4.552	0.410	4.962	3.959	1.003
WUP-11-MW								4.813	4.883	4.823	4.683	4.553	4.493	4.513	4.635		4.883	4.493	0.390	4.883	3.938	0.945
WUP-12-MW								4.713	4.783	4.743	4.613	4.483	4.423	4.433	4.533		4.783	4.423	0.360	4.783	3.876	0.907
WUP-13-MW								4.993	5.043	4.953	4.813	4.663	4.623	4.663	4.797		5.043	4.623	0.420	5.043	4.044	0.999
WUP-14-MW								5.733		4.773	4.583	4.493	4.433	4.463	4.673		5.733	4.433	1.300	5.733	3.959	1.774
WUP-15-MW									4.613	4.583	4.463	4.333	4.313	4.323	4.433		4.613	4.313	0.300	4.613	3.787	0.826
WUP-16-MW								4.423	4.463	4.423	4.313	4.273	4.163	4.183	4.293		4.463	4.163	0.300	4.463	3.691	0.772
WUP-17-MW								4.583	4.693	4.643	4.533	4.403	4.373	4.343	4.456		4.693	4.343	0.350	4.693	3.806	0.887

Notes

masl Metres above sea level

3.862 Measured minimum groundwater elevation for monitoring period April 9 to September 23, 2004

4.956 Measured maximum groundwater elevation for monitoring period April 9 to September 23, 2004

1 Historical data for: April 28, 2002 to September 23, 2005 from *Bickerton et al*. (2005); September & October 2001 and February & March 2002 from *CH2M Hill* (2002); August 2002 from *Franz Environmental* (2003)

Table 2.2 Apparent LNAPL Thicknesses

Well	9-Apr-04 (cm)	16-Apr-04 (cm)	25-Apr-04 (cm)	29-Apr-04 (cm)	5-May-04 (cm)	13-May-04 (cm)	21-May-04 (cm)	28-Jun-04 (cm)	2-Jul-04 (cm)	19-Jul-04 (cm)	30-Jul-04 (cm)	13-Aug-04 (cm)	31-Aug-04 (cm)	13-Sep-04 (cm)	21-Sep-04 (cm)	22-Sep-04 (cm)	Maximum 2004 (cm)	Minimum 2004 (cm)	Range 2004 (cm)	Maximum 2001-2004[1] (cm)	Minimum 2001-2004[1] (cm)	Range 2001-2004[1] (cm)
ASTF-06-MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.3	0.0	0.3
ASTF-10-MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.1	0.0	0.1
ASTF-14-MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.1	0.0	0.1
ASTF-15-RW	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.2	0.0	0.2
BH210	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.1	0.0	0.1
BH211	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		1.5	0.0	1.5
BH212	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		5.5	0.0	5.5
BH213	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		2.0	0.0	2.0
EC-01	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.1	0.0	0.1
EC-03	0.0	1.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	1.0	0.0	1.0	62.5	0.0	62.5
EC-06	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.1	0.0	0.1
TW-00-9	59.0	60.5	72.5	79.0	79.5	84.0	92.0		101.9	92.0	87.5	86.0	55.0	8.0		9.7	101.9	8.0	93.9	101.9	0.0	101.9
TW-99-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		4.3	0.0	4.3
TW-99-3	0.0	0.0	20.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0			0.0	0.0	20.0	0.0	20.0	20.0	0.0	20.0
TW-99-4								0.0	0.0	8.5	27.0	16.0	17.0	17.0			27.0	0.0	27.0	27.0	0.0	27.0
WDA-1-MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	11.0	0.0		0.0	11.0	0.0	11.0	11.0	0.0	11.0
WUP-01-MW								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		1.5	0.0	1.5
WUP-02-MW								0.0	0.0	0.0	5.0	6.0	0.0	16.5	0.0		16.5	0.0	16.5	16.5	0.0	16.5
WUP-08-MW								0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0		0.5	0.0	0.5	7.7	0.0	7.7
WUP-10-RW								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		2.5	0.0	2.5
WUP-14-MW								2.5		8.0	14.0	10.0	14.0	10.0	0.0		14.0	0.0	14.0	14.0	0.0	14.0

Notes

1 Historical data for: April 28, 2002 to September 23, 2005 from *Bickerton et al*. (2005); September & October 2001 and February & March 2002 from *CH2M Hill* (2002); August 2002 from *Franz Environmental* (2003)

Table 3.1 Reported Detection Limits and Data Sources

Sample Dates			Note	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m-p Xylene (µg/L)	o Xylene (µg/L)	Styrene (µg/L)	Total Xylene (µg/L)	Total TMB[8] (µg/L)	Total TeMB[9] (µg/L)	TPH gasoline[10] (mg/L)	TPH diesel[11] (mg/L)	TPH gas/diesel (mg/L)	Data Source (see Reference section for details)
31-Oct-96	to	8-Nov-96	7	0.5	0.5	na				na					na	Jacques Whitford Environmental (1997)
20-Oct-99			7	0.2	0.2	0.2	0.4	0.2							0.1	CH2M Gore and Storrie (2000)
24-Oct-00			7	0.5	0.5	0.5	0.5	0.5							na	CH2M Hill (2001)
6-Sep-01	to	8-Mar-02		0.5	0.5	0.5	1	0.5					0.1	0.1		CH2M Hill (2002)
11-Aug-02	to	15-Aug-02	1	0.3	0.2	0.3	0.3	0.1					0.5	0.5		Environment Canada (2005)
14-Aug-02	and	20-Aug-02	2	0.5	0.5	0.5				1.5			0.1	0.1		Franz Environmental (2003)
27-Sep-02			7	0.5	0.5	0.5				1.5			0.1	0.1		Franz Environmental (2003)
17-Jun-03	to	15-Sep-03	1	0.3	0.2	0.3	0.3	0.1					0.5	0.5		Environment Canada (2005)
24-Oct-03	to	29-Oct-03	3	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.5	0.5		Environment Canada (2005)
Jan-04			4	0.1	0.2	0.1				0.1			0.1	0.1		KGS (2004)
12-Jan-04	to	30-Sep-04	5	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.2	0.1		Environment Canada (2005)
16-May-04	to	30-Sep-04	6	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.2	0.1		Environment Canada (This Report)

Notes

1 Method detection limits (MDL) as defined under Ontario MISA program, actual detection limits may be lower

2 Samples collected on August 14, 2001 refer only to wells with WUP prefix

3 Method detection limits (MDL) for TPH as defined under Ontario MISA program, actual detection limits may be lower

4 Actual sample dates not provided

5 Reference refers to samples collected from wells without WUP or FEI prefixes (excluding FEI-MW1 and FEI-MW2); TPH samples from September 2004 were obtained under the scope of this report

6 Reference refers to samples collected from wells with WUP or FEI prefixes (excluding FEI-MW1 and FEI-MW2)

7 Method detection limits (MDL) were not explicitly provided; *na* indicates that MDL could not be inferred

8 TMB refers to the sum of the (1,2,3), (1,2,4) and (1,3,5) isomers of trimethylbenzene

9 TeMB refers to the sum of the (1,2,3,4), (1,2,3,5) and (1,2,4,5) isomers of tetramethylbenzene

10 Depending on the data source, the gasoline fraction has also been referred to as Total Purgeable Hydrocarbons or the C_6 to C_{10} fraction

11 Depending on the data source, the diesel fraction has also been referred to as Total Extractable Hydrocarbons or the C_{11} to C_{24} fraction

Actual detection limits may be higher than the method detection limits (MDL) for a given sample if dilution is required for analyses

Not applicable or no appropriate measurements

Table 3.2 Federal and Provincial Water Quality Guidelines

Petroleum Hydrocarbon	Units	CCME (2003) Water Community	CCME (2003) Water Aquatic Life	MOE (1997) Table A Potable Groundwater	MOE (1997) Table B [1] Nonpotable Groundwater	MOEE (1994) PWQO [2] Surface Water	ASTF Plume [3] Maximum 2004	WUP Plume Maximum 2004	Sentinel Wells [4] Maximum 2004	Groundwater Seepage [5] Maximum 2004
Benzene	(µg/L)	5	370	5	1900	100	40	5	2	tr
Toluene	(µg/L)	24 [a]	2	24	5900	0.8	5	3	0.2	tr
Ethylbenzene	(µg/L)	2.4 [a]	90	2.4	28000	8	187	65	19	4
m-Xylene	(µg/L)					2				
o-Xylene	(µg/L)					40	218	30	2	0.2
p-Xylene	(µg/L)					30				
m-p-Xylene	(µg/L)						274	53	27	tr
Xylene	(µg/L)	300 [a]		300	5600		468	70	28	0.2
Styrene	(µg/L)		72	100	940	4	8	3	0.1	nd
TPH gas/diesel	(mg/L)			1			430	150	1	
TMB	(µg/L)					3	2255	985	154	3
TeMB	(µg/L)						905	400	67	0.1

Notes

a	Aesthetic objective
nd	No detectable concentration
tr	Trace concentration level detected but not quantifiable (< MDL)
1	Values refer to criteria for coarse-grained textured (criteria for medium and fine textured soils is less stringent)
2	Provincial water quality objectives (PWQO) also apply to groundwater discharging to surface
3	Include monitoring wells in Environment Canada's treatment area
4	Includes well within 30 m of Moose River (i.e. EC-30, FEI-MW1, FEI-MW2, FEI-MW3, FEI-MW4, FEI-MW5 & FEI-MW8)
5	Sampled from groundwater seepage observed in vicinity of FEI-MW1, FEI-MW4 & FEI-MW5

