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FEASIBILITY STUDY (FS) REPORT

Duva Property
Town of Clay, New York

New York State Department of
Environmental Conservation Site No. 7-34-051

Prepared as Required by
NYSDEC Order on Consent
Index No. A7-0233-90-05

PRINTED ON

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DECEMBER 1992

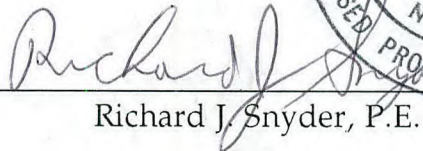
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CONESTOGA-ROVERS & ASSOCIATES

CERTIFICATION

I, Richard J. Snyder, a Registered Professional Engineer in the State of New York, have reviewed the document entitled "Feasibility Study (FS) Report, Duva Property", and certify on behalf of Conestoga-Rovers & Associates that the Feasibility Study has been prepared in accordance with sound engineering practice.




Richard J. Snyder, P.E.

June 1, 1992

Date

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
1.1 GENERAL	1
1.2 BACKGROUND	3
1.2.1 Site Location	3
1.2.2 Site History	4
1.2.3 Previous Investigations	7
1.2.3.1 1989 Soil Sampling Program	7
1.2.3.2 Soil IRM Investigations	8
1.2.3.3 IRM Groundwater Sampling Program	9
1.2.3.4 1990 Indoor Air Monitoring	10
1.2.3.5 Remedial Investigation	11
1.2.4 Interim Remedial Measures Implemented To Date	12
1.2.4.1 Groundwater Interim Remedial Measures	12
1.2.4.2 Soils Interim Remedial Measures	14
1.2.5 Nature and Extent of Contamination	14
1.2.5.1 General	14
1.2.5.2 Soils	16
1.2.5.3 Groundwater	19
1.2.5.4 Sediment and Surface Water	21
1.2.5.5 On-Site Air	22
1.2.6 Contaminant Migration Pathways	23
1.2.7 Baseline Risk Assessment	25
2.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES	27
2.1 INTRODUCTION	27
2.2 REMEDIAL ACTION GOALS AND OBJECTIVES	28
2.2.1 Remedial Action Goals	28
2.2.2 Remedial Action Objectives	29
2.3 POTENTIAL FEDERAL AND STATE STANDARDS, CRITERIA AND GUIDELINES (SCGs)	32
2.3.1 Applicability and Types of SCGs	32
2.3.1.1 Chemical-Specific SCGs	33
2.3.1.2 Location-Specific SCGs	36
2.3.1.3 Action-Specific SCGs	36
2.4 IDENTIFICATION OF GENERAL RESPONSE ACTIONS	37
2.4.1 General	37
2.4.2 Soils	38
2.4.2.1 No Further Action	38
2.4.2.2 Limited Further Action	39
2.4.2.3 Physical Containment Action	39

TABLE OF CONTENTS

	<u>Page</u>
2.4.2.4 In Situ Treatment Action	40
2.4.2.5 Removal/Treatment Action	41
2.4.2.6 Removal/Disposal Action	43
2.4.3 Groundwater	43
2.4.3.1 No Further Action	44
2.4.3.2 Limited Further Action	44
2.4.3.3 Physical Containment Action	45
2.4.3.4 Hydraulic Containment Action	45
2.4.3.5 Source Removal Action	45
2.4.3.6 In Situ Treatment Action	46
2.4.4 Surface Water/Sediments	46
2.4.5 Ambient Air	47
2.5 SCREENING OF SOIL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS	47
2.5.1 Physical Containment	48
2.5.2 Ex Situ Soil Treatment	50
2.5.2.1 Landfarming	51
2.5.2.2 Low Temperature Thermal Extraction	53
2.5.2.3 Ex Situ Solvent Extraction	54
2.5.2.4 Biological	56
2.5.2.5 On-Site Incineration	58
2.5.2.6 Off-Site Incineration	59
2.5.3 In Situ Soil Treatment	60
2.5.3.1 Biological	60
2.5.3.2 Vacuum Extraction	61
2.5.3.3 Soil Flushing	64
2.5.4 Removal/Disposal	65
2.5.4.1 On-Site Landfill	66
2.5.4.2 Off-Site Landfill	66
2.6 SCREENING OF GROUNDWATER REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS	67
2.6.1 Physical Containment Action	68
2.6.2 Hydraulic Containment Action	69
2.6.3 Source Removal Action	69
2.6.4 In Situ Treatment Action	70

TABLE OF CONTENTS

	<u>Page</u>
2.7 SUMMARY OF PRELIMINARY EVALUATIONS OF RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES	71
2.7.1 No Further Action	72
2.7.2 Limited Further Action	72
2.7.3 Physical Containment - Soils	72
2.7.4 Low Temperature Thermal Extraction - Soils	73
2.7.5 In Situ Vacuum Extraction	74
2.7.6 In Situ Soil Flushing	74
2.7.7 Source Removal Action - Groundwater	75
3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES	76
3.1 BASIS FOR DEVELOPMENT OF REMEDIAL ALTERNATIVES	76
3.2 NO FURTHER ACTION ALTERNATIVE	79
3.3 LIMITED FURTHER ACTION ALTERNATIVE	79
3.4 PHYSICAL CONTAINMENT - SOIL COVER	80
3.5 IN SITU TREATMENT OF SOILS	80
3.6 REMOVAL/TREATMENT OF SOILS	81
3.7 DUAL SOIL VAPOR/GROUNDWATER EXTRACTION	81
4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES	83
4.1 GENERAL	83
4.2 GENERAL DESCRIPTION OF REMEDIAL ALTERNATIVES	83
4.2.1 Remedial Alternative No. 1 - No Further Action	84
4.2.2 Remedial Alternative No. 2 - Limited Further Action	86
4.2.3 Remedial Alternative No. 3 - Physical Containment - Soil Cover	87
4.2.4 Remedial Alternative No. 4 - In Situ Soil Treatment	88
4.2.4.1 Remedial Alternative No. 4A - Soil Vapor Extraction	89
4.2.4.2 Remedial Alternative No. 4B - Soil Flushing	91
4.2.5 Remedial Alternative No. 5 - Removal/Treatment of Soils	91
4.2.6 Remedial Alternative No. 6 - Dual Soil/Groundwater Treatment System	93

TABLE OF CONTENTS

	<u>Page</u>
4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES	94
4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES	98
4.4.1 Threshold Criteria	99
4.4.1.1 Overall Protection of Human Health and the Environment	99
4.4.1.2 Compliance with SCGs	100
4.4.1.3 Summary of Threshold Criteria Analysis	101
4.4.2 Primary Balancing Criteria	102
4.4.2.1 Long Term Effectiveness and Permanence	102
4.4.2.2 Reduction of Toxicity, Mobility or Volume Through Treatment	103
4.4.2.3 Short Term Effectiveness	104
4.4.2.4 Implementability	106
4.4.2.5 Estimated Cost	107
5.0 PREFERRED REMEDIAL ALTERNATIVE	110

LIST OF FIGURES
(Following Report)

FIGURE 1.1	SITE LOCATION
FIGURE 1.2	SITE LAYOUT
FIGURE 1.3	TOTAL VOC CONCENTRATIONS IN SURFACE SOILS (0-6")
FIGURE 1.4	TOTAL VOC CONCENTRATIONS IN SUBSURFACE SOILS (18-30")
FIGURE 1.5	TOTAL VOC CONCENTRATIONS IN SUBSURFACE SOILS (>30")
FIGURE 1.6	TOTAL VOC CONCENTRATIONS IN GROUNDWATER
FIGURE 1.7	TOTAL VOC CONCENTRATIONS IN SURFACE WATER AND SEDIMENT SAMPLES
FIGURE 4.1	TREATMENT SYSTEM FLOW SCHEMATIC

LIST OF TABLES
(Following Report)

TABLE 2.1	NEW YORK STATE GROUNDWATER AND SURFACE WATER STANDARDS AND GUIDELINE CONCENTRATIONS FOR SITE-SPECIFIC PARAMETER LIST
TABLE 2.2	NEW YORK AMBIENT GUIDELINES CONCENTRATIONS FOR SITE-SPECIFIC PARAMETER LIST
TABLE 2.3	POTENTIAL ACTION-SPECIFIC STANDARDS, CRITERIA AND STANDARDS
TABLE 2.4	IDENTIFICATION OF RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
TABLE 2.5	SUMMARY OF PRELIMINARY EVALUATION OF SOIL REMEDIAL TECHNOLOGIES
TABLE 2.6	SUMMARY OF PRELIMINARY EVALUATIONS OF GROUNDWATER REMEDIAL TECHNOLOGIES
TABLE 4.1	SUMMARY OF DETAILED COMPARATIVE ANALYSES OF REMEDIAL ALTERNATIVES
TABLE 4.2	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 1
TABLE 4.3	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 2
TABLE 4.4	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 3
TABLE 4.5	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 4A
TABLE 4.6	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 4B
TABLE 4.7	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 5
TABLE 4.8	COST ESTIMATE REMEDIAL ALTERNATIVE NO. 6

1.0 INTRODUCTION

1.1 GENERAL

The Duva Property (referred to herein as "Site") is located in the Town of Clay, north of Syracuse, New York, and occupies approximately five acres of a partially wooded field. A number of abandoned drums (which were believed to contain hazardous materials including solvents and resins) were discovered on the Site in 1987. Under the direction of the New York State Department of Environmental Conservation (NYSDEC), the abandoned drums were removed and some underlying soils were removed and/or staged on Site.

In mid 1989, groundwater in the basement sumps of several homes adjacent to the Site was sampled and found to contain solvents. As a result, an interim remedial measures (IRM) program was initiated to address groundwater contamination at the Site.

In August 1989, the NYSDEC listed the Site on the Registry of Inactive Hazardous Waste Disposal Sites in New York State (Site #734051) and classified the Site as a "significant threat to the public health or environment, action required" (Classification "2"). Subsequently, the NYSDEC requested that a remedial investigation/feasibility study (RI/FS) be conducted and additional interim remedial measures be considered to address residual soil contamination at the Site. Accordingly, in July 1990, an IRM program was initiated which included soil sampling and characterization with specific provisions for removal/disposal of soil, if

warranted. In addition, an RI/FS Work Plan and associated project specific plans were submitted to the NYSDEC by letter dated November 27, 1990. The NYSDEC subsequently approved the RI/FS Work Plan and associated project specific plans as modified by letter dated November 20, 1990.

Implementation of the RI/FS for the Duva property began in December 1990 under the terms and conditions of an Order on Consent (Index No. A7-0233-90-05) entered into by the NYSDEC and the participating respondents (PRs) including General Electric Company (GE), the Estate of Peter Duva, and Donald W. Miller, Inc. The RI field activities were performed by Conestoga-Rovers & Associates (CRA) between December 1990 and December 1991. An RI Report was submitted to the NYSDEC on April 1, 1992.

The results of the RI, as presented in the RI Report, have been used to develop the Feasibility Study for the Site, as presented herein. The FS develops and assesses remedial alternatives for soils and groundwater potentially contaminated with Site-related chemicals. The FS Report contains the following:

- i) Section 1.0 states the purpose of the report and presents: the organization of the report; a general introduction and history of the Site; a summary of remedial actions completed; and, a summary of current Site conditions as determined by the RI, including a description of the nature and extent of contamination;

- ii) Section 2.0 identifies the standards, criteria and guidelines (SCGs) to be considered in the development and evaluation of remedial actions, presents the remedial action goals and objectives, presents an initial screening of remedial technologies applicable to the goals and objectives , and identifies those technologies to be considered in the assembly of remedial alternatives;
- iii) Section 3.0 presents the assembly of remedial alternatives to be considered for detailed analysis, based on remedial technologies retained from the technology screening process;
- iv) Section 4.0 summarizes the evaluation criteria for the detailed analysis of the assembled remedial alternatives, presents a detailed description and analysis of each of the remedial alternatives, and presents a comparative analysis of the remedial alternatives considered.; and
- v) Section 5.0 presents the preferred remedial alternative and schedule of activities for implementation of the preferred remedial alternative, based on the results of the detailed and comparative analyses.

1.2 BACKGROUND

1.2.1 Site Location

The Site is located in the Town of Clay, New York approximately four miles north of the City of Syracuse, New York. The Site

encompasses former agricultural land and is situated south of West Taft Road and immediately north of a residential development, Platinum Drive. The general location and layout of the Site are illustrated on Figures 1.1 and 1.2, respectively.

Property immediately to the south and west of the Site consists of recently constructed, single family residential homes; property immediately east and north of the Site consists of undeveloped land. All residential development in the vicinity of the Site is serviced by municipal water and sewer.

The Site occupies approximately five acres of land and is secured with a chain-link fence. The Site itself is partially wooded with heavier vegetation lying immediately to the east. The surface of the Site is grassed and gently slopes from north to south. The topography of the Site and significant surficial features are illustrated on Plan 1 of the RI Report, dated April 1, 1992.

1.2.2 Site History

The complete history of the Site is presented in the RI Report. A summary of the Site history is presented below.

The Site was originally owned by Mr. Peter Duva who operated a truck farm business on the property. In December 1986, Mr. Duva

sold the property to Donald W. Miller, Inc. Mr. Duva subsequently passed away and Mr. Duva's interests in the Site were assumed by the Duva Estate.

In mid-1987, residents of the adjacent properties contacted the NYSDEC and reported the presence of drums on the Site. In July 1987, the NYSDEC inspected the Site and found numerous drums staged in three separate areas of the property (refer to Figure 1.2). The NYSDEC reportedly collected several samples of the drummed material and of stained soils near the drums. Some of the drum contents and surrounding soils were found to contain resins and low levels of solvents.

Mr. Duva, Donald W. Miller, Inc., and General Electric Company were subsequently identified by the NYSDEC as potentially responsible parties for the Site.

In late 1988, Industrial Oil Tank Service Corporation was retained by Donald W. Miller, Inc. to remove the drums from the Site and dispose of them at an appropriate off-Site disposal facility. Underlying soils from the drum disposal area were also disposed of and/or staged on the Site. The drum removal program was performed under the direction of the NYSDEC.

In mid 1989, the NYSDOH collected groundwater samples from the basement sumps of several homes adjacent to the Site which were found to contain solvents. The PRs were notified of the findings by the NYSDOH and NYSDEC. The PRs engaged Malcolm-Pirnie to address groundwater contamination attributable to the Site. The basement sumps in

four homes located immediately adjacent to the Site were subsequently sealed in an enclosure and vented to the outside. In addition, four groundwater monitoring wells were installed and sampled at the Site in June 1989 in order to investigate groundwater contamination at the Site.

An interim remedial measures (IRM) program was implemented in accordance with the terms and conditions of an Order on Consent (Index No. A7-0225-90-03) entered into by the PRs and the NYSDEC to address groundwater contamination attributable to the Site. The groundwater IRM work activities began in mid 1990 and included: the installation and operation of a groundwater collection trench and sump on the downgradient side of the Site and the installation and operation of an on-Site water treatment plant.

In August 1989, the NYSDEC listed the Site on the "Registry of Inactive Hazardous Waste Disposal Sites in New York State" and classified it as a Class 2 site. A Class 2 site is defined as a "significant threat to the public health or environment - action required". At that time, the PRs were requested by the NYSDEC to investigate and remediate potential soil contamination at the Site. An Interim Remedial Measures program for soils and a remedial investigation were subsequently implemented at the Site.

The results of the various programs implemented at the Site are summarized in the sub-sections which follow.

1.2.3 Previous Investigations

The principal investigative activities conducted to date at the Site consist of: soil sampling in early 1989 following the completion of the drum removal project; groundwater sampling performed in 1989 as part of the groundwater IRM program; soil sampling performed in 1990 as part of the soil IRM program; and soil and groundwater sampling performed in 1991 as part of the RI Program.

The following discussion briefly summarizes each sampling program. Available data and associated documentation from each is presented in the RI Report.

1.2.3.1 1989 Soil Sampling Program

In January 1989, after the drum and soil removal project was complete, the remaining soil in the three drum staging areas was sampled by J.D. Plumley Engineering, P.C. of Syracuse, New York. A total of 29 sample aliquots were collected and composited in six samples for analyses. Each composite sample represented a suspected "hot spot" within the former drum staging areas.

1.2.3.2 Soil IRM Investigations

The proposed soil IRM Program was presented in the "Interim Remedial Measures Work Plan, Duva Property, Town of Clay, New York", dated June 26, 1990. Implementation of the soil IRM Program began in July 1990 under the terms and conditions of an Order on Consent (Index No. A7-0232-90-05) entered into by the NYSDEC and the PRs.

The soil IRM Program consisted of the performance of three major tasks, as identified in the soil IRM Work Plan, which included:

- i) investigation/characterization of soils by performance of a magnetometer survey of the Site and the collection of soil samples;
- ii) removal of significantly contaminated soils, if any, which represent an imminent risk or hazard to public health or the environment; and
- iii) temporary securement/isolation of residually contaminated soils remaining on Site, if appropriate.

The field investigative component of the soil IRM Work Plan consisted of a field survey to establish horizontal control; performance of a magnetometer survey over the Site; the screening of surficial soils for organic vapors; and the collection and analysis of surficial and subsurface soil samples for VOCs. This work was conducted by CRA on behalf of the PRs in July 1990.

The data from this investigation has been presented in the report entitled "Soil Interim Remedial Measures, Interim Data Report, Duva Property, Town of Clay, New York", dated September 1990 (CRA).

Based on the soil IRM data, the soils located within or adjacent to the former disposal areas did not appear to represent an imminent threat to human health or the environment. However, in order to address visual contamination observed in the soil which had been stockpiled on Site during the original drum removal program, the removal and off-Site disposal of this soil had been recommended and was performed in early 1991.

1.2.3.3 IRM Groundwater Sampling Program

In mid 1989, a groundwater investigation program which included the installation and sampling of four groundwater monitoring wells and sampling of adjacent residential basement sumps, was implemented.

In May 1989, the New York State Department of Health (NYSDOH) sampled basement sumps in homes adjacent to the Site. Samples were analyzed for VOCs.

In June 1989, four groundwater monitoring wells were installed and groundwater samples were collected from each of the four monitoring wells and analyzed for VOCs.

The analytical data obtained from these sampling events were previously reported in the document entitled "Interim Remedial Measures, Duva Property, Town of Clay, New York, Site Code 7-34-051, Volume III", March 23, 1990 (Malcolm Pirnie). Additional data which have been generated during the on-going operation of the groundwater collection trench and on-Site water treatment plant and which are presented under separate cover include: water level measurements, analytical data for extracted groundwater and analytical data from adjacent monitoring wells.

1.2.3.4 1990 Indoor Air Monitoring

Indoor air monitoring was conducted in four homes immediately adjacent to the southeast perimeter of the Site by NYSDOH in January and March 1990. This monitoring was intended to determine the impact the Site may have had on air quality within the adjacent homes and the effectiveness of the corrective measures which had been implemented to seal and vent the basement sumps of these same residences located immediately downgradient of the Site earlier in 1990.

In March 1992, additional monitoring of the indoor air quality in four homes adjacent to the southeast perimeter of the Site was performed by Malcolm Pirnie, Inc. in consultation with the Weinberg Consulting Group. Data from this air monitoring program was used to supplement the existing indoor air monitoring data base for use in the PHE.

The results of indoor air sampling performed to date are summarized in the "Remedial Investigation Report", dated March 31, 1992.

1.2.3.5 Remedial Investigation

The characterization of the nature and extent of contamination at the Site was achieved through the completion of the various field activities as proposed in the approved RI/FS Work Plan. These activities included the following:

- i) topographic survey of the Site;
- ii) magnetometer survey of the area north and west of the Site;
- iii) collection of soil samples for the development of a Site Specific Parameter List (SSPL);
- iv) investigation of surficial and/or shallow subsurface soils in the area north and east of the westernmost drum staging area;
- v) collection of subsurface soil samples;
- vi) excavation of test pits;

- vii) installation and sampling of three monitoring wells within the till unit and five shallow monitoring wells within the shallow sand unit overlying the till;
- viii) collection of surface water and sediment samples in drainage swales and ponded areas upstream and downstream of the drum staging areas; and
- ix) related air monitoring.

All results, data and figures produced relating to these activities are presented in the "Remedial Investigation Report", dated March 31, 1992.

1.2.4 Interim Remedial Measures Implemented To Date

Two separate programs, one for groundwater and one for soils, have been developed and implemented as interim remedial measures for the Site. These programs are discussed below.

1.2.4.1 Groundwater Interim Remedial Measures

In June 1989, an interim remedial measures program was implemented pursuant to the Order on Consent (Index No. A7-0225-90-03) to address off-Site contaminated groundwater migration. This program,

conducted by Malcolm Pirnie, Inc., included: installation of groundwater piezometers; and the design and construction of a groundwater collection trench to intercept groundwater beneath the Site and prevent its migration off Site. The primary components of the system include:

- i) a subsurface collection drain and collection manhole at the downgradient perimeter of the Site which collects groundwater from the alluvium material situated above the lower permeability till unit;
- ii) a buried forcemain to convey collected groundwater from the collection trench to the on-Site water treatment plant;
- iii) an on-Site water treatment plant which utilizes carbon adsorption for treatment of organics and chemical precipitation for removal of metals (the latter is necessary for removal of iron to meet surface water discharge criteria); and
- iv) a buried discharge pipe leading to a tributary of Bloody Brook.

Groundwater collected in the sumps of the downgradient residences which showed the presence of Site contaminants is also pumped into the on-Site collection trench for subsequent treatment at the on-Site water treatment facility.

Details of the design of the groundwater collection and treatment systems were submitted to the NYSDEC in the report entitled "Interim Remedial Measures, Duva Property, Town of Clay, New York",

March 23, 1990 (Malcolm Pirnie, Inc.). The system was installed and put into operation during the summer of 1990.

1.2.4.2 Soils Interim Remedial Measures

In July 1990, the field investigation phase of the soil IRM Program was performed in accordance with the approved soil IRM Work Plan. Based on the soil IRM investigative results, it was recommended that soil generated during the original drum removal program and which had been stockpiled on Site be removed and disposed off Site in order to address visual contamination observed in the stockpile. By letter dated November 1, 1990, NYSDEC agreed with the recommendation and further requested that additional soil stockpiled on Site as a result of the groundwater interim remedial measures be removed. The work, as proposed and recommended, was performed during the winter/spring of 1991. A description of activities performed is presented in the "Soil Interim Remedial Measures, Soil Stockpile Removal/Disposal, Final Engineering Report, Duva Property, Town of Clay, New York", dated October 1991.

1.2.5 Nature and Extent of Contamination

1.2.5.1 General

Media investigated at the Site prior to and during the RI consisted of the following:

- i) Soils
 - background soils,
 - surface and sub-surface soils over the entire Site;
- ii) Surface Water and Sediments
 - on-Site surface water and sediment,
 - off-Site, downgradient surface water and sediment;
- iii) Groundwater
 - overburden (alluvium and underlying till);
- iv) Air
 - on-Site air quality during active remediation,
 - inside air quality in adjacent residences.

The primary Site contaminants are VOCs consisting of trichloroethene, 1,1,1-trichloroethane, 1,2-dichloroethene, tetrachloroethene, toluene, acetone, ethylbenzene and xylene. The most predominant Site contaminant is trichloroethene. The distribution of contaminants within these media is illustrated on Figures 1.3 to 1.7, inclusive, and is further described in the sections which follow.

1.2.5.2 Soils

Background Soils

None of the TCL VOCs were detected in the background samples except for trichloroethene. Trichloroethene was detected at estimated concentrations below the practical quantitation limits.

BNAs, including fluoranthene, pyrene, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, chrysene, benzo(a)fluoranthene (b and k isomers), were also detected at estimated concentrations below the practical quantitation limits; no other BNAs were detected.

DDD, DDE, and DDT (which are generally ubiquitous in agricultural areas) were detected in background surficial soil samples at concentrations ranging from 13J µg/kg to 630 µg/kg. All of the TAL metals were detected within published concentration ranges for natural soils. No cyanide was detected in the background soil samples.

Surficial and Shallow Subsurface Soils

Residual VOC contamination in surficial soils was greatest within or immediately adjacent to the former drum staging areas. Organic vapor concentrations recorded on Site in the upper foot of the soil horizon indicated the greatest levels of residual organic concentrations in surficial soils located along the western limit of the easternmost drum staging

area. The apparent zone of contamination, based on organic vapor concentrations, extends from the northern limit of the eastern most drum storage area, runs southward along a narrow strip located between the two easternmost drum staging areas, and terminates approximately 100 feet south of these areas.

This general distribution of contaminants in the surficial soils was confirmed by the analytical results for the surficial soil samples collected on Site. Concentrations of total VOCs in surficial soils within or immediately adjacent to the former drum staging areas ranged up to 225 ppm. Total VOCs in adjacent surficial soils decreased rapidly with distance from the staging areas and are generally less than 1 ppm. No significant VOC contamination was detected in the surficial soils from the westernmost drum staging area.

The relative distribution of contaminants in the shallow subsurface soils (18 to 30 inches) is generally consistent with the surface soils. The concentrations of VOCs were, however, generally higher in this zone and ranged up to approximately 7,300 ppm with the highest VOC concentrations reported within or immediately adjacent to the former drum staging areas.

Subsurface Soils

The primary VOCs detected in the on-Site subsurface soils consisted of: 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, 1,2-dichloroethene, toluene, ethylbenzene, and xylenes.

The distribution of contaminants in the subsurface soils was generally consistent with the distribution noted in the surficial soils. VOCs were present at elevated concentrations beneath and downgradient of the drum staging areas. VOCs reported in the sub-surface soils were generally present at higher concentrations than the overlying surficial soils.

Total VOC levels in the westernmost former drum staging areas were generally less than 1 ppm in the shallow subsurface soils and in the deeper subsurface soils.

