2021 Hazardous Waste Scanning Project

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STREAMLINED FEASIBILITY STUDY

Niagara County Refuse Site
Wheatfield, New York

July 3, 1993

RESPONSES TO USEPA COMMENTS RECEIVED JUNE 14, 1993 ON "STREAMLINED FEASIBILITY STUDY" NIAGARA COUNTY REFUSE SITE WHEATFIELD, NEW YORK, MAY 1993

GENERAL COMMENTS

1. USEPA General Comment

The primary correction that needs to be made to the FS is the deletion of references to the Baseline Risk Assessment performed by Conestoga-Rovers & Associates (BRA-CRA). As per correspondence dated January 28, 1993 and June 9, 1993 from the EPA to the NCR Steering Committee, the Risk Assessment performed by EPA's contractor, TRC Environmental Corporation, is the correct risk assessment for the site. All references in the FS to the BRA-CRA (Section 1.4 and elsewhere) need to be revised to reflect the EPA Risk Assessment. Similarly the risk assessment tables (Tables 1.2 - 1.4) will have to be modified to be consistent with the EPA Risk Assessment. This will not significantly alter the Remedial Technologies Identification and Screening and Development of Detailed Analysis of Remedial Alternatives sections of the FS for the following reasons:

- *EPA's Risk Assessment indicated risk(s) for groundwater ingestion within EPA's acceptable risk range of 10^{-4} to 10^{-6}. Also, the risks were associated with inorganic compounds measured below maximum contaminant levels (MCLs) which may be attributable to background conditions;*
- *capping of the site would alter site hydrology, reduce leachate generation, and likely reduce risk levels over time; and*
- *groundwater monitoring will continue to ensure compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and to be considered (TBC) criteria.*

In addition, although the EPA defines 10^{-4} to 10^{-6} as an acceptable risk range, the New York State Department of Health (NYSDOH) does not. Statements in the FS such as "current potential health risks associated with the Site are acceptable" (p. 80), need to be excluded or modified to explain that the greatest risks attributable to the site are from inorganic concentrations in site groundwater below action levels. This comment is also referenced in the specific comments below.

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Response

The text has been revised by deleting references to the Baseline Risk Assessment performed by Conestoga-Rovers & Associates (BRA-CRA) and replacing these references with the EPA's Risk Assessment. Similarly, the risk assessment tables (Tables 1.2-1.4) have been revised/replaced with Tables 1.2 - 1.6 to be consistent with the EPA's Risk Assessment. Statements in the FS have also been modified to explain that the greatest risks attributable to the Site are from inorganic concentrations in Site groundwater below action levels.

2. **USEPA General Comment**

Section 5.0, Recommendation of Preferred Alternative, is inappropriate for the FS and needs to be deleted from the report. The EPA will render its decision on the appropriate alternative for remediation of the site in the Record of Decision (ROD) based on public comment after the release of the Proposed Plan.

Response

Section 5.0 has been deleted accordingly.

3. **USEPA General Comment**

The FS contains inappropriate subjective phraseology. Statements in the FS such as "The leachate seeps have had, at most, a limited adverse effect on surface water and surface water sediments in the on-site perimeter swales" (p.33) are misleading. Although site impacts on the environment have been mitigated by the geology of the site and previous closure actions, contaminants have been detected to varying degrees in all site media. For example, New York State Ambient Water Quality Criteria (NYS AWQC) were exceeded in site surface water for a number of parameters including phthalates and certain inorganics. Additionally, such broad conclusions on the impacts of leachate can not be substantiated based on the sampling of 9 out of 30 total leachate seeps. The cited language needs to be excluded entirely or modified to explain the analytical data more precisely (e.g., the RI analytical data indicates phthalates in six out of ten surface water samples, with a maximum detected concentration of 1000 ppb). This comment is also referenced in the specific comments below and is particularly evident in Section 1.4.5, RI Report Conclusions and Section 2.2, Remedial Goals.

Response

See responses to Specific Comments 14 and 17.

4. **USEPA General Comment**

The conclusion that no Chemical-Specific ARARs are applicable for the Site since the Risk Assessment did not identify any unacceptable risk(s) associated with site contaminants is false. MCLs, NYS AWQCs, etc, are Chemical-Specific ARARS regardless of what levels of contaminants have been measured at the site (and, in fact, Chemical-Specific ARARs have been exceeded at the site).

Response

Chemical-specific ARARs have been added to Section 2.1.1 of the FS.

5. **USEPA Comment**

The conclusion that any leachate entering the overburden groundwater flow will remain in place beneath the area of the landfill cells indefinitely is false. Although the gradients in the upper bedrock aquifer and lower till unit appear to be low, gradients do exist. Therefore, contaminant/leachate migration will eventually occur.

Response

See response to Specific Comment 17.

6. **USEPA General Comment**

Impacts on wetland areas are poorly defined. Although the need for a complete wetlands assessment is identified in the FS, the potential impact of each remedial alternative on the wetlands needs to be included. Also, the wetland's hydraulics and interactions with landfill surface hydrology have not been addressed.

Response

The PRPs recognize that each of the remedial alternatives could potentially impact the wetlands. However, since each of the alternatives subjected to detailed analyses in the FS, with the exception of Alternative 1 (No Action) and Alternative 2 (Deed Restrictions, Access Controls, Monitoring) would potentially impact the wetlands to a similar degree since they all include capping of the Site with large volumes of soils, there is no need to carry the wetlands remediation through on each individual alternative. Section 1.1 of the FS has been expanded to summarize the contents of the wetlands assessment to be conducted during the RD.

7. <u>USEPA General Comment</u>

The RCRA standard cap presented by CRA is not consistent with the design presented in the CERCLA Municipal Landfill Guidance. CRA should verify the design specifications for a RCRA cap and revise the specifications and associated cost estimates for this alternative accordingly.

<u>Response</u>

See response to Specific Comment 36.

8. <u>USEPA General Comment</u>

CRA has concluded that a gas venting layer will not be needed in the design of any of the landfill caps due to low gas production and suggests that perimeter gas venting trenches be utilized instead. However, it is difficult to accurately predict landfill gas generation and the potential exists for increased volumes of gas production in the future. Some gas venting across the surface of the landfill will be required.

<u>Response</u>

The FS concluded that gas venting trenches across the landfill were required and that gas venting trenches around the perimeter of the Site were not required. However, Section 3.2.4 of the FS has been revised to clarify this as follows:

> "The passive gas venting layer would be effective in venting the landfill gas through the cap, thereby eliminating the potential for lateral movement of gas away from the Site. The gas venting layer would be installed for all capping options in accordance with 6 NYCRR Part 360. Alternatively, gas collection trenches could be installed in the cap instead of a gas venting layer. Given the low volume of gas generated at the Site, trenches beneath the cap would be effective for controlling lateral gas migration.

Due to the installation of a gas venting layer/trenches in the cap for all capping options, and given the low amount of gas generated by the landfill, a passive perimeter gas collection trench would not increase the overall effectiveness of the gas collection system. However, for those alternatives where the leachate subsurface perimeter drain is installed, the perimeter gas collection trench could be incorporated into its design at a minimal cost."

9. <u>USEPA General Comment</u>

The figures presented in the FS depicting the various capping alternatives are difficult to interpret due to their small scale (although no scales are specified on these figures). CERCLA Municipal Landfill Guidance (Section 3.3.2) recommends that, to evaluate the various remedial action alternatives for landfill contents and any hot spots, data gathered during the site characterization include 1-foot contour maps on an appropriate scale (e.g., 1 inch equals 50 feet) so that slope length and gradients can be assessed for capping alternatives. Therefore, contour maps should be developed which are more consistent with the recommendations of the CERCLA Municipal Landfill Guidance to allow proper evaluation of the capping alternatives.

Additionally, it would be useful to include any or all of the following in the figures section of the report: vertical/lateral extent of fill in each cell; depth to water table across site with respect to fill depth and anticipated fluctuations in water levels; thickness of the geologic units across the Site and the variability observed; lateral continuity of presumed confining layers; and locations of leachate seeps with respect to the configuration of the landfill cell(s).

<u>Response</u>

As discussed and agreed to between Dick Frankoski (BP America) and Mike Negrelli (USEPA) the provision of the two capping alternative figures at a revised scale and/or 1-foot contour intervals would not assist in the evaluation or selection of the appropriate capping alternative (i.e. RCRA Cap vs. NYS Standard Cap). Therefore, these figures have not been revised. However, the following figures and plans with appropriate references in the text, which were also presented in the RI Report, have been added to the FS:

Figure 1.4	Flood Boundaries
Figure 1.5	Typical Compacted Clay Barrier Perimeter Seal Detail
Figure 1.6	Landfill Area as of 1973
Figure 1.7	Cross-Section Locations
Figure 1.8	Cross-Section A-A'
Figure 1.9	Cross-Section B-B'

Figure 1.10	Cross-Section C-C' and D-D'
Figure 1.11	Soil Boring Concentrations, Plan View
Figure 1.12	Soil Boring Concentrations, Cross-Section A-A'
Figure 1.13	Soil Boring Concentrations, Cross-Section B-B'
Figure 1.14	Leachate Concentrations
Figure 1.15	Surface Water Concentrations
Figure 1.16	Sediment Concentrations
Figure 1.17	Silt Unit Groundwater Concentrations
Figure 1.18	Clay/Upper Till Unit Groundwater Concentrations
Figure 1.19	Bedrock Unit Groundwater Concentrations

Plan 2	Leachate Seeps
Plan 3	Site Property Map
Plan 4	Monitoring Well Locations
Plan 5	Sampling Locations
Plan 6	Top of Clay/Upper Till Contours
Plan 7	Top of Bedrock Contours
Plan 8	Lower Till Groundwater Contours (04/19/91)
Plan 9	Bedrock Groundwater Contours (04/19/91)
Plan 10	Leachate Elevation (10/30/90) Fill Material

10. **USEPA General Comment**

Although primarily a design issue, it should be noted in the detailed analysis of alternatives that fugitive dust emissions during remedial activities will be controlled by utilizing dust control measures during construction such as the application of water or calcium chloride, and by implementing soil erosion control measures both during and after construction.

Response

Control measures for fugitive dust emissions are addressed in Section 4.3.4.1, Alternative 3 - Short-Term Effectiveness. This section is also referenced, where appropriate, for the other capping alternatives (Alternatives 4, 5 and 6).

SPECIFIC COMMENTS

Section 1.0 INTRODUCTION

1. **USEPA Specific Comment - p. 1, ¶3**

The text refers to two additional Site investigation activities. Please identify.

Response

The text has been revised to include the identification of the field tile investigation and resampling of well NCR-12D conducted during October 1991 as the two additional Site investigation activities.

2. USEPA Specific Comment - p. 2, ¶3

The last paragraph references the BRA-CRA. Modify as per General Comment 1.

Response

The text has been revised accordingly.

3. USEPA Specific Comment - p. 3, ¶1

Delete entire paragraph.

Response

The text has been revised accordingly.

4. USEPA Specific Comment - p. 3, ¶2

Delete " considering containment technologies as discussed with the EPA and NYSDEC during a meeting on March 19, 1992," from the second sentence. The statement infers a pre-selection of the remedy.

Response

The text has been revised accordingly.

5. USEPA Specific Comment - p. 4, ¶1

Delete "The EPA approved the Scoping Plan in a letter...As stated in the April 15, 1993 letter, from the PrPs to the EPA". This summary of correspondence is superfluous to the development of the FS report.

Response

The text has been revised accordingly.

6. <u>USEPA Specific Comment - p. 4, ¶2</u>

Delete the last sentence that begins "The submission..." and ends "the EPA's exception to the schedule." at the top of page 5.

<u>Response</u>

The text has been revised accordingly.

7. <u>USEPA Specific Comment - p. 6, ¶3</u>

The location (distance upstream/downstream of the Site) of the Niagara County Water Supply intake on the Niagara River in relation to the Site should also be presented. This information is needed to evaluate potential receptor populations.

<u>Response</u>

Section 1.3.1 of the FS states "The intake for the Niagara County Water Supply is located in the Chippawa Channel of the Niagara River on the west side of Grand Island." The Site is located on the Tonawanda Channel of the Niagara River on the east side of Grand Island. Therefore, the Niagara County Water Supply intake is neither upstream nor downstream of the Site and is not a potential receptor. The Site location on the Niagara River (i.e. Tonawanda Channel) has been added to the first paragraph of Section 1.3.1.

8. <u>USEPA Specific Comment - p. 7, ¶2</u>

Any community, private, and/or agricultural wells that are located in the proximity of the site should also be included in the site background.

<u>Response</u>

Section 3.6 of the RI Report states that "No private or public wells are known to be in use in the vicinity of the Site (Ebasco, 1988). Surface water from the Niagara River is the sole source of water for the Town of Wheatfield (Ebasco, 1988), the City of North Tonawanda, the City of Tonawanda, the Town of Lockport and the City of Niagara Falls." The FS text has been revised to include the above text from the RI Report.

9. <u>USEPA Specific Comment - p.10, ¶5</u>

The location of 30 leachate seeps need to be shown on a figure presented in the FS.

<u>Response</u>

The location of the leachate seeps were shown on Plan 2 presented with the RI Report. This plan has also been added to the FS as Plan 2.

10. <u>USEPA Specific Comment - p. 11, ¶3I</u>

It is not clear how the volume of waste deposited at the Site was determined. The methodology used to determine this value should be presented in the FS.

<u>Response</u>

The methodology used to determine the volume of waste deposited at the Site was presented in Section 2.5 of the RI Report. The FS has been revised to include an overview of the methodology presented in the RI Report and a reference to Section 2.5 of the RI Report.

11. <u>USEPA Specific Comment - p. 12, ¶2</u>

Delete "However, as discussed in the Ebasco report..." through "by basing it on conflicting historic data." at the top of page 13. Even though the RI was designed to investigate site conditions without prejudice, previous site investigations should not be discredited.

<u>Response</u>

The text has been revised accordingly.

12. <u>USEPA Specific Comment - p. 18, ¶4</u>

The EPA and NYSDEC do not agree that the potential for horizontal leachate migration in the field tile is limited. It has been agreed in previous meetings that the field tile be cut off and any residual contamination consolidated in the landfill before capping. Modify this statement to reflect these concerns.

Response

Section 4.12.2 of the RI Report provides a discussion of the field tile investigation. As part of the field tile investigation, the field tile was severed in three different test pit locations. At each test pit location the area around the field tile in each pit was dug out and backfilled with clay to plug off any flow along the tile. The clay was compacted into this dug-out area with the bucket of the backhoe. The clay was obtained by skimming off the top of the native red-brown silty clay layer at the bottom of the test pit. Subsequently, each test pit was backfilled with the excavated materials. Therefore, the potential for horizontal leachate migration in the field tile is limited. A reference to severing and plugging the clay tile has been added to Section 1.3.5.3 of the FS Report. It is agreed that any residual contamination present in the on-Site swales will be consolidated in the landfill before capping. Reference to this has been added to Section 2.2 of the FS Report under the subsection entitled "Remediating Contaminated Surface Water and Sediments".

13. USEPA Specific Comment - p. 19, ¶2

CRA indicates that surface water flow from the Site only occurs during heavy or prolonged rain events. CRA also concludes (see Section 1.3.5.2) that leachate from the landfill is not likely to migrate into the subsurface due to the low permeability of underlying geologic units. Considering these conditions, precipitation infiltrating the landfill is likely to be "stored" and released slowly (delayed drainage) via the leachate seeps. Therefore, it is likely that leachate will continue to be released through these seeps following a rainfall event, at which time there will be no dilution due to surface water runoff. When leachate is being released via these seeps and no rainfall is occurring, the impact to wetlands and surface waters that receive the leachate may be greater. Therefore the claim is erroneous and needs to be modified.

Additionally, the "limited impact" that the leachate seeps have had on surface water quality is not established, nor that the impacts are "significantly lowered" by heavy or prolonged rain events. Exclude or modify this statement as per General Comment 3.

Response

The above referenced paragraph was excerpted with minor editorial revisions, from the RI Report, Section 5.5.4. The objective of the paragraph is to indicate that surface water flow from the Site only occurs during heavy or prolonged rain events. Thus, any leachate which had previously been released to the on-Site swales or wetlands, via leachate seeps, would be diluted during these periods prior to flowing from the on-Site swales or from Section 5.4 of the RI Report and added to the FS to establish the impacts that the leachate seeps have had on surface water quality.

14. <u>USEPA Specific Comment - p. 20, ¶1</u>

A total of thirty (30) leachate seeps were identified at the Site; however; only nine (9) of these seeps were sampled. Leachate seeps occurring from different portions of the landfill can vary in content and constituent levels due to waste disposal practices. The rationale for sampling only nine of the leachate seeps and whether the analytical data obtained for these seeps can be considered representative of those seeps not sampled needs to presented.

<u>Response</u>

The nine samples were collected at the approximate locations identified in the EPA-approved "Project Operations Plan" (POP) prepared by CRA in 1990. As discussed in the POP the final sample locations, which were mutually agreed to in the field by the CRA and the USEPA representatives, were based on evidence of leachate seepage. In addition, real-time air monitoring using both an FID and a PID was used to assist in leachate seep sample location selection. The locations sampled were considered to represent the worst leachate (i.e. worse-case conditions) at the Site. Therefore, by assuming that the data from these seeps is representative of those seeps not sampled is a conservative approach. The above rationale has been added to the leachate seep assessment in the FS.

15. <u>USEPA Specific Comment - p. 21, ¶1 and p. 23 ¶1</u>

CRA should provide a summary of the rationale that contaminants detected in the surface water sample collected at the point at which the 30-inch diameter culvert passing under River Road discharges to the Niagara River are not attributable to the Site. Please provide the additional information if there is another source area(s) that has contributed to the contamination detected at this sampling location.

<u>Response</u>

The rationale was previously provided to USEPA in response to their comments of June 25, 1992 (see July 24, 1992 letter from Richard Frankoski (BP America) to Mike Walters (USEPA)) and is repeated here for ease of review.

Section 2.1 of the RI Report discusses that the Site is generally surrounded to the west by active farmland for the production of wheat and/or corn; to the north by wooded wetlands, a clay-mining operation, a Niagara Mohawk

Power Corporation transmission line, and a right-of-way owned by the New York State Department of Transportation (NYSDOT) which was intended for construction of an extension of the existing Lasalle Expressway; and to the east by woodlands and low density housing which is approximately 1,000 feet from the edge to the Site; and to the south by access roads, railroad tracks, and River Road (NYS Route 265/384). Commercial and light industrial development exists along River Road in the vicinity of the Site.

All of these sources, with the exception of the low density housing to the east of the Site, contribute surface water runoff to the 30-inch diameter culvert. In addition, there could potentially be other sources contributing flow to the 30-inch diameter culvert, however, they were not identified during the RI. The RI was designed to collect information relevant to the impacts of the Site on the surrounding area and did not evaluate/investigate the impact of off-Site sources on surface water discharge at location SW-18. Since there was no surface water flow from the Site on the day of and for a period of 22 days preceding sample collection at SW-18, some or all of the surface water flow at location SW-18 at the time of sample collection was from the above-referenced off-site sources.

16. <u>USEPA Specific Comment - p. 25-32</u>

The Baseline Risk Assessment section needs to be rewritten to reflect EPA's Risk Assessment, as per General Comment 1.

<u>Response</u>

The text has been revised accordingly.

<u>1.4.5 RI Report Conclusions</u>

17. <u>USEPA Specific Comment - p. 32-34</u>

The RI Report Conclusions each contain the subjective language referred to in General Comment 3 (i.e., "limited adverse effect", "limited impact", etc.). This section needs to be rewritten as per the following Specific Comments and General Comment 3.

<u>Response</u>

The RI Report Conclusions have been excerpted verbatim from the USEPA-approved RI Report. Changing the conclusions within the FS would constitute changing an already approved document. It is recognized that the

USEPA will attach an addendum to the PRAP, which will outline the disagreement/redefinition of the RI conclusion language.

18. USEPA Specific Comment - p. 33, ¶1

Item #2 states that leachate generated at the site is similar in characteristics to that generated in other municipal solid waste landfills. Reference the data to support this statement.

Response

Supporting data is provided in Section 6.5 of the RI Report.

19. USEPA Specific Comment - p. 33, ¶2

Item #3 makes claims based on 9 leachate seep samples out of thirty leachate seeps, which makes the conclusion suspect. Modify or delete accordingly.

Response

See responses to Specific Comments 14 and 17.

20. USEPA Specific Comment - p. 33, ¶3

Item #4 relates to impacts on site ground water. Although data may indicate that contaminants are not currently detected in the upper bedrock aquifer, it is possible that contaminant/leachate breakthrough may occur in the future. Modify or delete accordingly.

Response

See response to Specific Comment 17.

21. USEPA Specific Comment - p. 33, ¶4

Item #5 concludes that any leachate entering the overburden groundwater flow regime will remain in place within the area of the landfill cells. It is not clear what type of time frame is indicated by this statement. Groundwater flow will occur, albeit slowly, and, therefore, contaminants entering the groundwater flow regime will migrate. CRA does not present any groundwater contours or groundwater modeling results in the FS to support the contention that contaminants will not migrate from the Site with *groundwater flow. At a minimum, long-term monitoring of groundwater quality in each stratigraphic unit is needed to assess the migration of contaminants in ground water. Modify or delete accordingly.*

Response

See response to Specific Comment 17.

22. USEPA Specific Comment - p. 34, ¶1

Item #6 states that additional air monitoring for landfill gases may be necessary during the remedial design phase. Monitoring of landfill gases will be necessary during implementation and following completion of the remedial action at the Site. Since much of the refuse appears to be saturated based upon discussion in the FS, complete low permeability capping of the landfill will likely lower the water table in the refuse due to decreased infiltration of precipitation. Under saturated conditions, biodegradation of the waste may be significantly impeded. Therefore, significant volumes of the waste deposited may not yet have undergone the bulk of degradation. Once the water level in the waste is lowered following capping, significant generation of landfill gases may occur. The present lack of gas odors at the Site may be due to inhibited degradation to date, rather than significant degradation having already occurred. Modify statement accordingly.

Response

See responses to General Comment 8 and Specific Comment 17.

23. USEPA Specific Comment - p. 34, ¶2

Item #7 identifies a target risk range of 1.0E-06 to 1.0E-04, which is incorrect. As per General Comment 1, EPA's acceptable risk range is E-06 to E-04; note also, though, the NYSDOH exclusion.

Response

Since the USEPA did not previously approve the risk assessment portion of the RI Report, this conclusion has been deleted. Conclusions associated with the BRA-TRC are presented in Section 1.4.3.3 of the FS.

24. USEPA Specific Comment - p. 34, ¶3

Item #8 draws its conclusion based on a suspect conclusion (Comment 19, Item #3). Also the impact of the site on adjacent wetlands has not yet been established. Modify or delete accordingly.

Response

Since the USEPA did not previously approve the risk assessment portion of the RI Report, this conclusion has been deleted. Conclusions associated with the BRA-TRC are presented in Section 1.4.4 of the FS.

Section 2.0 REMEDIAL ACTION OBJECTIVES

25. USEPA Specific Comment - p. 35, ¶2

Typographic error: §121, Y2 U.S.C. should read §121, 42 U.S.C. Also, since SARA is referenced in the subsequent paragraph, it should be defined here (i.e., Superfund Amendments and Reauthorization Act (SARA)).

Response

The text has been revised accordingly.

26. USEPA Specific Comment - p. 38, ¶2

As per General Comment 4, MCLs, NYS AWQCs, etc. are Chemical-Specific ARARs regardless of what levels of contaminants have been measured at the site and must be included in this discussion (in fact, Chemical-Specific ARARs have been exceeded at the site). Also delete the reference to the BRA-CRA and "were not found to be adversely impacted on the Site at present conditions." (See General Comment 3).

Response

The text has been revised accordingly and new Tables 2.1 and 2.2 have been added which present a summary of the USEPA and NYS ARARs for groundwater and surface water, respectively.

27. USEPA Specific Comment - p. 38, ¶3

The discussion of Location-Specific ARARs refers to Table 2.1. Other potential Location-Specific ARARs that must be included are: National Historic Preservation Act, which will require a Stage IA cultural resources survey; Coastal Zone Management Act, which will require a coastal zone consistency determination; and Farmland Protection Policy Act, which will require a determination of impacts on adjacent agricultural lands.

Response

Table 2.3 (formerly Table 2.1) has been revised accordingly.

28. USEPA Specific Comment - p. 38, ¶4

Action-specific ARARs may also establish minimum standards for *specific treatment and disposal activities.*

Regarding Table 2.2 (Action-Specific ARARs), the list of action-specific ARARs presented does not appear complete when compared to the list presented in Table 5-3 of the CERCLA Municipal Landfill Guidance. Although the list presented in the Municipal Landfill Guidance contains ARARs which are not applicable to the site, several of those that are applicable have not been included in Table 2.2. Also note that a New York State ARAR exists for surface water runoff compliance.

Response

The text and Table 2.4 (formerly Table 2.2) have been revised accordingly.

29. USEPA Specific Comment - p. 37-38

Merely listing the ARARs is not sufficient for an ARARs analysis. The requirements associated with each ARAR must be discussed fully so that the remedial alternatives can be developed to meet each requirement. For instance, ARAR requirements for RCRA landfill cap (i.e., permeability of clay layers, etc.) must be identified prior to developing the capping alternative to assure compliance with ARARs. The ARAR listings provided in the RI/FS Work Plan must, therefore, be expanded in the FS to present all requirements associated with each ARAR.

Response

The requirements for each ARAR have been added to the appropriate tables.

2.2 Remedial Goals

30. USEPA Specific Comment - p. 39, ¶3

As per the NYSDOH exception, it is not correct to say the site does not pose a principal threat to human health. However it can be stated that risks fall within the EPA's acceptable risk range. Also delete reference to BRA-CRA.

Response

The text has been revised accordingly.

31. USEPA Specific Comment - p. 40, ¶3

Although the gradients observed in the bedrock and till aquifers are low, this does not entirely preclude the potential of groundwater to migrate from the Site. As the cumulative volume of leachate generated by the landfill increases, the potential for contaminants to leach to groundwater and migrate off site also increases. The purpose of containment actions such as capping is to reduce the amount of precipitation infiltrating the landfill and thereby reduce leachate production. Reductions in leachate production are needed to minimize the future potential for contaminants to leach to groundwater and migrate off site with groundwater flow and/or migrate off site via leachate seeps. Current groundwater monitoring data may indicate that contaminants have not migrated off site via groundwater flow. However, it is possible that with continued leachate production this will occur in the future. Therefore, reduction of contaminant leaching to groundwater is necessary to minimize the potential for migration of contaminants off site in the future. Modify or delete the last two sentences accordingly.

Response

The last two sentences have been deleted accordingly.

32. USEPA Specific Comment - p. 41, ¶4

Same as Specific Comment 30, above.

Response

The text has been revised accordingly.

33. USEPA Specific Comment - p. 42, ¶2

It should be noted in this paragraph that groundwater collection and treatment is currently not necessary at the site and that a groundwater monitoring program will be implemented to ensure that contaminants are not migrating off site.

Response

The text has been revised accordingly.

34. USEPA Specific Comment - p. 42, ¶3

Since Chemical-Specific ARARs and TBC criteria have been exceeded in surface water, ongoing monitoring of surface water and sediments should occur to allow assessment of surface water quality during and subsequent to implementation of the remedial action. Also see Specific Comment 19.

Response

The text has been revised accordingly.

Section 3.0 REMEDIAL TECHNOLOGIES IDENTIFICATION AND SCREENING

35. USEPA Specific Comment - p. 48, ¶1

Please modify to state "clean demolition and construction debris as grading material" as per EPA and NYSDEC acceptability.

Response

The text has been revised accordingly.

36. USEPA Specific Comment - p. 49, ¶1

According to the CERCLA Municipal Landfill Guidance, specifications for a RCRA cap are as follows:

- *vegetative and protective layer - 24 inches of native soil;*
- *drainage layer - 12 inches of sand (permeability ≥ 1 x10^{-2} centimeters/second) or geonet (transmissivity ≥*

3×10^{-5} meters^2/second);

- *first barrier layer component - Flexible Membrane Liner (FML) (20-mil minimum);*
- *second barrier layer component - 24 inches of clay (permeability $\leq 1 \times 10^{-7}$ centimeters/second); and*
- *bedding layer (optional) - 12 inches of native soil or sand subgrade.*

The RCRA standard cap presented by CRA is not consistent with the design presented in the CERCLA Municipal Landfill Guidance. In addition, the RCRA landfill cap design presented in Figure 4.2 of the FS appears to be inconsistent with the design presented on page 49 of the FS and that which is presented in the CERCLA Municipal Landfill Guidance. Please revise all references for consistency with the RCRA cap presented in the CERCLA Municipal Landfill Guidance and revise the specifications and associated cost estimates for this alternative accordingly.

Response

The RCRA cap discussed in Section 3.1.3 of the FS is consistent with the technical guidance for RCRA caps. As listed in Section 3.1.3, the RCRA cap evaluated includes vegetative cover and a total of 30 inches of topsoil/fill. It also includes a 12-inch sand drainage layer. The combined depth for the topsoil/fill/sand layers of 42 inches is required due to the maximum frost depth penetration in the area. Beneath the sand drainage layer is the HDPE liner (30-mil, although not specifically stated in Section 3.1.3) and a 24 inch layer of compacted clay. The requirements for each layer (i.e. hydraulic conductivity or HDPE thickness) have been added to the text for clarification.

The design presented in Figure 4.2 is consistent with that discussed above, with the exception of a 6-inch bedding layer between the 30-mil HDPE liner and the underlying 24-inches of clay. The figure has been revised to remove this bedding layer to maintain consistency with EPA guidance. The costs presented in the FS are based on the RCRA cap components discussed in Section 3.1.3, and do not include the 6-inch bedding layer. Therefore, the cost estimate for the RCRA cap does not require revision.

37. USEPA Specific Comment - p. 50, ¶3

In addition to controlling leachate seeps the purpose of a leachate collection system is to minimize the potential for leachate and associated contaminants to migrate to groundwater.

Response

The text has been revised accordingly.

38. **USEPA Specific Comment - p. 53, ¶3**

The discussion of biodegradation of landfill organics via biological treatment processes is not complete. Many constituents found in leachate from landfills are refractory and are not amenable to biological degradation. Additionally, some metals (inorganic compounds) may be toxic to biological processes.

Response

The text has been revised to indicate that the presence of inorganics at high concentrations may reduce the efficiency of biological treatment due to several factors including precipitation and toxicity.

39. **USEPA Specific Comment - p. 54, ¶3**

Pretreatment of the waste stream may be necessary prior to carbon adsorption, the added costs of which should be included in the evaluation of the feasibility of this treatment technology. Suspended solids, oil and grease, and unstable chemical compounds (including inorganic species) in the waste stream are the most problematic.

Response

Section 3.2.5 of the FS discusses the need for pretreatment. The costs estimated in the evaluation of on-Site treatment consider pretreatment requirements.

40. **USEPA Specific Comment - p. 55, ¶2**

Pretreatment of the waste stream may be necessary prior to air stripping to remove suspended solids and dissolved iron. Iron in the waste stream would be oxidized on contact with air in the stripping tower. The resulting ferric hydroxide would plate out on the packing, increasing the pressure drop through the tower and reducing the surface area available for air-water contact.

Response

See response to Specific Comment 39.

41. USEPA Specific Comment - p. 56, ¶2

The City of North Tonawanda's publicly-owned treatment works (POTW) is not clearly described. It is not apparent whether the carbon columns are a component of a secondary biological treatment system with the carbon serving as a media for fixed-film bacteria, or whether treatment provided is due to adsorption only. Please elaborate.

Response

The carbon columns provide secondary treatment by adsorption as the wastewater is pumped up through the carbon. The text has been revised accordingly.

42. USEPA Specific Comment - p. 56, ¶3

It is proposed that leachate be pumped into the sanitary sewer along Warner Avenue. It must be verified that this is a closed system; this can not be a viable option if the sanitary sewer has open exposure points along its route to the POTW.

Response

The sanitary sewer along Warner Avenue is strictly a sanitary sewer and is not combined with a storm sewer. As such, the sanitary sewer is a 'closed system' and does not receive any stormwater runoff and does not have any 'open exposure points' (i.e. stormwater grates) along its route to the POTW. The text has been revised to clarify that the sanitary sewer is a 'closed system'.

43. USEPA Specific Comment - p. 57, ¶2

The accuracy of the cost estimates developed for each remedial technology need to be specified. The CERCLA Municipal Landfill Guidance indicates (Section 5.7) that FS cost estimates should provide an accuracy of +50 percent to -30 percent.

Response

The text has been revised to indicate that the FS cost estimates provide an accuracy of +50 percent to -30 percent.

44. <u>USEPA Specific Comment - p. 58, ¶3</u>

The CERCLA Municipal Landfill Guidance (Section 3.3.2) recommends that climatic conditions, including the 25-year-24-hour storm, frost depth, and surface water runoff velocity, also be considered in the design of the cap. It does not appear that this information was used in the development of the capping configurations.

<u>Response</u>

The maximum frost depth penetration for the area (42 inches, see response to Specific Comment 36) was considered. Also, as specified in Section 3.3.2, a minimum slope of 4 percent and a maximum slope of 33 percent was used in evaluation of the capping alternatives. These slopes are consistent with 6 NYCRR Part 360 and EPA guidance. As part of the remedial design for the selected capping alternative (i.e. RCRA cap or NYS Standard Cap), stormwater runoff and runoff velocities will be calculated. It is not considered necessary to conduct these calculations as part of the FS, since the outcome will not significantly change either the design (e.g. slope) or cost of the selected capping alternative.

45. <u>USEPA Specific Comment - p. 61, ¶1 and ¶2</u>

It is not clear whether the cost estimates presented in Appendix D include labor costs associated with the implementation/construction of each of components of the remedial alternatives. Please elaborate.

<u>Response</u>

The cost estimates presented in Appendix D and throughout the FS include all costs including labor associated with the implementation/construction of each component of each of the remedial alternatives.

46. <u>USEPA Specific Comment - p. 62, ¶2</u>

The two bullet items need to be revised as per Specific Comments 18 and 30 respectively.

<u>Response</u>

For the first bullet, see response to Specific Comment 18. The second bullet has been revised according to Specific Comment 30.

47. USEPA Specific Comment - p. 64, ¶3

Same as Specific Comment 45, above.

Response

See response to Specific Comment 45.

48. USEPA Specific Comment - p. 68, ¶2

As per General Comment 8, the potential exists for increased volumes of gas production in the future. Some gas venting across the surface of the landfill will be required.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

49. USEPA Specific Comment - p. 69, ¶2

Same as Specific Comment 45, above.

Response

See response to Specific Comment 45.

50. USEPA Specific Comment - p. 70, ¶1

Same as Specific Comment 48, above.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

51. USEPA Specific Comment - p. 73, ¶1

It is not clear how the values of $600,000 and $200,000 were arrived at for the capital cost of the onsite treatment system and the operation and maintenance of the system, respectively. These costs are presented as lump *values in Appendix D with no references or calculations presented to support these estimates. Please clarify.*

Response

As discussed in Section 3.2.5 of the FS, it is unlikely that a single on-Site process option would be adequate for efficient and reliable on-Site leachate treatment. Treatability studies would be necessary before a final design could be specified. The on-Site treatment system is assumed to consist of physical and/or chemical pretreatment, aerobic biological treatment and activated granular carbon. Based on CRA's past experience with on-Site treatment systems of this nature, capable of treating groundwater at a rate of 5 gpm, a lump sum cost of $600,000 was estimated. Similarly, based on CRA's past experience with operation, maintenance and monitoring associated with an on-Site treatment system of this size, a lump sum cost of $200,000 was estimated. To provide further breakdown of costs at this time would tend to indicate an accuracy associated with the costs which is not attainable unless a pilot test is conducted. The estimates are, however, considered to be accurate to within +50 percent to -30 percent and are adequate to assess on-Site versus off-Site treatment costs.