Not applicable or no appropriate measurements

Table 3.3 QA/QC Results for May 2004 and September 2004 Groundwater Sampling

Monitoring Well	Sampling Event	Sample Comment	1,3,5 TMB (µg/L)	1,2,4 TMB (µg/L)	1,2,3 TMB (µg/L)	1,2,4,5 TeMB (µg/L)	1,2,3,5 TeMB (µg/L)	1,2,3,4 TeMB (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m-p-Xylene (µg/L)	o-Xylene (µg/L)	TPH-Gas (mg/L)	TPH-Diesel (mg/L)
Blind Field-Duplicates															
ASTF-10-MW	Sep-2004	original	10.90	74.00	42.10	4.00	12.80	29.50	3.00	0.50	12.60	21.80	0.50	0.40	0.50
ASTF-10-MW	Sep-2004	duplicate												0.40	0.50
		original/duplicate													
EC-30	Sep-2004	original	nd	0.40	1.30	0.10	tr	0.10	1.19	tr	tr	0.20	tr	nd	nd
EC-30	Sep-2004	duplicate	nd	0.67	2.01	0.20	0.20	0.40	1.22	tr	tr	0.40	tr	nd	nd
		original/duplicate		**168%**	**155%**	**200%**		**400%**	**103%**			**200%**			
EC-32	Sep-2004	original	12.96	68.18	49.76	7.46	15.76	34.66	0.40	0.10	14.92	24.04	9.04	0.40	0.50
EC-32	Sep-2004	duplicate	10.34	53.86	38.94	6.06	11.50	26.08	0.40	0.10	14.64	21.96	7.18	0.40	0.40
		original/duplicate	**80%**	**79%**	**78%**	**81%**	**73%**	**75%**	**100%**	**100%**	**98%**	**91%**	**79%**	**100%**	**80%**
FEI-MW2	Sep-2004	original	2.68	25.06	31.74	4.82	6.56	8.26	0.10	0.10	nd	6.12	0.30	nd	0.20
FEI-MW2	Sep-2004	duplicate	3.86	30.70	40.08	6.38	10.83	11.73	0.10	tr	nd	6.82	0.30	nd	0.30
		original/duplicate	**144%**	**123%**	**126%**	**132%**	**165%**	**142%**	**100%**			**111%**	**100%**		**150%**
FEI-MW3	Sep-2004	original	13.13	103.00	38.23	10.97	20.01	36.43	1.30	tr	19.00	6.76	2.31	0.40	0.50
FEI-MW3	Sep-2004	duplicate	7.00	58.40	26.10	3.80	12.00	28.80	1.00	nd	12.80	4.00	0.50	0.20	0.30
		original/duplicate	**53%**	**57%**	**68%**	**35%**	**60%**	**79%**	**77%**		**67%**	**59%**	**22%**	**50%**	**60%**
FEI-MW4	May-2004	original	tr	tr	nd	tr	tr	nd	tr	tr	nd	tr	tr	nd	nd
FEI-MW4	May-2004	duplicate	0.00	tr	tr	0.10	0.20	tr	tr	tr	tr	tr	nd		
		original/duplicate													
WDA-1-MW	Sep-2004	original	5.36	45.00	35.28	7.08	12.13	16.12	1.54	tr	8.98	12.19	0.30	0.20	0.30
WDA-1-MW	Sep-2004	duplicate	5.08	48.26	38.86	6.12	10.42	14.30	1.68	nd	9.86	14.14	0.30	0.20	0.30
		original/duplicate	**95%**	**107%**	**110%**	**86%**	**86%**	**89%**	**109%**		**110%**	**116%**	**100%**	**100%**	**100%**
WUP-01-MW	May-2004	original	130.00	499.00	270.00	15.00	75.00	245.00	2.50	2.50	65.00	40.00	30.00	1.60	8.50
WUP-01-MW	May-2004	duplicate	105.00	415.00	225.00	15.00	65.00	215.00	2.50	nd	52.00	30.00	25.00		
		original/duplicate	**81%**	**83%**	**83%**	**100%**	**87%**	**88%**	**100%**		**80%**	**75%**	**83%**		
Field Duplicates															
EC-19	Sep-2004	original	8.29	24.62	30.03	5.59	17.27	41.24	tr	tr	1.48	2.64	1.22	nd	nd
EC-19	Sep-2004	duplicate	5.26	15.25	18.41	3.56	10.99	27.19	tr	tr	1.35	1.87	0.92		
		original/duplicate	**63%**	**62%**	**61%**	**64%**	**64%**	**66%**			**91%**	**71%**	**75%**		
FEI-MW1	Sep-2004	original	nd	nd	tr	2.57	3.42	0.20	0.10	tr	nd	tr	nd	nd	nd
FEI-MW1	Sep-2004	duplicate	nd	nd	tr	2.26	3.31	0.20	0.10	tr	nd	tr	nd		
		original/duplicate				**88%**	**97%**	**100%**	**100%**						
WDA-1-MW	Sep-2004	original	5.08	48.26	38.86	6.12	10.42	14.30	1.68	nd	9.86	14.14	0.30	0.20	0.30
WDA-1-MW	Sep-2004	duplicate	6.00	44.91	33.79	6.97	13.70	6.06	1.58	tr	9.30	12.90	0.30		
		original/duplicate	**118%**	**93%**	**87%**	**114%**	**131%**	**42%**	**94%**		**94%**	**91%**	**100%**		

Notes

TMB	Trimethylbenzene		Not applicable or no appropriate measurements
TeMB	Tetramethylbenzene		Reported analytical values at concentrations above MDL but less than practical quantification limits (~ 5x MDL); subject to greater error
TPH	Total Petroleum Hydrocarbons	nd	no detectable concentration
		tr	Trace concentration detected but not quantifiable (i.e. < MDL)

Table 3.4 Plume Stability Analysis Based on Mann-Kendall Test

Borehole	Sample Events	Analysis Period		TPH (gas/diesel)	Sample Events	Analysis Period		Ethylbenzene	m-p Xylene	o-Xylene	Sample Events	Analysis Period		TMB	TeMB
ASTF Plume															
ASTF-10-MW	9	Sep-01	Sep-04	**Probably Increasing**	4	Jan-04	Sep-04	No trend	No trend	**Probably Decreasing**	5	Oct-03	Sep-04	No trend	No trend
BH203	8	Oct-96	Sep-04	No trend											
BH210	4	Oct-96	Oct-01	No trend											
BH211	4	Oct-96	May-04	No trend											
BH213	4	Oct-96	May-04	No trend											
EC-02	5	Aug-02	Sep-04	**Probably Decreasing**							4	Oct-03	Sep-04	No trend	No trend
EC-04	4	Aug-02	Sep-04	No trend	6	Jan-04	Sep-04	No trend	**Probably Increasing**	**Probably Increasing**	7	Oct-03	Sep-04	**Probably Increasing**	**Probably Increasing**
EC-05	6	Aug-02	Sep-04	No trend	4	Jan-04	Aug-04	No trend	No trend	No trend	5	Oct-03	Aug-04	**Probably Increasing**	**Probably Increasing**
EC-06					5	Jan-04	Sep-04		No trend	No trend	6	Oct-03	Sep-04	No trend	No trend
EC-07	4	Aug-02	Sep-04	**Probably Decreasing**	5	Jan-04	Sep-04	No trend	**Probably Decreasing**	**Probably Decreasing**	6	Oct-03	Sep-04	No trend	**Probably Decreasing**
EC-09	5	Aug-02	Sep-04	No trend							4	Oct-03	Aug-04	No trend	No trend
EC-31					5	Feb-04	Sep-04	No trend	No trend	No trend	6	Oct-03	Sep-04	No trend	No trend
EC-32	4	Oct-03	Sep-04	No trend							6	Oct-03	Sep-04	No trend	**Probably Decreasing**
FEI-MW1					4	Jan-04	Sep-04		No trend	No trend	5	Oct-03	Sep-04	No trend	**Probably Decreasing**
FEI-MW2	6	Aug-02	Sep-04	No trend											
TW-99-3	7	Oct-99	Sep-04	No trend	5	Feb-04	Sep-04	**Probably Decreasing**	**Probably Increasing**	No trend	5	Feb-04	Sep-04	**Probably Increasing**	No trend
TW-00-9	6	Oct-00	Sep-04	No trend	5	Jan-04	Sep-04	No trend	No trend		6	Oct-03	Sep-04	No trend	No trend
WDA-1-MW	6	Sep-01	Sep-04	No trend											
WUP Plume															
FEI-MW3	5	Aug-02	Sep-04	No trend											
FEI-MW7	4	Aug-02	Sep-04	**Probably Decreasing**											

