Honeywell

Honeywell
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Morristown, NJ 07962

April 15, 2013

VIA EMAIL AND REGULAR MAIL

Mr. Galo Jackson
Remedial Project Manager
US EPA Region 4
61 Forsyth St. S.W.
Atlanta, Georgia 30303-8960

Re: LCP Chemical Company NPL Site, Brunswick, Glynn County, Georgia
Feasibility Study (FS) Tasks 1-6 – Draft OU3 FS Technical Memorandum

Dear Mr. Jackson,

Please find enclosed the Draft OU3 FS Technical Memorandum, FS Tasks 1-6 deliverable for your review. We are encouraged that the Memorandum concludes that the remaining risks at the site should not require additional remedial work, although it does recommend re-characterization in one focused area.

As we have discussed previously, the PRPs would like to have a meeting with the Agencies to discuss the draft in order to help resolve any questions or issues needed to finalize the document. We look forward to meeting with representatives from the EPA and the Georgia Environmental Protection Division at your earliest convenience. To that end, please provide a few dates so that we may schedule such a meeting in Atlanta.

As always, I can be reached at (973) 722-1656, if you have any questions.

Sincerely,

Prashant K. Gupta

Enclosure

cc: Jim McNamara, EPD
Brett Mitchell, Georgia Power
Paul Taylor, ARCO

Prepared for:

LCP SITE STEERING COMMITTEE

DRAFT- DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES OPERABLE UNIT 3 – UPLAND SOILS

LCP Chemicals Site
Brunswick, Georgia

Prepared by:

EPS

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Kirk Kessler, P.G., Principal

April 2013

EPS

DRAFT - DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES OPERABLE UNIT 3 – UPLAND SOILS

LCP Chemicals Site
Brunswick, Georgia

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1 INTRODUCTION

1.1 Overview

Honeywell International Inc. ("Honeywell"), formerly AlliedSignal, Inc., the Atlantic Richfield Company ("Arco"), a successor to Atlantic Refining Company, and the Georgia Power Company are responsible parties to an Administrative Order by Consent ("AOC"), USEPA Docket No.: 95-17-C requiring a Remedial Investigation/Feasibility Study ("RI/FS") of the LCP Chemical Site located in Brunswick, Georgia ("Site").

The upland soils portion of the Site is designated as Operable Unit 3 ("OU3"). Prior to 2006, the upland and estuarine portions of the Site were designated as a single unit, Operable Unit 1 ("OU1"). The United States Environmental Protection Agency ("USEPA") requested in 2006 that upland soils and LCP estuary be divided into two separate operable units (USEPA 2006). The estuarine portions of the Site are now referred to as OU1, while the upland soils are designated as OU3. The groundwater (and soils beneath the former Cell Building) at the Site are designated as Operable Unit 2 ("OU2").

In the 1990s, based on multiple sampling programs to assess Site conditions, approximately 170,000 cubic yards of contaminated soil and waste in the upland setting were excavated and disposed off-site as part of a time-critical removal action. Since that time, five additional sampling programs for the upland soils have been completed at the Site.

A Remedial Investigation ("RI") Report, encompassing a Human Health Baseline Risk Assessment ("HHBRA") (EPS, 2012) and Baseline Ecological Risk Assessment ("BERA") (CDR and EPS, 2010), has been completed for OU3 and approved by the USEPA (EPS, 2013). The RI presented an overview of the Site's history, background and setting, and provided a narrative of Site activities (industrial and manufacturing). A conceptual site model of Site conditions was also presented in the RI Report.

This technical memorandum is being submitted on behalf of the responsible parties to fulfill the requirement of Task 6 of the RI/FS process for OU3 as outlined in the AOC.

1.2 Objectives

This technical memorandum was developed: to identify potential remedial action areas to meet certain land reuse goals; to identify viable process options (technologies) for these areas; and to assemble viable process options into potential remedial action alternatives. The overall objectives of this memorandum are as follows:

- refine and document Remedial Action Objectives (RAOs) for OU3 that specify the soil contaminants, exposure pathways and receptors, and an acceptable contamination level or range of levels for each exposure route;

- develop General Response Actions to satisfy the RAOs;
- identify the areas to which the response actions may apply based on RAOs;
- develop and evaluate remedial process options that are capable of controlling or eliminating current and/or future exposures or pathways for exposure (i.e., evaluating alternatives that meet the threshold criterion of protecting human health and the environment); and
- identify remedial alternatives by analysis of technical equivalency of the remedial alternatives and comparing their performance.

1.3 Report Organization

The memorandum is organized as follows:

- Section 2: Site Background and History
- Section 3: Remedial Action Objectives
- Section 4: General Response Actions
- Section 5: Potential Remedial Action Areas
- Section 6: Identification and Screening of Preliminary Process Options
- Section 7: Assemblage of Refinement of Remedial Alternatives
- Section 8: References.

2 SITE BACKGROUND

2.1 Location and Surroundings

The Site property occupies approximately 813 acres immediately northwest of the City of Brunswick, Glynn County, Georgia (Figure 2-1). Tidal marshland comprises about 670+ acres of the property. The primary upland at the Site, where manufacturing operations at the LCP Site occurred, is located on 133.5 acres of upland area, east of the marsh and bordered by a county land disposal facility and a pistol firing range on the north, Ross Road on the east, the Turtle River and associated marshes to the west, and Brunswick Cellulose to the south. The Arco refinery also utilized land to the east of Ross Road for product storage in four above ground storage tanks (referred to herein as the “off-site tank farm").

2.2 Past Industrial Activities

Arco operated the Site as a petroleum refinery from 1919 to the early 1930s. At one time, over 100 process and storage tanks were present on Site. The refinery was fueled by coal until 1922, after which oil was used as fuel. The refinery ceased operations by 1935. Concrete tank supports and numerous buildings from this time period remain at the Site. Much of the steel was salvaged for scrap in World War II or moved to other locations (GAEPD, 1990).

Georgia Power purchased portions of the Site in 1937, 1942, and 1950. These purchases included two parcels of land and two 750 kilowatt ("kW") electric generators from Arco. Georgia Power subsequently added an additional 4.0 megawatts of electric generation capacity at the Site. Thus, power generation capacity increased at the Site from 1500 kW in 1937 to 5500 kW by 1941. Bunker C oil was used as the fuel source for the power plant (GAEPD, 1990).

The Dixie Paint and Varnish Company operated a paint and varnish manufacturing facility at the Site from 1941 to 1955 on a portion of the Site property south of the Georgia Power parcel. The Dixie Paint and Varnish Company became the Dixie O’Brien Corporation and eventually a wholly owned subsidiary of the O’Brien Corporation (GAEPD, 1990).

In 1955, after acquiring almost all the land constituting what is now known to be the Site, Allied Chemical and Dye Corporation established and operated a chlor-alkali facility at the Site, principally for the production of chlorine gas, hydrogen gas, and caustic solution. The plant operated using the mercury cell process, which involves passing a concentrated brine solution between stationary graphite or metal anode and a flowing mercury cathode to produce chlorine gas, sodium hydroxide (caustic) solution, and hydrogen gas, as a by-product. Sodium hypochlorite (bleach) was also produced in a secondary reaction.

LCP purchased the property and the chlor-alkali plant in 1979. The chlor-alkali process continued with modification following the purchase. Part of the modification included the production of hydrochloric acid by reacting chlorine and hydrogen. Manufacturing operations continued until February 1994, when LCP's corporate headquarters shutdown the plant. Honeywell repurchased the property in 1998 and currently owns the property, except for a portion of the property located in OU3 that was sold to Glynn County in 2012 for redevelopment.

2.3 Site Features

The dominant physical feature of the Site property is the large expanse of tidal marsh located in the western areas of the Site. The salt marsh is characterized by a flat, heavily vegetated surface (approximate elevation of 2 to 3 feet ("ft") above mean sea level ("amsl") dissected by numerous channels and larger creeks under tidal influence from the nearby Turtle River.

The upland area to the east of the marshland is characterized by gently sloping terrain ranging from approximately 5 ft amsl along the marsh/upland border to an elevation of approximately 15 ft amsl along Ross Road. This area of the Site is roughly divided in half (north/south) by the east-west entrance road (B Street), which transitions into the causeway road where B Street ends at the marsh-upland border and extends to Purvis Creek. The upland portion of the Site is also roughly divided in half (east/west) by a fence line separation of the land used in former industrial operations and land primarily used for non-industrial operations (office and storage facilities). These natural property breaks developed into geographic quadrants used as Exposure Units in the HHBRA (Figure 2-2).

3 REMEDIAL ACTION OBJECTIVES

3.1 Overview

Remedial Action Objectives ("RAOs") are Site-specific clean-up objectives established for protecting human health and the environment. RAOs specify contaminants and media of concern, potential exposure pathways and receptors, and acceptable contaminant level or range of levels. Since protection of human and ecological receptors may be achieved by reducing or eliminating exposure pathways as well as by reducing contaminant concentrations, RAOs propose both a contaminant level and exposure route, and may rely on both approaches to manage risk, rather than a singular approach. The RAOs for this technical memorandum are based on the assessments of the HHBRA, BERA, Site conditions and features as provided in the RI Report, as well as future land reuse options.

The following sections provide an assessment and refinement of RAOs to be applied to identify potential remedial action areas. Contaminant concentration and exposure route based RAOs are provided based on remedial goal options ("RGOs") from the HHBRA and BERA, and Site-specific soils screening levels ("SSLs") for potential leaching of soil constituents for groundwater.

3.2 Remedial Action Objectives

RAOs for OU3 soils are provided below.

Receptor	Remedial Action Objective
Human Health	Assess and develop a protective remedy for surface soils that contribute significantly to exposures for industrial and excavation workers resulting in excess lifetime cancer risks that exceed EPA's acceptable risk range of 1E-4 to 1E-6, and non-cancer hazard indices that exceed 1.
Ecological	Assess and develop a protective remedy for surface soils that present an unacceptable risk to local populations of birds and mammals present or potentially present in areas of the Site that will provide long-term habitat for these populations.
Protection of Groundwater	Assess and develop a protective remedy for vadose zone soils that exhibit a geographic continuity of constituents above Site-specific soil screening levels and which could adversely impact groundwater.

3.3 Applicable or Relevant and Appropriate Requirements

Applicable or Relavant and Appropriate Requirements ("ARARs") are used in conjunction with risk-based goals to govern Superfund response activities and to establish cleanup goals. Since conditions vary widely from Superfund site to Superfund site, ARARs alone may not adequately protect human health and the environment or other factors may govern the response. When ARARs are not fully protective, EPA may implement other federal or state policies, guidelines, or proposed rules capable of reducing the risks posed by a site. These alternative response options are referred to as To Be Considered ("TBC") criteria. While not legally binding, TBC criteria may be used in conjunction with ARARs to achieve an acceptable level of risk. TBCs are evaluated along with ARARs as part of the risk assessment conducted for each CERCLA site to set protective cleanup levels and goals.

Section 121 of the Superfund Amendments and Reauthorization Act ("SARA") established cleanup criteria for Superfund sites. This section of the statute sets forth the need for appropriate remedial actions, consistent with the National Contingency Plan ("NCP"), which provides a cost-effective response. Subsection (d) of Section 121 generally requires that remedial actions attain a level or standard of control at least equivalent to ARARs promulgated under federal or state laws. ARARs are identified on a Site-specific basis and involve a two-part analysis: (i) relevance and appropriateness; or (ii) applicability. "Applicable standards" are those cleanup or control standards and other substantive environmental protection requirements, criteria or limitations, promulgated under federal or state law, which specifically addresses a hazardous substance, pollutant, contaminant, remedial action location, or other circumstances at a Superfund site. "Relevant and appropriate standards" refer to those cleanup or control standards and other substantive environmental protection requirements, criteria or limitations, promulgated under federal or state law that, while not "applicable", address problems or situations sufficiently similar to those encountered under Superfund sites that their use is well suited to the particular site. Non-promulgated advisories or guidance documents issued by federal or state governments do not have the status of potential ARARs. However, they may be considered in determining the necessary level of cleanup for protection of human health or the environment.

The USEPA has identified three categories of ARARs:

- Chemical-specific ARARs are health- or risk-based concentrations that have been established for specific chemicals;
- Location-specific ARARs are restrictions on the concentrations of certain chemicals based on their specific physical locations at a site; and
- Action-specific ARARs are technology- or activity-based requirements on actions taken with respect to cleanup of hazardous substances at a site. These requirements are triggered by the particular activities that are selected to accomplish a remedy.

These categories are not always mutually exclusive and they may be conceptually overlapping. Tables 3-1a to 3-1c identify the federal and state laws that contain promulgated standards, requirements, criteria, and limitations that are considered potential ARARs.

3.4 Refinement of Chemical-Specific Remedial Goals

Chemical-specific remedial goals ("RGs") for OU3 soils are provided in this section for each RAO. The chemical-specific RGs are derived from modeled risk as provided in the approved HHBRA and BERA, and evaluation of Site soils with regard to their potential to leach to groundwater. RGs are refined herein by consideration of Site-specific conditions and exposure, identified uncertainties, feasibility considerations, and relevant ARARs.

3.4.1 Chemical-Specific RGs for Protection of Human Health

The current and the intended future land use is commercial/industrial use. Honeywell has no intention of converting any portion of the property to residential use, and this restriction will be recorded (i.e., deed restriction) to prevent such future use in the event the property or portions thereof are sold. Therefore, presentation of human health RGs is specific to future industrial and commercial worker exposure.

The excess lifetime cancer risk ("ELCR") estimates for industrial and excavation workers in all exposure units ("EUs") were within the USEPA's target risk range of 1E-6 to 1E-4. With respect to potential non-carcinogenic effects, the Reasonable Maximum Exposure ("RME") Excavation Worker scenario in Quadrant 4 had cumulative hazard index ("HI") estimates that exceeded the threshold value of one, while the Central Tendency Exposure ("CTE") Excavation Worker scenario was well below the threshold value of one. The HI estimates for all other receptors and EUs were below one. With the RME case, the risk is driven by PCBs, including both Aroclor-1260[1] and Aroclor-1268. RGs for the protection of human health are provided below.

3.4.1.1 Human Health RGs

Table 6-1 of the RI Report presented a matrix of RGOs for soils under a range of various Hazard Quotients ("HQ") and exposure scenarios. PCBs were the only constituents warranting RGOs at the Target HQ of unity (1), and this was limited to Quadrant 4 soils.

These values are brought forth herein to establish chemical-specific human health RGs for the purpose of the FS as follows:

- Aroclor-1260 RGO = 4.19 mg/kg; and
- Aroclor-1268 RGO = 4.19 mg/kg (if assuming the surrogate Aroclor-1254 RfD; it would not warrant an RG if assuming the surrogate Aroclor-1016 RfD)

[1] Arolcor-1260 exhibits a highly skewed concentration distribution (low detection frequency with some high concentration detections) causing ProUCL to recommend an EPC near the maximum detected concentration.

3.4.2 Chemical-Specific RGs for Protection of Ecological Health

The OU3 BERA used food-web models to evaluate potential adverse effects to avian and mammalian terrestrial wildlife. Daily intakes of the primary constituents of potential concern ("COPC") (*i.e.*, lead, methyl mercury, inorganic mercury, and Aroclor-1268), based on the mean and maximum measured concentrations in samples of soil and food items, were calculated and then compared to dietary toxicity reference values ("TRVs"). TRVs based on no observed adverse effects levels ("NOAELs"), lowest observed adverse effects levels ("LOAELs"), and geometric mean adverse effects levels ("GMAELs") were used to generate HQs.

The wildlife food-web models were also used to back-calculate soil Remedial Goal Options ("RGOs")[2] for all COPC that had calculated maximum GMAEL HQs above 1. This was a highly conservative approach that did not consider site-wide or area-specific concentrations of the COPC. This approach essentially assumes that all of the ecological receptors would be continuously exposed to the soil and prey items with the highest concentrations of COPC, which is an unrealistic assumption. The RGOs based on NOAEL and LOAEL toxicity endpoints for each receptor were used in a "Nodal" or "Rule of 5" approach that creates a matrix of potential RGOs across the nodal spectrum (Charters and Greenburg, 2004).

From this set of RGOs, the values based on the LOAEL endpoints are selected as the RGs to be further evaluated in the FS. The use of the LOAEL RGs is appropriate and consistent with guidance established in USEPA's *Ecological Risk Assessment and Management Principles for Superfund Sites,* which states, "Superfund remedial actions should not be designed to protect organisms on an individual basis (the exception being designated protected status resources, such as listed or candidate threatened and endangered species or treaty-protected species that could be exposed to site releases), but to protect local populations and communities of biota" (USEPA, 1999). Given the conservative and unidirectional manner in which uncertainties were addressed in the BERA, RGs based on LOAEL endpoints are most applicable to the evaluation of population-level effects. The LOAEL RGs are provided below and are used to identify areas for a refined evaluation of potential adverse effects to ecological receptors in Section 5.3.

[2] The term Preliminary Remediation Goal ("PRG") was used in the BERA. RGO is used here for consistency with the HHBRA.

Summary of Ecological RGOs Considered as Chemical-Specific RGs

COPC / Receptor	RG (mg/kg)
Mercury	
Broad-winged hawk (based on methyl Hg)	5.0/10 [(a)]
Mourning Dove (based on inorganic Hg)	13
Long-tailed weasel (based on methyl Hg)	11
Meadow vole (based on inorganic Hg)	3.6
Short-tailed shrew (based on inorganic Hg)	2.8
Aroclor-1268	
Meadow vole	3.6
Short-tailed shrew	2.1
Long-tailed weasel	6.0
Lead	
Mourning dove	400
Short-tailed shrew	2,400

[(a)] RGs associated with assumptions of 50% and 100% methyl Hg in prey items

3.4.3 Chemical-Specific RGs for Potential Leaching of Constituents from Soil to Groundwater

SSLs are risk-based concentrations derived from exposure and toxicity information to evaluate the need for a response action, but alone do not trigger the need for a response. This section examines SSLs for potential leaching of vadose zone soil constituents. As outlined in the RI Report, an evaluation of potential leaching of constituents from the Site vadose soil zone to groundwater was performed in accordance with USEPA Region 4's recommended approach (USEPA, 2012), which identified constituents to be evaluated further in the OU3 FS. In general, the evaluation identified constituents with a multistep analysis based on direct comparisons of soils data to USEPA provided benchmark criteria, and to Site-specific empirical data (groundwater data and batch leaching data) collected to assess evidence of potential leaching.

3.4.3.1 Overview of the Leaching Analysis from the RI Report

The first step of the evaluation screened out constituents based on relevance to the Site, specifically, constituents that were identified as analytical artifacts or as background were removed. Second, the analysis identified constituents unlikely to leach to groundwater, based on a direct comparison of soils data (*e.g.* maximum detected concentration and detection frequency) to default benchmark values (*e.g.* default soil screening levels, at a Dilution Attenuation Factor ("DAF") set to 1). Third, the analysis identified constituents unlikely to leach to groundwater through a comparative exercise based on current groundwater data. Lastly, the analysis compared soils data to empirical evidence obtained through batch leaching results of Site soils.

3.4.3.2 Summary of Constituents for the OU3 Feasibility Study Based on Leaching Potential

Following the approach recommended by USEPA Region 4, the constituents listed in the table below (Table D-4 of the OU3 RI Report) may have the potential to leach to groundwater and are evaluated further in as part of this technical memorandum.

Constituents Evaluated in the OU3 Feasibility Study

Off-Site Tank Farm	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
Lead	None	None	Benzene Dichloromethane Lead Mercury 2-Methylnaphthalene Naphthalene 1,3,5-Trimethylbenzene 1,2,4-Trimethylbenzene	Lead Mercury Naphthalene 1,2,4-Trimethylbenzene

3.4.3.3 Contaminant Level RGs for Soil Leaching

Contaminant level RGs for constituents listed in the above table were developed based on Site-specific properties and exposure routes to refine SSLs. Soil screening levels may be used to identify areas that require further investigation, but alone do not establish target levels for remedial action. Soil screening levels for constituents listed in the above table, which are to be used in the identification of areas requiring further investigation, were refined based on the following two criteria.

1) <u>Ingestion-Based Exposure Route</u>

   Four constituents are refined by applying a representative exposure route founded on ingestion-based exposure, consistent with the exposure route applied in USEPA Maximum Contaminant Levels ("MCLs") (MCL are based on direct ingestion of water only). The four leaching constituents of concern that lack a MCL are: 2-methylnaphthalene, naphthalene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene. In the absence of a MCL, USEPA Regional Screening Levels ("RSL") for tap water can be applied (using the ingestion screening level columns in the tap water table).

   The calculations of ingestion-based tap water RSL values for the four constituents are provided in Appendix A.

Site Specific Soil Fraction of Organic Carbon (f_{oc})

   A Site-specific soil f_{oc} for vadose zone soils was determined to be 0.0083 (n=30). Default SSLs, when applicable, were refined accordingly to Site-specific soil conditions.

Refined SSLs for constituents identified in the OU3 RI are provided below and are used as RGs to identify areas for a refined evaluation of the leaching potential of soil constituents to groundwater.

Refined Chemical-Specific RGs for Soil Leaching based on Site-Specific Soil Data and Applicable Exposure

Constituents	Default SSL (mg/kg) DAF=1	RG SSL (mg/kg) DAF=1	RG SSL (mg/kg) DAF=20	Modifying Factors
Benzene	0.0026	0.0072	0.14	Site-specific f_{oc}
Dichloromethane	0.0013	0.002	0.04	Site-specific f_{oc}
Lead	77	77	1,540	Empirical SSL (ESSL)
Mercury	0.1	16	320	Empirical SSL (ESSL)
2-Methylnaphthalene	0.14	1.3	26	Site-specific f_{oc}, ingestion-based tap water
Naphthalene	0.000047	4.0	81	Site-specific f_{oc}, ingestion-based tap water
1,2,4-Trimethylbenzene	0.021	0.85	17	Site-specific f_{oc}, ingestion-based tap water
1,3,5-Trimethylbenzene	0.12	0.84	17	Site-specific f_{oc}, ingestion-based tap water

4 GENERAL RESPONSE ACTIONS

According to the document entitled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988), general response actions describe "those actions that will satisfy the remedial action objectives." Based on an evaluation of the remedial action objectives identified in Section 3 of this technical memorandum and a review of available general response actions, the following general response actions have been selected for OU3:

- no further action;
- natural recovery;
- re-characterization of chemical concentration in soils (where the RI data is old or is otherwise questionable in terms of representing the true condition);
- containment (contingency); and
- removal (contingency).

4.1 No Further Action

The No Further Action alternative provides a baseline for comparing other alternatives. In this alternative, no active remediation would be implemented and no long term monitoring would be performed.

4.2 Natural Recovery

This response action consists of allowing natural processes to reduce chemical concentrations over time, through biodegradation, dispersion, sorption, volatilization and/or dilution. Monitoring is performed to examine the rates at which these processes serve to reduce constituent's concentration over time. The frequency and locations of monitoring are determined based on Site-specific conditions affecting the rate of migration and the extent of chemicals in soil. Performance criteria are developed to evaluate whether the monitoring data demonstrate that the RAOs are being achieved, typically by comparing concentrations against criteria and/or by testing for statistically significant changes in concentrations over time.

4.3 Re-characterization

The re-characterization action provides an opportunity to reassess areas of potential concern identified through RGs. This response action will be executed in instances where:

- the data is old and/or entirely reliant upon data from the onsite lab used during the Removal Action;

- potential concern is based on post-excavation confirmation samples that span a large vertical interval in both vadose and saturated soils (i.e., the actual depth of contamination is uncertain); and
- the area of potential concern is driven by a select few data points in the midst of mostly all clean backfill.

In this alternative, if the re-characterization identifies a potential concern, one of the other general response actions would be the contingency action.

4.4 Containment

Containment includes the construction of a physical barrier above the upland soils to prevent human and wildlife contact with the soil and/or to prevent infiltration of precipitation. A cap is applicable when protection from potential direct exposures must be addressed. A cap does not reduce the toxicity or volume of constituents.

4.5 Removal/Disposal

This general response action includes three separate components. First, the soils at the Site would be excavated using conventional mechanical equipment (i.e., backhoe). Second, the soils would be physically or chemically treated to meet handling or disposal requirements. Finally, the material would be shipped offsite to be disposed in an appropriately permitted landfill. Based upon many years of Site-specific experience with this type of response action, it is assumed excavated soils would pass TCLP testing and be eligible for Subtitle D disposal (residual concentrations of PCBs in excavated soils are expected to be below the TSCA threshold of 50 ppm and thus would not be regulated under TSCA).

5 IDENTIFICATION OF POTENTIAL REMEDIAL ACTION AREAS

5.1 Overview

This section identifies potential remedial action areas for OU3 soils based on RAOs and chemical-specific RGs as presented in Section 3. Potential remedial action areas consider elements of the human health protection, ecological protection and groundwater protection (leaching).

5.2 Potential Action Areas to Address Human Health Risk

5.2.1 Review of Modeled Risk Estimates

A summary of risk estimates from the HHBRA and a review of the analytical data driving those risk estimates for each exposure unit are provided below.

<u>Quadrant 1</u>

No data gaps or uncertainties were identified for Quadrant 1. Past remedial actions included a shallow surface soil removal and a soil cap at former above ground storage tank locations. The baseline (i.e., post-removal action) non-cancer HI and ELCR estimates for Quadrant 1 are less than threshold criteria, when evaluated including and excluding data generated by the TEG on-site laboratory[3]. A summary is provided below.

[3] The data records produced by the TEG laboratory were in support of the upland removal response action. Some of these data had anomalous results and were performed using sub-standard quality control (described in Appendix A of the OU3 HHBRA). For this reason TEG was replaced by QAL labs for the remainder of the removal action. The remainder of the OU3 data records were generated by other off-site commercial laboratories. Risk calculations that included data records from the TEG lab were presented in Appendix A of the OU3 HHBRA and discussed in the Uncertainty Analysis section of that report.

Quadrant 1 Risk Summary

Worker Scenario	RME Summary			CTE Summary		
	HI (Low)[1]	HI (High)[2]	ELCR	HI (Low)[1]	HI (High)[2]	ELCR
	w/o TEG Data					
Industrial	0.1	0.1	3E-06	0.02	0.02	2E-07
Excavation	0.2	0.2	2E-07	0.05	0.1	2E-08
	w/ TEG Data					
Industrial	0.1	0.1	4E-06	0.02	0.03	3E-07
Excavation	0.4	0.7	3E-07	0.1	0.2	4E-08

[1] Aroclor-1016 RfD used as a surrogate for Aroclor-1268.
[2] Aroclor-1254 RfD used as a surrogate for Aroclor-1268.

Quadrant 2

Quadrant 2 remedial action during the 1994-97 removal response was limited to a discrete excavation at the hydrogen line metering station at the southeastern edge of the quadrant. The low level of removal activity in Quadrant 2 reflects the area's primary use as administrative support for past industrial activities in other areas of the Site. The baseline (i.e., post-removal action) non-cancer HI and ELCR estimates for Quadrant 2 are less than threshold criteria. A summary is provided below.

Quadrant 2 Risk Summary

Worker Scenario	RME Summary			CTE Summary		
	HI (Low)[1]	HI (High)[2]	ELCR	HI (Low)[1]	HI (High)[2]	ELCR
	w/o TEG Data					
Industrial	0.4	0.7	1E-05	0.07	0.1	9E-07
Excavation	0.2	0.2	2E-07	0.2	0.4	7E-08
	w/ TEG Data					
Industrial	0.8	1.0	2E-05	0.1	0.2	2E-06
Excavation	2	4	1E-06	0.5	1	1E-07

[1] Aroclor-1016 RfD used as a surrogate for Aroclor-1268.
[2] Aroclor-1254 RfD used as a surrogate for Aroclor-1268.

It is noted that the HI for the Excavation Worker scenario exceeds the threshold value of 1 when data from the TEG laboratory were included in the analysis. Soil investigations early in the removal-response action identified two areas in Quadrant 2 with modest detections of Aroclor-1268, although these detections were below the removal action criteria. Many of these data records were associated with the TEG on-site laboratory. Re-characterization of these areas in 2008 confirmed the slightly elevated PCB condition in only one of these two areas (along the western boundary of Quadrant 2 adjacent to the former cell building), although this condition was not sufficient to elevate the risk above EPA thresholds (it was incorporated into the Baseline Risk Assessment). Given the re-characterization of these areas, reliance on the soils dataset excluding the TEG data is warranted.