Subsurface soil contamination in the two easternmost drum staging areas did not extend significantly beyond the eastern and western limits of the drum staging areas. VOC contamination within and/or between the two easternmost former drum staging areas was present up to depths ranging from about 4 feet to 30 feet. VOC contamination downgradient of the eastern drum staging areas was generally present to a maximum depth of approximately 10 feet below ground surface (BGS).

The highest total VOC concentrations reported in any on-Site sample was 41,329 ppm from a depth of 8 to 9 feet below grade at Station B/1+00. The sample was collected from a sand pocket encountered within the till. The sand pocket and associated VOC concentrations were not detected in any adjacent boreholes indicating that the sand pocket is a very localized feature.

The greatest concentrations of VOCs in the remaining sub-surface soils appeared at or above the till contact beneath and downgradient of the easternmost drum staging areas. Soils above the till contact tended to be consistently wet to moist and displayed the highest concentrations of VOCs throughout the Site suggesting this zone represents the primary contaminant migration pathway at this Site. The lower permeability till underlying the Site appears to retard the vertical migration of groundwater and contaminants. This is confirmed by the rapid decrease in VOC concentrations with depth in the till where samples were collected.

1.2.5.3 Groundwater

As was anticipated due to the dense, low permeability nature of the till beneath the Site, groundwater analyses confirmed the most significant groundwater contamination is present on Site in the lacustrine sands overlying the till. The highest estimated total VOC concentrations of 281.136 ppm and 342.816 ppm were reported in monitoring well MW-6, a shallow well completed above the till contact. Total VOC concentrations were several orders of magnitude lower in monitoring well MW-7 (1.569J ppm and 0.887J ppm), the deeper well of the pair completed in the till. VOC concentrations were also lower in monitoring well MW-1 (0.290J ppm and 1.526J ppm) located downgradient of MW-6 on the downgradient side of the groundwater collection trench.

The significantly lower concentrations of VOCs in the till further suggest this layer is retarding the vertical migration of contaminants at the Site.

The significant reduction in contaminant concentrations in MW-1, MW-10, MW-2, MW-9 and MW8, immediately downgradient of the groundwater collection trench, confirm the trench is effectively containing contaminants to the Site. Fluctuations in VOC concentrations in well MW-1 (as well as others on Site) appears to be related to groundwater conditions with higher concentrations reported during relatively dry periods. As a result, no reduction in VOC concentrations have been observed in this well.

No significant concentrations of VOCs were reported in the remaining monitoring wells installed on or adjacent to the Site. Consequently, the lateral extent (east-west) of on-Site groundwater contamination has been defined and is limited in an east-west or cross-gradient direction. This pattern of contamination is consistent with what would be expected from a discrete source of contamination such as the drum staging areas.

Monitoring well MW-13, installed adjacent to Platinum Drive, downgradient of the Site, had reported total VOC concentrations of 1.26J ppm, 0.067 ppm, 0.013 ppm and 0.007J ppm during the four events it was sampled. These results, presented in their sequence of collection, indicate a significant decrease in concentrations of total VOCs has occurred over time.

VOCs were reported during one event only at 0.004J ppm in monitoring well MW-12, located west of MW-13. The samples collected from temporary probes advanced downgradient of MW-13 were also reported to contain residual low level VOCs.

No significant VOC concentrations were reported in samples collected from MW-14, MW-15, and MW-16 which are downgradient of MW-13. Samples collected from MW-17, immediately downgradient and to the east of MW-13, showed decreasing levels of VOCs in consecutive sampling rounds.

The analytical results from samples collected from downgradient monitoring wells have clearly identified the terminus of the contaminated plume and have delineated the extent of the off-Site migration of contaminants. Additionally, the analytical data indicated a reduction in the spread of contaminants off Site. This reduction in the concentration of VOCs over time indicate that the projects undertaken to date have been successful in reducing the off-Site spread of contamination from on-Site source areas.

A complete description of off-Site groundwater sampling activities and a presentation of associated results are presented under separate cover in the report entitled, "Off-Site Investigation, Addendum, Duva Property, Town of Clay, New York".

1.2.5.4 Sediment and Surface Water

Surface water and sediment samples were collected at two on-Site and three downgradient off-Site locations.

VOCs were not detected in any of the off-Site surface water samples collected. VOCs were detected in the off-Site sediment samples at total VOC concentrations ranging from 0.164 ppm to 0.260 ppm.

VOCs were detected in both on-Site surface water and sediment samples. The highest total VOC concentrations reported were 1.167(J) ppm for surface water and 0.168(J) ppm for sediment at a location immediately downgradient of the easternmost drum staging area. Significantly lower concentrations of VOCs were reported in the surface water and sediment samples collected downgradient of the westernmost drum staging area.

The results indicate residual soil contamination at the Site has had a limited effect on on-Site surface water and sediment quality and a negligible effect on sediment located off-Site. No effect on off-Site surface water was observed.

1.2.5.5 On-Site Air

Total VOCs were measured in the worker breathing zone and around the perimeter of active work areas during all ground intrusive

activities conducted at the Site. Although VOCs were detected in the immediate vicinity of some soils disturbed during the investigation, total VOC concentrations rapidly dissipated and no effects on air quality were noted downwind of the active work zones.

Undisturbed soils at the Site are not expected to have any significant effect on ambient air quality based on existing Site conditions including:

- i) the vegetative cover established over the on-Site soils;
- ii) reported concentrations and limited areal extent of contaminants in the surficial soils; and
- iii) lack of any surface discharge of sub-surface contaminants.

This scenario is supported by the fact that even disturbed contaminated soils, which would have the greatest potential effect on ambient air quality, had a minimal effect on air quality at the Site.

1.2.6 Contaminant Migration Pathways

Potential contaminant migration pathways which exist at the Site are as follows:

- i) atmospheric dispersion;

- ii) physical contact;
- iii) surface water runoff; and/or
- iv) groundwater migration.

Contaminant migration by atmospheric dispersion, physical contact, and surface water runoff are restricted to contaminants present in surficial soils, specifically VOC contamination. The extent of potential contaminant migration associated with each of these pathways is further limited based on the following Site conditions:

- i) a well established vegetative cover is present over the on-Site soils;
- ii) reported concentrations and limited areal extent of contaminants in the surficial soils; and
- iii) lack of any surface discharge of sub-surface contaminants.

Exposure by physical contact is considered to be negligible due to the Site security/limited access measures implemented to date (perimeter security fencing with locked gates).

Contaminant migration by atmospheric dispersion or surface water runoff are also considered to be negligible due to the lack of significant on-Site air contamination, surficial soil contamination and sediment and surface water contamination off-Site.

Contaminant migration by groundwater dispersion off-Site has, in the past, been the primary pathway of concern due to detected levels of VOC contamination in off-Site downgradient wells and in residential basement sumps. The present and future mass flux of contaminants, however, has been addressed and practically nullified through the interim remedial measures implemented to date for groundwater.

The remaining historical off-Site contaminant plume is currently being addressed by off-Site groundwater sampling.

1.2.7 Baseline Risk Assessment

A Public Health Evaluation (PHE) containing a baseline risk assessment for the Duva Property was prepared and is described in the report entitled "Public Health Evaluation, Duva Property, Town of Clay, New York", dated March 1992.

The PHE identified chemicals of potential concern for the various media investigated during the RI. Those chemicals of potential concern were selected from the SSPL and are all VOCs.

The PHE was prepared using conservative assumptions regarding the following potential exposure scenarios:

- i) exposure by inhalation of air born Site-related chemicals;

- ii) exposure by direct contact (incidental ingestion or dermal contact and absorption) to Site-related chemicals; and
- iii) exposure to Site-related chemicals by use of on-Site groundwater as a future potable water supply.

Indoor air samples collected at some residences after installation of the IRMs have been found to contain chemicals known to be present at the Site. The presence of such chemicals would pose an excess cancer risk at the lower end of the range of risks typically considered by USEPA as acceptable (pursuant to the USEPA guidance on risk management and risk assessment). This risk is a result of a contaminant detected in the air in the homes (tetrachloroethene) which is known to be present at the Site.

Exposure by direct contact through ingestion or dermal absorptions by residents or by on-Site workers was found to pose no significant health risks to the individuals under any of the scenarios examined. Short term exposure by on-Site workers is possible but could not be evaluated due to a lack of data comparable to the occupational exposure criteria.

Long term ingestion of on-Site groundwater usages (as potable water) at some time in the future may potentially pose an unacceptable risk. This risk, however, was developed assuming that the on-Site water would be used in the future and can be reduced by prohibiting the installation of on-Site wells or off-Site downgradient wells until groundwater conditions are remediated or confirmed.

2.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

2.1 INTRODUCTION

Based on a review of existing Site conditions, potential contaminant migration pathways and the results of the PHE, the media which are considered most likely to require some form of remediation are soils and groundwater. Additional media which must be addressed include surface water/sediment and air if not adequately addressed by the proposed response to the primary media of concern.

The primary contaminants of concern in the affected media are VOCs consisting largely of chlorinated organics. Concentrations of specific metals and BNAs have also been reported above background at several discreet locations, however, remedial efforts at the Site will be driven primarily by the presence of the VOCs due to the distribution and concentrations of these constituents and to the results of the PHE.

This section defines the remedial action goals and objectives and presents a review of remedial technologies potentially applicable to the media of concern and associated contaminants identified during previous investigative activities conducted at the Site. A description of the relevant technologies, including an evaluation of their applicability to the Site is also provided.

2.2 REMEDIAL ACTION GOALS AND OBJECTIVES

2.2.1 Remedial Action Goals

The primary goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time and that minimize untreated waste, as stated in the National and Hazardous Substances Pollution Contingency Plan (NCP).

Remedial Action Goals for CERCLA sites, as established under CERCLA Section 121 (Cleanup Standards), and amended by SARA, include the following:

- i) preference is to be given to selection of remedial actions "in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principal element" (SARA Section 121(b)(1));
- ii) "The off-Site transport and disposal of hazardous substances or contaminated materials without such treatment (as in (i) above) should be the least favored alternative remedial action where practicable treatment technologies are available." (SARA Section 121(b)(1));
- iii) remedial actions "shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the

environment and or control of further release at a minimum which assures protection of human health and the environment" (SARA Section 121(d)(1)); and

- iv) "with respect to any hazardous substances, pollutant, or contaminant that will remain on Site" the residual levels will attain "any standard, requirement, criteria, or limitation under any Federal environmental law" and "any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than the Federal requirements where such goals are relevant and appropriate." (Section 121(d)(2)(A)).

Federal and State standards, criteria and guidelines (SCGs) potentially applicable to the Site which satisfy the above referenced Federal and State requirements are detailed in Section 2.3.

2.2.2 Remedial Action Objectives

The contaminants of potential concern in groundwater and soils at the Site, which would present a potential unacceptable level of risk to human health if ingested or used as a potable water supply are VOCs.

The Site related contaminated groundwater is a potential source of drinking water and is a fresh groundwater, and hence can be classified as a Class GA groundwater according to the New York State Environmental Conservation Law (ECL) groundwater classification

guidelines. Under such classification, the primary exposure pathway would be the ingestion of Site related contaminated groundwater extracted through an on-Site well. However, since the area is serviced by municipal potable water, and no production wells are currently located within the known zone of contamination, this exposure pathway would only be completed under the hypothetical scenario that a future water supply well is located within the zone of groundwater contamination.

The primary exposure pathway of the Site related contaminated soils would be the ingestion of such soils. However, based on the existing surficial cover, restricted access, and distribution of the more highly contaminated soils at depths below the ground surface, this exposure pathway would only be completed under the hypothetical scenario that in the future the underlying soils would become uncovered and that public and environmental exposure to these soils would occur.

The PHE evaluated both current and/or future scenarios involving groundwater ingestion and direct contact with on-Site soils. A summary of the results of the qualitative risk estimates are described as follows:

- i) a hypothetical scenario involving the long term ingestion of groundwater at the Site was evaluated as a potential future land use scenario since, currently, potable water wells are not located within the zone of contamination. Total cancer and non-cancer risks from this scenario were estimated to be 3×10^{-2} and 34, respectively; and

- ii) direct contact with on-Site surface soil by residences and with on-Site subsurface soils by future on-Site workers would not pose significant potential cancer or non-cancer health risks. Estimated cancer risks ranged from 1×10^{-9} to 4×10^{-7} . All estimated non-cancer risks were less than 1 by at least several orders of magnitude.

The USEPA generally consider excess lifetime cancer risks within a range of 10^{-4} to 10^{-6} and non-cancer risk values less than 1 to be acceptable for exposure to known or potential carcinogens and non-carcinogens in the environment. The USEPA has also determined that remedial action is generally not warranted where the Site total cancer risk is less than 10^{-4} . Accordingly, the risk assessment indicates a need to address the contaminated groundwater at the Site in order to prevent potential future exposure to groundwater from the Site which have contamination present in excess of the MCLs or a total excess cancer risk for all contaminants greater than 10^{-4} to 10^{-6} .

Consistent with the foregoing, the remedial action objectives for Site-related contaminated groundwater and soils at and in the vicinity of the Site are as follows:

- i) to prevent or mitigate the migration of Site-related contaminated soils and groundwater, both on-Site and downwind or downgradient from the Site;

- ii) to remediate Site-related contaminated soils and groundwater to the point where leachate from the soils and on-Site groundwater does not present an unacceptable health risk;
- iii) to monitor groundwater and, if warranted, sample soils in a manner to verify the effectiveness of any remedial measures performed; and
- iv) to minimize future site restrictions to the maximum extent practical in order to allow for potential unimpeded future use of the site.

2.3 POTENTIAL FEDERAL AND STATE STANDARDS, CRITERIA AND GUIDELINES (SCGs)

2.3.1 Applicability and Types of SCGs

SCGs are used to develop remedial action objectives and to scope and formulate remedial action technologies and alternatives. SCGs are applicable or relevant and appropriate New York State standards, criteria and guidelines. SCGs also include federal standards which are more stringent than State standards. SCGs are categorized as:

1. chemical-specific requirements that define acceptable exposure limits and can therefore, be used in establishing preliminary remediation goals;

2. location-specific requirements that may restrict activities within specific locations such as floodplains or wetlands; and
3. action-specific requirements which may establish controls or restrictions for specific treatment and disposal activities.

2.3.1.1 Chemical-Specific SCGs

Chemical-specific SCGs establish the acceptable amount or concentration of a particular chemical that may be either found in, or discharged to the ambient environment. Concentration limits provide protective Site cleanup levels or may be used as a basis for estimating appropriate cleanup levels for the chemicals of concern in the various media. Chemical-specific SCGs may be used to determine treatment and disposal requirements for remedial activities and to assess the effectiveness or suitability of a remedial alternative. These values are usually based on health or risk considerations for the protection of either human health or the environment. Chemical-specific SCGs may be regulated standards or non-regulated guidance values. Guidance values may be appropriate where a standard for a particular substance is not available. If a chemical compound has more than one SCG, the most stringent is generally required to be met.

Chemical-specific SCGs for the Site potentially apply to groundwater, surface water and air. There are currently no chemical-specific SCGs for soils in New York State.

Groundwater and Surface Water

Guideline concentrations have been summarized in Table 2.1 for groundwater and surface water at the Site for the compounds on the Site Specific Parameter List (SSPL) and for which standards or guideline values have been established. The most stringent values from the applicable sources have been compiled for Class GA groundwater and Class AA surface water.

Class GA groundwater pertains to fresh groundwater found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock. The best usage of Class GA groundwater is as a source of potable water supply. It is noted that there are currently no users of groundwater as a potable water source at the Site.

Potential chemical-specific SCGs for Class GA groundwater are the most stringent of:

1. maximum contaminant levels (MCLs) for drinking water promulgated in 10 NYCRR Subpart 5-1, Public Water Supplies;
2. water quality standards for drinking water promulgated under the Safe Drinking Water Act;
3. water quality standards promulgated in 10 NYCRR Part 170, Sources of Water Supply; or

4. items and specifications found in 10 NYCRR Parts 700-705, Water Quality Regulations.

Class AA surface waters are waters that will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes. It is noted that Bloody Creek is not currently used as a drinking water source.

Potential chemical-specific SCGs for Class AA surface water are the most stringent of:

1. 10 NYCRR Part 170, Source of Water Supply;
2. 10 NYCRR Part 5, Drinking Water Supplies; or
3. the lowest value derived using the methodologies and procedures found in 10 NYCRR Parts 701.4 to 701.7, Water Quality Regulations.

Air

The chemical-specific New York State SCGs for air are presented in Table 2.2. The occupational values and current ambient guideline concentrations as presented in the New York State Air Guide-1, 1991, have been included. Concentrations are expressed as eight-hour time-weighted averages or threshold limit values. Potential SCGs are

provided for SSPL compounds detected in the soils and groundwater that may be potentially released to the atmosphere during remedial activities.

2.3.1.2 Location-Specific SCGs

Location-specific SCGs are regulations that are applicable to specific physical and environmental settings. The Site is not located in a wetland area or a floodplain. SCGs pertaining to these environmental locations are not applicable to the Site. Potential settings that may be applicable to the Site include:

- streams or rivers (Bloody Creek).

The corresponding Federal SCGs to the above settings are:

- Fish and Wildlife Coordination Act (40 CFR 6.302)

Potential New York State SCGs applicable to the Site include Use and Protection of Waters (6 NYCRR Part 608.)

2.3.1.3 Action-Specific SCGs

Action-specific SCGs are determined by the particular remedial activities that are selected to address the Site cleanup. Action-specific requirements establish controls or restrictions on the design,

implementation and performance of remedial activities. Following the development of the remedial alternatives, action-specific SCGs that specify performance levels, actions, technologies or specific levels for discharged or residual chemicals provide a means for assessing the feasibility and effectiveness of the remedial activities.

The federal and New York State action-specific SCGs which may be applicable to Site remediation are presented in Table 2.3.

2.4 IDENTIFICATION OF GENERAL RESPONSE ACTIONS

2.4.1 General

This section presents the development of general response actions for each medium of interest. Potential treatment, containment, and disposal technologies for each remedial response action and potential process options are also identified for each of the following media:

- i) soils;
- ii) groundwater;
- iii) surface water/sediments; and
- iv) ambient air.

2.4.2 Soils

Although the surface soils and subsurface soils are evaluated separately in a risk assessment, soils are treated as one media of concern for the purposes of evaluating remedial alternatives.

Potential general remedial response actions for addressing soil contamination are listed below:

- no further action;
- limited further action;
- physical containment;
- in situ treatment action;
- removal/treatment action; and
- removal/disposal action.

Potential remedial technologies and process options associated with each of these response actions are listed in Table 2.4. A general description of each of these response actions is presented below.

2.4.2.1 No Further Action

The National Contingency Plan (NCP) requires the evaluation of a "no action" alternative as a basis for comparison with other remedial alternatives. Under the no action response, no measures are taken to improve environmental conditions with respect to the soils at the Site,

however, monitoring will continue to be conducted, as appropriate. Since Interim Remedial Measures have already been implemented at the Site, this alternative will be assessed as a "no further action" alternative.

2.4.2.2 Limited Further Action

The limited further action response involves implementing institutional controls to reduce potential human exposure to Site-related chemicals in the soils. The institutional controls include initiation of deed restrictions to restrict access to the Site and to limit future uses of the Site. This alternative will be assessed in addition to the interim actions implemented to date.

2.4.2.3 Physical Containment Action

The physical containment response action involves the use of physical means to limit exposure to, contain and/or restrict the mobility and migration of chemicals associated with the Site soils. Potential containment technologies include:

- i) covering all or portions of the Site where soil concentrations exceed potential soil cleanup goals; and
- ii) surface water runoff diversion.

Alternative capping options include a permeable soil cover or low permeability cap constructed to specific design standards (e.g., NYSDEC standards for a sanitary landfill).

Surface water runoff diversion options include grading portions of the Site and construction of ditches or berms to divert surface water runoff away from the areas where soil concentrations exceed the potential cleanup goals.

2.4.2.4 In Situ Treatment Action

This response action involves in situ treatment of the soils to achieve the potential soil cleanup goals. The in situ treatment process could be conducted using either biological or physical treatment technologies. Potential physical treatment options include vacuum extraction and soil flushing.

Biological treatment involves the development of a bacterial colony within the soils. The bacteria break down specific chemicals to less toxic components. Biodegradation of the chemical constituents depends on the Site soils, climatic conditions and the specific chemicals present.

Treatment by vacuum extraction involves stripping the volatile organic parameters from the soil by drawing a quantity of air through the soil by vacuum. In the in situ applications, either wells or trenches with

horizontal perforated pipes are installed in the desired cleanup zones. Blowers are used to draw air from the wells thereby moving air through the soils. The air removed is typically directed through a carbon filter and then either reinjected into the soil or exhausted to the atmosphere. The effectiveness of the system is dependent upon the type of soils, the chemicals present, and the rate at which the air is moved through the soil.

Soil flushing is very similar in principle to the vacuum extraction process except that water is used as the flushing media. Water is flushed through the soils solubilizing chemicals from the soil. The water is collected and treated to remove chemicals and then reinjected. Again, the effectiveness of the system is dependent upon the type of soils, and the chemicals present.

2.4.2.5 Removal/Treatment Action

The removal/treatment action involves excavation of the soils with chemical concentrations exceeding the potential soil cleanup goals and treating the soils either on Site or at an off-Site facility. Potential on-Site treatment technologies include physical, chemical or biological treatment. The only currently available commercial off-Site treatment technology for soils is physical treatment via incineration.

Potential on-Site physical treatment options include landfarming which involves aeration of the soil by tilling. The landfarming operation is conducted on an engineered treatment pad. Excavated soils are

processed on the treatment pad to reach target cleanup levels. This technology may be supplemented by the addition of biological treatment.

Potential on-Site thermal treatment options include low temperature thermal treatment and on-Site incineration. Low temperature thermal extraction involves excavating and placing the soils into a portable low temperature thermal desorption unit located on Site. Low temperature heat would be used to desorb volatile and semi-volatile chemicals from the soil and condense the chemicals into a concentrated residual which can be more economically disposed at an off-Site facility (i.e. incinerator).

On-Site incineration involves transporting a mobile incineration unit to the Site. The excavated soils are placed into the incinerator and high temperatures are used to break down the chemical constituents to less toxic components.

On-Site chemical treatment could be accomplished utilizing solvent extraction treatment technology. The solvent extraction technology involves mixing the soils with an aliphatic solvent, such as triethylamine (TEA), at low temperatures in a mixing vessel. At low temperatures, the solvent solubilizes both hydrocarbons and water. The liquid phase separates from the soil and is pumped to a decanter. The solvents are then separated from the water. The contaminants remain with the solvent and are then separated from the solvents using an evaporator or an evaporator combined with a distillation column. The solvent is typically reused and the contaminants may be sent off Site for treatment and/or disposal.

2.4.2.6 Removal/Disposal Action

The removal/disposal response action involves excavation of soils with concentrations exceeding potential soil cleanup goals and disposal either on Site or off Site by landfilling.

2.4.3 Groundwater

Potential general remedial response actions for addressing chemicals detected in the groundwater are listed below:

- i) no further action;
- ii) limited further action;
- iii) physical containment action;
- iv) hydraulic containment action;
- v) source removal action; and
- vi) in situ treatment action.

The potential remedial technologies and process options associated with each of these response actions are listed in Table 2.4. A general description of each of these technologies is presented below.

An existing groundwater collection/treatment system is currently being operated at the Duva property. This treatment system treats

water collected by the downgradient collection drain as described in Section 1.2. Since this system has already been designed and installed at the Site and on-going monitoring indicates the system is effective in treating groundwater collected at the Site, a re-evaluation of all potential treatment alternatives will not be completed in this report.

2.4.3.1 No Further Action

The NCP requires the evaluation of a no action alternative as a basis for comparison with other remedial alternatives. Under the no action response, no further measures are taken to improve environmental conditions with respect to the groundwater at the Site, however, monitoring is performed as appropriate. This action will be assessed assuming interim measures implemented to date will continue to be operational.

2.4.3.2 Limited Further Action

The limited further action response involves implementing institutional controls to reduce the potential human exposure to Site-related chemicals in the groundwater. The institutional controls include initiation of deed restrictions and/or municipal by-laws to restrict groundwater use on and in the immediate vicinity of the Site.

2.4.3.3 Physical Containment Action

The physical containment response action involves the use of physical means to contain and restrict the mobility and migration of chemicals in the groundwater. A potential physical containment technology involves construction of a low permeability barrier wall(s) either downgradient or around the area of concern to restrict the movement of chemicals from the Site via groundwater flow. Barrier walls can be constructed of soil/bentonite, cement/bentonite, or sheet piling.

2.4.3.4 Hydraulic Containment Action

The hydraulic containment action involves groundwater extraction downgradient of the area of concern to reduce the migration of chemical constituents from the Site via groundwater flow. Hydraulic containment may be achieved by installing either groundwater extraction wells or horizontal groundwater collection tile drains. The horizontal groundwater collection drain installed at the Duva property, as described in Section 1.2, is acting as a hydraulic barrier to contain groundwater to the Site.

2.4.3.5 Source Removal Action

The source removal response action involves extracting groundwater throughout the area of concern utilizing either groundwater

extraction wells or groundwater collection trenches. The collected groundwater would be treated on Site using the existing treatment system.

2.4.3.6 In Situ Treatment Action

In situ treatment can be utilized to reduce chemical concentrations in the groundwater. The most common technology currently used in in situ treatment of groundwater is biological treatment. Biological in situ treatment of groundwater involves development and maintenance of a bacterial culture in the groundwater under controlled conditions. The bacteria eventually breaks down specific organic chemical constituents to less-toxic components. Inorganic chemical constituents are generally not affected by biological treatment.

Ex situ treatment processes will not be further evaluated since the existing groundwater treatment systems has been demonstrated to effectively treat the extracted groundwater.

2.4.4 Surface Water/Sediments

The presence of Site specific chemicals in surface water and/or sediment is primarily attributable to the leaching of contaminants from surface soils in the vicinity of the former drum storage areas. Remedial response actions that address soil contamination will address potential sediment (i.e. surface soil in swales/ditches) contamination and surface water

contamination. Hence, on-site remedial response actions to specifically address surface water/sediment are not necessary.