Notes

Not applicable or insufficient measurements available

Appendix A

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene	Toluene	Ethylbenzene	m-p Xylene	o Xylene	Styrene	Total Xylene
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
ASTF-06-MW	14-Aug-02	0.0b	0.5	14.0				58.0
ASTF-09-MW	12-Sep-01	0.0b		0.0b	0.0b	0.0b		0.0b
ASTF-09-MW	18-May-04	tr	nd	nd	tr	nd	nd	tr
ASTF-09-MW	28-Sep-04	nd	tr	nd	tr	nd	nd	tr
ASTF-10-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-10-MW	5-Mar-02	>2.0c	0.0b	>3.5c	>18.0c	>4.5c		>22.5c
ASTF-10-MW	11-Aug-02	nd	0.3	4.9	10.9	1.5		12.4
ASTF-10-MW	17-Jun-03	>1.3c	0.0b	>2.6c	>42.3c	>11.2c		>53.5c
ASTF-10-MW	15-Sep-03	>3.0c	>0.2c	>0.7c	>34.5c	>2.9c		>37.4c
ASTF-10-MW	27-Oct-03	>5.5c	>0.2c	>27.7c	>41.6c	>25.3c	0.0b	>66.9c
ASTF-10-MW	12-Jan-04	5.0	0.1a	tr	>26.0e	29.0	6.0	>55.0e
ASTF-10-MW	23-May-04	6.0	0.4a	80.0	83.0	9.0	0.2a	92.0
ASTF-10-MW	14-Aug-04	4.0a	tr	11.4	21.2	tr	nd	22.2
ASTF-10-MW	25-Sep-04	3.0a	tr	12.6	21.8	tr	nd	22.3
ASTF-11-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-11-MW	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-11-MW	25-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
ASTF-11-MW	14-Jan-04	tr	tr	nd	nd	nd	nd	nd
ASTF-11-MW	18-May-04	tr	nd	tr	tr	nd	nd	tr
ASTF-11-MW	27-Sep-04	tr	nd	tr	nd	nd	nd	nd
ASTF-12-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-12-MW	11-Aug-02	nd	0.2	nd	0.4	nd		0.4
ASTF-12-MW	25-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
ASTF-12-MW	15-Jan-04	tr	tr	tr	nd	nd	nd	nd
ASTF-12-MW	18-May-04	tr	tr	nd	nd	nd	nd	nd
ASTF-12-MW	28-Sep-04	nd	tr	nd	nd	nd	nd	nd
ASTF-14-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-14-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b
ASTF-14-MW	19-May-04	tr	nd	nd	nd	nd	nd	nd
ASTF-14-MW	30-Sep-04	tr	nd	tr	tr	nd	nd	tr
ASTF-15-RW	20-Oct-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-15-RW	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
ASTF-15-RW	23-May-04	0.2a	1.0	nd	65.0	>218.0e	6.0	>283.0e
ASTF-15-RW	26-Sep-04	nd	tr	nd	57.3	198.3	6.0a	255.5
BH203	31-Oct-96	0.0b	>1.2c	0.0b				0.0b
BH203	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
BH203	6-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
BH203	11-Aug-02	nd	0.2	0.1a	0.6	0.1		0.8
BH203	17-Jun-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
BH203	29-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
BH203	15-Jan-04	tr	tr	tr	tr	nd	nd	tr
BH203	18-May-04	tr	tr	tr	tr	tr	nd	tr
BH203	14-Aug-04	tr	tr	tr	tr	nd	nd	tr
BH203	28-Sep-04	tr	tr	tr	tr	tr	nd	tr
BH210	31-Oct-96	0.0b	>1.2c	>8.7c				>10.6c
BH210	20-Oct-99	0.0b	0.0b	>0.4c	0.0b	0.0b		0.0b
BH210	24-Oct-00	0.0b	0.0b	>2.2c	>2.4c	>1.7c		>4.1c
BH210	20-Oct-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
BH210	1-Mar-04	tr	0.2a	nd	2.0	tr	nd	2.1
BH210	26-Sep-04	nd	tr	2.5	0.3a	0.1a	nd	0.4a

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene	Toluene	Ethylbenzene	m-p Xylene	o Xylene	Styrene	Total Xylene
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
BH211	31-Oct-96	0.0b	0.0b	0.0b				>770.0c
BH211	20-Oct-99	>0.2c	>0.4c	>4.4c	>165.0c	>43.3c		>208.3c
BH211	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
BH211	2-Mar-04	tr	1.0	3.0	6.0	4.0	tr	10.0
BH211	23-May-04	0.1a	0.4a	2.0	7.0	3.0	tr	10.0
BH211	26-Sep-04	0.1a	0.9	6.1	33.0	9.9	0.2a	42.9
BH212	31-Oct-96	0.0b	>78.0c	0.0b				>950.0c
BH212	24-Oct-00				>134.0c	>163.0c		>297.0c
BH212	2-Mar-04	tr	nd	tr	10.0a	6.0a	tr	16.0a
BH212	23-May-04	tr	tr	0.1a	0.1a	0.1a	nd	0.2a
BH212	26-Sep-04	tr	tr	tr	tr	nd	nd	tr
BH213	31-Oct-96	0.0b	>110.0c	0.0b				>1650.0c
BH213	20-Oct-99	>0.2c	0.0b	>0.7c	>0.9c	>3.8c		>4.8c
BH213	24-Oct-00	0.0b	0.0b	0.0b	>2.7c	>1.5c		>4.2c
BH213	2-Mar-04	0.6a	1.0a	10.0	47.0	35.0	1.0a	82.0
BH213	23-May-04	tr	tr	10.0	24.0	7.0	tr	31.0
BH213	27-Sep-04	0.2a	1.4	5.4	20.9	17.0	0.5a	37.9
EC-01	11-Aug-02	nd	0.3	nd	0.5	nd		0.5
EC-01	17-Jun-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
EC-01	25-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
EC-01	15-Jan-04	tr	nd	nd	nd	nd	nd	nd
EC-01	20-May-04	tr	tr	tr	tr	nd	nd	tr
EC-01	14-Aug-04	tr	tr	nd	nd	nd	nd	nd
EC-01	28-Sep-04	tr	nd	tr	tr	nd	nd	tr
EC-02	12-Aug-02	nd	nd	0.9	2.5	0.3		2.8
EC-02	15-Sep-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
EC-02	27-Oct-03	0.0b	0.0b	0.0b	>0.1c	0.0b	0.0b	>0.1c
EC-02	14-Jan-04	tr	tr	tr	0.1a	tr	tr	0.2a
EC-02	17-May-04	tr	tr	tr	tr	nd	nd	tr
EC-02	29-Sep-04	tr	nd	nd	tr	nd	nd	tr
EC-03	13-Aug-02	nd	0.5	30.5	150.0	9.4		159.4
EC-03	17-May-04	tr	tr	tr	0.2a	0.4a	nd	0.6a
EC-03	26-Sep-04	tr	nd	nd	tr	tr	nd	tr
EC-04	12-Aug-02	nd	0.0a	0.2a	0.9	0.1a		1.0
EC-04	27-Oct-03	0.0b	0.0b	0.0b	>0.4c	0.0b		>0.4c
EC-04	16-Jan-04	tr	tr	nd	nd	nd	nd	nd
EC-04	17-May-04	tr	tr	tr	tr	tr	nd	tr
EC-04	14-Aug-04	tr	tr	tr	nd	nd	nd	nd
EC-04	26-Sep-04	0.1a	0.1a	0.1a	nd	0.1a	nd	0.1a
EC-05	12-Aug-02	10.0	1.8	143.0	316.0	36.8		352.8
EC-05	15-Sep-03	0.0b	0.0b	0.0b	>0.4c	>0.8c		>1.2c
EC-05	26-Oct-03	>0.6c	0.0b	0.0b	>0.1c	>0.3c	0.0b	>0.4c
EC-05	12-Jan-04	tr	tr	tr	0.9a	tr	nd	1.3a
EC-05	4-Feb-04	0.1a	tr	0.3a	1.0	0.4a	tr	1.4
EC-05	3-Mar-04	0.1a	tr	0.3a	1.0	0.3a	nd	1.3
EC-05	17-May-04	2.0	tr	6.0	5.0	0.5	tr	5.5
EC-05	14-Aug-04	3.1	tr	1.7	2.0	2.2	tr	4.1
EC-05	26-Sep-04	3.8	tr	2.8	2.7	2.5	tr	5.2
EC-06	12-Aug-02	nd	0.3	36.8	91.3	5.5		96.8
EC-06	28-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene	Toluene	Ethylbenzene	m-p Xylene	o Xylene	Styrene	Total Xylene
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
EC-06	12-Jan-04	tr	tr	tr	0.7a	tr	nd	0.8a
EC-06	3-Mar-04	0.2a	0.4a	1.0	1.0	1.0	tr	2.0
EC-06	17-May-04	0.5	0.1a	0.5	22.0	14.0	0.4a	36.0
EC-06	14-Aug-04	tr	tr	0.9	4.0	0.9	tr	4.9
EC-07	13-Aug-02	0.3a	0.4	1.5	5.4	0.9		6.3
EC-07	27-Oct-03	>0.3c	>0.1c	0.0b	>1.4c	>0.1c	0.0b	>1.5c
EC-07	14-Jan-04	0.2a	tr	tr	2.0	tr	nd	2.1
EC-07	4-Mar-04	1.0	0.1a	1.0	6.0	tr	nd	6.1
EC-07	18-May-04	tr	nd	tr	tr	nd	nd	tr
EC-07	14-Aug-04	tr	nd	nd	tr	nd	nd	tr
EC-07	25-Sep-04	0.1a	tr	0.2a	0.3a	tr	nd	0.4a
EC-08	12-Aug-02	nd	nd	0.3	0.9	0.1		1.0
EC-08	25-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
EC-08	13-Jan-04	tr	tr	nd	nd	nd	nd	nd
EC-08	18-May-04	0.1a	nd	2.0	3.0	0.0a	nd	3.0
EC-08	27-Sep-04	tr	nd	tr	tr	tr	nd	tr
EC-09	13-Aug-02	1.2	0.4	7.4	21.4	3.9		25.3
EC-09	17-Jun-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
EC-09	27-Oct-03	>2.3c	>0.1c	>1.6c	>13.8c	>1.0c	>0.1c	>14.8c
EC-09	14-Jan-04	3.0	0.2a	13.0	28.0	1.0	tr	29.0
EC-09	4-Mar-04	3.0	0.3a	14.0	13.0	0.9a	nd	13.9
EC-09	18-May-04	0.2a	tr	1.0	2.0	tr	nd	2.1
EC-09	14-Aug-04	1.8	tr	9.6	7.7	0.8	tr	8.4
EC-09	25-Sep-04	0.9a	tr	1.8	1.9	tr	nd	2.0
EC-12	12-Aug-02	nd	nd	1.7	4.6	0.5		5.1
EC-12	17-May-04	nd	tr	tr	tr	tr	nd	tr
EC-12	29-Sep-04	tr	0.2a	tr	tr	nd	nd	tr
EC-30	15-Aug-02	nd	0.5	3.2	13.3	3.3		16.6
EC-30	27-Sep-02	0.0b	0.0b	0.0b				0.0b
EC-30	17-Jun-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
EC-30	28-Aug-03	0.0b	0.0b	0.0b	>1.1c	0.0b		>1.1c
EC-30	24-Oct-03	0.0b	0.0b	0.0b	>0.1c	>0.1c	0.0b	>0.1c
EC-30	21-May-04	0.2a	tr	nd	0.2a	tr	nd	0.3a
EC-30	14-Aug-04	0.7	tr	tr	0.3a	tr	nd	0.4a
EC-30	24-Sep-04	1.2	tr	tr	0.2a	tr	nd	0.3a
EC-31	27-Oct-03	>6.2c	>0.3c	>52.3c	>80.0c	>4.7c	>0.2c	>84.7c
EC-31	4-Feb-04	15.0	tr	187.0	274.0	9.0	tr	283.0
EC-31	17-May-04	5.0	tr	149.0	175.0	5.0	tr	180.0
EC-31	14-Aug-04	tr	tr	142.0	233.0	8.0a	nd	241.0
EC-32	27-Oct-03	>1.9c	>0.1c	>27.1c	>33.9c	>2.4c	>0.1c	>36.3c
EC-32	4-Feb-04	2.0a	tr	17.0	30.0	1.9a	nd	31.9
EC-32	3-Mar-04	1.0a	tr	24.0	31.0	4.0	tr	35.0
EC-32	17-May-04	1.0a	tr	23.0	22.0	2.0a	nd	24.0
EC-32	14-Aug-04	0.4a	tr	8.5	9.8	3.4	tr	13.2
EC-32	25-Sep-04	0.4a	tr	14.9	24.0	9.0	0.3a	33.1
EC-33	27-Oct-03	>16.2c	>0.6c	>42.7c	>36.2c	>3.7c	>0.1c	>39.9c
EC-33	17-May-04	5.0	tr	18.0	11.0	0.5a	nd	11.5
EC-33	26-Sep-04	10.1	tr	59.9	25.5	tr	nd	26.0
EC-34	29-Oct-03	>0.1c	0.0b	>0.1c	>0.1c	0.0b	0.0b	>0.1c
EC-34	13-Jan-04	tr	tr	nd	nd	nd	nd	nd