Quadrant 3

Quadrant 3 was subject to extensive excavation and backfill during the 1994-97 removal response action. As a result, Quadrant 3 soils are abundantly characterized, with many of the samples that comprise the Quadrant 3 soils dataset having been collected from sidewalls or bottoms (often sloped surfaces) of excavated areas. Those samples tend to skew the COPC concentrations higher in those removal areas because the clean backfill is not numerically accounted for in the derivation of the exposure point concentrations ("EPCs") used in the risk calculations. Nevertheless, the baseline (i.e., post-removal action) non-cancer HI and ELCR estimates for Quadrant 3 are less than threshold criteria when data from the TEG laboratory are excluded. A summary is provided below.

Quadrant 3 Risk Summary

Worker Scenario	RME Summary			CTE Summary		
	HI (Low)[1]	HI (High)[2]	ELCR	HI (Low)[1]	HI (High)[2]	ELCR
	w/o TEG Data					
Industrial	0.9	1	1E-05	0.2	0.2	8E-07
Excavation	1	1	4E-07	0.4	0.4	6E-08
	w/ TEG Data					
Industrial	1	1	2E-05	0.2	0.3	1E-06
Excavation	1	2	1E-06	0.5	0.5	1E-07

[1] Aroclor-1016 RfD used as a surrogate for Aroclor-1268.
[2] Aroclor-1254 RfD used as a surrogate for Aroclor-1268.

It is noted that the HI for the Excavation Worker scenario exceeds the threshold value of 1 when data from the TEG laboratory were included in the analysis. A closer examination of the HI indicates that 4,6-Dinitro-2-methylphenol is a significant contributor to the summed HI value. This constituent was only detected in 2 out of 59 samples in the Quadrant 3 soils dataset. The ProUCL software used in the development of the Quadrant 3 exposure point concentrations recommended the 99% KM (Chebychev) UCL (8.7 mg/kg) in the case of 4,6-Dinitro-2-methylphenol. ProUCL does this because it recognizes that the data are skewed, even though this is due to the mostly non-detect dataset, so the internal algorithm calls for extra conservatism (i.e., use of the 99% UCL rather than the traditional 95% UCL). If one simply used the 95% KM(Chebychev) UCL (4.3 mg/kg) as the EPC, the result is an acceptable HI for the RME Excavation Worker scenario. This example illustrates the degree to which the skewed soils dataset artificially inflates the ELCR and HI estimates.

Quadrant 4

Like Quadrant 3, Quadrant 4 was subject to extensive excavation/backfill actions during the 1994-97 removal action. As a result, Quadrant 4 soils are abundantly characterized. The calculated risk estimates for future industrial and/or excavation worker reflects the occurrence of Aroclors contributing 90% of the overall HI in Quadrant 4 soils. A summary of the HI and ELCR for Quadrant 4 is provided below.

Summary of Quadrant 4 Risk

Worker Scenario	RME Summary			CTE Summary		
	HI (Low)[1]	HI (High)[2]	ELCR	HI (Low)[1]	HI (High)[2]	ELCR
	w/o TEG Data					
Industrial	0.9	1	3E-05	0.2	0.3	2E-06
Excavation	2	3	1E-06	0.5	0.9	2E-07
	w/ TEG Data					
Industrial	1	1	3E-05	0.2	0.3	2E-6
Excavation	2	3	2E-06	0.6	0.8	2E-07

[1] Aroclor-1016 RfD applied to Aroclor-1268 risk model
[2] Aroclor-1254 RfD applied to Aroclor-1268 risk model

It is noted that more than 50% of the HI for the Excavation Worker Scenario is contributed by Aroclor-1260. The soil dataset for Aroclor-1260 is highly skewed, with a small number of moderate- to high-concentration detections and a preponderance of non-detect results. To quantitatively evaluate the effects associated with this skewed dataset for Aroclor-1260, the ELCR and HI estimates were recalculated for Quadrant 4 following the exclusion of appropriate select data records. For surface soil, these are the same sample locations omitted from the ecological risk characterization presented in the Appendix C of the OU3 RI Report. The specific samples excluded from this supplemental risk recalculation are described below.

Surface Soils, Industrial Worker Scenario (Figure 5-1)

- 96207-M76 – This is a 3-point composite sample collected in 1996 from the 0-1 ft bgs interval at the northern sidewall of a removal area that abuts the southern boundary of the Cell Building cap. This sample was analyzed by the QAL on-site lab and had a detection of Aroclor-1268 at 240 mg/kg, which was the only detected PCB. The detected mercury concentration was also high at this location, 142 mg/kg. It is appropriate to exclude this sample location from the risk analysis given that it is a sidewall sample bordered to the south by clean backfill and to the north by the Cell Building cap.
- 96289-CPS-06 – This is a 3-point composite sample collected in 1996 from the 0-1 ft bgs interval at the northern sidewall of a removal area that abuts a warehouse building in Quadrant 4. This sample was analyzed by the QAL on-site lab and had a detection of Aroclor-1268 at 34 mg/kg, which was the only detected PCB. This sample is bordered to the south by clean backfill and to the north by the building.

- 96303-CPS-14 – This is a second 3-point composite sample collected in 1996 from the 0-0.5 ft bgs interval at the northern sidewall of a removal area that abuts the same warehouse building in Quadrant 4. This sample was analyzed by the QAL on-site lab and had a detection of Aroclor-1268 at 12 mg/kg, which was the only detected PCB. This sample is bordered to the south by clean backfill and to the north by the building.
- 96303-CPS-15 – This is a third 3-point composite sample collected in 1996 from the 0-0.5 ft bgs interval at the northern sidewall of a removal area that abuts the same warehouse building in Quadrant 4. This sample was analyzed by the QAL on-site lab and had no PCB detections. However, it had a detection limit of 2.4 mg/kg for all PCBs. This sample is bordered to the south by clean backfill and to the north by the building.
- LC-204-SLA – This is a 5-point composite sample collected in 1994 from the 0-1 ft bgs interval in an area to the west of the cell cap in Quadrant 4. This sample was analyzed by the ESD lab, which reported Aroclor-1260 at 110 mg/kg. Aroclor-1268 was also detected at 12 mg/kg. The very high concentration of Aroclor-1260 in this sample is inconsistent with numerous discrete samples subsequently collected in the same area. Given the sample in question was a multi-point areal composite, it is possible that portions of the composite sample were collected from an area addressed during the subsequent removal action.
- LC-639-SLA – This is a 5-point areal composite sample collected in 1994 from the 0-1 ft bgs interval in an area to the southwest of the cell cap in Quadrant 4. This sample was analyzed by the ESD lab, which reported Aroclor-1260 at 160 mg/kg and Aroclor-1254 at 6.9 mg/kg. The very high concentration of Aroclor-1260 in this sample is inconsistent with numerous discrete samples subsequently collected in the same area. Given the sample in question was a multi-point areal composite, it is possible that portions of the composite sample were collected from an area addressed during the subsequent removal action.

Mixed Surface and Subsurface Soils, Excavation Worker Scenario (Figure 5-2)

In addition to the six surface soil samples described above, two subsurface soil samples were excluded for the risk recalculation for the excavation worker in Quadrant 4, (*i.e.* 8 total data records apply to the excavation worker scenario).

- LC-639-SLB – This sample is co-located with LC-639-SLA and represents the subsurface soil at this location. This is a 5-point areal composite sample collected in 1994 from the 2-3 ft bgs interval in an area to the southwest of the cell cap in Quadrant 4 (Figure 5-2). This sample was analyzed by the ESD lab, which reported Aroclor-1260 at 120 mg/kg and Aroclor-1254 at 9.2 mg/kg. The very high concentration of Aroclor-1260 in this sample is inconsistent with discrete samples subsequently collected in the same area. Given the sample in question was a multi-point areal composite, it is possible that portions of the composite sample were collected from an area addressed during the subsequent removal action.

- AC9-4 – This is a grab sample collected in 1995 from the 4-6 ft bgs interval in Quadrant 4 (Figure 5-2). This sample was analyzed by the Columbia Analytical Services lab, which reported Aroclor-1260 at 25 mg/kg and Aroclor-1254 at 3.5 mg/kg. It was collected as part of the Altamaha Canal ("AC") deep soil boring investigation, which included soil sampling below the water table. . The local water table in this area is only 3 to 4 ft bgs, which locates this sample below the vadose soil zone. (see Section 5.4.1 for further discussion of the Vadose zone).

The risk recalculation for Quadrant 4 was conducted by flagging each of the samples described above as "removed" in the non-TEG soil dataset that – that is, all of the data records for those samples were excluded, new EPCs were derived using ProUCL software, and the ELCR and HI estimates were computed based on those new EPCs. The table below summarizes the risk recalculation based on the exclusion of select data records for the Quadrant 4 Industrial and Excavation Worker scenarios.

Quadrant 4 Risk Recalculation Summary

		ProUCL "With ND" Mode		
	Scenario	**HI (low)**	**HI (high)**	**ELCR**
Site Worker	Baseline	0.9	1	3E-05
	Recalculated	0.1	0.3	1E-05
Excavation Worker	Baseline	2	3	1E-06
	Recalculated	0.4	0.8	6E-07

The risk recalculation exercise results in non-cancer HI and ELCR estimates for Quadrant 4 that are less than threshold criteria. This analysis illustrates the degree to which the skewed soils dataset artificially inflates the ELCR and HI estimates.

Former Offsite Tank Farm

The former off-site tank farm located east of the Ross Road was characterized as part of the 1994-97 removal action. The non-cancer HI and ELCR estimates for the former tank locations are less than threshold criteria. A summary of the HI and ELCR for the former offsite tank farm is provided below.

Summary of Former Offsite Tank Farm 4 Risk

Worker Scenario	RME Summary			CTE Summary		
	HI (Low)[1]	HI (High)[2]	ELCR	HI (Low)[1]	HI (High)[2]	ELCR
	w/o TEG Data					
Industrial	0.01	0.01	6E-06	0.002	0.002	4E-07
Excavation	0.03	0.03	3E-07	0.009	0.009	4E-08
	w/ TEG Data					
Industrial	0.01	0.01	6E-06	0.002	0.002	4E-07
Excavation	0.03	0.03	3E-07	0.009	0.009	4E-08

[1] Aroclor-1016 RfD applied to Aroclor-1268 risk model
[2] Aroclor-1254 RfD applied to Aroclor-1268 risk model

5.2.2 Action Areas for Human Health Protection

As shown in the preceding section, the Excavation Worker scenario was the only non-residential receptor evaluated in the HHBRA with ELCR or HI estimates that exceeded threshold criteria. When these estimates were subjected to further scrutiny, there is sufficient information to support the conclusion that the HI estimates presented in the HHBRA are exaggerated due to the skewed nature of Quadrant 3 and 4 soil datasets and the fact that substantial areas of clean backfill were not numerically accounted for in the HHBRA. Based on this information, no action areas are proposed on the basis of human health risk.

5.3 Potential Action Areas to Manage Ecological Risk

5.3.1 Review of Modeled Risk Estimates

The OU3 BERA presented a conservative evaluation of potential adverse effects to three terrestrial mammalian receptors (meadow vole, short-tailed shrew, and long-tailed weasel) and three terrestrial avian receptors (mourning dove, Carolina wren, and broad-winged hawk) that are representative of multiple feeding guilds that are present or are potentially present at the Site. The food-web modeling presented in the BERA utilized COPC concentration data from samples of soil and biological tissue collected in 2007 and 2008 from multiple locations across the Site and outside areas of clean backfill from the removal response action. Table 5-1 summarizes the mean and maximum NOAEL, LOAEL and GMAEL HQs derived in the BERA. Although RGs were developed for all COPC and receptor combinations with a maximum GMAEL HQ above 1, it is noteworthy that there were no LOAEL mean HQs that exceeded 1 and the only GMAEL or NOAEL mean HQs that exceeded 1 were for Aroclor-1268 in the three mammalian species evaluated (meadow vole, short-tailed shrew, and long-tailed weasel)[4].

As described in Section 3.4.2, the LOAEL RGs endpoints were selected as the RGs to identify potentially actionable areas in FS. Appendix C of the OU3 RI Report presented an analysis in

[4] These HQs are considered highly uncertain because a TRV for Aroclor-1254, likely a more toxic PCB mixture, was used in their derivation. Uncertainties associated with the use of this TRV are discussed in Section 5.3.5.

which the Site was divided into 1-acre grid cells and the central tendency concentrations (mean and median) of mercury, lead, and PCBs in each grid cell were compared to the LOAEL RGOs (EPS, 2013). The site data were also subjected to several different data treatments to evaluate the uncertainties associated with use of several samples that are considered to contribute minimally to ecological receptor exposure, the use of data from the TEG onsite laboratory and data with elevated detection limits in general, and the effect of quantitatively accounting for the substantial amount of the Quadrant 3 and 4 surface area that is represented by clean backfill.

The following sections build on that analysis and discuss general and COPC-specific issues that inform considerations about the need for remedial actions to address ecological concerns. These issues include:

1) uncertainties associated with the HQ methodology used to assess effects to ecological receptors;
2) the relationship between the spatial extent of soil concentrations above the RGs and the degree of receptor exposure in these areas;
3) toxicological uncertainties; and
4) the potential for adverse effects on the different receptor groups at the level of local populations or communities.

5.3.2 HQ Methodology

Although consistent with standard practice for the conduct of most site-specific ecological risk assessments, the HQ methodology used in the OU3 BERA to evaluate the potential for adverse effects to birds and mammals has significant limitations, and is only one line of evidence for risk characterization at sites, and does not represent an actual assessment of population-level risks as described in the USEPA (1999) risk management guidance. The HQ is not really a measure of "risk", that is, a probability that an adverse effect will occur (Tannenbaum, 2003, 2005; Hope, 2012). Rather, the HQ provides an evaluation of whether a receptor(s) could obtain a COPC dose from the site environment that exceeds a defined toxicological threshold. The HQ assessment is usually very conservative in nature, both in terms of exposure assumptions and the non-site-specific literature-derived toxicity thresholds that are used. As such, by using an HQ approach as part of remedial decision-making, the risk management decisions made are conservative.

5.3.3 Mercury

The evaluation presented in Appendix C of the OU3 RI Report indicates that mercury drives identification of more 1-acre grid cells with central tendency concentrations that exceed the most conservative ecological RGs, than either lead or Aroclor-1268. Use of the median concentration in each grid cell was the only data treatment evaluated that significantly reduced the number of grid cells exceeding an RG. This interpretation is justified considering that the dataset for mercury in surface soil is generally skewed due to higher concentrations detected in various sidewall and bottom samples collected during the removal-response action. As described elsewhere in this document, those samples over-represent the COPC concentrations in soil in those removal areas because the clean backfill is not numerically accounted for in the computational risk assessments.

The lowest ecological RGs for mercury are for the short-tailed shrew (2.8 mg/kg) and meadow vole (3.6 mg/kg). The 1-acre size of the grid cells used in this evaluation is appropriate given the relatively small home range of these small mammals. As depicted in the Figure C-3 series of the OU3 RI Report, most of the grid cells exceeding the RG are located in the low-quality habitat areas of the Site, associated with buildings, paved surfaces, and the former cell building soil cover. Many of the grid cells with RG exceedences are partially characterized by clean backfill. Quantitatively factoring this clean backfill into the analysis significantly reduced the number of cells exceeding the ecological RGs.

Four contiguous 1-acre grid cells in the southern portion of Quadrant 2[5], exceeded the mammalian RGs under all of the various data treatments. Grid cell 28 was the location of a hydrogen metering station where a focused removal action was performed in 1997. The other three cells in this group are each characterized by a single 5-point composite sample, with the composite sample result used to depict the condition across the entire 1-acre grid cell. This contributes significant uncertainty about the exposure potential in this area of the Site.

A number of the 1-acre grid cells had median concentrations that exceed the LOAEL RG for the broad-winged hawk (the most conservative RG for the avian receptors). However, similar to the mammals, only the three contiguous cells in the southern portion of Quadrant 2 were in a relatively undisturbed area of the Site and uninfluenced by areas of clean fill. In addition, the 1-acre grid cell size used in this analysis represents a small fraction of the home range for the hawk and other avian receptors evaluated in the BERA.

Based on these considerations, it is considered unlikely that the concentrations of mercury in OU3 soils represent an unacceptable risk to local populations of avian or mammalian ecological receptors.

5.3.4 Lead

Although the average concentration of lead in OU3 soil is relatively low, ecological RGs were derived for the mourning dove and the short-tailed shrew because the maximum GMAEL HQs exceeded 1 for these receptors. The evaluation presented in Appendix C of the OU3 RI Report demonstrates that only four non-contiguous 1-acre grid cells exceed the RG for the mourning dove (400 mg/kg) and no cells exceed the RG for the short-tailed shrew (2400 mg/kg). As depicted in the Figure C-4 series of the OU3 RI Report, two of the four grid cells that exceeded the mourning dove RG (cells 114 and 133) were subject to significant removal actions thus largely occupied by clean backfill (not accounted for numerically in the grid averaging). The majority of the area in grid cell 114 is comprised of more than 1 ft of clean fill. Grid cell 133 is characterized by a sliver of upland area that borders the "Dillon Duck" salt marsh inlet feature. As described previously, the 1-acre grid cell size used in this analysis represents a small fraction of the mourning dove's home range. These factors indicate that the concentrations of lead in

[5] These cells were identified by the numbers 27, 28, 36, and 37 in Appendix C of the OU3 RI Report.

OU3 soils do not represent a threat to local populations of avian or mammalian ecological receptors.

5.3.5 Aroclor-1268

The most significant uncertainties in the OU3 BERA are associated with the evaluation of potential adverse effects of this PCB mixture to wildlife. These uncertainties fall into two categories. The first category relates to the depiction of Aroclor-1268 concentrations in upland soil based on the complete OU3 dataset. The second category relates to the use Aroclor-1254 as a toxicological surrogate for Aroclor-1268 for mammalian receptors. These two categories of uncertainty are discussed below.

5.3.5.1 OU3 Soil Dataset Uncertainties Pertaining to Ecological Considerations

Of the ecological COPC, Aroclor-1268 is the most sensitive to the various data treatments applied in Appendix C of the OU3 RI Report. The Appendix evaluated the uncertainties associated with issues described in Section 5.3.1, meaning that each successive data treatment resulted in fewer grid cells with central tendency concentrations that exceeded one or more of the ecological RGs. The results of this analysis also demonstrated that neither Aroclor-1254 nor Aroclor-1260 contributes significantly to the estimated PCB exposures for the avian and mammalian receptors evaluated.

The lowest ecological RGs for Aroclor-1268 are for the short-tailed shrew (2.1 mg/kg) and meadow vole (3.6 mg/kg). As depicted in the OU3 RI Report Figure C-7 series, most of the grid cells exceeding the RG are located in the low-quality habitat areas of the Site, associated with buildings, paved surfaces, and the former cell building soil cover. Many of the grid cells with RG exceedences are partially characterized by clean backfill. Numerically accounting for this clean backfill further reduced the number of cells exceeding the ecological RGs.

5.3.5.2 Toxicological Uncertainties

Aroclor-1268 is a unique PCB mixture that consists of highly chlorinated congeners (68% chlorine). At the time the OU3 BERA was prepared, there were no toxicological studies evaluating mammalian (*e.g.*, mink, weasel) exposure to Aroclor-1268. Therefore the TRVs used to evaluate food-chain risks to mammalian receptors in the BERA were derived by the USEPA using information from a 9-month study in which mink were administered 0, 5, or 10 mg/kg of various Aroclors mixtures in their diet (Aulerich and Ringer, 1977). Of the four Aroclors administered (1016, 1221, 1242, 1254), only Aroclor-1254 had adverse effects on reproduction, typical of those mediated through the activation of the aryl hydrocarbon hydroxylase (Ah) receptor. At the lowest dietary concentration used in the study (5 mg/kg), only one of the seven females in that group gave birth to a live kit. Based on this study, USEPA (1995) derived a LOAEL of 0.3 mg Aroclor-1254/kg-bw/day and used an uncertainty factor of 10 to obtain a NOAEL of 0.03 mg Aroclor-1254/kg-by/day. These values were used in the OU1 BERA.

Appendix A of the OU3 BERA Report describes the results of several studies that estimated the relative potency of Aroclor-1268, compared with Aroclor-1254, at binding and activating the Ah receptor, which is the first step in a biological cascade resulting in toxicological responses that include dermal toxicity, immunotoxicity, carcinogenicity, and adverse effects on endocrine, reproductive, and developmental functions. These studies suggest that Aroclor-1268 is a considerably less potent activator of the Ah receptor than is Aroclor-1254 (Villeneuve et al., 2001; Burkhard and Lukasewycz, 2008).

Honeywell recently sponsored a reproductive toxicity study of Aroclor-1268 in mink conducted by scientists at Michigan State University. In this study seven groups (negative control, positive control, and five Aroclor-1268 dose groups), each with ten female mink were given Aroclor-1268 via in their diet for two months prior to breeding, with exposure continuing through parturition and lactation. The exposure concentrations in this study bracket the concentrations of Aroclor-1254 administered in the study by Aulerich and Ringer (1977), with the two highest exposure concentrations at 17 and 29 mg/kg/day.

The researchers presented their data in a poster presentation at the 2012 Annual Meeting of the Society for Environmental Toxicology and Chemistry (SETAC) (Folland et al., 2012). There was no evidence of reproductive failure or reduced reproductive capacity for any of the treatment groups. The authors did report several statistically significant responses in the highest exposure groups, including decreases in adult female body weight in the 17 and 29 mg/kg groups, decreases in kit body weight at six weeks in the 29 mg/kg group, and a decrease in kit survival at three weeks in the 29mg/kg group. The authors attributed all of these effects to changes in nutritional status related to the reduced palatability of the food administered to the higher treatment groups. Kit mortality in the 29 mg/kg group was due primarily to infanticide, suggesting that females consumed kits rather than eating unpalatable Aroclor 1268-spiked diet. The authors also reported a reduction in serum thyroxine in the 10, 17, and 29 mg/kg groups, but suggested that this response could also be related to nutritional status. Regardless of whether the effects observed in the highest Aroclor-1268 dose groups were related to toxicity or food avoidance, the corresponding dose levels were much higher than Aroclor-1254 doses associated with near-complete reproductive failure. The data presented from this study provide further support for the proposition that the mixture of PCB congeners in Aroclor-1268 are less potent at activating the Ah receptor as compared with Aroclor-1254, and therefore exhibit lower toxicity to mammals.

Based on these considerations, it is considered unlikely that the concentrations of Aroclor-1268 in OU3 soils represent an unacceptable risk to local populations of avian or mammalian ecological receptors.

5.3.5.3 Population-Level Considerations

The effects of PCBs on local population demographics of short-tailed shrews were evaluated in a field study near the Housatonic River in Massachusetts (Boonstra and Bowman, 2003). The authors evaluated a variety of demographic characteristics of short-tailed shrews in six discrete areas with spatially-weighted total PCB concentrations in soil that ranged from 1.5 to 38.5 mg/kg (comprised primarily of Aroclor-1254 and Aroclor-1260). These researchers concluded that there were no significant differences attributable to PCB concentrations among the different areas in terms of shrew population density, body weight, survival, sex ratio, or reproductive status. The results of this study suggest the LOAEL RGs for Aroclor-1268 (which again are based on a more conservative TRV for Aroclor-1254) for small mammals (2.1, 3.6, and 6.0 mg/kg for the short-tailed shrew, meadow vole, and long-tailed weasel, respectively) provide an overly conservative depiction of the hazards to these receptors. These factors further indicate that the concentrations of Aroclor-1268 in OU3 soils are unlikely to present a risk to local populations of avian or mammalian ecological receptors.

5.3.6 Recommended Action Areas for Ecological Protection

Taken together, the uncertainties associated with the OU3 surface soil dataset and the toxicological uncertainties associated with the use of an Aroclor-1254 TRV to evaluate Aroclor-1268 suggest that the OU3 BERA provides a conservative representation of the risks posed by Aroclor-1268 in Site soils to terrestrial mammals. Based on this information, no action areas are proposed on the basis of ecological risk.

5.4 Potential Action Areas to Manage Soil Leaching Risk

5.4.1 Soil Zone (Vadose Soils)

The soil zone for potential leaching of soil constituents to groundwater is the vadose zone that occurs above the high water table mark across the Site. The water table is susceptible to both tidal and climatic (rainfall) fluctuations. Note that for simplicity and convenience, vadose zone soils were conservatively established uniformly across the Site as a depth from 0 to 5 ft below ground surface ("bgs") for the HHBRA. For the purpose of the soil-to-groundwater leaching it is more appropriate to consider the true configuration of the vadose zone/saturated zone interface across the Site geography. Site groundwater levels from 65 monitoring wells (Site wells designated as shallow) were examined for the period of 2001 to 2012 to identify the configuration of this interface. Both an average vadose thickness model (Figure 5-3) and minimum (high water mark) vadose zone thickness model (Figure 5-4) were developed from these data to guide potentially actionable soils.

Average Depth Model

As provided in Figure 5-3, the average vadose zone thickness for OU3 ranges from greater than 7 ft in Quadrant 1 (former drive-in-theatre) to 2 ft along the marsh-upland border in Quadrants 3 and 4. The two western Quadrants (3 & 4) were identified in the RI as exhibiting soil with potential leaching issues. The majority of the Quadrant 3 vadose zone soil thickness is in the range of 3 to 4 ft. The majority of the Quadrant 4 area exhibits a vadose zone soil depth in the range of 4 to 5 ft in depth, shallowing somewhat to 3 to 4 ft in depth along the northern and western (shoreline) margins.

High Water Table Model

As provided in Figure 5-4, the high water vadose zone thickness for OU3 also ranges from greater than 7 ft in Quadrant 1 (former drive-in-theatre), but exhibits very thin vadose zones in both Quadrant 3 (1 to 2 ft) near the marsh inlet and Quadrant 4 (less than 1 ft). The majority of

Quadrant 3 and Quadrant 4 exhibit a vadose zone soil depth in the range of 2 to 3 ft in depth, with some areas near the shore thinning to less than 2 ft.

5.4.2 Review of Leaching COC in Vadose Soil Zone

The following summary analysis is a point-driven assessment of soils identified in the OU3 RI as requiring further investigation for potential leaching to groundwater. Soil data included in this assessment includes all soil samples in which any portion of the sample is located within the vadose zone model provided in Figure 5-3 (*i.e.* the tag of the sample depth interval identified as "D1" (the top of the sampled interval) in the database is located within the vadose zone).

The assessment and determination of each soil constituents potential to leach to groundwater is based on the following lines of evidence:

1) Is the leaching COC currently reported in groundwater (comprehensively sampled in 2012) above ingestion-based risk values (MCL or ingestion-based tap water RSL)?
2) Is the leaching COC currently reported in vadose zone soils above the Site-specific SSL?
3) Is there co-location of soils above the Site-specific SSL and groundwater that exceeds the ingestion-based risk value for the leaching COC?

The assessment process was performed by reviewing the lines of evidence through a graphical review of information for each leaching COC. For each leaching COC the soils data was superimposed on the average soil vadose zone model, and done separately for shallow soils or D2 <= 2 ft bgs (the "a" figure for each COC) and for deep soils or D2 > 2 ft bgs (the "b" figure for each COC). The D2 (bottom of sample depth interval) value for each soil sample is placed over the data point to allow for comparison of sample depth to water table depth. In addition, groundwater data for shallow wells (wells potentially influenced by soil leaching) are provided to compare to the overlying soil data to identify potential zones of leaching.

Quadrant 3 Analysis

Benzene (Figures 5-5a and 5-5b): Four wells in Quadrant 3 exhibit benzene above the MCL (5 μg/L) with all four wells located in the vicinity of the former Brunswick-Altamaha Canal. The Brunswick-Altamaha Canal was located along the Site's marsh-upland border. Three of the four wells are grouped at the marsh-upland border in the central portion of Quadrant 3 (DP-6A, MW-110A and MW-302) and one well (MW-111A) is located at the northern end of Quadrant 3, also in the vicinity of the canal. Soils above the Site-specific SSL (0.0072 mg/kg) are grouped near the former Brunswick-Altamaha Canal and previously identified petroleum hydrocarbon source areas excavated during the 1994-97 Removal Action. Soils above the benzene SSL are almost exclusively present where sample depths are within the zone of water table fluctuation (compare Figure 5-6a to 5-6b). No soils are co-located with the north Quadrant 3 well (MW-111A) reported above the benzene MCL.

Dichloromethane (Figures 5-6a and 5-6b): Two wells (MW-111A and MW-302) in Quadrant 3 exhibit dichloromethane above the MCL (5 μg/L), both located adjacent to the former Brunswick-Altamaha Canal. One is located near the marsh-upland border (consistent with benzene) with the other located at the northern end of Quadrant 3. Soils above the Site-specific SSL (0.002 mg/kg) are grouped, as with benzene, near the former Brunswick-Altamaha Canal and previously identified petroleum hydrocarbon source areas excavated during the 1994-97 Removal Action. Soils above the dichloromethane SSL are much more frequent at depth compared to near surface soils and like benzene, most of the soil samples span to depths below the water table.