2.4.5 Ambient Air

Remedial response actions that address groundwater migration toward the private residences located south of the Duva property and response actions that address surface soil contamination will address potential ambient air contamination. Evaluation of alternatives for these other media will consider the potential effect on chemical concentrations in the ambient air. Hence, on-Site remedial response actions to specifically address chemicals in the ambient air are not necessary.

2.5 SCREENING OF SOIL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS

This section presents a preliminary evaluation of the remedial response actions, technologies and process options applicable to soil. The initial screening of response actions, technologies and process options is based upon general technical feasibility which incorporates effectiveness and implementability. General cost considerations will also be utilized in this preliminary screening of technologies.

This preliminary screening is used to select those technologies and process options that are considered to be most appropriate to

address identified chemical presence at the Site and to eliminate the less effective or less reliable technologies and process options from detailed consideration.

The following sections present the preliminary evaluation of the identified response actions, technologies and process options. Table 2.5 summarizes the results of the evaluation.

2.5.1 Physical Containment

Specific containment objectives for remediation of soils at this Site may include:

- i) minimize potential dermal contact with chemicals detected in surface soils;
- ii) minimize volatilization of chemicals in the near-surface soils to the atmosphere;
- iii) minimize the potential transport of chemicals in surface water by isolating chemicals in the surface soils from surface water runoff; and
- iv) minimize infiltration and hence reduce leaching of chemicals in the soils to the shallow groundwater.

Containment options considered for the Site will address one or more of the stated objectives. These options include: i) a permeable soil cover which would isolate the contaminated surficial soils from direct exposure to the public and surface water runoff while allowing normal infiltration, and ii) a low permeability soil cover such as a clay cap. A description of each cap design is presented below:

Soil Cover

- 6 to 18 inches of compacted fill or regraded Site material to promote drainage;
- 6 inches of top soil; and
- vegetative cover.

Low Permeability Cap (Typical)

- 18 inches of compacted clay;
- 24 inches of compacted fill;
- 6 inches of top soil; and
- vegetative cover.

Construction of either cover design utilizes common construction practices and readily available materials. Once constructed and established, the cover will provide long term reliability and continue to be effective.

The low permeability cap design would meet all the containment objectives by minimizing potential dermal contact with chemicals associated with surface soils; minimizing volatilization of chemicals in the near surface soils to the atmosphere; and minimizing the potential transport of chemicals in the surface water runoff by eliminating contact between surface water runoff and chemicals in surface soils. The low permeability cap is more effective in reducing leachate generation. Hence, this cap should be considered in any alternatives where capping is the only means of remediation for soil and groundwater. Since an operating groundwater remediation program is currently in place at the Site, further consideration of a low permeability cap is not warranted.

A soil cover design consisting of compacted fill and/or vegetated top soil would reduce potential public exposure and direct contact between surface water and contaminated soil as well as reduce volatilization of chemicals to air while promoting infiltration. This technology does not meet all identified containment objectives and should therefore only be considered in conjunction with other remedial technologies.

2.5.2 Ex Situ Soil Treatment

A total of six ex situ treatment process options were identified for potential soil remediation. These process options include:

- on-Site landfarming;
- on-Site low temperature thermal extraction;

- on-Site solvent extraction;
- on-Site biological treatment;
- on-Site incineration; and
- off-Site incineration.

Although all ex situ methods will effectively treat the soil removed, clean backfill may be subject to passive recontamination by groundwater and/or diffusion of VOCs through soil vapor. In addition, on-Site treatment technologies must be able to operate within the limits of the Site. The six ex situ treatment options are described below.

2.5.2.1 Landfarming

The landfarming treatment technology involves aeration and biological degradation of the soils by tilling on an engineered treatment pad. The soils are placed in a lift of approximately 1 foot thick on the treatment pad. Tilling is conducted on a regular basis to ensure sufficient oxygen is available for the aerobic decomposition of compounds. Volatilization of the contaminants to the surrounding air occurs as a side effect of tilling. Additives can be used to enhance the biodegradation process. This process continues until acceptable contaminant levels were achieved.

The major organic (volatile and semi-volatile) chemicals detected in soils at the Duva property have a high or moderate potential for successful treatment under aeration and/or biological degradation. However,

inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by a landfarming alternative.

The cost for this option is similar to other non-thermal alternatives. A significant disadvantage of this technology is the potential for excessive uncontrolled air emissions due to the volatilization of chemicals and fugitive dust emissions during the treatment process. Due to the potential high emission rates from the soils, workers may be required to wear respiratory protection during the treatment process. Since the Site is located in close proximity to residential areas, it may be difficult to implement a landfarming alternative without extensive air emission controls that may reduce the effectiveness of the system while increasing implementation costs. Any precipitation contacting the soils over the treatment period would likely require collection and treatment at the on-Site treatment system.

The implementation of a landfarming remedy utilizes common construction techniques, however, depending on the volume and physical nature of the material requiring treatment as well as climatic conditions, the remedy may require a long treatment duration. Based upon the anticipated lengthy duration of a landfarming remedy and the associated air emission concerns in close proximity to a residential area, this alternative will not be evaluated further in this FS. Other alternatives provide a greater anticipated level of effectiveness with fewer operational concerns.

2.5.2.2 Low Temperature Thermal Extraction

Low temperature thermal treatment is a potential treatment technology for soils which have a high solid content with low to medium levels (<10%) of organic compounds. Thermal volatilization involves heating the soil to the appropriate temperature (200 to 1100°F) to cause volatilization of organic compounds into a carrier gas. The treatment process requires excavation of all contaminated soil with concentrations above chemical cleanup goals.

Excavated soils are placed into the desorber and are heated. After being heated in the desorber, the carrier (purge) gas stream is cooled in stages to low temperatures to condense the volatilized water and organics into liquids. Recycled water is usually used from downstream in the process for gas cooling via heat exchange or direct quenching systems. The cooled carrier gas must be treated further to meet air pollution requirements before venting to the atmosphere. Treatment typically includes baghouses, cyclone separators, carbon adsorption or liquid scrubber systems. Carrier gases are sometimes recycled to the desorber for reuse in oxygen purging.

The condensed water/organic mixture is collected and the water is separated from the organics, usually by gravity. The water is recycled for reuse in processing or treated for release to ground or surface water or collected for off-Site disposal. Treatment can include filtration and carbon adsorption processing.

The condensed and separated liquid organics are also collected for further treatment. This treatment may include chemical fixation or solidification, incineration or containment.

Typical treatment rates for low temperature thermal treatment units range from approximately 75 to 150 tons/day of potentially contaminated soils. There are a number of mobile low temperature thermal treatment units available from several suppliers, therefore it is reasonable to assume the technology can be readily implemented. Spatial requirements at the Site may limit the size of the unit which can be operated on Site which will result in a slower treatment rate of potentially contaminated soils. Residential concerns for air emissions from an incinerator-type technology may be an issue for a low temperature thermal extraction alternative, however, engineering controls are readily available to ensure protection of residences. Costs for this technology are typically higher than alternate on site non-thermal treatment options. This technology has been demonstrated effective for treatment of organic compounds including those detected at the Duva property, however, inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by this alternative. This option will be carried through for detailed evaluation in this FS.

2.5.2.3 Ex Situ Solvent Extraction

Solvent extraction is a process that is suitable for the treatment of materials with varying compositions of water, oil and solids.

This technology has not been widely used for full-scale operations and therefore, its effectiveness and reliability for the reduction of hazardous constituents in soils is questionable. The treatment process requires total excavation of the contaminated soil creating potential dust and chemical air emission concerns.

The solvent extraction process involves mixing potentially contaminated soils with an aliphatic solvent, such as triethylamine (TEA), at low temperatures in a vessel equipped with steel paddles or plows for mixing. The first extraction of the potentially contaminated soil is conducted at a temperature below 40°F. At low temperatures the solvent solubilizes both hydrocarbons and water. The homogeneous liquid phase separates from the soil and is pumped into a decanter. The remaining solids portion is "washed" again in the solvent at higher temperatures of about 130°F. At these temperatures, solubility of the organic compounds in the solvent increases which enhances their removal from the potentially contaminated soils. The required number of "washes" varies depending upon soil conditions and contaminants present. Once the liquid phase from the last "wash" is removed from the solids, the solids are dried by injecting steam in the jacket surrounding the vessel. Steam is also injected into the solids to strip any remaining solvent, which is later recovered.

The liquid phase from the initial extraction is heated to the temperature at which the solvent and water become immiscible (130°F for TEA). The chemicals, however, remain with the solvent. The solvent-chemical portion is pumped into a solvent recovery system along

with the liquid phase from the higher temperature subsequent extractions. The solvent recovery system may be an evaporator or an evaporator combined with a distillation column. The solvent is condensed and reused, and the chemicals removed from the soil are sent off for disposal or treatment. The water portion is pumped to a stripping column to remove any traces of the solvent. The remaining water can be treated on Site through a carbon filter unit or collected and disposed of off Site.

There are a limited number of mobile solvent extraction units available, hence the technology may not be readily implemented depending on vender availability.

This technology is not anticipated to be as effective as low-temperature thermal extraction for treatment of organic compounds and is on the same order of magnitude in cost for implementation. Solvent extraction also presents some concern for residual concentrations of the solvent in the treated residual soil. Thus, this technology will not be considered further in this FS.

2.5.2.4 Biological

Biological treatment involves providing a favorable environment to enhance the development of a bacteria culture in the soils. This usually involves the addition of nutrients and oxygen to the soil. The bacteria eventually breaks down the chemicals to less-toxic components. Bioremediation is most commonly conducted by landfarming as described in

Section 2.5.2.1. The landfarming process provides for both volatilization of chemicals to the atmosphere and biological breakdown of the less volatile chemicals. However, inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by this technology.

A disadvantage of bioremediation is the potential for excessive air emissions due to volatilization of chemicals and/or fugitive dust emissions during the treatment process. Odors may also be a concern since the Site is in close proximity to residences.

Biological remediation can also be conducted in situ or in conjunction with other treatment processes. Costs for this technology are highly variable and may exceed alternate ex situ alternatives.

The design of a biological treatment system would necessitate the completion of laboratory studies to determine the appropriate composition of a bacterial culture for Site specific soils. As discussed under the landfarming alternative, there are concerns related to air emissions and the lengthy period necessary to complete a treatment operation. Based on this preliminary evaluation, biological treatment will not be further considered as a primary remedial process in this FS. It may however be considered at a later date as a supplement to an alternate remedial process.

2.5.2.5 On-Site Incineration

Incineration is an effective treatment method for organic compounds which uses high temperature oxidation under controlled conditions to degrade a substance into carbon dioxide, nitrogen oxides, sulfur dioxide, hydrogen chloride gases and ash. The hazardous products of incineration, such as particulates, sulfur dioxide, nitrogen oxides and hydrogen chloride typically require air emission control equipment.

Inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by this alternative.

Due to the expected low BTU value of the Site soils, an additional fuel such as natural gas, oil or pulverized coal would be required to achieve and maintain the temperatures required for complete combustion.

The residence time and temperature depend upon the combustion characteristics and chemical properties of the waste. Residence times can range from a few seconds for liquid with a high BTU value to an hour or more for bulk solids.

Typical treatment rates for mobile incineration range from 100 to 200 tons/day. Treatment costs are significantly higher than other on-Site non-thermal treatment alternatives but considerably lower than off-Site incineration.

There are numerous mobile incineration units available, however, the required trial burn may translate into an RD/RA period of approximately two years prior to implementation. In addition, residential concerns regarding air emissions from an incinerator unit may also be an issue. Thus, on-Site incineration will not be carried on to detailed evaluation in this FS.

2.5.2.6 Off-Site Incineration

Excavated soil could be transported off Site for incineration. This technology is essentially the same as the on-Site incineration as presented in Section 2.5.2.5. Rotary kiln incinerators or other various incineration methods have a demonstrated removal efficiency greater than 99.99 percent for organic chemicals.

Although numerous incinerator vendors are available, existing capacity is an issue and would likely extend the active remediation of the Site into a multi-year program. Ongoing daily truck traffic creates an additional hazard and nuisance for the community. Off-Site incineration is also cost prohibitive compared to on-Site techniques due to both treatment and transportation costs. Thus, this alternative is eliminated from further evaluation in this FS.

2.5.3 In Situ Soil Treatment

Three alternative process options were identified for in situ treatment of soils at the Site. These are:

- biological,
- vacuum extraction, and
- soil flushing.

A description of each of these process options is presented below.

2.5.3.1 Biological

In situ biological treatment is a process where oxygen and nutrients are added to the soils to promote the breakdown of contaminants by naturally occurring microorganisms (usually bacteria). This is usually accomplished by adding nutrient-enhanced water to the system through infiltration basins at the ground surface or through recharge wells. The water is circulated through the soils to be remediated. The water used to transport the nutrients can also work to dissolve sorbed contaminants. The extracted water would be treated on Site, if required, to remove dissolved chemicals prior to reinjection.

Several factors influence the effectiveness of an in situ biological treatment process. These factors include:

- available oxygen concentration;
- appropriate levels of macronutrients and micronutrients;
- redox potential;
- soil pH;
- degree of water saturation;
- soil temperature;
- competition, predators, presence of toxins;
- chemicals to be treated and concentration; and
- hydraulic conductivity of soils.

Bench scale and/or pilot-scale tests are required to fully ascertain the effectiveness of biological treatment at any particular site.

In situ biological treatment is not a well demonstrated technology. There are a great number of variables as indicated above that impact the potential effectiveness of the remedy. In addition, inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by this alternative. Conditions at the Duva property do not present ideal conditions for biological treatment, thus this alternative will not be carried on to detailed evaluation in this FS.

2.5.3.2 Vacuum Extraction

The in situ vacuum extraction process involves the removal of vapors containing VOCs and some semi-volatile organic compounds from within the contaminated soil horizon. The vacuum

extraction process induces a vacuum to create air flow through the soil and cause volatilization and stripping of VOCs from the soil matrix to the air. Extraction wells or piping are installed within the desired cleanup zone, with vacuum and positive pressures being applied at alternating well or trench locations. The air stream is then treated, if required, prior to reinjection or discharge to the atmosphere.

The vacuum extraction process removes chemical vapors trapped in soil pore spaces, but also affects, to a limited extent, residual liquid contaminants and dissolved contaminants from the groundwater. Water in the collected air stream is condensed and separated from the air stream and is transferred to a water treatment system or to waste.

Several factors impact the effectiveness of in situ vacuum extraction at any particular site. These factors include:

- chemicals to be treated and concentrations;
- soil temperature;
- soil air conductivity;
- moisture content;
- geological conditions; and
- soil sorption capacity.

In situ vacuum extraction is a well-demonstrated technology that has been used to cleanup VOC contaminated soils from numerous remediation sites. The technology has been successfully applied over a wide range of geologic and hydrogeologic conditions.

The in situ vacuum process is most successful in unsaturated soil or the vadose zone. Water generally deters the volatilization of contaminants reducing the available air-filled pore spaces. Accordingly, groundwater is frequently extracted simultaneously from the area of concern in order to increase the depth of the unsaturated zone and the volume of soil treated.

Fluctuations in the water table previously noted at this Site would render all or portions of the system ineffective during specific time periods. A dual groundwater/soil vapor extraction system will, therefore, be considered for this Site to minimize the impact of fluctuations in the water table on the treatment of in situ soils. The dual system will maintain a constant depth of the vadose zone to enhance treatment of in situ soils while collecting potentially contaminated groundwater from beneath the Site.

Studies have shown that vacuum extraction remediation can also promote biodegradation due to the increased supply of oxygen. The biological degradation process can be further enhanced, in conjunction with the vacuum extraction process, by adding nutrients to the soils in a similar fashion, as described for the biological treatment process.

In situ vacuum extraction has been demonstrated as effective for removing volatile organic compounds present in soil. Inorganic chemicals, if present in the soils at concentrations above designated cleanup criteria, will not be addressed by this alternative.

A dual groundwater/soil vapor extraction system would be relatively easy to install and operate. Minimal maintenance would be required. In addition, continued operation of the system would have a minimal impact on the surrounding environment and community. Costs for this option are similar to other on-Site treatment alternatives. This alternative will undergo a detailed evaluation in this FS.

The effectiveness of this technology has been demonstrated in numerous similar applications. However, a Pilot Study was performed at the Miller/Duva Site to ensure the process will be effective at this Site and to obtain sufficient predesign information necessary to allow the final system design to be performed, if necessary. The Pilot Study was performed as described in the Work Plan entitled, "Work Plan for Soil Vapor Extraction Pilot Study, Miller/Duva Site", dated July 1992 and subsequent correspondence. The Work Plan was approved by the NYSDEC by letter dated July 31, 1992. The results of this study have been previously submitted under separate cover in the report entitled, "Addendum: Report on the Results of the Soil Vapor Extraction Feasibility Study at the Miller/Duva Site in Clay, New York", dated October 1992.

2.5.3.3 Soil Flushing

Soil flushing involves circulating water through the soil to be treated in order to dissolve the chemicals into the water or otherwise mobilize the residual chemicals. The circulated water with dissolved

chemicals is then brought to the ground surface using extraction wells or tile drain collectors and treated prior to reinjection.

The degree to which soil flushing is effective is primarily dependant upon the following factors:

- soil hydraulic conductivity;
- soil carbon content; and
- chemical-specific properties such as water solubility, sorption characteristics, vapor pressure, liquid viscosity and liquid density.

Surfactants can be added to the flushing water to help mobilize contaminants. Surfactants are natural or synthetic chemicals that have the ability to promote wetting, solubilization or emulsification of various organic chemicals.

This technology is similar to vacuum extraction and will be carried on to detailed evaluation in this FS as a comparison to vacuum extraction. Demonstratable effectiveness based on Site conditions and cost will be major considerations during the detailed evaluation.

2.5.4 Removal/Disposal

The removal/disposal response action identified for potential soil remediation involves the excavation of contaminated soils and the disposal in an off-Site or on-Site landfill.

2.5.4.1 On-Site Landfill

Disposal in an on-Site landfill would involve the construction of a landfill or containment cell/vault for the placement of contaminated soils. Disposal of contaminated soils in an on-Site landfill would not reduce the volume or toxicity of contaminants, but would limit the migration of contaminants. However, given the topography of the Site, and the lack of space on Site, construction of a landfill on Site is not practical. In addition, there would be a potential long term liability remaining on Site. Therefore, this remedial option will not be evaluated further in this FS.

2.5.4.2 Off-Site Landfill

Disposal of contaminated soils in an off-Site landfill would involve the excavation and transportation of contaminated soils to an appropriate off-Site landfill. This method would limit the migration of contaminants, but, would not reduce the volume or toxicity of the waste. The off-Site transportation of contaminated soils would result in daily truck traffic which may create additional hazards and nuisance. In addition, the remedial action goals established in Section 121 of CERCLA states that off-Site transport and disposal of contaminated materials without treatment is the least favored remedial action where practicable treatment technologies exist. Therefore, disposal in an off-Site landfill will not be considered on its own for remediation of this Site. Off-Site disposal could, however, be considered if

limited or discrete areas of contaminants are not addressed by the primary remedial technology and, if left unremediated, would represent an unacceptable risk to public health or the environment.

2.6 SCREENING OF GROUNDWATER REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS

This section presents a preliminary evaluation of the remedial response actions and technologies applicable to groundwater. The initial screening process parallels the process used for screening the soil remedial alternatives (Section 2.5).

The screening process takes into consideration the existing downgradient groundwater collection and associated on-Site treatment system. Thus, this preliminary screening is used to select those technologies and process options that are considered most appropriate to enhance the effectiveness of the existing perimeter collection and treatment system or address source control/removal.

The following sections present the evaluation of different response actions, technologies and process options. Table 2.6 summarizes the results of this evaluation.

2.6.1 Physical Containment Action

The objective of a physical containment action consisting of a barrier wall involves the elimination of potential downgradient migration of contaminated groundwater by placement of a barrier wall downgradient of the existing groundwater collection system. An upgradient barrier wall may also be installed to reduce potential leaching of contaminants from soils by reducing the quantity and rate of groundwater flow through the identified contaminated soils.

An upgradient and/or downgradient barrier wall in association with a low permeability cap could be implemented to completely contain the contaminated soil and groundwater, however, this option does not serve to reduce the mass, volume or toxicity of the source of contamination. This requires long-term monitoring and limited land use in perpetuity.

Hence, barrier walls are an effective means of reducing the chemical transport via groundwater, however, the source of contamination is not addressed. The physical containment action should reasonably be considered only when a hydraulic containment action or other suitable alternative can not be effectively implemented. Since the existing hydraulic containment system has been demonstrated to be effective, physical containment will not be further evaluated.

2.6.2 Hydraulic Containment Action

Based on initial operational monitoring data, the existing downgradient groundwater collection system has demonstrated success in intercepting off-Site groundwater transport of Site related chemicals. An evaluation of alternate means of achieving a hydraulic barrier such as extraction wells is not necessary.

An expansion of the existing hydraulic containment system will be considered in the event ongoing performance monitoring indicates potentially contaminated groundwater is being released from the Site and may result in unacceptable concentrations of contaminants in off-Site groundwater.

2.6.3 Source Removal Action

A source removal action at the Duva property would involve either a groundwater extraction well system or a network of groundwater collection trenches similar in design to the existing downgradient groundwater collection system described in Section 1.2.

The relatively low hydraulic conductivity of the soil formations beneath the Duva property would most likely require a very extensive groundwater extraction well system. Based on the demonstrated effectiveness and relative cost of a groundwater collection drain at the Duva

property, this would be the recommended technology for implementation of a source removal action at the Site.

This technology will be considered as part of a dual groundwater/soil vapor extraction system.

2.6.4 In Situ Treatment Action

Biological treatment to address elevated chemical concentrations is similar in concept to biological treatment of soil as described in Section 2.5.2.3. A biological culture must be developed and maintained that will break down the detected compounds to less toxic compounds. Biological treatment of groundwater can be implemented as a direct treatment process for a groundwater collection system or implemented in situ. An ex situ treatment process will not be further evaluated since the existing groundwater treatment system has been demonstrated to effectively treat the extracted groundwater.

In situ biological treatment has been used to remediate specific organic compounds in groundwater, primarily non-chlorinated compounds (e.g., hydrocarbons). The primary chemicals of concern at the Site are VOCs with trichloroethylene being the most predominant VOC. Degradation of trichloroethylene and other chlorinated VOCs may produce more toxic substances (e.g., vinyl chloride). Inorganic chemicals, if present at concentrations above designated cleanup criteria, will not be addressed by this technology.

Design of an in situ biological treatment system would require the completion of laboratory studies to determine the appropriate composition of biological culture. In many cases, it is difficult to maintain the ideal conditions required by the selected bacterial culture for the efficient degradation of contaminants. Studies would also be required in association with extensive monitoring to establish an operational program to introduce the bacterial culture to the groundwater media and maintain the culture in a dynamic system.

Based on the demonstrated success of the existing groundwater treatment system and the complexity of a biological treatment system for groundwater, this alternative will not be considered in the detailed evaluation in this FS.

2.7 SUMMARY OF PRELIMINARY EVALUATIONS OF RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES

A preliminary evaluation of potentially applicable remedial response actions, technologies and process options to address soil and groundwater mediums was presented in Section 2.5 and 2.6, respectively. The preliminary review considered the relative effectiveness, cost and implementability of available actions specific to conditions at the Duva property.

Based upon this preliminary evaluation, several remedial response actions, technologies and process options were selected for further evaluation during this Feasibility Study as summarized below.

2.7.1 No Further Action

In accordance with the NCP, the No Action or No Further Action alternative shall be evaluated in this FS.

2.7.2 Limited Further Action

Subsequent to the completion of the Risk Assessment, limited further actions consisting of deed restrictions and/or institutional and other related controls shall be evaluated alone or as part of other remedial alternatives in this FS.

2.7.3 Physical Containment - Soils

The construction of a soil cover shall be evaluated as a separate response alternative or in association with other response actions such as soil vapor extraction or soil flushing in this FS. Further investigative or treatability studies are not necessary to fully evaluate capping alternatives.

2.7.4 Low Temperature Thermal Extraction - Soils

Low temperature thermal extraction has been selected as the most potentially appropriate ex situ treatment alternative to address soil remediation and will be further evaluated in this FS.

The technology has a demonstrated success in small and large scale remedial actions including various superfund sites. This success has been documented in achieving approved cleanup levels for similar volatile and semi-volatile compounds.

Of the several ex situ processes reviewed, low temperature thermal extraction is considered to cause the minimum impact associated with dust emissions, chemical emissions and odor emissions upon the nearby residences while providing demonstrated effectiveness.

The detailed evaluation of low temperature thermal extraction does not require further Site investigative or treatability studies. The physical nature of the soils present on the Site and the contaminants of concern are known. This information is sufficient to enable an evaluation of the effectiveness of the system to meet potential site cleanup objectives for soil.

2.7.5 In Situ Vacuum Extraction

In situ vacuum extraction in conjunction with groundwater extraction will be carried on into the detailed evaluation stage in the FS. The dual groundwater/soil vapor extraction process has been demonstrated to be effective in the remediation of VOC contaminated groundwater and soils without excavation. The extraction system is relatively easy to install, operate and maintain. A soil cover option for some specific areas of the Site may be necessary to prevent short circuiting of the air stream and enhance the effectiveness.

The physical and hydrogeologic conditions of the Site have been sufficiently determined and the technology has documented success at a number of sites and is therefore known to be effective for treatment of the primary organic contaminants of concern. A pilot scale study was performed to evaluate the applicability of this remedial technology to the physical and hydrogeologic conditions at the Site and has been used as a basis for the evaluation of soil vapor extraction treatment technology during the development of this FS.

2.7.6 In Situ Soil Flushing

Soil flushing is a technology relatively similar to soil vapor extraction. The technology has demonstrated success at addressing organic compounds. Soil flushing may also address inorganic compounds to

a lesser degree of success depending on the physical and hydrogeologic nature of the site and the relative mobility of the compounds of concern.