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene	Toluene	Ethylbenzene	m-p Xylene	o Xylene	Styrene	Total Xylene
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
EC-34	20-May-04	tr	nd	nd	nd	nd	nd	nd
EC-34	29-Sep-04	tr	nd	nd	nd	nd	nd	nd
FEI-MW1	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW1	27-Sep-02	0.0b	0.0b	0.0b				0.0b
FEI-MW1	25-Oct-03	>0.2c	0.0b	>0.1c	>0.1c	0.0b	0.0b	>0.1c
FEI-MW1	1-Jan-04	<0.1d	<0.2d	<0.2d				1.0
FEI-MW1	14-Jan-04	0.1a	tr	nd	1.0	tr	nd	1.1
FEI-MW1	3-Mar-04	1.0	tr	nd	3.0	0.1a	nd	3.1
FEI-MW1	18-May-04	0.4a	tr	2.0	0.2a	tr	nd	0.3a
FEI-MW1	14-Aug-04	tr	tr	tr	tr	nd	nd	tr
FEI-MW1	24-Sep-04	0.1a	tr	nd	tr	nd	nd	tr
FEI-MW1 (Seep)	27-Sep-04	tr	tr	tr	tr	nd	nd	tr
FEI-MW10	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.2d
FEI-MW2	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW2	27-Sep-02	0.0b	0.0b	0.0b				0.0b
FEI-MW2	28-Aug-03	0.0b	0.0b	>1.6c	>33.2c	>0.6c		>33.8c
FEI-MW2	24-Oct-03	0.0b	0.0b	0.0b	>13.2c	>0.5c	0.0b	>13.7c
FEI-MW2	13-Jan-04	0.6	0.2a	nd	23.7	1.7	tr	25.4
FEI-MW2	18-May-04	2.0	tr	5.0	27.0	0.6a	tr	27.6
FEI-MW2	14-Aug-04	tr	tr	tr	5.7	tr	nd	5.8
FEI-MW2	24-Sep-04	tr	tr	nd	6.1	0.3a	nd	6.4
FEI-MW3	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW3	27-Sep-02	0.0b	0.0b	>1.0c				6.5
FEI-MW3	1-Jan-04	<0.1d	<0.2d	<0.1d				1.0
FEI-MW3	21-May-04	0.6	tr	tr	tr	tr	nd	tr
FEI-MW3	27-Sep-04	1.3	tr	19.0	6.8	2.3	tr	9.1
FEI-MW4	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW4	27-Sep-02	0.0b	0.0b	0.0b				0.0b
FEI-MW4	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.2d
FEI-MW4	21-May-04	tr	tr	nd	tr	tr	nd	tr
FEI-MW4	27-Sep-04	tr	tr	6.6	0.9	0.7	tr	1.6
FEI-MW4 (Seep)	27-Sep-04	tr	nd	3.5	nd	0.2a	nd	0.2a
FEI-MW5	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW5	27-Sep-02	0.0b	0.0b	0.0b				0.0b
FEI-MW5	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.2d
FEI-MW5	21-May-04	tr	tr	tr	tr	tr	nd	tr
FEI-MW5	27-Sep-04	tr	tr	tr	tr	nd	nd	tr
FEI-MW5 (Seep)	27-Sep-04	tr	nd	tr	nd	nd	nd	nd
FEI-MW7	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW7	1-Jan-04	0.1	0.6	0.1				0.7
FEI-MW7	23-May-04	0.2a	0.4a	tr	0.1a	0.1a	nd	0.2a
FEI-MW7	27-Sep-04	tr	nd	nd	nd	nd	nd	nd
FEI-MW8	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW8	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.1d
FEI-MW9	20-Aug-02	0.0b	0.0b	0.0b				0.0b
FEI-MW9	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.2d
FEI-MW9	21-May-04	tr	tr	nd	tr	0.1a	tr	0.2a
FEI-MW9	27-Sep-04	0.2a	tr	7.9	4.2	0.6	tr	4.7
GUST-1-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
GUST-1-MW	26-Oct-03	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m-p Xylene (µg/L)	o Xylene (µg/L)	Styrene (µg/L)	Total Xylene (µg/L)
GUST-1-MW	15-Jan-04	tr	tr	tr	nd	nd	nd	nd
GUST-1-MW	19-May-04	tr	nd	nd	nd	nd	nd	nd
GUST-1-MW	29-Sep-04	nd	nd	tr	tr	nd	nd	tr
TW-00-7	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-00-7	6-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-00-7	11-Aug-02	nd	0.4	1.5	3.9	0.9		4.9
TW-00-8	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-00-8	6-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-00-8	29-Oct-03	>0.1c	0.0b	0.0b	0.0b	0.0b	0.0b	0.0b
TW-00-8	18-May-04	tr	nd	nd	nd	nd	nd	nd
TW-00-8	28-Sep-04	tr	tr	nd	nd	nd	nd	nd
TW-00-9	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-00-9	5-Mar-02	0.0b	0.0b	0.0b	>750.0c	>450.0c		>1200.0c
TW-00-9	29-Oct-03	0.0b	>0.0c	0.0b	>0.2c	>0.1c		>0.3c
TW-00-9	13-Feb-04	4.7a	1.1a	95.0	236.0	198.0	6.0	434.0
TW-00-9	5-Mar-04	3.0a	tr	89.0	240.0	211.0	6.0a	451.0
TW-00-9	16-May-04	3.0a	tr	83.0	250.0	218.0	8.0a	468.0
TW-00-9	14-Aug-04	tr	tr	70.0	246.0	204.0	7.0a	450.0
TW-00-9	24-Sep-04	tr	tr	76.0	259.0	146.0	tr	405.0
TW-99-1	20-Oct-99	>0.4c	>1.8c	>18.0c	>123.0c	>73.0c		>196.0c
TW-99-1	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-1	19-May-04	nd	nd	nd	tr	nd	nd	tr
TW-99-1	29-Sep-04	0.3a	0.3a	0.3a	0.3a	0.3a	nd	0.5a
TW-99-2	20-Oct-99	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-2	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-2	6-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-2	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-2	29-Oct-03	0.0b	0.0b	0.0b	>1.2c	0.0b	0.0b	>1.2c
TW-99-2	19-May-04	nd	nd	nd	tr	tr	nd	tr
TW-99-2	28-Sep-04	tr	tr	tr	tr	nd	nd	tr
TW-99-3	20-Oct-99	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-3	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-3	6-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-3	11-Aug-02	nd	0.5	nd	0.5	0.1a		0.6
TW-99-3	26-Oct-03	0.0b	>2.3c	0.0b	>0.4c	0.0b		>0.4c
TW-99-3	15-Jan-04	tr	2.0	tr	tr	tr	nd	tr
TW-99-3	17-May-04	tr	4.0	nd	nd	tr	nd	tr
TW-99-3	28-Sep-04	tr	2.2	nd	nd	nd	nd	nd
TW-99-4	20-Oct-99	>63.2c	>0.9c	>178.0c	>594.0c	>145.0c		>739.0c
TW-99-4	24-Oct-00	0.0b	0.0b	0.0b	1010.0	405.0		1415.0
TW-99-5	20-Oct-99	>1.2c	0.0b	>0.8c	>0.6c	>0.5c		>1.2c
TW-99-5	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-5	20-Oct-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-5	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-6	20-Oct-99	0.0b	0.0b	>2.9c	>15.1c	>15.8c		>30.9c
TW-99-6	24-Oct-00	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
TW-99-6	14-Aug-02	0.0b	0.0b	0.0b				0.0b
WDA-1-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WDA-1-MW	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WDA-1-MW	11-Aug-02	1.6	0.3	61.4	141.0	4.6		145.6