Lead (Figures 5-7a and 5-7b): Only one of the shallow wells (MW-111A) in Quadrant 3 exhibits lead above the MCL (15 μg/L), and is located at the northern end of Quadrant 3. Soils above the Site-specific SSL (77 mg/kg, based on the batch extraction study at a DAF=1) are reported consistently across Quadrant 3. The lack of correlation between the soil SSL exceedance (at DAF=1) and groundwater exceedance (limited to just one well) is empirical evidence that a DAF=1 SSL is not appropriate. Note that very few soil locations exceed the SSL at a DAF=20.

Mercury (Figures 5-8a and 5-8b): Only one of the shallow wells (MW-111A) in Quadrant 3 exhibits mercury above the MCL (2 μg/L), and is located at the northern end of Quadrant 3 (same well where the lead concentration exceeds the MCL). Soils above the Site-specific SSL (16 mg/kg) are few with only seven locations occurring near the southeast portion of Quadrant 3. No soils above the Site-specific SSL are co-located with the north Quadrant 3 well reported above the MCL.

2-Methylnaphthalene (Figures 5-9a and 5-9b): Two wells (DP-6A and MW-111A) in Quadrant 3 exhibit 2-Methylnaphthalene above the ingestion-based tap water RSL (63 μg/L), both located adjacent to the former Brunswick-Altamaha Canal. One of the two wells (DP-6A) is located near the marsh-upland border (consistent with benzene) with the other located at the northern end of Quadrant 3 (MW-111A). Soils above the Site-specific SSL (1.3 mg/kg) are grouped near the former Brunswick-Altamaha Canal and previously identified petroleum hydrocarbon source areas excavated during the 1994-97 Removal Action. Soils above the 2-Methylnaphthalene SSL are much more frequent at depth compared to surface soils, similar to the other organic constituent distributions. Note that the area of highest soil concentration grouped in the northern portion of Quadrant 3 (Figure 5-9b), does not adversely affect groundwater as the nearest down gradient monitoring well is non-detect (MW-301).

Naphthalene (Figures 5-10a and 5-10b): No wells in Quadrant 3 exhibit Naphthalene above the ingestion-based tap water RSL (310 μg/L) indicting any potential leaching from soil is not adversely affecting groundwater.

1,2,4-Trimethylbenzene (Figures 5-11a and 5-11b): Three wells (DP-6A, MW-110A and MW-111A) in Quadrant 3 exhibit 1,2,4-Trimethylbenzene above the ingestion-based tap water RSL (160 μg/L) with all wells located along the marsh-upland border near the former Brunswick-Altamaha Canal. As is the case with the other petroleum hydrocarbons, the preponderance of soil samples exceeding the SSL occur in deeper samples, where a portion of the sample interval is within the zone of water table fluctuation (below the high or even average water table mark).

1,3,5-Trimethylbenzene (Figures 5-12a and 5-12b): No wells in Quadrant 3 exhibit 1,3,5-Trimethylbenzene above the ingestion-based tap water RSL (160 µg/L) indicting any potential leaching from soil is not adversely affecting groundwater.

Quadrant 4 Analysis

The caustic brine pool ("CBP") is a unique region of the Site where past caustic releases have significantly altered the pH of the groundwater, and in turn enhanced the solubility of metals (and organics) to dissolve into groundwater. The CBP is defined geochemically as the region where the groundwater pH exceeds 10.5 Standard Units. Within this region and down gradient to the west, the CBP effects on the constituent solubility are evident in the results of groundwater data, and this condition does not necessarily imply ongoing leaching. In fact, USEPA did not consider data from this region when evaluating soil leaching for the Site. Therefore the following analysis of the leaching potential for Quadrant 4 focuses on areas outside the region of CBP influence (i.e., southern portion of the quadrant).

Lead (Figures 5-13a and 5-13b): As was the case with Quadrant 3, there are numerous locations in the southern portion of Quadrant 4 that exceed the DAF=1 SSL for lead in soil (77 mg/kg), more notably in shallow soils (Figure 5-13a). However, reported lead concentrations in the shallow wells within and downgradient of this region in the southern portion of Quadrant 4 do not exceed the MCL for lead, indicating that the DAF=1 value is inappropriate. None of the soils (either depth interval) exceed the DAF=20 SSL for lead.

Mercury (Figures 5-14a and 5-14b): Soils above the Site-specific SSL (16 mg/kg) are few, virtually nonexistent outside the bounds of the CBP indicated soil leaching is unlikely to be adversely affecting groundwater.

Naphthalene (Figures 5-15a and 5-15b): No wells in Quadrant 4 exhibit Naphthalene above the ingestion-based tap water RSL (310 µg/L) indicting any potential leaching from soil is not adversely affecting groundwater. Furthermore, the frequency of soils exceeding the SSL is low, and is higher in the deeper soil samples many of which span vertically beneath the water table.

1,2,4-Trimethylnaphthalene (Figures 5-16a and 5-16b): Two wells in Quadrant 4 exhibit 1,2,4-Trimethylbenzene slightly above the ingestion-based tap water RSL (160 µg/L),. Soils above the Site-specific SSL (0.85 mg/kg) are few and most notable with deeper soil samples many of which were collected below the average or high water table depth.

Former Off-Site Tank Farm

Lead is the only constituent identified in soils at the former off-site tank farm deemed to have the potential to leach to groundwater (Figure 5-17). Some of the soil samples were present at concentrations exceeding the SSL at DAF=1 and one location at a concentration exceeding the DAF=20 SSL. However, all down gradient wells in Site Quadrant 1 and Quadrant 2 exhibit less than 1 µg/L lead (MCL=15 µg/L).

5.4.3 Analysis of Soil Assessments and Selection of Action Areas

Two well-defined trends for leaching COC above Site-specific RGs are apparent from the data review. First, metal leaching COCs occur more often and at higher concentrations in the shallow soils, but with no prevailing co-location of soils above the SSL and groundwater above ingestion-based criteria. Second, SVOCs and VOC occur more often and at higher concentrations in the deeper soils, most of which span the depth of the high or even the average water table depth. This spatial distribution of organics as shown by their greater occurrence at depth, specifically within the zone of water table fluctuation, is consistent with a petroleum-based smear zone.

The reported occurrence of some organics in shallower soils is potentially an artifact of the removal action confirmation sample program, which collected confirmation samples as composites spanning a large vertical interval at the base of excavation. The large vertical interval at the base of excavation was necessary as the shallow nature of the Site water table, and poor soil stability due to saturation limited vertical sidewall depth. As seen in Figure 5-18 (when comparing this with Figures 5-3 or 5-4), many excavation grids were completed below water table depth. The overall consequence of the large vertical range of these samples is a level of uncertainty as to the true depth of contamination in vadose zone soils.

The uncertainty of depth of contamination, specifically for organics in former removal areas, is realized in the results of more recent soil grab samples collected specifically in vadose zone soils adjacent to or below former removal areas as described below. These soil samples, largely collected for the Site soil leaching study, were targeted to historic areas reporting elevated soil concentrations. The results of the grab soil samples collected since 2008 (post removal) are provided below and in Figure 5-19 for constituents of interest identified in the OU3 RI Report.

Detection Frequency Above SSLs of Leaching COCs in Grab Samples Collected from 2008 to 2010

Parameter	Exceedances – default SSL		Exceedances - Site SSLs	
	Quad 3	Quad 4	Quad 3	Quad 4
Benzene	0/8	---	0/8	---
Dichloromethane	0/8	---	0/8	---
Lead	1/15	4/35	1/15	4/35
Mercury	0/15	0/35	0/15	0/35
2-Methylnaphthalene	1/11	---	0/11	---
Naphthalene	10/11	17/21	0/11	0/21
1,3,5-Trimethylbenzene	0/8	---	0/8	---
1,2,4-Trimethylbenzene	0/8	0/17	0/8	0/17

As revealed in more recent targeted sampling, benzene, dichloromethane, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene, (representing all VOCs in the SSL analysis) were not reported once above either their default or site-specific leaching RG in vadose zone soil. Naphthalene was identified to occur in several locations in Quadrant 3 and Quadrant 4 above the default SSL, but is not reported above the Site-specific leaching RG. Lastly, 2-Methylnapthalene was only reported once above the default SSL, with no soil concentrations above the Site-specific SSL. These recent sample results taken together support a probability that past sample result values were influenced by deep sample issues not replicated in true vadose zone soil sampling.

Selection of Action Areas Based on Leaching

Lines of evidence to identify areas of true soil leaching risk were identified through the graphical evaluation process in the prior sections. The process identified an area in Quadrant 3 in which soils within the vadose zone exhibit benzene, dichloromethane and 1,2,4-trimethylebzene above their respective Site-specific SSL, and are concurrently present in the proximate shallow wells. This action area is identified as L-1 on Figure 5-20. Some uncertainty is recognized for soils in L-1 as more recent sampling events have not reproduced soil VOC and SVOC concentrations reported from the confirmational sampling program from the 1994-97 Removal Action.

5.5 Summary of Areas Warranting Remedial Action

This section provides a summary of potential remedial action areas based on the RAOs for human health risk, ecological risk, and potential leaching of soil constituents to groundwater.

Human Health Risk

As provided in Section 5.2, no exposure unit exhibits risk above threshold criteria for the Industrial Worker scenario or the Excavation Worker scenario considering the uncertainties associated with specific soil sample locations (n=6 for surface soil, n=8 for subsurface soil). Accordingly, no action areas are identified to address human health risk for future land use scenarios.

Ecological Risk

Based on the information presented in Section 5.3, it is reasonable to conclude that no specific actions are necessary to address ecological concerns for population level effects. Accordingly, no action areas are identified to address ecological risk.

Potential Soil Leaching Risk

The assessment completed for soil-to-groundwater leaching risk identified one potential action area. This area, L-1, is located in Quadrant 3 and represents an area of potential co-location of soil constituents above Site SSL and groundwater above ingestion-based MCLs. Due to uncertainties provided in Section 5.4, re-characterization of the vadose zone soil condition in L-1 is carried forward as a remedial action. If the soil condition is not confirmed, no soil-to-groundwater leaching action areas are identified.

6 IDENTIFICATION AND SCREENING OF PROCESS OPTIONS

6.1 Overview

This section provides a preliminary screening of remedial options to address Site RAOs. As stated previously, Honeywell has no intention of converting any portion of the property to residential use, and this restriction will be recorded (i.e., deed restriction) to prevent such future use in the event the property or portions thereof are sold. This deed restriction, later referred to as an "institutional control", will be a component of whichever remedial approach is selected.

The screening process for this technical memorandum is consistent with procedures in the following USEPA documents: "Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA" [USEPA, 1988], and "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA", [USEPA, 1993].

6.2 Screening Criteria and Options Considered

In accordance with nomenclature used in USEPA guidance documents, the following terminology is used within this document:

- "remedial technologies" refers to general treatment categories, such as chemical treatment, capping, or physical treatment; and
- "process options" refers to specific treatment processes within each remedial technology.

Remedial technologies and process options included in "Technology Screening Guide for Treatment of CERCLA Soils and Sludges" [USEPA, 1988] were reviewed during the preparation of the OU3 RI/FS Work Plan to identify other remedial technologies or process options potentially applicable to the LCP Superfund Site.

The criteria used for the preliminary screening of the process options were:

- Applicability - the process option is appropriate for the type(s) of contamination at the Site; and
- Technical Implementability - the process can be constructed and reliably operated, and can meet the remedial action objectives during and after implementation; also, the components of the process option can be operated, maintained, replaced, and monitored, as necessary, after the remedial action is completed.

The process options included in the preliminary screening are listed below:

General Response Action	Remedial Technologies	Process Options
No Further Action		
	No Further Action	Signage
Natural Recovery		
	Soil Assessment	Revise Assessment
Re-characterization (with Contingency Remedy)		
	Removal	To be determined
	Capping	To be determined

7 ASSEMBLAGE AND PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

7.1 Overview

The remedial action alternatives ("RAAs") represent assemblages of actions, treatments and/or containment technologies to address environmental risk and meet Site RAOs and comply with ARARs. As stated previously, Honeywell has no intention of converting any portion of the property to residential use, and this restriction will be recorded (i.e., deed restriction) to prevent such future use in the event the property or portions thereof are sold. This deed restriction will be a component of whichever remedial option is selected.

7.2 Preliminary Remedial Alternative for OU3 Soils

The following RAAs were developed to meet RAOs for OU3 soils based on the analyses of the HHBRA, the BERA and potential soil-to-groundwater leaching. As previously noted, assessments completed for human and ecological risk (Section 5) identifies risk as below threshold criteria. Therefore, remedial technologies applicable to their RAOs are limited to options presented under RAA1 and RAA2 only. One area of potential leaching ("L1") was identified based on the review in Section 5, acknowledging the possibility that the soil condition represented in the dataset may not accurately reflect the true condition above the water table, and therefore it is proposed to re-characterize the vadose zone soil in this area as RAA3.

7.3 Evaluation Criteria for Remedial Action Alternatives

The RAAs developed for OU3 soils are described in this section by assessment of four factors: technical implementability, short-term effectiveness, long-term effectiveness and relative cost. These factors are further described below.

- Implementability – This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required inputs and services.
- Short-Term Effectiveness – The assessment for this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until the remedial action objectives have been met. This includes an estimate of time until RAOs are achieved.

- Long-Term Effectiveness and Permanence – The assessment of alternatives for this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.
- Cost – This assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative.

7.4 Evaluation of Remedial Action Alternatives

7.4.1 Remedial Action Alternative 1 (RAA1): No Further Action with Institutional Controls

7.4.1.1 Description of Alternative

The No Further Action alternative provides a baseline for comparing other alternatives. In this alternative, there is no active remediation and no monitoring. Selection of the RAA is predicated on the conclusion that past removal actions have achieved Site RAOs and that the assessment of Site risk to future industrial/excavation workers is acceptable. It is also based on the conclusion that soil-to-groundwater leaching is not adversely affecting groundwater. The fencing already in place at the Site would remain and a deed restriction will be recorded to prevent future residential use in the event the property or portions thereof are sold.

7.4.1.2 Implementability

This alternative would be simple to implement.

7.4.1.3 Long-Term Effectiveness and Performance

Long-term effectiveness and performance are satisfactory under this RAA if past removal actions have achieved Site RAOs and the assessment of Site risk to future industrial/excavation workers is acceptable. No rebound of COPC concentrations would be expected and no increased residual risk to human health and the environment is expected. Also, existing soil Aroclor-1268 is expected to remain immobile. Existing institutional controls, which include on-Site fencing and signage, would remain but would not be maintained into the future under a no action alternative. The deed restriction would be permanently recorded to prevent any future residential land use.

7.4.1.4 Short-Term Effectiveness

Because there are no actions to implement, there will be no additional short-term risks posed to the community or the environment as a result of this alternative being implemented.

7.4.1.5 Compliance with ARARs

Compliance with ARARs for RAA1 is limited to chemical-specific ARARs since there are no actions contemplated, and location-specific ARARs listed on Table 3-1 do not appear applicable to this alternative.

7.4.1.6 Cost

There is no cost for the no further action alternative.

7.4.2 Remedial Action Alternative 2 (RAA2): Monitored Natural Recovery with Institutional Controls

7.4.2.1 Description of Alternative

This alternative includes continuance of existing on-Site institutional controls (perimeter fencing and signage), a deed restriction, and implementation of routine soil monitoring to confirm that natural processes are effectively reducing the mass, toxicity, mobility, volume, or concentrations of the residual COPCs. This alternative is predicated on the assumption that the baseline HHBRA estimation of the Site risk is deemed within acceptable levels by the USEPA for industrial/excavation worker exposure and soil-to-groundwater leaching is not adversely affecting groundwater. During monitoring events, samples would be collected on a periodic basis and analyzed for COPCs to confirm that natural recovery processes are occurring. Monitoring data would be analyzed statistically in accordance with USEPA guidance to determine whether there is a significant decrease in the COPC concentrations. Statistical analysis of the data would be conducted according to guidance provided in "Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Groundwater" by the Environmental Statistics and Information Division, Office of Policy, Planning and Evaluation, USEPA, July 1992.

Under the natural recovery remedy, CERCLA mandates a five-year review of Site monitoring and the rate of recovery and also allows for implementation of additional remedial action measures. After each 5-year review period involving monitoring and statistical analysis of temporal trends, the effectiveness of the natural recovery processes to achieve the remedial goals would be evaluated. Institutional controls (*e.g.*, deed restrictions, fencing, Site security) would be evaluated for continued effectiveness.

7.4.2.2 Implementability

RAA2 would be relatively simple to implement as the monitoring can be easily accomplished. Required laboratory testing is readily available through multiple vendors. Administrative controls proposed for RAA2 are straightforward and have been successfully implemented at numerous sites.

7.4.2.3 Long-Term Effectiveness and Performance

Metal COPCs are expected to remain immobile under this remedial alternative and the organics are expected to attenuate with natural processes. Thus, RAA2 would meet the criteria of long-term effectiveness and permanence.

7.4.2.4 Short-Term Effectiveness

RAA2 involves no active remediation or construction and therefore, short-term effectiveness is not an applicable criterion.

7.4.2.5 Compliance with ARARs

Similar to RAA1, compliance with ARARs for RAA2 is limited to chemical-specific ARARs since no actions are contemplated, and location-specific ARARs listed on Table 3-1b and 3-1c do not appear applicable to this alternative. The Site would remain a Type 5 status under the Georgia Hazardous Site Response requiring indefinite maintenance of institutional controls consistent with the basis for the exposure assumptions in the baseline HHBRA, until COPC levels are within one of the other Type standards.

7.4.2.6 Cost

The cost of a monitored natural attenuation approach is considered low to moderate due to the continued requirement for annual monitoring and maintenance of the grounds including the perimeter fence.

7.4.3 Remedial Action Alternative 3 (RAA3): Re-characterization of Area L1 with Contingency Remedy

7.4.3.1 Description of Alternative

This alternative involves re-characterization of the vadose zone soil in the L1 Area in Quadrant 3. A Sampling and Analysis Plan and Work Plan would be prepared during Remedial Design to document the sampling approach, analytical testing program, and data evaluation methods to be applied to the sampling results in establishing whether remedial action is warranted (on the basis of soil leaching). The Work Plan would present the selected contingency remedy, likely to involve either excavation or capping.

7.4.3.2 Implementability

RAA3 can be readily implemented.

7.4.3.3 Long-Term Effectiveness and Performance

Excavation (removal) or capping actions contemplated as a contingency remedy under RAA3 would be effective at reducing exposure and infiltration. Capping does not remove any contaminant mass.

7.4.3.4 Short-Term Effectiveness

Excavation (removal) or capping contingency remedial actions are fairly straightforward and do not pose significant challenges for short-term effectiveness. Capping the upland areas delineated in Figure 5-20 would require extensive clearing and material handling. These types of activities do pose a slight increase in short-term risk owing to worker exposure and increased heavy equipment traffic locally.

7.4.3.5 Compliance with ARARs

Many of the potential ARARs listed on Table 3-1a to 3-1c could apply to RAA3 if the contingency remedy is required.

7.4.3.6 Cost

The cost of either of the contingency remedies is considered moderate.

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TABLES

Table 3-1a
Potential ARARs and TBCs
Chemical Specific

Regulatory Program	Regulatory Authority	Type of ARAR/TBC	Title	Citation	Brief Description	ARAR/TBC Status
Environmental Protection	State	Chemical	*Georgia Rules and Regulations for Water Quality Control*	Chapter 391-3-6.03-Water Use Classifications and Water Quality Standards	Provide enhancement of water quality and prevention of pollution; to protect the public health and welfare in accordance with the public interest of drinking water supplies, conservation of fish, wildlife and other beneficial aquatic life.	Relevant and Appropriate – To site characterization and potential remedial alternatives implemented at the site.
Water	Federal	Chemical	*Toxic Pollutant Effluent Standards*	40 CFR 129	Establishes effluent standards and prohibitions for certain pesticides and PCBs if being discharged to navigable waters.	Potentially Applicable – If wastewater will be treated and discharged to the estuary during remediation activities.
Toxic Substances/TSCA	Federal	Chemical	*Polychlorinated Biphenyls (PCBs) Manufacturing Process, Distribution in Commerce, and Use Prohibitions*	40 CFR 761	Provides cleanup methodology and standards for PCBs.	Potentially Applicable – To the remediation of PCB-containing soil.
Waste Management	Federal	Chemical	*Identification and Listing of Hazardous Waste*	40 CFR 261	Defines solid wastes which are subject to regulation as hazardous wastes under 40 CFR 262-265 and 40 CFR 270. Establishes testing requirements for profiling wastes prior to disposal.	Applicable - All wastes must be profiled prior to disposal. If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.), then additional requirements will apply.
USEPA	Federal	Chemical	Protection of Groundwater Risk-Based Soil Screening Levels (SSLs)	USEPA RSL Table, 2012	Generic screening levels for constituents in soil based on potential to leach to groundwater.	TBC - Non-promulgated risk-based guidance levels for constituents.
USEPA	Federal	Chemical	Protection of Groundwater MCL-Based Soil Screening Levels (SSLs)	USEPA RSL Table, 2012	Generic screening levels for constituents in soil based on potential to leach to groundwater.	TBC - Non-promulgated risk-based guidance levels for constituents.
USEPA	Federal	Chemical	Migration to Groundwater - Default Dilution Attenuation Factor Soil Screening Level	USEPA Soil Screening Guidance (SSG) 1996	Generic screening levels for constituents in soil based on potential to leach to groundwater - modified for dilution and attenuation of the constituent.	TBC - Non-promulgated risk-based guidance levels for constituents.
USEPA	Federal	Chemical	Migration to Groundwater - Site Specific Dilution Attenuation Factor Soil Sc4reening Level	USEPA Soil Screening Guidance (SSG) 1996	Site-specific screening levels for constituents in soil based on potential to leach to groundwater - based on empirical data and model.	TBC - Non-promulgated risk-based guidance levels for constituents.
USEPA	Federal	Chemical	Safe Drinking Water Act, National Primary Drinking Water Regulations, Maximum Contaminant Levels	40 CFR Part 141.61(a)	Specifies the maximum permissible concentrations of contaminants in public drinking water supplies. Federally enforceable standards based, in part, on health effects and on the availability and cost of treatment technologies.	Applicable - Relevant and appropriate for groundwater that is or may be used for drinking water.
State of Georgia	State	Chemical	Georgia Safe Water Drinking Action, Primary Maximum Contaminant Levels (MCLs)	Georgia Rule 391-3-5.18(2)(b)	Specifies the Primary Maximum Contaminant Levels (MCLs) for Drinking Water for Organic contaminates as specified in GA Rule 391-3-5.18(2)(b) and 40CFR 141.61(a).	Applicable - Relevant and appropriate for groundwater that is or may be used for drinking water.
State of Georgia	State	Chemical	Georgia Rules and Regulations for Water Quality Control - Protection of adjacent surface water body	Georgia Rule 391-3-6-.03(5)(e)	All waters of the State shall be free from toxic, corrosive, acidic and caustic substances in amounts, concentrations, or combinations which are harmful to humans, animals or aquatic life.	Applicable - Relevant and appropriate to discharge from any source, including non-point sources.
State of Georgia	State	Chemical	Georgia Rules and Regulations for Water Quality Control - Protection of adjacent surface water body	Georgia Rule 391-3-6-.03(5)(e)(iv)	In stream concentrations shall not exceed the specific concentrations for site-related contaminants of concern.	Applicable - Relevant and appropriate to discharge from any source, including non-point sources to site ponds or marsh.
Special Cleanup Provisions (Superfund, etc.)	State	Chemical	*Georgia Hazardous Site Response Act*	Georgia Hazardous Site Response Act	Governs the remediation of contaminated sites in Georgia by classifying sites and risk-reduction standards based on the nature of the site and anticipated future land use.	TBC - For site characterization and potential remedial alternatives implemented at the site.
Environmental Protection	State	Chemical	*Risk Reduction Standards*	Chapter 391-3-19-.07	Chemical Specific Risk Reduction Standards.	TBC - to demonstrate compliance with HSRA.

Table 3-1b
Potential ARARs and TBCs
Location Specific

Regulatory Program	Regulatory Authority	Type of ARAR/TBC	Title	Citation	Brief Description	ARAR/TBC Status
Environmental Protection	Federal	Location	*Procedures for Implementing the Council on Environmental Quality on the National Environmental Protection Act*	40 CFR 6	Any activity that proposes to affect fish and wildlife, endangered species, historic resources, wetlands, floodplains, etc. requires specific review.	Potentially Applicable - If the remedial action will affect such resources.
Environmental Protection	Federal	Location	*Executive Order 11990 Protection of Wetlands*	40 CFR 6, Appendix A	Requirements to minimize destruction, loss, or degradation of wetlands.	Potentially Applicable - If remedial actions result in discharges to marsh.
Environmental Protection	Federal	Location	*Endangered Species Act*	50 CFR Part 200 and Part 402	Requires protection of endangered species.	Not Applicable - No endangered species identified for OU3.
Special Cleanup Provisions (Superfund, etc.)	Federal	Location	*National Oil and Hazardous Substances Pollution Contingency Plan*	40 CFR 300	Provides for Federal oversight and planning dealing with releases of hazardous substances and remedial actions.	Applicable - This rule defines the federal-level decision-making process for Superfund sites.

Table 3-1c
Potential ARARs and TBCs
Action Specific

Regulatory Program	Regulatory Authority	Type of ARAR/TBC	Title	Citation	Brief Description	ARAR/TBC Status
Miscellaneous Provisions	Federal	Action	*Intergovernmental Review of Environmental Protection Agency Programs and Activities*	40 CFR 29	Requires communication between EPA administrator and state and local officials to explain the project and to provide a comment period for state review. Consultation with other federal agencies is also required.	Potentially Applicable - Project will require intergovernmental review if the project uses federal and other funds.
Safety	Federal	Action	*Occupational Safety and Health Standards*	29 CFR 1910	Requirements for worker safety.	Applicable - To any field activities.
Safety	Federal	Action	*Safety and Health Regulations for Construction*	29 CFR 1926	Requirements for safe construction practices.	Applicable - To any field and potential construction activities.
Transportation	Federal	Action	DOT Regulations (several)	49 CFR Parts 171-180 (post HM181)	Regulates transportation of hazardous materials.	Applicable – To the offsite transportation of hazardous materials (including wastes).
Waste Management	Federal	Action	*Hazardous Waste Management Systems: General*	40 CFR 260	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Part 260-265, including the requirements for petitioning for the delisting of a particular hazardous waste.	Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.).
Waste Management	Federal	Action	*Standards Applicable to Generators of Hazardous Waste*	40 CFR 262	Establishes standards for generators of hazardous waste, including determination of generator status, receipt of a hazardous waste ID number, recordkeeping, etc.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.).
Waste Management	Federal	Action	*Standards Applicable to Transporters of Hazardous Waste*	40 CFR 263	Establishes standards for persons transporting hazardous waste within the US.	Potentially Applicable - If the remedial action results in the offsite transportation of hazardous waste (excavated soils, PPE, etc.).
Waste Management	State	Action	*Standards Applicable to Transporters of Hazardous Waste*	GA Rule 391-3-11-.-8(2)	Use of hazardous waste manifests on forms as designated by the Director, Requires the use of US EPS form "Uniform Hazardous Waste Manifest" for manifesting waste.	Potentially Applicable - If the remedial action results in the offsite transportation of hazardous waste (excavated soils, PPE, etc.).
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities-Corrective Actions for Solid Waste Management Units*	40 CFR 264, Subpart S	Provides conditions for designating corrective action management units (CAMU) at facilities undergoing RCRA cleanup.	Potentially Relevant and Appropriate – In the handling of waste and in the evaluation and selection of remedial actions.
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*	40 CFR 264/265	Defines licensing and handling requirements for hazardous waste TSD facilities.	Potentially Applicable - The full provisions of this regulation only will apply if the remedial action will result in the permitted storage (>90 days) hazardous waste. In this case, all subpart provisions will apply (A-CC), covering containers, tanks, waste piles, etc. If not (i.e., LQG/SQG status), only selected provisions will apply, as detailed below. Regardless, these provisions also will apply to the selected offsite hazardous waste disposal facility.
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities-Preparedness and Prevention and Contingency Plan and Emergency Procedures*	40 CFR 265, Subparts C and D	Defines emergency planning requirements for hazardous waste generators.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.).
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities-Use and Management of Containers*	40 CFR 265, Subpart I	Requirements for generators and TSDFs storing hazardous waste in containers.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.) that are stored in containers.
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities-Use and Management of Tanks*	40 CFR 265, Subpart J	Requirements for generators and TSDFs storing hazardous waste in tanks.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.) that are stored in tanks.
Waste Management	Federal	Action	*Standards/Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities-Air Emissions Standards for Tanks, Surface Impoundments, and Containers*	40 CFR 265, Subpart CC	Requirements for LQGs and TSDFs storing organic-containing wastes in tanks, containers and the like.	Potentially Applicable - If the remedial action results in the generation of organic hazardous wastes (excavated soils, PPE, etc.) that are stored in containers, tanks, etc.
Waste Management	Federal	Action	*Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities*	40 CFR 266	Establishes requirements, which apply to hazardous waste burned or processed in boilers or industrial furnaces, including used oil.	Potentially Applicable – To the TSDF, if the remedial action results in the generation of hazardous waste that will be treated offsite.
Water	Federal	Action	*National Pollutant Discharge Elimination System (NPDES)*	40 CFR 122	Covers permits for water discharges (storm water and/or industrial process water) into navigable waters.	Potentially Applicable – If wastewater will be discharged to the estuary during remediation activities.
Waste Management	Federal	Action	*Land Disposal Restrictions*	40 CFR 268	Identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise restricted waste may continue to be land disposed.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.).