A detailed evaluation of soil flushing will be completed in this FS without further investigative activities or treatability studies. This technology has documented success at several sites and is known to be effective for contaminants reported at the Duva Site.

2.7.7 Source Removal Action - Groundwater

The only additional response action to specifically address groundwater that will be carried on to detailed evaluation in this FS is a source control action. A source control action would consist of collection trenches and/or wells installed as part of or independent of a soil vapor extraction system.

3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

3.1 BASIS FOR DEVELOPMENT OF REMEDIAL ALTERNATIVES

The remedial response actions/technologies identified in Section 2.0 for further consideration following the initial screening process have been assembled into various remedial alternatives designed to address, to the extent practical, the remedial action goals and objectives developed for the Site. Each remedial alternative developed, as presented in this section, is described and analyzed in detail in Section 4.0.

To assist in the development of remedial alternatives, Section 300.430(a)(1)(iii) of the NCP identifies six "expectations" which should be considered. These "expectations" are summarized as follows:

- i) use of treatment(s) which address the principal threats posed by a site;
- ii) use of engineering controls;
- iii) use of a combination of methods, as appropriate, to achieve protection of human health and the environment;
- iv) use of institutional controls, as appropriate, to supplement engineering controls to prevent or limit exposure;
- v) consider the use of innovative technologies; and
- vi) return usable groundwaters to beneficial use wherever practical.

All alternatives have been developed and will be evaluated based on the following assumptions:

- i) operation and maintenance of the existing groundwater collection/treatment system shall continue, as appropriate, until remedial action goals and objectives have been otherwise satisfied;
- ii) performance monitoring of the existing groundwater collection/treatment system shall continue while the system is in operation to ensure it continues to contain contaminated groundwater which would otherwise be released from the Site;
- iii) the existing security fence around the Site shall be maintained, as required, to ensure that access to the Site continues to be restricted;
- iv) the operation and maintenance of sump vents and air filters in adjacent homes will continue, as appropriate; and
- v) off-Site groundwater quality monitoring to determine the nature and extent of any historical contaminant plume attributable to the Site shall be performed; the remediation of any detected off-Site contaminant plume, if appropriate, is not specifically addressed by this FS.

Operation and monitoring of the existing groundwater extraction/treatment system will continue to address on-Site groundwater contamination attributable to the Site. Consequently, remedial alternatives have been assembled which, in conjunction with the existing groundwater extraction/treatment system, will address the remedial action goals and

objectives for soils and/or groundwater affected by past Site activities.

Developed alternatives therefore focus on one or more of the following:

- i) reduction of risks associated with direct exposure to soils by isolating and/or containing residual soil contamination; and/or
- ii) treatment and/or control of the source of groundwater contamination and reduction of risks associated with direct exposure by treating residually contaminated soils.

Each alternative is based upon one of the response actions/technologies retained for further consideration, as such, each developed alternative will undergo a detailed analysis and will not be subject to further screening processes.

Remedial alternatives developed include:

- i) No Further Action;
- ii) Limited Further Action;
- iii) Physical Containment - Soil Cover;
- iv) In-Situ Treatment of Soils
 - 4A. Vacuum Extraction,
 - 4B. Soil Flushing;
- v) Removal/Treatment of Soils by Low Temperature Thermal Extraction (LTTE); and
- vi) Dual Soil Vapor/Groundwater Extraction.

The scope and general rationale or basis for each developed alternative are summarized in the sub-sections which follow. Detailed descriptions and analysis of each developed alternative are provided in Section 4.0.

3.2 NO FURTHER ACTION ALTERNATIVE

The no action or "no further action" remedial alternative does not provide for any additional actions to be performed over and above those already implemented and/or ongoing at the Site. Any protection provided by this alternative is derived from measures already in place at the Site. The "no action" alternative is included in the remedial alternatives considered in accordance with the NCP.

3.3 LIMITED FURTHER ACTION ALTERNATIVE

The limited further action alternative utilizes deed restrictions, deed notations and other institutional controls to: identify the presence of contaminants on a site; limit activities on a site to minimize/prevent exposure to or release of such contaminants; and, prohibit use of and exposure to potentially contaminated groundwater. Protection derived from this alternative is due to the restricting or controlling of activities which could lead to exposure.

3.4 PHYSICAL CONTAINMENT - SOIL COVER

The physical containment alternative consists of the construction of a clean permeable soil cover over contaminated surficial soils or shallow subsurface soils to: eliminate potential for direct contact; eliminate potential for migration of surficial contaminants by wind dispersion or surface water runoff; and, minimize potential volatilization of contaminated soils. This alternative provides protection against exposure to or release of contaminants from soils and relies on the existing groundwater collection/treatment system to contain groundwater.

3.5 IN SITU TREATMENT OF SOILS

This alternative will reduce the mass of VOCs in the soils which are the source of groundwater contamination by one of the following methods:

- i) soil vacuum extraction; and
- ii) soil flushing.

Both alternatives may be combined with a soil cover to isolate contaminated soils during the treatment process. Protection is provided by reducing the concentration of contaminants in the soil to an acceptable level, thus eliminating risks associated with direct contact. VOC loading to groundwater is also significantly reduced by treatment of in situ soils.

3.6 REMOVAL/TREATMENT OF SOILS

This alternative requires the excavation of soils to be treated, on-Site treatment in a mobile LTTE unit, and placement of treated soils back in the excavation.

Long term benefits associated with the removal, treatment and replacement of soils are similar to those derived from in situ treatment. Although this alternative would be completed sooner than the in situ processes, it requires significant disturbance and handling of contaminated soils.

In addition, backfilled soils may be subject to recontamination by contact with contaminated groundwater and/or the passive migration of organic vapors from underlying or adjacent soils into the clean soils. All ex situ treatment systems require sufficient on-Site space for operation of the system as well as handling treated and untreated soils.

3.7 DUAL SOIL VAPOR/GROUNDWATER EXTRACTION

Under this alternative, extraction pipes and/or wells are utilized for the dual purpose of extracting soil vapors and groundwater from identified source areas. The combination will increase the depth of the vadose zone resulting in increased removal of VOCs from in situ soils while enhancing the effectiveness of the existing groundwater extraction program.

Benefits derived from this alternative are similar to those associated with in situ soil treatment, however an additional level of groundwater protection is provided.

A complete description and evaluation of each alternative is provided in Section 4.0.

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 GENERAL

Remedial alternatives developed and presented in Section 3.0 are described in detail in the sub-sections which follow. A detailed analysis of each alternative, based on the evaluation criteria stipulated in the NCP was performed and is presented herein. A comparative analysis of the remedial alternatives, based on the degree to which each remedial alternative satisfies the evaluation criteria, was also performed and is presented herein. A preferred remedial alternative was then selected based on the results of the comparative analysis; the selection of the preferred alternative is presented in Section 5.0.

4.2 GENERAL DESCRIPTION OF REMEDIAL ALTERNATIVES

The remedial alternatives developed for detailed analysis are summarized in Section 3.0. A general description of each developed alternative is presented in the sub-sections which follow.

In addition to the scope of each remedial alternative presented in the general description. Specific components which are common to each alternative, as described in Section 3.0, are as follows:

- i) continued operation and maintenance of the groundwater collection/treatment system previously installed at the Site;

- ii) continued performance monitoring to ensure satisfactory performance of the groundwater collection/treatment system;
- iii) maintenance of the existing security fence to continue to restrict access to the Site; and
- iv) completion of a groundwater investigation downgradient of the Site to further delineate the nature and extent of any historic contaminant plume released from the Site.

4.2.1 Remedial Alternative No. 1 - No Further Action

The NCP requires the development of a "No Action" alternative as a basis for comparison of remedial alternatives. Since significant remedial activities have already been performed at the Site, and under this alternative, the operations and maintenance of the existing groundwater collection trench and treatment system would continue, this remedial alternative shall be treated as a no "further" action alternative. As such, no further actions, over and above those already implemented at the Site, will be performed.

This Alternative relies upon natural attenuation/degradation and/or leaching and subsequent collection by the existing groundwater collection system for the reduction of the contaminant mass in the underlying soils and groundwater. Natural degradation is the

tendency of the contaminant mass to be reduced through physical, chemical and biological processes in the natural environment. Attenuation is the tendency of a contaminant to bind to in situ soil particles or organic matter reducing its mobility. The leaching process relies upon infiltration or groundwater flow to desorb contaminants from the soil mass and carry them to the existing groundwater collection/treatment system where they are ultimately removed.

Based on the information and conditions as presented in the "Handbook of Environmental Degradation Rates", by Howard, Boethling, Jarvis, Meylam, and Michalenks, a time frame for the natural restoration of the Site soils and groundwater may be estimated. Conservatively, the primary soil contaminant was assumed to be trichloroethene (TCE) due to its long half-life in soil, and the primary groundwater contaminant was assumed to be 1,2-dichloroethene (1,2-DCE) due to its long half-life in groundwater. Those half lives as published in the "Handbook of Environmental Degradation Rates" are 8640 hours and 69,000 hours, respectively. The estimated time frame for the TCE contaminated soil to degrade to an average concentration of 5 ppm to 10 ppm was approximately 8 years. Likewise, the estimated time frame for the 1,2-DCE contaminated groundwater to degrade to an average concentration of 5 ppm to 10 ppm would be in excess of 55 years.

4.2.2 Remedial Alternative No. 2 - Limited Further Action

Remedial Alternative No. 2 is similar to Alternative No 1 in that no active remediation is performed at the Site over and above those actions already implemented and being operated. This Alternative utilizes deed restrictions and/or institutional controls to identify the presence of contaminants and restrict exposures to such contaminants. Specific activities to be performed include:

- i) placement of a notification on the property deed to identify the presence of site contaminants;
- ii) placement of restrictions on the property deed to limit use of the Site to activities which will not lead to exposure to or release of contaminants; and
- iii) implementation of institutional controls (i.e. municipal by-laws) to prohibit use of groundwater potentially impacted by the Site.

Reduction of the contaminant mass would only occur through natural attenuation/degradation and leaching consistent with the reduction mechanism described in Remedial Alternative Number 1 - No Further Action.

Limited soil and groundwater sampling may also be performed as part of the Limited Further Action alternative. Due to the

length of time required for various Site constituents to degrade, routine sampling over and above that proposed for the performance monitoring of the groundwater collection/treatment system shall not be performed.

Concentration of contaminants detected in the collected groundwater shall be monitored as part of the operation of the system and additional sampling may be proposed as the influent samples approach applicable regulatory levels or if no reductions in VOC concentrations are noted for an extended period of time.

4.2.3 Remedial Alternative No. 3 - Physical Containment - Soil Cover

Remedial Alternative 3 consists of the construction of a permeable soil cover over portions of the Site where contaminants have been detected in surficial and/or shallow subsurface (upper 2 feet) soil samples. The proposed cap will isolate surficial and subsurface soils to prevent direct dermal contact with on-Site personnel and eliminate potential migration of contaminants in soil by wind dispersion or surface water runoff.

The existing groundwater collection/treatment system shall continue to contain contaminated groundwater, consequently, construction of a low permeability soil cover to minimize infiltration is not required and would potentially lengthen the time required for ultimate remediation of the Site.

Reduction in the contaminant mass and monitoring of such reductions would be consistent with that described under Remedial Alternative No. 2 - Limited Further Action.

Remedial Alternative No. 3 would be combined with Remedial Alternative No. 2 to eliminate the potential for future exposure to Site contaminated groundwater.

4.2.4 Remedial Alternative No. 4 - In Situ Soil Treatment

Remedial Alternative No. 4 consists of the in situ treatment of soil contaminants by one of the following methods:

- Remedial Alternative 4A - Soil Vacuum Extraction
- Remedial Alternative 4B - Soil Flushing.

Under these alternatives, soil will be treated in place and periodically sampled to determine when applicable cleanup criteria have been achieved. Treatment will reduce the mass of contaminants in the soil, thus, minimizing potential long term direct exposure to soils and reducing the source of groundwater contamination.

A clean soil cover may be placed over areas to be treated (as described in Remedial Alternative No. 3). The soil cover will promote

uniform air flow into the in situ soils if a soil vacuum extraction system is utilized.

Sampling of soils would be performed on an occasional basis to monitor the performance of the treatment process. Sampling events would be scheduled based on operational monitoring performed during active treatment. For soil vacuum extraction, air flow and concentrations of VOCs in the air stream shall be monitored to determine when soil sampling should be performed. In the case of soil flushing, the concentrations of VOCs in the recovered "flushing" liquid shall be used as an indication of when soil sampling should be performed.

A description of each treatment process is presented in the sub-sections which follow.

4.2.4.1 Remedial Alternative No. 4A - Soil Vapor Extraction

In situ soils shall be treated to reduce residual VOC contamination using soil vacuum extraction technology. The primary components of the vacuum extraction system consist of:

- i) soil vapor extraction wells (vertical or horizontal);
- ii) vapor collection manifold piping;
- iii) air/liquid separation vessel;
- iv) vacuum extraction unit; and

v) an extracted vapor treatment system.

The vacuum extraction unit generates a vacuum which is transmitted to the subsurface soils through the manifold piping and soil vapor extraction wells. Extracted vapors are drawn through the piping to an air/liquid separator. Liquids are separated in the process and extracted soil vapor is treated prior to discharge to atmosphere.

As the vacuum is transmitted to the subsurface, air flow is induced through the soil. Air containing vapor phase VOCs is drawn to the soil vapor extraction wells and to the surface for subsequent treatment. Residual liquid contaminants and dissolved contaminants in groundwater will also be removed to a very limited extent. The most effective treatment will occur within the vadose zone, consequently, soils situated beneath the water table will be left untreated by this method.

Based on an average soil VOC concentration of 710 ppm and an estimated total contaminated soil volume of 20,000 c.y., it is estimated that 15 years of treatment will be necessary to reduce the average VOC concentrations in the range of 5 ppm to 10 ppm. This estimated 15 year period for the treatment of potentially contaminated soils by Remedial Alternative No. 4A takes into consideration that the soil vapor extraction system would only be effective during the dry periods of the year due to the seasonally fluctuating water table at the Site. Potentially contaminated soils which are situated beneath the water table or are saturated cannot be effectively treated by soil vapor extraction alone. Additionally, based on the total estimated weight of VOCs in the soil (approximately 19,000 pounds),

approximately 140 tons of activated carbon will be needed throughout the estimated seven years of system operation. However, a timed rate of carbon usage cannot be estimated due to the inconsistent VOC extraction rate.

4.2.4.2 Remedial Alternative No. 4B - Soil Flushing

Remedial Alternative No. 4B consists of the injection of water (or alternate flushing liquid) into the contaminated soil area in order to "flush" the VOCs out of the soil. VOCs are desorbed from the soil into the flush which is then extracted through the existing groundwater containment/collection system and treated to remove the VOCs prior to reinjection or discharge. It is estimated that the soil flushing system will be required to be in operation for a minimum of 22 years to reduce the average VOC concentration in the soil in the range of 5 ppm to 10 ppm.

4.2.5 Remedial Alternative No. 5 - Removal/Treatment of Soils

Remedial Alternative No. 5 consists of the excavation of all soils identified as requiring treatment, the on-Site treatment of excavated soils and placement of treated soils into the excavation. Treatment would be provided by a mobile LTTE unit.

The majority contaminant mass will be removed through direct treatment of the soils. It is therefore assumed that soils which are

returned to the excavation will not represent a potential risk due to dermal contact and will no longer represent a source of groundwater contamination. Treated soils placed into the excavation may be subject to passive recontamination through contact with contaminated groundwater from the fluctuating water table at the Site and/or passive migration of organic vapors from adjacent or underlying soils.

The mobile treatment unit will be set up on Site prior to excavation of soils. On-Site space limitations may preclude the use of larger units which consist of up to 40 tractor-trailer loads of plant, equipment and materials. Excavated soils will be placed in the mobile unit at the rate of approximately 4 to 10 tons per hour (depending upon the unit) where they will be heated to the appropriate temperature (200° to 1100°F) in order to volatilize organic compounds into a carrier gas. The carrier gas will then be cooled to condense the volatilized water and organics into liquids. The condensed liquids may be treated in the on-Site groundwater treatment system or reused as cooling water. The remaining gas will be filtered through a carbon adsorption filter.

Assuming that the smaller LTTE unit would be required, soil would be treated at a rate of 4 tons per hour. A treatment time of approximately four years is estimated to be required for the treatment of approximately 20,000 cubic yards (30,000 tons) of residually contaminated soils to an average VOC concentration in the range of 5 ppm to 10 ppm. The activated carbon in the exhaust gas filtering system would require reactivation at the rate of 9.3 pounds carbon per ton of soil treated. The

groundwater extraction system would be required to operate for up to five years to remove residually contaminated groundwater.

4.2.6 Remedial Alternative No. 6 -
Dual Soil/Groundwater Treatment System

Remedial Alternative No. 6 provides simultaneous remediation of soil and groundwater through the extraction and treatment of soil vapors and groundwater. Extraction wells or piping are installed below the water table to remove groundwater thereby increasing the depth of the vadose zone and providing for removal of soil vapors from the vadose zone and subsequent treatment of a much larger soil mass.

The treatment system will be similar to the soil vacuum extraction system described in Remedial Alternative No. 4A. However, the extraction wells or piping shall also be equipped to collect/extract groundwater from within the contaminated soil area and may be used to inject air in to the subsurface soil to ensure adequate air is available for efficient soil treatment. The dual extraction of groundwater would lower the water table and increase the effective volume of soil which can be treated by soil vapor extraction. A soil cap could also be installed at the Site to prevent short circuiting of the soil vapor extraction system and to limit contact with contaminated surface soils.

The reduction in the water table will allow for more efficient and year round treatment of soils by vacuum extraction since

vacuum extraction will only treat soils within the vadose zone. In addition, more efficient and complete removal of groundwater is provided by expanding the groundwater extraction system.

Based on an average soil VOC concentration of 710 ppm and an estimated total contaminated soil volume of 20,000 c.y., it is estimated that this dual groundwater/soil vapor extraction and treatment system would require 2 to 3 years to reduce the average VOC concentration in the range of 5 ppm to 10 ppm and a total of 8 to 10 years to reduce the VOC concentration to 1 ppm. The extended duration of treatment is required due to the low permeability of till underlying the Site.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The nine evaluation criteria stipulated in Section 300.430(e)(9)(iii) of the NCP for the detailed analysis of remedial alternatives are as follows:

- "(A) Overall protection of human health and the environment. Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals consistent with §300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.
- (B) Compliance with ARARs. The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate

requirements under federal environmental laws and state environmental or facility siting laws or provide grounds for invoking one of the waivers under paragraph (f)(1)(ii)(C) of this section.

- (C) Long-term effectiveness and permanence. Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:
- (1) Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.
 - (2) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.
- (D) Reduction of toxicity, mobility, or volume through treatment. The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:
- (1) The treatment or recycling processes the alternatives employ and materials they will treat;
 - (2) The amount of hazardous substances, pollutants or contaminants that will be destroyed, treated, or recycled;
 - (3) The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;
 - (4) The degree to which the treatment is irreversible;

- (5) The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents; and
 - (6) The degree to which treatment reduces the inherent hazards posed by principal threats at the Site.
- (E) Short-term effectiveness. The short-term impacts of alternatives shall be assessed considering the following:
- (1) Short-term risks that might be posed to the community during implementation of an alternative;
 - (2) Potential impacts of workers during remedial action and the effectiveness and reliability of protective measures;
 - (3) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and
 - (4) Time until protection is achieved.
- (F) Implementability - The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate:
- (1) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
 - (2) Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions);
 - (3) Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.
- (G) Cost - The types of costs that shall be assessed include the following:

- (1) Capital costs, including both direct and indirect costs;
 - (2) Annual operation and maintenance costs; and
 - (3) Net present value of capital and O&M costs.
- (H) State acceptance - Assessment of state concerns may not be completed until comments on the RI/FS are received but may be discussed, to the extent possible, in the proposed plan issued for public comment. The state concerns that shall be assessed include the following:
- (1) The state's position and key concerns related to the preferred alternative and other alternatives; and
 - (2) State comments on ARARs or the proposed use of waivers.
- (I) Community acceptance - This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment may not be completed until comments on the proposed plan are received."

A detailed analysis of the seven remedial alternatives was conducted, based on seven of the evaluation criteria (A through G above). The State acceptance and Community acceptance criteria (H and I above) were not evaluated in this Feasibility Study since they are based on agency and public comments, if any, issued following completion of the Feasibility Study.

A summary of the detailed analysis of the seven remedial alternatives based on evaluation criteria A through G above is presented in Table 4.1. For each of the evaluation criteria, each remedial alternative was ranked considering the relative degree to which the remedial alternative satisfied the specific evaluation criteria. The rankings are discussed in the respective sections which follow.

4.4 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The evaluation criteria used for the detailed analysis of the remedial alternatives, as discussed in Section 4.3, are categorized in Section 300.430(f)(1)(i) of the NCP into three criteria groups, as follows:

- "(A) Threshold criteria - Overall protection of human health and the environment and compliance with ARARs (unless a specific ARAR is waived) are threshold requirements that each alternative must meet in order to be eligible for selection.
- (B) Primary balancing criteria - The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity; mobility or volume through treatment; short-term effectiveness; implementability; and cost.
- (C) Modifying criteria - State and community acceptance are modifying criteria that shall be considered in remedy selection."

A comparative analysis of the Remedial Alternatives was performed which considered the relative degree to which each Remedial Alternative satisfied the evaluation criteria in criteria Groups A and B above. Criteria Group C was not considered in the feasibility study since it is based on agency and public comments, if any, issued following completion of the Feasibility Study. A comprehensive summary of the comparative analysis based on the evaluation criteria in criteria Groups A and B is presented in Table 4.1, respectively, and the comparative analysis based on each evaluation criteria is summarized in the following sections.

4.4.1 Threshold Criteria

4.4.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment provided by the remedial alternatives retained for detailed analysis ranges from no additional protection, provided by Remedial Alternative No. 1, limited protection provided by Remedial Alternative Nos. 2 and 3, to maximum protection provided by Remedial Alternative Nos. 4A, 4B, 5 and 6.

All seven remedial options address potential human health concerns due to air quality by the operation and maintenance of sump vents and air filters in homes adjacent to the Site. In addition, all seven remedial options address the off-Site migration of contaminated groundwater contamination. As determined during the RI, the existing groundwater collection system effectively prevents the off-Site migration of contaminants, therefore, there is no current threat from contaminated groundwater to human health and the environment.

Remedial Alternative Nos. 3, 4A, 4B and 6 address potential health concerns due to exposure to Site soils by the installation of a soil cover. Remedial Alternative Nos. 4A, 4B and 6 further addresses the source of groundwater (e.g., residual Site soil contamination) contamination by use of in-situ treatment techniques to remove residual soil contamination. Remedial Alternative No. 5 addresses soil exposure and the source of groundwater contamination by use of an ex situ soil treatment technology.

Remedial Alternative No. 5 requires the ongoing excavation of potentially contaminated soils for treatment in the LTTE unit which may result in the generation of dust and volatilization of VOCs. Since the estimated treatment time for this alternative is about four years, implementation of Remedial Alternative No. 5 may potentially impact surrounding air quality for the short term.

4.4.1.2 Compliance with SCGs

Compliance with SCGs for VOCs in groundwater would be met for all seven remedial alternatives. The operation of the existing groundwater collection system has effectively prevented off Site contaminant migration. The SCGs for treated effluent discharge requirements would be met for all remedial alternatives through use of the existing groundwater treatment system.

Compliance with SCGs for VOCs in soil would vary from long term compliance for Remedial Alternative Nos. 1, 2 and 3, short term compliance for Remedial Alternative Nos. 4A, 4B, 5 and 6. Remedial Alternative Nos. 1, 2 and 3 rely on attenuation/degradation/leaching to remove groundwater contamination, whereas Remedial Alternative Nos. 4A, 4B, 5 and 6 use treatment technologies to remove residual soil contamination.

All remedial alternatives would comply with SCGs for air emissions. Remedial Alternative No. 4A, 5 and 6 would require a treatment system to remove volatiles from air streams containing volatiles generated by the treatment processes.

4.4.1.3 Summary of Threshold Criteria Analysis

All of the remedial alternatives provide complete protection of human health and the environment from contaminated groundwater since the presently operating groundwater collection system, which effectively prevents the off-Site migration of contaminants, will continue to operate for the duration of the implementation and operation of any remedial alternative. Presently, no exposure pathway to groundwater exists and only under a hypothetical scenario of the installation of a production well within the Site boundaries will a future exposure pathway to groundwater be created.

Remedial Alternative No. 1 and 2 allow the possibility of direct human contact with contaminated soil by trespassers. Remedial Alternatives Nos. 3, 4A, 4B, 5 and 6 minimize direct exposure to contaminated soils by the isolation and/or removal of the residual soil contamination. Remedial Alternative Nos. 4A, 4B, 5 and 6 provide for contaminant reduction in soils over the short term using proven treatment technologies to satisfy the cleanup criteria within a reasonable time frame. The use of institutional controls and deed restrictions in conjunction with Remedial Alternatives Nos. 3, 4A, 4B, 5 and 6 would provide complete

protection of human health and the environment until the remedial alternatives have satisfied the SCGs.

4.4.2 Primary Balancing Criteria

4.4.2.1 Long Term Effectiveness and Permanence

The long term effectiveness and permanence with respect to further migration of VOC contaminants in the groundwater would be complete for all remedial alternatives as the existing groundwater collection system effectively prevents the migration of contaminants off Site. Long term groundwater monitoring and maintenance of the groundwater treatment system would be required until health based cleanup goals for groundwater are met. Groundwater monitoring and maintenance of the groundwater treatment system would be longest for Remedial Alternative Nos. 1, 2 and 3 and shortest for Remedial Alternative No. 5. The long term effectiveness and permanence with respect to contaminants in Site soils would be negligible for Remedial Alternative Nos. 1 and 2, partial for Remedial Alternative Nos. 3 and 5 and complete for Remedial Alternative Nos. 4A, 4B and 6.