Table A.1 BTEX in Groundwater: October 1996 to September 2004

Well	Sample Date	Benzene	Toluene	Ethylbenzene	m-p Xylene	o Xylene	Styrene	Total Xylene
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
WDA-1-MW	17-Jun-03	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WDA-1-MW	26-Oct-03	>0.1c	0.0b	>0.1c	>0.3c	>0.1c	0.0b	>0.4c
WDA-1-MW	14-Jan-04	3.0	tr	24.0	37.0	0.6a	nd	37.6
WDA-1-MW	3-Mar-04	3.0	tr	35.0	52.0	1.0a	nd	53.0
WDA-1-MW	18-May-04	tr	tr	tr	tr	nd	nd	tr
WDA-1-MW	14-Aug-04	0.7	tr	8.3	7.0	0.2a	tr	7.2
WDA-1-MW	26-Sep-04	1.5	tr	9.0	12.2	0.3a	tr	12.5
WUP-01-MW	12-Sep-01	0.0b	0.0b	>200.0c	>650.0c	>350.0c		>1000.0c
WUP-01-MW	22-May-04	tr	tr	65.0	40.0	30.0	nd	70.0
WUP-01-MW	27-Sep-04	tr	nd	40.0	39.0	26.0	tr	65.0
WUP-02-MW	28-Sep-04	tr	nd	tr	tr	tr	nd	tr
WUP-05-MW	12-Sep-01	>8.5c	>0.5c	>66.0c	>170.0c	>7.0c		>177.0c
WUP-07-MW	12-Sep-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-07-MW	5-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-07-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b
WUP-07-MW	1-Jan-04	<0.1d	<0.2d	<0.1d				<0.2d
WUP-07-MW	22-May-04	tr	tr	tr	tr	nd	nd	tr
WUP-07-MW	27-Sep-04	tr	nd	nd	tr	nd	nd	tr
WUP-08-MW	20-Oct-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-08-MW	22-May-04	0.7	tr	0.2a	3.0	0.3a	nd	3.3
WUP-08-MW	27-Sep-04	tr	tr	nd	12.8	tr	nd	13.3
WUP-09-MW	20-Oct-01	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-09-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b
WUP-10-RW	20-Oct-01	>1.0c	0.0b	0.0b	>70.0c	>1.5c		>71.5c
WUP-10-RW	22-May-04	0.3a	tr	7.0	9.0	tr	nd	9.1
WUP-10-RW	28-Sep-04	2.0a	tr	19.4	53.3	tr	nd	53.8
WUP-11-MW	6-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-11-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b
WUP-12-MW	6-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-12-MW	14-Aug-02	0.0b	0.0b	0.0b				18.0
WUP-12-MW	23-May-04	0.2a	tr	nd	6.0	0.3a	nd	6.3
WUP-12-MW	27-Sep-04	0.2a	tr	nd	20.3	3.9	tr	24.2
WUP-13-MW	6-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-14-MW	6-Mar-02	0.0b	0.0b	0.0b	>7.0c	0.0b		>7.0c
WUP-14-MW	23-May-04	0.2a	0.1a	0.7	23.0	tr	tr	23.1
WUP-15-MW	6-Mar-02	0.0b	0.0b	0.0b	>10.0c	0.0b		>10.0c
WUP-15-MW	30-Sep-04	tr	tr	nd	3.3	0.2a	nd	3.5
WUP-16-MW	6-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-16-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b
WUP-16-MW	30-Sep-04	tr	nd	nd	tr	nd	nd	tr
WUP-17-MW	6-Mar-02	0.0b	0.0b	0.0b	0.0b	0.0b		0.0b
WUP-17-MW	14-Aug-02	0.0b	0.0b	0.0b				0.0b

Table A.2 TMB and TeMB in Groundwater: October 2003 to September 2004

Well	Sample Date	Total TMB (µg/L)	Total TeMB (µg/L)
ASTF-09-MW	18-May-04	tr	tr
ASTF-09-MW	28-Sep-04	nd	0.7a
ASTF-10-MW	27-Oct-03	205.3	60.5
ASTF-10-MW	12-Jan-04	>160.0e	55.0
ASTF-10-MW	23-May-04	>435.0e	139.0
ASTF-10-MW	14-Aug-04	125.0	33.2a
ASTF-10-MW	25-Sep-04	127.0	46.3a
ASTF-11-MW	25-Oct-03	nd	nd
ASTF-11-MW	14-Jan-04	nd	nd
ASTF-11-MW	18-May-04	nd	nd
ASTF-11-MW	27-Sep-04	tr	nd
ASTF-12-MW	25-Oct-03	nd	nd
ASTF-12-MW	15-Jan-04	nd	nd
ASTF-12-MW	18-May-04	nd	nd
ASTF-12-MW	28-Sep-04	nd	nd
ASTF-14-MW	19-May-04	nd	nd
ASTF-14-MW	30-Sep-04	nd	nd
ASTF-15-RW	23-May-04	>477.0e	200.0
ASTF-15-RW	26-Sep-04	573.8	240.3
BH203	29-Oct-03	nd	tr
BH203	15-Jan-04	0.2a	1.0a
BH203	18-May-04	0.4a	0.8a
BH203	14-Aug-04	tr	0.4a
BH203	28-Sep-04	1.6a	2.9a
BH210	1-Mar-04	3.0	49.0
BH210	26-Sep-04	5.0	3.2a
BH211	2-Mar-04	107.0	127.0
BH211	23-May-04	5.3	5.1a
BH211	26-Sep-04	62.1	12.7a
BH212	2-Mar-04	575.0	879.0
BH212	23-May-04	33.0	59.0
BH212	26-Sep-04	89.5	102.0
BH213	2-Mar-04	218.0	122.0
BH213	23-May-04	96.0	37.0
BH213	27-Sep-04	110.5	73.0
EC-01	25-Oct-03	nd	nd
EC-01	15-Jan-04	nd	nd
EC-01	20-May-04	nd	nd
EC-01	14-Aug-04	nd	0.2a
EC-01	28-Sep-04	tr	tr
EC-02	27-Oct-03	2.1a	7.9a
EC-02	14-Jan-04	16.0	35.0
EC-02	17-May-04	2.4a	4.3a
EC-02	29-Sep-04	0.3a	nd
EC-03	17-May-04	55.0	>89.0e
EC-03	26-Sep-04	6.9	32.0
EC-04	16-Jan-04	tr	0.4a
EC-04	17-May-04	1.5a	3.2a
EC-04	14-Aug-04	nd	tr