Table 3-1c
Potential ARARs and TBCs
Action Specific

Regulatory Program	Regulatory Authority	Type of ARAR/TBC	Title	Citation	Brief Description	ARAR/TBC Status
State of Georgia	State	Action	Management of Storm water Runoff	O.C.G.A 12-7-6(b)	Implementation of best management practices to prevent and minimize erosion and resultant sedimentation during excavation activities.	Potentially Applicable - If the remedial action results in excavation and movement of soils.
State of Georgia	State	Action	Management of Storm water Runoff	GA Rule 391-3-7-.06	Requires controlling the turbidity so storm water runoff discharges to ensure the limits in O.C.G.A 12-7-6(b) are not exceeded.	Potentially Applicable - If the remedial action results in excavation and movement of soils.
State of Georgia	State	Action	Fugitive Dust	GA Rule 391-3-1-.02(2)(n)(1)	Requires reasonable measures to prevent fugitive dust from becoming airborne during site actions.	Potentially Applicable - If the remedial action results in excavation and movement of soils.
State of Georgia	State	Action	Fugitive Dust	GA Rule 391-3-1-.02(2)(n)(2)	Prohibits the percent opacity from any fugitive dust source to equal ort exceed 20 percent.	Potentially Applicable - If the remedial action results in excavation and movement of soils.
Waste Management	Federal	Action	Disposal of RCRA-hazardous waste in a land-based unit	40 CFR 268	Allows waste to be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40CFR268.40 prior to land disposal.	Potentially Applicable - If the remedial action results in excavation and movement of soils.
Waste Management	Federal	Action	Disposal of RCRA-hazardous waste in a land-based unit	40 CFR 268	Requires that waste must be treated according to the alternative treatment standards of 40CFR268.49.	Potentially Applicable - If the remedial action results in the generation of hazardous waste (excavated soils, PPE, etc.).

Table 5-1
Hazard Quotients (HQs) for Primary COPC Evaluated in Food-Web Exposure Models for OU3

COPC	Exposure Basis	Calculated Intake (mg/kg-bw/day)	Toxicity reference value --TRV (mg/kg-bw/day)[a]			Hazard quotient -- HQ (Intake / TRV)[b]		
			LOAEL	GMAEL	NOAEL	LOAEL	GMAEL	NOAEL
		Mourning Dove (*Zenaida macroura*)						
Inorganic mercury								
	Site mean[c]	0.13	0.90	0.64	0.45	0.1	0.2	0.3
	Site maximum	0.96	0.90	0.64	0.45	1	**2**	**2**
Methylmercury								
	Site mean	0.00055	0.06	0.035	0.02	0.01	0.02	0.03
	Site maximum	0.0048	0.06	0.035	0.02	0.08	0.1	0.2
Aroclor 1268								
	Site mean	0.077	3.9	2.3	1.3	0.02	0.03	0.06
	Site maximum	0.60	3.9	2.3	1.3	0.2	0.3	0.5
Lead								
	Site mean	3.1	11.3	6.6	3.85	0.3	0.5	0.8
	Site maximum	22	11.3	6.6	3.85	**2**	**3**	**6**
		Carolina Wren (*Thryothorus ludovicianus*)						
Inorganic mercury								
	Site mean	0.00019	0.90	0.64	0.45	0.0002	0.0003	0.0004
	Site maximum	0.13	0.90	0.64	0.45	0.1	0.2	0.3
Methylmercury								
	Site mean	0.0097	0.06	0.035	0.02	0.2	0.3	0.5
	Site maximum	0.025	0.06	0.035	0.02	0.4	0.7	1
Aroclor 1268								
	Site mean	0.0550	3.9	2.3	1.3	0.01	0.02	0.04
	Site maximum	0.22	3.9	2.3	1.3	0.06	0.1	0.2
Lead								
	Site mean	0.66	11.3	6.6	3.85	0.06	0.1	0.2
	Site maximum	4.8	11.3	6.6	3.85	0.4	0.7	1
		Broad-Winged Hawk (*Buteo platypterus*)						
Inorganic mercury								
	Site mean							
	90% IHg:	0.036	0.90	0.64	0.45	0.04	0.06	0.08
	50% IHg	0.024	0.90	0.64	0.45	0.03	0.04	0.05
	0% IHg	0.011	0.90	0.64	0.45	0.012	0.017	0.024
	Site maximum							
	90% IHg:	0.18	0.90	0.64	0.45	0.2	0.3	0.4
	50% IHg	0.13	0.90	0.64	0.45	0.1	0.2	0.3
	0% IHg	0.056	0.90	0.64	0.45	0.06	0.09	0.1
Methylmercury								
	Site mean							
	10% MeHg	0.0027	0.06	0.035	0.02	0.05	0.08	0.1
	50% MeHg	0.014	0.06	0.035	0.02	0.2	0.4	0.7
	100% MeHg	0.027	0.06	0.035	0.02	0.5	0.8	1
	Site maximum							
	10% MeHg	0.015	0.06	0.035	0.02	0.3	0.4	0.8
	50% MeHg	0.072	0.06	0.035	0.02	1	**2**	**4**
	100% MeHg	0.14	0.06	0.035	0.02	**2**	**4**	**7**
Aroclor 1268								
	Site mean	0.061	3.9	2.3	1.3	0.02	0.03	0.05
	Site maximum	0.48	3.9	2.3	1.3	0.1	0.2	0.4
Lead								
	Site mean	1.1	11.3	6.6	3.85	0.1	0.2	0.3
	Site maximum	5.0	11.3	6.6	3.85	0.4	0.8	1
		Meadow Vole (*Microtus pennsylvanicus*)						
Inorganic mercury								
	Site mean	0.18	0.37	0.37	0.37	0.5	0.5	0.5
	Site maximum	1.5	0.37	0.37	0.37	**4**	**4**	**4**
Methylmercury								
	Site mean	0.00096	0.15	0.11	0.075	0.01	0.01	0.01
	Site maximum	0.0085	0.15	0.11	0.075	0.06	0.08	0.1
Aroclor 1268 (as Aroclor 1254)	Site mean	0.11	0.3	0.095	0.03	0.4	1	**4**
	Site maximum	0.87	0.3	0.095	0.03	**3**	**9**	**29**
Lead								
	Site mean	3.4	80	25	8	0.04	0.1	0.4
	Site maximum	21	80	25	8	0.3	0.8	**2.63**
		Short-Tailed Shrew (*Blarina carolinensis*)						
Inorganic mercury	Site mean	0.24	0.37	0.37	0.37	0.6	0.6	0.6
	Site maximum	1.9	0.37	0.37	0.37	**5**	**5**	**5**
Methylmercury								
	Site mean	0.016	0.15	0.11	0.075	0.1	0.1	0.2
	Site maximum	0.060	0.15	0.11	0.075	0.4	0.5	0.8
Aroclor 1268[c] (as Aroclor 1254)	Site mean	0.18	0.3	0.095	0.03	0.6	**2**	**6**
	Site maximum	0.86	0.3	0.095	0.03	**3**	**9**	**29**
Lead								
	Site mean	4.6	80	25	8	0.06	0.2	0.6
	Site maximum	27	80	25	8	0.3	1	**3**

Table 5-1

Hazard Quotients (HQs) for Primary COPC Evaluated in Food-Web Exposure Models for OU3

Long-Tailed Weasel (*Mustela frenata*)

Inorganic mercury								
	Site mean							
	90% IHg:	0.039	0.37	0.37	0.37	0.1	0.1	0.1
	50% IHg	0.026	0.37	0.37	0.37	0.07	0.07	0.07
	0% IHg	0.0094	0.37	0.37	0.37	0.03	0.03	0.03
	Site maximum							
	90% IHg:	0.20	0.37	0.37	0.37	0.5	0.5	0.5
	50% IHg	0.13	0.37	0.37	0.37	0.4	0.4	0.4
	0% IHg	0.049	0.37	0.37	0.37	0.1	0.1	0.1
Methylmercury								
	Site mean							
	10% MeHg	0.0032	0.15	0.11	0.075	0.02	0.03	0.04
	50% MeHg	0.016	0.15	0.11	0.075	0.1	0.1	0.2
	100% MeHg	0.032	0.15	0.11	0.075	0.2	0.3	0.4
	Site maximum							
	10% MeHg	0.017	0.15	0.11	0.075	0.1	0.2	0.2
	50% MeHg	0.084	0.15	0.11	0.075	0.6	0.8	**1**
	100% MeHg	0.17	0.15	0.11	0.075	1	**2**	**2**
Aroclor 1268[c] (as Aroclor 1254)	Site mean	0.070	0.3	0.095	0.03	0.2	0.7	**2**
	Site maximum	0.56	0.3	0.095	0.03	**2**	**6**	**19**
Lead								
	Site mean	0.75	80	25	8	0.01	0.03	0.09
	Site maximum	4.9	80	25	8	0.06	0.2	0.6

Notes:

[a] LOAEL (lowest-observed-adverse-effect-level) and NOAEL (no-observed-adverse-effect-level). GMAEL (geometric-mean-adverse-effect-level) TRVs are the geometric means of LOAEL and NOAEL TRVs. Note that mammalian TRVs for Aroclor-1254 are based on a study with Aroclor-1254, a substantially more toxic PCB.

[b] HQs greater than 1 (rounded to one significant digit) are identified in **bold print**.

[c] HQs based on mean intake estimates are shown with gray shading.

FIGURES

Site Location

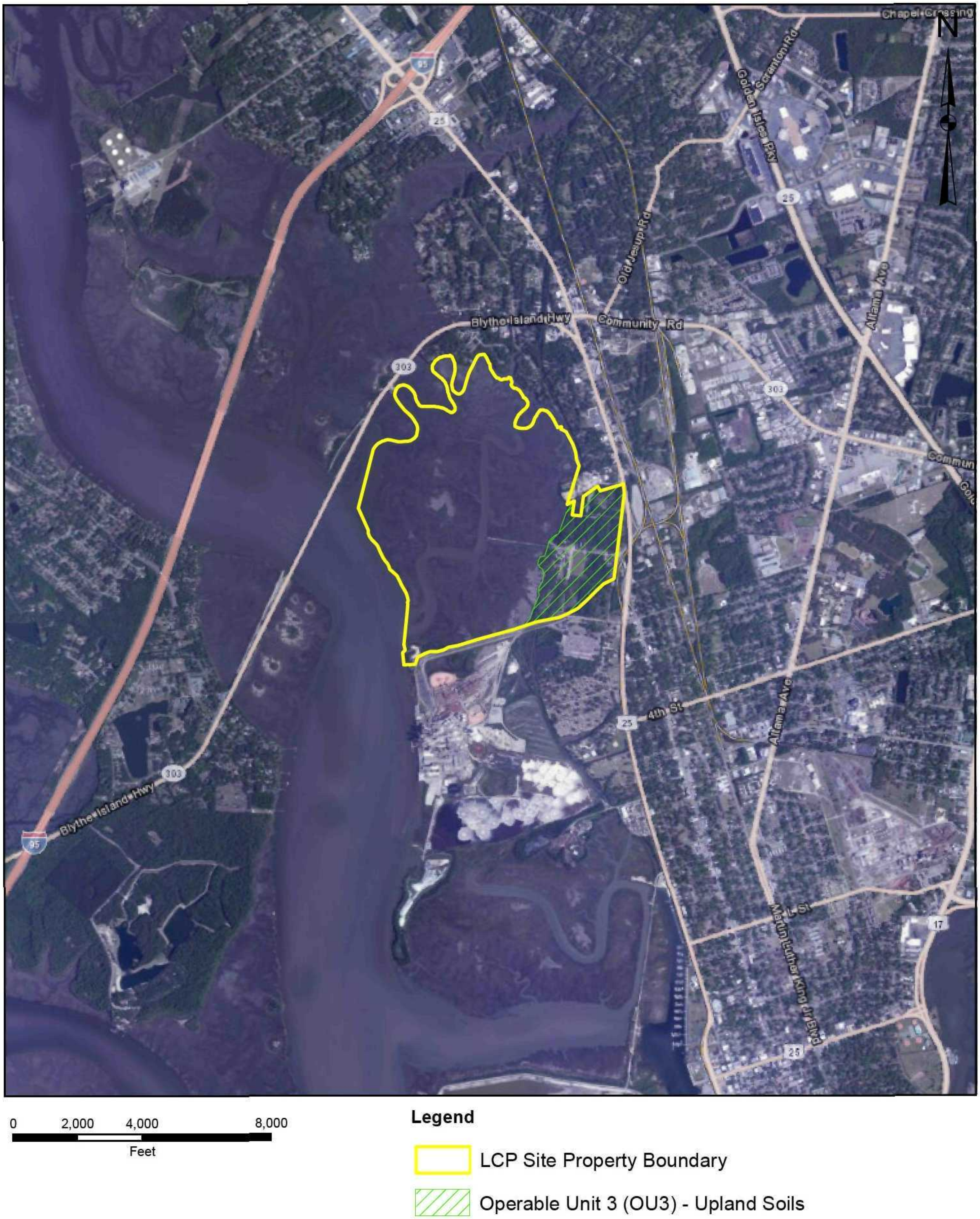


Figure No.2-1

Human Health Risk Assessment Exposure Units

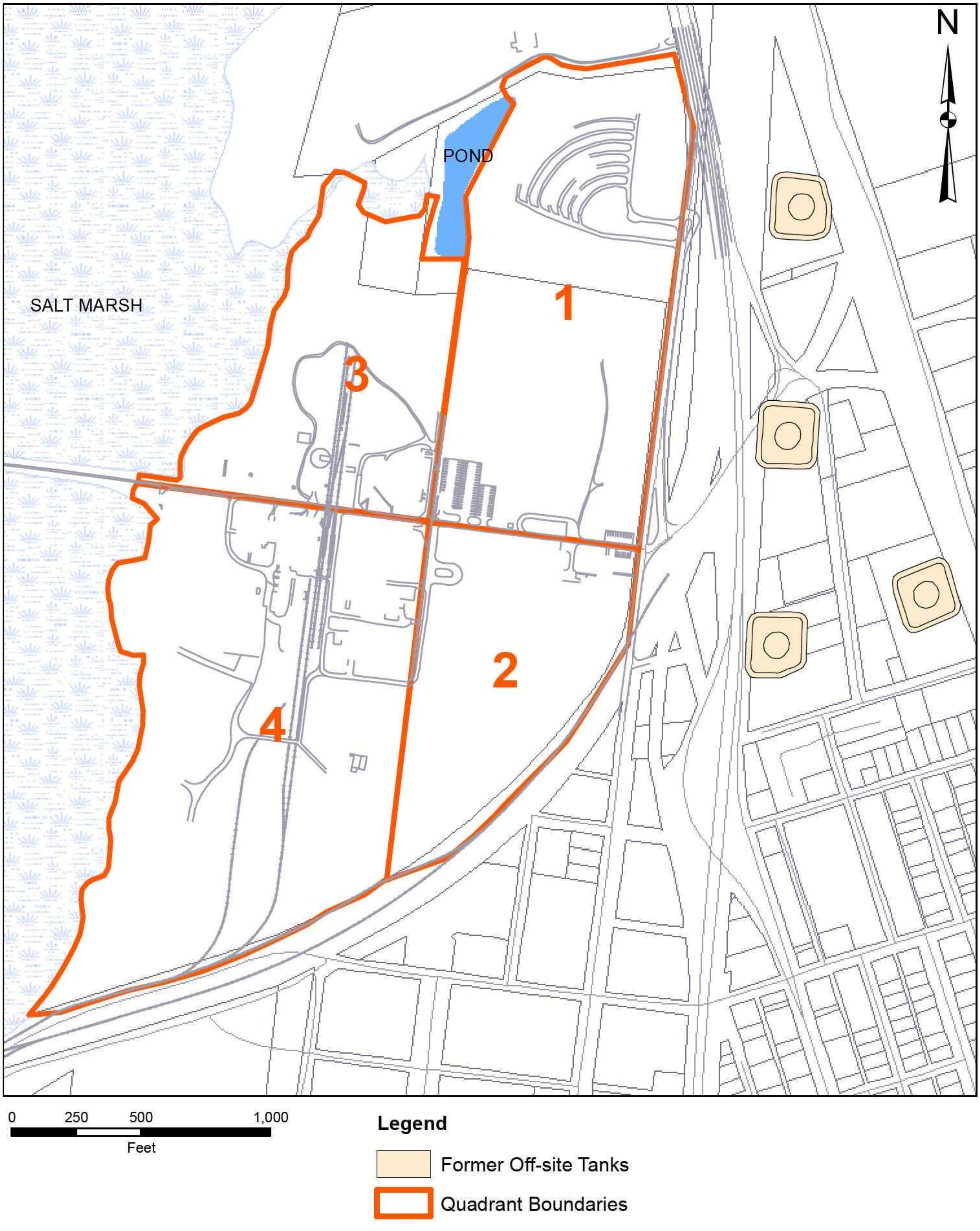


Figure No.2-2

Quadrant 4 Surface Soil Select Data Exclusions

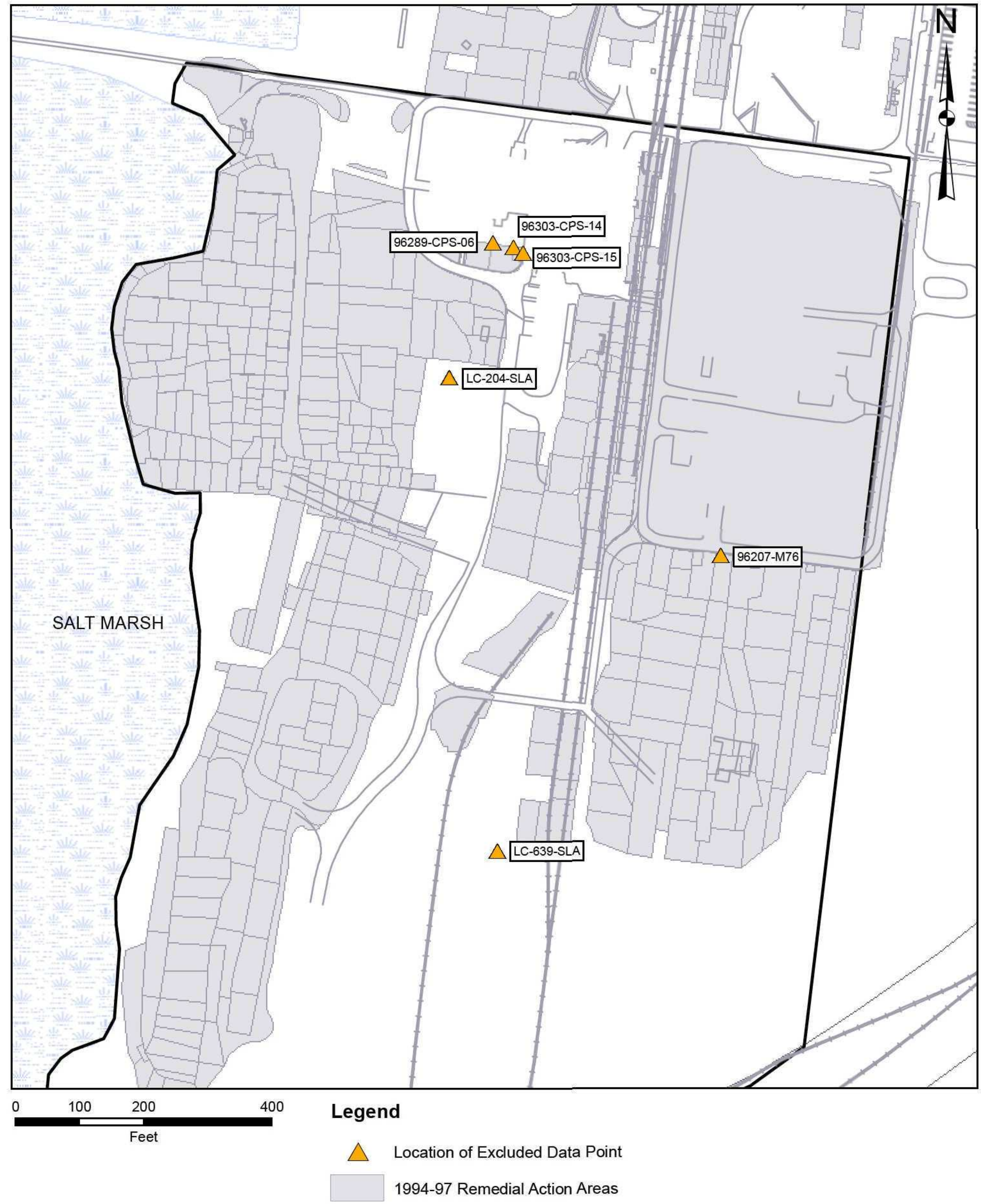
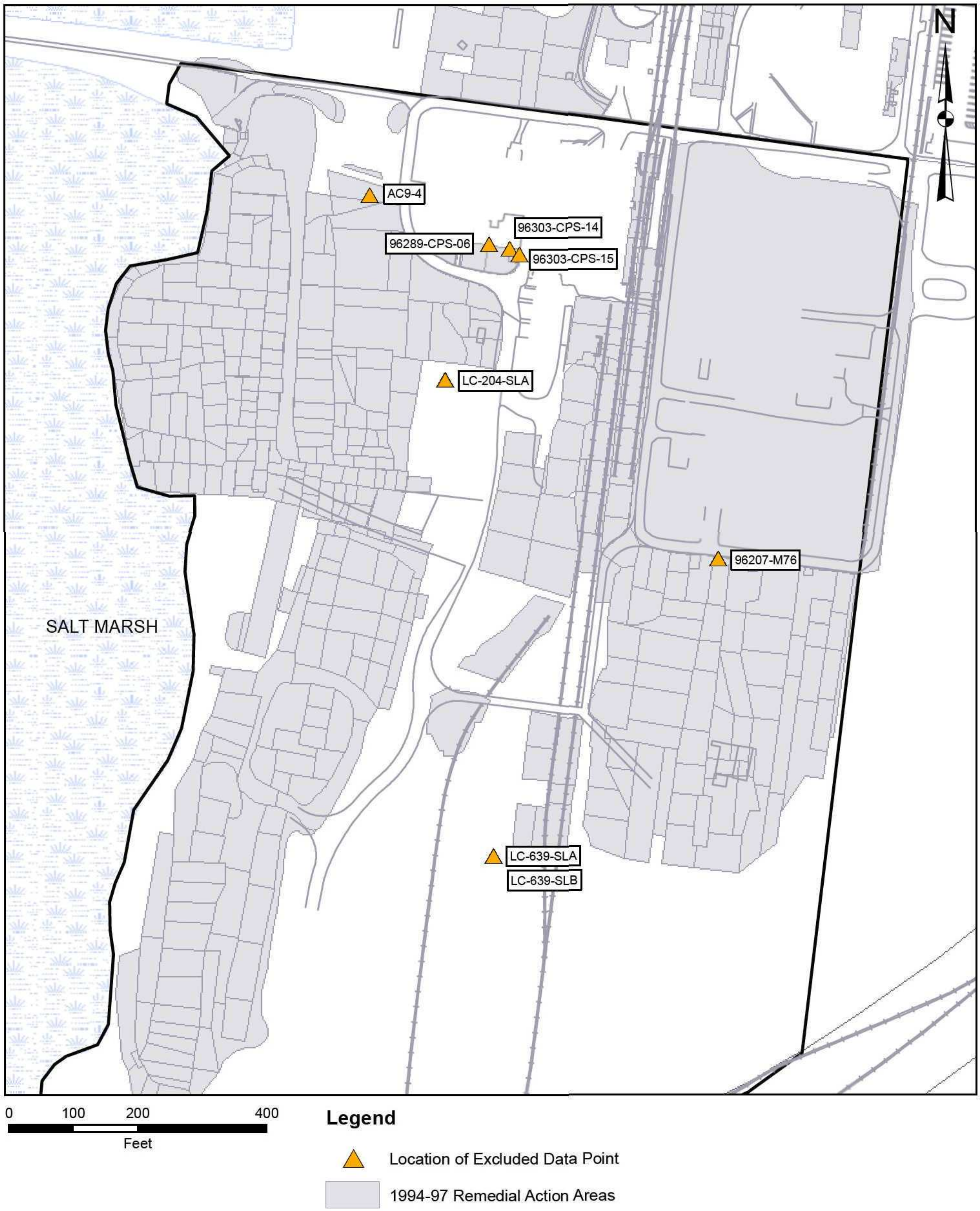


Figure No.5-1

Quadrant 4 Subsurface Soil Select Data Exclusions



LCP OU3 Vadose Zone Soil Thickness
Average Water Table Depth (2001-2012)