Section 4.0 DEVELOPMENT OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

52. USEPA Specific Comment - p. 78, ¶4

The proposed monitoring well program does not provide adequate coverage of all strata and areas. For example, groundwater flow in the lower till unit in the southern half of the Site is to the southwest. However, it is proposed that only one monitoring well (NCR-9M) in this area will be included in the monitoring program and this well is screened in bedrock. Therefore, monitoring of this well will not provide any data regarding contaminant presence/migration in the lower till unit in this area of the landfill. Modify the program for more complete coverage. Additionally, the label "Background Location" for monitoring wells NCR-1, 2, and 11 should be deleted as the background status of these wells has not been unequivocally demonstrated (see EPA's letter re Risk Assessment dated June 9, 1993).

Response

The following groundwater monitoring wells have been added around the perimeter of the landfill: five bedrock wells, four lower till unit wells and three shallow (silt unit) wells. Section 4.3.1 and Figure 4.1 of the FS have been revised to include these proposed wells. Due to the addition of the new monitoring wells around the perimeter of the landfill, existing monitoring wells at well nests NCR-1,2 and 11 and wells NCR-8M and -9M are not considered necessary. Well nests NCR-1, 2 and 11 are all located at least 500 feet away from the Site whereas the proposed wells are located immediately around the perimeter of the landfill and will provide early detection of any groundwater contaminants which may potentially migrate from the Site in the future. Therefore, the wells at well nests NCR-1, 2 and 11 have been deleted from Section 4.3.1 and from Figure 4.1. Wells NCR-8M and -9M are bedrock wells completed in the Vernon Formation. Due to the addition of five new bedrock wells to the monitoring well network, these two wells become redundant and are not proposed to be sampled. They will, however, be maintained for hydraulic monitoring. As summarized in Section 4.3.1 of the FS, the proposed monitoring well network will now consist of six shallow silt unit wells, nine lower till unit wells and nine bedrock wells for a total of 24 monitoring wells.

53. USEPA Specific Comment - p. 80, ¶4, p. 82, ¶2, p. 92, ¶3, p. 98, ¶2, p. 117, ¶3

Each citation mentions currently acceptable health risks and/or the BRA-CRA. Modify as per previous comments, i.e., current site risks are within EPA's acceptable risk range and delete reference to the BRA-CRA.

Response

The text has been revised to indicate that the volume of contaminants migrating to groundwater would be reduced by capping. Furthermore, the mobility of contaminants within the landfill material would be reduced by diminishing the mechanism (i.e. infiltration) by which the contaminants are mobilized.

54. USEPA Specific Comment - p. 86, ¶3

For the cost discussions associated with each alternative, please elaborate as to whether this includes labor costs associated with the implementation/construction of each of the components of the remedial alternatives. (See Specific Comment 45, above).

Response

The costs include labor costs associated with implementation/construction of each component of the remedial alternatives. The text has been revised to clarify this.

55. USEPA Specific Comment - p. 90, ¶3

The mobility of contaminants in groundwater is influenced by their physical and chemical characteristics. The construction of the RCRA cap would not reduce the mobility of contaminants in groundwater. The RCRA cap would reduce the amount of leachate generated by the landfill, thereby reducing the potential for leachate and associated contaminants to migrate from the Site. Modify text.

Response

The text has been revised to indicate that the volume of contaminants migrating to groundwater would be reduced by capping. Furthermore, the mobility of contaminants within the landfilled material would be reduced by diminishing the mechanism (i.e. infiltration), by which the contaminants are mobilized.

56. USEPA Specific Comment - p. 91, ¶4

As per General Comment 8, the potential exists for increased volumes of gas production in the future. Some gas venting across the surface of the landfill will be required.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

57. USEPA Specific Comment - p. 96, ¶2

Same as Specific Comment 55, above.

Response

The text has been revised accordingly.

58. USEPA Specific Comment - p. 97, ¶4

Same as Specific Comment 56, above.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

59. **USEPA Specific Comment - p. 104, ¶5**

Same as Specific Comment 56, above.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

60. **USEPA Specific Comment - p. 106, ¶2**

Same as Specific Comment 42, above.

Response

See response to Specific Comment 42. the text has been revised to clarify that the sanitary sewer is a 'closed system'.

61. **USEPA Specific Comment - p. 111, ¶2**

Same as Specific Comment 56, above.

Response

See response to General Comment 8. The installation of trenches incorporated as part of the cap is specified.

STREAMLINED FEASIBILITY STUDY

Niagara County Refuse Site
Wheatfield, New York

JULY 1993

REF. NO. 2677 (16)

This report is printed on recycled paper.

CONESTOGA-ROVERS & ASSOCIATES

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLANS

1.0 INTRODUCTION

1.1 OVERVIEW

The Niagara County Refuse Landfill Site (Site), covering approximately 50 acres, is an inactive municipal landfill, located along the eastern border of the Town of Wheatfield and the western border of the City of North Tonawanda in Niagara County, New York. The southern edge of the Site lies approximately 500 feet north of the Niagara River. Figure 1.1 shows the location of the Site and Figure 1.2 presents a Site Plan of existing topographic conditions.

Refuse disposal operations were conducted at the Site by the Niagara County Refuse (NCR) Disposal District between 1969 and 1976. Wastes reported to have been disposed of at the Site include solid household, yard, institutional, commercial, industrial, demolition and construction, agricultural, sewage treatment plant sludges, street sweepings and tires.

A Remedial Investigation (RI) of the Site was conducted between May 1990 and June 1991 by Conestoga-Rovers & Associates (CRA) on behalf of the Niagara County Refuse Site PRP Committee (PRP Committee). In October 1991, two additional Site investigation activities; a field tile investigation and resampling of well NCR-12D, outside the scope of the RI, were also conducted by CRA on behalf of the PRP Committee. The results of these investigations were included in the RI Report, as discussed below.

The primary objective of the RI and the additional Site investigation activities was to determine the nature and extent of any threat to the public health, welfare or to the environment by the release of hazardous substances and/or pollutants or contaminants from the Site.

The report entitled "Remedial Investigation (RI) Report, Volumes I to III, Niagara County Refuse Site, Wheatfield, New York" (CRA, July 1992), hereafter referred to as the "RI Report", was completed and submitted to the EPA. The RI Report summarized the data collected and the conclusions drawn from the investigated areas at the Site and included the following information:

- an updated Site description;
- Site maps;
- field investigation results;
- results of the hydrogeological modeling effort;
- chemical analyses results; and
- results of the baseline risk assessment.

A Baseline Risk Assessment was conducted by TRC Environmental Corporation (TRC) for the EPA. The results of the Risk Assessment are presented in the report entitled "Final Risk Assessment, Niagara County Refuse Site, Wheatfield, New York, Work Assignment: C02089 (Ref. No. 1-635-259)" dated January 21, 1993 (BRA-TRC). The BRA-TRC characterized the current and potential threats to human health and the environment that may be posed by the presence and/or release of hazardous substances and/or pollutants or contaminants from the Site. A

Baseline Risk Assessment was also conducted by CRA (BRA-CRA) and was included as part of the RI Report. However, the BRA-TRC is, according to the EPA, the correct risk assessment for the Site. Therefore, all references to the Baseline Risk Assessment in this streamlined FS Report are specifically to the BRA-TRC. The RI Report, and the BRA-TRC, provide the basis upon which this streamlined Feasibility Study (FS) Report has been prepared for determining appropriate remedial courses of action for the Site.

This report presents a streamlined FS for the Site. Due to the typical low level long-term threat of the Site a streamlined FS is considered appropriate for the Site. The term "streamlined" refers to the screening process of remedial technologies and their development into potential remedial action alternatives. As discussed in "Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites", EPA/5401P-91/001, (EPA, February 1991), hereafter referred to as the "Municipal RI/FS Guidance", many CERCLA municipal landfill sites share similar characteristics. Consequently, they typically exhibit the same primary remedial action objectives, thus lending themselves to remediation by similar technologies. The Municipal RI/FS Guidance identifies methods to streamline the RI/FS process particularly by making available a list of remedial technologies practical for use at CERCLA municipal landfills.

This streamlined FS Report has been prepared in accordance with the National Contingency Plan (NCP) (40 CFR 300); the EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final", EPA/540/G-89/004, October 1988 (RI/FS Guidance Document) (EPA, October 1988); "Conducting Remedial

Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites", EPA/540/P-91/001, February 1991 (EPA, February 1991); and with the report entitled "Scoping Plan for Streamlined Feasibility Study, Niagara County Refuse Site, Wheatfield, New York, Feb. 15, 1993" (Scoping Plan) (CRA, February 1993).

Leachate sample collection was considered necessary for completion of the FS report. Therefore, expedited leachate sampling and analyses have been performed as part of the FS and is discussed in Section 1.3.6 of this report.

The PRP's recognize that a wetlands assessment will be required to be conducted as part of the remedial design for the selected remedial alternative. The wetlands assessment will include an accurate delineation and marking in the field of the boundaries of the wetland potentially affected by the selected remedial alternative. The delineation will follow the method described in the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" dated January 1989.

Following delineation of the wetlands, a detailed assessment will be performed consisting of the following:

- a description of the selected remedial alternative;
- a description of the wetlands at and in the vicinity of the Site;
- a description of the effects of the selected remedial alternative on the wetlands; and
- a delineation of measures to minimize potential harm to wetlands.

If it is determined that the selected remedial alternative cannot be developed without impacting the wetlands/water resources, the following procedures will be considered to reduce any impact:

- enforcing seasonal restrictions on construction activities as practical;
- restoring surface and subsurface flow patterns;
- proper erosion and sedimentation control;
- prohibiting dumping in wetlands/water resources;
- limiting size of the construction equipment;
- ensuring appropriate chemical concentration levels for effluent discharges to wetlands/water bodies;
- use of water only for dust control; and
- restoring the disturbed portion of the buffer zone.

1.2 ORGANIZATION OF REPORT

This FS Report is organized in the following manner:

- Section 1.0 provides background information.
- Section 2.0 provides a review of environmental regulations identifying applicable and relevant and appropriate requirements (ARARs) and discusses remedial action objectives for the Site.
- Section 3.0 presents the general response actions required to satisfy the remedial action objectives. Potential technologies and process options are

also identified and screened based upon effectiveness, implementability and cost.

- Section 4.0 presents the development and detailed analysis of the remedial alternatives. The evaluation of the alternatives consists of a detailed analysis against the statutory requirements, goals and objectives of CERCLA.

1.3 SITE BACKGROUND

1.3.1 Site Location

The Site, comprised of approximately 50 acres, is located along the western border of the Town of Wheatfield, Niagara County, New York and the eastern border of the City of North Tonawanda. The southern edge of the Site lies approximately 500 feet north of the Tonawanda Channel of the Niagara River on the east side of Grand Island. Figure 1.1 shows the location of the Site and Figure 1.2 and Plan 1 present a Site Plan of existing topographic conditions. Figure 1.3 presents a 1989 aerial photograph of the Site.

The Site is situated in an area designated as "Zone C" by the Federal Emergency Management Agency under the National Flood Insurance Program. "Zone C" is outside the 100-year and 500-year flood boundaries and is defined as "areas of minimal flooding". Figure 1.4 presents the flood zones in the vicinity of the Site, as determined by the Federal Emergency Management Agency.

The drinking water intakes for the City of North Tonawanda, the City of Tonawanda and the Town of Lockport are located approximately two miles upstream of the Site in the Niagara River. The Town of Wheatfield receives its water supply from the Niagara County Water Supply. The intake for the Niagara County Water Supply is located in the Chippawa Channel of the Niagara River on the west side of Grand Island. The drinking water intake for the City of Niagara Falls is located in the Niagara River approximately three miles downstream of the Site.

The Site is generally surrounded to the west by active farmland for the production of wheat and/or corn; to the northwest a residential development has been proposed and the three farms immediately west of the Site are to be included in this development; to the north by wooded wetlands, a clay-mining operation, a Niagara Mohawk Power Corporation transmission line, and a right-of-way owned by the New York State Department of Transportation (NYSDOT) which was intended for construction of an extension of the existing Lasalle Expressway; and to the east by woodlands, low density housing, some commercial and light industrial development; and to the south by access roads, railroad tracks and River Road (NYS Route 265/384) which is adjacent to the Niagara River. In addition, commercial and light industrial development exists along River Road in the vicinity of the Site.

No private or public wells are known to be in use in the vicinity of the Site (Ebasco, 1988). Surface water from the Niagara River is the sole source of water for the Town of Wheatfield (Ebasco, 1988), the City of

North Tonawanda, the City of Tonawanda, the Town of Lockport and the City of Niagara Falls.

The Site is not serviced by any open public roads and access to the Site is restricted to authorized vehicular traffic.

1.3.2 Site History/Site Operations

In 1969, the Niagara County Refuse (NCR) Disposal District, formerly the Niagara County Solid Waste Disposal Agency, commenced refuse disposal operations at the Site.

Solid waste was hauled to the Site by either municipal or privately operated collection agencies. Refuse reported to have been disposed of at the Site includes solid household, yard, institutional, commercial, industrial, demolition and construction, agricultural, sewage treatment plant sludges, street sweepings and tires.

The NCR Disposal District undertook the following work, as specified in the 1973 Operating Plan (Krehbiel et al, 1973) commencing in July 1973, in order to minimize surface water infiltration into the solid waste reducing the amount of leachate generated and subsequent minimization of leachate migration to surrounding drainage swales:

1) Application of a minimum of one foot of impervious cover material over the top surfaces of the entire Site except those areas being actively worked.
2) Application of a minimum of two feet of impervious cover on the side slopes of the Site.
3) Sealing the edges of the landfill with a clay barrier from the toe of the side slopes down to original clay soil.
4) Grading the top surface of the landfill to prevent accumulation of surface water including swale cleaning and other drainage improvements.
5) Removing all tires, barrels and other loose material to the working face for proper burial.

The above work was completed on previously landfilled areas in late 1973. It is important to note, as identified in Item 3. above, that a Compacted Clay Barrier Seal (Clay Seal) was reported to have been installed around the perimeter of the landfill from the toe of the side slopes down to the top of the underlying clay. A typical detail of the Clay Seal construction, is illustrated on Figure 1.5. The area of the Site landfilled as of October 1973 is delineated on Figure 1.6.

Subsequent to issuance of the Operating Plan (Krehbiel et al, 1973) in October 1973, the northernmost cell (approximately eight acres) as can be located on Figure 1.2 and Plan 1, was excavated and filled with solid waste. It is presumed that this cell was constructed similarly to the previously landfilled areas, however, documentation of whether a Clay Seal was constructed around the northern cell is not available.

The Site was operated by NCR Disposal District until October 1976 at which time it was officially closed. Subsequently, the Town of Wheatfield acquired ownership of the Site on June 30, 1977.

1.3.3 Present Conditions

The Site, consisting of six distinct landfill cells indicated by Site topography, is an elongated Site, approximately 50 acres in size, running north to south. It has a maximum length of 3,800± feet and a maximum width of 720± feet. The topography of the area surrounding the Site is flat, with an elevation of approximately 575 feet above mean sea level (AMSL). The landfill cover has eroded in several places causing solid waste to be exposed in some of the northern areas. Vegetation on the landfill cells includes annual and perennial grasses and pioneering herbs, shrubs, and trees. Plant species are identified in the Vegetation and Faunal Survey Report presented in the RI Report.

The six distinct landfill cells are mounded above the surrounding land and have a maximum elevation of approximately 597 feet AMSL. The six cells are separated and/or bounded by drainage swales and the on-Site access road, as shown on Figure 1.2 and Plan 1.

Only a small section of the perimeter swales contain water year-round. This is the N-S swale along the east side of the Site, adjacent to the NCR-6 well nest. All other swales contain water seasonally or after a heavy rain. Off-Site flow for surface drainage is possible from two points: a 30-inch diameter culvert beginning at the southwest corner of the Site which runs under River Road and discharges to the Niagara River; and, a 24-inch diameter culvert running under the Summit Park Development access road, 700 feet northwest of the Site.

There is a freshwater marsh at the north end of the Site which drains into Black Creek which then drains into Bergoltz Creek and finally drains into the Niagara River.

As part of the Site reconnaissance performed during the RI, approximately 30 leachate seeps were noted and documented at the Site. The leachate seeps observed at the Site are shown on Plan 2.

In June 1993, a legal property survey for the Site was conducted and the property lines and corners re-established in the field. Plan 3 shows the property boundaries of the Site. As shown on Plan 3, the landfill cells encroach upon properties to the west, east and south of the Site.

The Site has not had a security fence since its initial development in 1969. However, fence gates were installed during the RI at the southern entrance to the Site via the main access road and at the eastern entrance to the Site on Warner Avenue. Although the Site had been closed in 1976, refuse continued to be placed by unknown parties along the access road until the fence gates were installed. As specified in the EPA-approved "Project Operations Plan", (POP) (CRA, July 1990), a fence will be installed around the entire perimeter of the Site. A survey has determined that the landfill has encroached upon several adjacent properties. The fence cannot be installed until the necessary easements are obtained from these property owners.

During the course of the RI, approximately 40 metal warning signs bearing the legend "Danger - Hazardous Area - Authorized Personnel Only" were posted on and around the perimeter of the Site. Due to vandalism, only eight signs remain posted at the Site as of August 20, 1991.

The volume of solid waste disposed of at the Site was estimated in Section 2.5 of the RI Report at approximately 1,800,000 cubic yards. This estimate of solid waste was based on historic Site operation information, historic borehole data, new well NCR-12D borehole data and 1989 topographic conditions. The volume of solid waste was calculated for each individual landfill cell to arrive at a total for the Site.

1.3.4 Historic Site Investigations

Subsurface drilling and sampling programs have been conducted during various investigative programs conducted at the Site. These include borings completed by the United States Geologic Survey (USGS), NUS Corp., and EA Science and Technology (EAST) and are listed as follows:

April 1973: Niagara County Health Department - sampling and testing of surface water. Samples were analyzed by NYS Department of Health (NYSDOH) in June 1973.

September 1980:	Surface water and sediment samples were taken and tested by the USEPA Region II Source Monitoring Program.
March 1981:	Surface water and sediment samples were taken and tested by Fred C. Hart Associates for USEPA Region II.
June 1981:	Surface water and sediment samples were taken and tested by NYSDEC.
1982:	Ten boreholes were drilled, samples taken and tested by USGS. Monitoring wells were installed in two of the boreholes.
1980, 1981, 1983:	Sediment, surface and groundwater samples were collected and tested by NUS Corporation for USEPA. In 1983 NUS installed five bedrock monitoring wells.
November, 1985, 1987:	EAST installed four monitoring wells within the landfill for NYSDEC. Samples were collected and tested.

The Site has been the focus of several investigations by USEPA, NYSDEC and USGS since 1980, as summarized above. These investigations have focussed on limited sampling of on-Site soils, groundwater, drainage swale surface water and sediments, as well as some off-Site soil, surface water and sediment sampling.

1.3.5 Remedial Investigation

The RI Report characterized the nature and extent of contamination at the Site. This was achieved through the completion of the field investigation activities as summarized below:

1) Site reconnaissance visit;

2) Topographic survey of the Site and surrounding areas;

3) Property survey of the Site;

4) Geophysical investigation consisting of an electromagnetic survey around the Site perimeter;

5) Collection of air samples from six points at two "worst case" areas of emission from the landfill for benzene, chlorobenzene, vinyl chloride, methylene chloride, toluene and phenol analyses;

6) Completion of a qualitative biota survey at the Site and the immediately surrounding areas;

7) Installation of two weirs to quantify surface water runoff from the Site;

8) Excavation of three test pits;

9) Installation of five shallow overburden, nine deep overburden and nine bedrock monitoring wells at the Site;

10) Collection of 26 subsurface borehole soil samples and three duplicate soil samples during monitoring well drilling for complete Target Compound List/Target Analyte List (TCL/TAL) analyses;

11) Collection of two additional subsurface soil samples subsequent to monitoring well drilling from one monitoring well location for Volatile Organic Compound (VOC) analyses;

12) Collection of nine leachate samples and one duplicate leachate sample from seeps at the Site for complete TCL/TAL analyses;

13) Collection of 18 sediment samples and two duplicate sediment samples from the drainage swales at the Site for complete TCL/TAL analyses;

14) Collection of 10 surface water samples and one duplicate surface water sample from drainage swales at the Site for complete TCL/TAL analyses;

15) Completion of a minimum of 15 hand auger borings around the perimeter of the Site and submission of five discrete soil samples from the hand auger borings for complete TCL/TAL analyses;

16) Collection of two complete sets of discrete groundwater samples from the 23 new monitoring wells installed at the Site for complete TCL/TAL analyses;

17) Completion of purging and re-sampling of monitoring well location NCR-12D;

18) Completion of field permeability testing of all new wells by packer testing (bedrock wells) or slug or falling head tests (overburden wells); and

19) Completion of a field tile investigation in field west of the Site.

Plan 4 presents the locations of all monitoring wells installed as part of the RI activities and Plan 5 presents all sampling locations for each type of sample collected as part of the RI activities.

The following subsections provide a summary of the RI findings.

1.3.5.1 Site Geology

The Site geology is discussed in detail in Section 5.1 of the RI Report. The following presents a summary of the Site geology.

The Site geology can be subdivided into four stratigraphic units based on data collected during drilling activities: silt unit, clay unit; till unit (upper and lower till unit) and bedrock. The bedrock is comprised of the Vernon Formation and Oak Orchard Formation.

Geologic cross-sections A-A' through D-D', presented on Figures 1.8 through 1.10, illustrate the stratigraphy of the Site. Figure 1.7 illustrates the cross-section locations.

The average thickness of the silt unit is 4.2 feet. The average thicknesses of the clay unit and the upper till unit are 17.1 feet and 12.9 feet, respectively, with a combined average thickness of 30 feet. The average thicknesses of the lower till unit is 15.7 feet. Top of clay and upper till unit contours have been constructed for the Site and are presented on Plan 6. The top of clay and upper till contours have been combined on Plan 6 because the clay unit and the upper till unit exhibit similar hydrogeologic properties, as discussed in Section 5.2 of the RI Report. Along the western side and northern end of the Site, the top of the clay and upper till units gently slope downward to the west and north, respectively.

The Vernon Formation, a highly weathered gray shale was encountered underlying the lower till unit, at three well locations beneath the southern end of the Site and ranged in thickness from 7.5 to 23.0 feet thick. The Oak Orchard Formation, a highly weathered and fractured dolomite, underlies the lower till unit and/or shale at the Site. Top of bedrock contours have been constructed for the Site and are presented on Plan 7. The depth to the Oak Orchard Formation is typically on the order of

50 feet below original ground surface, while the Vernon Shale, where present, is typically 30 feet below original ground surface.

1.3.5.2 Site Hydrogeology

The Site hydrogeology is discussed in detail in Section 5.2 of the RI Report. The following presents a summary of the Site hydrogeology.

The four geologic units present at the Site are categorized into the following four hydrostratigraphic units: silt unit; clay/upper till aquitard; lower till unit and bedrock aquifer (Vernon and Oak Orchard Formations).

The silt unit is a perched groundwater stratum whose primary source of water is from infiltration of precipitation. Some wells completed in this unit are dry at certain times of the year. The unit's geometric mean horizontal hydraulic conductivity is 4.2×10^{-6} cm/sec. The low hydraulic conductivity exhibited by this unit is due to its high silt and clay content. Due to the low hydraulic conductivity of this unit and limited water source, very little horizontal groundwater flow is expected to occur. Groundwater flow that does occur will follow the top of the clay/upper till aquifer contours presented on Plan 6. Very little vertical groundwater movement is also expected to occur due to the low hydraulic conductivities in the underlying clay/upper till aquitard (10^{-8} cm/sec to 10^{-6} cm/sec). Due to the limited saturated thickness of the silt unit, its low hydraulic conductivity, and the intermittent presence of groundwater, it is not considered to be a productive usable aquifer.

The clay unit and upper till unit encountered beneath the Site are considered to be hydrostratigraphically connected since they exhibit similar hydrogeologic characteristics. The geometric means of the hydraulic conductivity in the clay and upper till are 3.0×10^{-8} cm/sec (vertical) and 1.8×10^{-6} cm/sec (horizontal), respectively. Based on the hydraulic conductivities exhibited, the clay and upper till units are considered an aquitard and to be non-waterbearing.

The lower till unit is coarser and consequently exhibits a higher hydraulic conductivity than the upper till unit. The lower till unit exhibits characteristics of a confined or semi-confined aquifer and exhibits a geometric mean hydraulic conductivity of 3.1×10^{-4} cm/sec. Piezometric contours, based on April 19, 1991 data, for the lower till unit wells have been constructed and are presented on Plan 8. As illustrated on Plan 8, horizontal groundwater flow in this unit is to the southwest in the southern half of the Site and towards the north/northwest in the northern half of the Site. The average horizontal linear groundwater velocity in the lower till unit was found to be minimal; 0.3 ft/yr, due to the flat gradient (0.0002 ft/ft) across the Site. The average vertical linear groundwater velocity in the lower till unit was found to be minimal; 0.5 ft/yr, due to low hydraulic conductivity of the overlying lower permeable clay/upper till aquitard. Although the lower till unit is waterbearing, it is not considered to be a usable aquifer, compared to the highly fractured underlying bedrock aquifer.

The two upper bedrock formations, Vernon and Oak Orchard, are grouped as one hydrostratigraphic unit since they exhibit similar hydrogeologic properties. The upper bedrock aquifer exhibits confined conditions. The geometric mean of the horizontal hydraulic conductivities for the Vernon and Oak Orchard Formations are 1.7×10^{-3} cm/sec and 1.4×10^{-3} cm/sec, respectively. Piezometric contours, based on April 19, 1991 data, for the upper bedrock wells have been constructed and are presented on Plan 9. As illustrated on Plan 9, the flow direction is towards the west beneath the southern two-thirds of the Site and is toward the north-northwest beneath the northern one-third of the Site. The groundwater flow direction in the upper bedrock aquifer is similar to the flow direction exhibited by the overlying lower till unit and is consistent with the regional bedrock groundwater flow direction. The average horizontal linear groundwater velocity within the upper bedrock aquifer beneath the Site was estimated to be 15 ft/yr. The upper bedrock aquifer is hydraulically interconnected with the Niagara River and in the vicinity of the Site is considered to be recharged by the Niagara River.

1.3.5.3 Site Landfill Cells

The Site landfill cells are discussed in detail in Section 5.3 of the RI Report. The following presents a summary of the Site hydrogeology.

The Site consists of six distinct landfill cells mounded above the surrounding land. The six cells are separated and/or bounded by drainage swales and the on-Site access road as shown on Plan 1.

As discussed in Section 2.2.1 of the RI Report, excavations for solid waste disposal in the southern five cells were completed in the clay/upper till aquitard at approximately 11 feet below ground surface, or at about 560 feet AMSL. As shown on Plan 7, the top of the bedrock beneath the southern end of the Site ranges in elevation from approximately 520 feet AMSL (Oak Orchard Formation) to approximately 545 feet AMSL (Vernon Formation). Therefore, excavation of the southern five cells was completed from approximately 15 to 40 feet above the top of the bedrock.

Data for the northernmost cell indicates that excavation for this cell was extended down to approximately 551 feet AMSL. As shown on Plan 7, the top of the bedrock (Oak Orchard Formation) beneath the northernmost cell ranges from approximately 520 feet AMSL to 530 feet AMSL. Therefore, based on the data presented in the RI Report excavation of the northernmost cell was completed approximately 20 to 30 feet above the top of bedrock.

Sustained leachate mounding occurs within the cells to a maximum elevation of approximately 579 feet AMSL. Groundwater in the surrounding shallow silt unit is intermittent. When present, the groundwater has ranged in elevation from approximately 569 feet AMSL to 576 feet AMSL. Plan 10, enclosed, illustrates leachate mounding within the landfill cells as measured on October 30, 1990. Due to the sustained leachate mounding the potential for vertical and horizontal leachate migration exists at the Site.

The potential of the vertical migration of leachate to the upper bedrock aquifer is, however, severely limited across the entire landfill due to the presence and low permeability of the underlying clay/upper till aquitard (10^{-8} cm/sec to 10^{-6} cm/sec).

The potential for horizontal leachate migration from the landfill to the shallow silt unit is also limited due to the low horizontal hydraulic conductivity (4.6×10^{-6} cm/sec) of the silt unit which surrounds the landfill and the Clay Seal, if present.

A field tile, which terminated in the east-west swale on the west side of the landfill, was confirmed to be present up to the access road running north-south down the western limit of the landfill. However, it did not exhibit hydraulic connection to the landfill as supported by the analytical data presented in the RI Report. Also, during the field tile investigation, the clay tile was severed in three places, all of which were backfilled with compacted clay to plug off any potential flow along the tile. Therefore, the potential for horizontal leachate migration in the field tile is limited.

Leachate breakouts in the form of toe discharge from the slopes have developed at the Site due to the limited ability of leachate to migrate vertically through the clay/upper till aquitard underlying the Site or horizontally through the shallow silt unit surrounding the Site, and the Clay Seal, if present. Approximately 30 leachate seeps have been identified at the Site as shown on Plan 2.

1.3.5.4 Site Hydrology

The Site hydrogeology is discussed in detail in Section 5.4 of the RI Report. The following presents a summary of the Site hydrology.

As discussed in Section 6.5 of the RI Report, the leachate seeps have had, at most, a limited adverse effect on surface water quality on and in the vicinity of the Site. Parameters which exceeded their respective NYS Ambient Water Quality Standards in the surface water samples were detected infrequently and when detected were just above the NYS Ambient Water Quality Standards.

Surface water flow from the Site occurs only during heavy or prolonged rain events. The limited impact that the leachate seeps have had on the surface water quality on Site are significantly lowered due to dilution by the heavy or prolonged rains in any surface water flow that migrates off Site.

1.3.5.5 Nature and Extent of Contamination

The nature and extent of contamination at the Site is discussed in detail in Section 6.0 of the RI Report. The following subsections provide a summary of the nature and extent of contamination at the Site.

Subsurface Soil Assessment

As discussed in Section 6.4 of the RI Report, two subsurface soil samples were collected from each monitoring well location, with two additional subsurface soil samples being collected from location NCR-13. Also, six subsurface soil samples were collected using a hand auger sampler. The soil samples collected for chemical analysis were selected based on HNU readings, visual evidence of contamination, soil grain size and water content. Therefore, the soil samples are considered to represent "worst case" conditions. Soil samples collected for chemical analyses were analyzed for the complete Target Compound List/Target Analyte List (TCL/TAL) parameters, with the exception of the two additional subsurface soil samples collected from location NCR-13, which were analyzed for TCL Volatile Organic Compound (VOC) parameters.

Section 6.4 of the RI Report demonstrated that few VOCs, Semi-Volatile Organic Compounds (SVOCs) and pesticides were detected in the subsurface soil samples. The SVOCs detected consisted mainly of phthalate isomers, phenolic compounds and polycyclic aromatic hydrocarbons (PAHs). Figures 1.11, 1.12 and 1.13 present parameter concentrations for total VOCs, phthalate isomers, phenol isomers and PAHs. Figure 1.11 presents the data in plan view and Figures 1.12 and 1.13 present the data in cross-sectional view. Figure 1.7 presents the cross-section locations. As indicated on Figures 1.11, 1.12 and 1.13, total VOC, phthalate isomer and phenolic compound concentrations are sporadically distributed both horizontally and vertically in the subsurface soils.

Several metals were also detected in most samples, however, the concentration of inorganic parameters detected on Site are consistent with the Site-specific background inorganic soil concentrations, as discussed in detail in Section 6.4 of the RI Report.

Leachate Seep Assessment

As discussed in Section 6.5 of the RI Report, a total of seven liquid leachate seep samples and two stained soil samples were collected for chemical analysis. The nine samples were collected at the approximate locations identified in the EPA-approved "Project Operations Plan" (POP) (CRA 1990). As discussed in the POP the final sample locations, which were mutually agreed to in the field by the CRA and the USEPA representatives, were based on evidence of leachate seepage. In addition, real-time air monitoring using both an FID and a PID was used to assist in leachate seep sample location selection. The locations sampled were considered to represent the "worse-case" conditions at the Site. All samples were analyzed for the complete TCL/TAL parameters.

Section 6.5 of the RI Report demonstrated that VOCs, PAHs, phenolic compounds and phthalate isomers were present above New York State (NYS) Ambient Water Quality Standards in most leachate samples collected within the perimeter of the landfill. Figure 1.14 presents total VOC, PAH, phenolic compound and phthalate isomer concentrations. As shown on Figure 1.14, the maximum concentrations detected in the seep samples for total VOCs, PAHs, phenolic compounds and phthalate isomers were 2.4 ppm, 2.6 ppm, 5.8 ppm and 2.3 ppm, respectively.

Various metals were also detected in the leachate samples above their respective NYS Ambient Water Quality Standards, including barium, chromium, iron, magnesium, manganese and zinc, as discussed in detail in Section 6.5 of the RI Report.

Surface Water Assessment

As discussed in Section 6.7 of the RI Report, a total of ten surface water samples were collected for chemical analyses. All samples were analyzed for the complete TCL/TAL parameters.

Section 6.7 of the RI Report demonstrated that limited VOCs, SVOCs and pesticides were detected in the surface water samples. In cases where organic compounds were detected, they were sporadic. With the exception of carbon disulfide, toluene, di-n-butylphthalate, bis(2-ethylhexyl)phthalate and delta-BHC, all other organic parameters were single detections. The single detection parameters exhibited concentrations below or just above their respective NYS Ambient Water Quality Standards. PAHs were not detected in any of the surface water samples. Figure 1.15 presents total VOC, phenolic compounds and phthalate isomer concentrations for surface water.

Various inorganics were also detected in the surface water samples and those which exceed NYS Ambient Water Quality Standards are discussed in detail in Section 6.7 of the RI Report and are identified below.

Four surface water samples (SW-1, SW-2, SW-4 and SW-5) collected near the north end of the Site exhibited limited presence of organic parameters. The maximum concentrations detected in these four samples for total VOCs, phenolic compounds and phthalate isomers were 0.004 ppm, 0.011 ppm and 0.003 ppm, respectively. Three surface water samples (SW-7, SW-8 and SW-10) collected from the N-S drainage swale, approximately 600 feet west of the western boundary of the landfill cells, also exhibited limited presence of organic parameters. VOC and phenolic compounds were not detected and the maximum concentration detected for total phthalate isomers was 0.08 ppm. TCL organic parameters were not detected in the furthermost downstream sample (SW-10) on the western boundary. Two surface water samples (SW-11 and SW-13) were collected from a N-S drainage swale along the eastern perimeter of the landfill cells. These samples also exhibited limited presence of organic parameters. The maximum concentrations detected in these two samples were at the upstream sample location SW-11. The total VOC, phenolic compound and phthalate isomer concentrations were 0.0107 ppm, 0.007 ppm (estimated) and 0.0809 ppm, respectively. The downstream sample location (SW-10) exhibited total VOCs and phthalate isomers at concentrations of 0.002 ppm and 0.008 ppm, respectively. Phenolic compounds were not detected at this location. A surface water sample was also collected from an off-Site location (SW-18), the point at which the 30-inch diameter culvert passing under River Road discharges to the Niagara River. Total VOC and phthalate isomer concentrations detected in this sample were 0.012 ppm and 1.0 ppm, respectively. As discussed in detail in Section 6.7 of the RI Report, the VOCs and phthalate isomers detected at this location are not attributed to the Site.