Table A.2 TMB and TeMB in Groundwater: October 2003 to September 2004

Well	Sample Date	Total TMB (µg/L)	Total TeMB (µg/L)
EC-04	26-Sep-04	0.2a	nd
EC-05	26-Oct-03	8.2	14.0a
EC-05	12-Jan-04	3.4a	1.6a
EC-05	4-Feb-04	6.8	3.4a
EC-05	3-Mar-04	7.0	3.4a
EC-05	17-May-04	15.0	5.0
EC-05	14-Aug-04	14.1	14.2
EC-05	26-Sep-04	17.3	24.3
EC-06	28-Oct-03	nd	nd
EC-06	12-Jan-04	15.0	10.8a
EC-06	3-Mar-04	28.0	19.0
EC-06	17-May-04	>312.0e	>152.0e
EC-06	14-Aug-04	90.8	42.8
EC-07	27-Oct-03	16.2	5.2a
EC-07	14-Jan-04	9.7	3.6
EC-07	4-Mar-04	22.0	8.0
EC-07	18-May-04	tr	nd
EC-07	14-Aug-04	nd	nd
EC-07	25-Sep-04	0.8a	tr
EC-08	25-Oct-03	nd	nd
EC-08	13-Jan-04	nd	nd
EC-08	18-May-04	4.4a	0.2a
EC-08	27-Sep-04	tr	tr
EC-09	27-Oct-03	88.0	39.1
EC-09	14-Jan-04	106.0	26.0
EC-09	4-Mar-04	87.0	20.0
EC-09	18-May-04	5.2a	0.7a
EC-09	14-Aug-04	47.1	12.6
EC-09	25-Sep-04	18.7a	4.2a
EC-12	17-May-04	tr	tr
EC-12	29-Sep-04	nd	tr
EC-30	24-Oct-03	1.7	tr
EC-30	21-May-04	1.1a	tr
EC-30	14-Aug-04	1.5a	0.4a
EC-30	24-Sep-04	1.7a	0.3a
EC-31	27-Oct-03	>316.3e	>113.8e
EC-31	4-Feb-04	>1053.0e	259.0
EC-31	17-May-04	>916.0e	277.0
EC-31	14-Aug-04	1002.5	235.0a
EC-32	27-Oct-03	>178.2e	>80.0e
EC-32	4-Feb-04	124.0	50.6a
EC-32	3-Mar-04	160.0	49.0
EC-32	17-May-04	204.0	86.0
EC-32	14-Aug-04	62.4	21.7
EC-32	25-Sep-04	130.9	57.9
EC-33	27-Oct-03	>292.0e	>129.5e
EC-33	17-May-04	133.0	86.0
EC-33	26-Sep-04	194.1	176.3
EC-34	29-Oct-03	nd	nd

Table A.2 TMB and TeMB in Groundwater: October 2003 to September 2004

Well	Sample Date	Total TMB (µg/L)	Total TeMB (µg/L)
EC-34	13-Jan-04	nd	nd
EC-34	20-May-04	nd	nd
EC-34	29-Sep-04	nd	nd
FEI-MW1	25-Oct-03	2.3a	13.0
FEI-MW1	14-Jan-04	22.3a	23.0
FEI-MW1	3-Mar-04	31.0	19.0
FEI-MW1	18-May-04	6.4a	6.0
FEI-MW1	14-Aug-04	nd	4.7a
FEI-MW1	24-Sep-04	nd	6.2a
FEI-MW1 (Seep)	27-Sep-04	tr	nd
FEI-MW2	24-Oct-03	93.7	40.5
FEI-MW2	13-Jan-04	>93.1e	31.5
FEI-MW2	18-May-04	104.0	25.0
FEI-MW2	14-Aug-04	44.9	11.9
FEI-MW2	24-Sep-04	59.5	19.6
FEI-MW3	21-May-04	0.2a	2.7
FEI-MW3	27-Sep-04	154.4	67.4
FEI-MW4	21-May-04	tr	tr
FEI-MW4	27-Sep-04	17.3	1.1a
FEI-MW4 (Seep)	27-Sep-04	2.6	tr
FEI-MW5	21-May-04	tr	nd
FEI-MW5	27-Sep-04	tr	tr
FEI-MW5 (Seep)	27-Sep-04	nd	nd
FEI-MW7	23-May-04	tr	tr
FEI-MW7	27-Sep-04	nd	tr
FEI-MW9	21-May-04	tr	tr
FEI-MW9	27-Sep-04	22.9a	10.7
GUST-1-MW	26-Oct-03	nd	nd
GUST-1-MW	15-Jan-04	nd	nd
GUST-1-MW	19-May-04	nd	nd
GUST-1-MW	29-Sep-04	tr	nd
TW-00-8	29-Oct-03	nd	tr
TW-00-8	18-May-04	nd	nd
TW-00-8	28-Sep-04	nd	tr
TW-00-9	13-Feb-04	1220.0	391.0
TW-00-9	5-Mar-04	1221.0	396.0
TW-00-9	16-May-04	1308.0	421.0
TW-00-9	14-Aug-04	1584.0	611.0
TW-00-9	24-Sep-04	1455.0	396.0a
TW-99-1	19-May-04	tr	nd
TW-99-1	29-Sep-04	0.3a	1.4a
TW-99-2	29-Oct-03	nd	nd
TW-99-2	19-May-04	nd	nd
TW-99-2	28-Sep-04	nd	nd
TW-99-3	26-Oct-03	nd	nd
TW-99-3	15-Jan-04	nd	tr
TW-99-3	17-May-04	nd	nd
TW-99-3	28-Sep-04	tr	nd
WDA-1-MW	26-Oct-03	24.3	31.0

Table A.2 TMB and TeMB in Groundwater: October 2003 to September 2004

Well	Sample Date	Total TMB (µg/L)	Total TeMB (µg/L)
WDA-1-MW	14-Jan-04	74.0	12.0a
WDA-1-MW	3-Mar-04	236.0	60.0
WDA-1-MW	18-May-04	1.5a	1.0a
WDA-1-MW	14-Aug-04	25.0	7.3
WDA-1-MW	26-Sep-04	85.6	35.3
WUP-01-MW	22-May-04	899.0	335.0a
WUP-01-MW	27-Sep-04	985.0	399.5
WUP-02-MW	28-Sep-04	159.0a	331.0a
WUP-07-MW	22-May-04	nd	nd
WUP-07-MW	27-Sep-04	nd	nd
WUP-08-MW	22-May-04	134.0	150.0
WUP-08-MW	27-Sep-04	326.8	200.8
WUP-10-RW	22-May-04	117.0	80.0
WUP-10-RW	28-Sep-04	316.8	136.7
WUP-12-MW	23-May-04	39.0	25.0
WUP-12-MW	27-Sep-04	246.8	185.7
WUP-14-MW	23-May-04	461.0	203.0
WUP-15-MW	30-Sep-04	81.5a	86.1
WUP-16-MW	30-Sep-04	0.5a	0.5a

Table A.3 TPH in Groundwater: October 1996 to September 2004

Well	Sample Date	TPH gasoline (mg/L)	TPH diesel (mg/L)	TPH gas/diesel (mg/L)
ASTF-06-MW	14-Aug-02	0.6	0.7	1.3
ASTF-09-MW	12-Sep-01	<0.0d	0.7	<0.7d
ASTF-09-MW	18-May-04	<0.2d	<0.1d	<0.3d
ASTF-09-MW	28-Sep-04	<0.2d	<0.1d	<0.3d
ASTF-10-MW	12-Sep-01	<0.1d	0.3	<0.4d
ASTF-10-MW	5-Mar-02	0.2	0.4	0.6
ASTF-10-MW	11-Aug-02	0.1a	0.4a	0.5a
ASTF-10-MW	17-Jun-03	0.4a	2.4	2.8a
ASTF-10-MW	15-Sep-03	0.3a	1.6	2.0a
ASTF-10-MW	27-Oct-03	0.3a	1.4	1.7a
ASTF-10-MW	18-May-04	1.6	1.1	2.7
ASTF-10-MW	23-May-04	1.8	1.1	2.9
ASTF-10-MW	25-Sep-04	0.4	0.5	0.9
ASTF-11-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
ASTF-11-MW	5-Mar-02	<0.0d	<0.0d	<0.0d
ASTF-11-MW	25-Oct-03	nd	nd	nd
ASTF-11-MW	18-May-04	<0.2d	<0.1d	<0.3d
ASTF-11-MW	27-Sep-04	<0.2d	<0.1d	<0.3d
ASTF-12-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
ASTF-12-MW	11-Aug-02	0.1a	0.3a	0.3a
ASTF-12-MW	25-Oct-03	0.0a	nd	0.0a
ASTF-12-MW	18-May-04	<0.2d	<0.1d	<0.3d
ASTF-12-MW	28-Sep-04	<0.2d	<0.1d	<0.3d
ASTF-14-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
ASTF-14-MW	14-Aug-02	<0.1d	<0.1d	<0.2d
ASTF-14-MW	19-May-04	<0.2d	<0.1d	<0.3d
ASTF-14-MW	30-Sep-04	<0.2d	<0.1d	<0.3d
ASTF-15-RW	20-Oct-01	0.2	0.8	1.0
ASTF-15-RW	23-May-04	1.8	1.3	3.1
BH203	31-Oct-96			3.1
BH203	24-Oct-00			0.2
BH203	6-Sep-01	<0.1d	<0.1d	<0.2d
BH203	11-Aug-02	0.1a	0.2a	0.3a
BH203	17-Jun-03	0.1a	0.8	0.9a
BH203	29-Oct-03	0.0a	0.0a	0.0a
BH203	18-May-04	0.2	<0.1d	<0.3d
BH203	28-Sep-04	<0.2d	<0.1d	<0.3d
BH210	31-Oct-96			0.8
BH210	20-Oct-99			1.0
BH210	24-Oct-00			1.0
BH210	20-Oct-01	<0.1d	<0.1d	<0.2d
BH211	31-Oct-96			14.0
BH211	20-Oct-99			83.0
BH211	24-Oct-00			15.5
BH211	23-May-04	0.4	0.7	1.1
BH212	31-Oct-96			17.0
BH212	24-Oct-00			16040.0
BH212	23-May-04	0.2	0.5	0.7
BH213	31-Oct-96			35.0