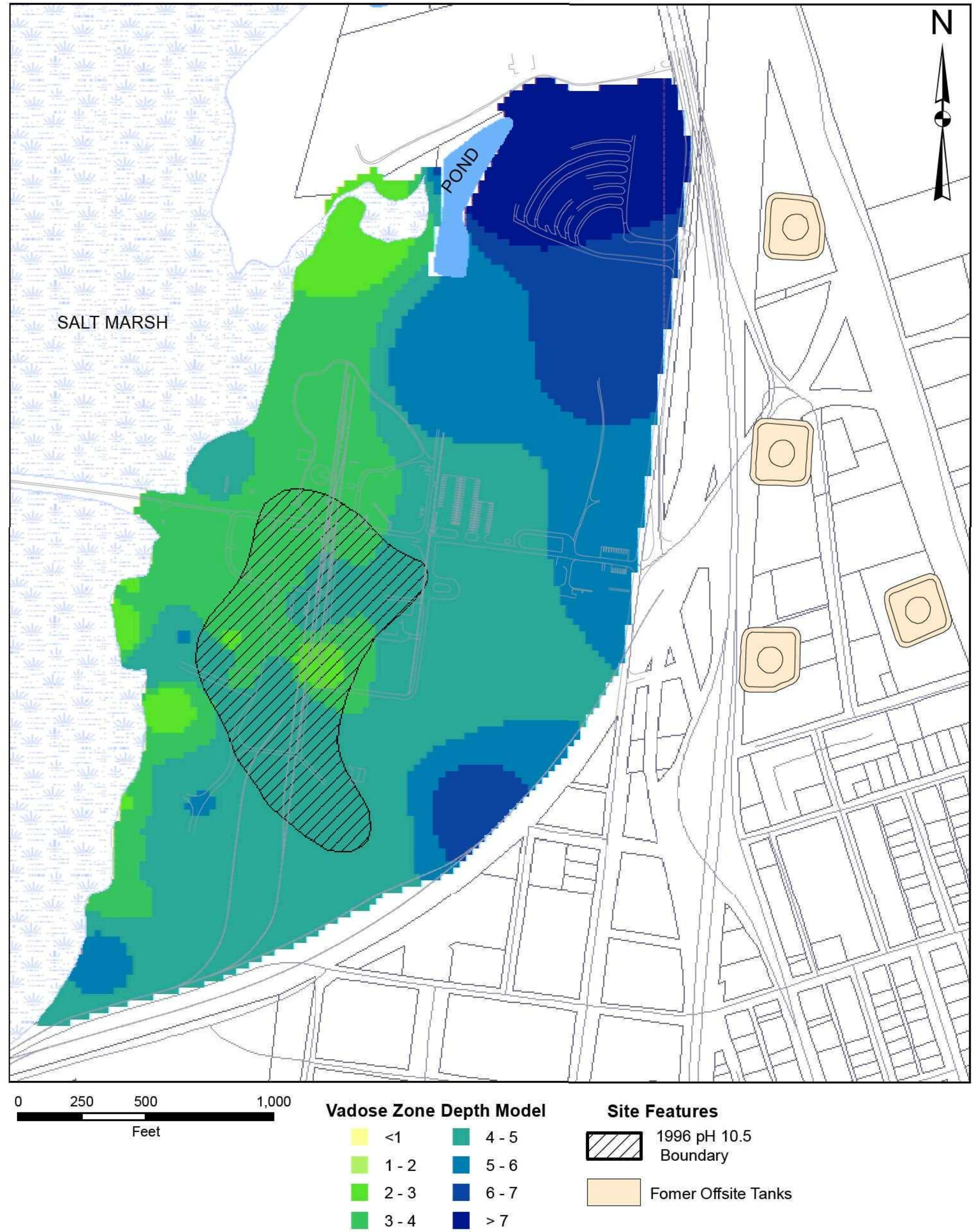


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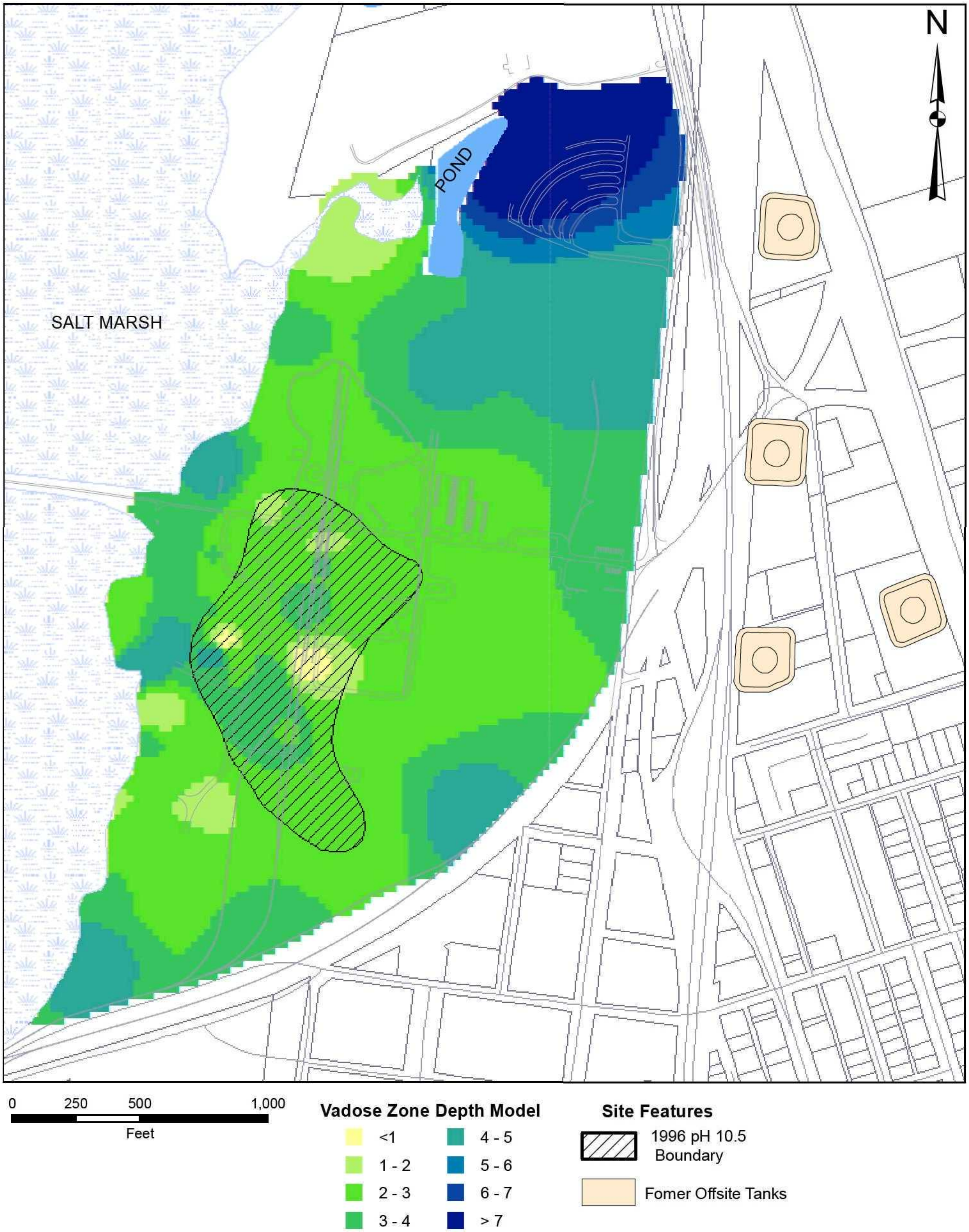
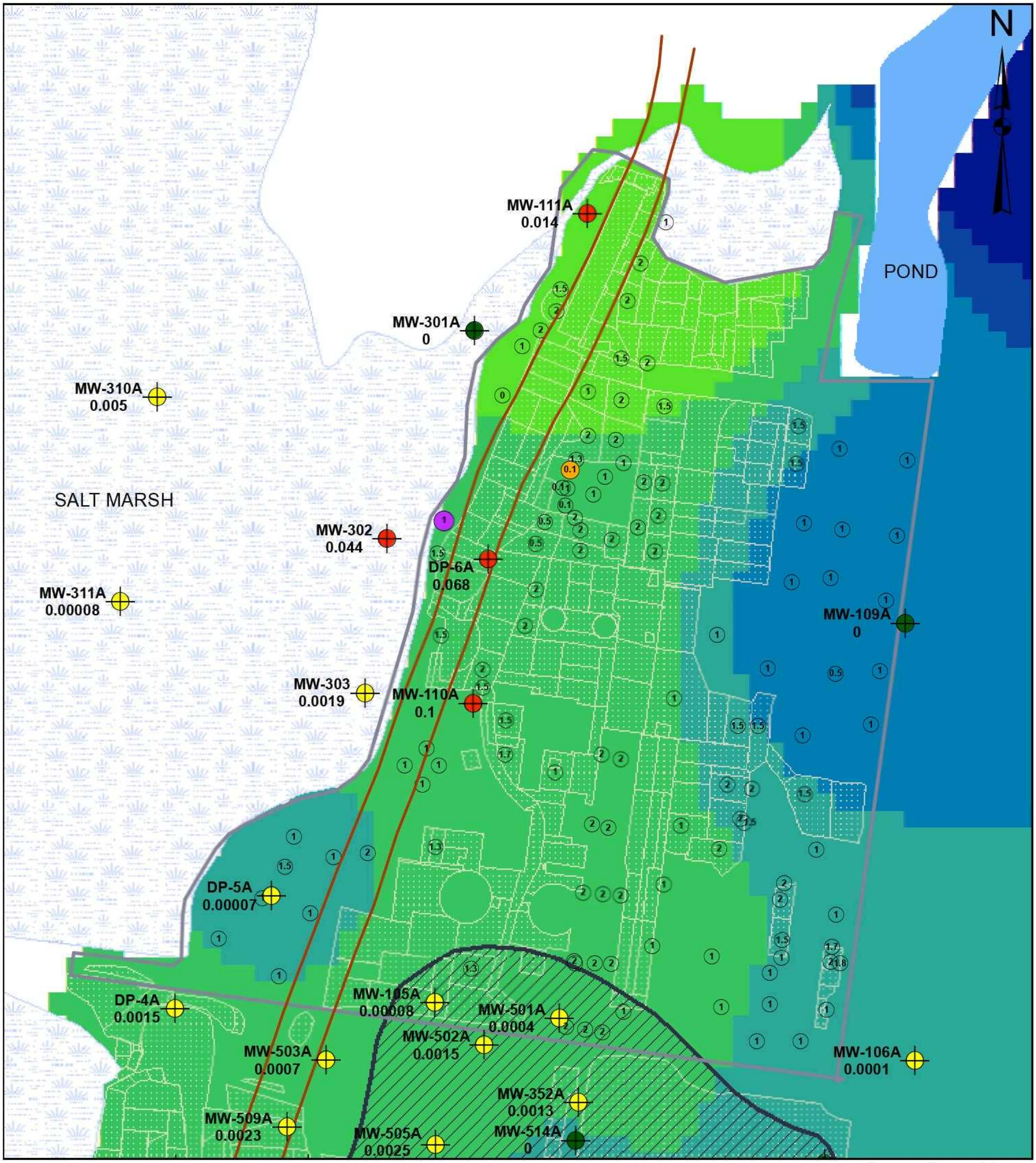
Figure No.5-3

LCP OU3 Vadose Zone Soil Thickness
High Water Table Depth (2001-2012)



Soil Leaching Potential of Benzene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3



0 100 200 400
Feet

2012 GW Result
Data shown as mg/L
ND | < MCL | > MCL

Leaching COC Profile
- < Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=20

Note: D2 of Sample Depth Shown

Vadose Zone Depth
<1 | 1 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 - 6 | 6 - 7 | > 7

Former Brunswick-Altamaha Canal
1994-97 Removal Action Areas
1996 pH 10.5 Boundary - "CBP"

Soil Leaching Potential of Benzene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

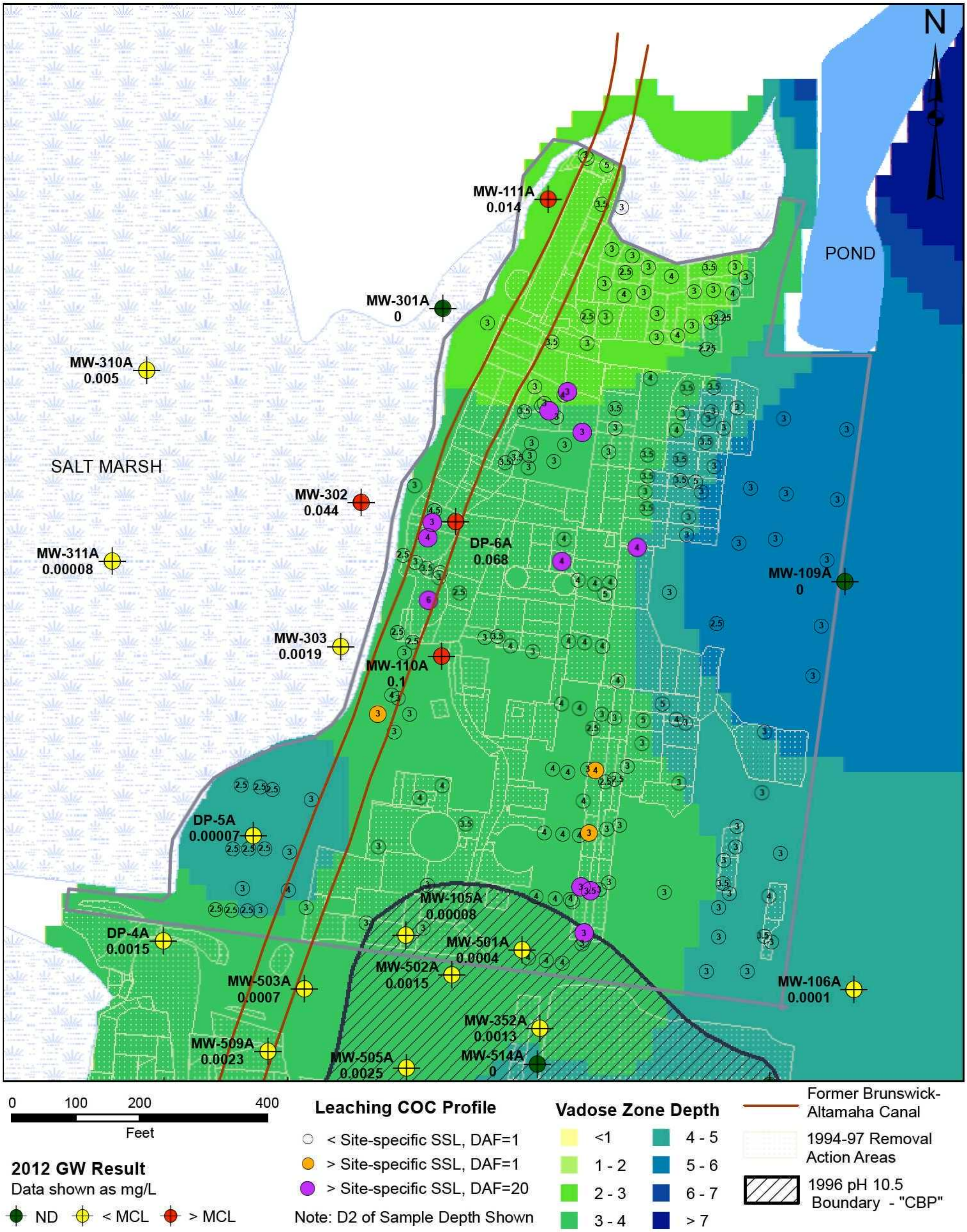


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Figure No.5-5b

Soil Leaching Potential of Dichloromethane in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

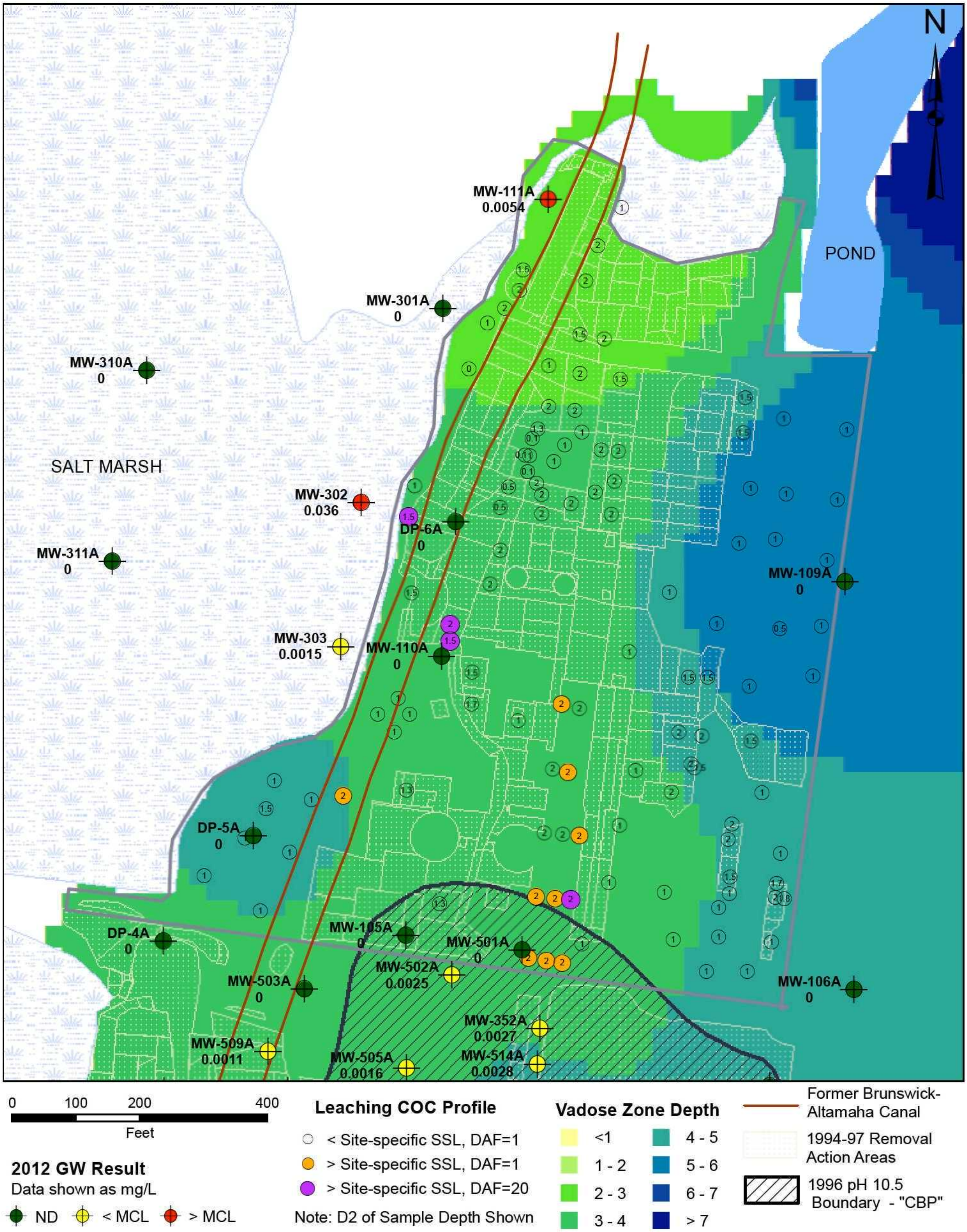

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Figure No.5-6a

Soil Leaching Potential of Dichloromethane in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

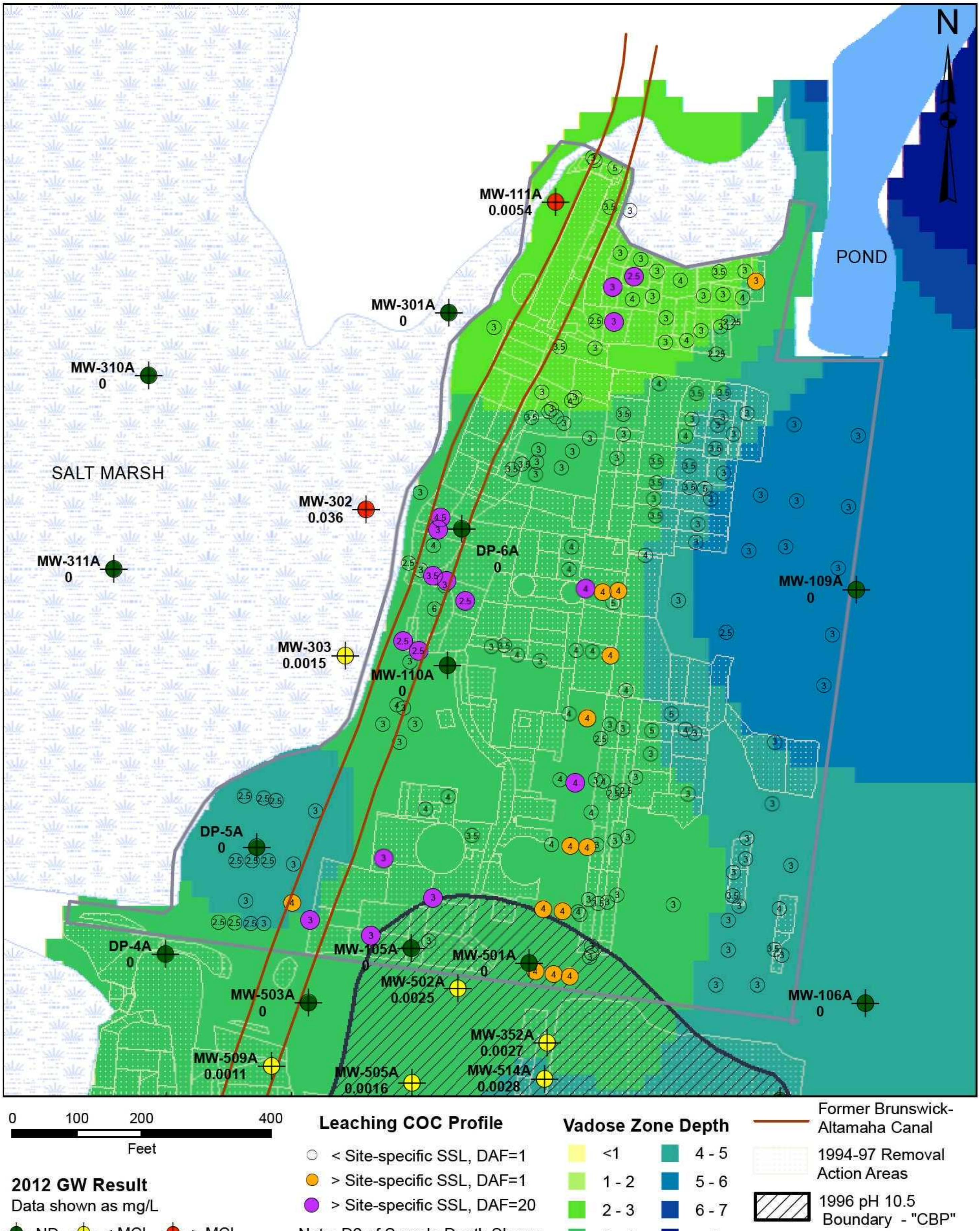

Figure No.5-6b

Soil Leaching Potential of Lead in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

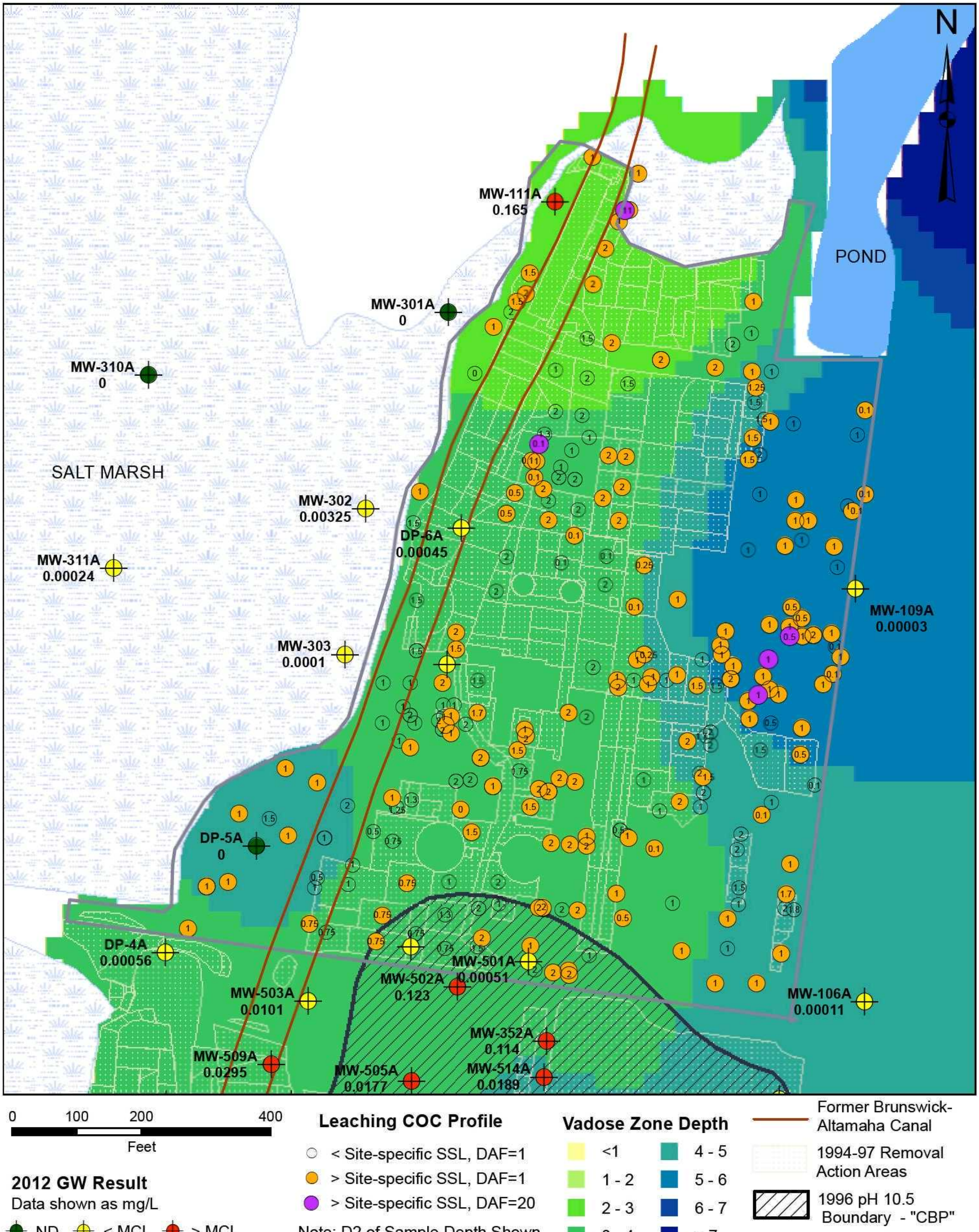

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Figure No.5-7a

Soil Leaching Potential of Lead in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

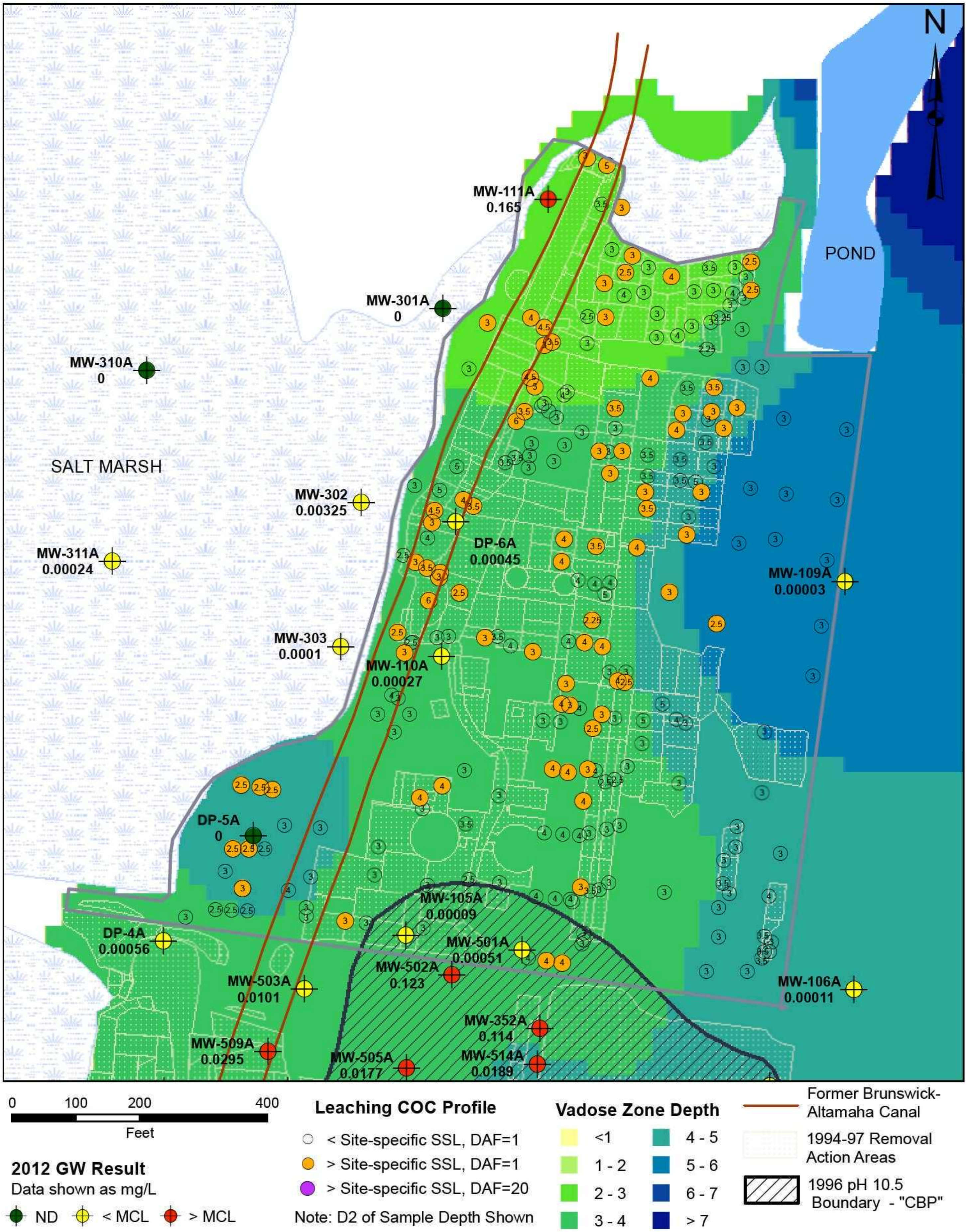

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Figure No.5-7b

Soil Leaching Potential of Mercury in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