As discussed in Section 6.7 of the RI Report, excluding the data from off-Site location SW-18, the following six individual organic and five inorganic parameters in surface water collected on the Site exceeded NYS Ambient Water Quality Standards: xylene; 2,4-dimethylphenol; phenol; bis(2-ethylhexyl) phthalate; 4,4'-DDT; heptachlor epoxide; iron; lead; magnesium; manganese; and zinc. These parameters were infrequently detected, with the exception of iron, and when detected the parameters' concentrations were just above the NYS Ambient Water Quality Standards. Iron was detected above its NYS Ambient Water Quality Standard at all locations.

The principal sources of any Site-related surface water contamination are the leachate seeps identified at the Site. The organic parameter bis(2-ethylhexyl)phthalate was detected in most leachate seep samples. The inorganic parameters iron, magnesium, manganese and zinc were also detected in the leachate samples above their respective NYS Ambient Water Quality Standards.

Surface Sediment Assessment

As discussed in Section 6.8 of the RI Report, a total of 18 surface sediment samples were collected for chemical analyses. All samples were analyzed for the complete TCL/TAL parameters.

Section 6.8 of the RI Report demonstrated that surface sediment samples detected limited VOCs, SVOCs and pesticides. Phenolic compounds were not detected in surface sediments. Figure 1.16 presents total VOC, PAH and phthalate isomer concentrations for surface sediments.

Several metals were also detected in most samples, however, the concentration of inorganic parameters detected on Site, with the exception of iron, potassium, sodium and zinc, are consistent with Site-specific background inorganic soil concentrations. Detected concentrations for iron, potassium, sodium and zinc were typically just above Site-specific background inorganic soil concentrations.

Maximum concentrations of total VOCs and phthalate isomers detected at the Site, with the exception of the sample collected at the point which the 30-inch diameter culvert passing under River Road discharges to the Niagara River (SW-18), were 0.138 ppm and 0.97 ppm, respectively. The sample collected at the point at which the 30-inch diameter culvert passing under River Road discharges to the Niagara River (SW-18) exhibited a total phthalate isomer concentration of 3.9 ppm. As discussed in Sections 6.7 and 6.8 of the RI Report, the phthalate isomers detected at this location are not attributed to the Site.

The leachate data show that the phenolic compounds and phthalate isomers were the SVOCs most frequently detected in the leachate seeps. Phenolic compounds were not detected in any surface sediment samples, however, phenol biodegrades rapidly and is, therefore, not expected to be present in the sediments. Phthalate isomers, however, have a strong tendency to adsorb to soils or sediments. Phthalate isomers were detected in the sediment samples collected from the perimeter drainage swales around the landfill cells at a maximum concentration of 0.97 ppm. Phthalate isomers were also detected in the surface water. Phthalate isomers have a low water solubility limit, and as such the phthalate isomers would have a tendency to be adsorbed to sediments. Therefore, phthalate isomers entering the surface water in the drainage swales, via leachate seeps, would have a tendency to adsorb to the sediments and not be transported off Site via surface water flow. This is supported by the data, which shows phthalate isomer concentrations in the sediments to be approximately one order of magnitude higher than detected in the surface water.

Groundwater Assessment

As discussed in Section 6.9 of the RI Report, two rounds of groundwater samples were collected from each of the groundwater monitoring wells installed at the Site during the RI and a third set of groundwater samples were collected from well NCR-12D as part of the additional Site investigation activities. Each sample was analyzed for the complete TCL/TAL parameters.

Section 6.9 of the RI Report demonstrated that very few of the TCL (organic) parameters are present in the groundwater. On the few occasions where they are present in more than one sample in their respective units, the concentrations are below their corresponding NYS and/or EPA MCLs or MCLGs. Figures 1.17, 1.18 and 1.19 present total VOC, PAH, phenolic compounds and phthalate isomer concentrations for groundwater in the shallow silt unit, the clay/upper and basal till units, and the Vernon and Oak Orchard Formations, respectively.

For the TAL (inorganic) parameters, the concentrations are consistent with groundwater quality expected in the Niagara region. Specifically, the groundwater consistently exhibits levels of magnesium, sodium and iron above their respective NYS and/or EPA MCLs or MCLGs.

1.3.6 Leachate Characterization Study

As discussed in Section 1.1, as part of the FS, a leachate sample collection program was carried out in March 1993 by CRA to characterize the leachate from the Site. The leachate characterization study was performed to provide Site-specific leachate data on which to develop on-Site treatment processes and evaluate the feasibility of both on-Site and off-Site treatment (at nearby Publicly Owned Treatment Works (POTW)).

Discrete leachate samples were collected from historic leachate wells EAST-A, -B, -C and -D. The samples were collected utilizing the same protocols employed for groundwater sampling during the RI. The samples were analyzed in accordance with their respective SW-846 (3rd Ed.) methods.

In order to estimate a representative leachate quality for the entire Site, the analytical data from each well were prorated based on estimated area of contribution, resulting in a calculated weighted-average concentration for each parameter. Table 1.1 summarizes the estimated representative leachate quality. The laboratory data reports for the four discrete leachate samples are presented in Appendix A.

As shown on Table 1.1, the leachate generally exhibits relatively high concentrations of inorganic compounds; calcium, iron, magnesium, potassium, sodium and organic compounds; acetone, benzoic acid and phenols.

1.4 BASELINE RISK ASSESSMENT

TRC, under contract to the EPA, conducted a baseline risk assessment (BRA-TRC) which included both a public health and ecological risk assessment as specified by the final rule of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 1990). The purpose of the baseline risk assessment was to characterize the current or potential future risks to public health or the environment in the absence of remediation.

The public health risk assessment presented in the BRA-TRC is primarily a quantitative analysis based on the results of the RI and other information. The ecological risk assessment is both quantitative and qualitative and is based on previously published information in addition to information obtained during the RI.

The following subsections provide a summary of the BRA-TRC.

1.4.1 Contaminants of Concern

In the BRA-TRC, contaminants of concern (COCs) were selected for detailed evaluation. COCs were selected separately for each sampled environmental medium with complete exposure pathways (i.e. surface soils, subsurface soils, landfill perimeter groundwater, northernmost landfill cell groundwater, drainage swale surface water, drainage swale sediments, leachate soils and leachate water). The concentration-toxicity screening procedure was used to identify the COCs (i.e., chemicals contributing 99 percent of the risk for each medium at the Site based on concentration and toxicity). Table 1.2 summarizes the COCs selected in the BRA-TRC for each medium with complete exposure pathways. The BRA-TRC then conservatively evaluated the potential human health risks associated with reasonable maximum exposure to these COCs.

1.4.2 Human Exposure Pathways

To evaluate potential human health risks, several exposure pathways were evaluated in the BRA-TRC under current and potential future land use conditions. Exposure pathways which were considered complete and were evaluated in the BRA-TRC under present and future conditions included:

- subsurface soil, inadvertent ingestion by present and future workers;

- sediment, dermal contact and inadvertent ingestion at the present time by trespassers and in the future by trespassers and workers;
- leachate seeps, dermal contact and inadvertent ingestion in the present and future by trespassers;
- surface soils, inadvertent ingestion in the present and future by trespassers; and
- groundwater, ingestion in the future by residents.

For each of the current and potential future exposure pathways identified above, total incremental lifetime carcinogenic risks and non-carcinogenic hazards were estimated based on "Reasonable Maximum Exposure" (RME) assumptions.

1.4.3 Human Health Risk Characterization

Exposure doses for each COC in each media were calculated using RME exposure factors based on the 95th percentile assumptions, taken from the most recent USEPA guidance. The RME exposure point concentrations used to calculate exposure doses, for each COC in each media, were based on the upper 95 percent confidence limit of the mean concentration or the maximum concentration, whichever is lower. The RME concentrations used for each COC in each media and the exposure factors are summarized in the BRA-TRC.

The exposure factors and the RME concentrations were then applied to the standard EPA equation to estimate exposure doses for each COC in each media received by the receptor populations for all scenarios.

The estimated potential incremental carcinogenic risks and non-carcinogenic hazards were calculated by applying chemical-specific toxicity constants to exposure doses for each COC for all scenarios. Chemical-specific toxicity information was obtained from the scientific literature and the most current EPA database.

1.4.3.1 Carcinogenic Risk

The incremental carcinogenic (CA) risk associated with exposure to Site COCs was calculated according to the following equation:

Incremental CA Risk = Slope Factor x Dose

where the incremental CA risk represents the probability of developing cancer over a 70-year lifetime from exposure to the contaminants associated with the site. Cancer risk is unitless and is expressed here in scientific notation. For example, a risk of 1×10^{-6} indicates that an individual has one chance in 1,000,000 of developing cancer as a result of exposure to onsite contaminants during a lifetime.

The slope factor represents the carcinogenic potency of a chemical. The dose, or intake, represents the amount of contaminant to which a receptor is exposed. When evaluating carcinogenic risk, the dose in all exposure scenarios is the estimated daily intake of each contaminant, received during the specified period of exposure, and averaged over a 70-year lifetime.

Incremental CA risk was calculated for each carcinogenic COC, having a designated slope factor, in all applicable exposure pathways (ingestion of groundwater and soil media). Risk values for all COCs assessed were summed by exposure pathway to provide total pathway-specific risks.

EPA has not identified a single value that represents a significant incremental cancer risk. However, the NCP acceptable risk range for Superfund sites has been set at E-06 to E-04 per environmental medium (NCP, 1990). In other words, the goal of the NCP is to reduce the cancer risk associated with site COCs in a given medium to within or below a range of 1 in 1,000,000 to 1 in 10,000.

1.4.3.2 Noncarcinogenic Effects

Potential noncarcinogenic effects were evaluated based on a comparison of chemical-specific subchronic or chronic exposure doses (depending on the scenario-specific exposure duration) with corresponding protective doses from health criteria. The result of this comparison is expressed as the Hazard Quotient:

$$\text{Hazard Quotient} = \frac{\text{Exposure Dose}}{\text{Protective Dose}}$$

A Hazard Quotient (HQ) that exceeds unity suggests a greater likelihood of developing an adverse subchronic, or chronic toxic effect. However, the uncertainty factors built into the protective doses result in conservative protective dose values. Therefore, the protective dose is likely well below that for which adverse effects will be seen.

Hazard Quotients were calculated for each COC for which health criteria are currently available. The HQs for each COC were summed to produce a rough estimate of the exposure pathway-specific risk, the Hazard Index (HI). Where appropriate, Hazard Indices for all soil media exposure pathways were summed to provide a total medium-specific risk. In estimating total noncarcinogenic risk, potential responses were conservatively assumed to be additive. Note that not all COCs have the same or similar toxic endpoints and responses may not be additive. Therefore, in those cases where the HI exceeded one, further analyses were undertaken to evaluate which specific chemicals might exhibit toxic effects.

1.4.3.3 Human Health Risk Summary and Conclusions

An overall summary of Site carcinogenic and noncarcinogenic risks is presented in Tables 1.3 and 1.4, respectively. These tables include cumulative cancer risk values and HIs for each exposure pathway and receptor population, and for present and future land use scenarios. Medium-specific risk, for which the NCP acceptable risk range of E-06 and E-04 applies, are derived by adding all pathways for a given medium.

The greatest carcinogenic risk values are associated with the highly conservative groundwater ingestion scenarios (see Table 1.3). The perimeter groundwater scenario produced an incremental risk of 2E-04 while the northern landfill cell groundwater scenario produced an incremental risk of E-04. Two other exposure pathways produced carcinogenic risk in excess of E-06; ingestion of surface soils by youth trespassers (4E-06) and ingestion of sediments by youth trespassers (5E-06). These values are all, however, within the acceptable risk range established by the NCP. Cumulative carcinogenic risk estimates for each receptor did not exceed the incremental risk level for future resident ingestion of perimeter groundwater (see Table 1.5).

Noncarcinogenic HIs, summed across chemicals for each exposure route (see Table 1.4) exceeded one for perimeter groundwater ingestion (HI = 5) and for northern landfill cell groundwater ingestion (HI = 4). No other exposure pathways produced noncarcinogenic HIs greater than one. The cumulative noncarcinogenic HI for a future excavation worker living in an adjacent residence totaled 6 (see Table 1.6).

The results of the BRA-TRC indicate that, under current Site conditions, Site media do not pose a risk to public health. The RME upperbound additional lifetime cancer risks are on the order of 5×10^{-6} or less. The HI values for noncarcinogenic effects are less than unity. However, under certain future conditions, groundwater at the Site may pose a future potential risk if future residents adjacent to the Site install drinking water wells, and groundwater COCs at the Site migrate to these future wells.

The risks associated with groundwater use from both the perimeter wells and the northernmost landfill cell wells are attributed primarily to inorganics. Carcinogenic risks in both scenarios are attributed primarily to arsenic and beryllium, and to a lesser extent, styrene in the northern landfill cell groundwater evaluation. The highest levels of arsenic were detected in samples from wells (NCR-1, NCR-2 and NCR-11) located beyond the immediate perimeter of the landfill cells and may reflect background concentrations of inorganics rather than Site-related contamination. Beryllium was detected in 9 out of 45 samples analyzed from the perimeter groundwater wells and in one out of three samples in the northern landfill cell well NCR-12. Increased CA risks due to beryllium in perimeter groundwater were based on an RME concentration of 1.05 μg/L, which is below the USEPA MCL of 4 μg/L.

Noncarcinogenic risks associated with both groundwater use scenarios are attributed primarily to antimony and to a lesser extent, iron, aluminum, arsenic and manganese. Since outlying wells (NCR-11, NCR-1 and NCR-2) are the source of the highest concentrations of these COCs, their presence may reflect background concentrations rather than Site-related contamination.

No other future scenarios indicated a potential for significant risk.

1.4.4 Ecological Risk Assessment

An ecological risk assessment was conducted by TRC to evaluate the potential risks associated with the exposure of biota to surface water/sediments, surface soils and leachate contaminants detected during the RI. The ecological risk assessment identified wildlife species and habitats that have been noted or are expected to be occurring at the Site and in the immediate vicinity. Potential exposure pathways, potential media and contaminants of concern were identified followed by a toxicity assessment and a quantitative and qualitative risk characterization.

The following conclusions were presented in the ecological risk assessment:

- northern wetland stream sediments do not pose a significant risk to aquatic benthic organisms. The risk of aquatic organisms suffering acute and chronic adverse effects due to aluminum concentrations within the northern wetland surface water is low;

- surface water and sediment COC concentrations within the northern drainage swales are not expected to be acutely toxic to aquatic organisms;

- leachate water concentrations of 4-methylphenol, aluminum, lead and zinc may result in acute toxic effects to aquatic organisms, if present, within these areas. Elevated levels of heptachlor, 4,4-DDD, 4,4-DDT and mercury may induce adverse chronic effects in aquatic organisms, if present, within these areas;

- the concentration of aluminum in the surface water in the southern drainage swale may presently cause acute adverse effects in sensitive organisms. Maximum concentrations of aluminum, zinc, lead and bis(2-ethylhexyl)phthalate in surface water may result in chronic adverse effects if biota are exposed to these levels frequently. Receptor species may be exposed to pesticide concentrations in sediments within the southern drainage swales which may accumulate in tissues;

- 4,4-DDT concentrations in northern wetland stream sediments and northern drainage swale surface water may bioaccumulate within species that forage on aquatic species present in this area.

1.4.5 RI Report Conclusions

Based on the results of the RI and the additional Site investigations, the following conclusions, with the exception of those related to the risk assessment, were made in the RI Report:

1) The naturally low hydraulic conductivity of the shallow silt unit surrounding the Site and the Clay Seal, if present, has limited the potential for horizontal migration of chemicals into the silt unit. The clay/upper till aquitard underlying the Site has limited the potential for vertical migration of chemicals from the Site. Therefore, the Site has had a limited adverse effect on surrounding subsurface soils.

2) The leachate generated at the Site is similar in characteristics to that generated in other municipal solid waste landfills in the United States and supports historical operations information that industrial and municipal wastes were commingled at the landfill, including the northernmost cell. Phenolic compounds and phthalate isomers were detected in all leachate samples.

3) The leachate seeps have had, at most, a limited adverse effect on surface water and surface sediments in the on-Site perimeter swales.

4) The Site has had a limited impact on the groundwater beneath the Site. The natural conditions (low hydraulic conductivity of the clay/upper till aquitard) at the Site have served to protect the upper bedrock aquifer in the area as is evidenced by the lack of contaminant presence in the upper bedrock aquifer groundwater.

5) The clay/upper till aquitard underlying the Site has not been penetrated by landfilling operations and consequently, due to natural attenuation, provides an excellent barrier to leachate migration from the Site. The lack of prominent gradients in the upper bedrock aquifer and lower till unit have also greatly reduced the potential of groundwater to migrate from the Site. Consequently, any leachate entering the overburden groundwater flow regime will remain in place within the area of the landfill cells.

6) The ambient air quality across the Site is not expected to be above acceptable ambient air levels. Additional air monitoring for landfill gases may be necessary during the remedial design phase.

Conclusions related to the BRA-TRC are presented in Sections 1.4.3.3 and 1.4.4 for the human health and ecological risk assessments, respectively.

2.0 REMEDIAL ACTION OBJECTIVES

Section 2.1 presents the identification of applicable or relevant and appropriate requirements (ARARs) including chemical-specific, action-specific and location-specific ARARs. Section 2.2 presents the remedial goals for the Site, based on available Site-specific information and ARARs.

2.1 IDENTIFICATION OF ARARs

ARARs are used to develop remedial action objectives and to scope and formulate remedial action technologies and alternatives. ARARs are cleanup standards, control standards or other substantive environmental limitations promulgated under federal or state law. The consideration of ARARs is made in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, (CERCLA) §121, 42 U.S.C. §9621. CERCLA only requires the considerations of substantive requirements.

CERCLA/SARA requires that ARARs be identified during the RI/FS in order to aid in the preparation of a list of remedial alternatives, the evaluation of remedial alternatives under an FS, and ultimately, the selection of a remedy under the Record of Decision (ROD). ARARs pursuant to Superfund Amendments and Reauthorization Act (SARA), are defined below.

Applicable Requirements

Applicable requirements are promulgated federal and state requirements such as cleanup standards, standards of control, and other environmental protection criteria or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.

Relevant and Appropriate Requirements

Relevant and appropriate requirements are those promulgated federal and state requirements that, while not applicable as defined above to the circumstances at a site, address problems or situations sufficiently similar to those encountered at a site that their use is well suited. The regulations provide specific criteria for determining whether a requirement is relevant and appropriate.

During the feasibility study process and in the development of remedial alternatives, relevant and appropriate requirements are accorded the same weight and consideration as applicable requirements.

Other Requirements To Be Considered

This category contains other requirements and non-promulgated documents to be considered in the CERCLA process of developing and screening remedial alternatives. The To Be Considered (TBC) category includes federal and state non-regulatory requirements, such as guidance documents, advisories, or criteria. Non-promulgated advisories or guidance documents do not have the status of ARARs. However, if no ARARs for a contaminant or situation exist, guidance or advisories could be identified and used to ensure that a remedy is protective.

ARARs are categorized as follows:

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.

Each of these ARAR types are further discussed in the following subsections.

2.1.1 Chemical-Specific ARARs

Chemical-specific ARARs 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 ARARs 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 ARARs may be regulated standards. Guidance values might be considered appropriate where a promulgated standard for a particular substance is not available. If a chemical compound has more than one ARAR, the most stringent is generally required to be met.

Chemical-specific ARARs for the Site include groundwater and surface water federal and New York State ARARs. Tables 2.1 and 2.2 present a summary of the chemical-specific ARARs for groundwater and surface water, respectively.

2.1.2 Location-Specific ARARs

Location-specific ARARs are regulations that are applicable to specific physical and environmental settings. The regulations that pertain to this environmental setting are summarized in Table 2.3.

2.1.3 Action-Specific ARARs

Action-specific ARARs 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 ARARs 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 ARARs which may be applicable to Site remediation are presented in Table 2.4.

2.2 REMEDIAL GOALS

Remedial action objectives are specific remedial goals to protect human health and the environment. These objectives are based on available information, ARARs and risk-based levels established in the BRA. The BRA-TRC concludes that the risks associated with the Site fall within the EPA's acceptable risk range. The remedial action objectives are, therefore, not required to achieve risk-based levels.

As specified in the Municipal RI/FS Guidance, the primary remedial action objectives for remediating municipal landfill sites typically include:

- Preventing direct contact with landfill contents;
- Reducing contaminant leaching to groundwater;
- Controlling surface water runoff and erosion;
- Remediating hot spots;

- Collecting and treating contaminated groundwater and leachate;
- Controlling and treating landfill gas;
- Remediating contaminated surface water and sediments; and
- Remediating contaminated wetland areas.

A number of these objectives do not apply to the NCR Site, as discussed in the following paragraphs.

Reducing Contaminant Leaching to Groundwater

The RI Report concluded that the clay/till aquitard underlying the Site has not been penetrated by landfilling operations and consequently, due to its low permeability and to natural attenuation, provides an excellent barrier to leachate migration from the Site. The lack of prominent gradients in the bedrock aquifer and basal till unit have also greatly reduced the potential of groundwater to migrate from the Site.

Remediating Hot Spots

The Municipal RI/FS Guidance (pg. 4-12) states that "...hot spots that are appropriate for excavation and removal should be in discreet, accessible locations of a landfill where a waste type or mixture of wastes presents a principal threat to human health or the environment. The area should be large enough so that remediation will significantly reduce the risk posed by the overall site and small enough to be reasonably practicable for removal and/or treatment." As further discussed in the Municipal RI/FS Guidance (pg. 4-16), excavation and/or treatment of landfilled materials "...is considered a feasible alternative only for hot spots and, when practicable, for contents of small to moderate landfill (e.g. less than 100,000 cubic yards)."

The RI Report concluded that industrial and municipal wastes were commingled at the landfill, including the northernmost cell. The conclusion was based on the following:

- the northernmost cell was the only operating cell at the Site between approximately 1974 to closure of the Site in 1976;
- Municipal type refuse had been identified in all three borings (EAST-C, EAST-D and NCR-12D) completed within this cell; and
- leachate quality for the northernmost cell was similar in characteristics to the leachate quality for the southern five cells.

As discussed in Section 2.5 of the RI Report, the total estimated volume of solid waste disposed of at the Site was on the order of 1,800,000 cubic yards, of which approximately 285,000 cubic yards were disposed of within the northernmost cell.

The BRA-TRC concluded that the risks associated with the Site fall within the EPA's acceptable risk range.

Therefore, the northernmost cell does not meet the constituent, volume or risk criteria for separate alternative consideration and the excavation and/or treatment of landfilled materials is not practicable due to volume.

Collecting and Treating Contaminated Groundwater

The RI Report concluded that the Site has had a limited impact on the groundwater beneath the Site and no impact on the groundwater adjacent to the Site. The low hydraulic conductivity of the clay and till at the Site have served to protect the upper bedrock aquifer in the area as is evidenced by the lack of contaminant presence in the bedrock groundwater aquifer. Therefore, groundwater collection and treatment is currently not necessary at the Site. A groundwater monitoring program will be implemented to ensure that contaminants are not migrating off-Site.

Remediating Contaminated Surface Water and Sediments

The RI Report concluded that the leachate seeps have had, at most, a limited adverse effect on surface water and surface sediments in the on-Site perimeter swales. Therefore, remediation of these surface waters and sediments is not warranted at this time. However, during remedial activities at the Site any residual contamination present in the on-Site swales will be consolidated in the landfill prior to capping. In addition, as discussed in Section 1.1, wetlands mitigation efforts in the wetlands at the northern end of the Site may be required, pending the results of the wetlands assessment to be performed during the remedial design. Surface water and sediment monitoring will be conducted in order to assess surface water quality during and subsequent to the implementation of any remedial action.

The remaining remedial action objectives specified in the Municipal RI/FS Guidance do apply to the Site. With respect to these objectives, access to the Site is restricted to authorized vehicular traffic, however, the Site may be accessed overland from adjacent lands by unauthorized personnel. As discussed in Section 2.4 of the RI Report, the landfill cover at the Site has eroded in several places causing solid waste to be exposed and approximately 30 leachate seeps have been noted and documented at the Site. Also, air monitoring performed over the leachate seeps at the Site, identified landfill gas emissions at all locations monitored.

Therefore, the primary remedial action objectives for the Site are limited to:

- Preventing direct contact with landfill contents;
- Controlling surface water runoff and erosion;
- Collecting and treating landfill leachate;
- Controlling landfill gas; and
- Remediating contaminated wetland areas, if necessary.

In order to satisfy the above remedial action objectives, the following technologies, as identified in the Municipal RI/FS Guidance and the EPA-approved Scoping Plan (CRA, Feb 1993) have been evaluated as part of the FS:

- Access Restrictions;
- Containment;
- Collection and Treatment of Landfill Leachate; and
- Landfill Gas Collection.

3.0 REMEDIAL TECHNOLOGIES IDENTIFICATION AND SCREENING

Section 3.1 presents the general response actions required to satisfy the remedial action objectives identified in Section 2.2. Potential technologies and process options applicable to each general response action are also identified. Each response action technology and process option is then evaluated in Section 3.2 based initially upon technical feasibility. Alternative process options for each technology are then screened based upon effectiveness, implementability and cost in order to select the most appropriate process(s) for each technology type.

3.1 IDENTIFICATION OF GENERAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS ACTIONS

This section identifies the remedial response actions, technologies and process options that will potentially satisfy the remedial action objectives for the Site. The remedial action objectives for the Site, as identified in Section 2.2, are to:

- Prevent direct contact with landfill contents;
- Control surface water runoff and erosion;
- Collect and treat landfill leachate;
- Control landfill gas; and
- Remediate contaminated wetlands, if necessary.

As discussed in Section 1.1, the necessity of remedial activities associated with the wetlands, will be assessed during the remedial design and is not discussed further in the FS.

The general response actions presented in this section are broad remedial approaches capable of meeting the above remedial objectives. Some response actions such as containment are sufficiently broad in nature to be capable of meeting more than one remedial objective. However, combinations of response actions may be required to meet all of the remedial goals and objectives in some cases. Table 3.1 summarizes the general response actions which are applicable to achieving the remedial objectives for the Site. Table 3.1 also identifies the remedial technologies associated with each response action and various potential process options for each remedial technology. The technologies and potentially applicable process options are screened in Section 3.2.

3.1.1 No 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 measures would be taken to improve environmental conditions at the Site.

3.1.2 Limited Action

The limited action response involves the implementation of institutional controls to restrict access to the Site and to limit future uses of the Site. The process options of both fencing and deed restrictions will be assessed to implement the technology of access restrictions.

As discussed in Section 2.4 of the RI Report, a fence will be installed around the entire perimeter of the landfill. The fence will physically limit access of unauthorized personnel to the Site.

The deed restriction process option consists of a restrictive covenant written into the property deed to notify any potential purchaser that the land was used for waste disposal and that future land use must be restricted to avoid compromising existing Site control measures.

3.1.3 Containment Action

The containment response action includes grading, capping the landfill and the construction of a clay barrier wall around the perimeter of the landfill.

As discussed in Section 2.4 of the RI Report, the Site, consisting of six distinct landfill cells indicated by Site topography, is elongated and approximately 50 acres in size, running north to south. It has a maximum length of 3,800± feet and a maximum width of 720± feet. The topography of the area surrounding the Site is flat, with an elevation of approximately 575 feet above mean sea level (AMSL). The landfill cover has eroded in several places causing solid waste to be exposed. The six distinct landfill cells are mounded above the surrounding land and have a maximum elevation of approximately 597 feet AMSL. The six cells are separated and/or bounded by drainage swales and an on-Site access road. Perimeter drainage swales also surround the entire Site. Many of the swales are vegetated and/or heavily silted in. Therefore, in order to prevent direct contact with landfill contents, reduce leachate generation, and control surface water runoff and erosion, the options that will be assessed to implement containment will include grading, capping the landfill combined with a clay barrier wall around the perimeter of the landfill and revegetation.

The topographic map (Plan 1) shows that substantial grading of the landfill will be required in order to promote positive drainage, control surface water flow, control erosion and to manage surface water infiltration at the Site. Since the Site consists of six distinct landfill cells, two grading options will be assessed:

- Minimal grading and capping each distinct cell; and
- Extensive grading and capping all six cells as one contiguous cap.

These two grading options represent the two extremes and the final grading configuration may fall somewhere inbetween. The final capping configuration will be determined based on cost-effectiveness during the remedial design.

As part of the grading options assessment, the potential of utilizing clean demolition and construction debris as grading material as per EPA and NYSDEC acceptability will be considered. The utilization of clean demolition and construction debris as grading material could offset the cost to provide fill material to ensure proper grading of the Site. It is estimated that approximately 45,000 cubic yards of material will be required to ensure proper grading if each cell is capped separately and that approximately 330,000 cubic yards of material will be required to ensure proper grading if the entire Site is capped as one contiguous cap. The volume of fill material required for the capping option will, therefore, range between approximately 45,000 cubic yards to 330,000 cubic yards, depending on the final capping configuration that will be used, as determined during the remedial design. The existing cover material to the extent it is present, may be graded and used as fill material to minimize the amount of fill material to be imported.

The following types of capping options are assessed:

- RCRA Standard Cap;
- NYS Solid Waste Standard Cap; and
- Low Permeable Soil Cap.

"The Hydrologic Evaluation of Landfill Performance (HELP) Model, Volume I. User's Guide for Version I, Technical Resource Document for Public Comment" (U.S. EPA, June 1984), is utilized to evaluate percolation rates for the three different cap options. The design characteristics for the three cap options are summarized below:

RCRA Standard Cap

- Vegetative cover;
- 6 inches of topsoil;
- 24 inches of fill;
- 12-inch sand drainage layer (permeability $\geq 1 \times 10^{-2}$ cm/sec);
- HDPE liner (0.5% leakage through liner, 20-mil minimum thickness); and
- 24 inches of compacted clay liner (permeability $\leq 1 \times 10^{-7}$ cm/sec).

NYS Solid Waste Standard Cap

- Vegetative cover;
- 6 inches of topsoil;
- 24 inches of low permeable fill; and
- 18 inches of compacted clay liner (permeability $\leq 1 \times 10^{-7}$ cm/sec).

Low Permeable Soil Cap

- Vegetative cover;
- 6 inches of topsoil; and
- 24 inches of low permeable fill (permeability $\leq 1 \times 10^{-5}$ cm/sec).

Synthetic materials may also be substituted for some of the above materials (e.g. bentonite combined with HDPE liner in place of clay). The cost-effectiveness of using synthetic materials as substitutes for natural material will be evaluated during the remedial design.

In conjunction with all three capping options, a barrier wall (i.e. clay cutoff wall) constructed around the perimeter of the landfill cell is assessed. The clay cutoff wall will extend from the cap to the clay/till underlying the Site. The clay cutoff wall will serve to minimize the potential for leachate and gas migration from the landfill to the surrounding shallow silt unit.

Any of the above grading/capping options could potentially affect the wetlands at the Site during implementation (e.g. disturb buffer zones, sediment runoff during construction, etc.). As discussed in Section 1.1 as part of the wetlands assessment to be conducted during the RD, a description of the effects of the selected remedial alternative on the wetlands and a delineation of measures to minimize potential harm to wetlands will be provided.

3.1.4 Collection Action

The collection response action includes both leachate collection and gas collection, as discussed in the following subsections.

3.1.4.1 Leachate Collection Action

A leachate collection system is used to control leachate buildup within the landfill in order to prevent leachate seepage along the sideslopes of a landfill with ultimate discharge to surface water and/or sediments. In addition, a leachate collection system minimizes the potential for leachate and associated contaminants to migrate to groundwater. The two leachate collection system technologies that are assessed are:

- subsurface perimeter drains; and
- extraction wells.

The subsurface perimeter drains consist of gravel-filled trenches equipped with perforated pipe installed around the perimeter of the landfill. The trenches would be located within the waste perimeter/shallow silt unit identified at the Site. Additional lateral excavation may be required to ensure an adequate hydraulic connection with the landfill waste. The trenches would be located inside the clay cutoff wall which would be installed as part of the capping technology discussed in Section 3.1.3. The trenches would intercept and direct leachate to a sump from which it would be pumped and collected for treatment.

The leachate extraction wells consist of vertical wells drilled to the base of the landfill cells. The wells would be instrumented with submersible pumps to extract leachate from the landfill, thus creating hydraulic zones of influence to promote leachate flow towards the wells. The leachate would be pumped from the wells and through a collector system for ultimate treatment.

Leachate collected using either technology is expected to require either on-Site or off-Site treatment as discussed in Section 3.1.5.

3.1.4.2 Gas Collection Action

Landfill gas (LFG) is produced naturally when organic material from a landfill decomposes. As discussed in Section 3.1.3, the landfill may be capped by one of three capping options all of which exhibit low permeabilities. Such a cap will limit the vertical migration of LFG, which will then tend to collect below the cap and migrate horizontally. Therefore, landfill gas collection is assessed as a remedial technology.

Two types of collection systems are available to intercept and remove LFG from a capped landfill; passive systems and active systems. Both systems are assessed as LFG collection process options.

The passive system consists of a gas venting layer or of trenches underlying the low permeability cap material, connected to perimeter trench vents surrounding the landfill and/or vertical vent pipes along the cap of the landfill. As discussed in Section 3.1.3, a low permeable clay cutoff wall will be installed around the perimeter of the landfill if a cap is installed. The passive system will be located inside the clay cutoff wall which will increase its effectiveness in controlling horizontal LFG movement.

The active system consists of a series of gas extraction wells, gas collection headers, vacuum blowers or compressors, and gas treatment technologies, if necessary. Active systems are typically used in landfills where severe odor problems exist and to prevent LFG from migrating to and endangering nearby structures. Conditions at the Site do not warrant an active collection system (i.e. no odor problems and no nearby structures), however, the necessity of an active system at the Site has been assessed (see Section 3.2.4).

3.1.5 Leachate Treatment Action

Feasible leachate treatment technologies for the Site include both on- and off-Site treatment. On-Site leachate treatment technologies include physical, biological and chemical technologies or a combination of two or more. Off-Site leachate treatment consists of direct discharge to a POTW if the leachate is amenable to the treatment provided at the POTW. Pretreatment on-Site may be required before discharge to the POTW.

3.1.5.1 On-Site Treatment Technologies and Process Options

Due to the wide range of contaminants found in the leachate, no single treatment technology, outlined below, is likely to effectively and reliably reduce concentrations of both the organics and inorganics in the leachate sufficiently to meet the relevant criteria for a point source discharge. Rather, a combination of technologies is likely to be necessary for any on-Site treatment. Based on the available information on the Site leachate characteristics (see Section 1.3.6), the following treatment technologies are considered and assessed for on-Site leachate treatment:

- Biological Treatment

Aerobic biological treatment of wastewater is a proven technology from the municipal sewage application sector. The process involves the oxidation of organic content including VOCs and SVOCs of the liquid waste through the use of microorganisms in the presence of oxygen (air). Inorganics are not effectively treated by biological treatment and the presence of inorganics at high concentrations may reduce the efficiency of biological treatment due to several factors including precipitation and toxicity. The microorganisms utilize the organic contaminants as a source of carbon and energy to support their growth. They need nutrients such as nitrogen, phosphorous, and trace elements. The temperature and pH must also be controlled to optimize microbial activities. The microbial metabolism of the organics results in their mineralization to carbon dioxide and water. Treatment systems can be designed to promote suspended or fixed biological growth. In suspended culture systems, the organisms are maintained in a suspension form by mixing. The most commonly used suspended growth systems are referred to as activated sludge. In fixed-film systems, the culture is attached to a medium and the liquid waste flows through the medium. Examples of the fixed-film, attached-growth systems are trickling filters, rotating biological contactors (RBC) and submerged fixed-film reactors often referred to as biotowers.