Table A.3 TPH in Groundwater: October 1996 to September 2004

Well	Sample Date	TPH gasoline (mg/L)	TPH diesel (mg/L)	TPH gas/diesel (mg/L)
BH213	20-Oct-99			5.3
BH213	24-Oct-00			15.6
BH213	23-May-04	0.4	0.5	0.9
EC-01	11-Aug-02	0.1a	0.2a	0.3a
EC-01	17-Jun-03	0.0a	0.1a	0.1a
EC-01	25-Oct-03	nd	nd	nd
EC-01	20-May-04	<0.2d	<0.1d	<0.3d
EC-01	28-Sep-04	<0.2d	<0.1d	<0.3d
EC-02	12-Aug-02	0.1a	0.1a	0.2a
EC-02	15-Sep-03	0.0a	0.2a	0.2a
EC-02	27-Oct-03	nd	0.1a	0.1a
EC-02	17-May-04	<0.2d	<0.1d	<0.3d
EC-02	29-Sep-04	<0.2d	<0.1d	<0.3d
EC-03	13-Aug-02	0.5	1.8	2.3
EC-03	17-May-04	0.1	1.6	1.7
EC-04	12-Aug-02	0.1a	0.8	0.9a
EC-04	27-Oct-03	nd	nd	nd
EC-04	17-May-04	1.0	<0.1d	<1.1d
EC-04	26-Sep-04	<0.2d	<0.1d	<0.3d
EC-05	12-Aug-02	1.1	2.5	3.6
EC-05	15-Sep-03	0.2a	1.5	1.6a
EC-05	26-Oct-03	0.0a	0.1a	0.1a
EC-05	4-Feb-04	nd	nd	nd
EC-05	17-May-04	0.1	<0.1d	<0.2d
EC-05	26-Sep-04	0.1	0.2	0.3
EC-06	12-Aug-02	0.6	1.3	1.9
EC-06	28-Oct-03	0.0a	0.1a	0.1a
EC-06	17-May-04	0.1	1.8	1.9
EC-07	13-Aug-02	0.1a	0.4a	0.5a
EC-07	27-Oct-03	0.0a	0.0a	0.0a
EC-07	18-May-04	<0.2d	<0.1d	<0.3d
EC-07	25-Sep-04	<0.2d	<0.1d	<0.3d
EC-08	12-Aug-02	0.1a	0.4a	0.5a
EC-08	25-Oct-03	nd	nd	nd
EC-08	18-May-04	0.1	<0.1d	<0.2d
EC-09	13-Aug-02	0.2a	0.9	1.1a
EC-09	17-Jun-03	0.0a	0.2a	0.3a
EC-09	27-Oct-03	0.0a	0.7	0.7a
EC-09	18-May-04	1.2	<0.1d	<1.3d
EC-09	25-Sep-04	<0.2d	<0.1d	<0.3d
EC-12	12-Aug-02	0.1a	0.3a	0.4a
EC-12	17-May-04	1.2	<0.1d	<1.3d
EC-12	29-Sep-04	<0.2d	<0.1d	<0.3d
EC-30	15-Aug-02	0.1a	0.6	0.7a
EC-30	27-Sep-02	<0.1d	<0.1d	<0.2d
EC-30	17-Jun-03	0.0a	0.3a	0.3a
EC-30	28-Aug-03	0.1a	0.3a	0.3a
EC-30	24-Oct-03	0.0a	nd	0.0a
EC-30	24-Sep-04	<0.2d	<0.1d	<0.3d

Table A.3 TPH in Groundwater: October 1996 to September 2004

Well	Sample Date	TPH gasoline (mg/L)	TPH diesel (mg/L)	TPH gas/diesel (mg/L)
EC-31	27-Oct-03	1.1	1.8	2.9
EC-31	4-Feb-04	1.0	1.7	2.8
EC-31	17-May-04	2.8	2.3	5.1
EC-32	27-Oct-03	0.2a	0.9	1.2a
EC-32	4-Feb-04	0.2a	0.3a	0.5a
EC-32	17-May-04	1.0	0.7	1.7
EC-32	25-Sep-04	0.4	0.5	0.9
EC-33	27-Oct-03	0.8	1.2	1.9
EC-33	17-May-04	0.6	0.8	1.4
EC-33	26-Sep-04	0.8	1.0	1.8
EC-34	29-Oct-03	0.0a	nd	0.0a
EC-41	18-May-04	0.1	2.4	2.5
EC-42	18-May-04	0.1	<0.1d	<0.2d
EC-50	18-May-04	0.1	<0.1d	<0.2d
FEI-MW1	20-Aug-02	<0.1d	0.3	<0.4d
FEI-MW1	27-Sep-02	<0.1d	0.3	<0.4d
FEI-MW1	25-Oct-03	0.0a	0.0a	0.0a
FEI-MW1	1-Jan-04	<0.1d	<0.1d	<0.2d
FEI-MW1	18-May-04	0.1	<0.1d	<0.2d
FEI-MW1	24-Sep-04	<0.2d	<0.1d	<0.3d
FEI-MW10	1-Jan-04	<0.1d		<d
FEI-MW2	20-Aug-02	<0.1d	0.4	<0.5d
FEI-MW2	27-Sep-02	<0.1d	0.1	<0.2d
FEI-MW2	28-Aug-03	0.2a	0.5	0.7a
FEI-MW2	24-Oct-03	0.0a	nd	0.0a
FEI-MW2	18-May-04	0.4	0.3	0.7
FEI-MW2	24-Sep-04	0.1	0.2	0.3
FEI-MW3	20-Aug-02	0.3	0.8	1.1
FEI-MW3	27-Sep-02	0.1	0.1	0.2
FEI-MW3	1-Jan-04	<0.1d	0.1	<0.2d
FEI-MW3	21-May-04	0.1	0.9	1.0
FEI-MW3	27-Sep-04	0.4	0.5	0.9
FEI-MW4	20-Aug-02	<0.1d	0.3	<0.4d
FEI-MW4	27-Sep-02	<0.1d	<0.1d	<0.2d
FEI-MW4	1-Jan-04	<0.1d	<0.1d	<0.2d
FEI-MW4	21-May-04	<0.2d	<0.1d	<0.3d
FEI-MW4	27-Sep-04	0.1	0.3	0.4
FEI-MW5	20-Aug-02	<0.1d	0.3	<0.4d
FEI-MW5	27-Sep-02	<0.1d	<0.1d	<0.2d
FEI-MW5	1-Jan-04	<0.1d	<0.1d	<0.2d
FEI-MW5	21-May-04	<0.2d	<0.1d	<0.3d
FEI-MW5	27-Sep-04	<0.2d	<0.1d	<0.3d
FEI-MW7	20-Aug-02	<0.1d	0.6	<0.7d
FEI-MW7	1-Jan-04	<0.1d	0.3	<0.4d
FEI-MW7	23-May-04	0.1	<0.1d	<0.2d
FEI-MW7	27-Sep-04	<0.2d	<0.1d	<0.3d
FEI-MW8	20-Aug-02	<0.1d	<0.1d	<0.2d
FEI-MW8	1-Jan-04	<0.1d	<0.1d	<0.2d
FEI-MW9	20-Aug-02	<0.1d	<0.1d	<0.2d