Remedial Alternative Nos. 1 and 2 leave all of the contaminated soils in place with little reduction in risk of exposure to Site soils by trespassers and allows only for natural degradation to reduce the levels of contaminants in the soil. Remedial Alternative No. 3 also leaves all the Site soils in place but reduces a potential exposure to Site soils in the short

term with the use of a Site soil cover. Although the soil cover is an effective and accepted approach for reducing risk from direct contact with soils, it is less reliable in the long term than treatment methodologies since soil contamination remains. Institutional controls would be required in the long term to effectively prevent exposure to contaminants. Remedial Alternative No. 5 treats the bulk of the soil mass but leaves clean soils subject to passive recontamination and therefore provides only partial permanence.

Remedial Alternative Nos. 4A, 4B and 6 provide long term effectiveness and permanence for the prevention of risk of exposure to Site soils. Remedial Alternative Nos. 4A, 4B and 6 reduce the risk of exposure to soil in the short term by use of a soil cover, as previously discussed for Remedial Alternative No. 3, while removing soil contaminants using proven treatment technologies. Institutional controls would be required in the short term until health based cleanup criteria are met. Remedial Alternative No. 5 would reduce the risk of exposure to Site soils in the shortest time frame and would require almost no short or long term reliance on institutional controls.

4.4.2.2 Reduction of Toxicity, Mobility or Volume Through Treatment

The degree of reduction of toxicity, mobility or volume through treatment varies depending on the method of treatment.

All of the remedial alternatives utilize a groundwater extraction system and carbon adsorption as a primary treatment process for the extracted groundwater, thus reducing the toxicity, mobility and volume of the contaminants in the treated groundwater.

Remedial Alternative Nos. 1, 2 and 3 contain no treatment technologies to reduce the toxicity, mobility or volume of soil contaminants through treatment.

Remedial Alternative Nos. 4A, 4B, 5 and 6 utilize treatment technologies to reduce the volume of VOCs and therefore the toxicity and mobility of the VOCs in the Site soils. VOCs would be removed from the Site soils in air or water streams generated by the treatment processes. The organics would be removed from the air or water streams using a carbon adsorption system which would reduce the mobility of the organics.

The toxicity and volume of the organics will ultimately be reduced during the regeneration of the activated carbon as organics are driven from the carbon and incinerated as part of the off gas stream.

4.4.2.3 Short Term Effectiveness

The short term effectiveness of the remedial alternatives range from Remedial Alternative Nos. 1 and 2 which present no or minimal risk to the community, workers or the environment during implementation,

to Remedial Alternative No. 5 which present the greatest potential for additional risk to the community and workers due to the exposure to contaminated soils during excavation activities.

All of the remedial alternatives, with the exception of Remedial Alternative No. 6, present no or minimal risk to the community and Site workers due to exposure to groundwater as the groundwater is effectively controlled by the existing groundwater collection system. Remedial Alternative No. 6 presents a potential exposure of groundwater to Site workers if groundwater/vapor collection piping is installed below the existing water table. The implementation of standard health and safety protocols would minimize this risk.

Remedial Alternative Nos. 3, 4A, 4B and 6 provide moderate short term effectiveness as a potential for exposure due to particulate emissions during the installation of the soil vapor/groundwater collection systems and/or soil cover. However, the use of appropriate dust control measures and personnel protective equipment could reduce the risk of exposure to particulates. Remedial Alternative Nos. 4A, 4B and 6 could pose additional short term exposure to Site workers, the community and the environment due to the release of organic vapors during well installation or trenching activities. The implementation of standard health and safety protocols during well installation and excavation activities should minimize this risk.

Remedial Alternative No. 5 would present the greatest potential for exposure in the short term due to the extent of ground intrusive

activities. Potential exposure to Site contaminants may occur from the generation of dust and/or organic vapor during excavation activities.

Remedial Alternative No. 5 also requires the use of the most technologically complex equipment which could increase risk to Site workers in the event of an equipment failure. The implementation of the appropriate health and safety protocols for the soil handling activities and equipment operation would minimize the risk of exposures.

4.4.2.4 Implementability

Remedial Alternative Nos. 1 through 6 are technically and administratively feasible. Required services and materials are generally available and the technologies used for all remedial alternatives rely on standardized construction methods and demonstrated technologies.

Remedial Alternative No. 3 would be the simplest to implement. While construction of the soil cover requires significant materials handling operations, the materials and contractors are available locally.

Remedial Alternative Nos. 4A, 4B and 6 are more complex than Remedial Alternative No. 3 due to the installation of and operation of soil vapor extraction and/or treatment systems. The construction requirements for the extraction system and the treatment system are relatively simple. Once operating, the extraction and treatment systems may run unattended except for regular maintenance and sampling activities.

The systems to be constructed would be similar to the existing on-Site treatment system.

Remedial Alternative No. 5 is the most difficult alternative to implement. Soil excavation may be performed using standard construction techniques but the LTTE system is complicated to operate. During operation, the desorption unit would require constant attention to monitor and adjust operating parameters. The surface area required to install the LTTE unit may not allow the set up within the perimeter of the Site and would significantly hinder on-Site operations. Permits/easements would be required to set up and operate the LTTE unit off the Site.

4.4.2.5 Estimated Cost

The total estimated costs for the implementation of the remedial alternatives range from \$1,903,000. for Remedial Alternative No. 1 to \$18,387,000 for Remedial Alternative No. 5. Tables 4.2 to 4.8 present the estimated conceptual costs for implementation of all seven alternatives.

The estimated cost for the implementation of Remedial Alternative No. 5 is the highest of all the remedial alternatives due to the cost of the mobilization and operation of the low temperature thermal extraction unit.

The estimated costs for implementation of Remedial Alternative Nos. 1, 2 and 3 are \$1,903,000, \$1,960,000, and \$2,552,800,

respectively. The capital costs for the implementation of these three alternatives are negligible in comparison with the in situ and ex situ treatment alternatives. However, the annual costs associated with the implementation of these alternatives, extended over a 30-year time period, increases the total implementation cost to approximately equal to or greater than the in situ treatment remedial alternatives.

The estimated cost for the implementation of Remedial Alternative No. 4B is \$2,216,100. The capital costs and annual operating costs for the implementation of Remedial Alternative No. 4B are lower than for Remedial Alternative Nos. 4A and 6 but the longer duration required to achieve the SCGs increases the total cost of the implementation of Remedial Alternative No. 4B to approximately equal to the total cost for the implementation of Remedial Alternative Nos. 4A and 6.

The estimated costs for the implementation of Remedial Alternative Nos. 4A and 6 are \$3,651,000 and \$2,761,900, respectively. In comparison, Remedial Alternative No. 4A has lower capital costs than Remedial Alternative No. 6, as the physical installation of the soil vapor extraction system is less complex than the installation of the dual soil vapor/groundwater extraction system. In addition, the annual costs for Remedial Alternative No. 4A are lower than for Remedial Alternative No. 6 since Remedial Alternative No. 6 would require greater operational costs for the expanded operation of the groundwater collection system. However, since the annual costs are realized over a 15 year time period for Remedial Alternative No. 4A versus an 8 year time period for Remedial Alternative No. 6, the total estimated costs for implementation of Remedial

Alternative No. 4A is higher than the estimated cost for the implementation of Remedial Alternative No. 6.

5.0 PREFERRED REMEDIAL ALTERNATIVE

In the selection of the preferred remedial alternative preference is to be given to remedies that permanently reduce the toxicity, volume, or mobility of the hazardous substances, pollutants or contaminants and to remedies using treatment technologies.

Remedial Alternative Nos. 1, 2 and 3 were therefore omitted from consideration as the preferred alternative as they do not include the use of treatment technologies to reduce the volume, toxicity or mobility of Site contaminants.

Remedial Alternative No. 5 provides the most efficient reduction of Site contaminants in the shortest time frame but also has the highest potential short term risk of exposure of Site workers and the community. In addition, the permanence and implementability of this option are questionable due to the potential for recontamination of the clean soils and spatial requirements associated with this option. Since the potential effect of the Site on human health and the environment is relatively small and the use of other remedial alternatives will meet the soil cleanup criteria, the high cost of the implementation of Remedial Alternative No. 5 cannot be justified solely on the basis of duration of implementation. Remedial Alternative No. 5 was therefore not selected as the preferred remedial alternative.

Remedial Alternative No. 4B, although able to treat the soil contamination to acceptable levels at a total cost comparable to Remedial

Alternative Nos. 4A and 6, was omitted from consideration as the preferred remedial alternative due to the uncertainty in the length of time required to meet cleanup criteria.

Remedial Alternative Nos. 4A and 6 use the same soil treatment technology utilizing different installations for the collection of soil vapor. Remedial Alternative Nos. 4A and 6 have comparable installation and long term operational costs. Remedial Alternative Nos. 4 and 6 also include the construction of a low permeability soil cover to prevent short circuiting of the vapor extraction system and will also prevent direct contact with contaminated surficial soils and will eliminate potential migration of contaminants by wind dispersion or surface water runoff.

Remedial Alternative No. 4A will not treat soil beneath the water table and will therefore be ineffective during several periods of each year. Remedial Alternative No. 4A will therefore require a longer period of time than Remedial Alternative No. 6 to reach Site cleanup objectives. Remedial Alternative No. 6 provides additional control to the off-Site migration of contamination and a larger soil vadose zone providing for the more efficient and quicker removal of VOCs in the soil. The method has been demonstrated to be effective, can easily fit into the existing Site configuration and provides a permanent and implementable remedial solution for the Site. Remedial Alternative No. 6 is therefore the preferred remedial alternative for the Site. A pilot scale demonstration was performed at the Site and has demonstrated the effectiveness of this technology and has provided sufficient Site specific data to proceed with the design of the system.

A typical treatment system flow diagram is illustrated on

Figure 4.1.



FIGURES



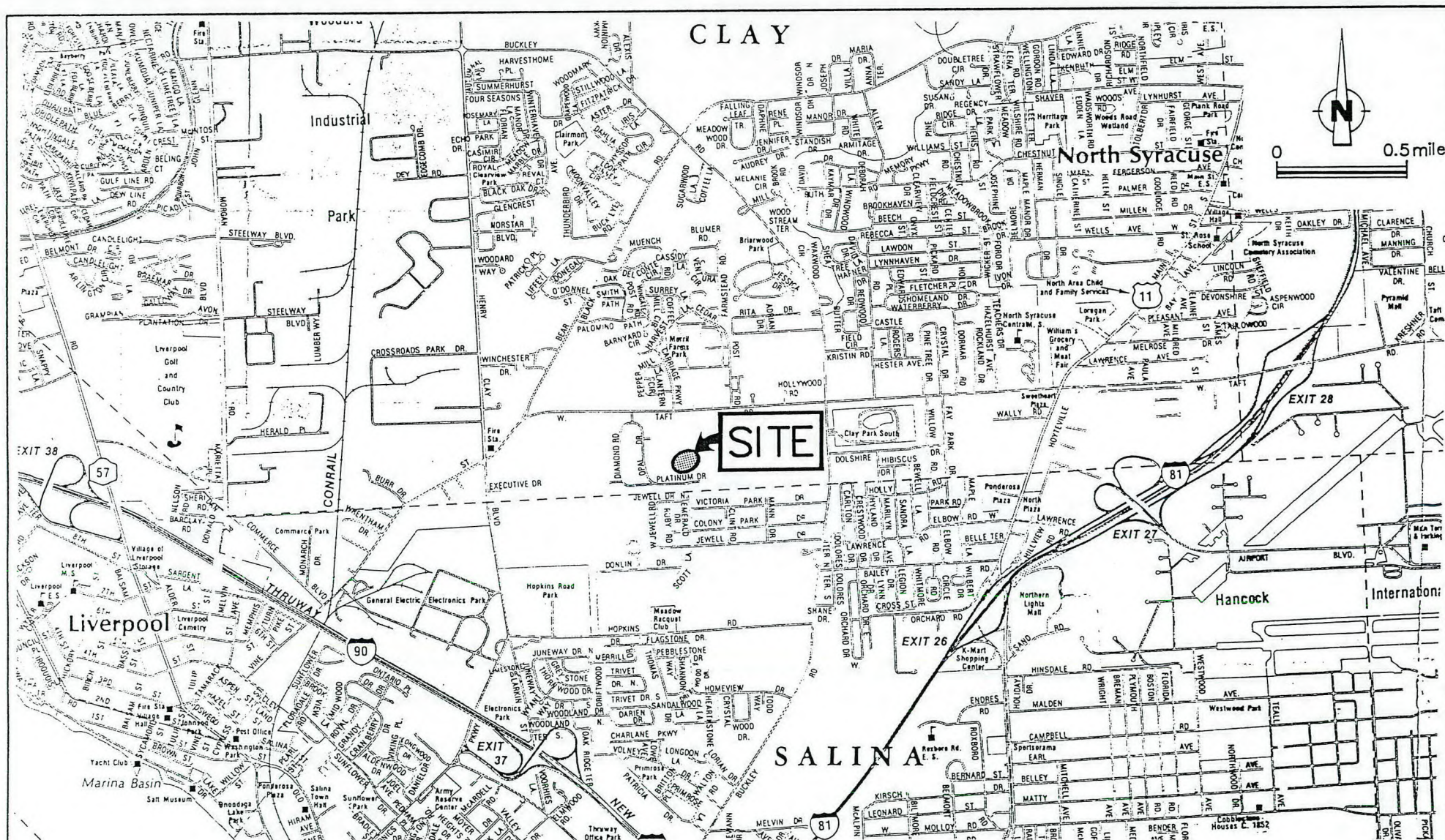
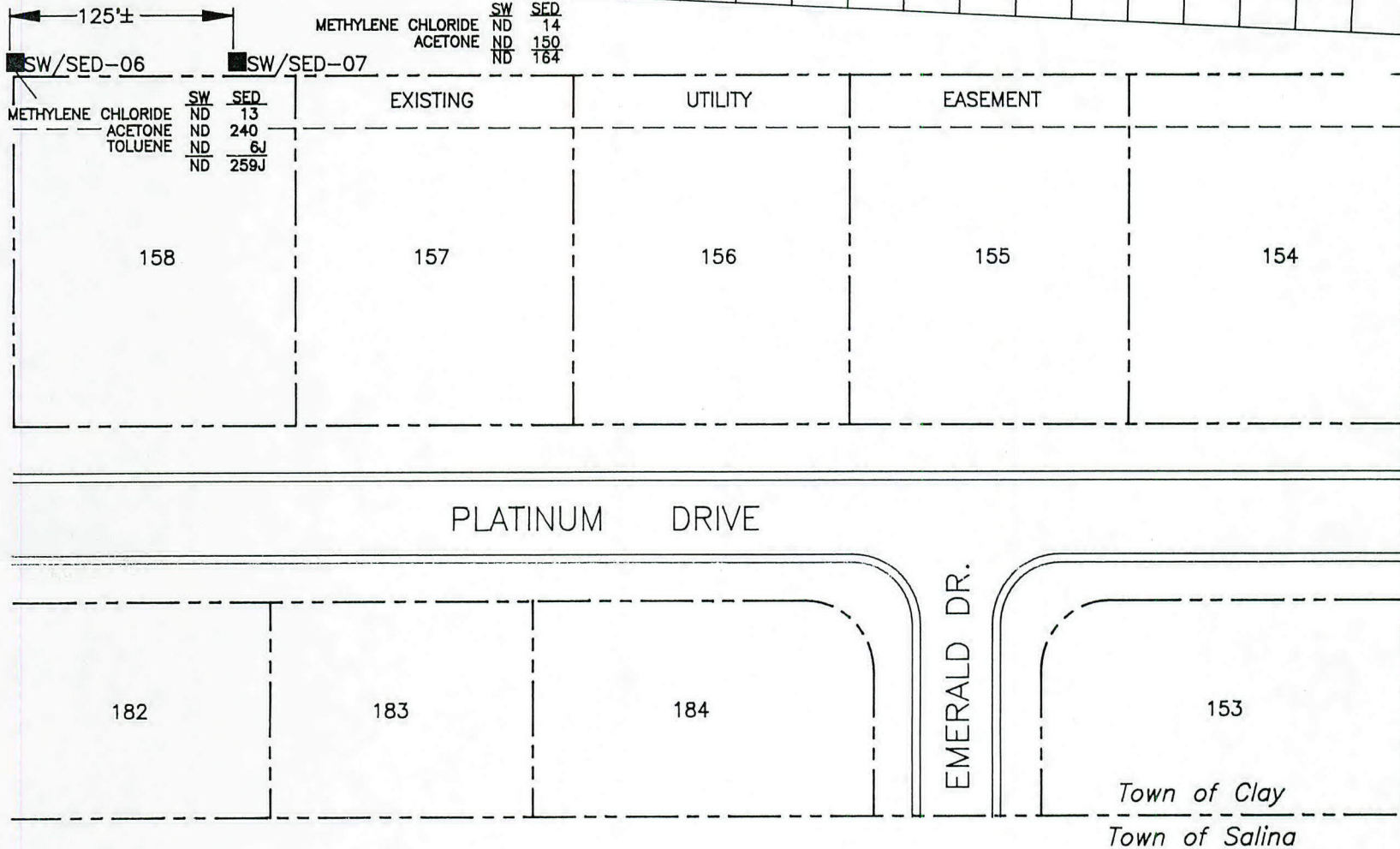


figure 1.1
 SITE LOCATION
 DUA PROPERTY
 Town of Clay, New York

CRA

3442-19/03/92-(NF)-13



LEGEND

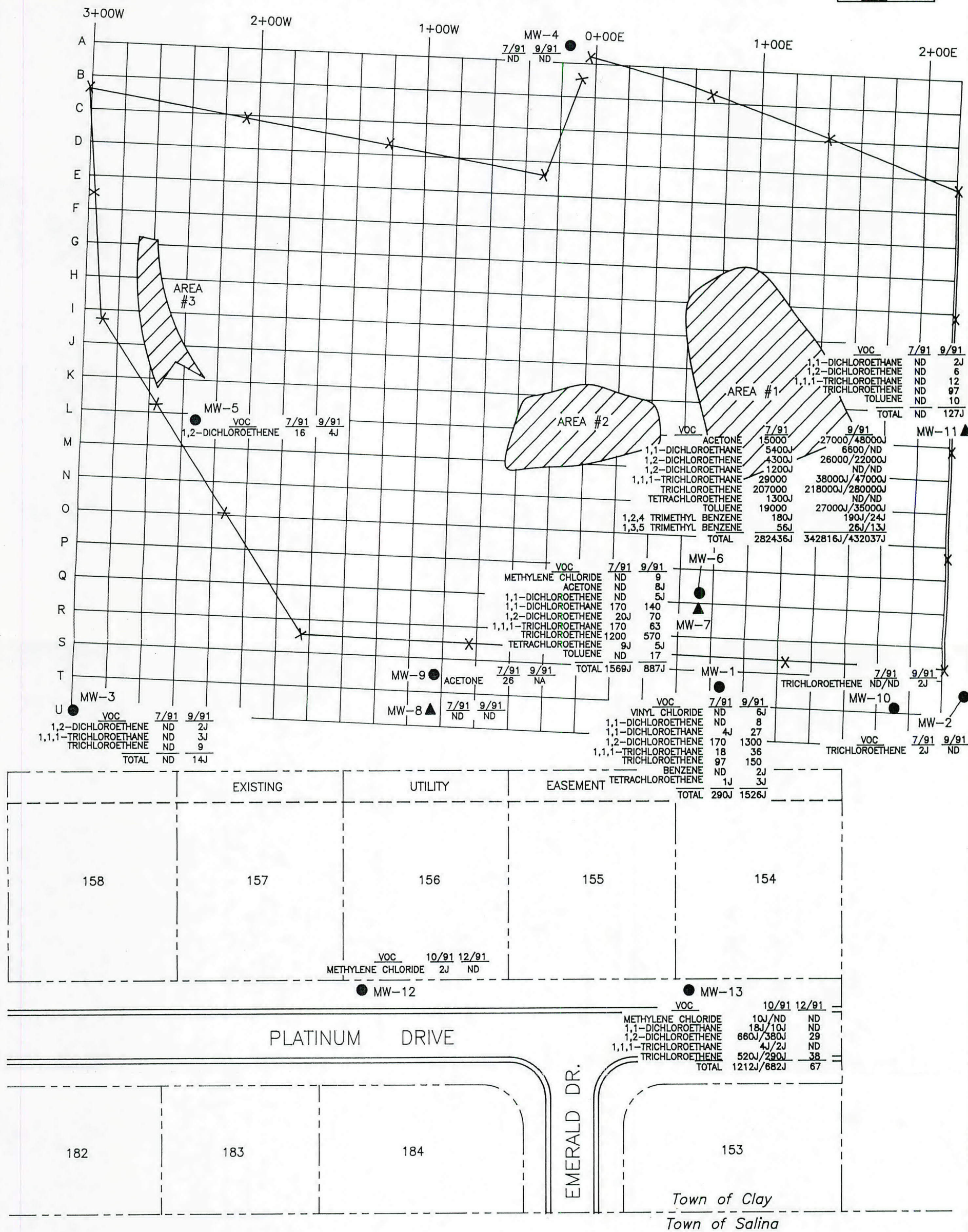
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- 240 TOTAL VOC's (ppb)
- J ESTIMATED VALUE
- ND NOT DETECTED

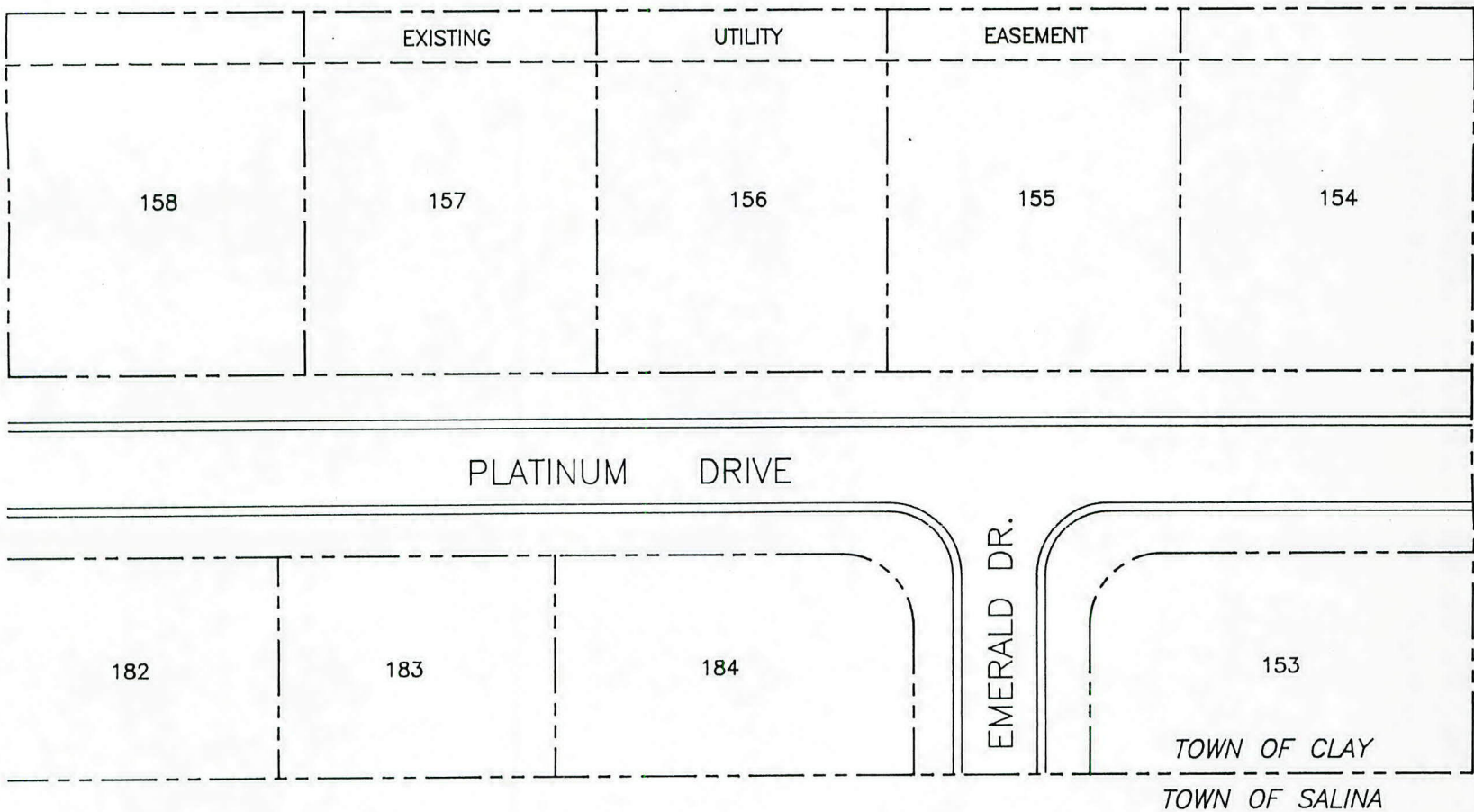
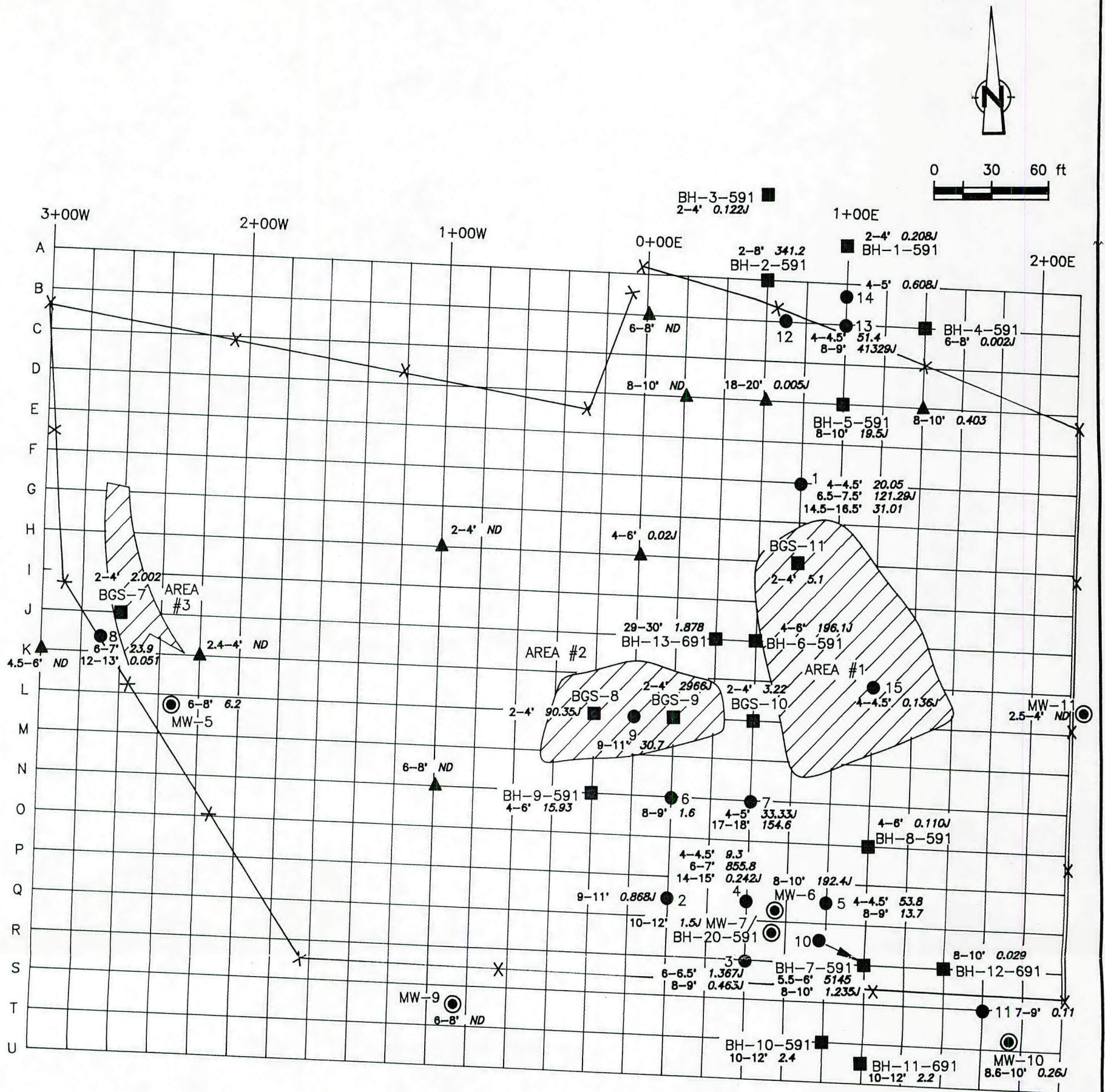
figure 1.7
TOTAL VOC CONCENTRATIONS
SURFACE WATER AND SEDIMENT SAMPLES
DUVA PROPERTY
Town of Clay, New York