- Carbon Adsorption

The process of adsorption onto granular activated carbon (GAC) is a proven and reliable treatment technology for the removal of many volatile and semivolatile organic compounds. The process involves contacting the waste stream with the carbon in packed beds.

The carbon adsorbs the organics and allows the treated water to pass through the bed. When the carbon reaches its maximum adsorptive capacity, it is replaced by fresh carbon. The spent carbon is typically regenerated. Carbon adsorption capacity depends on such factors as polarity, molecular weight, and chemical structure of the adsorbent, pH of the liquid waste, and characteristics of the activated carbon used. Typical use of granular activated carbon for liquid waste treatment is limited to treatment of organic compounds with at least 10 percent organic loading potential.

- Air Stripping

Air stripping is a reliable process for removing VOCs from liquid streams. The process allows the VOCs to be transferred from a liquid stream to an air stream. Packed towers, commonly known as stripping towers, are used for continuous contact of the liquid with air in a countercurrent flow. In this design, the water is distributed over and trickles down through the packed bed, exposing a large surface area to contact the air. This packed tower design is the most efficient method of contacting air and water in order to achieve high percent removal of volatile compounds. Air stripping can also be accomplished by sparging the contaminated water in an enclosed basin. In this design, the air is forced through diffusers located in the bottom of the basin and exits at the top with the volatile organic compounds. This particular design is more cost effective for the treatment of low flow rate streams, particularly when the waste contains high concentrations of metals and suspended solids.

Depending upon the concentration of VOCs in the off-gas stream, air pollution control devices may be required (e.g. vapor phase carbon treatment). Post-treatment facilities will be required following air stripping to remove semivolatile organic compounds and to reduce biochemical oxygen demand (BOD) levels.

3.1.5.2 Off-Site Treatment Technologies and Process Options

For purposes of evaluating off-Site leachate treatment, the City of North Tonawanda's wastewater treatment facility (POTW) has been assessed. This facility is the closest POTW to the Site which has appropriate treatment technology to treat the leachate. It is located to the southeast of the Site, as shown on Figure 1.1.

The treatment process at the POTW consists of preliminary treatment, primary treatment, sand filtration, physical-chemical treatment and disinfection and sludge handling. The physical-chemical treatment process includes six 30-foot diameter, 49-foot tall carbon columns which operate in the upflow mode to effectively treat sanitary and industrial waste. These columns remove the soluble BOD by adsorption as the wastewater is pumped up through the carbon.

The Site leachate would be pumped via direct discharge by forcemain to the City of North Tonawanda's sanitary sewer system. The sanitary sewer is strictly a sanitary sewer and is not combined with a storm sewer. As such, the sanitary sewer is a 'closed system' and does not receive any stormwater runoff and does not have any 'open exposure points' (i.e. stormwater grates) along its route to the POTW. The sanitary sewer along Warner Avenue is in close proximity to the Site, approximately 500 feet to the east.

The POTW currently receives approximately seven million gallons per day (mgd) and is permitted for 14 mgd. The option of direct discharge to the POTW is feasible since:

1) the POTW was designed to treat industrial wastes (i.e. it includes carbon adsorption as part of the treatment process);
2) the leachate generated from the Site is conservatively estimated to be up to 6,500 gpd (five gpm) which is equivalent to less than 0.1 percent of the total flow (seven mgd) currently received at the POTW; and
3) the POTW has a current unused capacity of approximately seven mgd.

Based on a review of the leachate characteristics (see Section 1.3.6) and on preliminary conversations with the superintendent of the POTW, it is believed that the Site leachate can be effectively treated at the POTW without any pretreatment required at the Site. If, during the remedial design, pretreatment is determined to be required, a pretreatment system would need to be designed to meet the required standards for discharge of the leachate to the POTW.

3.2 SCREENING OF REMEDIAL RESPONSE ACTIONS AND TECHNOLOGIES

3.2.1 General

This section presents an evaluation of the remedial response actions, technologies and process options developed in Section 3.1. The process options considered to be feasible are evaluated in Section 3.2.2 based upon effectiveness, implementability and cost considerations. The cost comparisons applied at this stage of the evaluation are based primarily upon engineering experience and judgment and are of sufficient detail and accuracy to allow comparison of the different technologies and process options. The cost estimates provide an accuracy of +50 percent to -30 percent. This initial screening process is used to select those technologies and process options that are considered to be most appropriate for conditions at the Site and to achieve the remedial action objectives, so that the less effective or less reliable technologies and process options can be eliminated. Table 3.2 summarizes the results of the screening process.

The selected process options are retained for inclusion in the development of potential remedial alternatives to be further evaluated in Section 4.0. The following subsections present the evaluation of different capping, leachate, gas collection and leachate treatment options. Minor process options consisting of fencing, deed restrictions, grading and revegetation are evaluated in Table 3.2 and are retained for inclusion in the development of remedial alternatives for the Site.

3.2.2 Capping Process Options

The capping objectives for the Site are to:

- eliminate the potential for dermal contact with landfill contents and leachate from seeps in the landfill;
- minimize precipitation infiltration to reduce leachate generation; and
- minimize the potential transport of leachate off Site by minimizing landfill erosion and by controlling surface water runoff.

Three capping options are considered for the Site as discussed in Section 3.1.3. These include a RCRA cap, a NYS Solid Waste Standard cap and a low permeable soil cap. All capping process options incorporate a clay perimeter barrier wall extending from the cap to the underlying clay/till unit underlying the Site.

All capping process options would require a significant amount of grading of the landfill before placement of the cap. As discussed in Section 3.1.3, each cell may be graded and capped individually or all the cells may be graded and capped as one contiguous cap. These two capping options represent the two extremes and the final grading configuration may fall somewhere inbetween. The final capping configuration will be determined, based on cost-effectiveness, during the remedial design. However, for the purpose of this evaluation it is assumed that the entire landfill will be graded as one cell. As discussed in Section 3.1, approximately 330,000 cubic yards of clean demolition and construction debris would be required to properly grade the Site under this scenario. This amount of demolition and construction debris may be slightly reduced by regrading and using the existing cap material as fill material.

All three cap designs assume a minimum 4 percent slope along the upper (i.e. top) portions of the landfill cap to promote positive surface water drainage and a maximum 33 percent slope along the lower (i.e. sides) portions of the landfill cap to minimize erosion.

- Effectiveness

All three capping options will meet the previously stated capping objectives. The effectiveness of each cap design for reducing infiltration was evaluated using the HELP model. The HELP modeling results are presented in Appendix B. Five years of climatological data for Buffalo, New York were used in the model. A summary of the modeling results is presented in Table 3.3. As shown in Table 3.3, the RCRA cap is the most effective design for reducing leachate generation with an estimated annual infiltration rate of 0.0067 inches/year (9,000 gallons/year) compared to the NYS Solid Waste Standard cap with an estimated annual infiltration rate of 1.74 inches/year (2.4 million gallons/year) and the low permeable soil cap with an estimated annual infiltration rate of 5.67 inches/year (7.7 million gallons/year).

- Implementability

Construction of all three capping designs would involve common construction practices. Specialized equipment would be required for the placement of the synthetic liner for the RCRA cap; however, contractors are readily available with this expertise.

Construction of the cap would be implemented over two construction seasons. During the first construction season all necessary fill placement and grading of the existing landfill cover to achieve design grades would be completed. The landfill contents and fill material would be allowed to settle over the winter season. Subsequently, during the next construction season, areas of settlement would be filled and graded, as necessary. The final cap would then be constructed.

The low permeable soil cap does not meet the current minimum design requirements for final cap design for municipal sanitary landfill caps as specified in 6 NYCRR Part 360. Therefore, it is anticipated that state approval of this design would be difficult to obtain.

- Costs

General estimated unit costs for the capping process options are listed below:

RCRA Cap	$300,000/acre
NYS Solid Waste Standard Cap	$200,000/acre

Low Permeable Soil Cap	$120,000/acre

Based on these costs, the total estimated costs for placement of the caps excluding placement of clean demolition and construction debris, compaction, grading and installation of the clay barrier wall, which are constant for all three capping options, are:

RCRA Cap	$15,000,000
NYS Solid Waste Standard Cap	$10,000,000
Low Permeable Soil Cap	$ 6,000,000

- Summary

All three cap designs will meet the capping objectives to eliminate potential dermal contact with landfill contents; minimize leachate generation; minimize landfill erosion and control surface water runoff. However, approval for a low permeable soil cap would be difficult because it does not meet the minimum cap requirements for NYS sanitary landfills. The low permeable soil cap is, therefore, not retained for further evaluation.

Both the NYS Solid Waste Standard cap and the RCRA cap meet all of the capping objectives and satisfy the minimum cap requirements for NYS sanitary landfills. Both the NYS Solid Waste Standard cap and the RCRA cap are, therefore, retained for further evaluation. It is to be noted, however, that the RCRA cap is considered to be an over-designed alternative for the following reasons:

- the leachate generated at the Site is similar in characteristics to that generated in other municipal solid waste landfills in the United States which supports historical operations information that industrial and municipal wastes were comingled at the landfill; and

- risks associated with the disposed materials at the Site fall within the EPA's acceptable risk range.

3.2.3 Leachate Collection Process Options

The leachate collection objective for the Site is to lower the leachate mound within the landfill to eliminate leachate seeps along the side of the landfill.

Leachate collection systems consist of either a passive subsurface perimeter drain or active extraction wells, as discussed in Section 3.1.4.1. The subsurface perimeter drain would consist of below ground gravel filled trenches equipped with perforated pipe to intercept and channel leachate to a sump for collection. The active extraction well system would consist of the installation of leachate wells to the base of the landfill and a pumping system and collection network to actively pump and collect leachate from the wells. Alternatively, leachate extraction wells could be installed around the perimeter of the landfill.

- Effectiveness

The passive subsurface perimeter drain would be effective in lowering the leachate level within the landfill, thereby reducing the potential for leachate seeps along the slopes of the landfill and the potential for leachate migration into the surrounding shallow silt unit.

The active extraction well system is more appropriate in areas of a landfill where there is highly contaminated leachate or when the potential exists for significant groundwater/leachate mixing. Neither of these situations applies to the Site. In addition, due to the low volume of leachate that would be produced with either a RCRA or a NYS Solid Waste Standard cap, 25 and 6,500 gallons per day, respectively, over the 50-acre Site, an active extraction well system would not be appropriate. An active extraction well system is, therefore, not considered suitable for the Site.

- Implementability

The passive subsurface perimeter drain can be implemented relatively easily as it involves common construction practices. The installation of the drain would require excavation into the refuse at the toe of the landfill. Excavated refuse would be relocated and regraded on Site. Health and safety protocols would be implemented to protect workers during excavation activities. The subsurface perimeter drains would require periodic inspection, maintenance and cleaning to ensure optimal performance of the system.

The active extraction well system would be more difficult to implement than the passive system due to the more complex design and mechanical equipment required. A greater level of inspection, maintenance and operation would be required for the active system. In addition, the wells must be properly sealed where they penetrate the cap to prevent infiltration into the landfill.

- <u>Cost</u>

The estimated capital costs for each leachate collection system are listed below:

Passive Subsurface Perimeter Drain	$ 600,000
Active Extraction Well System	$ 1,000,000

Long-term operation and maintenance costs would be somewhat higher for the active extraction well system due to the additional mechanical requirements of the system.

- <u>Summary</u>

The passive subsurface perimeter drain is the more effective process option for meeting the remedial objective of collecting leachate for the Site. Further, the active extraction well system is not suitable for the Site due to the absence of highly contaminated areas of leachate, insignificant groundwater/leachate mixing and the low volume of leachate that would be generated under any of the two capping process options retained. The active extraction well system is, therefore, not retained for further evaluation.

3.2.4 Gas Collection Process Options

The objective of the gas collection system is to prevent the lateral migration of landfill gas from the Site. As discussed in Section 3.1.4.2, a landfill gas collection system would consist of either a passive or active system. Passive collection systems to be evaluated include a gas venting system installed in the cap and perimeter gas collection trenches. Active gas collection systems to be evaluated include one process option, gas extraction wells.

The passive gas venting layer system would consist of either a 12-inch thick permeable gravel layer or gravel filled trenches installed beneath the lowermost barrier layer of the cap. Vertical gas vent pipes would be installed throughout the cap at a minimum frequency of one vent/acre. The passive perimeter gas collection trench would consist of a gravel-filled trench surrounding the Site. Vertical gas vent pipes would be installed at an appropriate spacing along the length of the trench. The clay barrier wall would be installed on the outside of the trench to block the flow path to the shallow silt unit. The gas collection trench may be installed in conjunction with the leachate collection subsurface perimeter drain, if selected as a preferred process option.

The active gas extraction system would consist of gas extraction wells installed within the refuse at spacings on the order of 100 to 300 feet. Gas collection headers, vacuum blowers or compressors would be used to create negative pressure gradients inducing gases to be drawn up from the extraction wells.

- Effectiveness

In order to determine the estimated landfill gas generation rate for the Site the Scholl-Canyon Model was used. A general overview of the modeling process and the results of the Scholl-Canyon Model are presented in Appendix C.

The gas generated from the Site in 1993, as estimated by using the Scholl-Canyon Model is approximately 2.5 million cubic yards of gas per year or approximately 126 cubic feet per minute (cfm). An active gas collection system typically requires a minimum of 500 cfm of gas to work effectively. In addition, an active collection system is typically used in landfills where severe odor problems exist and/or when significant risk to nearby structures is evident. Since insufficient gas volumes are generated, odor problems do not exist and there are no structures nearby, an active gas collection system is not required for this Site.

The passive gas venting layer would be effective in venting the landfill gas through the cap, thereby eliminating the potential for lateral movement of gas away from the Site. The gas venting layer would be installed for all capping options in accordance with 6 NYCRR Part 360. Alternatively, gas collection trenches could be installed in the cap instead of a gas venting layer. Given the low volume of gas generated at the Site, trenches beneath the cap would be effective for controlling lateral gas migration.

Due to the installation of a gas venting layer/trenches in the cap for all capping options, and given the low amount of gas generated by the landfill, a passive perimeter gas collection trench would not increase the overall effectiveness of the gas collection system. However, for those alternatives where the leachate subsurface perimeter drain is installed, the perimeter gas collection trench could be incorporated into its design at a minimal cost.

- Implementability

The passive gas venting layer/trenches would be incorporated as the lowermost layer into the design of the cap for the Site. The passive gas venting layer/trenches in the cap can be implemented relatively easily as they involve common construction practices. The installation of the cap and gas venting layer/trenches would be conducted following the completion of grading activities for the Site and prior to final cap construction.

The gas venting layer is a requirement of New York State for municipal solid waste facilities (6 NYCRR Part 360) so state approval for this process option would not be difficult to obtain. Although the installation of trenches in the cap in place of a gas venting layer is not in accordance with 6 NYCRR Part 360, given the low volume of gas generated at the Site, it is anticipated state approval for this option could be obtained, similar to that obtained by Niagara County Refuse District for its current landfill site.

The passive gas collection trench around the perimeter of the landfill can also be implemented relatively easily as it involves common construction practices. The passive collection trench around the perimeter of the landfill could be incorporated into the design of the perimeter leachate collection trench (if installed). Installation of the trench would be coordinated with the installation of the perimeter leachate collection trench (if installed) and/or the clay barrier wall.

The active gas extraction wells would be more difficult to implement than the passive gas collection systems due to the more complex design and mechanical equipment required. A greater level of inspection, maintenance and operation would be required for the active system.

- Cost

General estimated capital costs for the gas collection options are listed below:

Passive Gas Venting Layer Under Cap	$ 2,300,000
Passive Gas Venting Trenches Under Cap	$ 250,000
Passive Gas Perimeter Collection Trench	$ 250,000
Active Gas Extraction Wells	$ 800,000

The active gas collection system would also have regular operation and maintenance costs.

The cost for the passive perimeter gas collection trench would not be realized if it was installed in conjunction with the leachate collection trench.

- <u>Summary</u>

The passive gas collection process option consisting of either a gas venting layer or trenches in the cap, is an effective remedial option to control the lateral migration of landfill gas at the Site. Although the gas venting layer is a requirement of New York State, trenches in the cap are considered more than sufficient for the control of landfill gas at this Site. Therefore, the gas venting layer is not retained for further evaluation due to its significantly higher cost.

The passive gas perimeter collection trench will not significantly enhance the effectiveness of the passive gas venting trenches beneath the cap given the low amount of gas being generated under current and future conditions. However, it will be retained for further evaluation given the low cost of implementation when installed in conjunction with the leachate subsurface perimeter drain.

The active gas collection process option is not suitable for the Site since insufficient gas volumes are generated, odor problems do not exist and there are no nearby structures. The active gas collection well system is, therefore, not retained for further evaluation.

3.2.5 Leachate Treatment Process Options

As discussed in Sections 3.1.5.1 and 3.1.5.2, leachate treatment process options include both on- and off-Site treatment. On-Site treatment process options include physical treatment (carbon adsorption, air stripping), chemical treatment (UV/oxidation) and biological treatment. Off-Site treatment process options include treatment of the leachate at the City of North Tonawanda's POTW.

- Effectiveness

The chemical characteristics of the leachate at the Site indicate elevated concentrations of calcium and iron. The presence of these metals at high concentrations reduces the efficiency of biological treatment due to several factors including precipitation and toxicity. Chemical and/or physical pretreatment to reduce metal concentrations in the leachate prior to biological treatment may be necessary.

Carbon fouling and encrustation are potential problems for the effectiveness of carbon adsorption due to the high organic and metals (particularly calcium and iron) content of the Site leachate. Fouling in carbon causes back pressure, and the carbon has to be backwashed or replaced more frequently. Metal precipitation and microbial growth are the main causes of carbon fouling. Pretreatment with aeration and biological treatment may be necessary prior to carbon treatment. In addition, based on the total organic carbon (TOC) characteristics of the leachate at the Site, the anticipated carbon usage and cost would be high, unless activated carbon is used only as a final polishing step.

Air stripping may require the use of air pollution control devices (e.g. vapor phase carbon treatment), depending upon the concentration of volatile compounds in the off-gas stream. Post-treatment facilities would be required following air stripping to remove semi-volatile organic compounds and to reduce biochemical oxygen demand (BOD) levels. Due to elevated concentrations of TOC and metals (particularly calcium and iron) in the leachate, fouling and scale formation are potential problems for air stripping. Fouling can also occur as a result of water hardness and bacterial growth on organic compounds in the leachate.

Off-Site treatment at the City of North Tonawanda's POTW is considered an effective treatment option. At a maximum the leachate will comprise approximately 0.1 percent of the total current flow at the facility. The POTW includes carbon adsorption and is designed to handle and effectively treat industrial waste.

Treatability studies would be required for all on-Site and off-Site process options to determine the effectiveness of a particular treatment system.

- Implementability

The implementation of on-Site treatment would be contingent upon treatability studies to determine the appropriate technologies for the leachate. The necessary permits would be required to operate the system. Ongoing maintenance of the system would be required to ensure optimal performance.

Off-Site treatment at the City of North Tonawanda POTW could readily be implemented following permission from the proper authorities.

- Cost

The capital cost for an on-Site treatment system consisting of a combination of physical and/or chemical pretreatment, aerobic biological treatment and activated granular carbon is estimated to be $600,000. The system will also involve operation and maintenance costs estimated to be $200,000 per year, based on a flow rate of a 5 gpm system.

The capital cost for the off-Site treatment system to install forcemain to the municipal sanitary sewer system is estimated to be $30,000. The annual cost for treatment at the City of North Tonawanda's POTW is estimated to be $40,000 per year, based on a treatment cost of $0.016 per gallon and a flow rate of 5 gpm (based on preliminary discussions with the POTW's supervisor).

• Summary

It is unlikely that a single on-Site process option would be adequate for efficient and reliable on-Site leachate treatment. Treatability studies would be necessary before a final design could be implemented. Based on the available Site information, the following on-Site treatment system would be required:

1) Physical and/or chemical pretreatment; required primarily to reduce metal concentrations and minimize solid formation. This may involve aeration and/or pH adjustment followed by flocculation.
2) Aerobic biological treatment, using a suitable system for dealing with high strength and variable effluents (e.g. sequencing batch reactor or rotating biological contactors).
3) Activated granular carbon treatment may be required for final polishing, depending on the effluent discharge criteria.

The process options for this on-Site treatment system will be retained for further evaluation.

The off-Site treatment process option at the City of North Tonawanda's POTW is considered effective and will be retained for further evaluation.

3.2.6 Summary of Technologies and Process Options Retained for Further Evaluation

Based on the discussions presented in the previous subsections, Table 3.4 provides a summary of remedial response actions and corresponding technologies and process options retained for further evaluation.

4.0 DEVELOPMENT AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 CRITERIA FOR SCREENING OF ALTERNATIVES

The Site-wide remedial alternatives for the Site are assembled in Section 4.2, utilizing the general response actions, technologies and process options retained from the initial screening conducted in Section 3.2. The alternatives are described and evaluated in Section 4.3. The evaluation of the alternatives consists of a detailed analysis against the statutory requirements, goals and objectives of CERCLA.

Nine criteria, as presented in the NCP, for evaluation of alternatives have been developed by the EPA. These evaluation criteria include:

- Threshold Criteria

  1) overall protection of human health and the environment;
  2) compliance with ARARs;

- Primary Balancing Criteria

  3) long-term effectiveness and permanence;
  4) reduction of toxicity, mobility or volume through treatment;
  5) short-term effectiveness;
  6) implementability;
  7) cost;

- Modifying Criteria

  8) state acceptance; and
  9) community acceptance.

Compliance with ARARs and overall protection of human health and the environment relate to statutory requirements that must be made in the Record of Decision (ROD) and are, therefore, categorized as threshold criteria which are required be met by each alternative considered. However, ARARs may be amended or waived if an alternative remedial action attains an equivalent standard of performance through the use of another method or approach.

Short-term effectiveness, long-term effectiveness and performance, reduction in toxicity, mobility, or volume through treatment, implementability and cost are the primary balancing criteria upon which the analysis is based.

State acceptance and community acceptance cannot be evaluated at the FS stage since they are based upon public and agency comments received following release of an FS document. These two criteria are evaluated following comment on the FS and the proposed plan and addressed once a final decision is being made and the ROD is being proposed.

A list of the factors to be considered under each of the evaluation criteria is presented in Table 4.1.

4.2 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Six remedial alternatives for the Site have been assembled utilizing the general response actions, technologies and process options retained from the screening process conducted in Section 3.2. The six alternatives are presented in Table 4.2 and are described and evaluated in Section 4.3. The description and detailed analysis of each alternative is presented in Sections 4.3.2 to 4.3.7. A summary evaluation is presented in Section 4.4.

4.3 DESCRIPTION AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The detailed analysis of alternatives consists of the evaluation of each alternative against seven evaluation criteria which encompass technical, cost and institutional considerations; and compliance with statutory requirements. The detailed analysis presented in this section generally follows the outline presented in the Municipal RI/FS Guidance document.

A discussion of the general Site monitoring program which is a component of all alternatives with the exception of the No Action alternative (Alternative 1) is presented in Section 4.3.1. Additional monitoring required for alternatives involving treatment processes may also be required.

4.3.1 Monitoring Program

A general Site groundwater and surface water monitoring program will be implemented with all remedial alternatives with the exception of the No Action alternative (Alternative 1). The monitoring program will be designed to distinguish landfill-derived contamination from the existing groundwater and surface water quality at the Site.

Sampling and analyses will be conducted on a quarterly basis in accordance with 6 NYCRR Part 360.

The following twenty-four groundwater wells, of which 12 are proposed new wells, will be monitored to ensure that samples are collected from each of the waterbearing units:

Well	*Unit Monitored*
NCR-3S	Shallow Silt Unit
NCR-3M	Lower Till Unit
NCR-3D (Proposed)	Bedrock-Oak Orchard Formation
NCR-4S	Shallow Silt Unit
NCR-4M	Lower Till Unit
NCR-4D (Proposed)	Bedrock-Oak Orchard Formation
NCR-5S	Shallow Silt Unit
NCR-5M	Lower Till Unit
NCR-5D	Bedrock-Oak Orchard Formation
NCR-6M	Lower Till Unit
NCR-6D	Bedrock-Oak Orchard Formation
NCR-7I (Proposed)	Lower Till Unit

NCR-7M	Bedrock-Vernon Formation
NCR-8I (Proposed)	Lower Till Unit
NCR-8D	Bedrock-Oak Orchard Formation
NCR-10S (Proposed)	Shallow Silt Unit
NCR-10M	Lower Till Unit
NCR-10D (Proposed)	Bedrock-Oak Orchard Formation
NCR-13S (Proposed)	Shallow Silt Unit
NCR-13M (Proposed)	Lower Till Unit
NCR-13D (Proposed)	Bedrock-Oak Orchard Formation
NCR-14S (Proposed)	Shallow Silt Unit
NCR-14M (Proposed)	Lower Till Unit
NCR-14D (Proposed)	Bedrock-Oak Orchard Formation

In addition four surface water sample locations will be selected for monitoring.

Groundwater monitoring locations are shown on Figure 4.1.

Sampling and analysis will be conducted in accordance with 6 NYCRR Part 360. As specified in 6 NYCRR Part 360 Section 2.15(i) environmental monitoring points will be maintained and sampled for a minimum of thirty years. Sampling and analysis will be conducted quarterly, once annually for baseline parameters and three times annually for routine parameters as summarized in Table 4.3. The expanded parameters listed in Table 4.3, will only be analyzed if, during analysis of baseline parameters, contamination by any toxic metal, cyanide, volatile organic compound or other substance identified in Appendix 33 of 6 NYCRR Part 373-2 is found.

All environmental monitoring results would be reported to the EPA and NYSDEC on a quarterly basis as specified in 6 NYCRR Part 360 Section 1.4(c). In addition, annual monitoring reports will be submitted to the EPA and NYSDEC. Following the monitoring for the first five years, and for each subsequent 5-year period, the monitoring program will be reviewed with the EPA and NYSDEC in order to determine the sampling and analyses for the next 5-year period.

4.3.2 Alternative 1- No Action

The No Action alternative does not include any remedial measures following completion of the FS. The No Action alternative is required by the NCP to serve as a basis for comparison with other remedial alternatives.

4.3.2.1 Alternative 1 - Short-Term Effectiveness

As Alternative 1 involves no remedial action, there would be no additional benefits or risks to the community, workers or the environment as a result of the implementation of this alternative in the short term.

4.3.2.2 Alternative 1 - Long-Term Effectiveness and Permanence

The BRA-TRC indicates that the current health risks associated with the Site fall within the EPA's acceptable risk range. However, since the No Action alternative does not include remedial measures or maintenance, the existing cap may deteriorate resulting in increased leaching to the surface water and/or sediment. Therefore, this alternative would not be effective in the long-term and is not a permanent remedy for the Site.

4.3.2.3 Alternative 1 - Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 1 provides no additional reduction in the toxicity, mobility or volume of chemical contaminants at the Site beyond what would be achieved through natural attenuation.

4.3.2.4 Alternative 1 - Implementability

As Alternative 1 involves no remedial action, it can be easily implemented. The only activity associated with the No Action alternative is the 5-year periodic reviews. The 5-year review is administratively feasible but technically difficult since no monitoring is associated with this alternative. A quantitative assessment of the conditions of the Site would not be possible without a database.

4.3.2.5 Alternative 1 - Compliance with ARARs

The No Action alternative would not be in compliance with the New York Solid Waste Management Facilities Rules (6 NYCRR Part 360), which specifies that all landfills subject to regulation under this part must conform to the requirements for closure and post-closure care. These requirements include a final cover system, a landfill gas control system, a leachate collection system, surface drainage control and environmental monitoring.

4.3.2.6 Alternative 1 - Overall Protection of Human Health and the Environment

The No Action alternative would not reduce risks to human health and the environment. Based upon the results of the BRA-TRC current potential health risks associated with the Site fall within the EPA's acceptable risk range. However, since Alternative 1 does not include any remedial measures to address capping or maintenance of the existing cap increased leaching to the groundwater and surface water may result thereby increasing the potential future health and environmental risks associated with the Site. Under Alternative 1 future uses of the Site would be restricted.

4.3.2.7 Alternative 1 - Cost

The only costs associated with this alternative would occur as a result of the 5-year review of the Site. The cost associated with the implementation of this alternative is summarized in Table 4.4. The total present worth of Alternative 1, based on a 6 percent discount rate over a 30-year period is estimated to be $30,500. Detailed costs for Alternative 1 are provided in Appendix D.

4.3.3 Alternative 2 - Deed Restrictions, Access Control, Monitoring

Alternative 2 includes the implementation of institutional controls to minimize the potential exposure to landfill contents and to limit future uses of the Site.

A perimeter fence would be installed with locked gates. The fence would prevent access of unauthorized personnel to the Site.

Deed restrictions would consist of a restrictive covenant written into the landfill property deed to notify any potential purchaser of the property that the land was used for waste disposal and that future land use must be restricted in order to ensure the integrity of the existing cap. A restrictive covenant should limit subsurface development (excavation), excessive vehicular traffic (including off-road vehicles and dirt bikes) and groundwater use beneath the Site.

An environmental monitoring program would be implemented as discussed in Section 4.3.1.

4.3.3.1 Alternative 2 - Short-Term Effectiveness

As Alternative 2 involves no disturbance of any of the contents of the landfill there would be no additional short-term impacts to the community, workers or the environment as a result of implementation of this alternative. The institutional controls could be implemented in a relatively short period of time (estimated one year).

4.3.3.2 Alternative 2 - Long-Term Effectiveness and Permanence

Implementation of Alternative 2 would reduce the potential risks associated with direct contact of the landfill contents. The effectiveness of deed restrictions is dependent upon the laws of New York State and local municipal laws. Continued enforcement and maintenance would be required to ensure the long-term effectiveness of deed restrictions. Most deed restrictions are subject to changes in political jurisdiction, legal interpretation and level of enforcement. Since Alternative 2 does not include capping or maintenance of the existing cap, increased leaching may occur to the surface water and/or sediment, thereby increasing the potential future risks to human health and the environment. Therefore, Alternative 2 is not considered to be effective in the long-run and is not a permanent remedy for the Site.

4.3.3.3 Alternative 2 - Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 2 provides no additional reduction in the toxicity, mobility, or volume of chemical contaminants at the Site beyond what would be achieved through natural attenuation.

4.3.3.4 Alternative 2 - Implementability

Institutional controls are generally easy to implement. The installation of the perimeter fence involves common construction practices and materials that are readily available. It is unlikely that technical problems would lead to substantial delays for implementation.

The restrictive covenant for the Site to restrict land use to ensure the integrity of the waste containment system would require coordination with the Town of Wheatfield, City of North Tonawanda, surrounding property owners and municipal and state agencies.

4.3.3.5 Alternative 2 - Compliance with ARARs

Alternative 2 would not be in compliance with the New York Solid Waste Management Facilities Rules (6 NYCRR Part 360) which specifies that all landfills subject to regulation under this part must conform to the requirements for closure and post-closure care. These requirements include a final cover system, a landfill gas control system, a leachate collection system, if necessary, surface drainage control and environmental monitoring.

4.3.3.6 Alternative 2 - Overall Protection of Human Health and the Environment

Potential exposure pathways would be reduced for Alternative 2 by implementing institutional controls to reduce the chance of contact with landfill contents. However, since Alternative 2 does not include any remedial measures to address capping or maintenance of the existing cap increased leaching to the surface water and/or sediment may result, thereby increasing the potential future health and environmental risks associated with the Site. Under Alternative 2 future uses of the Site would be restricted.

4.3.3.7 Alternative 2 - Cost

The total cost including labor costs associated with the implementation of Alternative 2 is summarized in Table 4.5. The estimated capital costs are $267,400, while the estimated annual operation and maintenance costs are $130,300. The total present worth of Alternative 2, based on a 6 percent discount rate over a 30-year period, is estimated to be $2,501,900. Detailed costs for Alternative 2 are provided in Appendix D.

4.3.4 Alternative 3 - Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection

Alternative 3 includes the implementation of deed restrictions and fencing as presented in Section 4.3.3 for Alternative 2. Deed restrictions would be implemented to protect the capped areas from future disturbance. A perimeter fence would be constructed to limit Site access. In addition, the Site would be capped with a cap meeting RCRA standards as described in Section 3.1.3. The cap would also include gas venting trenches in the cap as described in Section 3.2.4. Figure 4.2 presents a typical section through the proposed RCRA cap. A clay perimeter barrier wall would be installed in conjunction with the cap. The barrier wall would be approximately five feet in thickness and would extend to the native clay unit (average depth of 4.2 feet BGS). The clay perimeter barrier wall in combination with the gas venting trenches installed in the cap would effectively prevent the lateral migration of landfill gas from the Site.

Alternative 3 does not include remedial measures to specifically address leachate collection. However, as presented in Section 3.2.2, the amount of leachate that would be generated with a RCRA cap would be approximately 9,000 gallons/year (25 gallons/day). This small amount of leachate for a 50-acre site, would not require a collection system, and therefore would not be required under 6 NYCRR Part 360. In addition, the proposed clay barrier wall and the existing low permeable base of the landfill would limit the horizontal and vertical migration of leachate.

Prior to capping, the area would be graded to promote surface water drainage off the finished cap and to conform with the maximum (33 percent) and minimum (4 percent) slope criteria as specified in 6 NYCRR Part 360. To bring the Site up to the required grade it is anticipated that clean demolition and construction debris would be used as fill material. It is estimated that if the Site is capped as one cell, 330,000 cubic yards of fill material would be required. If the Site is to be capped as six individual cells then approximately 45,000 cubic yards of fill material would be required. The proposed final contours for the single cap and multiple cap options are presented on Figure 4.3 and 4.4, respectively. The actual capping configuration would be determined during the remedial design.

The environmental monitoring program presented in Section 4.3.1 would be conducted for the Site.

4.3.4.1 Alternative 3 - Short-Term Effectiveness

The construction of the RCRA cap would not result in any short-term impacts which cannot be readily mitigated and controlled. Increased noise levels and traffic disruptions would result during construction activities. These impacts, however, are common to all construction-related activities in an urban community.

The primary environmental impacts expected from construction of the cap include the fugitive dust emissions and the increased sediment load to adjacent wetlands or surface water bodies during the revegetation of the cap. These impacts can be reliably controlled by utilizing dust control measures during construction (e.g. application of water, calcium chloride, etc.) and by implementing soil erosion control measures both during and after construction.

The preliminary work including the placement and compaction of fill material (demolition and construction debris) and grading before installation of the cap would also result in short-term impacts as described above.

A properly enforced health and safety plan and the use of water for dust suppression would ensure that Site workers are not exposed to potentially contaminated airborne particulates.

It is anticipated that construction activities for Alternative 3 could be completed within a 2-year period.