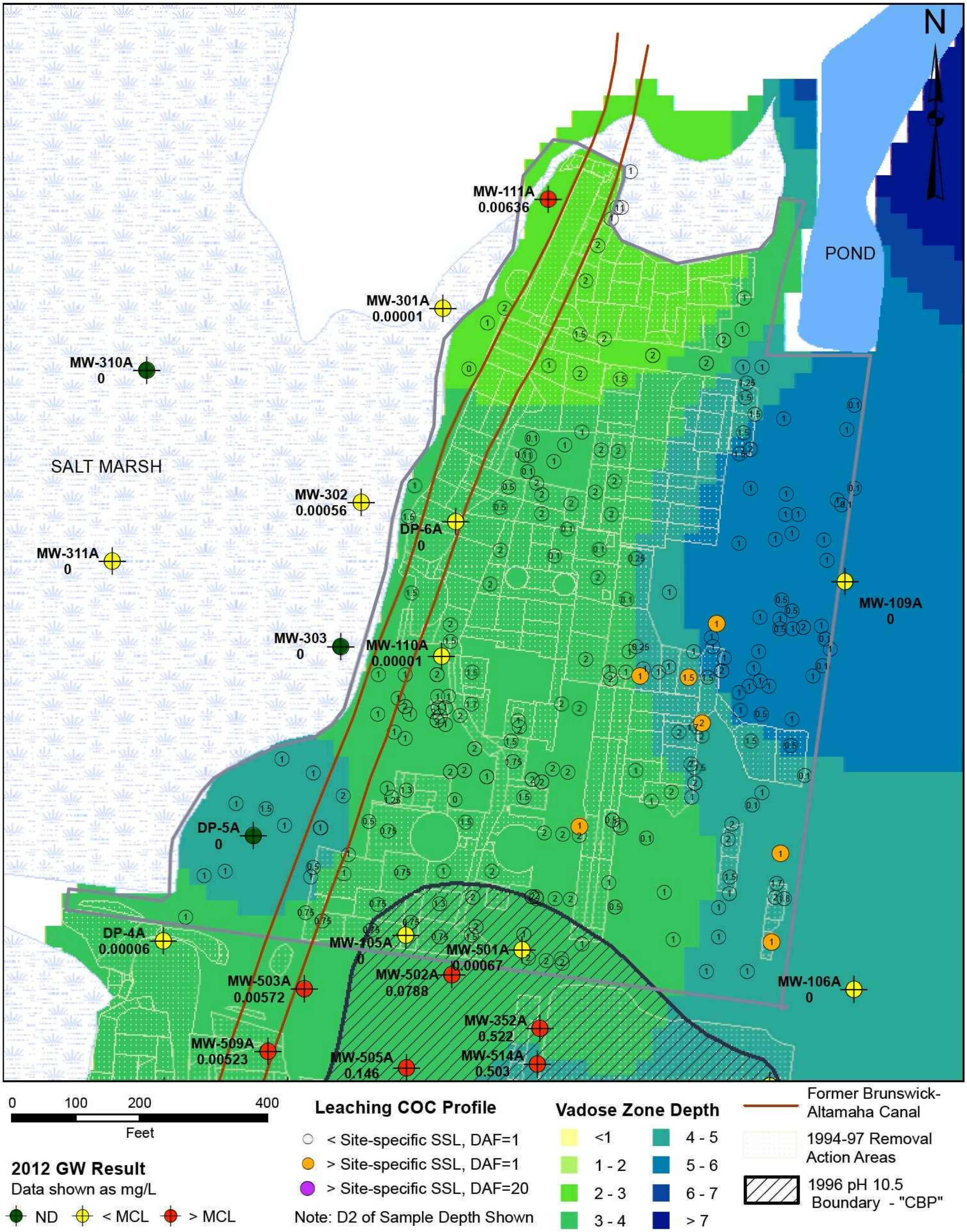

Figure No.5-8a

Soil Leaching Potential of Mercury in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

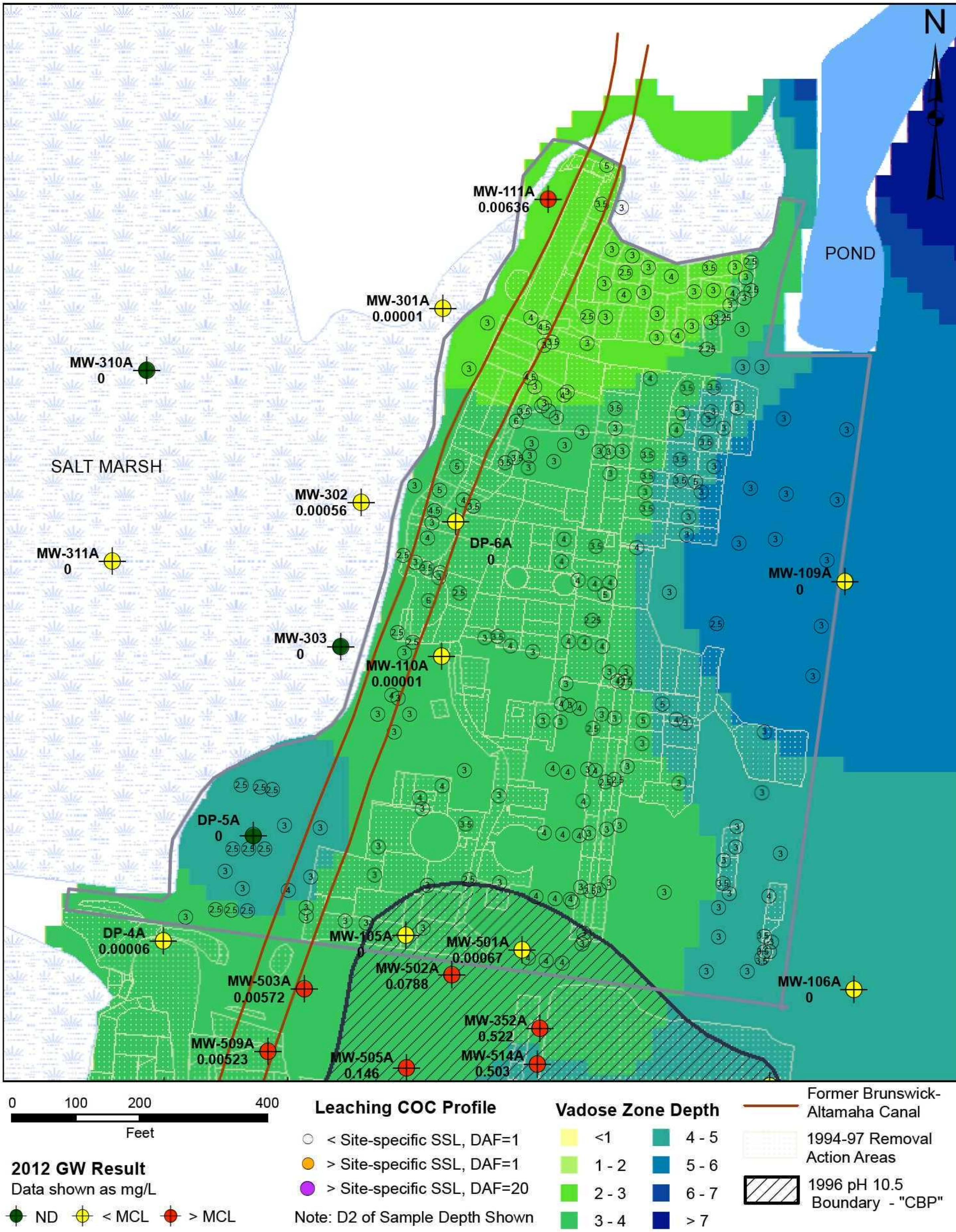

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Figure No.5-8b

Soil Leaching Potential of 2-Methylnaphthalene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

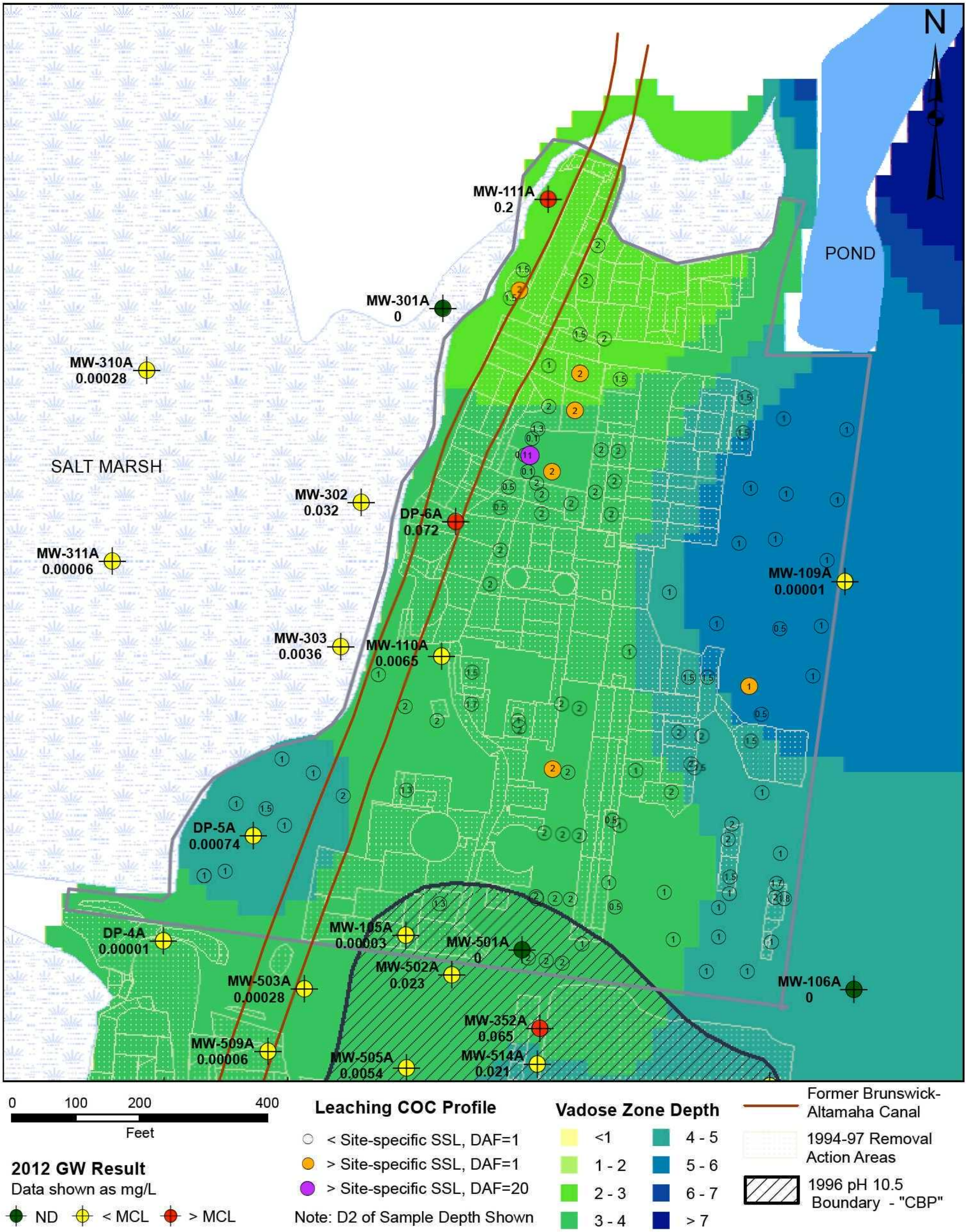


Figure No.5-9a

Soil Leaching Potential of 2-Methylnaphthalene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

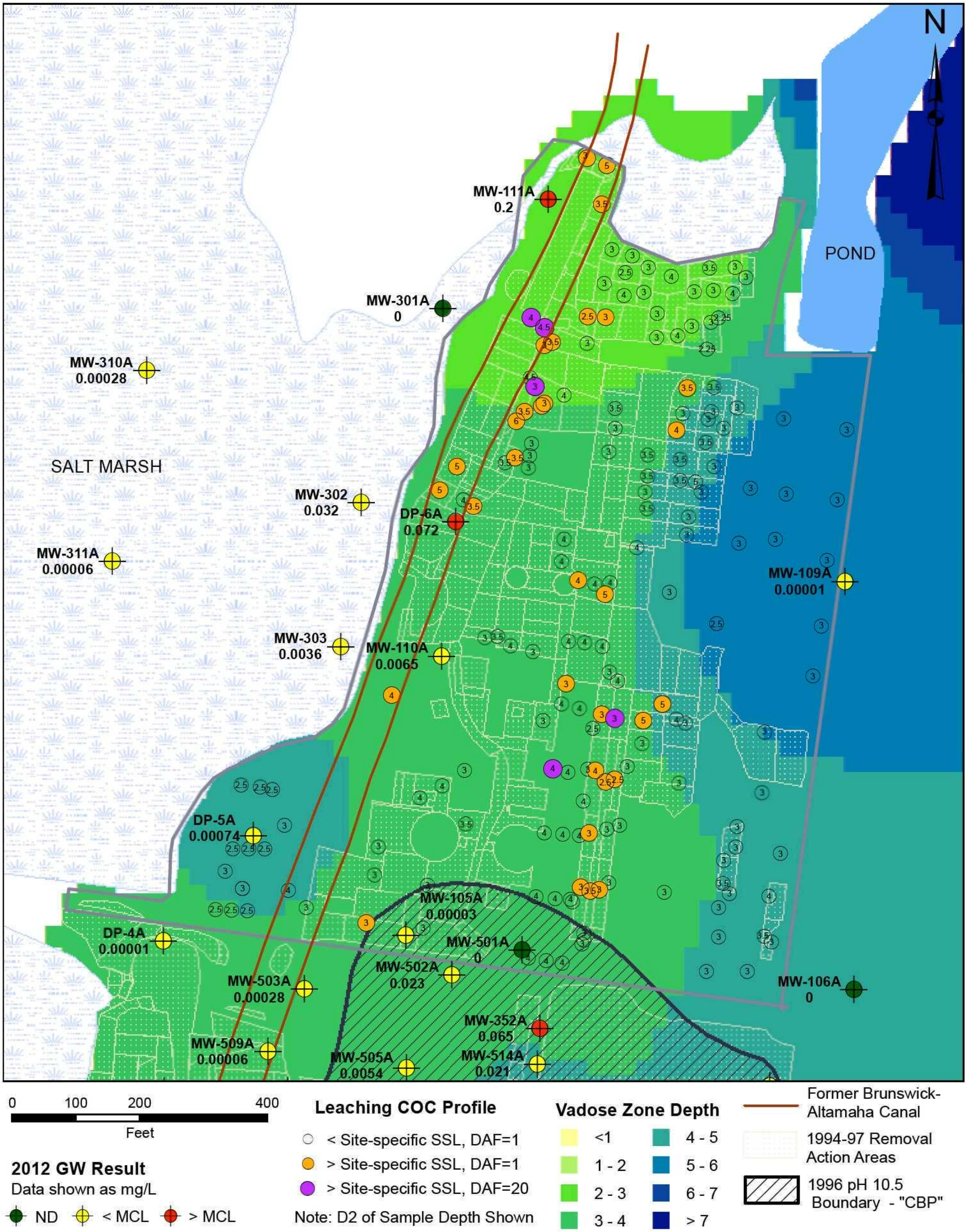


Figure No.5-9b

Soil Leaching Potential of Naphthalene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

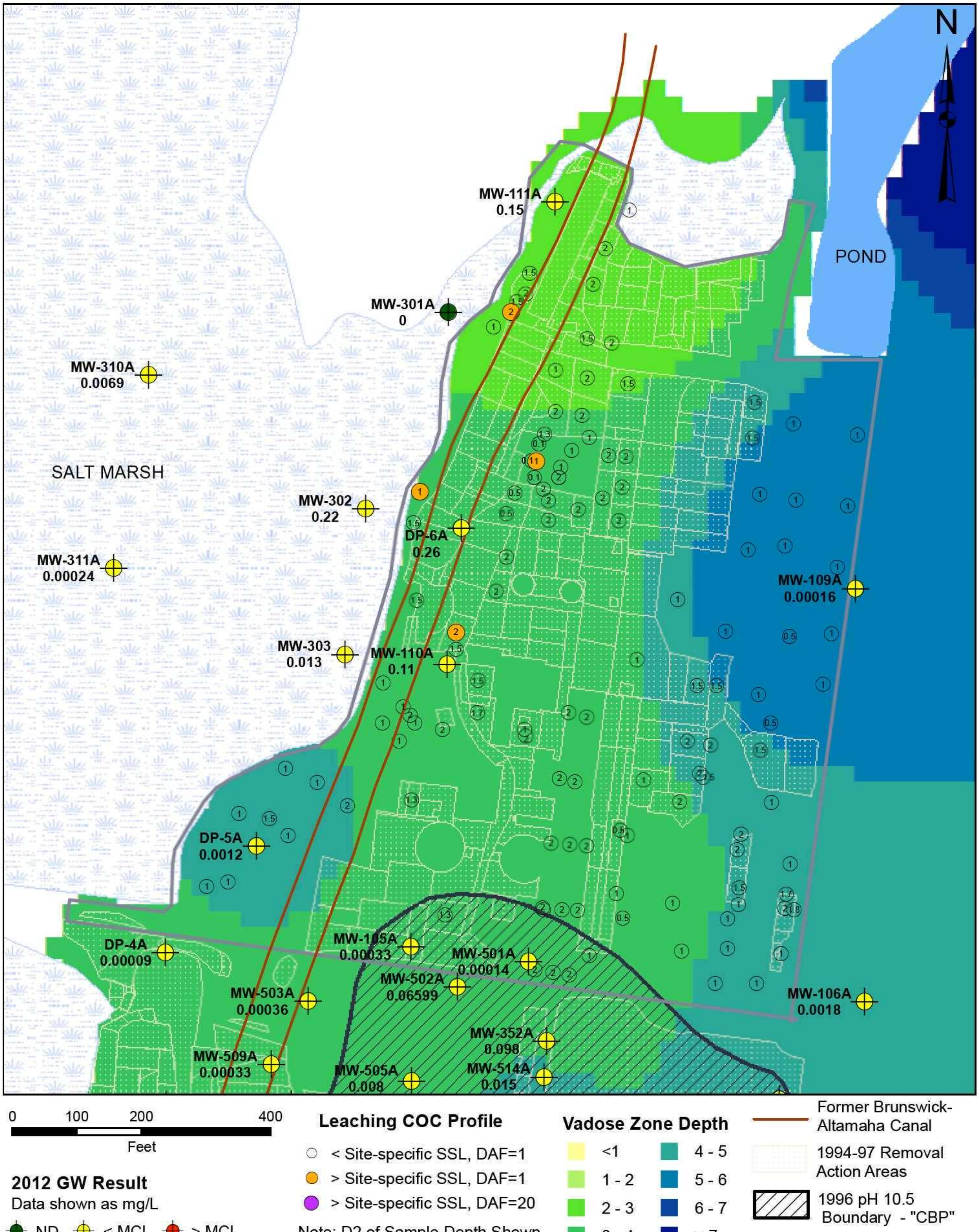
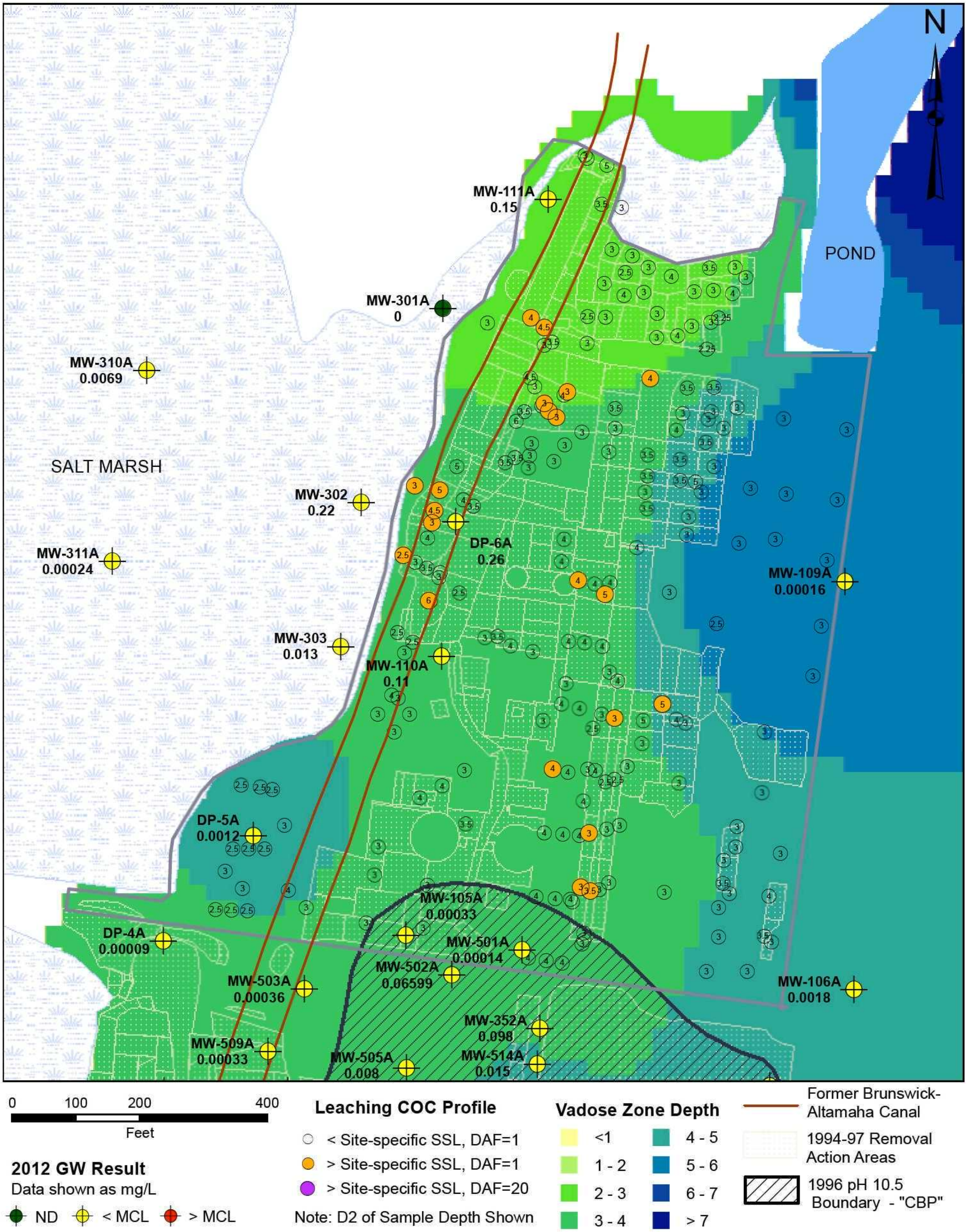


Figure No.5-10a

Soil Leaching Potential of Naphthalene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3



Environmental Planning Specialists, Inc.

Figure No.5-10b

Soil Leaching Potential of 1,2,4-Trimethylbenzene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

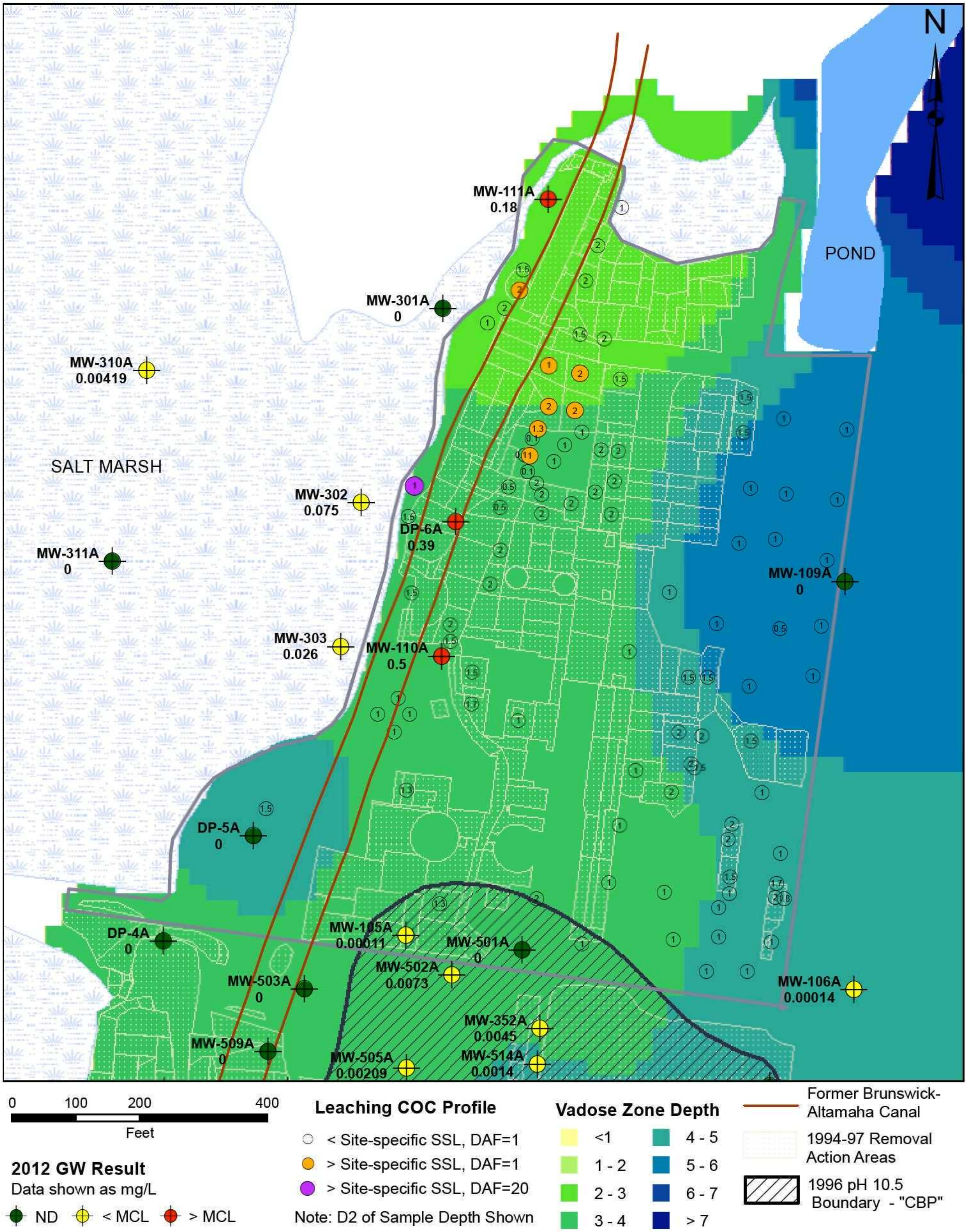


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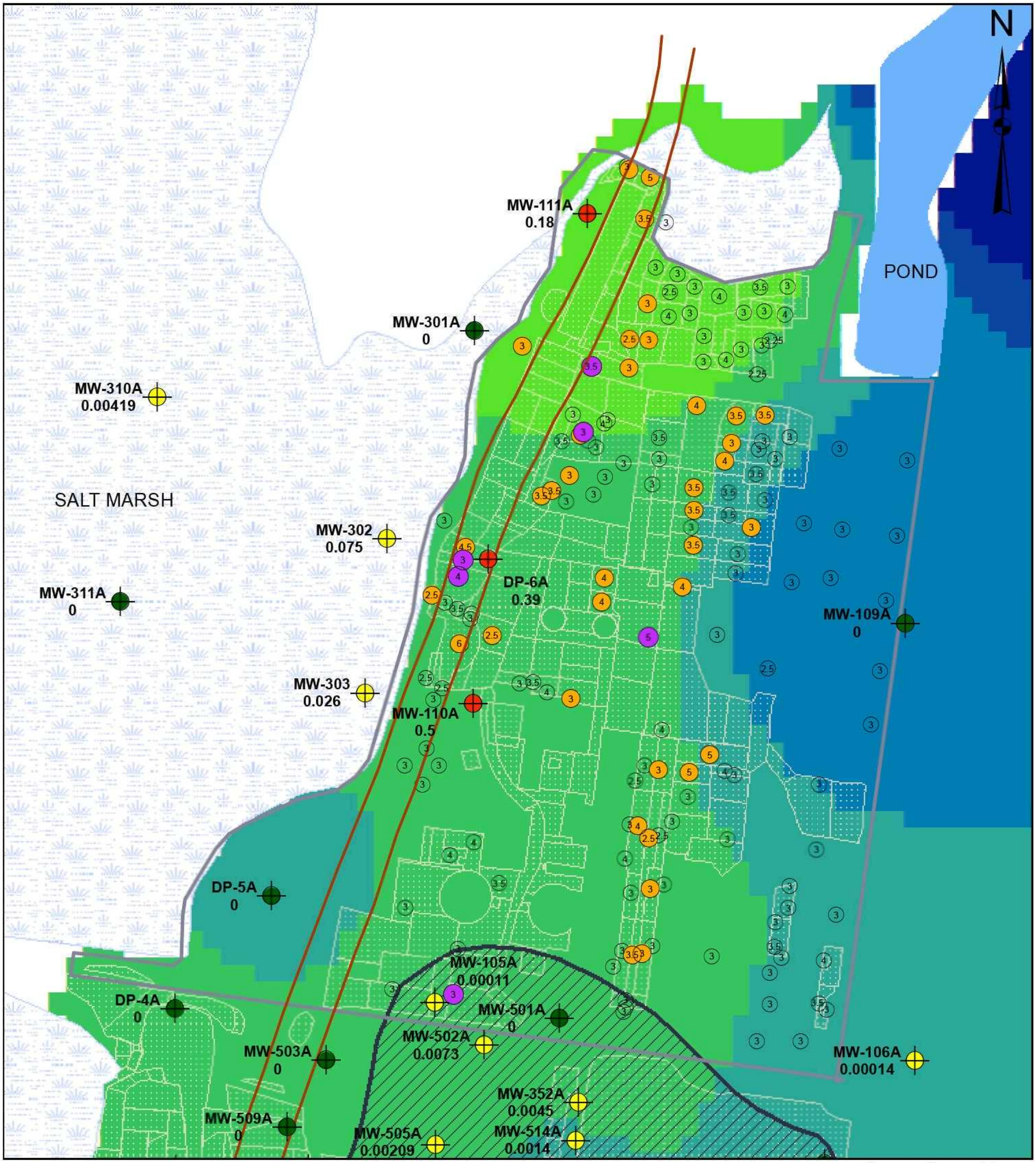
Figure No.5-11a