CRA



0 30 60ft



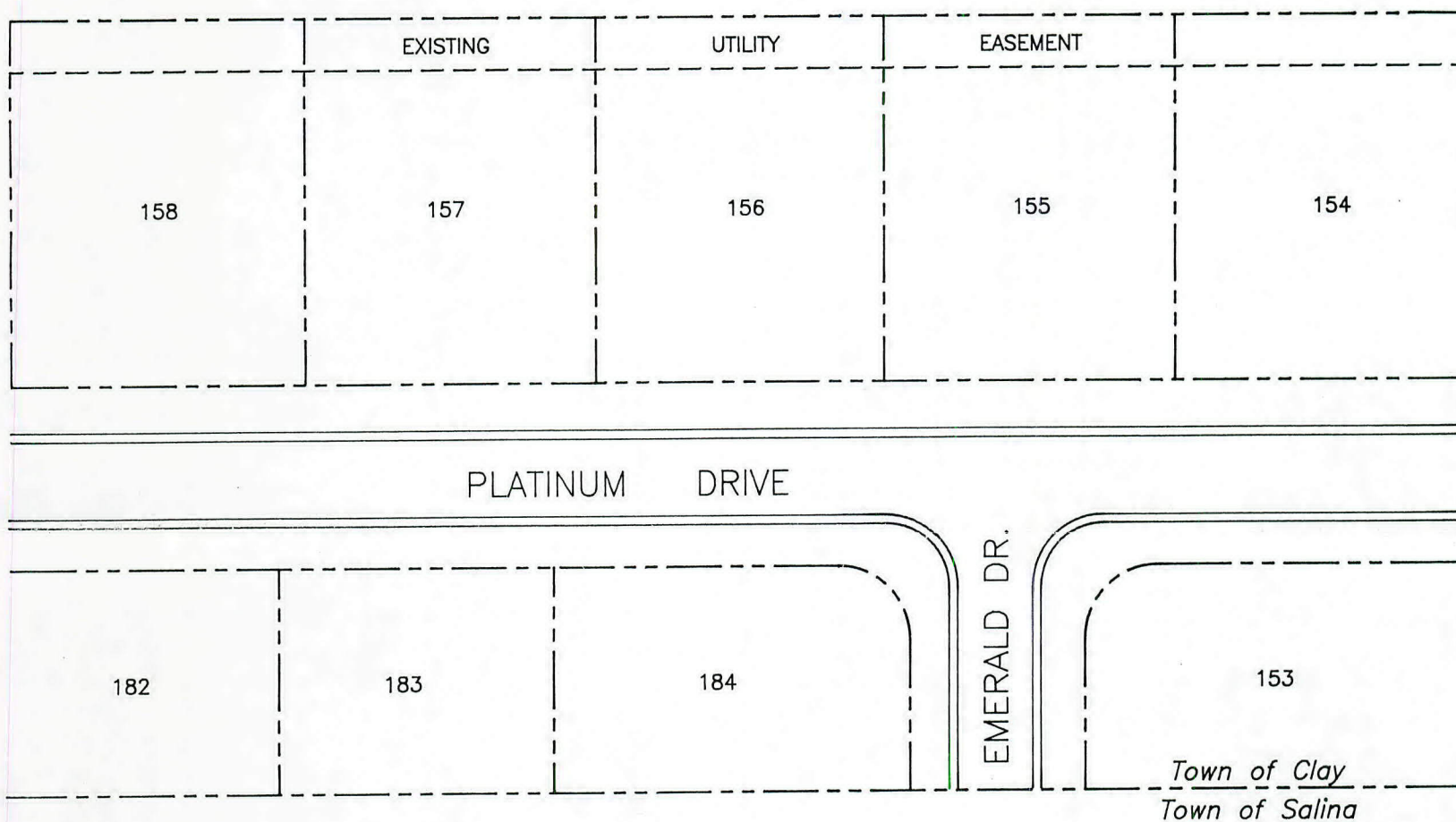
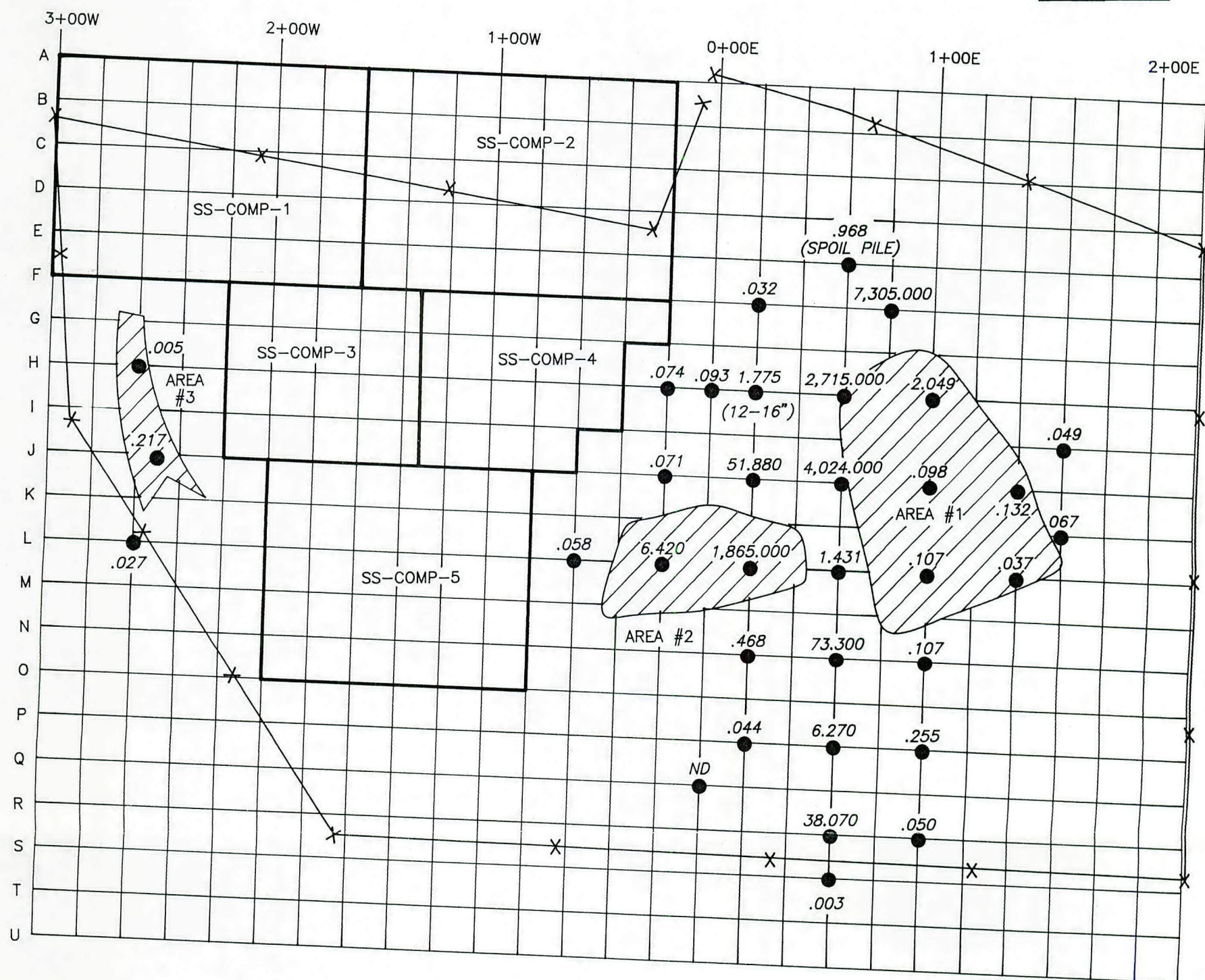
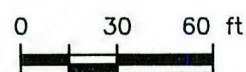


LEGEND

- 4 ● IRM BOREHOLE SAMPLING LOCATION
- BH-8-591 ■ RI BOREHOLE SAMPLING LOCATION
- ▲ ADRP BOREHOLE SAMPLING LOCATION
- ⊙ MONITORING WELL

figure 1.5
TOTAL VOC CONCENTRATIONS (ppm)
IN SUB-SURFACE SOILS (>30")
DUVA PROPERTY
Town of Clay, New York

CRA



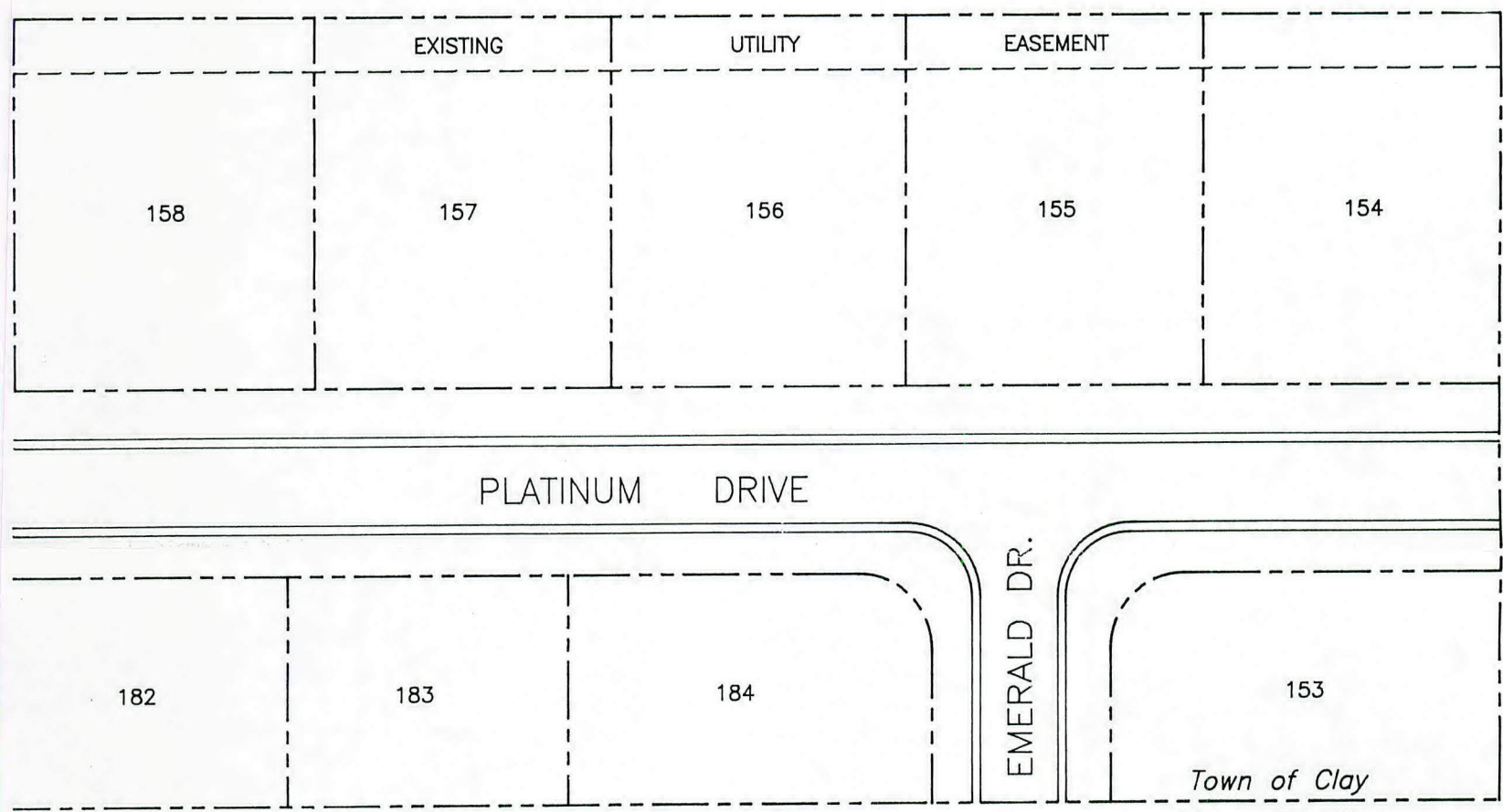
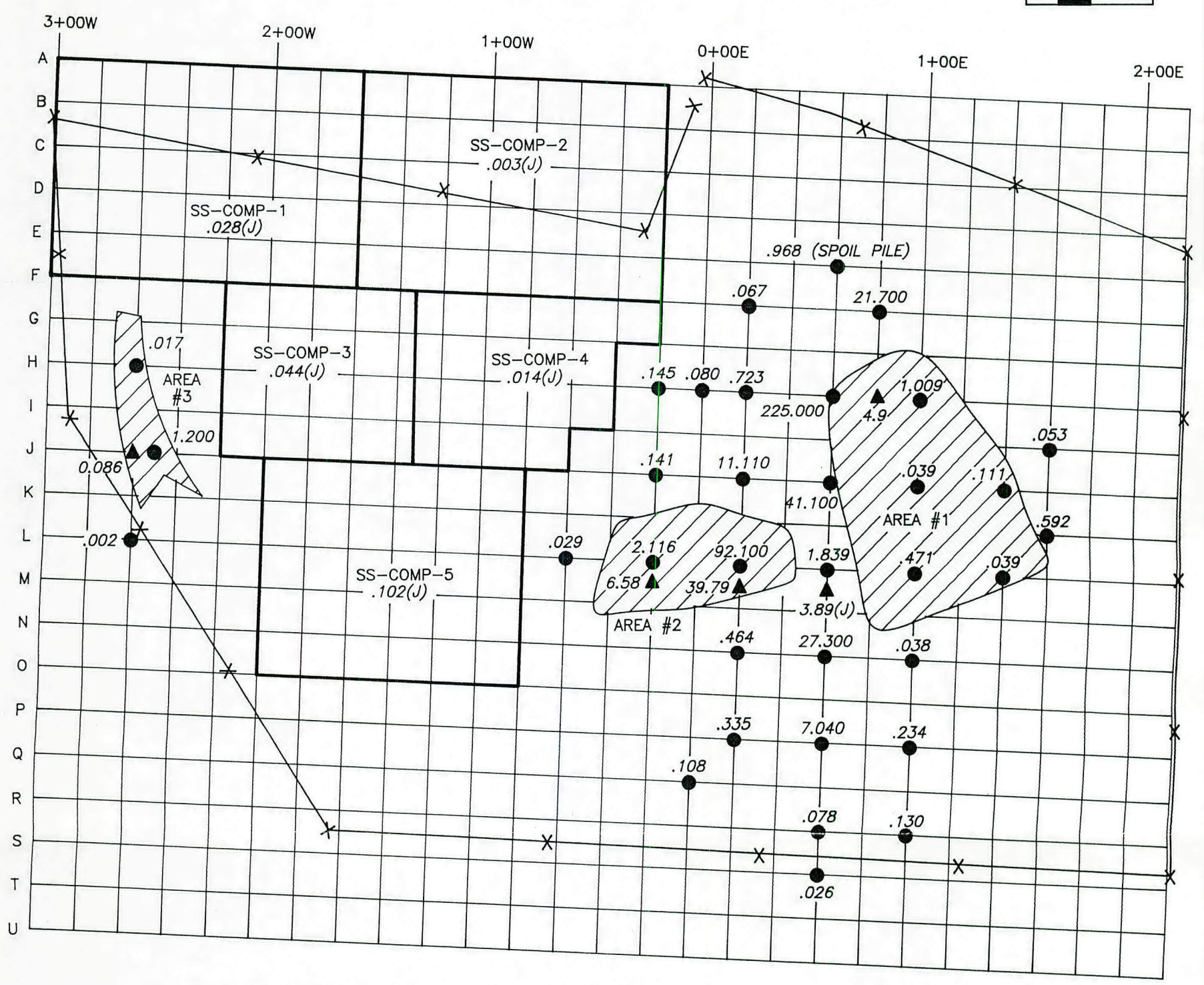
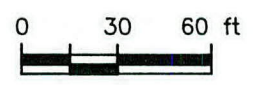
LEGEND

- .108 TOTAL VOC's (ppm)
- IRM SUB-SURFACE SOIL SAMPLING LOCATION
- RI SURFICIAL SOIL SAMPLING LOCATION - COMPOSIT SAMPLE

figure 1.4

TOTAL VOC CONCENTRATIONS
IN SUB-SURFACE SOILS (18-30")
DUVA PROPERTY
Town of Clay, New York

CRA

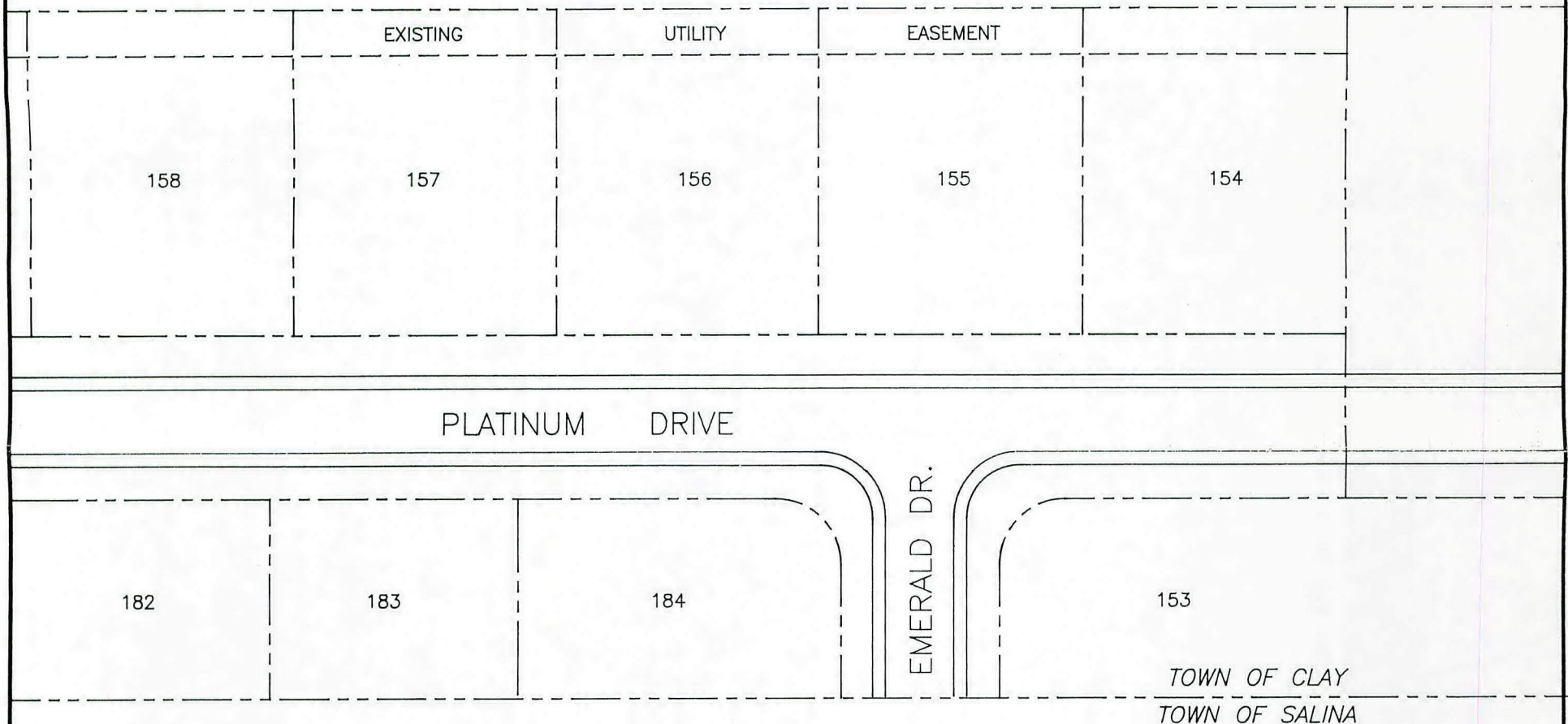
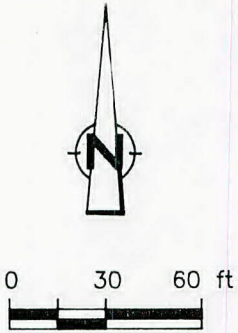
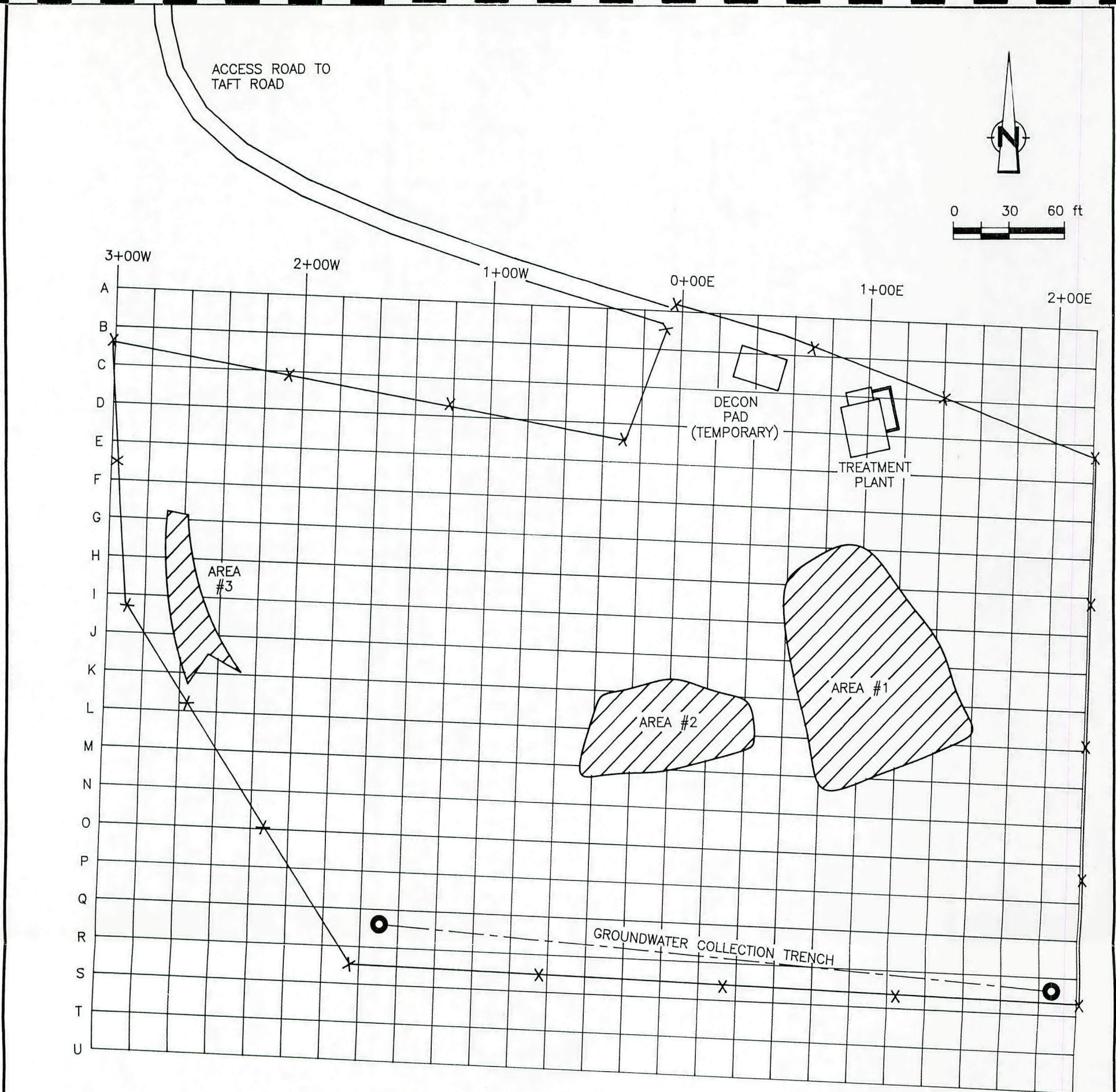