4.3.4.2 Alternative 3 - Long-Term Effectiveness and Permanence

The implementation of Alternative 3 would eliminate the potential risks due to contact/ingestion of landfill contents and leachate seeps. Leachate migration would be significantly reduced by the reduction of infiltration with the cap in place. The lateral migration of landfill gas would be prevented by the gas venting trenches installed in the cap and additionally by the clay perimeter barrier wall.

Provided that the cap is maintained, this capping action is considered to have high reliability and is considered effective in the long-term.

4.3.4.3 Alternative 3 - Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 3 achieves no direct reduction in the toxicity, mobility or volume of contaminants through treatment beyond what would be achieved through natural attenuation.

The volume of contaminants in groundwater would be greatly reduced due to a significant reduction in the amount of precipitation which would infiltrate the landfill wastes following the installation of the RCRA cap. The reduction in infiltration would significantly minimize the mobility of landfill contaminants to migrate to the groundwater. Analyses conducted using the HELP Model (Appendix A) indicate that less than one percent of the precipitation onto the landfill will infiltrate to the wastes following installation of the cap. The amount of leachate that would be generated over the 50-acre Site is estimated to be 25 gallons per day.

4.3.4.4 Alternative 3 - Implementability

Implementation of Alternative 3 would involve common construction practices for which services and materials are readily available. The construction of the RCRA cap would be contingent upon completion of the subgrade. Preparation of the subgrade would include a substantial amount of clean fill material (demolition and construction debris), compaction of the fill material and grading. Delays in completion of the subgrade may occur if a sufficient quantity of suitable fill material cannot readily be obtained. Substantive compliance with State permit regulations would be required in order for the Site to accept clean demolition and construction debris.

The cap would require regular periodic maintenance to ensure optimal performance. Maintenance would be required to address stability problems associated with multi-layer caps, problems related to settlement of the subgrade and erosional concerns.

4.3.4.5 Alternative 3 - Compliance with ARARs

The construction of the RCRA cap with deed restrictions and fencing would meet the applicable ARARs as discussed in Section 2.1. Due to the low amount of leachate generated with this capping option, a leachate collection system would not be required. Therefore, Alternative 3 would also meet the NYS requirements for municipal solid waste facilities (6 NYCRR Part 360).

The gas venting trenches which would be installed in the cap instead of a 12-inch gas venting layer are not in strict accordance with the requirements of 6 NYCRR Part 360, however, they would satisfy the intent of the regulation. Given the low current volume of gas being generated at the

Site (approximately 126 cfm) it is anticipated that a variance could be obtained to allow for the construction of the gas venting trenches in the cap in place of a gas venting layer.

4.3.4.6 Alternative 3 - Overall Protection of Human Health and the Environment

Alternative 3 would effectively protect human health, public welfare and the environment. The vegetated RCRA cap would provide protection against contaminant transport via the surface water runoff pathway.

Although the current risk to the public and environment falls within the EPA's acceptable risk range as determined by the BRA-TRC, risks to the public would be further reduced in the long-term due to a significant reduction of infiltration to the landfill wastes, thereby reducing the potential for leachate seeps. Contact with landfilled wastes would be eliminated following installation of the RCRA cap and the construction of the perimeter fence. Under Alternative 3 future uses of the Site would be restricted.

4.3.4.7 Alternative 3 - Cost

The total cost including labor costs associated with the implementation of Alternative 3 is summarized in Table 4.6. The estimated capital costs are $20,243,200 to $22,148,900, while the estimated operation and maintenance costs are $150,300. The total present worth of Alternative 3, based on a 6 percent discount rate over a 30-year period, is estimated to be $22,821,700 to $24,727,400. Detailed costs for Alternative 3 are provided in Appendix D.

4.3.5 Alternative 4 - Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection

Alternative 4 includes the implementation of deed restrictions and fencing as presented in Section 4.3.3 for Alternative 2 and Section 4.3.4 for Alternative 3. Deed restrictions and fencing would be used to protect the cap. The Site would be capped with a cap meeting the standards for municipal solid waste facilities (NYS standard cap) in accordance with 6 NYCRR Part 360 as described in Section 3.1.3. The cap would also include gas venting trenches installed in the cap as described in Section 3.2.4. Figure 4.5 presents a typical section through the proposed NYS standard cap. A perimeter clay barrier wall would be installed in conjunction with the cap as described for Alternative 3 (Section 4.3.4).

Alternative 4, similar to Alternative 3, does not include specific remedial measures to address leachate collection. As presented in Section 3.3.2 the amount of leachate that would be generated with a NYS standard cap would be approximately 2.4 million gallons/year (6,600 gallons/day). The proposed clay barrier wall and the existing low permeable base of the landfill would limit the horizontal and vertical migration of leachate.

As with Alternative 3, approximately 330,000 cubic yards of fill material (clean demolition and construction debris) would be required to bring the Site up to the required grade to achieve the maximum (33 percent) and minimum (4 percent) slope criteria as specified in 6 NYCRR Part 360 if the Site is to be capped as one landfill cell. If the Site is to be capped as six individual cells then approximately 45,000 cubic yards of fill material would be required. The actual capping configuration will be determined during the remedial design. Figures 4.3 and 4.4 present the proposed final contours for the single cap and multiple cap options, respectively.

An environmental monitoring program would be implemented as discussed in Section 4.3.1.

4.3.5.1 Alternative 4 - Short-Term Effectiveness

As with the construction of the RCRA cap (Alternative 3) the construction of the NYS standard cap would not result in any short-term impacts which could not be readily mitigated and controlled. These impacts including noise levels and traffic disruptions are common to all construction activities in an urban community. Environmental impacts such as fugitive dust emissions and increased sediment load can be alleviated by implementation of dust control and soil erosion control as described in Section 4.3.4.1.

All work would be conducted under appropriate health and safety provisions to protect Site workers from hazards associated with the Site.

It is anticipated that construction activities for Alternative 4 could be completed within a 2-year period.

4.3.5.2 Alternative 4 - Long-Term Effectiveness and Permanence

As with the construction of the RCRA cap (Alternative 3) the implementation of Alternative 4 would eliminate the potential risks due to contact/ingestion of landfill contents and minimize the potential risks due to leachate seeps. Leachate migration would be significantly reduced by the reduction of infiltration with the cap in place, however, infiltration may occasionally be great enough to cause leachate seeps to continue to occur. The lateral migration of landfill gas would be prevented by the gas venting trenches installed in the cap and additionally by the clay perimeter barrier wall.

Provided that the cap is maintained, the capping action is considered to have high reliability and is considered effective in the long term.

4.3.5.3 Alternative 4 - Reduction of Toxicity, Mobility or Volume Through Treatment

As with Alternative 3, Alternative 4 achieves no direct reduction in the toxicity, mobility or volume of contaminants through treatment beyond what could be achieved through natural attenuation.

The volume of contaminants in groundwater would be greatly reduced due to a significant reduction in the amount of precipitation which would infiltrate the landfill wastes following the installation of the NYS standard cap. The reduction in infiltration would significantly minimize the mobility of landfill contaminants to migrate to the groundwater. Analyses conducted using the HELP Model (Appendix B) indicate that less than five percent of the precipitation onto the landfill will infiltrate to the wastes following installation of the cap. The amount of leachate that would be generated is estimated to be 6,600 gallons/day.

4.3.5.4 Alternative 4 - Implementability

As with Alternative 3, implementation of Alternative 4 would involve common construction practices for which services and material are readily available.

The construction of the NYS standard cap would be contingent upon completion of the subgrade. Preparation of the subgrade would include a substantial amount of fill material (clean demolition and construction debris), compaction of the fill material and grading. Delays in completion of the subgrade may occur if a sufficient quantity of suitable fill material cannot readily be obtained. Substantive compliance with State permit regulations would be required in order for the landfill to accept clean demolition and construction debris.

The cap would require regular periodic maintenance to ensure optimal performance.

4.3.5.5 Alternative 4 - Compliance with ARARs

The construction of the NYS standard cap with deed restrictions and fencing would meet the applicable ARARs as discussed in Section 2.1. However, in accordance with 6 NYCRR Part 360.215(g) the NYSDEC may require the construction of a leachate collection system to control leachate outbreaks that could adversely affect the landfill cover or threaten surface water/sediment quality.

The gas venting trenches which would be installed in the cap instead of a 12-inch gas venting layer are not in strict accordance with the requirements of 6 NYCRR Part 360, however, they would satisfy the intent of the regulation. Given the low current volume of gas being generated at the Site (approximately 126 cfm) it is anticipated that a variance could be obtained to allow for the construction of the gas venting trenches in the cap in place of a gas venting layer.

4.3.5.6 Alternative 4 - Overall Protection of Human Health and the Environment

Alternative 4 would effectively protect human health, public welfare and the environment. However, the NYS standard cap, without leachate collection, may not provide sufficient protection against or minimize the potential contaminant transport via the surface water runoff pathway.

Although the current risk to the public and environment falls within the EPA's acceptable risk range as determined by the BRA-TRC, risks to the public would be further reduced in the long term due to a significant reduction of infiltration to the landfilled wastes, thereby reducing the potential for leachate seeps, however, leachate seeps could continue to occur without a collection system present. Contact with landfilled wastes would be eliminated following installation of the NYS standard cap and the construction of the perimeter fence. Under Alternative 4 future uses of the Site would be restricted.

4.3.5.7 Alternative 4 - Cost

The total cost including labor costs associated with the implementation of Alternative 4 is summarized in Table 4.7. The estimated capital costs are $14,946,700 to $16,611,700, while the estimated operation and maintenance costs are $150,300. The total present worth of Alternative 4, based on a 6 percent discount rate, over a 30-year period, is estimated to be

$17,524,900 to $19,190,200. Detailed costs for Alternative 4 are provided in Appendix D.

4.3.6 Alternative 5 - Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment

Alternative 5 is identical to Alternative 4 with the exception of leachate collection and treatment. For Alternative 5 leachate would be collected in subsurface perimeter drains and treated on-Site. The treated leachate would be discharged to a drainage ditch running along the southern portion of the Site. Figure 4.6 presents the location of the subsurface perimeter leachate collection system for Alternative 5 and Figure 4.7 provides a typical cross-section through the leachate collection system.

Alternative 5 includes the implementation of deed restrictions and fencing as presented for Alternatives 2, 3 and 4. Deed restrictions and fencing would be used to protect the cap. The Site would be capped with a cap meeting the standards for municipal solid waste facilities (NYS standard cap) in accordance with 6 NYCRR Part 360 as described in Section 3.1.3. The cap would also include gas venting trenches in the cap as described in Section 3.2.4. The perimeter clay barrier wall would be installed in conjunction with the cap as described for Alternative 3 (Section 4.3.4).

In order to convey the anticipated 5 gpm of leachate generated, as estimated by the HELP model for the NYS standard cap, the leachate collection system would consist of the following:

- 8-inch diameter perforated high density polyethylene (HDPE) pipe installed around the perimeter of the Site with an approximate length of 10,000 ft;
- the system would be installed above the water table such that its minimum elevation would be 566.00 ft (AMSL);
- the system would be installed in a granular trench with a geotextile installed at the clay/granular interface. The granular trench would be connected to the cap's gas collection trenches;
- four pumping stations would be required in order to properly convey the leachate in the system; and
- leachate would be discharged to an on-Site treatment facility.

A preliminary review of applicable and effective treatment technologies and process options was performed based on the representative leachate data for the Site. As presented in Section 3.2.5, the following is an outline of the key components for the anticipated on-Site treatment system:

- physical and or chemical pretreatment to reduce metal concentrations and minimize solid formation. This may involve aeration and or pH adjustment followed by flocculation;
- aerobic biological treatment, using a suitable system for dealing with high strength and variable effluents (e.g. sequencing batch reactors or isolating biological contactors); and
- activated granular carbon treatment may be required for final polishing depending on the ARARs as described in Section 2.1.

The on-Site treatment plant would be located on a parcel of land adjacent to the southwest corner of the Site. The effluent from this treatment plant would be discharged into the ditch that runs along the southern portion of the Site.

As with Alternatives 3 and 4, approximately 330,000 cubic yards of clean fill material (demolition and construction debris) would be required to bring the Site up to the required grade to achieve the maximum (33 percent) and minimum (4 percent) slope criteria as specified in 6 NYCRR Part 360 if the Site is to be capped as one landfill cell. If the Site is to be capped as six individual cells, then approximately 45,000 cubic yards of clean fill material would be required. The actual cap configuration would be determined during the remedial design.

An environmental monitoring program would be implemented as discussed in Section 4.3.1.

4.3.6.1 <u>Alternative 5 - Short-Term Effectiveness</u>

The perimeter subsurface leachate collection drains would be built in conjunction with the NYS standard cap and would not result in any short-term impacts which could not be readily mitigated and controlled. These impacts including increased noise levels and traffic disruptions are common to all construction activities in an urban community. Environmental impacts such as fugitive dust emissions and increased sediment load can be alleviated by applicable controls as described in Section 4.3.4.1.

All work would be conducted under the appropriate health and safety provisions to protect Site workers form hazards associated with the Site.

It is anticipated that construction activities for Alternative 5 could be completed within a 2-year period.

4.3.6.2 Alternative 5 - Long-Term Effectiveness and Permanence

As with capping Alternatives 3 and 4 the implementation of Alternative 5 would eliminate the potential risks due to contact/ingestion of landfill contents and surface water. The lateral migration of landfill gas would be prevented by the gas venting trenches installed in the cap and additionally by the clay perimeter barrier wall.

Leachate migration would be significantly reduced by the reduction of infiltration with the cap in place and by the leachate perimeter subsurface drains. Leachate from the Site would be effectively treated at the on-Site treatment facility for the length of remediation.

Provided that the cap and leachate collection system are maintained, Alternative 5 is considered to have high reliability and is considered effective in the long-term.

4.3.6.3 Alternative 5 - Reduction of Toxicity, Mobility or Volume Through Treatment

Unlike Alternatives 1 to 4, Alternative 5 would achieve a direct reduction in toxicity, mobility and volume of contaminants through the collection and treatment of approximately 6,600 gallons/day of leachate. The leachate would be effectively treated at the on-Site treatment facility and subsequently discharged to a drainage ditch that runs along the southern portion of the Site.

4.3.6.4 Alternative 5 - Implementability

The implementation of Alternative 5 would involve common construction practices for which services and material are readily available.

As for Alternatives 3 and 4, the construction of the NYS standard cap would be contingent upon completion of the subgrade. The preparation of the subgrade would involve a substantial amount of clean fill material (demolition and construction debris), compaction of the fill material and grading. Delays in completion of the subgrade may occur if a sufficient quantity of suitable fill material cannot readily be obtained. Substantive compliance with State permit regulations would be required in order for the Site to accept clean demolition and construction debris.

The installation of the perimeter subsurface leachate collection drain would be coordinated with the construction of the cap, gas venting trenches in the cap and the clay perimeter barrier wall. Refuse excavated during the installation of the leachate collection system would be relocated and graded on the landfill before completion of the final contours for the cap subgrade.

Prior to the final design and construction of the on-Site leachate treatment system treatability studies would be required to select the appropriate components of the treatment system.

The on-Site treatment facility would require routine inspection and maintenance as would the cap and leachate collection system to ensure optimal performance of the remedial components.

Substantive compliance with applicable State and Federal regulations would be required for direct discharge of treatment system effluent.

4.3.6.5 Alternative 5 - Compliance with ARARs

The construction of the NYS standard cap, leachate collection system, on-Site leachate treatment, deed restrictions and fencing would meet the ARARs as discussed in Section 2.1. The gas venting trenches which would be installed in the cap instead of a 12-inch gas venting layer are not in strict accordance with the requirements of 6 NYCRR Part 360, however, they would satisfy the intent of the regulation. Given the low current volume of gas being generated at the Site (approximately 126 cfm) it is anticipated that a variance could be obtained to allow for the construction of the gas venting trenches in the cap in place of a gas venting layer.

4.3.6.6 Alternative 5 - Overall Protection of Human Health and the Environment

Alternative 5 would effectively protect human health, public welfare and the environment. Contact with landfilled wastes and surface water runoff would be eliminated by the installation of the cap, deed restrictions and the perimeter fence.

The leachate collection system would effectively eliminate risks associated with contaminant migration to the surface water. The collected leachate would be effectively treated by the on-Site treatment facility before being released to the environment. Under Alternative 5 future uses of the Site would be restricted.

4.3.6.7 Alternative 5 - Cost

The total cost including labor costs associated with the implementation of Alternative 5 is summarized in Table 4.8. The estimated capital cost is $16,626,900 to $18,291,900, while the estimated annual operation and maintenance costs are $360,300. The total present worth of Alternative 5, based on a 6 percent discount rate over a 30 year period, is estimated to be $22,818,400 to $24,5483,400. Detailed costs are provided in Appendix D.

4.3.7 Alternative 6 - Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment

Alternative 6 is identical to Alternative 5 with the exception of leachate treatment. For Alternative 6, leachate would be collected and pumped via direct discharge by forcemain to the City of North Tonawanda's sanitary sewer system. The sanitary sewer is strictly a sanitary sewer and is not combined with a storm sewer. As such, the sanitary sewer is a 'closed system'. Connection to the sanitary sewer system would be made at the west manhole along Warner Avenue approximately 500 feet east of the Site. The leachate would then be treated at the City of North Tonawanda's wastewater treatment facility (POTW). Figure 4.8 presents the location of the subsurface perimeter leachate collection system for Alternative 6.

Similarly to Alternatives 4 and 5, Alternative 6 would include a NYS standard cap meeting the standards for municipal solid waste facilities in accordance with 6 NYCRR Part 360 as described in Section 3.2.3. The cap would include gas venting trenches installed in the cap as described in Section 3.2.4. A perimeter clay barrier wall would be installed in conjunction with the cap as described for Alternative 3 (Section 4.3.4).

As presented in Section 3.3.2 the amount of leachate that would be generated with a NYS standard cap would be approximately

2.4 million gallons/year (6,600 gallons/day). The proposed perimeter clay barrier wall and the existing low permeable base of the landfill would limit the horizontal and vertical migration of leachate. Therefore, it is anticipated that the leachate subsurface perimeter drains would collect the vast majority of the leachate generated by the Site. The estimated amount of leachate that would be collected and conveyed via the sanitary sewer system to the City of North Tonawanda's POTW represents approximately 0.1 percent of their current used capacity.

As with Alternatives 3, 4 and 5, approximately 330,000 cubic yards of clean fill material (demolition and construction debris) would be required to bring the Site up to the required grade to achieve the maximum (33 percent) and minimum (4 percent) slope criteria as specified in 6 NYCRR Part 360 if the Site is to be capped as one landfill cell. If the Site is to be capped as six individual cells, then approximately 45,000 cubic yards of fill material would be required. Figures 4.3 and 4.4 present the proposed final contours for the single cap and multiple cap options, respectively. The actual cap configuration would be determined during the remedial design.

An environmental monitoring program would be implemented as discussed in Section 4.3.1.

4.3.7.1 Alternative 6 - Short-Term Effectiveness

As with the cap construction for Alternatives 3 to 5, the construction of the NYS standard cap for Alternative 6 would not result in any short-term impacts which could not be readily mitigated and controlled. Environmental impacts such as fugitive dust emissions and increased sediment load can be alleviated by applicable controls as described in Section 4.3.4.1.

All work would be conducted under appropriate health and safety provisions to protect Site workers from hazards associated with the Site.

The connection to the sanitary sewer would be made approximately 500 feet east of the Site along Warner Avenue. As no houses have been constructed along this section of Warner Avenue, disruption to nearby residents would be minimal.

It is anticipated that construction activities for Alternative 6 could be completed within a 2-year period.

4.3.7.2 Alternative 6 - Long-Term Effectiveness and Permanence

As with the other capping alternatives (Alternatives 3, 4 and 5), the implementation of Alternative 6 would eliminate the potential risks due to contact/ingestion of landfill contents and surface water. The lateral migration of landfill gas would be prevented by the gas venting trenches installed in the cap and additionally by the clay perimeter barrier wall.

Leachate migration would be significantly reduced by the reduction of infiltration with the cap in place and by the leachate perimeter subsurface drains. Leachate from the Site would be effectively treated at the City of North Tonawanda's POTW for the length of remediation.

Provided that the cap and leachate collection system are maintained, Alternative 6 is considered to have high reliability and is considered effective in the long-term.

4.3.7.3 Alternative 6 - Reduction of Toxicity, Mobility or Volume Through Treatment

Similar to Alternative 5, Alternative 6 would achieve a direct reduction in toxicity, mobility and volume of contaminants through the collection and treatment of approximately 6,600 gallons/day of leachate. The leachate would be effectively treated at the City of North Tonawanda's POTW.

In addition, with the NYS standard cap in place, the amount of infiltration would be reduced to less than five percent of the precipitation onto the landfill, thereby reducing the potential for leachate seeps.

4.3.7.4 Alternative 6 - Implementability

The implementation of Alternative 6 would involve common construction practices for which services and material are readily available.

As for Alternative 3 to 5, the construction of the NYS standard cap for Alternative 6 would be contingent upon completion of the subgrade. Preparation of the subgrade would involve a substantial amount of clean fill material (demolition and construction debris), compaction of the fill material and grading. Delays in completion of the subgrade may occur if a sufficient quantity of suitable fill material cannot readily be obtained. Substantive compliance with State permit conditions would be required in order for the Site to accept clean demolition and construction debris.

Approvals and right-of-way access agreements would be required to connect the leachate collection system with the existing sanitary sewer system along Warner Avenue.

Approval from the City of North Tonawanda's POTW would be required for the treatment of the Site leachate. The POTW has all other necessary state and federal permits for the operation of its facility, so that no additional permits would be required. As the POTW's permits are renewed on an annual basis it cannot be guaranteed that the Site leachate would be accepted at the POTW in the long-term. Contingency measures would be required if acceptance of the leachate at the POTW is rescinded.

The cap and leachate collection system would require periodic inspection, cleaning and maintenance to insure optimal performance.

4.3.7.5 Alternative 6 - Compliance With ARARs

The construction of the NYS standard cap, leachate collection system, off-Site leachate treatment, deed restrictions and fencing would meet the ARARs as discussed in Section 2.1. The gas venting trenches, which would be installed in the cap instead of a 12-inch gas venting layer, are not in strict accordance with the requirements of 6 NYCRR Part 360, however, they would satisfy the intent of the regulation. Given the low current volume of gas being generated at the Site (approximately 126 cfm) it is anticipated that a variance could be obtained to allow for the construction of the gas venting trenches in the cap in place of a gas venting layer.

4.3.7.6 Alternative 6 - Overall Protection of Human Health and the Environment

Alternative 6 would effectively protect human health, public welfare and the environment. Contact with landfilled wastes and surface water runoff would be eliminated by the installation of the cap, deed restrictions and the perimeter fence.

The leachate collection system would effectively eliminate risks associated with contaminant migration to the surface water and/or sediments. The leachate would be effectively treated at the City of North Tonawanda's POTW. Under Alternative 6 future uses of the Site would be restricted.

4.3.7.7 Alternative 6 - Cost

The total cost including labor costs associated with the implementation of Alternative 6 is summarized in Table 4.9. The estimated capital costs are $15,907,700 to $17,572,700, while the estimated operation and maintenance costs are $198,700. The total present worth of Alternative 6 based on 6 percent discount rate over a 30-year period is estimated to be $19,318,800 to $20,983,800. Detailed costs for Alternative 6 are provided in Appendix D.

4.4 SUMMARY OF EVALUATION

Each remedial alternative was evaluated separately in Sections 4.3.2 to 4.3.7 using the seven evaluation criteria required for the detailed analysis. A summary of this evaluation is presented in Table 4.10. This section presents an evaluation of each of the alternatives relative to each other.

Short-Term Effectiveness

Alternatives 1 and 2 would not have any significant short-term effects on the community, workers or the environment. The installation of a cap for Alternatives 3 to 6 would eliminate potential contact with leachate seeps and landfill contents. The construction of the cap for Alternatives 3 to 6 would not result in any short-term impacts which cannot be readily mitigated and controlled.

It is anticipated that Alternatives 1 and 2 could be completed within a 1-year period. Construction activities for alternatives that include capping (Alternatives 3 to 6) would be completed within a 2-year period to allow for compaction of the fill material and settlement of landfilled waste over the winter season.

Long-Term Effectiveness and Permanence

The lack of maintenance for Alternatives 1 and 2 may result in further deterioration of the existing cap resulting in leachate contaminating surface water and sediment. Alternatives 1 and 2 are, therefore, not considered effective nor permanent in the long-term.

Provided that the cap is maintained, Alternatives 3 to 6 are considered effective and permanent in the long-term. Direct contact with landfill contents and leachate seeps would be eliminated; leachate generation and migration would be significantly reduced minimizing the potential for surface water and sediment contamination and lateral landfill gas migration would be effectively controlled. However, for Alternative 4, the installation of a NYS standard cap without a leachate collection system may result in the continued occurrence of leachate seeps.

The permanence of Alternatives 5 and 6 is also dependent upon the maintenance and long-term availability of the leachate treatment system for each alternative.

Reduction of Toxicity, Mobility or Volume Through Treatment

Alternatives 1 and 2 do not include treatment of the landfill contents and provide no additional reduction in the toxicity, mobility or volume of chemical contaminants at the Site beyond what would be achieved through natural attenuation.

The volume of contaminants would be significantly reduced by installation of either a RCRA cap (Alternative 3) or a NYS standard cap (Alternatives 4 to 6).

Alternatives 5 and 6 would provide an additional reduction in the toxicity, mobility and volume of contaminants through either on-Site leachate treatment (Alternative 5) or off-Site treatment (Alternative 6).

Implementability

Alternatives 1 and 2 can be readily implemented as they involve either no remedial action (Alternative 1) or deed restrictions and access control (Alternative 2).

The capping alternatives (Alternatives 3 to 6) can be readily implemented as they involve common construction techniques for which services and materials are readily available. The construction of the cap for Alternatives 3 to 6 would be contingent upon preparation of the subgrade which would involve the importation, compaction and grading of a substantial amount of clean demolition and construction debris as per EPA and NYSDEC acceptability. The cap would require regular maintenance to ensure optimal performance.

The installation of the perimeter subsurface leachate collection drain for Alternatives 5 and 6 would also involve common construction practices and could be readily implemented.

The on-Site leachate treatment facility for Alternative 5 would require treatability studies to determine the appropriate technology components prior to final design. A suitable area of the Site would be selected for locating the treatment facility.

The implementation of off-Site leachate treatment for Alternative 6 is contingent upon acceptance and approval by the City of North Tonawanda's POTW.

Substantive compliance with New York State air and SPDES permits may be required for on-Site leachate treatment for Alternative 5.

Leachate may be required to meet the requirements of 40 CFR Part 403 and the City of North Tonawanda's Sewer Use Ordinance for off-Site treatment for Alternative 6.

Alternatives 2 to 6 would be effectively monitored by the groundwater and surface water monitoring plan presented in Section 4.3.1.

Alternatives 1 to 6 would be subject to 5-year reviews.

Compliance With ARARs

Alternatives 1 and 2 would not be in compliance with action specific and location specific ARARs concerning closure and post-closure requirements for closed municipal landfills.

Alternatives 3 and 4 would be in compliance with applicable ARARs with the possible exception of 6 NYCRR Part 360 concerning requirements for a leachate collection system. Alternative 3 involves the installation of a RCRA cap which would reduce the estimated leachate generation to approximately 25 gallons/day; a quantity for which a leachate collection system is not considered necessary. The installation of a NYS standard cap for Alternative 4 would reduce the estimated leachate generation to approximately 6,600 gallons/day. A leachate collection system may, therefore, be considered necessary for Alternative 4.

Alternatives 5 and 6 would be in compliance with all applicable action specific and location specific ARARs.

Overall Protection of Human Health and the Environment

Although risks to human health and the environment fall within the EPA's acceptable risk range, the lack of maintenance for Alternatives 1 and 2 in the future may result in increased potential risks to human health and the environment on- and off-Site. Future use of the Site would be restricted for all alternatives.

Alternatives 3, 5 and 6 are considered protective of human health and the environment in the long-term. Alternative 4 would eliminate contact with landfilled wastes, however, leachate seeps may still occur potentially contaminating surface soils and surface water causing potential future risks to human health and the environment on- and off-Site.

The reduction of toxicity, mobility and volume of contaminants would be enhanced by the treatment of leachate either on Site (Alternative 5) or off Site (Alternative 6).

Cost

The capital costs, including labour costs, for Alternatives 2 to 6 range from $267,400 (Alternative 2) to $22,148,900 (Alternative 3). The No Action alternative (Alternative 1) would not involve any capital expenditures. The operation and maintenance costs, including labour costs, for Alternatives 1 to 6 range from $2,200 (Alternative 1) to $360,300 (Alternative 5). The present worth costs for Alternatives 1 to 6 range from $30,500 (Alternative 1) to $24,727,400 (Alternative 3).

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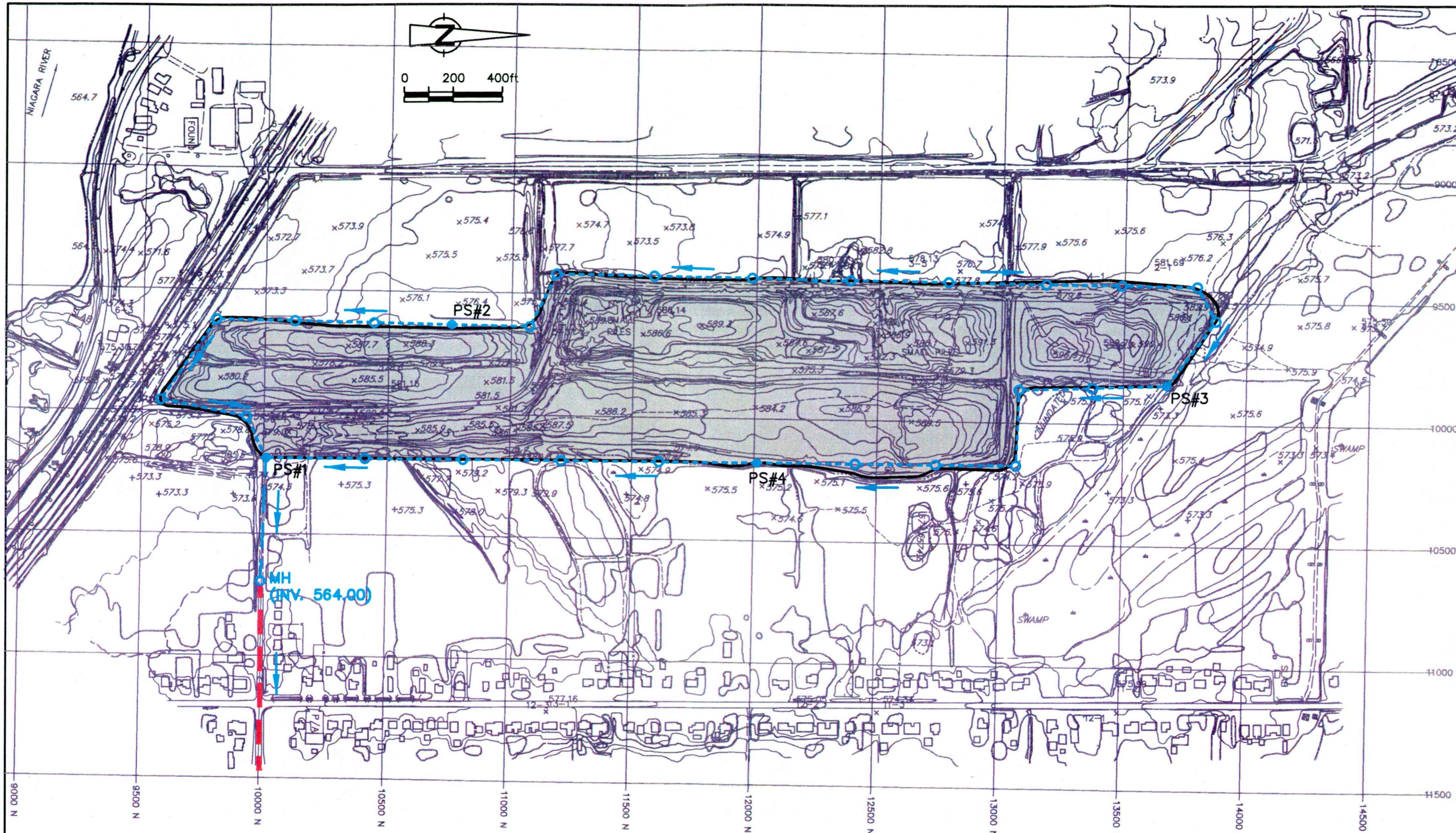
FIGURES



SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

×575.2 SPOT ELEVATION

PROPOSED CAP

PROPOSED MANHOLE

PS#4 PROPOSED PUMPING STATION

DIRECTION OF FLOW

EXISTING SANITARY SEWER

PROPOSED LEACHATE COLLECTION SYSTEM

PROPOSED FORCEMAIN

figure 4.8

ALTERNATIVE 6
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) APR 28/93 REV.0 (P-27)