Soil Leaching Potential of 1,2,4-Trimethylbenzene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3



0 100 200 400
Feet

2012 GW Result
Data shown as mg/L
ND · < MCL · > MCL

Leaching COC Profile
- < Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=20

Note: D2 of Sample Depth Shown

Vadose Zone Depth
<1 · 1 - 2 · 2 - 3 · 3 - 4 · 4 - 5 · 5 - 6 · 6 - 7 · > 7

Former Brunswick-Altamaha Canal
1994-97 Removal Action Areas
1996 pH 10.5 Boundary - "CBP"

Soil Leaching Potential of 1,3,5-Trimethylbenzene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 3

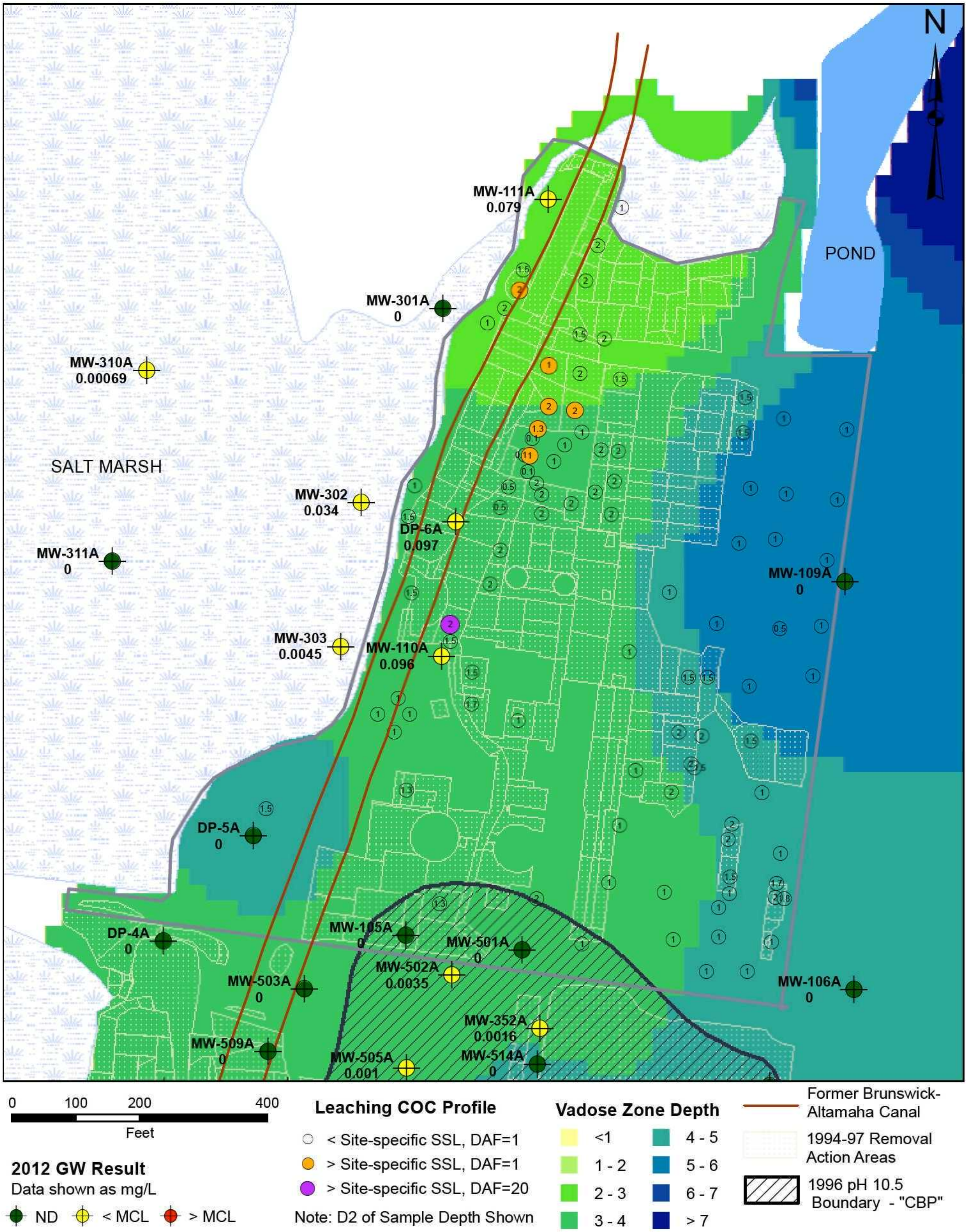


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Figure No.5-12a

Soil Leaching Potential of 1,3,5-Trimethylbenzene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 3

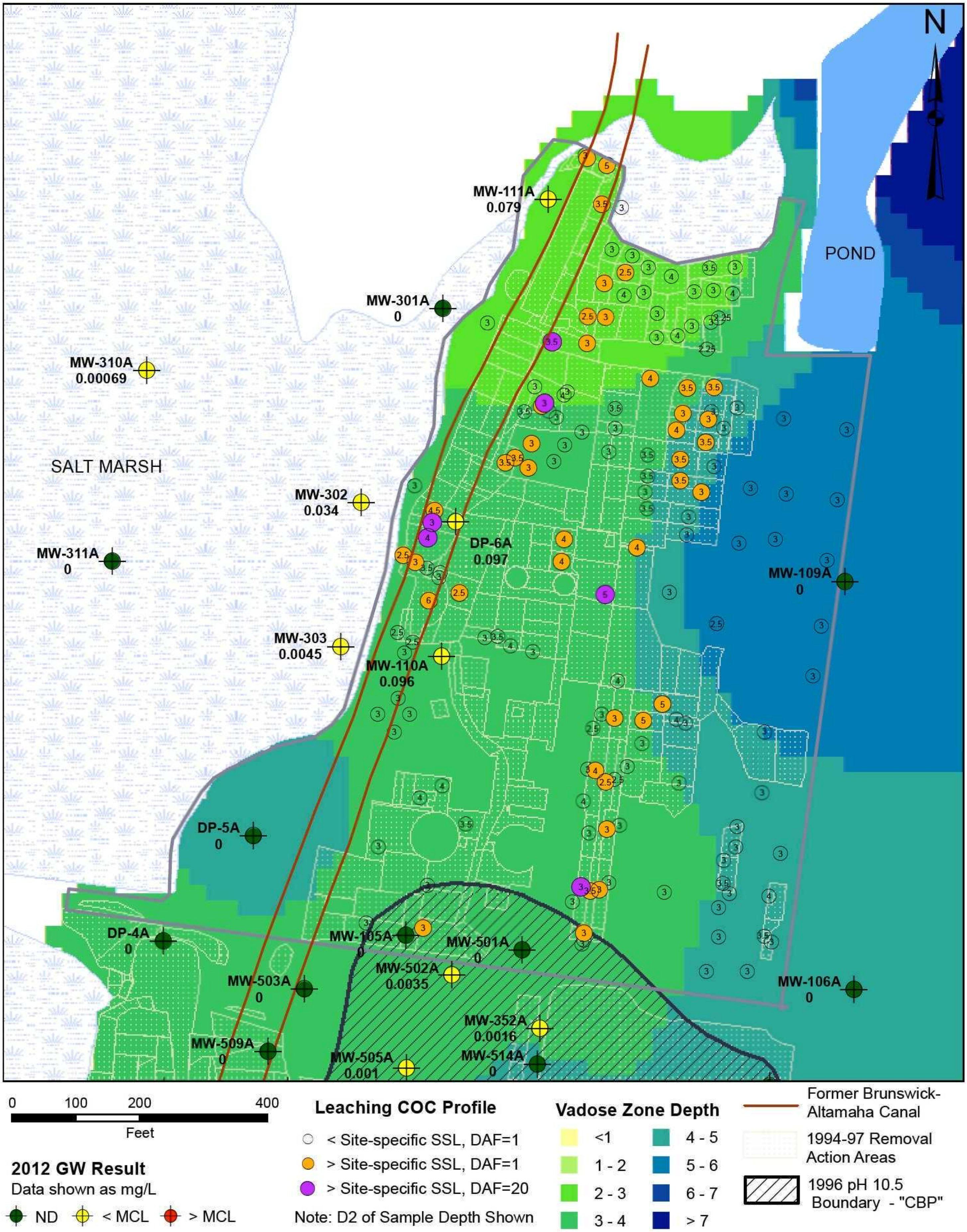


Figure No.5-12b

Soil Leaching Potential of Lead in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 4

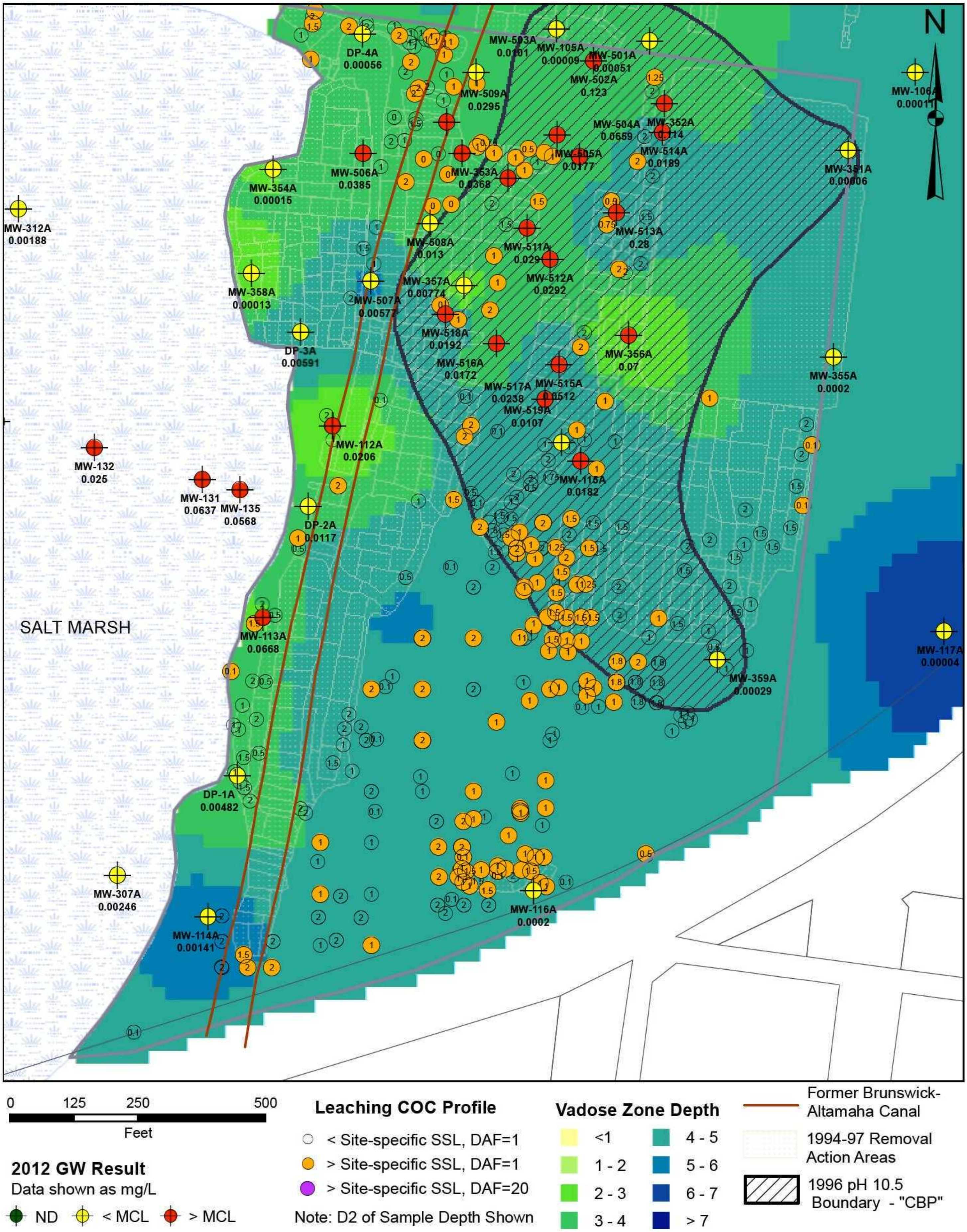
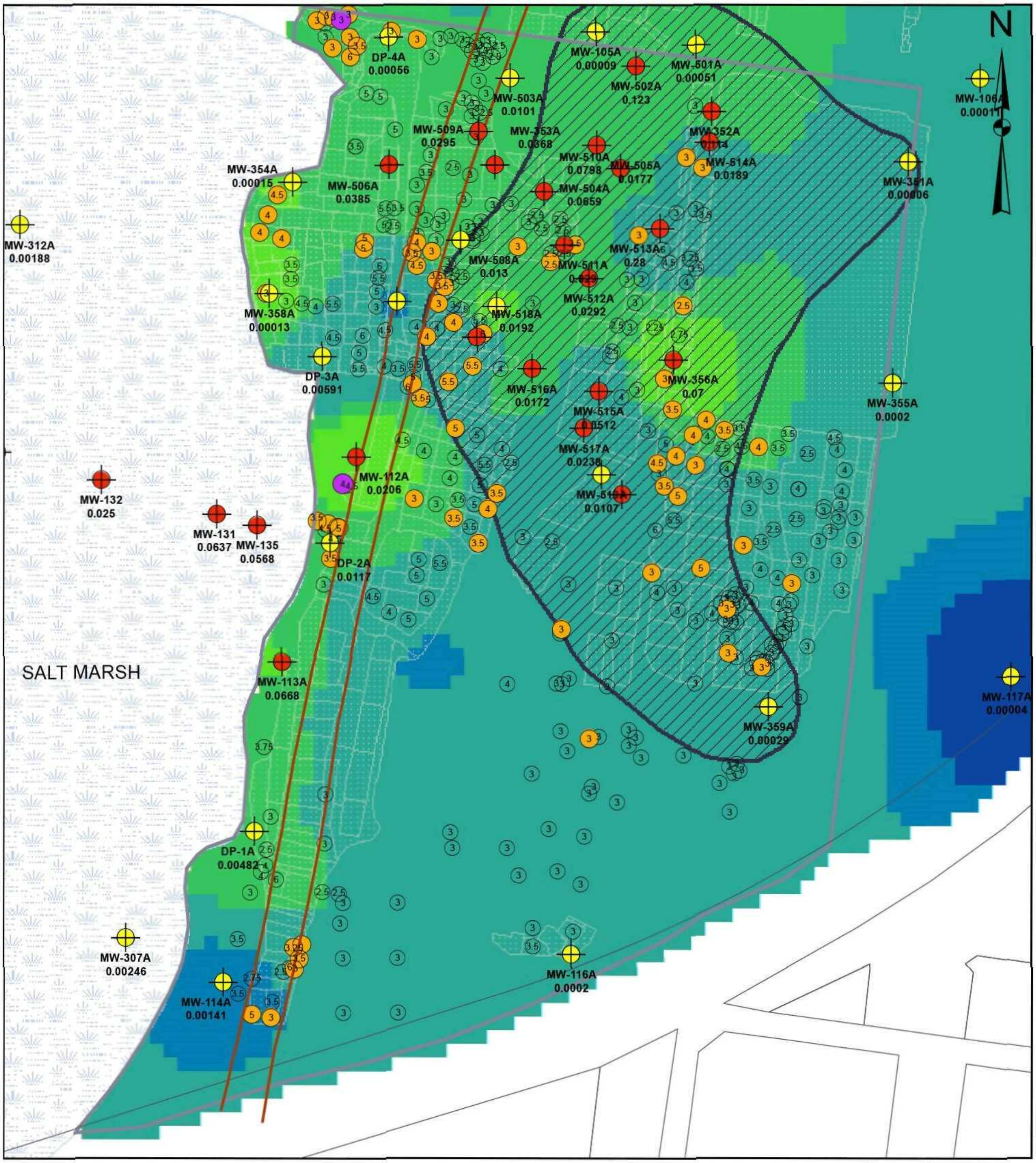


Figure No.5-13a

Soil Leaching Potential of Lead in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 4



0 125 250 500
Feet

2012 GW Result
Data shown as mg/L
ND · < MCL · > MCL

Leaching COC Profile
- < Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=20

Note: D2 of Sample Depth Shown

Vadose Zone Depth
- <1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- > 7

- Former Brunswick-Altamaha Canal
- 1994-97 Removal Action Areas
- 1996 pH 10.5 Boundary - "CBP"

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Figure No.5-13b

Soil Leaching Potential of Mercuy in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 4

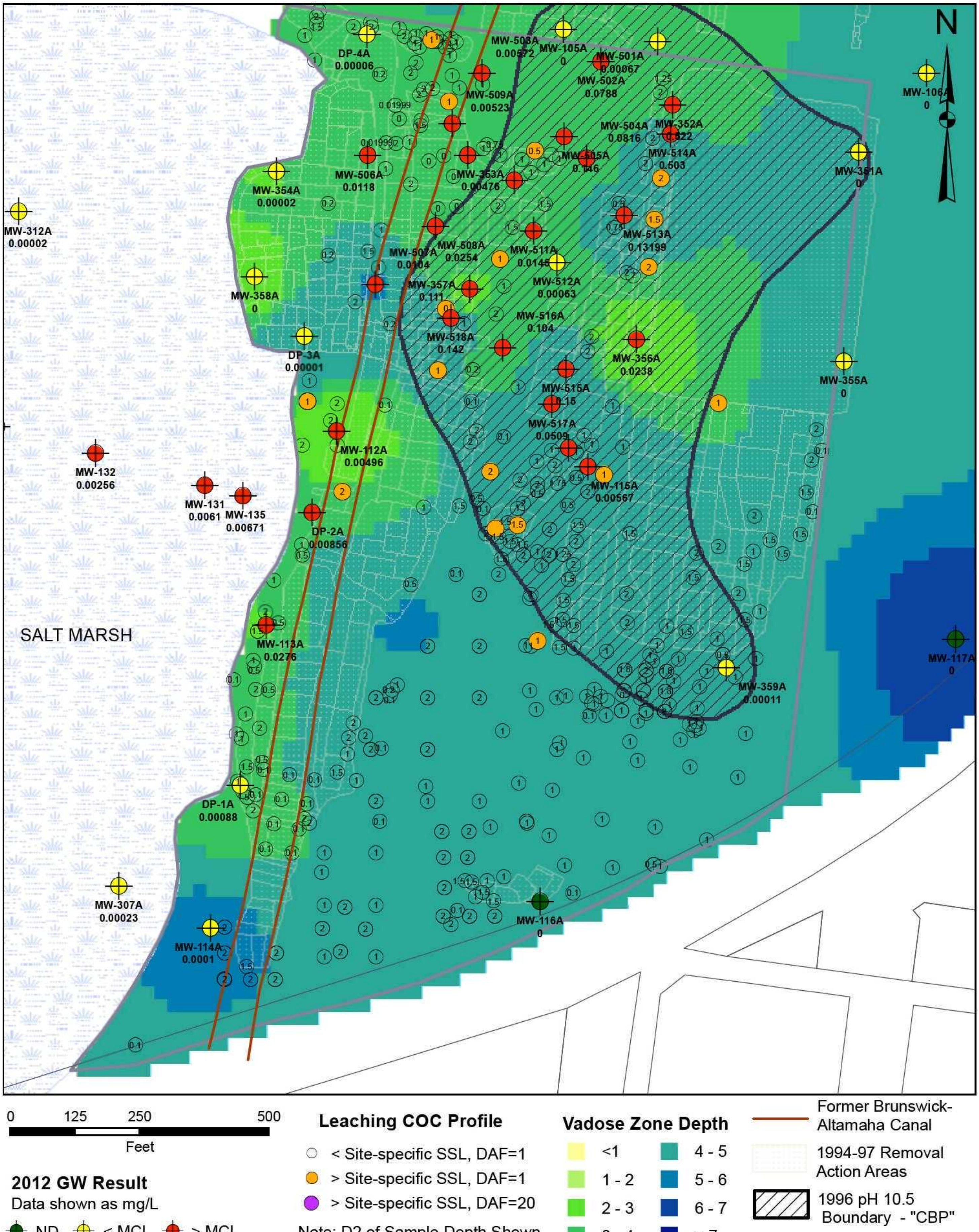
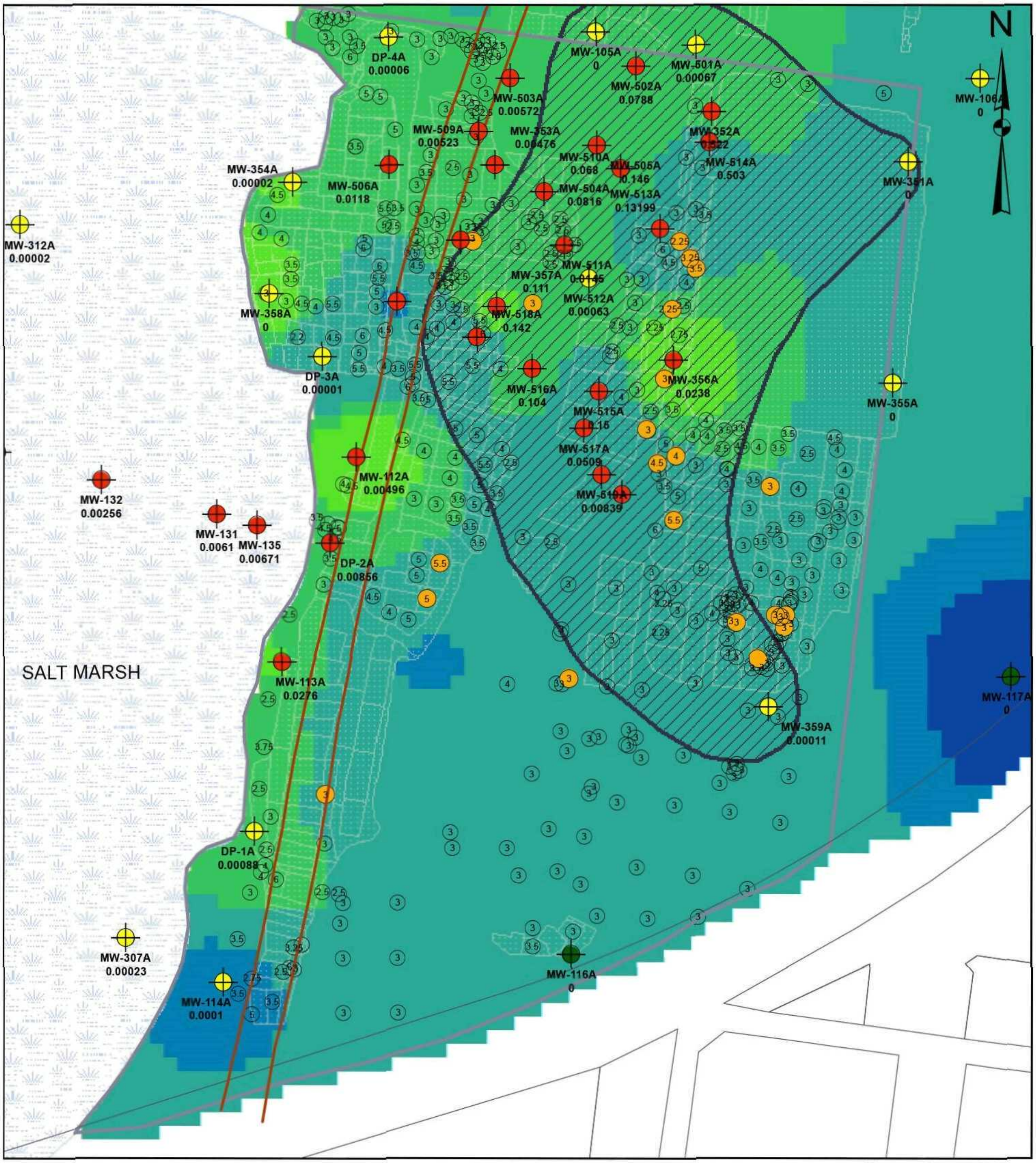


Figure No.5-14a

Soil Leaching Potential of Mercuy in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 4



0 125 250 500
Feet

2012 GW Result
Data shown as mg/L
ND · < MCL · > MCL

Leaching COC Profile
< Site-specific SSL, DAF=1
> Site-specific SSL, DAF=1
> Site-specific SSL, DAF=20
Note: D2 of Sample Depth Shown

Vadose Zone Depth
<1 · 1 - 2 · 2 - 3 · 3 - 4 · 4 - 5 · 5 - 6 · 6 - 7 · > 7

Former Brunswick-Altamaha Canal
1994-97 Removal Action Areas
1996 pH 10.5 Boundary - "CBP"

Soil Leaching Potential of Naphthalene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 4

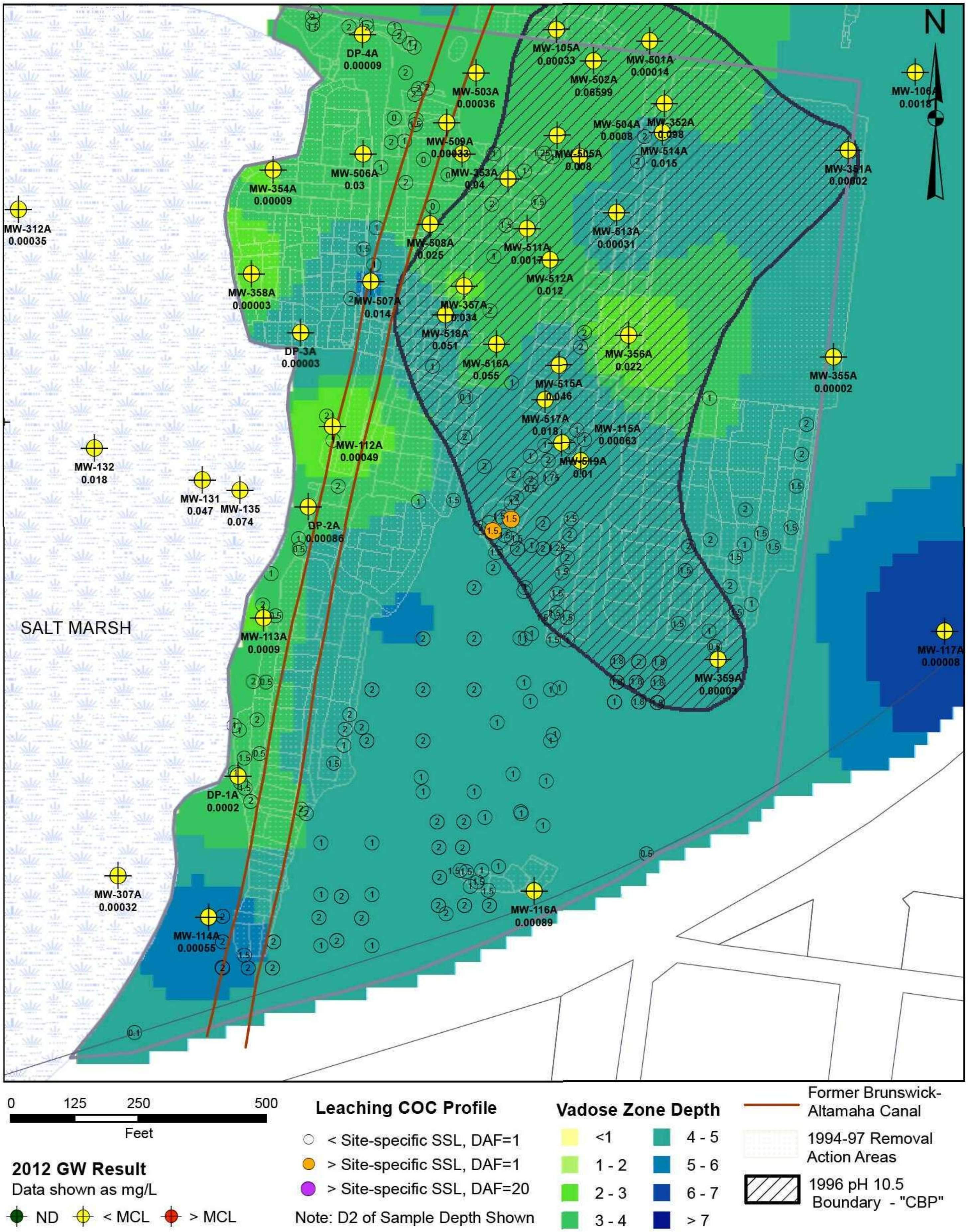


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Figure No.5-15a

Soil Leaching Potential of Naphthalene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 4