LEGEND

- .145 TOTAL VOC's (ppm)
- J ESTIMATED VALUE
- IRM SURFICIAL SOIL SAMPLING LOCATION
- ▲ RI SURFICIAL SOIL SAMPLING LOCATION - DISCREET SAMPLE
- RI SURFICIAL SOIL SAMPLING LOCATION - COMPOSIT SAMPLE

CRA

figure 1.3
TOTAL VOC CONCENTRATIONS
IN SURFACE SOILS (0-6")
DUVA PROPERTY
Town of Clay, New York



LEGEND



APPROXIMATE LOCATION OF FORMER
DRUM STAGING AREA

CRA

figure 1.2
SITE LAYOUT
DUVA PROPERTY
Town of Clay, New York

LEGEND

- (PG) PRESSURE GAUGE
- (FM) FLOW METER
- └─┘ SAMPLING PORT
- CONTROL VALVE

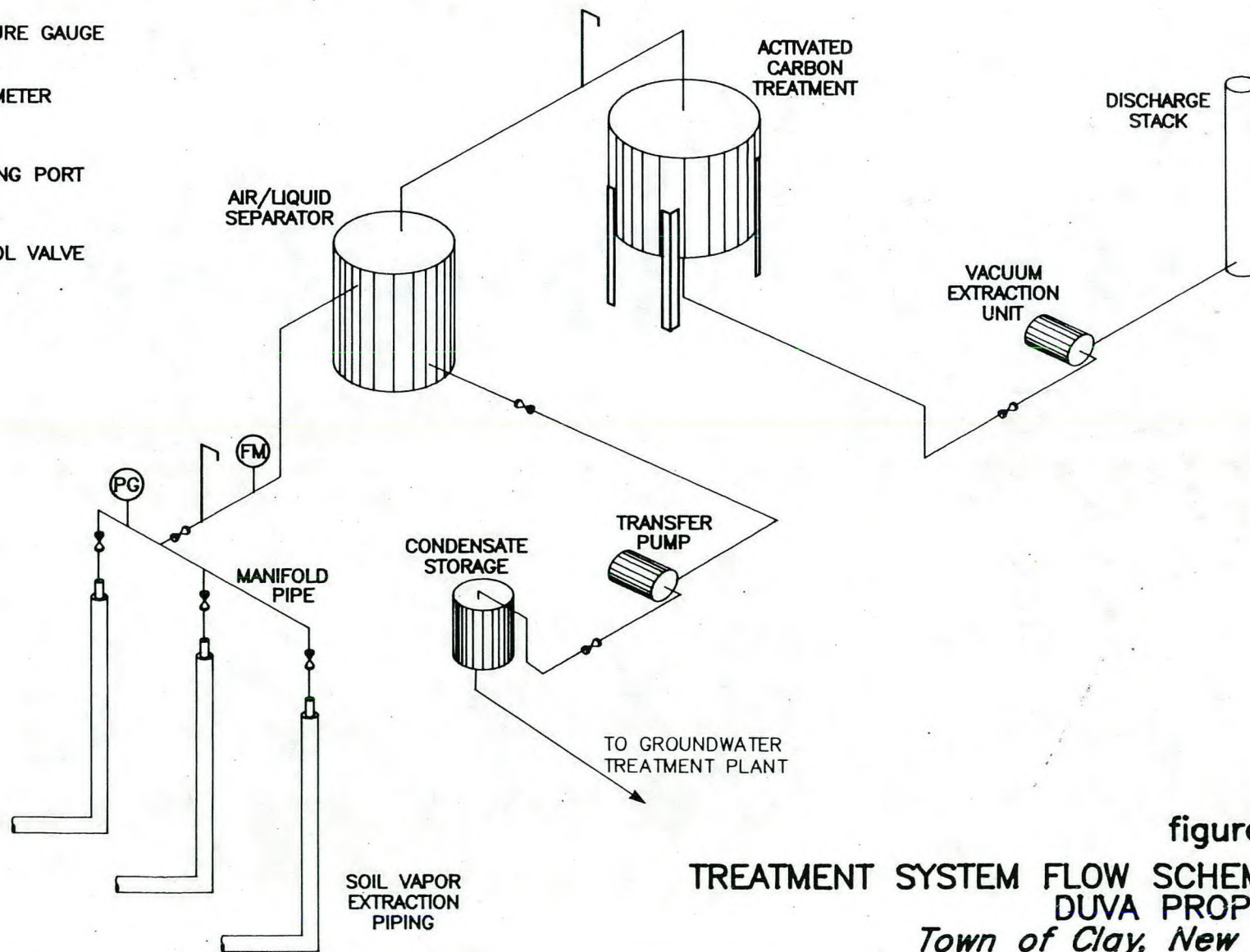


figure 4.1
TREATMENT SYSTEM FLOW SCHEMATIC
DUVA PROPERTY
Town of Clay, New York

CRA



TABLES



TABLE 2.1

NEW YORK STATE GROUNDWATER AND SURFACE WATER
STANDARDS AND GUIDELINE CONCENTRATIONS
FOR SITE-SPECIFIC PARAMETER LIST

Parameter	<u>Most Stringent Standards (1) (µg/L)</u>	
	Class GA Groundwater	Class AA Surface Water
Volatile Organic Compounds		
Acetone	NS/G ⁽²⁾	NS/G
Benzene	0.7 (S)	0.7 (S)
2-Butanone	NS/G	NS/G
1,1-Dichloroethane	5 (S)	5 (G)
1,2-Dichloroethane	5 (S)	0.8 (S)
1,1-Dichloroethene	5 (S)	0.07 (G)
1,2-Dichloroethene (trans)	5 (S)	5 (G)
Ethylbenzene	5 (S)	5 (G)
Methylene Chloride	5 (S)	5 (G)
4-Methyl-2-pentanone	NS/G	NS/G
Tetrachloroethene	5 (S)	0.7 (G)
Toluene	5 (S)	5 (G)
1,1,1-Trichloroethane	5 (S)	5 (G)
Trichloroethene	5 (S)	3 (G)
Vinyl chloride	2 (S)	0.3 (G)
Xylene (total)	5 (S) ⁽³⁾	5 (G) ⁽³⁾
Semi-Volatile Organic Compounds		
Benzo(a)pyrene	ND (S) ⁽⁴⁾	0.002 (G)
Benzo(b)fluoranthene	0.002 (G)	0.002 (G)
Benzo(g,h,i)perylene	NS/G	NS/G
Benzo(k)fluoranthene	0.002 (G)	0.002 (G)
Bis(2-ethylhexyl)phthalate	50 (S)	4 (G)
Chrysene	0.002 (G)	0.002 (G)
1,2-Dichlorobenzene	4.7 (S) ⁽⁵⁾	5 (S) ⁽⁶⁾
1,4-Dichlorobenzene	4.7 (S) ⁽⁵⁾	30 (S)
Fluoranthene	50 (G)	50 (G)
Indeno (1,2,3-CD)pyrene	0.002 (G)	0.002 (G)
2-Methylnaphthalene	NS/G	NS/G
Naphthalene	10 (G)	10 (S)
Phenathrene	50 (G)	50 (G)
Phenol	1 (S) ⁽⁷⁾	1 (S) ⁽⁷⁾
Pyrene	50 (G)	50 (G)
1,2,4-Trimethylbenzene	5 (S)	5 (G)
1,3,5-Trimethylbenzene	5 (S)	5 (G)

TABLE 2.1

NEW YORK STATE GROUNDWATER AND SURFACE WATER
STANDARDS AND GUIDELINE CONCENTRATIONS
FOR SITE-SPECIFIC PARAMETER LIST

<i>Parameter</i>	<i>Most Stringent Standards (1) (µg/L)</i>	
	<i>Class GA Groundwater</i>	<i>Class AA Surface Water</i>
Metals		
Arsenic	25 (S)	50 (S)
Cadmium	10 (S)	10 (S)
Chromium	50 (S)	50 (S)
Copper	200 (S)	200 (S)
Lead	25 (S)	50 (S)
Nickel	NS/G	NS/G
Silver	50 (S)	50 (S)
Zinc	300 (S)	300 (S)
Cyanide	100 (S)	100 (S)
Polychlorinated Biphenyls (PCBs)		
Arochlor 1254	0.1 (S) ⁽⁸⁾	0.6 pg/L (G) ⁽⁸⁾

Notes

- (1) The noted concentrations are the most stringent values obtained from "Water Quality Standards and Guidance Values", Division of Water, New York State Department of Environmental Conservation, Albany, N.Y., November 1991.
S - Standard
G - Guidance Value
- (2) NS/G - No standards or guidance values have been established for these substances.
- (3) Standard and guidance value applies to each isomer (o-,m-,p-) individually.
- (4) Non Detectable (ND) means by tests or analytical determinations referenced in 6 NYCRR Part 703.4.
- (5) Standard applied to sum of 1,2- and 1,4- Dichlorobenzene.
- (6) Standard applies to sum of Dichlorobenzene isomers.
- (7) Standard applies to sum of all phenolic compounds.
- (8) Standard and Guidance Value applies to sum of all polychlorinated biphenyls.

TABLE 2.2

**NEW YORK AMBIENT GUIDELINE CONCENTRATIONS
FOR SITE-SPECIFIC PARAMETER LIST ⁽¹⁾**

<i>Parameter</i>	<i>SGC⁽²⁾ ($\mu\text{g}/\text{m}^3$)</i>	<i>AGC⁽³⁾ ($\mu\text{g}/\text{m}^3$)</i>
Volatile Organic Compounds		
Acetone	140,000 (R)	14,000 (R)
Benzene	30 (P)	0.12 (E,U)
2-Butanone	140,000 (T)	300 (E)
1,1-Dichloroethane	190,000	500
1,2-Dichloroethane	950 (R)	0.039 (EU)
1,1-Dichloroethene (cis)	2000 (T)	0.02 (E,U)
1,2-Dichloroethene (total)	190,000 (T)	1,900 (T)
Ethylbenzene	100,000 (T)	1,000 (T)
Methylene Chloride	41,000 (T)	27 (D,U)
4-Methyl-2-pentanone	48,000 (R)	480 (R)
Tetrachloroethene	81,000 (T)	0.075 (D,U)
Toluene	89,000 (R)	2,000 (I)
1,1,1-Trichloroethane	450,000	1000
Trichloroethene	33,000 (R)	0.45 (D,U)
Vinyl Chloride	1,300 (T)	0.02 (E,U)
Xylene (total)	100,000 (T)	300 (I)
Semi-Volatile Organic Compounds		
Benzo(a)pyrene	-	0.002 (H,U)
Benzo(b)fluoranthene	-	-
Benzo(g,h,i)perylene	-	-
Benzo(k)fluoranthene	-	-
Bis(2-ethylhexyl)phthalate	1,200 (T)	12 (T)
Chrysene	-	-
1,2-Dichlorobenzene	30,000	200
1,4-Dichlorobenzene	-	-
Fluoranthene	-	-
Indeno (1,2,3-CD)pyrene	-	-
2-Methylnaphthalene	-	-
Naphthalene	12,000 (T)	120 (T)
Phenathrene	-	-
Phenol	4,500 (T)	9.6 (H)
Pyrene	-	-
1,2,4-Trimethylbenzene	29,000 (T)	290 (T)
1,3,5-Trimethylbenzene	29,000 (T)	290 (T)
Metals		
Arsenic	0.2 (R)	0.00023 (E,U)
Cadmium	0.2 (P)	0.0005 (H,U)
Chromium (hexavalent)	0.1 (R)	0.00002 (H,U)
Copper (fumes)	48 (T)	0.48 (T)
Copper (dusts/mists)	240 (T)	2.4 (T)

TABLE 2.2

**NEW YORK AMBIENT GUIDELINE CONCENTRATIONS
FOR SITE-SPECIFIC PARAMETER LIST ⁽¹⁾**

<i>Parameter</i>	<i>SGC⁽²⁾ ($\mu\text{g}/\text{m}^3$)</i>	<i>AGC⁽³⁾ ($\mu\text{g}/\text{m}^3$)</i>
Metals (cont'd)		
Lead	1.5 (4)	—
Nickel	1.5 (R)	0.02 (H)
Silver	—	—
Zinc	150 (5)	50 (S)
Cyanide	150 (S)	12 (T)
Polychlorinated Biphenyls (PCBs)		
Arochlor 1254	0.10 (R)	0.00045 (E,U)

Notes:

- (1) New York State Air Guide-1 (Draft), Division of Air Resources, NYSDEC, 1991.
— no Guideline concentrations have been established for these substances.
- (2) SGC "Short-Term Guideline Concentration", source:
(R) - SGC derived from NIOSH REL-TWA (1988);
(T) - SGC derived from ACGIH TLV-TWA (1990-1991);
(S) - SGC based on Federal or NYS standard.
- (3) AGC "Annual Guideline Concentration", source:
(R) - AGC derived from NIOSH REL-TWA (1988);
(T) - AGC derived from ACGIH TLV-TWA (1990-1991);
(S) - AGC based on Federal or NYS standard;
(D) - AGC derived by NYSDEC, Division of Air Resources;
(E) - AGC based on derivation by USEPA;
(I) - AGC based upon RFC developed by USEPA - Integrated Risk Information System (IRIS), input pending;
(H) - AGC derived by NYSDOH, Division of Environmental Health;
(U) - AGC is the ambient air concentration which corresponds to an excess cancer risk of 10^{-6} after lifetime exposure
- (4) New Federal standard for lead not yet officially adopted by NYS but is currently being applied to determine compliance status. Based on averaging period of three months.
- (5) $150 \mu\text{g}/\text{m}^3$ is the Federal SGC particulate standard (maximum 24 hour concentration not to be exceeded more than once per year).

TABLE 2.3

POTENTIAL ACTION-SPECIFIC STANDARDS, CRITERIA AND GUIDELINES

Activity	FEDERAL SCGs			NEW YORK STATE SCGs		
	Title	Subtitle	Citation	Title	Subtitle	Citation
Capping	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Closure and post-closure care	40 CFR 264.310	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
		Post-closure care and use of property	40 CFR 264.117(c)			
Container Storage	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Condition of containers	40 CFR 264.171	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
		Compatibility of waste with containers	40 CFR 264.172			
		Management of containers	40 CFR 264.173			
		Inspections	40 CFR 264.174			
		Containment	40 CFR 264.175			
Constuction of New Landfill on Site	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements	40 CFR 264.301	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
		Operation and maintenance	40 CFR 264.303-304			
		Closure and post-closure care	40 CFR 264.310			
		Groundwater protection	40 CFR 264.91-100			
Discharge of Treatment System Effluent	Administered permit programs: The national pollutant discharge elimination system	Establishing limitations, standards and other permit conditions	40 CFR 122.44 and State regulations approved under 40 CFR 131	Implementation of NPDES program in New York State	—	6 NYCRR Part 750-757
				Technical and Operations Guidance Series	—	—
	Criteria and standards for the national pollutant discharge elimination program	Best management practices	40 CFR 125.100	Blending policy for use of sources of drinking water	—	NYSDOH PWS 68
		Discharge to waters of the U.S.	40 CFR 125.104	Drinking water supplies	—	Part 5 of State Sanitary Code
	Guidelines establishing test procedures for the analysis of pollutants	Identification of test procedures and alternate test procedures	40 CFR 136.1-4	Use and protection of waters	—	6 NYCRR Part 608
Effluent guidelines and standards		Organic chemicals plastics and synthetic fibres	40 CFR Part 414			
Excavation	Land disposal restrictions (also see Closure)	Treatment standards	40 CFR 268 (Subpart D)	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
Incineration Off Site	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Waste analysis	40 CFR 264.341			
Land Treatment	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Treatment program	40 CFR 264.271	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
		Design and operating requirements	40 CFR 264.273			
		Unsaturated zone monitoring	40 CFR 264.278			
		Special requirements for ignitable or reactive waste	40 CFR 264.281			
New York air pollution control regulations					General provisions	6 NYCRR Part 200
					Permits and certificates	6 NYCRR Part 201
					General prohibitions	6 NYCRR Part 211
					General process emission sources	6 NYCRR Part 212
Placement of Waste in Land Disposal Unit	Land disposal restrictions	Treatment standards	40 CFR 268 (Subpart D)	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1
Surface Water Control	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements for waste piles	40 CFR 264.251(c),(d)	Hazardous waste treatment, storage and disposal facility permitting requirements	—	6 NYCRR Subpart 373-1 6 NYCRR Part 701 and Part 703
		Design and operating requirements for land treatment	40 CFR 264.273(c),(d)			
		Design and operating requirements for landfills	40 CFR 264.301(c),(d)			

TABLE 2.3

POTENTIAL ACTION-SPECIFIC STANDARDS, CRITERIA AND GUIDELINES

Activity	FEDERAL SCGs			NEW YORK STATE SCGs		
	Title	Subtitle	Citation	Title	Subtitle	Citation
Treatment (in a unit)	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements for waste piles	40 CFR 264.251	Hazardous waste treatment, storage and disposal facility permitting requirements	-	6 NYCRR Subpart 373-1
		Design and operating requirements for thermal treatment units	40 CFR 265.373	Interim status standards for owners and operators of hazardous waste facilities	-	6 NYCRR Subpart 373-3
		Design and operating requirements for miscellaneous treatment units	40 CFR 264.601	New York air pollution control regulations	General provisions	6 NYCRR Part 200
					Permits and certificates	6 NYCRR Part 201
Treatment (when waste will be land disposed)	Land disposal restrictions	Identification of waste	40 CFR 268.10-12	Hazardous waste treatment, storage and disposal facility permitting requirements	-	6 NYCRR Subpart 373-1
		Treatment Standards Waste	40 CFR 268 (Subpart D)	Interim status standards for owners and operators of hazardous waste facilities	-	6 NYCRR Subpart 373-3
		Specific prohibitions - Solvent wastes	40 CFR 268.30			
			RCRA Sections 3004 (d) (3), (e) (3) 42 USC 6924 (d) (3), (e) (3)			
Waste Pile	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Design and operating requirements	40 CFR 264.251	New York air pollution control regulations	General provisions	6 NYCRR Part 200
					Permits and certificates	6 NYCRR Part 201
					General prohibitions	6 NYCRR Part 211
					General process emission sources	6 NYCRR Part 212
Closure with Waste in Place	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Closure and post-closure care	40 CFR 264.258	Hazardous waste treatment, storage and disposal facility permitting requirements	-	6 NYCRR Subpart 373-1
		Post-closure care and groundwater monitoring	40 CFR 264.310	Interim status standards for owners and operators of hazardous waste facilities	-	6 NYCRR Subpart 373-3
Closure of Land Treatment Units	Standards for owners and operators of hazardous waste treatment, storage and disposal facilities	Closure of land treatment units	40 CFR 264.280	Final status standards for owners and operators of hazardous waste facilities	-	6 NYCRR Subpart 373-2
Transporting Hazardous Waste Off Site	Standards applicable to transporters of hazardous waste	-	40 CFR 263	Waste transport permits	-	5 NYCRR Part 364
				Hazardous waste manifest system and related standards for generators, transporters and facilities	-	6 NYCRR Part 372

TABLE 2.4
IDENTIFICATION OF RESPONSE ACTIONS,
TECHNOLOGIES AND PROCESS OPTIONS

<i>Media</i>	<i>General Response Action</i>	<i>Remedial Technology</i>	<i>Process Options</i>	<i>Description</i>
Soil	No Further Action	None	NA	No further action
	Limited Further Action	Access Restrictions	Deed Restrictions	Limit future uses of Site and of groundwater in the area
	Physical Containment	Cap	Soil Cover	Regrade, cover with compacted fill and topsoil
			Low Permeability Cap	Regrade, cover with compacted clay, fill and topsoil
			Surface Controls	Grading of the Site, construction of ditches or berms
	In Situ Treatment	Biological Treatment	Aerobic/Anaerobic Biodegradation	Nutrients are added to soils to stimulate bacterial degradation
		Physical Treatment	Vacuum Extraction	Extraction wells or trenches are used to extract volatilized contaminants from soils with a vacuum or positive pressure being applied
			Soil Flushing	Water or surfactant solution is circulated into the soil treatment area and removed by extraction drain collectors and treated prior to reinjection
	Removal/On-Site Treatment	Physical and Biological Treatment	Aeration by Landfarming	Excavation and treatment of contaminated soil by aeration (tilling)

TABLE 2.4
IDENTIFICATION OF RESPONSE ACTIONS,
TECHNOLOGIES AND PROCESS OPTIONS

<i>Media</i>	<i>General Response Action</i>	<i>Remedial Technology</i>	<i>Process Options</i>	<i>Description</i>
		Physical/Chemical Treatment	Solvent Extraction	Organic solvents are mixed with contaminated soils in a series of mixing/washing tanks
		Biological Treatment	Aerobic/Anaerobic Degradation	Nutrients are added to soils in a mixing tank or landfarm to promote biological degradation of contaminants
		Thermal Treatment	Low Temperature Thermal Extraction	Involves excavation of soils and heating the soil to volatilize organic compounds in combination with vapor treatment system
	Removal/Off-Site Treatment	Thermal Treatment	Incineration	Involves excavation of soils and high temperature oxidation/combustion
			Incineration	Excavation and transportation of contaminated soils to an off-site incinerator at permitted treatment, storage and disposal facilities
	Removal/Disposal	On-Site	Landfill	Construction of an on-site landfill or containment cell/vault for placement of contaminated soils
		Off-Site	Landfill	Excavation and transportation of contaminated soils to an off-site landfill facility
Groundwater	No Further Action	None	NA	Assumes existing groundwater extraction/treatment system will continue to be operational

TABLE 2.4
IDENTIFICATION OF RESPONSE ACTIONS,
TECHNOLOGIES AND PROCESS OPTIONS

<i>Media</i>	<i>General Response Action</i>	<i>Remedial Technology</i>	<i>Process Options</i>	<i>Description</i>
Groundwater	Limited Further	Access Restriction	Deed Restrictions	'Restrict' usage of site and groundwater in the vicinity of the site
	Physical Containment	Barrier Walls	Slurry Wall/Grout Curtain/ Sheet Piling	Construction of a barrier wall downgradient or around the area of concern to restrict off-site groundwater contaminate migration and limit upgradient groundwater flow to the Site
	Hydraulic Containment	Groundwater Extraction	Wells	Installation and operation of groundwater extraction wells, in addition to the existing groundwater collection drain/ trench, downgradient of the site to form a hydraulic barrier
			Trenches	Installation of additional horizontal groundwater collected on tile drains/ trenches to achieve a hydraulic barrier which will restrict off-site migration of groundwater
	Source Removal	Groundwater Extraction	Wells	Installation and pumping of extraction wells installed within the contaminated area of the site
			Trenches	Installation of shallow groundwater collection drains/trenches within the contaminated area of the site

TABLE 2.4
IDENTIFICATION OF RESPONSE ACTIONS,
TECHNOLOGIES AND PROCESS OPTIONS

<i>Media</i>	<i>General Response Action</i>	<i>Remedial Technology</i>	<i>Process Options</i>	<i>Description</i>
	In Situ Treatment	Biological Treatment	Aerobic/Anerobic Degradation	Contaminated groundwater is treated in place by using biological treatment
Surface Water	None	(Addressed by the remediation of contaminated soils on site)		
Sediment	None	(Addressed by the remediation of contaminated soils on site)		
Air	None	(Addressed by the remediation of contaminated groundwater)		

TABLE 2.5
SUMMARY OF PRELIMINARY EVALUATION OF SOIL REMEDIAL TECHNOLOGIES

<i>Soil Response Action</i>	<i>Remedial Technology/ Process Options</i>	<i>Screening Comment</i>	<i>Evaluation of Results</i>
No Further Action	NA	• Required by the NCP • Acceptable risk, identified in PHE, for direct contact with soils	Retained (1)
Limited Further Action	Access Restrictions/ Deed Restrictions	• Technically implementable • Must be enforced	Retained (1)
Physical Containment	Cap • soil cover	• Technically implementable • Effective in isolation of site contaminants; allows for surface water infiltration; no reduction in site contaminant levels	Retained (1)
	• impermeability cap	• Technically implementable • As effective in isolation of site contaminants as the soil cover • minimizes surface water infiltration	Eliminated
In Situ Treatment	Biological Treatment/ Aerobic/anaerobic Biodegradation	• In Situ process technologies are unproven • Degradation products (i.e. vinyl chloride) are more toxic • Technically unimplementable and not effective	Eliminated
	Physical Treatment • vacuum extraction	• Remove site contaminants of concerns (VOCs) from unsaturated zones • Technically implementable • Reduces source of contaminant loading to the groundwater • Requires vapor phase treatment • May require groundwater extraction to maintain unsaturated zone	Retained
	• soil flushing	• Technically feasible but may be difficult to implement	Retained (1)

TABLE 2.5
SUMMARY OF PRELIMINARY EVALUATION OF SOIL REMEDIAL TECHNOLOGIES

<i>Soil Response Action</i>	<i>Remedial Technology/ Process Options</i>	<i>Screening Comment</i>	<i>Evaluation of Results</i>
Removal/On-Site Treatment		• Requires hydraulic control and good understanding of groundwater flow system • Possible contamination due to surfactant additives, if used • Treatment of extracted water/surfactant required	
	Physical and Biological Treatment • landfarming/aeration	• Technically feasible • Difficult to control odors and air emissions from process • Long treatment duration • Requires excavation of soils	Eliminated
	Biological Treatment • aerobic/anaerobic	• Same as landfarming/aeration • Requires laboratory testing to determine suitable bacteria	Eliminated
	Thermal Treatment • low temperature thermal extraction	• Technically feasible but may be difficult to implement in residential area • Reduces site contaminant levels • Requires excavation of soils • Difficult to control air emissions during excavation • Limited mobile units available • May require treatment of off-gas	Retained
	• incineration	• Same as low temperature thermal extraction • Just as effective as low temperature thermal extraction • Generally not accepted by community • Test burns are required • Permanent facilities require permitting	Eliminated

TABLE 2.5
SUMMARY OF PRELIMINARY EVALUATION OF SOIL REMEDIAL TECHNOLOGIES

<i>Soil Response Action</i>	<i>Remedial Technology/ Process Options</i>	<i>Screening Comment</i>	<i>Evaluation of Results</i>
Removal/Off-Site Treatment	Thermal Treatment • incineration	• Technically feasible • Requires excavation of soils • Transportation of soils to an off-site facility may create traffic problems in a residential area • Difficult to control air emissions from excavation • Limited available capacity at off-site incinerators • Reduces site contaminant levels	Eliminated
Removal/Disposal	On-Site Landfill	• No reduction in Site contaminant levels • Requires excavation soils • Soil may require treatment to comply with land disposal restrictions • Potential long term liability • Site physical characteristics are not conducive to a construction of a landfill • Generally not accepted by communities • Difficult to implement	Eliminated
	Off-Site Landfill	• No reduction in soil contaminant levels • Requires excavation of soils • Soil may require treatment because of land disposal restrictions • Truck traffic may create problems in a residential area • Does not comply with CERCLA remedial action goals	Eliminated

Note:

(1) Retained as a support technology net as a primary technology.