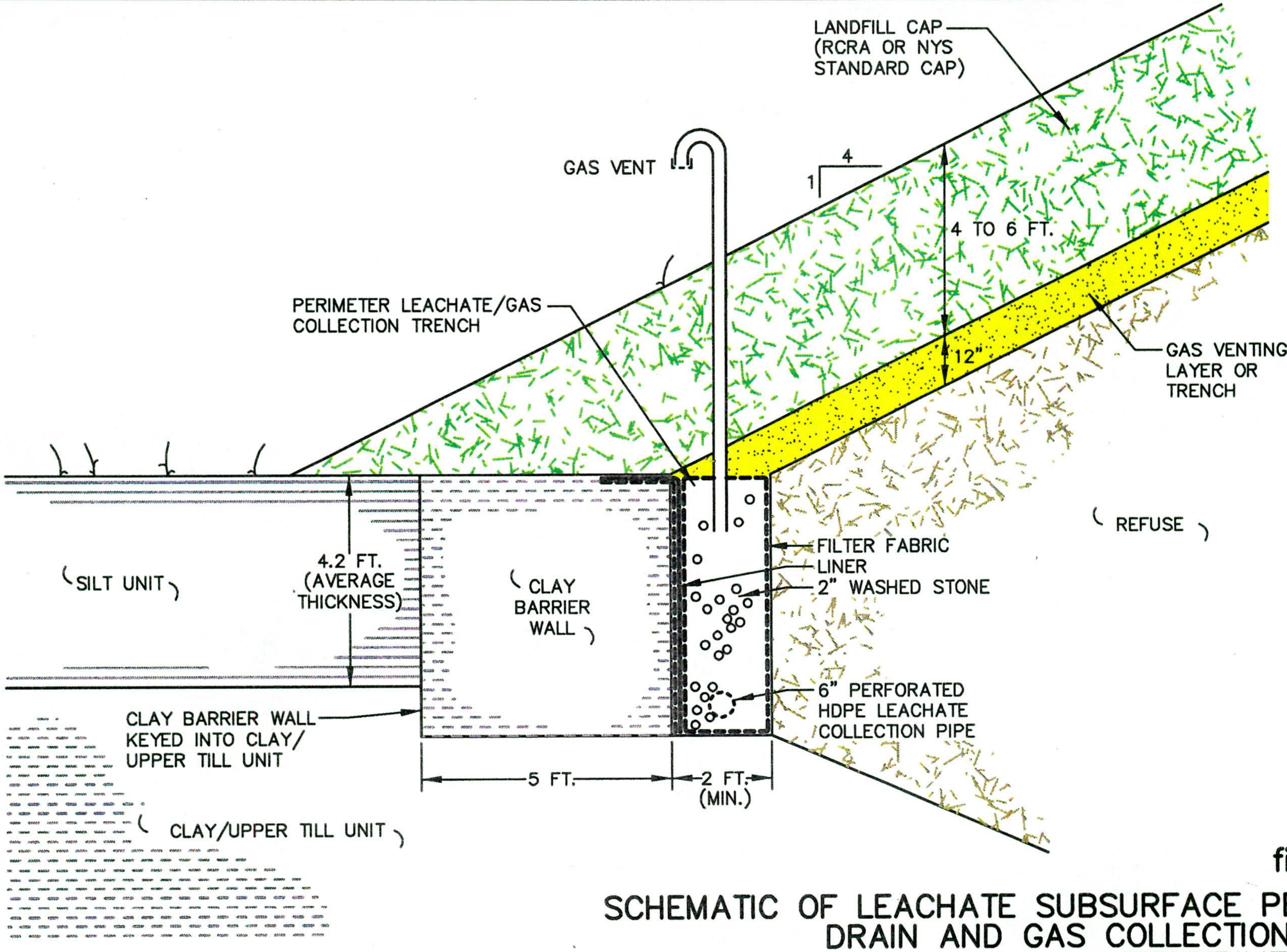
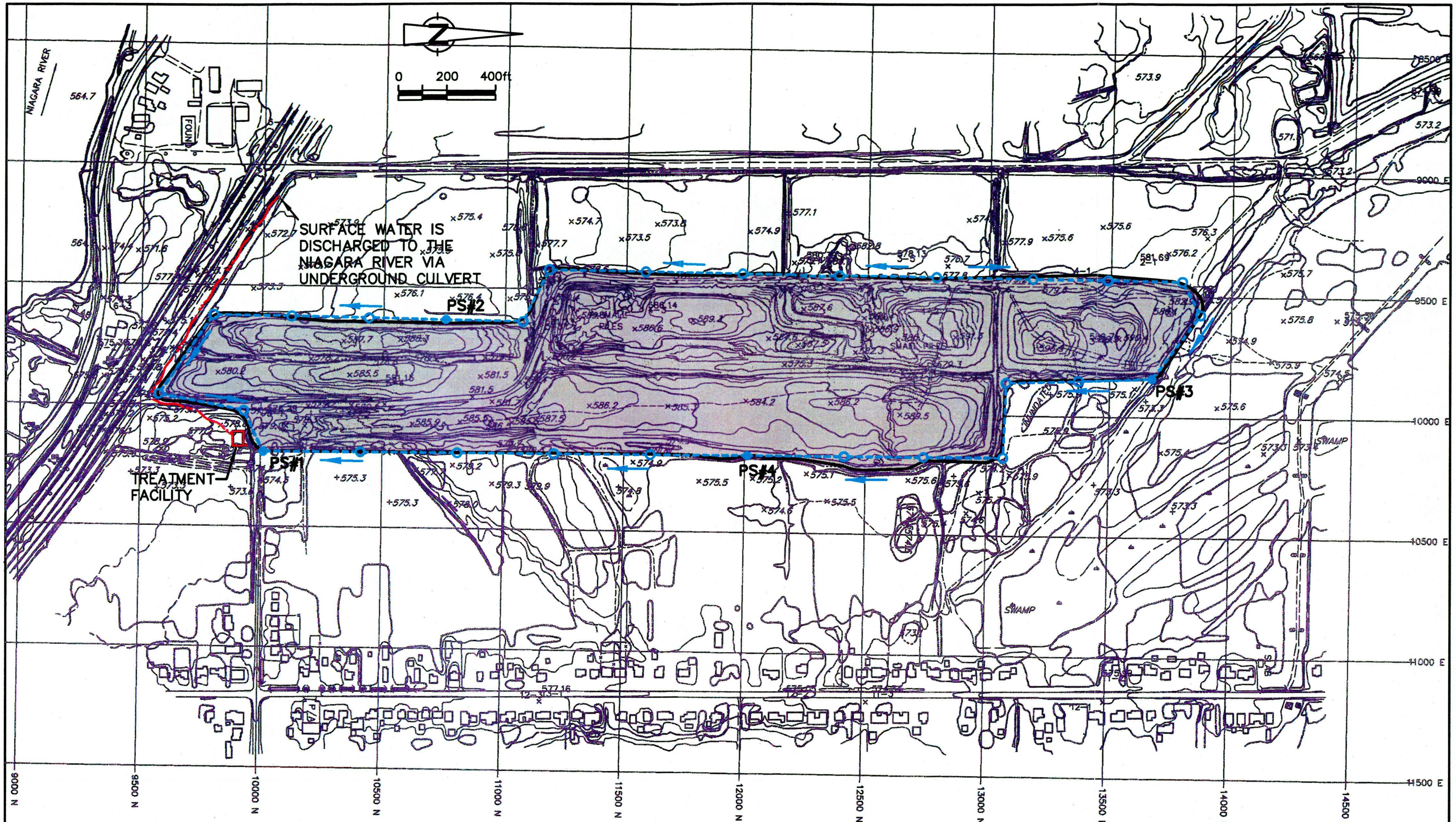


figure 4.7

SCHEMATIC OF LEACHATE SUBSURFACE PERIMETER DRAIN AND GAS COLLECTION SYSTEM
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) APR 06/93 REV.0 (D-06)



SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

×575.2 SPOT ELEVATION

PROPOSED CAP

PROPOSED MANHOLE

PS#4 PROPOSED PUMPING STATION

DIRECTION OF FLOW

PROPOSED LEACHATE COLLECTION SYSTEM

DISCHARGED TREATED WATER FROM TREATMENT FACILITY

figure 4.6

ALTERNATIVE 5
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) APR 28/93 REV.0 (P-28)

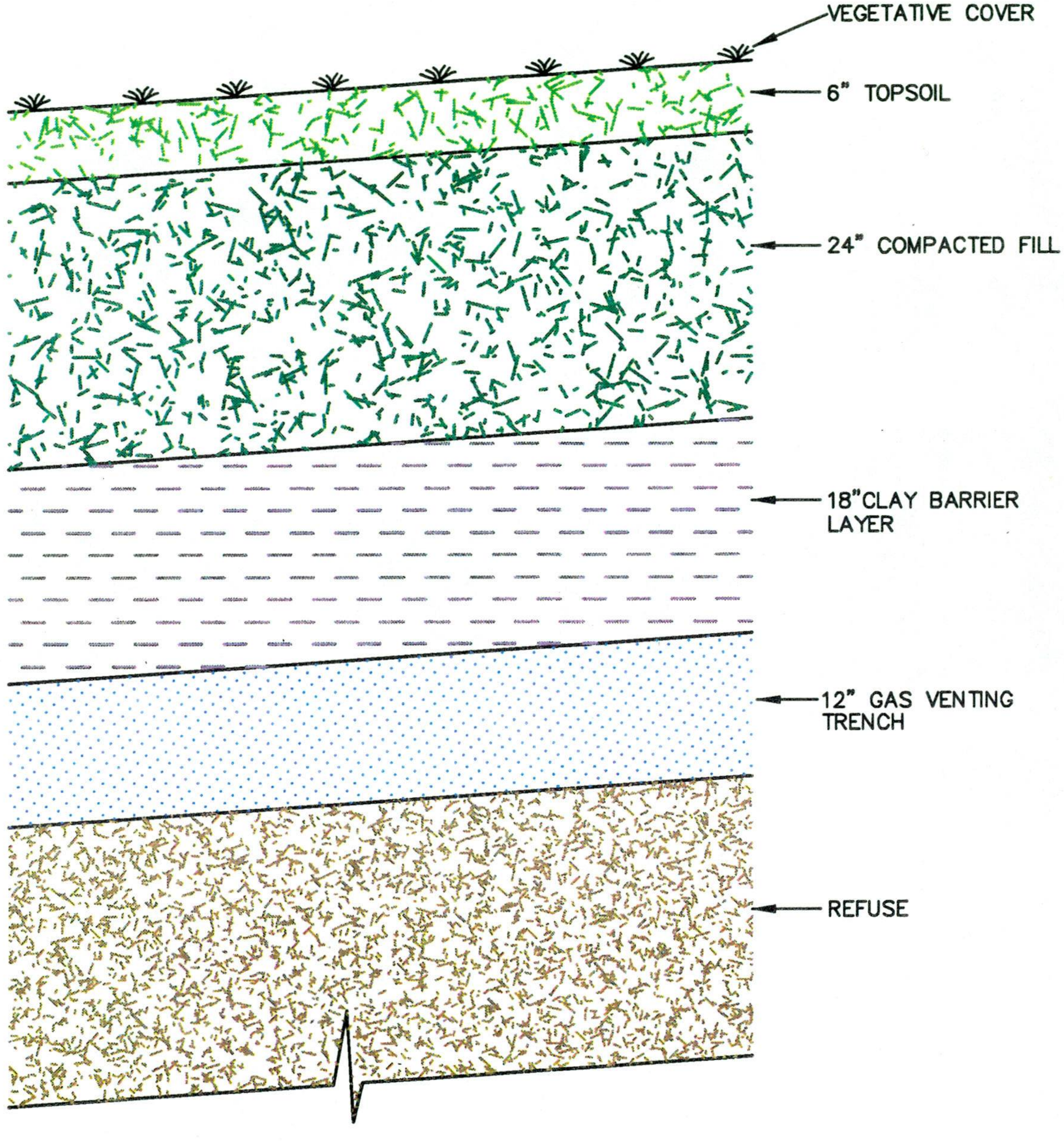
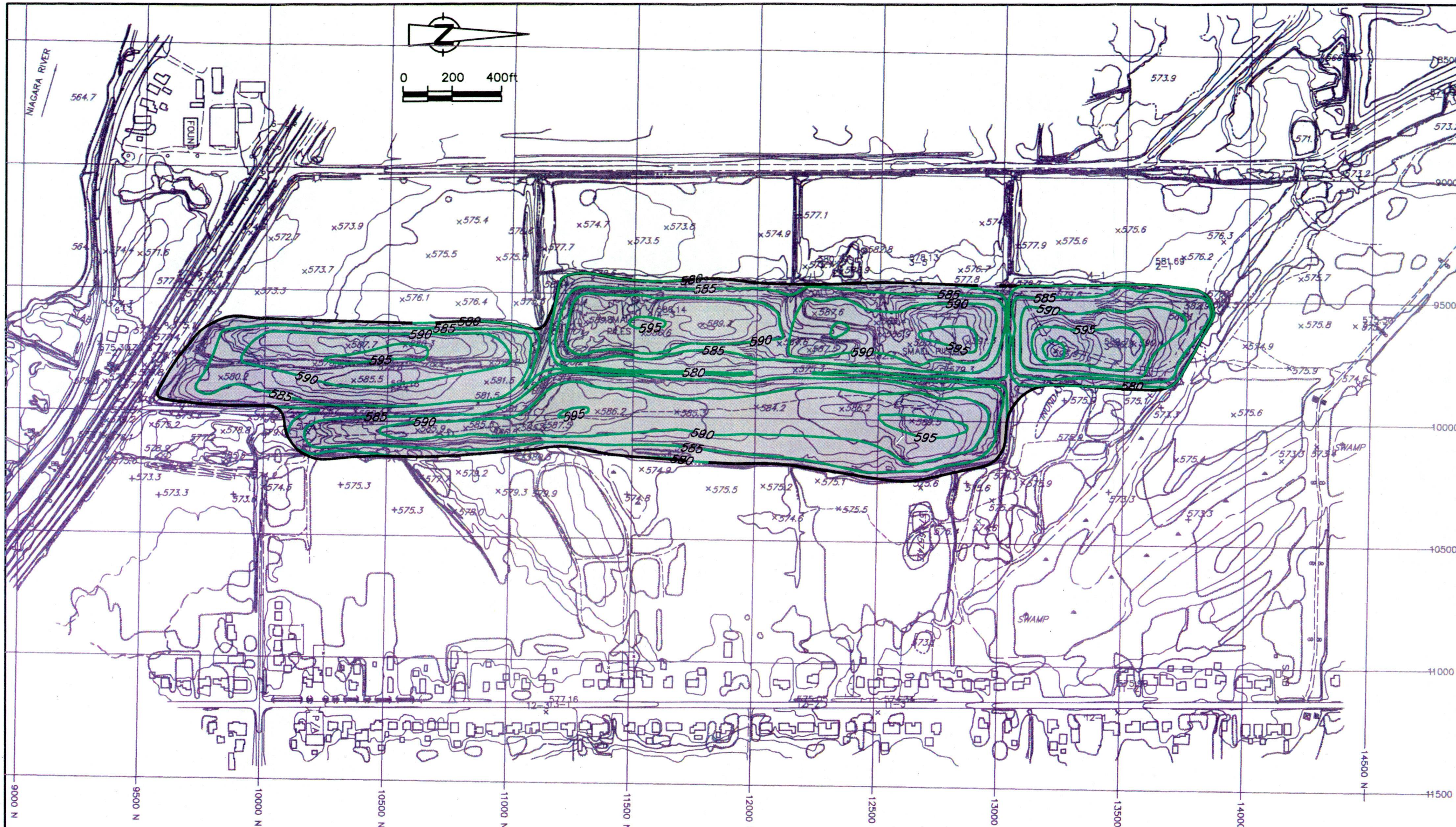


figure 4.5

TYPICAL SECTION NEW YORK STATE SANITARY LANDFILL CAP
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA



SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

×575.2 SPOT ELEVATION

590 PROPOSED GROUND CONTOUR

PROPOSED CAP

figure 4.4

MULTIPLE CAP OPTION
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) APR 28/93 REV.0 (P-25)

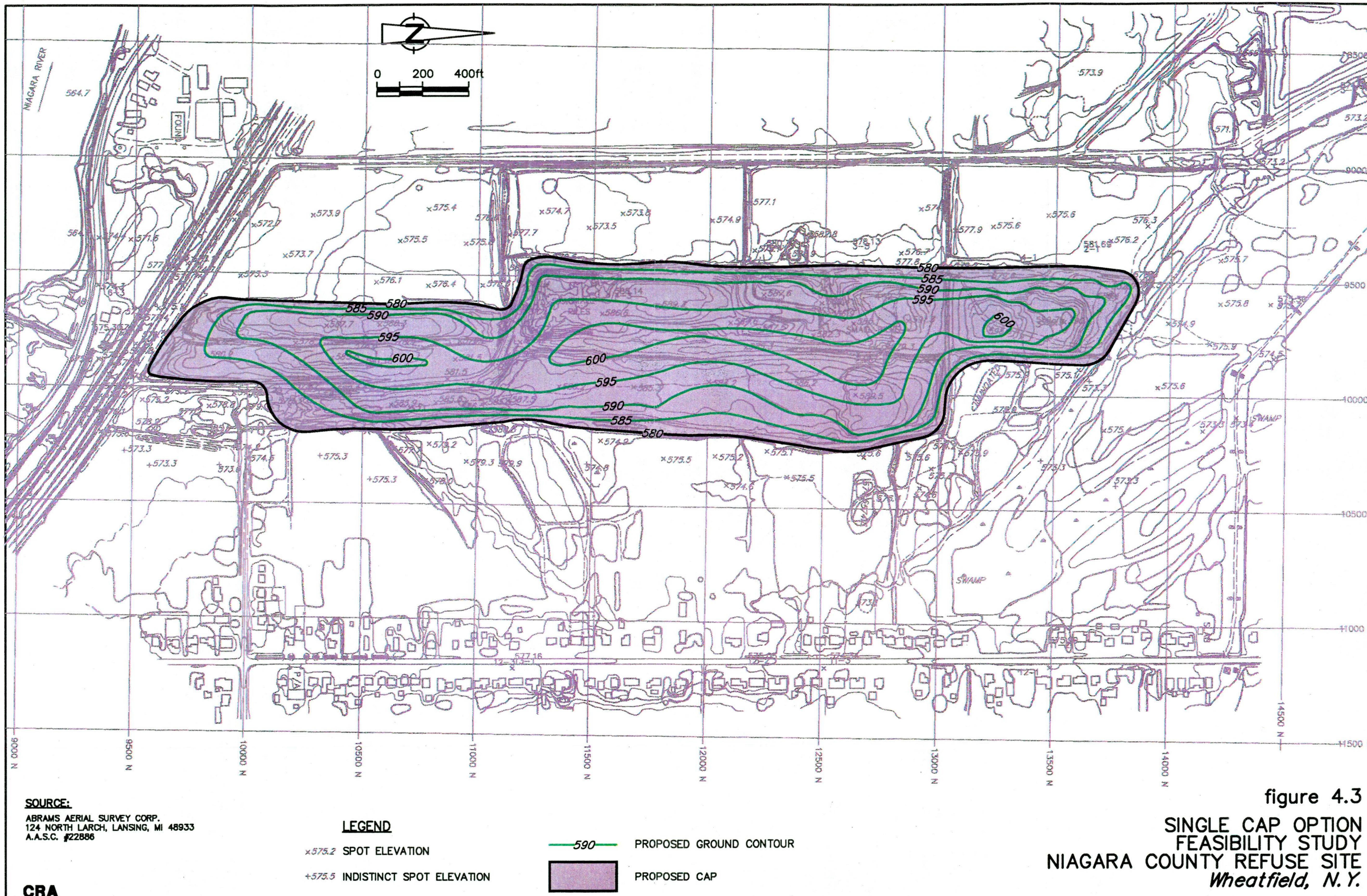


figure 4.3

SINGLE CAP OPTION
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

2677 (16) JULY 01/93(W) REV.1 (P-26)

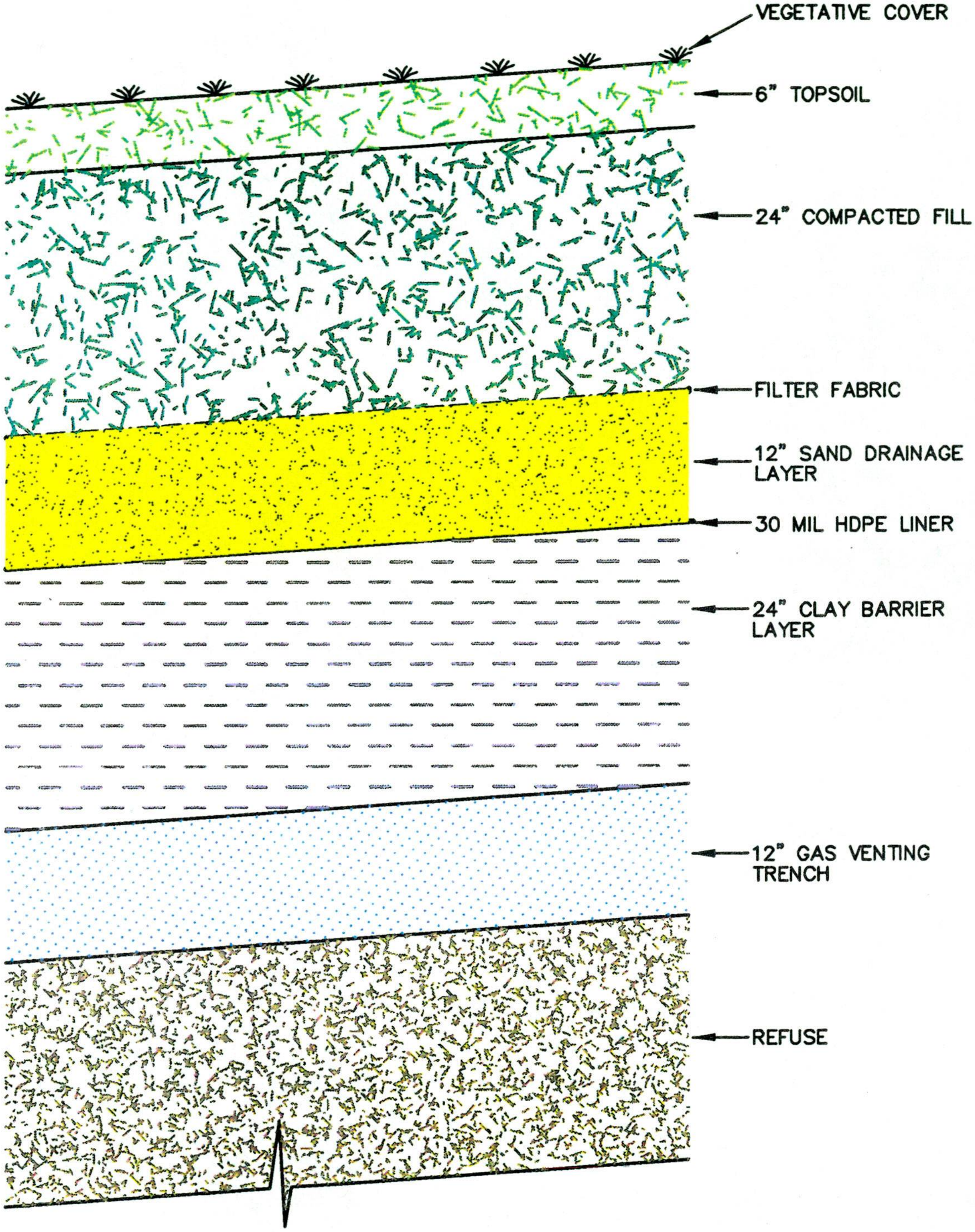
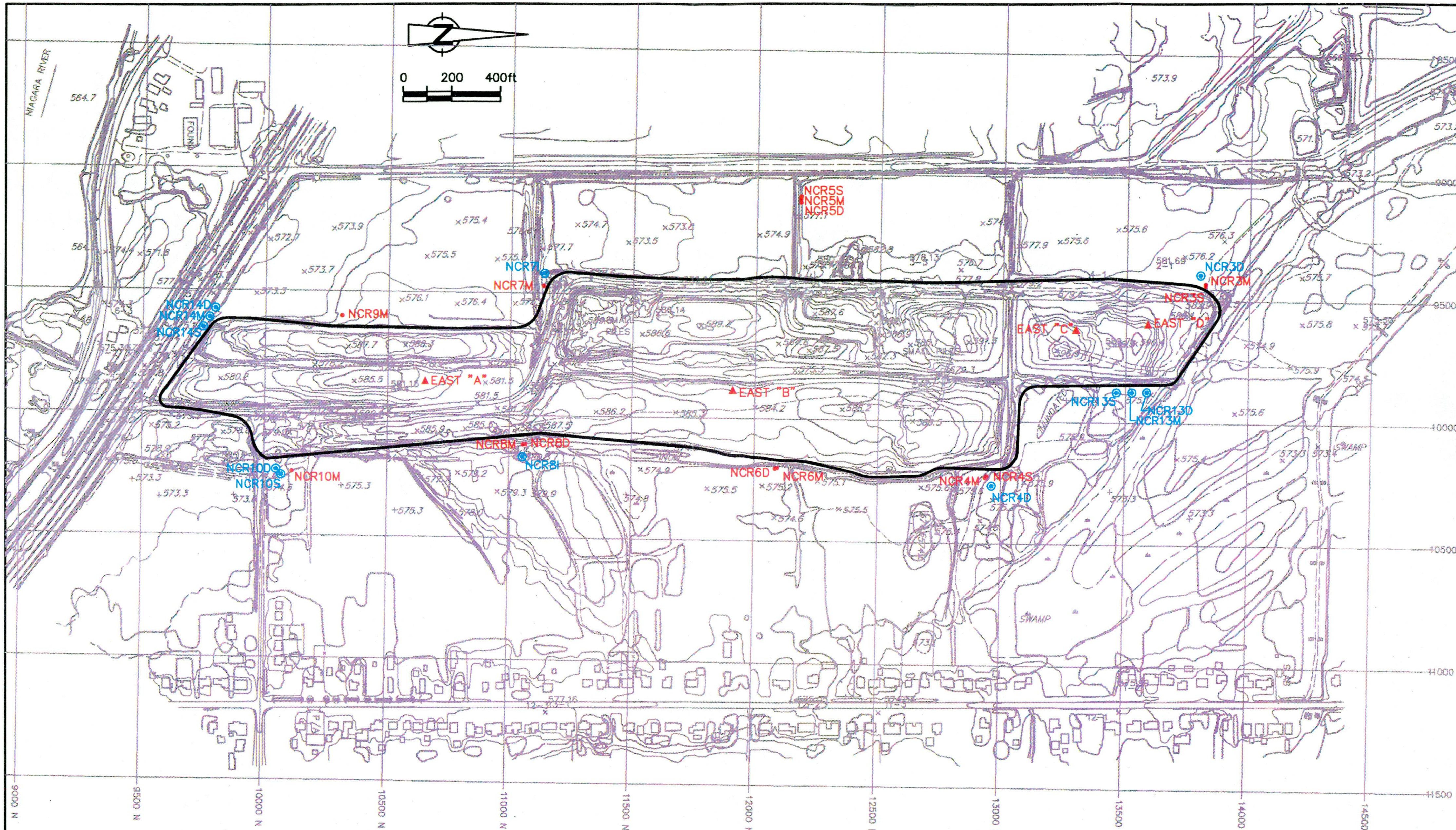


figure 4.2

TYPICAL SECTION RCRA LANDFILL CAP
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JULY 01/93(W) REV.1 (D-04)



SOURCE:

ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

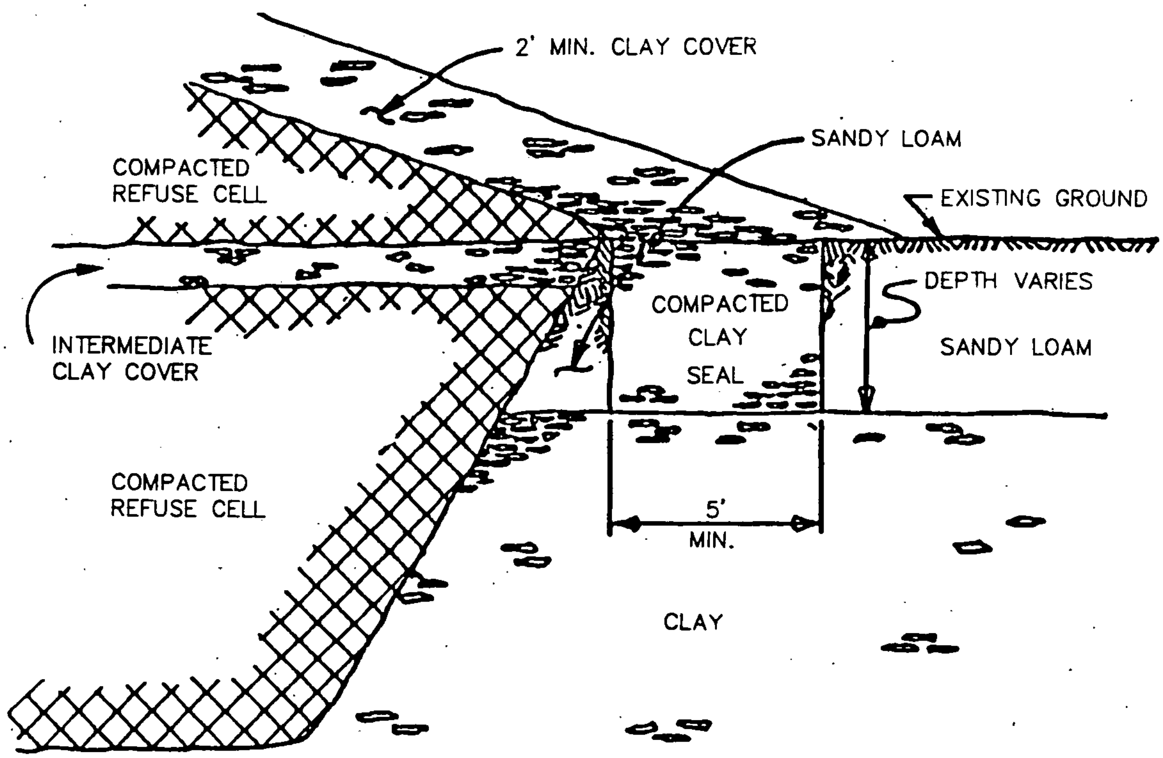
- ×575.2 SPOT ELEVATION
- • NCR11D MONITORING WELL LOCATION
- ▲EAST "B" LEACHATE WELL LOCATION
- ——— APPROXIMATE LIMIT OF REFUSE
- ◉ NCR11D PROPOSED MONITORING WELL LOCATION

CRA

figure 4.1

MONITORING WELL LOCATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

2677 (16) JULY 01/93(W) REV.0 (P-29)



N.T.S.

COPIED FROM:
"OPERATING PLAN FOR WHEATFIELD
REFUSE DISPOSAL SITE,
NIAGARA COUNTY REFUSE DISPOSAL"
DISTRICT, 1973, KREHBIEL–GUAY–RUGG–HALL
ENGINEERS – SURVEYORS

figure 1.5

TYPICAL COMPACTED CLAY BARRIER
PERIMETER SEAL DETAIL
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

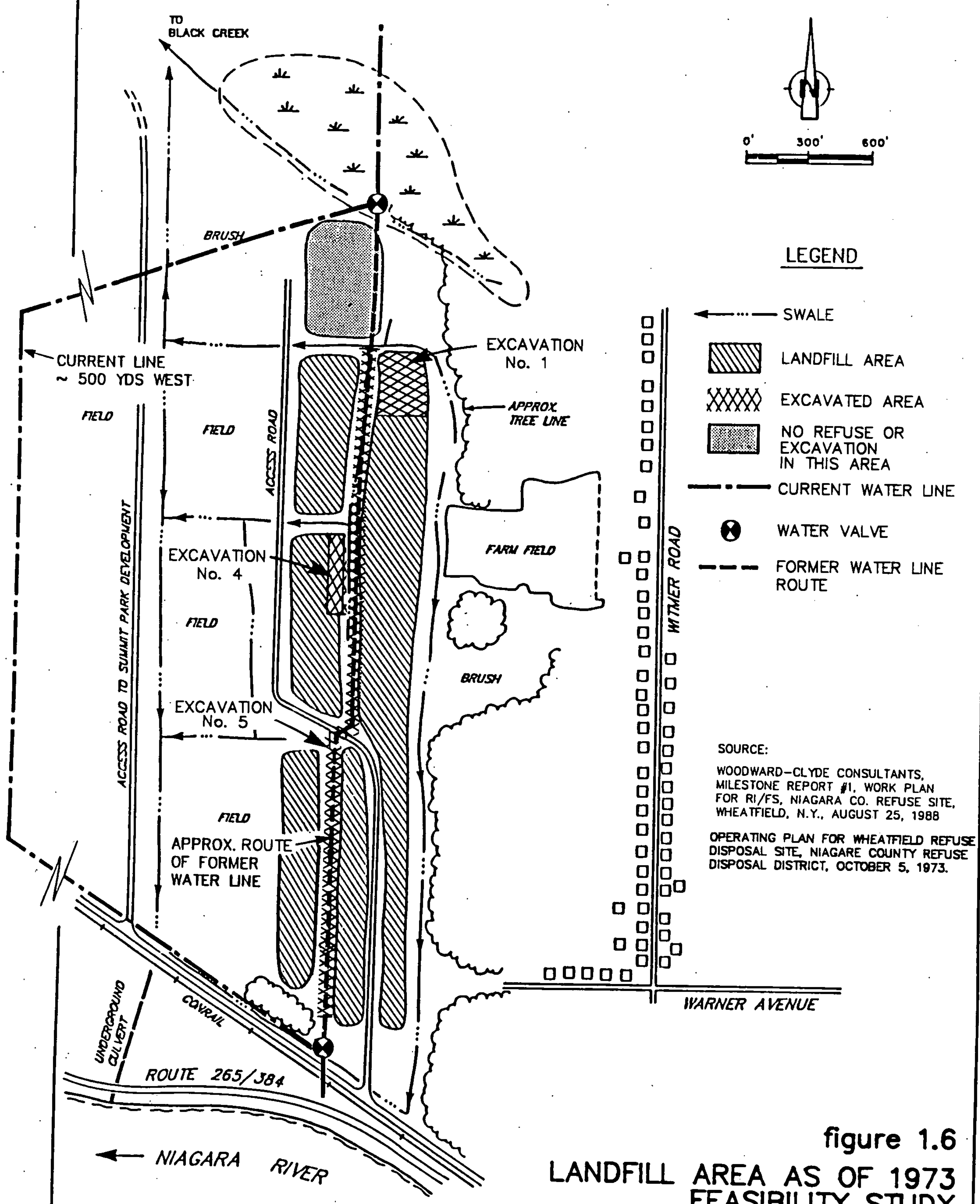


figure 1.6

LANDFILL AREA AS OF 1973
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677(16) JUNE 29/93 (W) REV.0