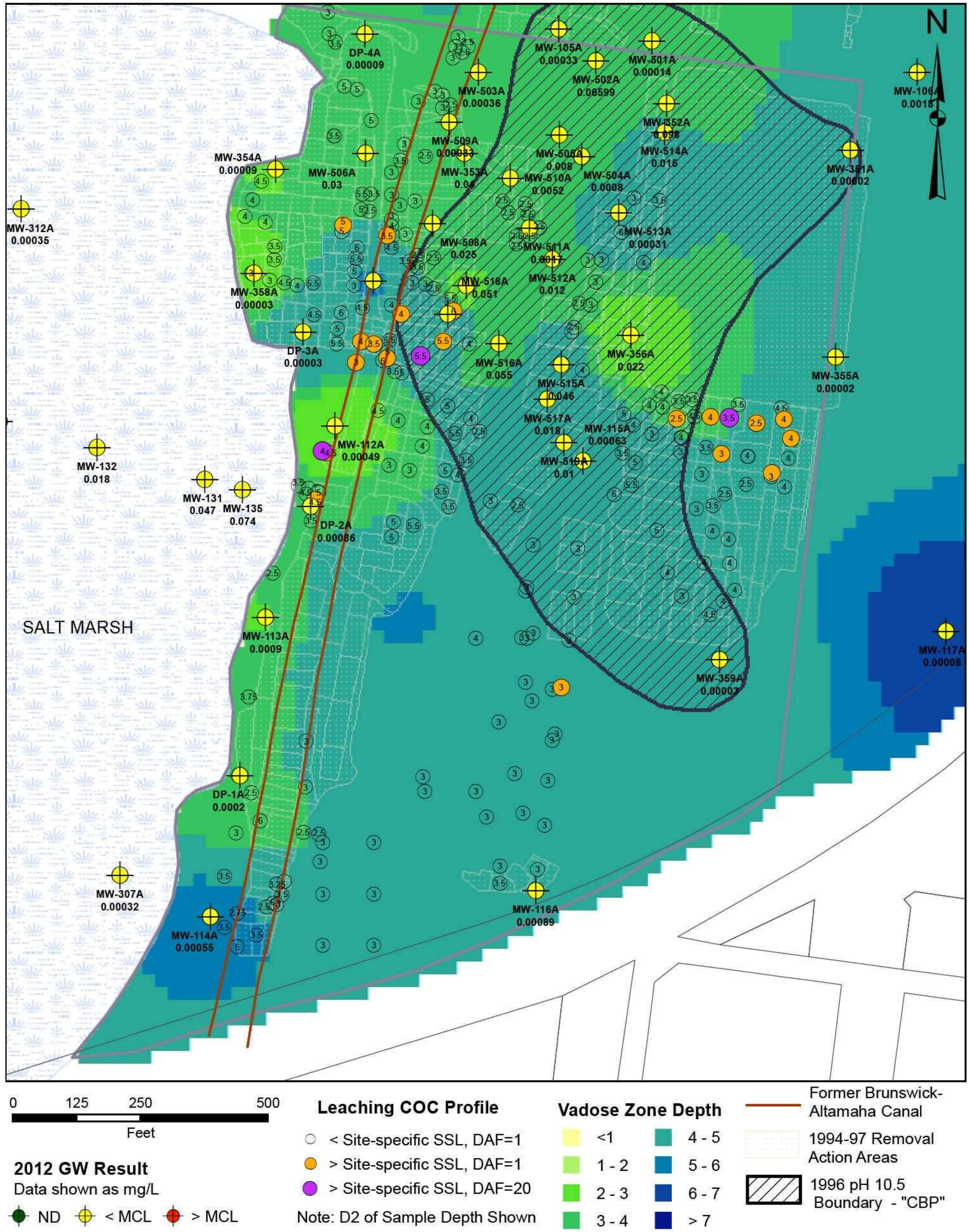

Figure No.5-15b

Soil Leaching Potential of 1,2,4-Trimethylbenzene in Vadose Zone Soils (D2 <= 2 ft bgs)
Quadrant 4

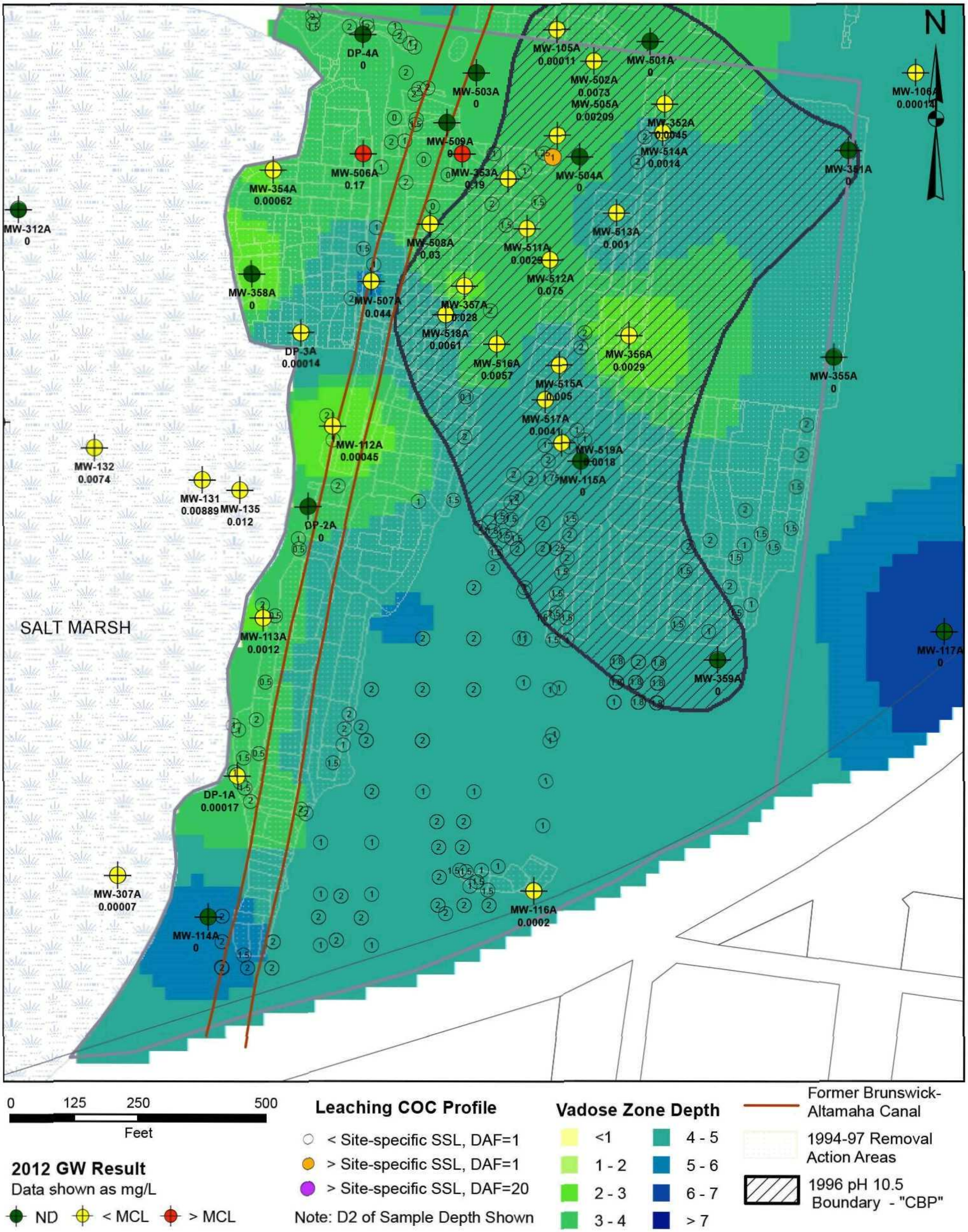

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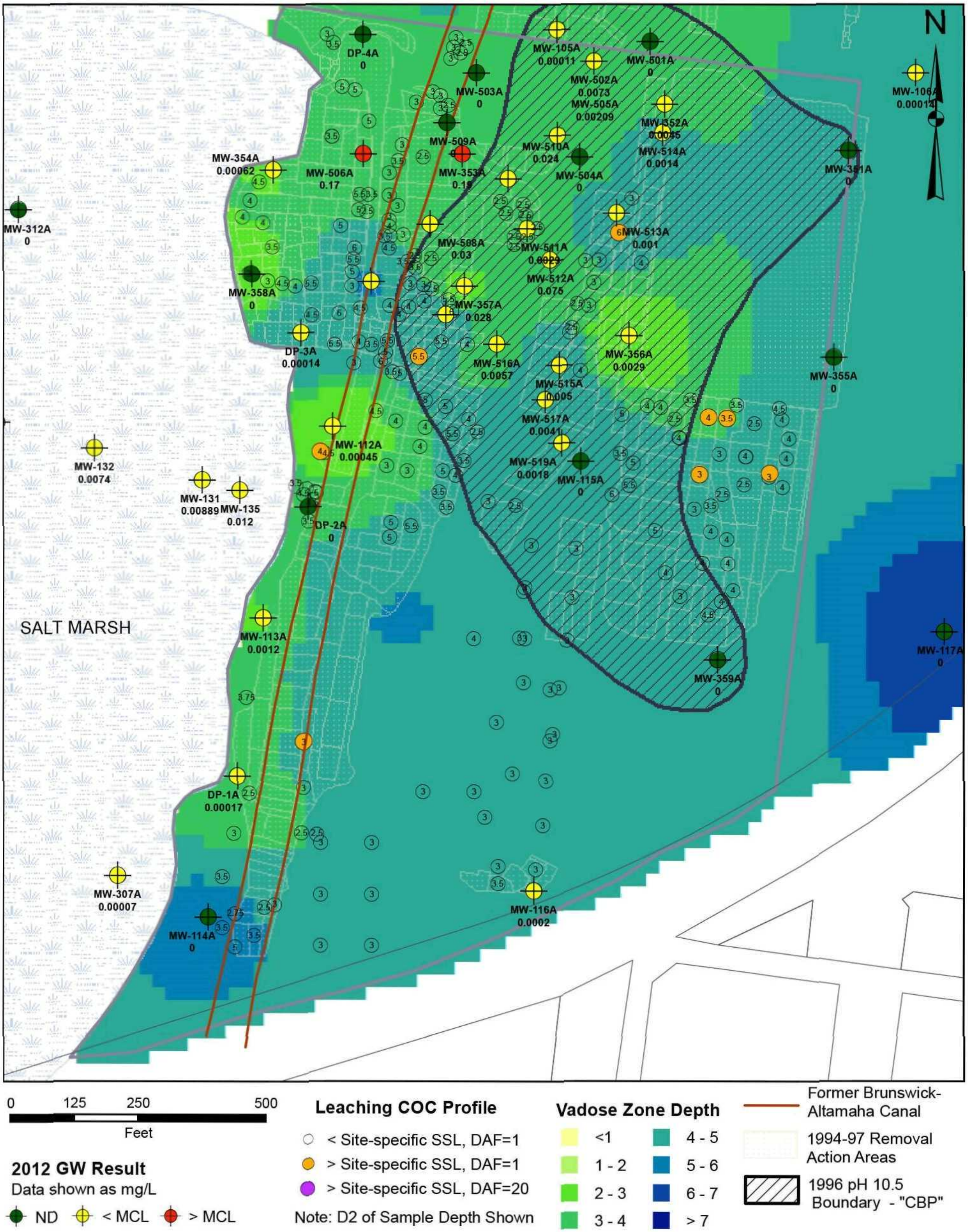
Figure No.5-16a

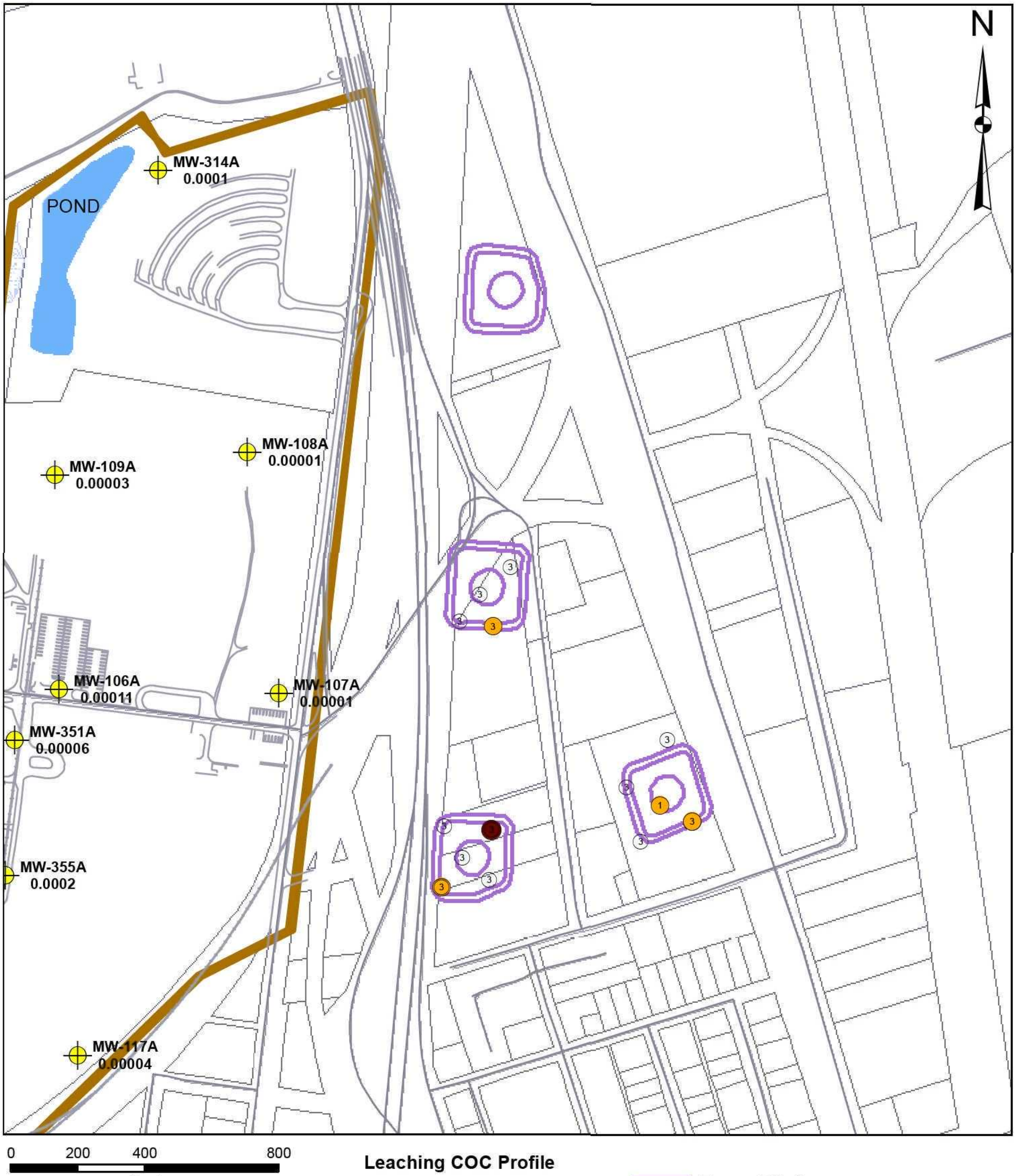
Soil Leaching Potential of 1,2,4-Trimethylbenzene in Vadose Zone Soils (D2 > 2 ft bgs)
Quadrant 4



Environmental Planning Specialists, Inc.

Figure No.5-16b

Soil Leaching Potential of Lead in Vadose Zone Soils
Former Off-site Tank Farm



Leaching COC Profile

- < Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=1
- > Site-specific SSL, DAF=20

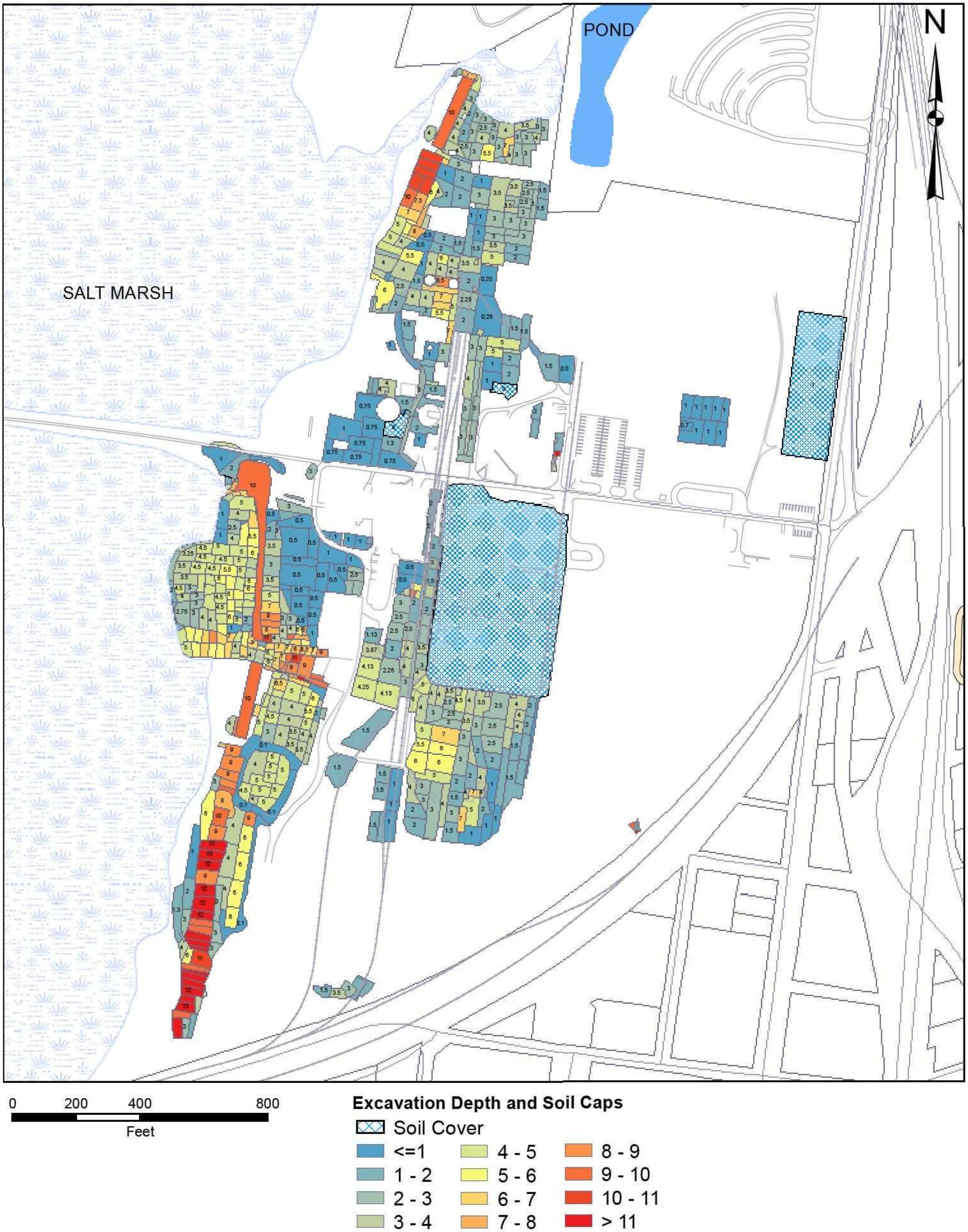
Note: D2 of Sample Depth Shown

Former Off-site Tank Location

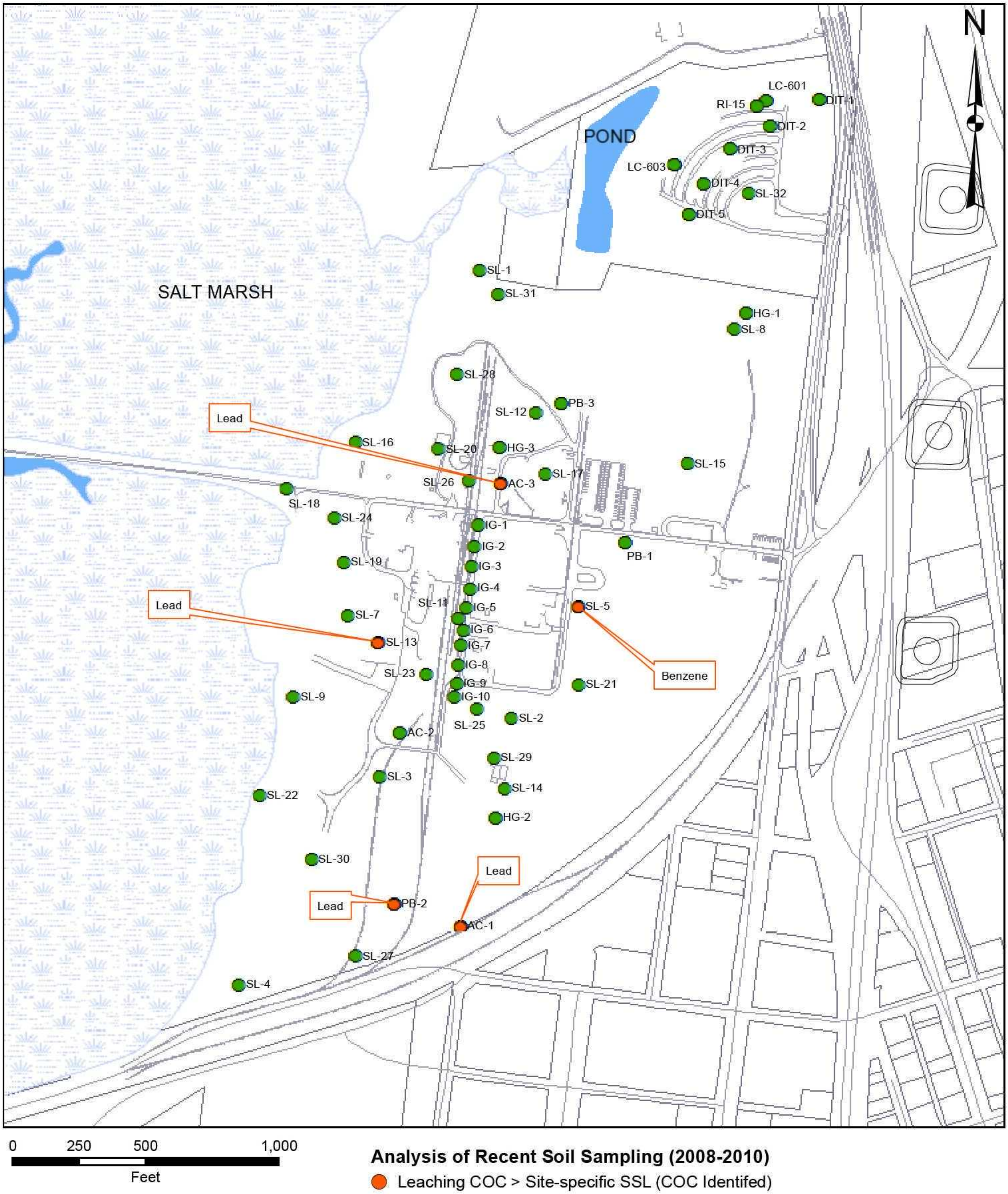
2012 GW Result
Data shown as mg/L

ND < MCL > MCL

1994-1997 Upland Remedial Actions



Detection Frequency Above SSLs of Leaching COCs in Grab Samples Collected from 2008 to 2010



Analysis of Recent Soil Sampling (2008-2010)

- Leaching COC > Site-specific SSL (COC Identifed)
- No Leaching COC > Site-specific SSL

Notes: DIT/SL Samples - Analyzed for all leaching COCs
AC/HG/LC/PB/RI Samples - Not analyzed for VOCs
IG Samples - Metals only

Potential Action Area for Protection of Groundwater

Figure No.5-20

APPENDIX A

Derivation of Site-Specific Soil Screening Levels

Table A1
Calculation of Refined Chemical-Specific RGs for Soil Leaching

Analyte	CAS No.	Ingestion TW RSL TR=1.0E-6 (ug/L)	Ingestion TW RSL TR=1.0E-5 (ug/L)	Inhalation TW RSL TR=1.0E-6 (ug/L)	Ingestion TW RSL HQ=1 (ug/L)	Inhalation TW RSL HQ=1 (ug/L)	MCL (ug/L)	Risk-Based to MCL Ratio	1.0E-6, HQ=1 Ing GW Target (ug/L)	Koc (L/kg)	Default Risk-based SSL (mg/kg)	Default MCL-based SSL (mg/kg)	Site-Specific SSL DAF1 (mg/kg)	Site-Specific SSL DAF20 (mg/kg)
Benzene	71-43-2	1.2E+00	1.2E+01	6.2E-01	1.5E+02	6.3E+01	5.0E+00	4.2E-06	5.0E+00	145.8	2.1E-04	2.6E-03	7.2E-03	1.4E-01
Methylene Chloride	75-09-2	9.0E+00	9.0E+01	1.0E+01	2.2E+03	2.2E+03	5.0E+00	5.6E-07	5.0E+00	21.73	1.2E-03	1.3E-03	2.0E-03	3.9E-02
~Methylnaphthalene, 2-	91-57-6				6.3E+01				6.3E+01	2478	4.1E-01		1.3E+00	2.6E+01
~Naphthalene	91-20-3			1.4E-01	3.1E+02	6.3E+00			3.1E+02	1544	4.7E-04		4.0E+00	8.1E+01
Trimethylbenzene, 1,2,4-*	95-63-6				1.6E+02	1.5E+01			1.6E+02	614.3	2.1E-02		8.5E-01	1.7E+01
Trimethylbenzene, 1,3,5-	108-67-8				1.6E+02				1.6E+02	602.1	2.1E-02		8.4E-01	1.7E+01

* 1,3,5-Trimethylbenzene applied as surrogate.

Table A2
Input Variables for Calculation of Refined Chemical-Specific RGs for Soil Leaching

SSG Leach Equation Inputs

Variable Name	Units	Value
CF	mg/ug	0.001
DAF1	unitless	1
DAF20	unitless	20
Foc*	g/g	0.0083
ω	g water/g soil	0.2
theta w	L_{water}/L_{soil}	0.3
theta a	L_{air}/L_{soil}	0.13396
rho b	g/cm3	1.5
n	L_{pore}/L_{soil}	0.43396
rho s	g/cm3	2.65

* Site-specific value

From USEPA RSL Users Guide

Soil to Groundwater SSL Factor Variables

Symbol	Definition (units)	Default	Reference
I	Infiltration Rate (m/year)	0.18	U.S. EPA. 1996a (pg. 31)
L	source length parallel to ground water flow (m)	site-specific	U.S. EPA. 1996a (pg. 31)
i	hydraulic gradient (m/m)	site-specific	U.S. EPA. 1996a (pg. 31)
K	aquifer hydraulic conductivity (m/year)	site-specific	U.S. EPA. 1996a (pg. 31)
θ_w	water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 1996a (pg. 31)
θ_a	air-filled soil porosity (L_{air}/L_{soil}) [n-θw]	n-θw	U.S. EPA. 1996a (pg. 31)
n	total soil porosity(L_{pore}/L_{soil}) [1-(ρb/ρs)]	1-(ρb/ρs)	U.S. EPA. 1996a (pg. 31)
ρ_s	soil particle density (Kg/L)	2.65	U.S. EPA. 1996a (pg. 31)
ρ_b	dry soil bulk density (kg/L)	1.5	U.S. EPA. 1996a (pg. 31)
H'	Dimensionless Henry Law Constant (unitless)	analyte-specific	EPI Suite
K_d	soil-water partition coefficient (L/kg)	Koc*Foc for organics	U.S. EPA. 1996a (pg. 31)
K_{oc}	soil organic carbon/water partition coefficient (L/kg)	analyte-specific	EPI Suite
f_{oc}	fraction organic carbon in soil (g/g)	0.002	U.S. EPA. 1996a (pg. 31)
d_a	aquifer thickness (m)	site-specific	U.S. EPA. 1996a (pg. 31)
d_s	depth of source (m)	site-specific	U.S. EPA. 1996a (pg. 31)
d	mixing zone depth (m)	site-specific	U.S. EPA. 1996a (pg. 31)