TABLE 2.6
SUMMARY OF PRELIMINARY EVALUATIONS OF
GROUNDWATER REMEDIAL TECHNOLOGIES

<i>Groundwater Response Action</i>	<i>Remedial Technology/ Process Options</i>	<i>Screening Comment</i>	<i>Evaluation Results</i>
No Further Action	None	• Required by NCP • Unacceptable risk levels identified in PHE if contaminated groundwater is ingested	Retained (1)
Limited Further Action	Access Restrictions • Deed Restrictions	• Implementable • Does not reduce contaminant levels • Requires enforcement • Reduces potential for ingestion of contaminated groundwater	Retained (1)
	• Municipal By-Laws	• Implementable • Does not reduce contaminant levels • Requires enforcement • Reduces potential for ingestion of contaminated groundwater	Retained
Physical Containment	Barrier Walls • Slurry Wall/Grout Curtain/Sheet Piling	• Technically implementable • Does not reduce contaminant levels • Off-Site migration of groundwater is already limited by existing hydraulic containment system	Eliminated
Hydraulic Containment	Groundwater Extraction • Wells	• Not evaluated since existing intercepter trench has been proven to be effective	Eliminated
	• Trenches	• Proven to be effective in providing a hydraulic barrier • Does not reduce Site contaminant levels • Technically implementable	Retained (1)

TABLE 2.6
SUMMARY OF PRELIMINARY EVALUATIONS OF
GROUNDWATER REMEDIAL TECHNOLOGIES

<i>Groundwater Response Action</i>	<i>Remedial Technology/ Process Options</i>	<i>Screening Comment</i>	<i>Evaluation Results</i>
Source Removal	Groundwater Extraction		
	• Wells	• May require extensive well network to be effective in removal of groundwater • Reduces Site contaminant levels • May require additional testing (i.e. pumping tests) • Requires long time to cleanup groundwater	Retained (1)
	• Trenches	• Proven to be effective in the collection of groundwater • Technically implementable • Reduces Site contaminant levels • Requires long time to cleanup groundwater if not used in conjunction with soil remedial technology (soil vapor extraction)	Retained (1)
In Situ Treatment	Biological Treatment		
	• Aerobic/Anaerobic Degradation	• Requires laboratory testing to find appropriate bacteria to degrade contaminants • Difficult to control process and maintain conditions required for biological degradation • Not reliable in reducing site contaminant levels	Eliminated

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 1 No Further Action</i>	<i>Alternative No. 2 Limited Further Action</i>	<i>Alternative No. 3 Soil Cover</i>	<i>Alternative No. 4A Soil Vapor Extraction</i>
Overall protection of human health and the environment	No reduction in risk to exposure to Site soils is realized as soil contamination is not addressed. Contaminated groundwater is effectively isolated to the Site by the groundwater collection system and should pose no present or future risk to human health and the environment.	Minimum reduction in risk to exposure realized through implementation of deed restrictions and institutional controls. Contaminated groundwater is effectively isolated to the Site by the groundwater collection system and should pose no present or future risk to human health and the environment.	Installation of a soil cover reduces risk of exposure to Site soils. Contaminated groundwater is effectively isolated to the Site by the existing groundwater collection system and should pose no present or future risk to human health and the environment.	See Alternative No. 3. Soil contamination will be addressed by use of a soil vapor extraction system which will eliminate the source of groundwater contamination.
Compliance with SCGs - - Chemical Specific	The existing groundwater collection system effectively prevents the off-Site migration of contaminants. Soil contamination is addressed through leaching and natural degradation.	See Alternative No. 1.	See Alternative No. 1.	See Alternative No. 1. Residual soil contamination will be addressed using a soil vapor extraction system. Soil cleanup criteria would be reached quicker than through natural degradation.
- Action Specific	Effluent from groundwater treatment system would meet SPDES discharge requirements.	See Alternative No. 1.	See Alternative No. 1.	See Alternative No. 1. Air discharge from carbon adsorption unit would meet NYSDEC established permitting requirements.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 1 No Further Action</i>	<i>Alternative No. 2 Limited Further Action</i>	<i>Alternative No. 3 Soil Cover</i>	<i>Alternative No. 4A Soil Vapor Extraction</i>
Overall protection of human health and the environment	No reduction in risk to exposure to Site soils is realized as soil contamination is not addressed. Contaminated groundwater is effectively isolated to the Site by the groundwater collection system and should pose no present or future risk to human health and the environment.	Minimum reduction in risk to exposure realized through implementation of deed restrictions and institutional controls. Contaminated groundwater is effectively isolated to the Site by the groundwater collection system and should pose no present or future risk to human health and the environment.	Installation of a soil cover reduces risk of exposure to Site soils. Contaminated groundwater is effectively isolated to the Site by the existing groundwater collection system and should pose no present or future risk to human health and the environment.	See Alternative No. 3. Soil contamination will be addressed by use of a soil vapor extraction system which will eliminate the source of groundwater contamination.
Compliance with SCGs - Chemical Specific	The existing groundwater collection system effectively prevents the off-Site migration of contaminants. Soil contamination is addressed through leaching and natural degradation.	See Alternative No. 1.	See Alternative No. 1.	See Alternative No. 1. Residual soil contamination will be addressed using a soil vapor extraction system. Soil cleanup criteria would be reached quicker than through natural degradation.
- Action Specific	Effluent from groundwater treatment system would meet SPDES discharge requirements.	See Alternative No. 1.	See Alternative No. 1.	See Alternative No. 1. Air discharge from carbon adsorption unit would meet NYSDEC established permitting requirements.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 4B</i> <i>Soil Flushing</i>	<i>Alternative No. 5</i> <i>Low Temperature Thermal Extraction</i>	<i>Alternative No. 6</i> <i>Soil Vapor/Groundwater Extraction</i>
Overall protection of human health and the environment	See Alternative No. 3. Soil contamination addressed by increasing natural flushing action of organics by continuous infiltration of water through Site soils.	Contaminated groundwater is effectively isolated to the Site by the existing groundwater collection system and should pose no present or future risk to human health and the environment. Contaminated Site soils are addressed by implementation of an ex situ treatment system. The potential does exist for potential impact to human health and the environment due to generation of dust and organic vapor during excavation activities. In addition, the excavation will be open for an extended period of time which increases the potential for the generation of and exposure to organic vapors.	See Alternative No. 4A. Groundwater collection will be enhanced with the installation of horizontal soil vapor/groundwater collection piping.
Compliance with SCGs - Chemical Specific	See Alternative No. 1. Residual soil contamination to be addressed by in situ soil flushing. Soil cleanup criteria reached quicker than by natural degradation but would require more time than soil vapor extraction.	See Alternative No. 1. Due to removal of soil contamination using an ex situ soil treatment process. The SCGs for Site groundwater will be achieved in a short time frame.	See Alternative No. 4A.
- Action Specific	See Alternative No. 1.	See Alternative No. 4A. Liquid phase organics generated during soil treatment would be disposed of in accordance with applicable regulations.	See Alternative No. 4A.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 1 No Action</i>	<i>Alternative No. 2 Limited Further Action</i>	<i>Alternative No. 3 Soil Cover</i>	<i>Alternative No. 4A Soil Vapor Extraction</i>
Long term effectiveness and permanence	The effectiveness for the potential exposure to Site soils is marginal in the long term, however, the continued extraction of groundwater until cleanup criteria are met due to the natural degradation and leaching of Site contaminants will provide for the long term effectiveness and permanence of this remedial alternative.	See Alternative No. 1.	Reliability of the Site cap in reducing exposure to soils is effective in the long term if the soil cover is properly maintained. The continued extraction of groundwater until cleanup criteria are met due to the natural degradation and leaching of Site contaminants will provide for the long term effectiveness and permanence of this remedial alternative.	Since the organics are removed from the Site soils and the off-site migration of contaminated groundwater is prevented, this remedial alternative is considered effective and permanent in the long term.
Reduction of toxicity mobility and volume	The mobility and volume of the contaminants are reduced by the collection and treatment of groundwater. The toxicity and volume of the organic contaminants would be reduced through oxidation of the organic vapors following regeneration of the activated carbon.	See Alternative No. 1.	See Alternative No. 1.	The volume of organics in the Site soils would be reduced using a soil vapor extraction system. The soil vapor would be treated using a carbon adsorption system. See Alternative No. 1.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 4B Soil Flushing</i>	<i>Alternative No. 5 Low Temperature Thermal Extraction</i>	<i>Alternative No. 6 Soil Vapor/Groundwater Extraction</i>
Long term effectiveness and permanence	See Alternative No. 4A.	See Alternative No. 4A. Passive recontamination of treated soil/backfill may result from residual groundwater contamination or remaining untreated soils.	See Alternative No. 4A.
Reduction of toxicity mobility and volume	See Alternative No. 1.	Contaminants in Site soils will be transferred from soil to vapor using an ex situ process. The soil vapors will be treated in a manner to directly destroy organics (oxidation) or to reduce mobility through carbon adsorption.	See Alternative No. 4A.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 1 No Action</i>	<i>Alternative No. 2 Limited Further Action</i>	<i>Alternative No. 3 Soil Cover</i>	<i>Alternative No. 4A Soil Vapor Extraction</i>
Short Term Effectiveness - Protection of community during implementation	No change in the risk to the community would be realized during implementation of this remedy.	Risk to the community would be decreased in the short term using deed restrictions and institutional controls. This would eliminate potential for possible future human exposure to groundwater.	A temporary increase in the generation of dust during installation of the soil cover may increase risk of exposure to the community.	See Alternative No. 3. Organic vapors generated by the soil vapor extraction system will be treated in a carbon adsorption system and therefore should pose no additional risk of exposure. The risk of exposure in the short term will also increase due to the potential generation of dust and organic vapors due to installation of wells or collection drains.
- Time until remedial response objectives are achieved	The remedial response objectives will be achieved in 55 years based on natural degradation, leaching and operation of the existing groundwater collection system.	See Alternative No. 1.	See Alternative No. 1.	It is estimated the remedial response objectives will be reached in 15 years.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 4B Soil Flushing</i>	<i>Alternative No. 5 Low Temperature Thermal Extraction</i>	<i>Alternative No. 6 Soil Vapor/Groundwater Extraction</i>
Short Term Effectiveness - Protection of community during implementation	See Alternative No. 3.	The risk of exposure will increase due to the potential generation of dust and organic vapors during soil excavation and soil handling operations.	See Alternative No. 4A.
- Time until remedial response objectives are achieved	It is estimated the remedial response objectives will be reached in 15 years.	The treatment of residually contaminated soils will achieve remedial objective in 1.5 to 3.5 years. Since the source of groundwater contamination will be eliminated the achievement of groundwater cleanup objectives will follow shortly thereafter.	It is estimated the remedial response objectives will be reached in 8-10 years.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 1 No Action</i>	<i>Alternative No. 2 Limited Further Action</i>	<i>Alternative No. 3 Soil Cover</i>	<i>Alternative No. 4A Soil Vapor Extraction</i>
Implementability Evaluation - technical feasibility	This alternative is implementable as no technical applications are required.	This alternative is implementable since no technical applications are required.	This alternative is implementable as there are no technical obstacles to the placement of a soil cover.	This alternative is implementable as there are no technical obstacles to the placement of soil cover or the installation of a soil vapor extraction system.
- administrative feasibility	The permit to discharge treated groundwater must be renewed as required to continue operation of the groundwater extraction system.	See Alternative No. 1.	See Alternative No. 1.	See Alternative No. 1. A permit to discharge treated soil vapor must be obtained from the NYSDEC. The permit should be easily obtained as use of carbon adsorption to treat organics in air streams is a proven technology.
- availability of services	Not Applicable.	Not Applicable.	All equipment and materials required to install a soil cover is readily available locally.	See Alternative No. 3. Equipment and materials for the installation of a soil vapor extraction system are readily available.
Estimated Cost*	\$1,903,000.00	\$1,960,000.00	\$2,552,800.00	\$3,651,000.00

* Present worth value is based on 5% annual rate of interest.

TABLE 4.1
SUMMARY OF DETAILED COMPARATIVE ANALYSIS
OF REMEDIAL ALTERNATIVES

<i>Criteria</i>	<i>Alternative No. 4B Soil Flushing</i>	<i>Alternative No. 5 Low Temperature Thermal Extraction</i>	<i>Alternative No. 6 Soil Vapor/Groundwater Extraction</i>
Implementability Evaluation - technical feasibility	This alternative is implementable as there are no technical obstacles to the placement of a soil cover and installation of a groundwater recirculation system.	This alternative is implementable as there are no technical obstacles to the setup and operation of a low temperature thermal desorption system.	See Alternative No. 4A.
- administrative feasibility	See Alternative No. 1.	See Alternative No. 1. A permit to discharge treated vapor from the low temperature thermal desorption unit will be required. This permit should be easily obtained as treatment will use proven technologies. Liquid phase organics may require disposal at a licensed TSD facility.	See Alternative No. 4A.
- availability of services	See Alternative No. 3. All equipment and materials to recirculate groundwater are readily available.	Low temperature thermal desorption units are readily available. Excavation equipment is readily available locally.	See Alternative No. 3. All equipment and materials to install the soil vapor/groundwater extraction system are readily available.
Estimated Cost*	\$2,216,100.00	\$18,387,000.00	\$2,761,900.00

* Present work value estimated costs based on 5% annual rate of interest.

TABLE 4.2
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 1
(NO FURTHER ACTION)

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>	<i>Capital Costs</i>	<i>Operating & Maintenance Annual Cost</i>	<i>Periodic Costs</i>
A. Indirect Costs					
1. Administrative and Legal Fees			\$ 2,500.	\$	
B. Operation of Existing Groundwater Interceptor & Treatment System					
1. Routine Operating Labor				35,400.	
2. Materials				34,000.	
3. Utilities				3,600.	
C. Long Term Performance Monitoring					
1. Routine Ground Water Level Monitoring				10,000.	
2. Sampling & Analyses				20,000.	
D. Periodic Site Review (Every 5 Years)					
1. Site Evaluation and Report Preparation					25,000.
SUB-TOTAL			\$ 2,500.	\$ 103,000.	\$ 25,000.
E. Contingency (15%)			400	15,500.	3800
TOTAL ESTIMATED COST			\$ 2,900.	\$ 118,500.	\$ 28,800.
PRESENT WORTH VALUE*			\$ 2,900.	\$ 1,821,600.	\$ 78,600.
<u>TOTAL PRESENT WORTH COSTS \$ 1,903,000</u>					

* Present value based on a 5 % interest rate and 30 years of operation.

TABLE 4.3
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 2
(LIMITED FURTHER ACTION)

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>	<i>Capital Costs</i>	<i>Operating & Maintenance Annual Cost</i>	<i>Periodic Costs</i>
A. Indirect Costs					
1. Administrative/Legal			\$ 2,500.		
2. Deed Restrictions			50,000.		
B. Operation of Existing Groundwater Interceptor & Treatment System					
1. Routine Operating Labor				35,400.	
2. Materials				34,000.	
3. Utilities				3,600.	
C. Long Term Performance Monitoring					
1. Routine Ground Water Level Monitoring				10,000.	
2. Sampling & Analyses				20,000.	
D. Periodic Site Review (Every 5 Years)					
1. Site Evaluation and Report Preparation					25,000.
SUB-TOTAL			\$ 52,500.	\$ 103,000.	\$ 25,000.
E. Contingency (15%)			\$ 7,500.	\$ 15,500.	\$ 3,800.
TOTAL ESTIMATED COST			\$ 60,000.	\$ 118,500.	\$ 28,800.
PRESENT WORTH VALUE*			\$ 60,000.	\$ 1,821,600.	\$ 78,600.

TOTAL PRESENT WORTH COSTS \$ 1,960,000

* Present value based on a 5% interest rate and 30 years of operation.

TABLE 4.4
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 3
(SOIL COVER)

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>	<i>Capital Costs</i>	<i>Operating & Maintenance Annual Cost</i>	<i>Periodic Costs</i>
A. Deed Restrictions			\$ 50,000.	\$	\$
B. Soil Cover					
1. Materials & Construction	6300	C.Y.	150,000.		
C. Indirect Costs					
1. Administrative/Legal (i)			10,000.		
2. Engineering/Design (ii)			30,000.		
3. Construction Supervision (iii)			20,000.		
D. Operation of Existing Groundwater Interceptor & Treatment System					
1. Labor				35,400.	
2. Materials				34,000.	
3. Utilities				3,600.	
E. Long Term Monitoring					
1. Routine Groundwater Level Monitoring				10,000.	
2. Sampling & Analyses				20,000.	
3. Cover Inspection & Maintenance				20,000.	
F. Periodic Site Review (Every 5 years)					
1. Site Evaluation and Report Preparation					25,000.
SUB-TOTAL			\$ 260,000.	\$ 123,000.	\$ 25,000.
G. Contingency (15%)			\$ 39,000.	\$ 18,500.	\$ 3,800.
TOTAL ESTIMATED COST*			\$ 299,000.	\$ 141,500.	\$ 28,800.
PRESENT WORTH VALUE (iv)			\$ 299,000.	\$ 2,175,200.	\$ 78,600.

TOTAL PRESENT WORTH COSTS \$ 2,552,800

Notes

- i 5% of direct capital costs.
- ii 15% of direct capital costs.
- iii 10% of direct capital costs.
- iv Present worth value based on 5% interest rate over 30 years

TABLE 4.5
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 4A
(SOIL VAPOR EXTRACTION)

<i>Item</i>	<i>Quantity</i>	<i>Unit</i>	<i>Capital Costs</i>	<i>Operating & Maintenance Annual Cost</i>	<i>Periodic Costs</i>
A. Soil Cover					
1. Construct Soil Cover	6300	C.Y.	\$ 150,000.	\$	\$
B. Soil Vapor Extraction System					
1. Equipment (incl. vapor treatment, piping, pumps, etc)			120,000.		
2. Construction & Installation			60,000.		
3. Carbon Usage & Disposal	45000	Lbs.		90,000.	
C. Indirect Costs					
1. Administrative/Legal (i)			13,400.		
2. Engineering/Design (ii)			40,200.		
3. Construction Supervision (iii)			28,600.		
D. Operation of Soil Vapor Extraction System Existing Groundwater and Interceptor & Treatment System					
1. Routine Labor				58,800.	
2. Materials				34,000.	
3. Utilities				7,200.	
E. Performance Monitoring					
1. Routine Groundwater Level Monitoring				30,000.	
2. Chemical Monitoring & Analyses				40,000.	
F. Periodic Site Review (Every 5 Years)					25,000.
SUB-TOTAL			\$ 429,000.	\$ 260,000.	\$ 25,000.
G. Contingency (15%)			\$ 64,400.	39,000.	3,800.
TOTAL ESTIMATED COST			\$ 493,400.	\$ 299,000.	\$ 28,800.
PRESENT WORTH VALUE (iv)			\$ 493,400.	\$ 3,103,500.	\$ 54,100.

TOTAL PRESENT WORTH COSTS \$ 3,651,000.

Notes

- i 5% of direct capital costs.
- ii 15% of direct capital costs.
- iii 10% of direct capital costs.
- iv Present worth value based on 5% interest rate over 15 years

TABLE 4.6
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 4B
(SOIL FLUSHING)

Item	Quantity	Unit	Capital Costs	Operating & Maintenance	
				Annual Cost	Periodic Costs
A. Soil Cover					
1. Materials & Construction	6300	C.Y.	\$ 150,000.	\$	\$
B. Soil Flushing System					
1. Equipment (i.e. leach field, pumps, etc.)			14,000.		
2. Construction & Installation			20,000.		
C. Indirect Costs					
1. Administrative/Legal (i)			9,200.		
2. Engineering/Design (ii)			27,600.		
3. Construction Supervision (iii)			18,400.		
D. Operation of Soil Flushing System & Existing Groundwater Interceptor & Treatment Systems					
1. Labor				35,400.	
2. Materials				34,000.	
3. Utilities				4,500.	
E. Performance Monitoring					
1. Routine Groundwater Level Monitoring				20,000.	
2. Chemical Monitoring & Analyses				30,000.	
F. Periodic Site Review (every 5 years)					
1. Site Evaluation and Report Preparation				0,000.	25,000.
SUB-TOTAL			\$ 239,200.	\$ 123,900.	\$ 25,000.
G. Contingency (15%)			\$ 35,900.	18,600.	3,800.
TOTAL ESTIMATED COST			\$ 275,100.	142,500.	\$ 28,800.
PRESENT WORTH VALUE (iv)			\$ 275,100.	\$ 1,876,000.	\$ 65,000.

TOTAL PRESENT WORTH COSTS \$ 2,216,100.

Notes

- i 5% of direct capital costs.
- ii 15% of direct capital costs.
- iii 10% of direct capital costs.
- iv Present worth value based on 5% interest rate over 22 years

TABLE 4.7
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 5
(LOW TEMPERATURE THERMAL DESORPTION)

Item	Quantity	Unit	Capital Costs	Operating & Maintenance	
				Annual Cost	Periodic Costs
A. Thermal Treatment					
1. Mobilization/Demobilization & Setup/Testing			\$ 300,000.	\$	\$
2. Excavation & Backfilling	20000	C.Y.	1,050,000.		
3. Treatment	30000	Tons	10,500,000.		
B. Indirect Costs					
1. Administrative/Legal (i)			592,500.		
2. Engineering/Design (ii)			1,777,500.		
3. Construction Supervision (iii)			1,185,000.		
C. Operation of Existing Groundwater Interceptor & Treatment System					
1. Routine Labor				35,400.	
2. Materials				34,000.	
3. Utilities				3,600.	
D. Performance Monitoring					
1. Chemical Monitoring & Analyses			80,000.	30,000.	
SUB-TOTAL			\$ 15,485,000.	\$ 103,000.	
E. Contingency (15%)			\$ 2,323,000.	15,500.	0.
TOTAL ESTIMATED COST			\$ 17,808,000.	\$ 118,500.	\$ 0.
PRESENT WORTH VALUE (iv)			\$ 17,808,000.	\$ 579,400.	\$ 0.

TOTAL PRESENT WORTH COSTS \$18,387,000.

Notes

- i 5% of direct capital costs.
- ii 15% of direct capital costs.
- iii 10% of direct capital costs.
- iv Present worth value based on 5% interest rate over 5 years

TABLE 4.8
COST ESTIMATE
REMEDIAL ALTERNATIVE NO. 6
(DUAL SOIL VAPOR/GROUNDWATER EXTRACTION)

Item	Quantity	Unit	Capital Costs	Operating & Maintenance Annual Cost	Periodic Costs
A. Soil Cover					
1. Construct Soil Cover	6300	C.Y.	\$ 150,000.	\$	\$
B. Dual Soil Vapor/Groundwater Extraction System					
1. Equipment (incl. vapor treatment, piping, pumps, etc)			205,000.		
2. Construction & Installation			135,000.		
3. Carbon Usage & Disposal	45000	Lbs.		90,000.	
C. Indirect Costs					
1. Administrative/Legal (i)			24,500.		
2. Engineering/Design (ii)			73,500.		
3. Construction Supervision (iii)			49,000.		
D. Operations of Soil Vapor/Groundwater Extraction System and Interceptor & Treatment Systems					
1. Routine Labor				58,800.	
2. Materials				44,000.	
3. Utilities				7,200.	
E. Performance Monitoring					
1. Routine Groundwater Level Monitoring				30,000.	
2. Chemical Monitoring & Analyses				40,000.	25,000.
			\$ 637,000.	\$ 270,000.	\$ 25,000.
SUB-TOTAL					
F. Contingency (15%)			\$ 95,600.	40,500.	3,800.
TOTAL ESTIMATED COST			\$ 732,600.	\$ 310,500.	\$ 28800.
PRESENT WORTH VALUE (iv)			\$ 732,600.	\$ 2,006,800.	\$ 22500.

TOTAL PRESENT WORTH COSTS \$ 2,761,900.

Notes

- i 5% of direct capital costs.
- ii 15% of direct capital costs.
- iii 10% of direct capital costs.
- iv Present worth value based on 5% interest rate over 8 years