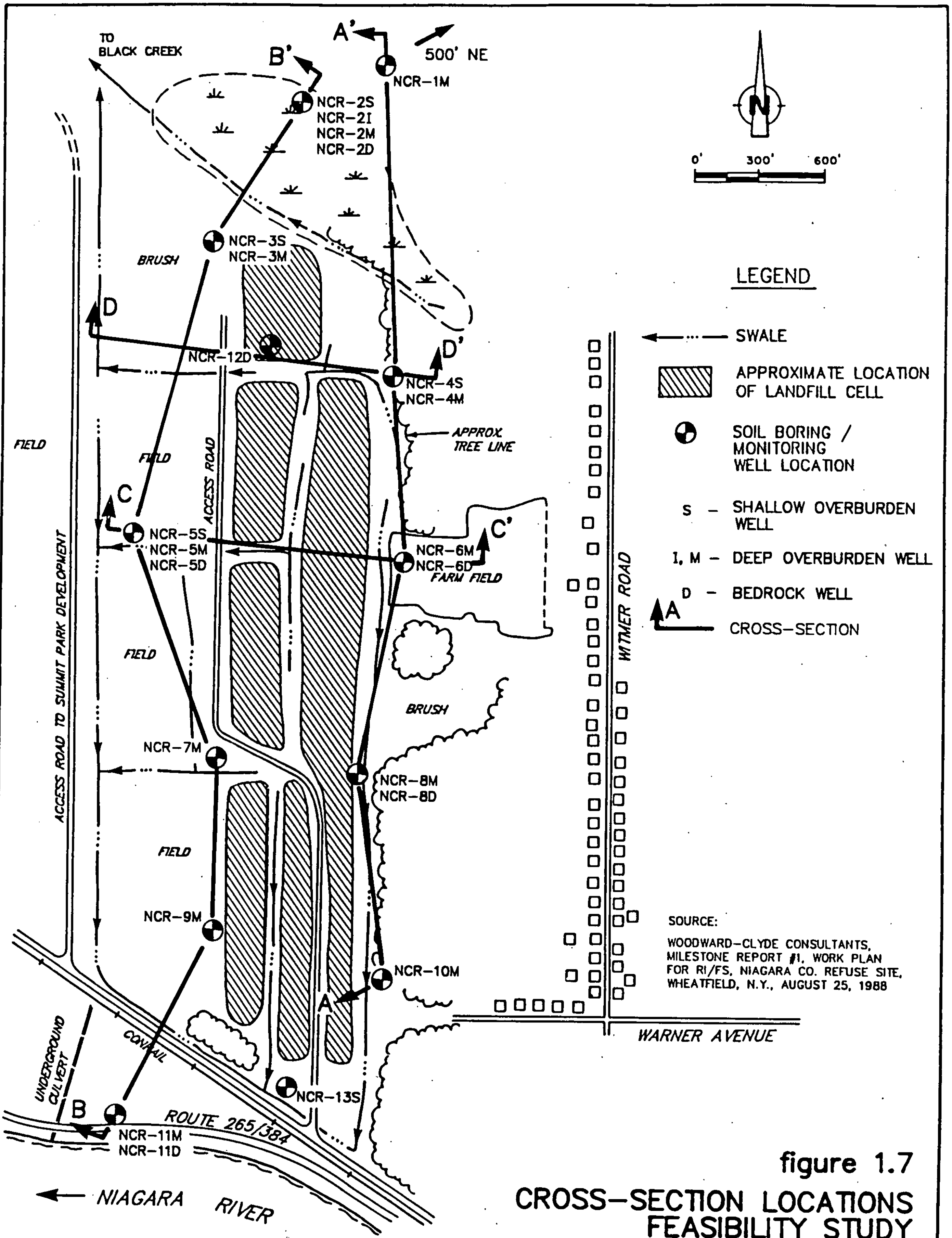
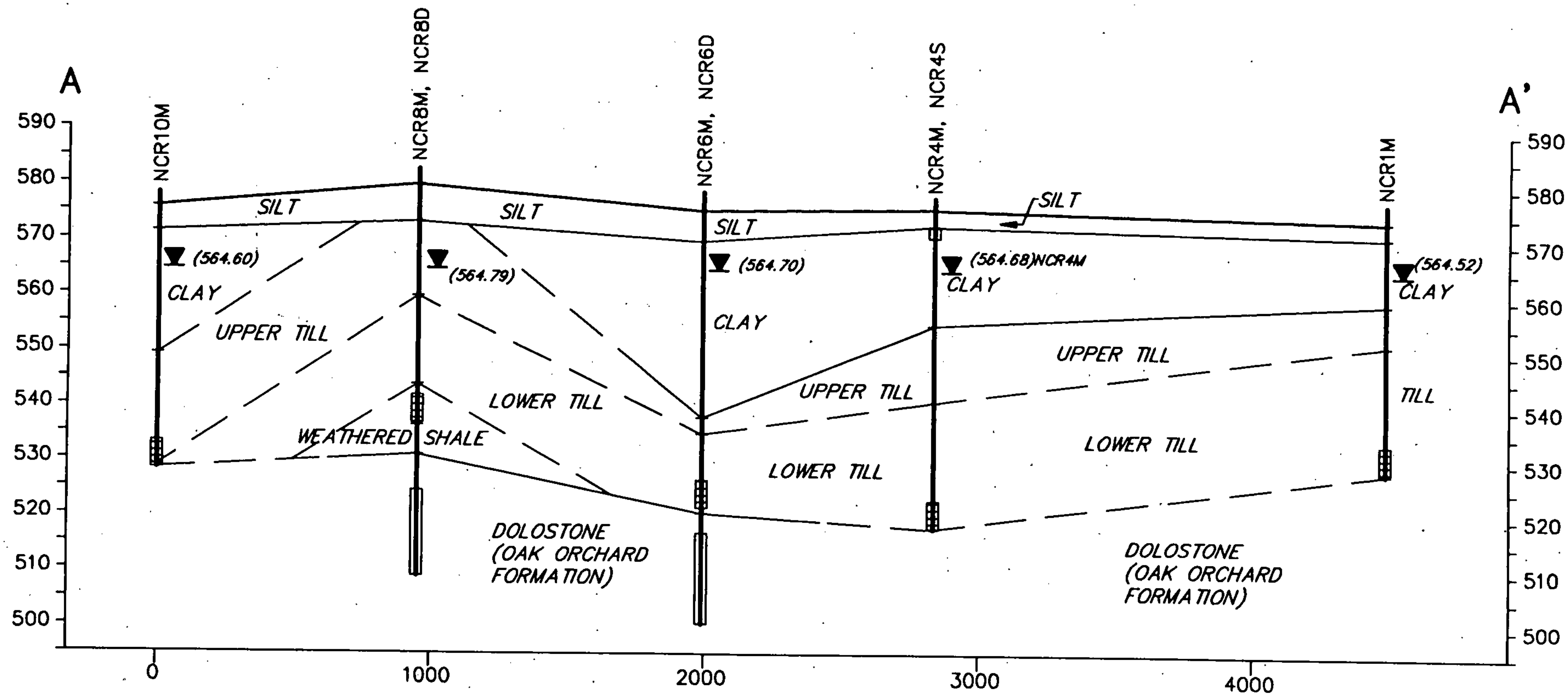


figure 1.7

CROSS-SECTION LOCATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0



MONITORED INTERVAL

SCREENED

OPEN HOLE

SCALE: VERT: 1"=30'
HORIZ: 1"=600'

NOTE:

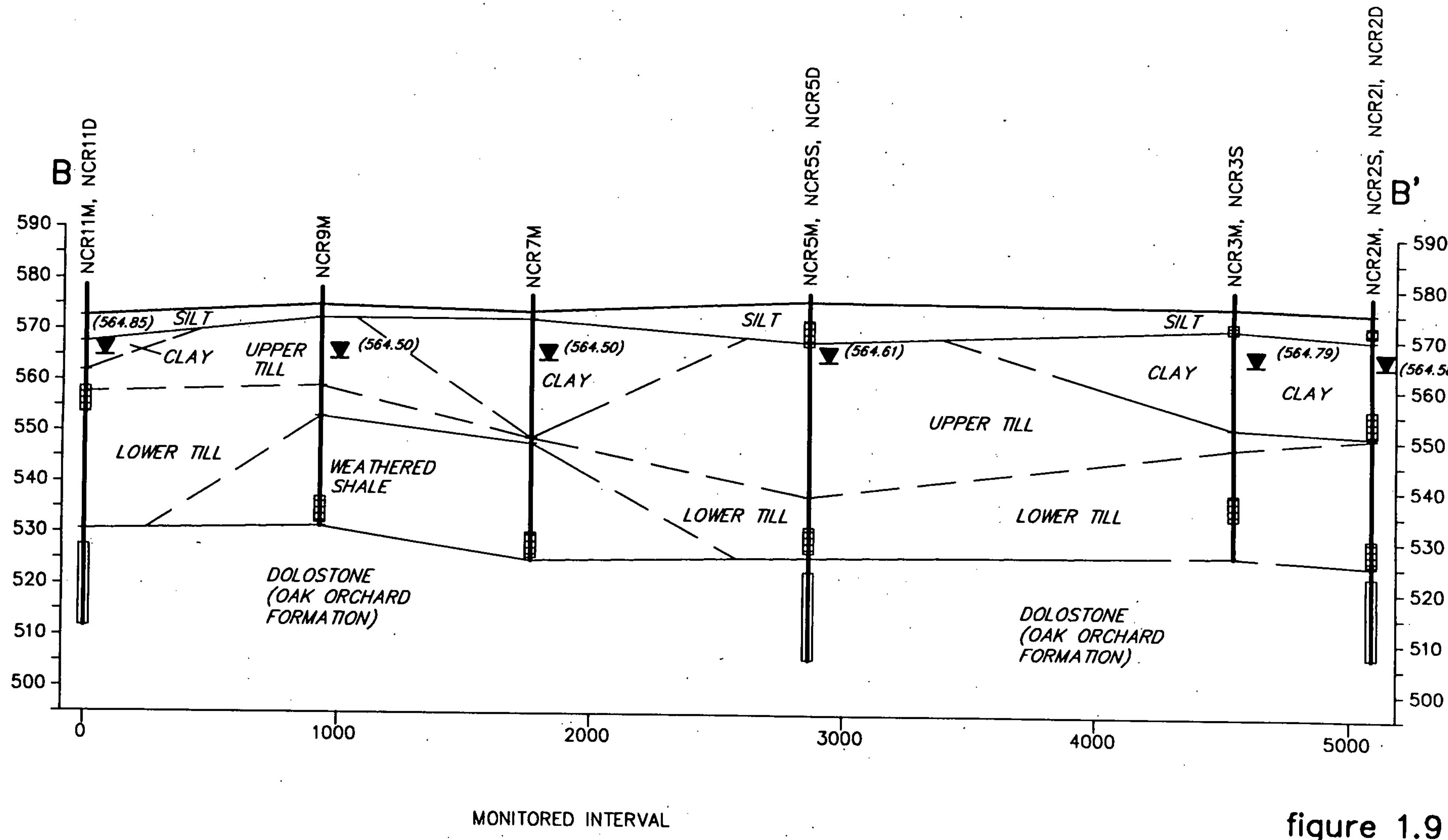
1. WATER LEVEL ELEVATIONS ARE FOR LOWER TILL / VERNON FORMATION WELLS ("M" WELLS) ON 10-30-90

figure 1.8

CROSS SECTION A – A'
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N,Y

CRA

2677 (16) JUNE 30/93(W) REV.0 (X-11)



SCALE: VERT: 1"=30'
HORIZ: 1"=600'

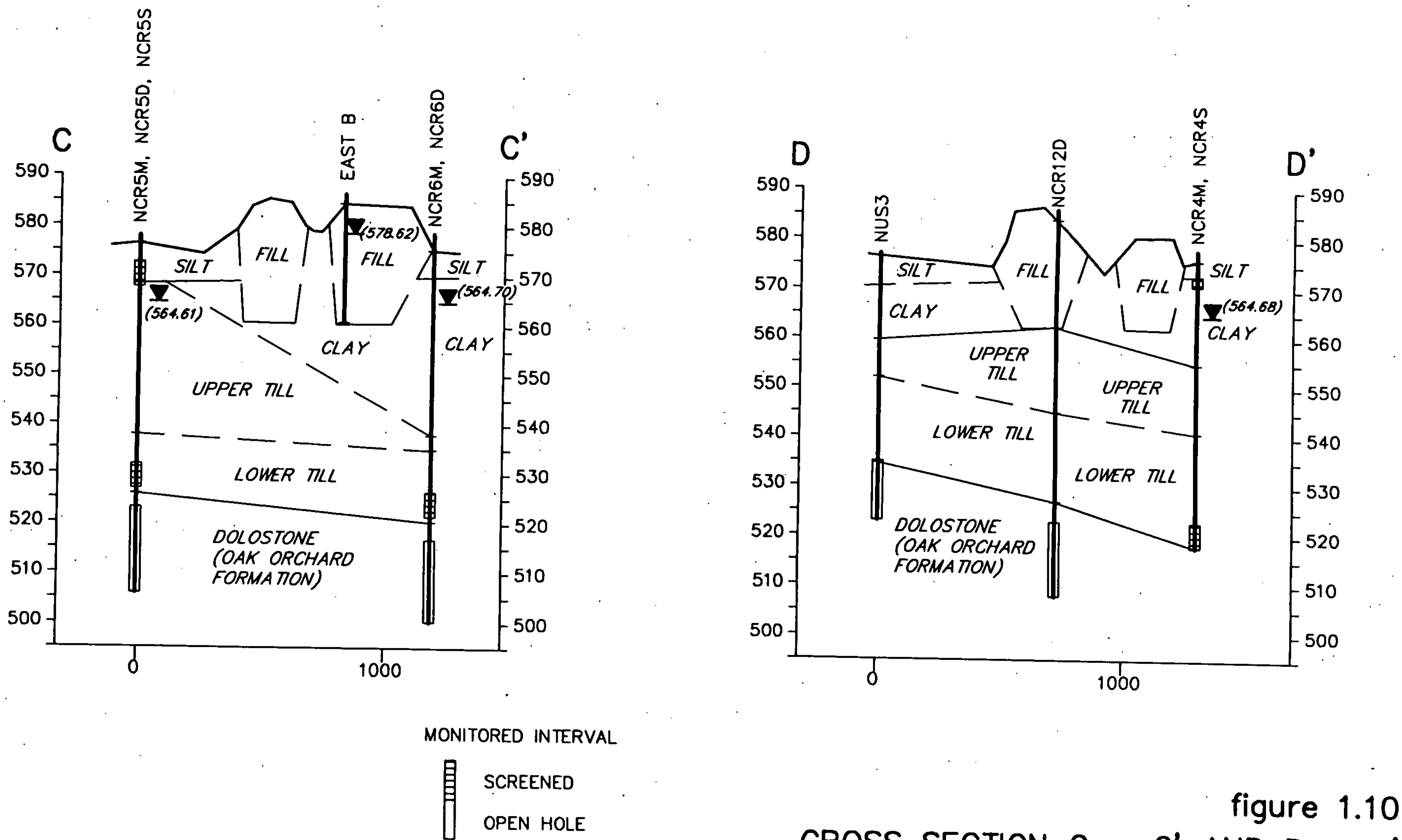
NOTE:
1. WATER LEVEL ELEVATIONS ARE FOR LOWER TILL / VERNON FORMATION WELLS ("M" WELLS) ON 10-30-90

figure 1.9

CROSS SECTION B – B'
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 30/93(W) REV.0 (X-12)



SCALE: VERT: 1"=30'
HORIZ: 1"=600'

NOTE:

1. WATER LEVEL ELEVATIONS ARE FOR LOWER TILL / VERNON FORMATION WELLS ("M" WELLS) ON 10-30-90

figure 1.10

CROSS SECTION C – C' AND D – D'
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 30/93(W) REV.0 (X-13)

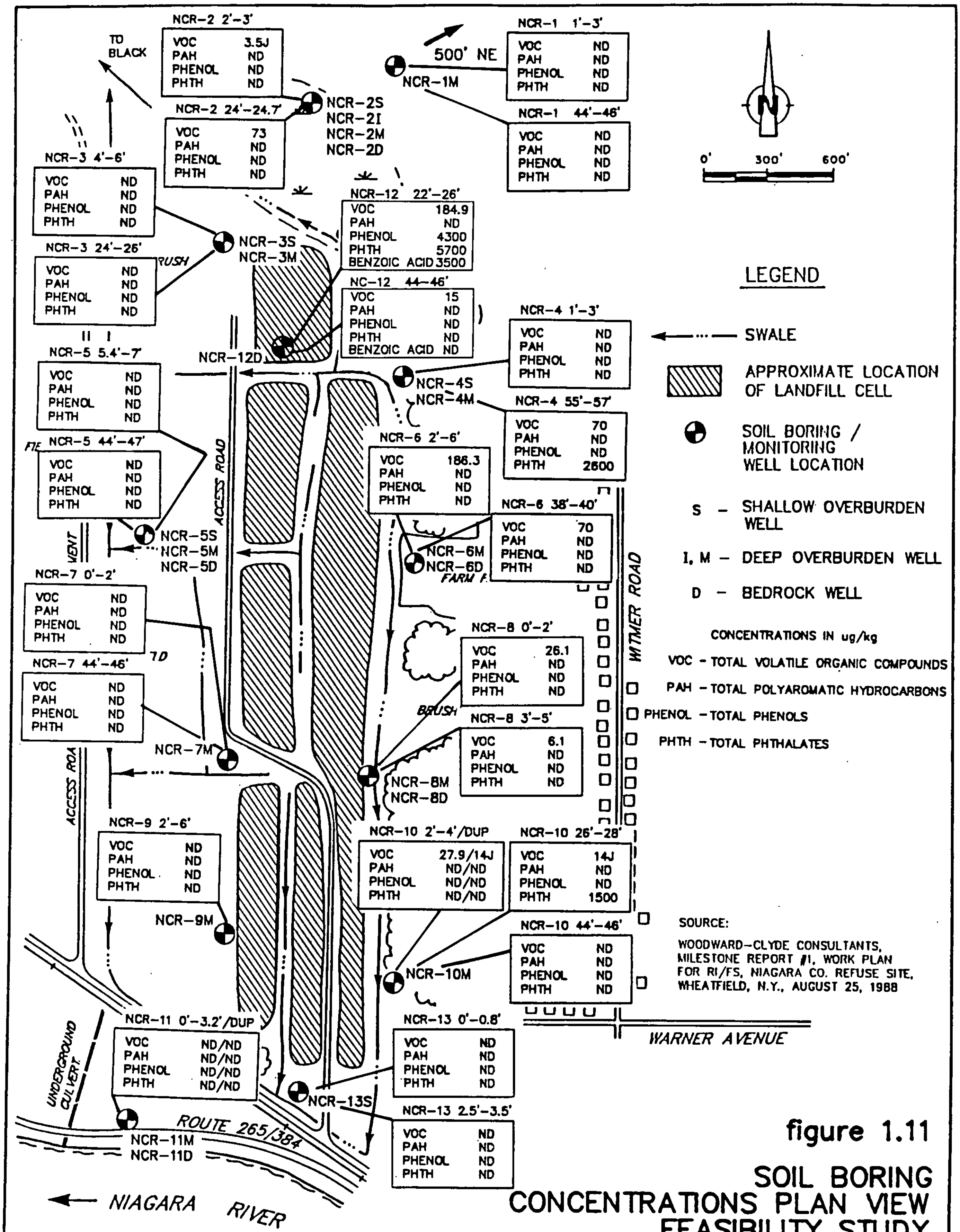
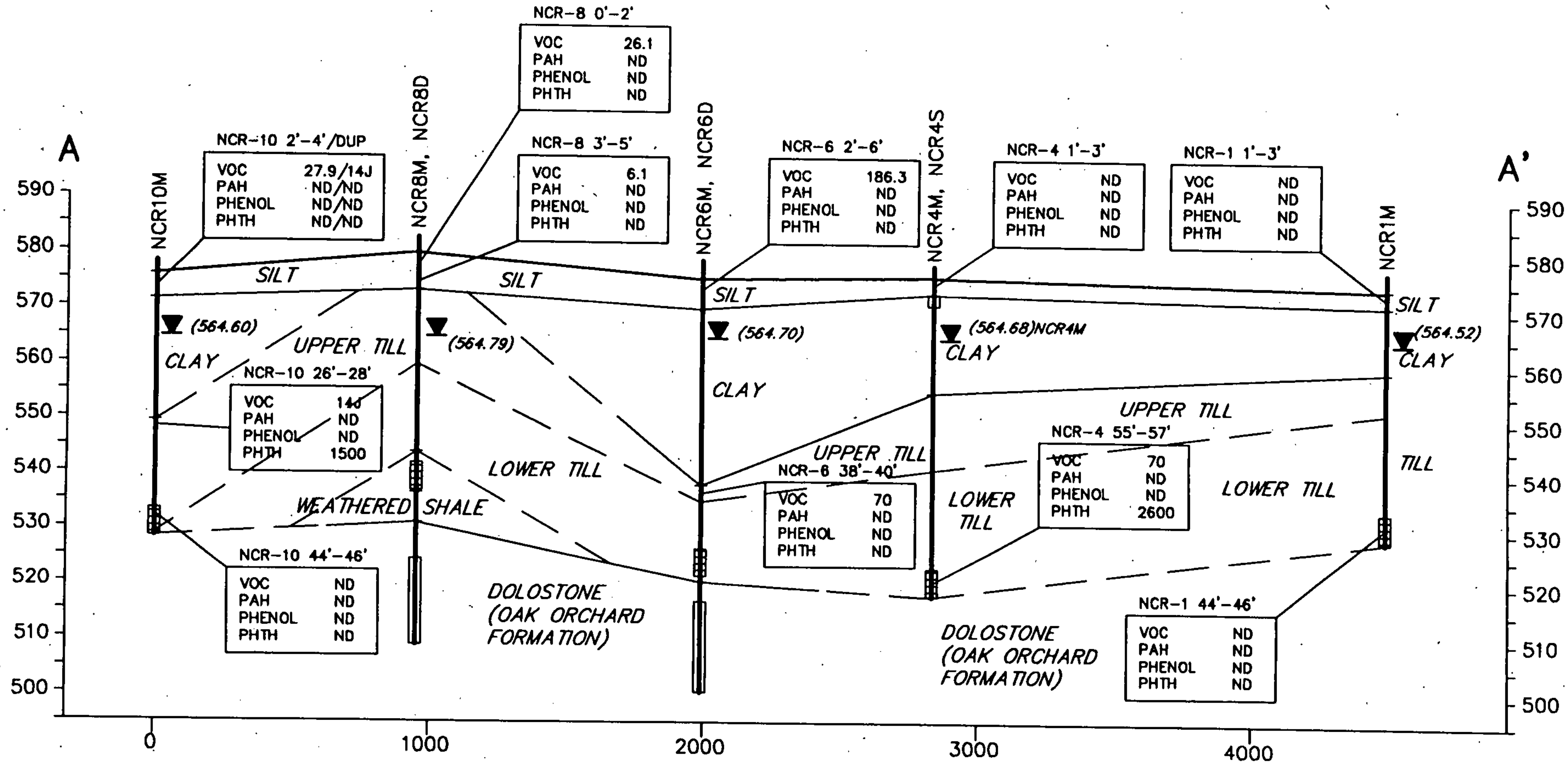


figure 1.11

SOIL BORING CONCENTRATIONS PLAN VIEW FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0



LEGEND

MONITORED INTERVAL

SCREENED

OPEN HOLE

CONCENTRATIONS IN ug/kg

VOC – TOTAL VOLATILE ORGANIC COMPOUNDS

PAH – TOTAL POLYAROMATIC HYDROCARBONS

PHENOL – TOTAL PHENOLS

PHTH – TOTAL PHTHALATES

NOTE: 1. WATER LEVEL ELEVATIONS ARE FOR LOWER TILL/ VERNON FORMATION WELLS ("M" WELLS) ON 10-30-90

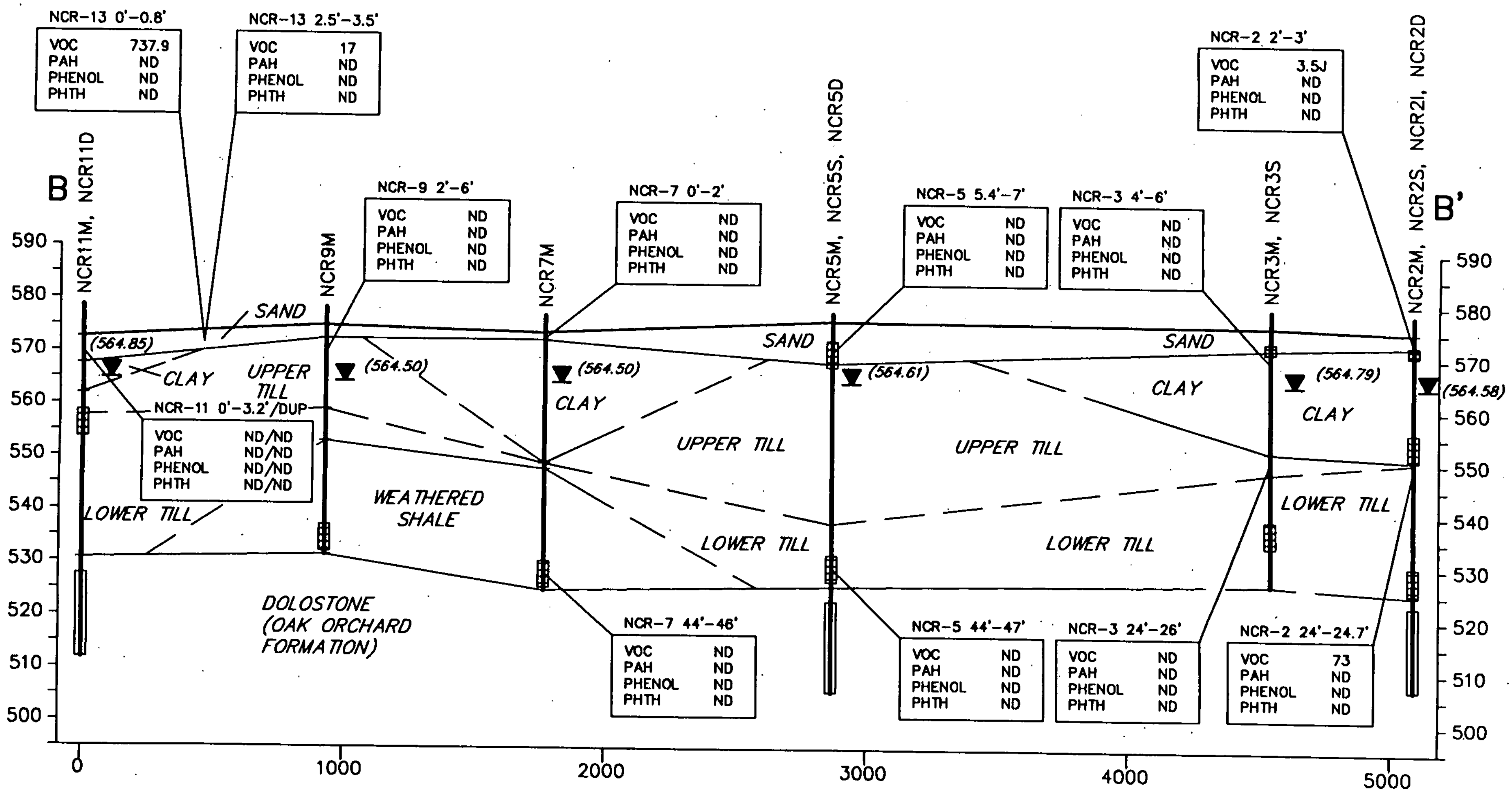
SCALE: VERT: 1"=30'
HORIZ: 1"=600'

figure 1.12

SOIL BORINGS CONCENTRATIONS
CROSS SECTION A – A'
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 30/93(W) REV.0 (X-14)



LEGEND

MONITORED INTERVAL

SCREENED

OPEN HOLE

CONCENTRATIONS IN ug/kg

VOC – TOTAL VOLATILE ORGANIC COMPOUNDS

PAH – TOTAL POLYAROMATIC HYDROCARBONS

PHENOL – TOTAL PHENOLS

PHTH – TOTAL PHTHALATES

NOTE: 1. WATER LEVEL ELEVATIONS ARE FOR BASAL TILL/ VERNON FORMATION WELLS ("M" WELLS) ON 10-30-90

SCALE: VERT: 1"=30'
HORIZ: 1"=600'

figure 1.13

SOIL BORINGS CONCENTRATIONS
CROSS SECTION B – B'
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 30/93(W) REV.0 (X-15)