Table A.3 TPH in Groundwater: October 1996 to September 2004

Well	Sample Date	TPH gasoline (mg/L)	TPH diesel (mg/L)	TPH gas/diesel (mg/L)
FEI-MW9	1-Jan-04	<0.1d	<0.1d	<0.2d
FEI-MW9	21-May-04	<0.2d	<0.1d	<0.3d
FEI-MW9	27-Sep-04	0.1	0.2	0.3
GUST-1-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
GUST-1-MW	26-Oct-03	nd	nd	nd
GUST-1-MW	29-Sep-04	<0.2d	<0.1d	<0.3d
TW-00-7	24-Oct-00			0.5
TW-00-7	6-Sep-01	0.2	1.1	1.3
TW-00-7	11-Aug-02	0.1a	0.7	0.8a
TW-00-8	24-Oct-00			0.4
TW-00-8	6-Sep-01	<0.1d	<0.1d	<0.2d
TW-00-8	29-Oct-03	0.0a	nd	0.0a
TW-00-8	18-May-04	<0.2d	<0.1d	<0.3d
TW-00-8	28-Sep-04	<0.2d	<0.1d	<0.3d
TW-00-9	24-Oct-00			0.8
TW-00-9	1-Oct-02	4.7	53.6	58.3
TW-00-9	29-Oct-03	5.1	45.5	50.6
TW-00-9	5-Mar-04	22.2	189.0	211.2
TW-00-9	16-May-04	10.0	<0.1d	<10.1d
TW-00-9	24-Sep-04	3.0	3.4	6.4
TW-99-1	20-Oct-99			9.7
TW-99-1	24-Oct-00			1.2
TW-99-1	19-May-04	0.1	1.3	1.4
TW-99-2	20-Oct-99			0.1
TW-99-2	24-Oct-00			0.8
TW-99-2	6-Sep-01	<0.1d	<0.1d	<0.2d
TW-99-2	5-Mar-02	<0.1d	<0.1d	<0.2d
TW-99-2	29-Oct-03	0.0a	nd	0.0a
TW-99-2	19-May-04	<0.2d	<0.1d	<0.3d
TW-99-2	28-Sep-04	<0.2d	<0.1d	<0.3d
TW-99-3	20-Oct-99			1.0
TW-99-3	24-Oct-00			0.6
TW-99-3	6-Sep-01	<0.1d	<0.1d	<0.2d
TW-99-3	11-Aug-02	0.1a	0.4a	0.5a
TW-99-3	26-Oct-03	0.0a	0.2a	0.2a
TW-99-3	17-May-04	<0.2d	<0.1d	<0.3d
TW-99-3	28-Sep-04	<0.2d	<0.1d	<0.3d
TW-99-4	20-Oct-99			8.4
TW-99-4	24-Oct-00			931.0
TW-99-5	20-Oct-99			0.1
TW-99-5	24-Oct-00			0.2
TW-99-5	20-Oct-01	<0.1d	<0.1d	<0.2d
TW-99-5	5-Mar-02	<0.1d	<0.1d	<0.2d
TW-99-6	20-Oct-99			0.8
TW-99-6	24-Oct-00			0.6
TW-99-6	14-Aug-02	<0.1d	<0.1d	<0.2d
WDA-1-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
WDA-1-MW	5-Mar-02	<0.1d	0.2	<0.3d
WDA-1-MW	11-Aug-02	0.2a	0.7	0.9a

Table A.3 TPH in Groundwater: October 1996 to September 2004

Well	Sample Date	TPH gasoline (mg/L)	TPH diesel (mg/L)	TPH gas/diesel (mg/L)
WDA-1-MW	17-Jun-03	0.0a	0.2a	0.3a
WDA-1-MW	26-Oct-03	0.0a	0.1a	0.1a
WDA-1-MW	18-May-04	0.1	430.0	430.1
WDA-1-MW	26-Sep-04	0.2	0.3	0.5
WUP-01-MW	12-Sep-01	46.0	220.0	266.0
WUP-01-MW	22-May-04	1.6	8.5	10.1
WUP-01-MW	27-Sep-04	1.2	19.0	20.2
WUP-02-MW	28-Sep-04	0.4	150.0	150.4
WUP-05-MW	12-Sep-01	1.6	1.5	3.1
WUP-07-MW	12-Sep-01	<0.1d	<0.1d	<0.2d
WUP-07-MW	5-Mar-02	<0.1d	<0.1d	<0.2d
WUP-07-MW	14-Aug-02	<0.1d	<0.1d	<0.2d
WUP-07-MW	1-Jan-04	<0.1d	<0.1d	<0.2d
WUP-07-MW	22-May-04	<0.2d	<0.1d	<0.3d
WUP-07-MW	27-Sep-04	<0.2d	<0.1d	<0.3d
WUP-08-MW	20-Oct-01	0.4	0.8	1.2
WUP-08-MW	22-May-04	0.6	9.6	10.2
WUP-08-MW	27-Sep-04	0.2	5.1	5.3
WUP-09-MW	20-Oct-01	<0.1d	<0.1d	<0.2d
WUP-09-MW	14-Aug-02	<0.1d	<0.1d	<0.2d
WUP-10-RW	20-Oct-01	1.1	2.0	3.1
WUP-10-RW	22-May-04	0.6	1.6	2.2
WUP-10-RW	28-Sep-04	0.6	1.5	2.1
WUP-11-MW	6-Mar-02	<0.1d	<0.1d	<0.2d
WUP-11-MW	14-Aug-02	<0.1d	<0.1d	<0.2d
WUP-12-MW	6-Mar-02	0.2	0.9	1.1
WUP-12-MW	14-Aug-02	0.6	1.8	2.4
WUP-12-MW	27-Sep-04	0.2	1.2	1.4
WUP-13-MW	6-Mar-02	<0.1d	<0.1d	<0.2d
WUP-14-MW	6-Mar-02	0.2	0.4	0.6
WUP-14-MW	23-May-04	1.2	42.0	43.2
WUP-15-MW	6-Mar-02	<0.1d	0.1	<0.2d
WUP-15-MW	30-Sep-04	0.1	0.5	0.6
WUP-16-MW	6-Mar-02	<0.1d	<0.1d	<0.2d
WUP-16-MW	14-Aug-02	<0.1d	<0.1d	<0.2d

Table A.4 Notes for Tables A1, A2 and A3

Notes

a	Reduced accuracy associated with reported value (e.g. poor quantification at low concentration levels)
b	Parameter originally reported below method detection limit (MDL) but is presented as a lower bound of 0.0 because the BTEX sample was unpreserved (or preservation not confirmed)
c	Parameter originally reported above method detection limit (MDL) but is presented as a lower bound because the BTEX sample was unpreserved (or preservation not confirmed)
d	Parameter originally reported below method detection limit (MDL) but is presented as an upper bound of MDL because the BTEX sample was preserved
e	Parameter could not be quantified properly (i.e. was off-scale) and is presented as a lower bound
nd	No detectable concentration
tr	Trace concentration level detected but not quantifiable (< MDL)

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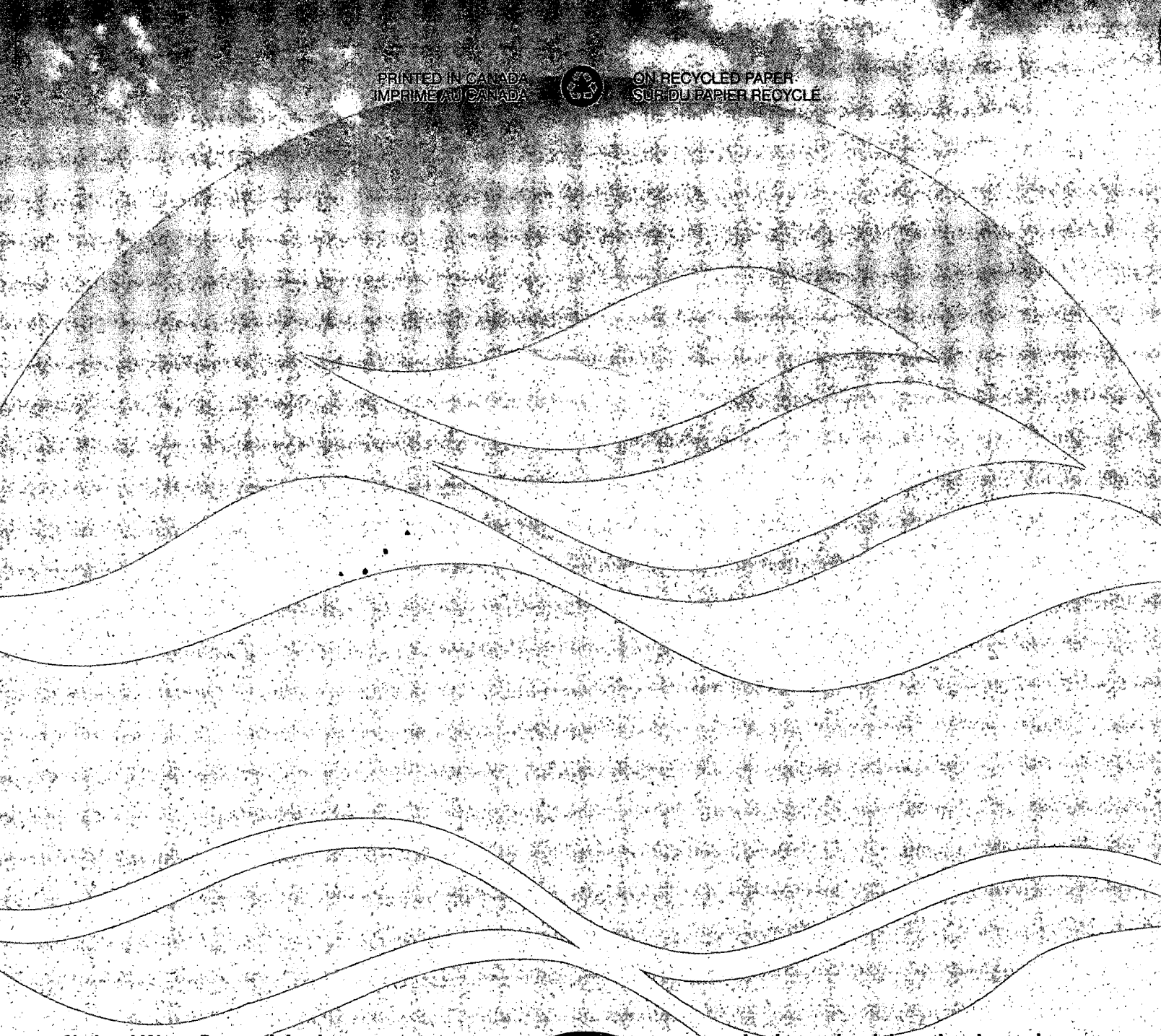

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