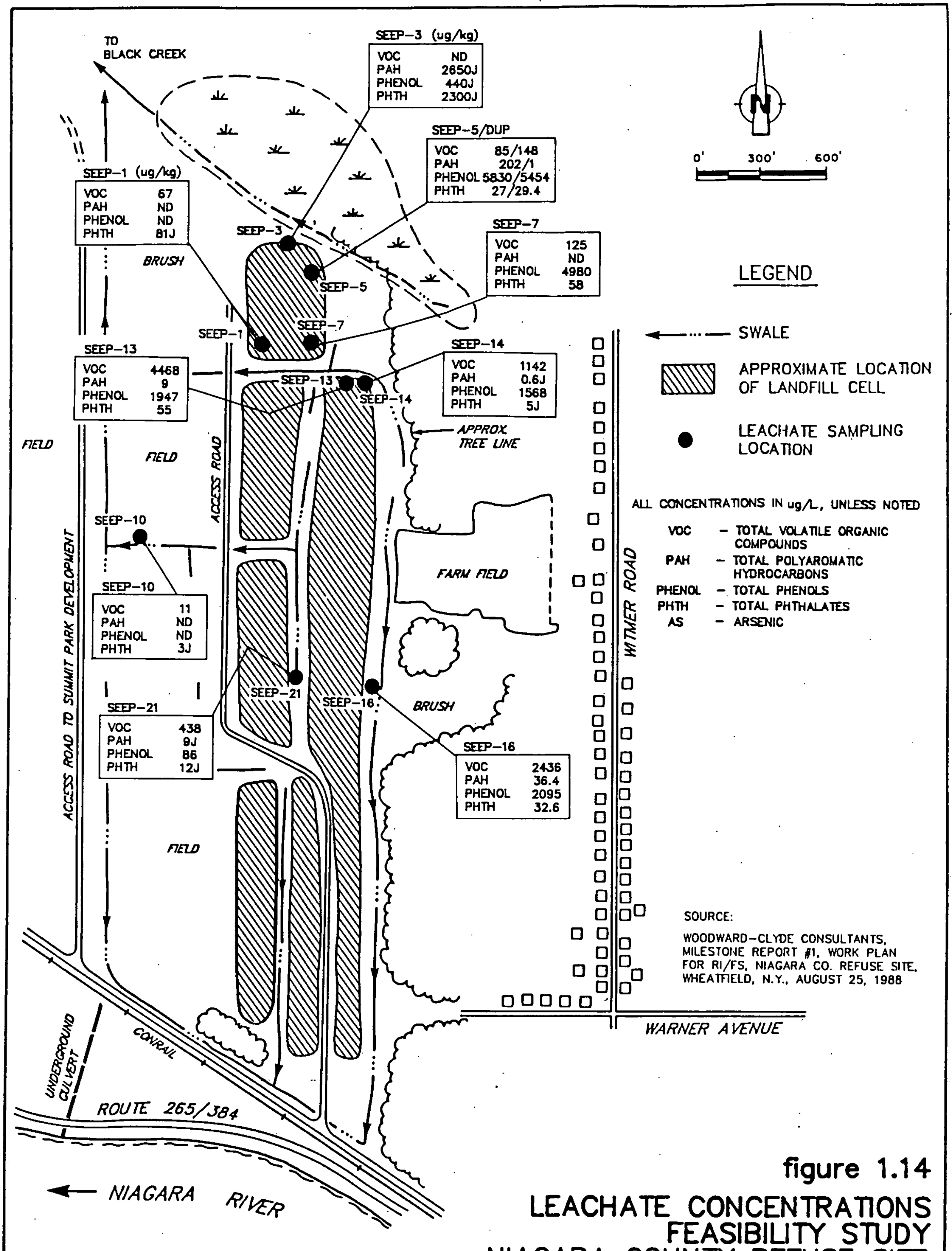


figure 1.14

LEACHATE CONCENTRATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

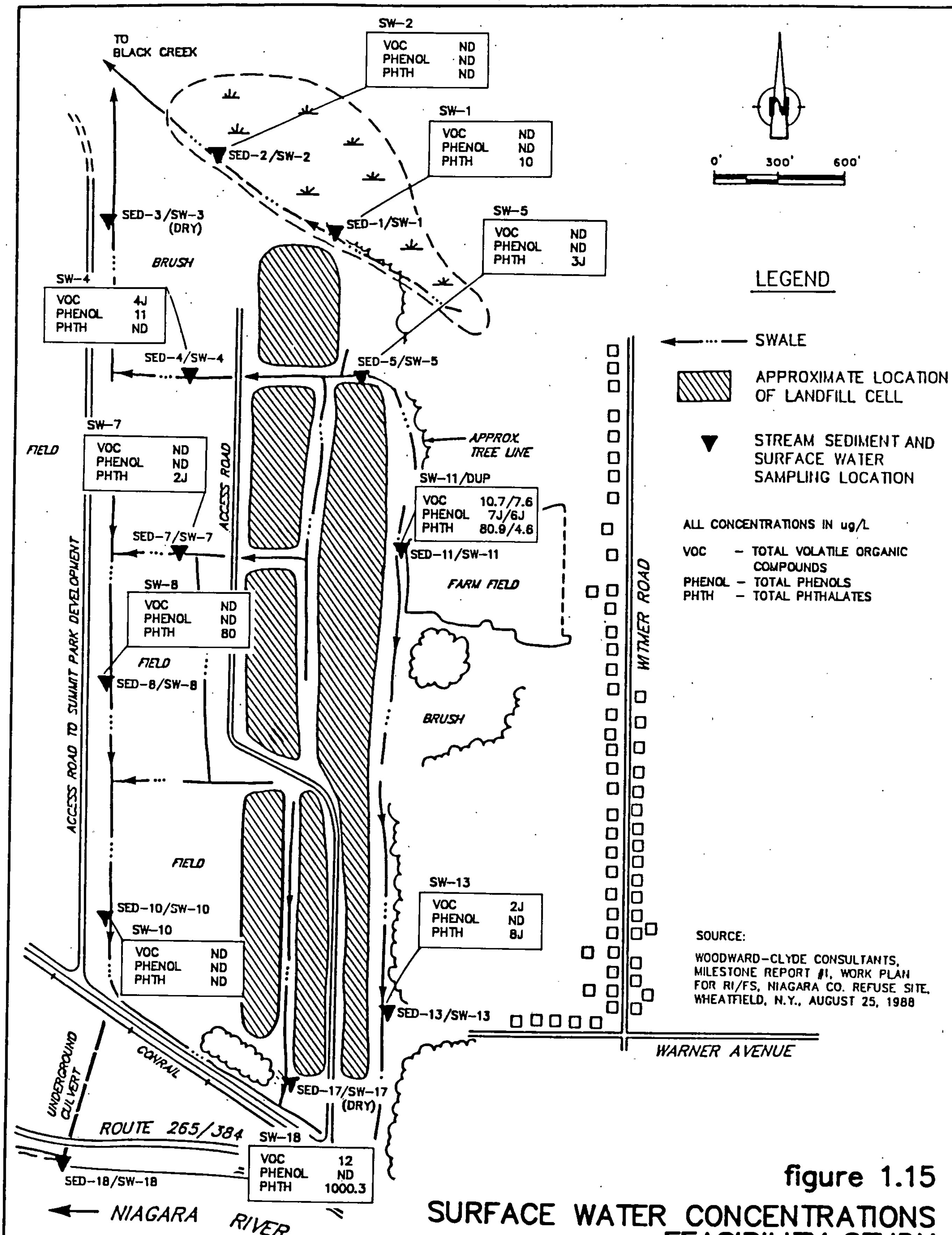


figure 1.15

SURFACE WATER CONCENTRATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

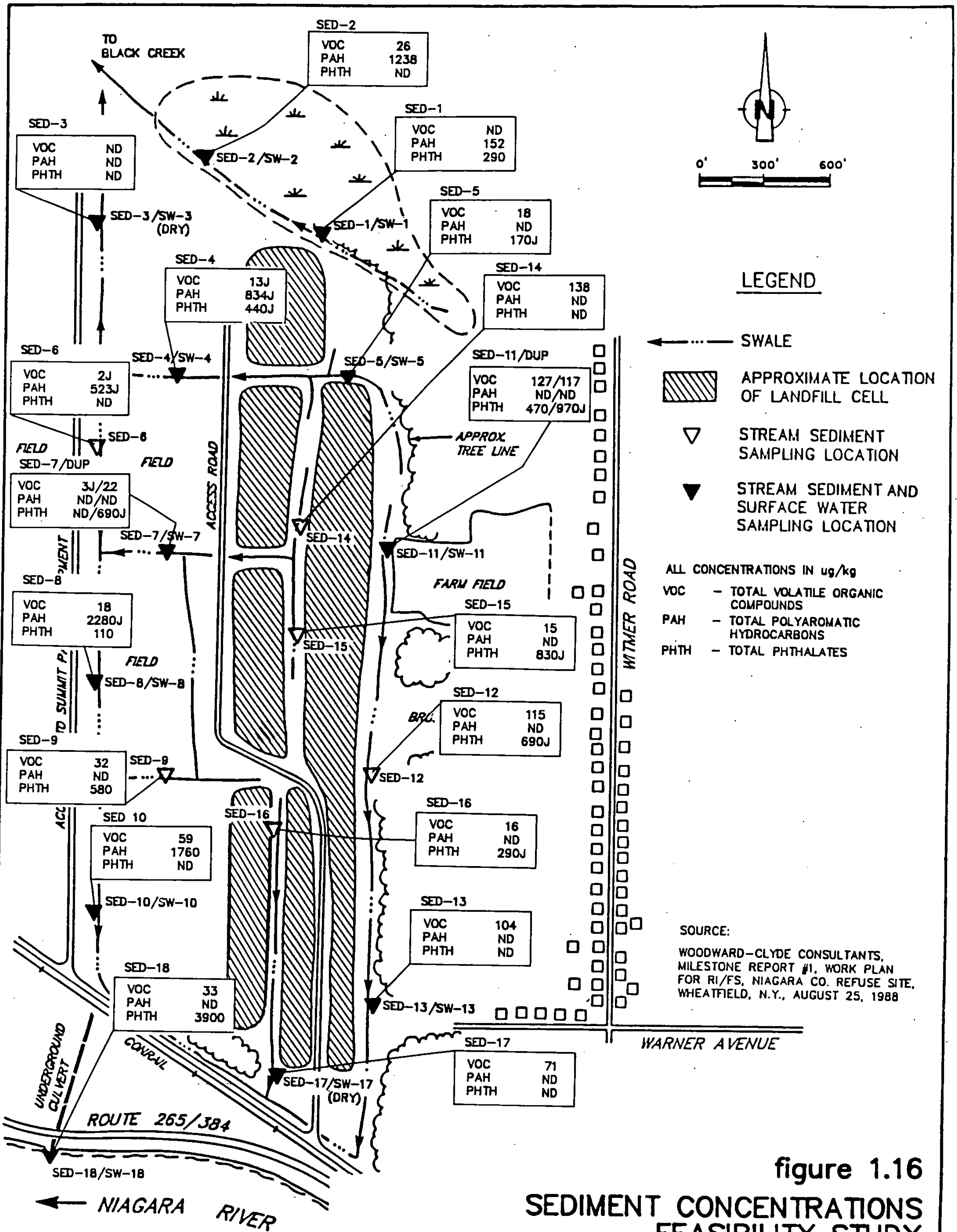


figure 1.16

SEDIMENT CONCENTRATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

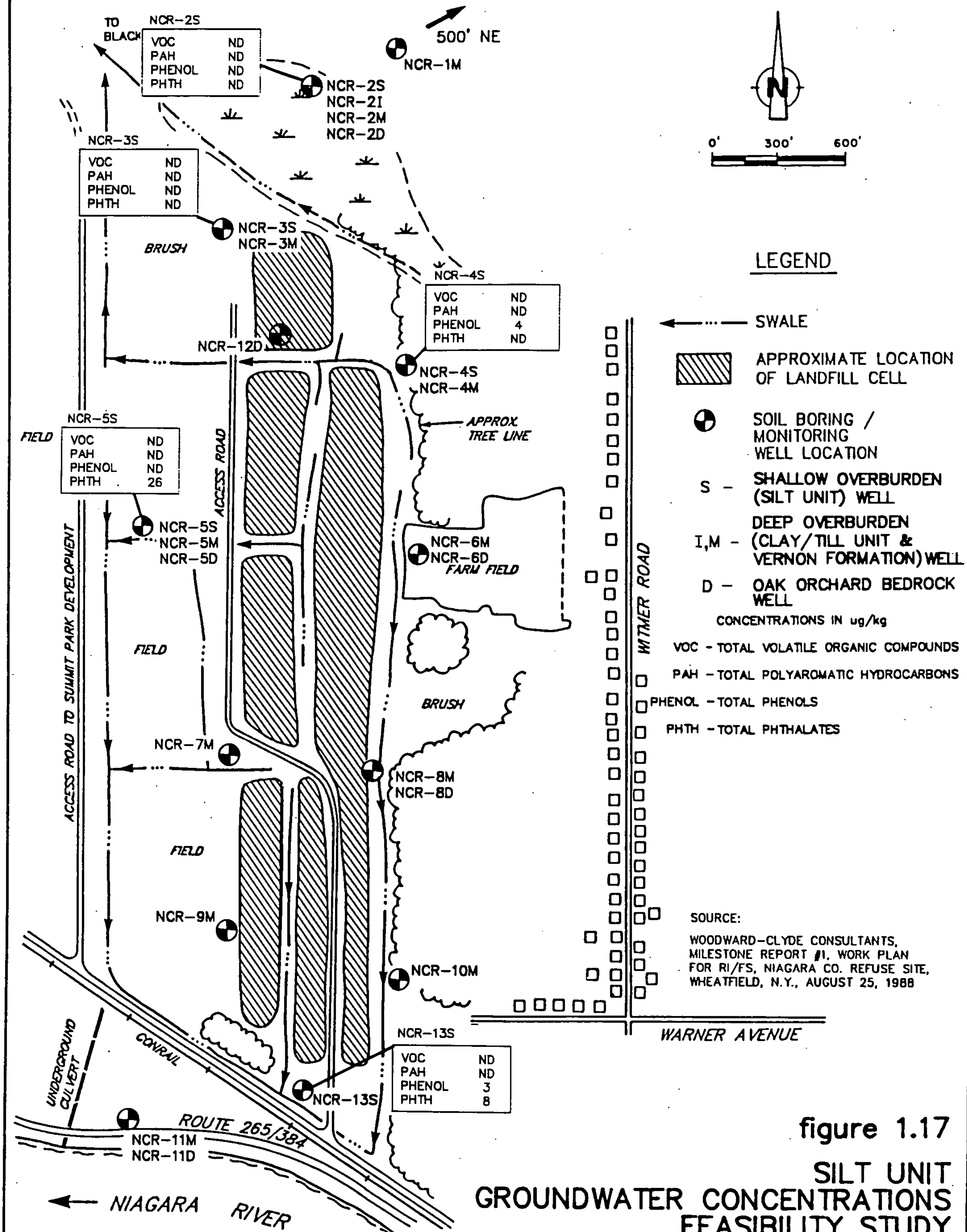


figure 1.17

SILT UNIT GROUNDWATER CONCENTRATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

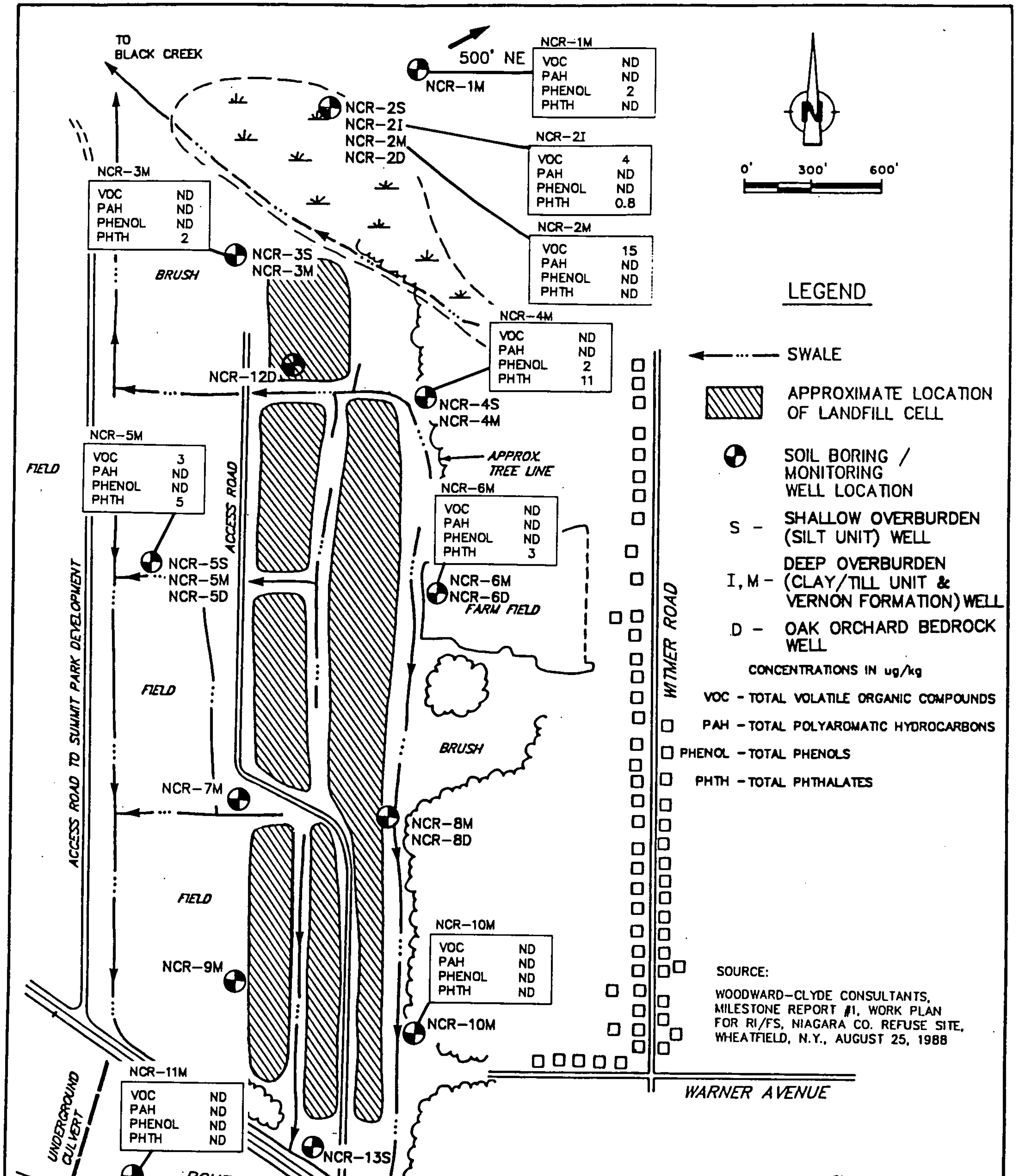


figure 1.18

CLAY/UPPER TILL UNIT GROUNDWATER CONCENTRATIONS
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

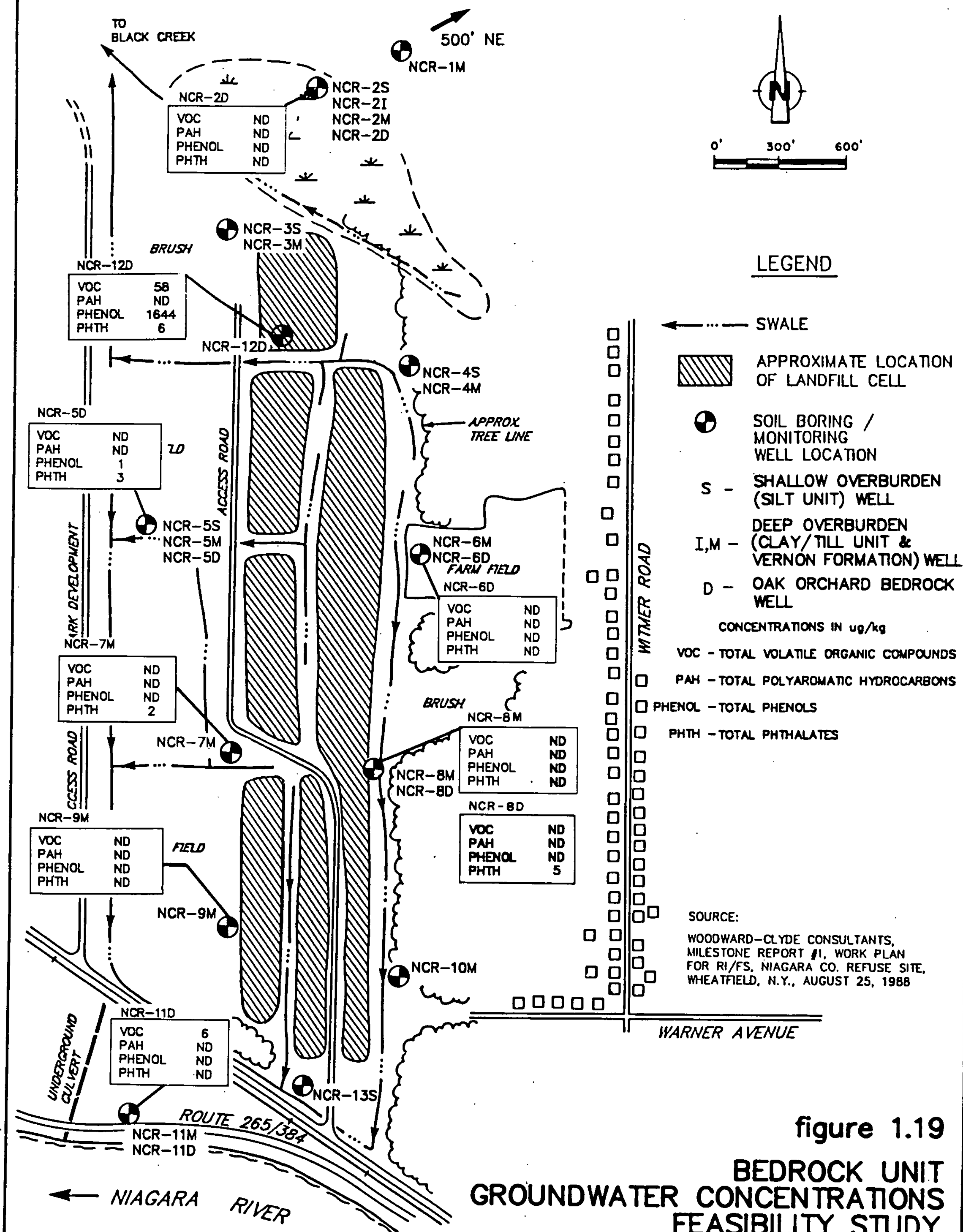


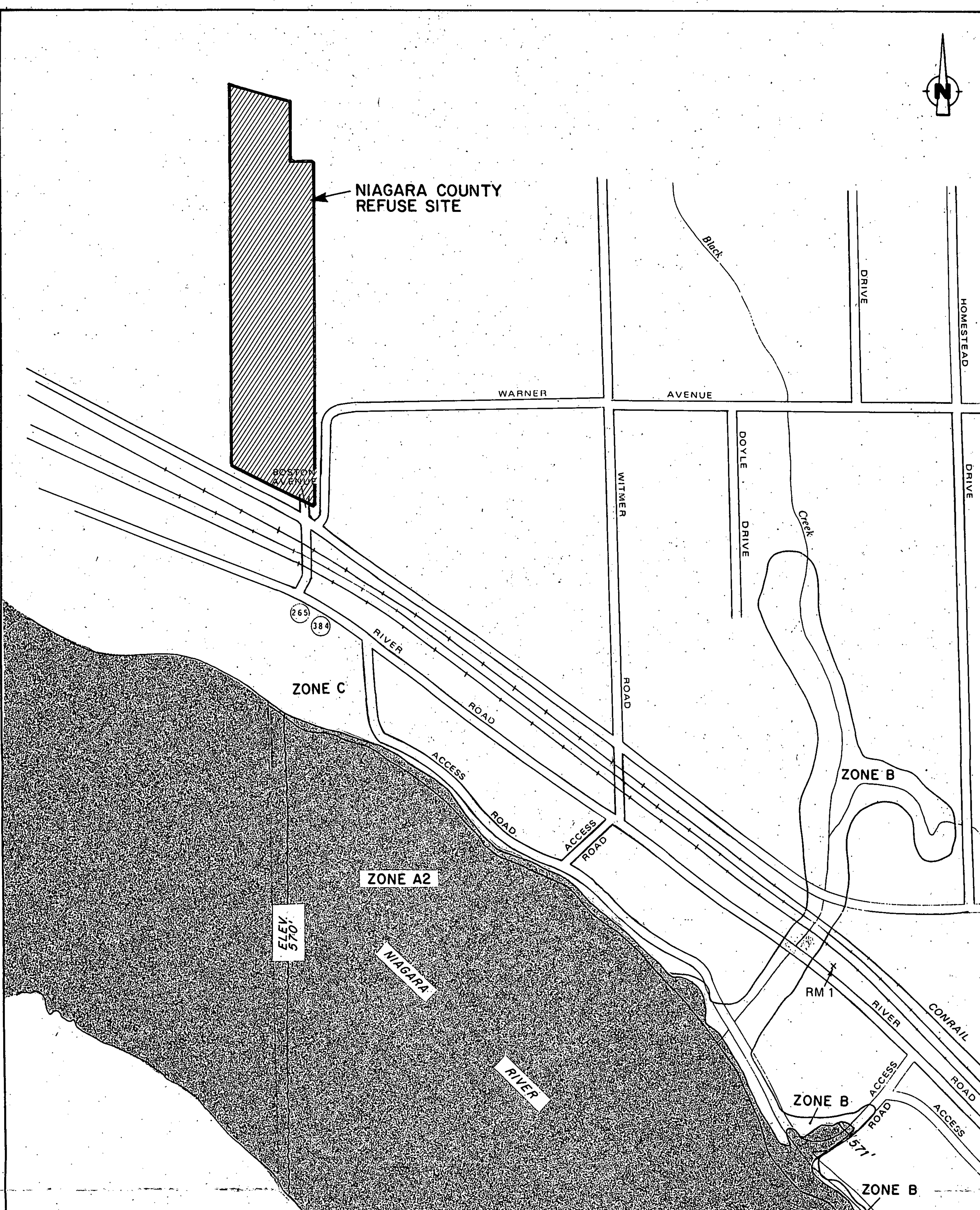
figure 1.19

BEDROCK UNIT GROUNDWATER CONCENTRATIONS FEASIBILITY STUDY

NIAGARA COUNTY REFUSE SITE

Wheatfield, N.Y.

CRA



KEY TO MAP

500-Year Flood Boundary	ZONE B
100-Year Flood Boundary	
Zone Designations *	ZONE A1
	ZONE A5
100-Year Flood Boundary	
500-Year Flood Boundary	ZONE B
Base Flood Elevation Line With Elevation In Feet	513

ZONE *	EXPLANATION
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)

SOURCE:
FLOOD INSURANCE RATE MAPPING CITY OF NORTH TONOWANDA, N.Y. 360508-0001B
FEDERAL EMERGENCY MANAGEMENT AGENCY

figure 1.4

FLOOD BOUNDARIES
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

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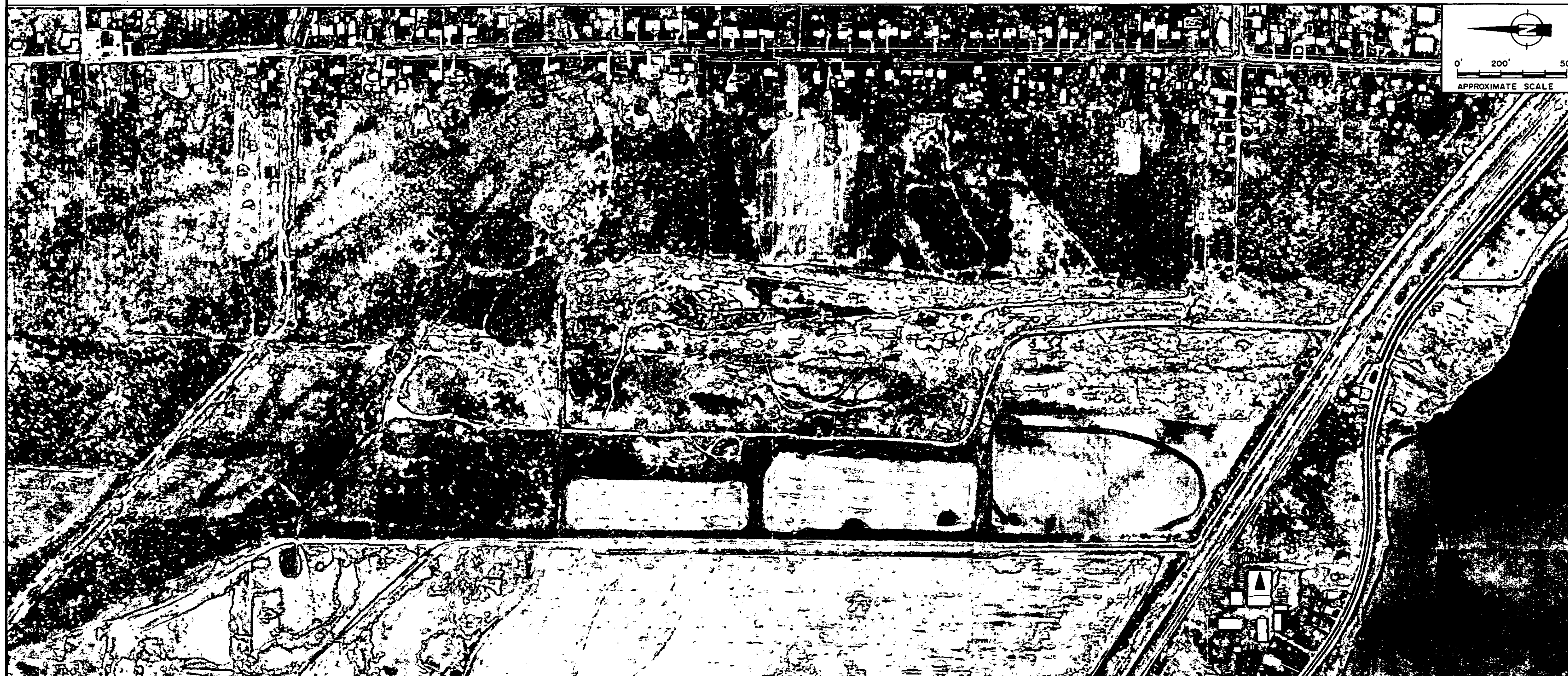
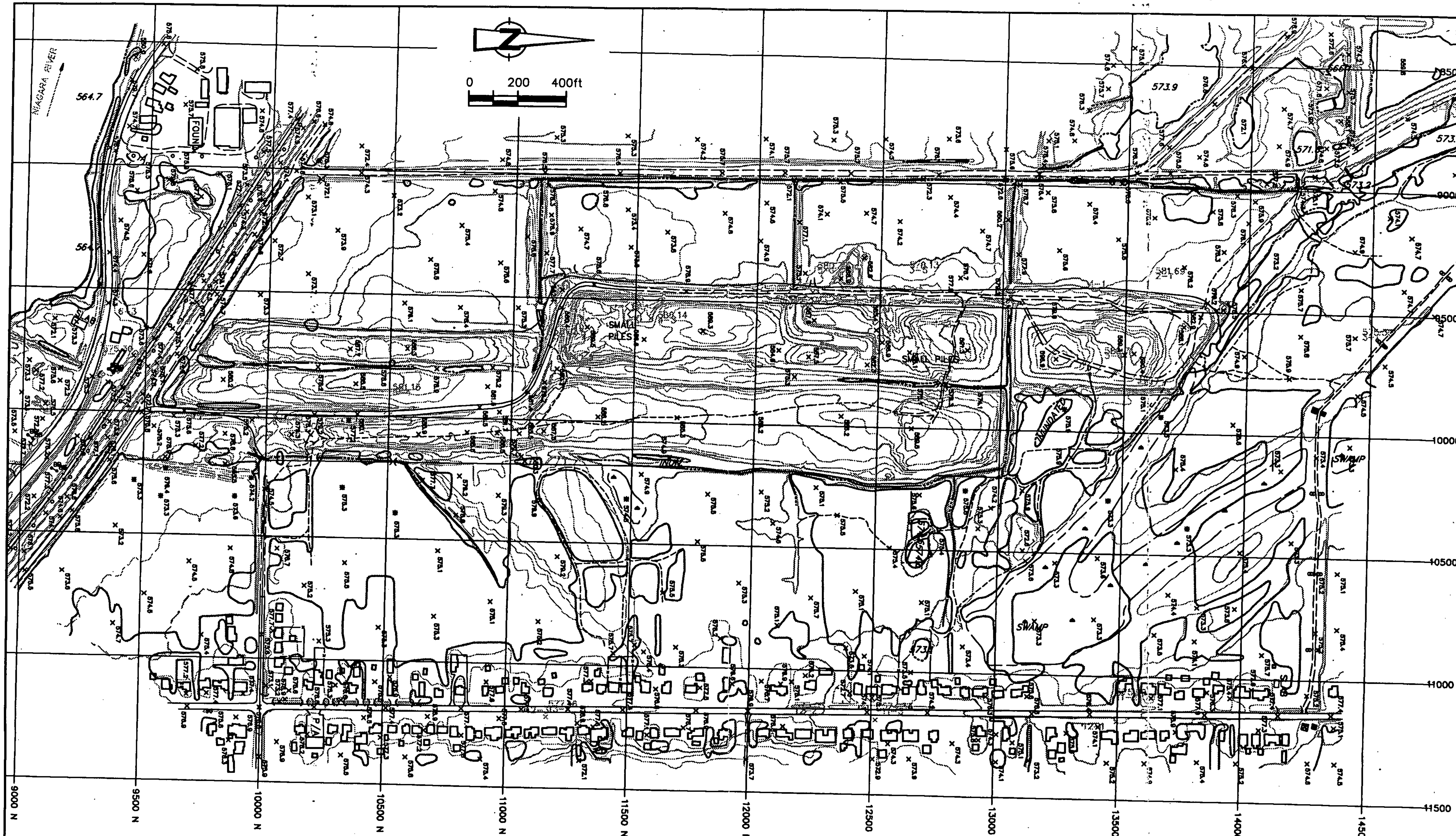


1989 PHOTOGRAPHY

figure 1.3
1989 AERIAL PHOTOGRAPH
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) APR.01/93 REV.0



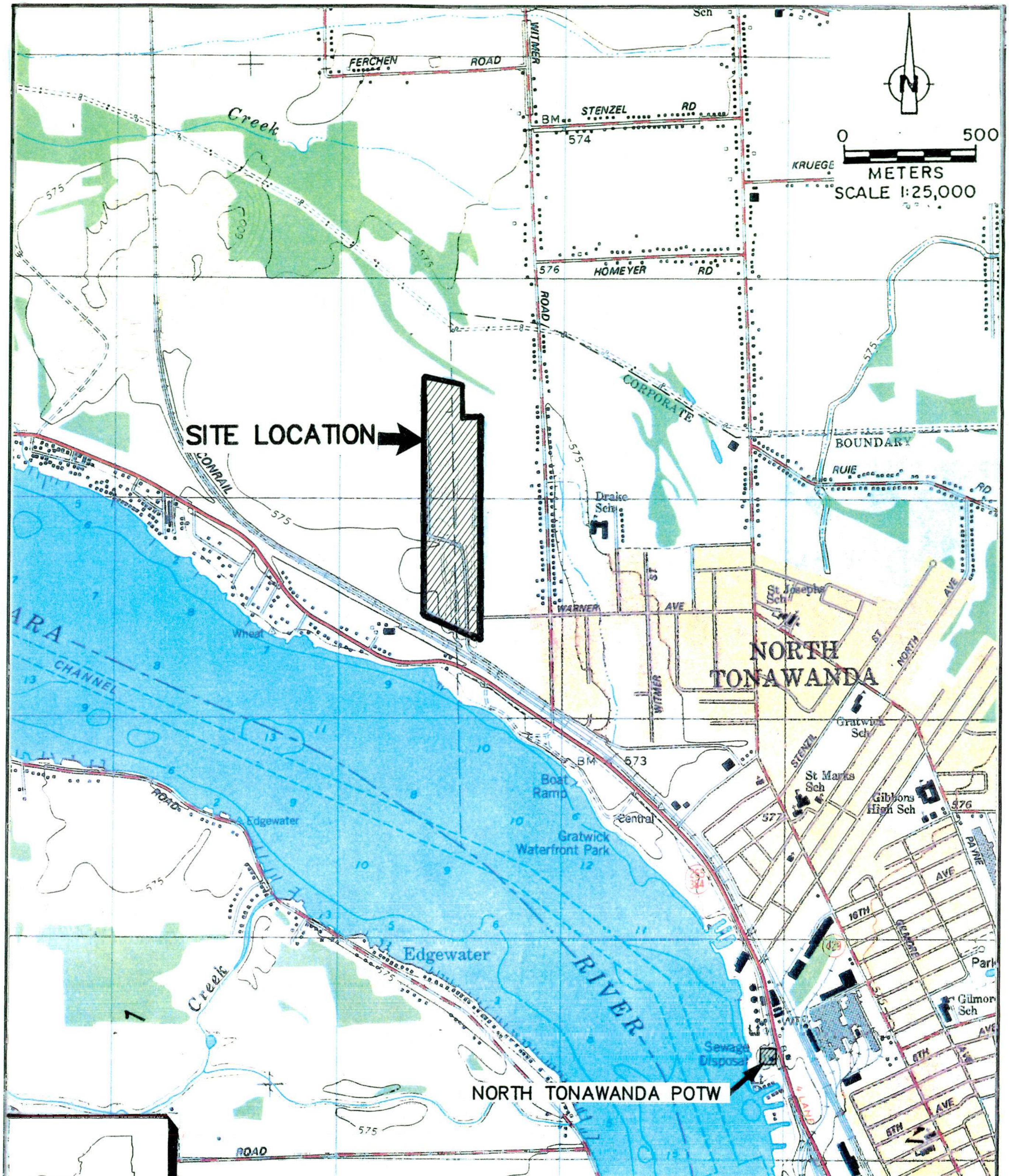
SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

figure 1.2

SITE PLAN
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 30/93(W) REV.0 (P-30)



SOURCE:

U.S. GEOLOGICAL SURVEY
SW/4 TONAWADA 15' QUADRANGLE

figure 1.1

SITE LOCATION
FEASIBILITY STUDY
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

2677 (16) JUNE 29/93 (W) REV.0

TABLES

TABLE 1.1

REPRESENTATIVE LEACHATE CONCENTRATIONS
NCR SITE
WHEATFIELD, NEW YORK

	Representative (1) Concentration
General Parameters (mg/L)	
Oil and Grease	156
pH	7
Conductivity	6,091
TSS	1,896
Alkalinity	3,009
Total Phosphorus	0
Soluble Phosphorus	0
Nitrate	ND
Nitrite	ND
BOD	713
Ammonia	248
Chloride	832
Sulfate	346
TDS	5,752
COD	6,428
TOC	1,940
DOC	1,862
Metals (μg/L)	
Aluminum	5,914
Antimony	ND
Arsenic	4
Barium	993
Beryllium	ND
Cadmium	ND
Calcium	480,293
Chromium	81
Cobalt	183
Copper	ND
Iron	325,837
Lead	276
Magnesium	242,455
Manganese	3,336
Mercury	0.33
Nickel	ND
Potassium	314,475

TABLE 1.1

REPRESENTATIVE LEACHATE CONCENTRATIONS
NCR SITE
WHEATFIELD, NEW YORK

	Representative (1) Concentration
Metals (cont'd) (μg/L)	
Selenium	ND
Silver	ND
Sodium	629,500
Thallium	ND
Vanadium	148
Zinc	11,942
Detected VOCs (μg/L)	
Methylene Chloride	293
Acetone	1,329
2-Butanone	552
Benzene	192
Toluene	183
Chlorobenzene	153
Ethylbenzyl	169
Xylene (total)	294
1,2-Dichlorobenzene	9
1,4-Dichlorobenzene	23
Detected BNAs (μg/L)	
Benzyl Alcohol	17
B2EHP	8
Diethylphthalate	7
Isophorone	10
Naphthalene	14
Benzoic Acid	3,742
2,4-Dimethyl Phenol	264
2-Methyl Phenol	2,002
4-Methyl Phenol	1,341
Phenol	42,020

(1) Concentration based on a representative contributing landfill area and then weighted in relation to the entire landfill.

TABLE 1.2

SUMMARY OF PARAMETERS OF POTENTIAL CONCERN(1)
NCR SITE
WHEATFIELD, NEW YORK

Parameter	*Surface Soil*	*Subsurface Soils*	*Landfill Perimeter Ground Water*	*NCR 12D Ground Water*	*Drainage Swale Surface Water*	*Drainage Swale Sediments*	*Leachate Soil*	*Leachate Water*
Volatiles								
Acetone	X	X	X	X		X		X
Benzene			X	X		X		X
2-Butanone				X				X
1,4-Dichlorobenzene				X			X	
Methylene Chloride	X	X	X	X		X	X	X
Styrene	X			X				
Trichloroethylene	X	X		X				
1,2,4-Trimethylbenzene				X				
Vinyl Chloride	X	X						
BNAs								
Benzo(a)anthracene						X	X	
Benzo(a)pyrene						X		
Bis(2-ethylhexyl)phthalate	X	X	X	X	X	X	X	X
4-Chloroaniline								X
2,4-Dimethylphenol				X	X			X
2,6-Dinitrotoluene								X
2-Methylphenol				X				X
4-Methylphenol		X		X			X	X
Naphthalene		X		X			X	X
Phenanthrene		X				X	X	X
Phenol			X	X	X			X

Note:

(1) Summarized from BRA-TRC.

TABLE 1.2

SUMMARY OF PARAMETERS OF POTENTIAL CONCERN(1)
NCR SITE
WHEATFIELD, NEW YORK

Parameter	*Surface Soil*	*Subsurface Soils*	*Landfill Perimeter Ground Water*	*NCR 12D Ground Water*	*Drainage Swale Surface Water*	*Drainage Swale Sediments*	*Leachate Soil*	*Leachate Water*
Pesticides								
Aldrin			X			X	X	X
Delta-BHC	X		X		X	X	X	X
4,4'-DDE			X			X	X	
4,4'-DDT			X		X	X		X
Dieldrin			X			X	X	
Heptachlor			X	X				X
Heptachlor Epoxide		X	X		X	X		
Inorganics								
Aluminum	X	X	X	X	X	X	X	X
Antimony		X	X	X		X		
Arsenic	X	X	X	X	X	X	X	X
Barium	X	X	X	X	X	X	X	X
Beryllium	X	X	X	X	X	X	X	X
Cadmium			X		X	X	X	X
Cobalt	X	X	X	X	X	X	X	X
Copper	X	X	X	X	X	X	X	X
Cyanide					X			
Iron	X	X	X	X	X	X	X	X
Lead	X	X	X		X	X	X	X
Manganese	X	X	X	X	X	X	X	X
Mercury		X				X	X	X
Nickel	X	X	X	X	X	X	X	X
Silver			X	X				
Thallium		X			X			
Vanadium	X	X	X	X	X	X	X	X
Zinc	X	X	X	X	X	X	X	X

Note:

(1) Summarized from BRA-TRC.

TABLE 1.3

SUMMARY OF CARCINOGENIC RISK ESTIMATES (1)
NCR SITE
WHEATFIELD, NEW YORK

Scenario	*Receptor*	*Present/Future*	*Incremental Risk*
Ground Water - Perimeter			
Ingestion	Resident	F	2E-04**
Ground Water - Northern Landfill Cell			
Ingestion	Resident	F	1E-04*
Surface Soil			
Ingestion	Youth Trespasser	P/F	4E-06*
Subsurface Soil			
Ingestion	Excavation Worker	F	7E-07
Sediments			
Ingestion	Youth Trespasser	P/F	5E-06*
Ingestion	Excavation Worker	F	9E-07
Leachate Soils			
Ingestion	Youth Trespasser	P/F	9E-08

Notes:

* Exceeds 10^{-6} risk
** Exceeds 10^{-4} risk
(1) Summarized from BRA-TRC

TABLE 1.4

SUMMARY OF NONCARCINOGENIC HAZARD INDICES (HI) (1)
NCR SITE
WHEATFIELD, NEW YORK

Scenario	*Receptor*	*Present/Future*		*Chronic HI*
Ground Water - Perimeter				
Ingestion	Resident	F		5E+00*
Ground Water - Northern Landfill Cell				
Ingestion	Resident	F		4E+00*
Surface Soil				
Ingestion	Youth Trespasser	P/F		9E-02
Subsurface Soil				
Ingestion	Excavation Worker	F		7E-01a
Sediments				
Ingestion	Youth Trespasser	P/F		1E-01
Dermal Contact	Youth Trespasser	P/F		2E-03
			Total	1E-01
Ingestion	Excavation Worker	F		7E-01a
Dermal Contact	Excavation Worker	F		1E-03a
			Total	7E-01a
Leachate Soils				
Ingestion	Youth Trespasser	P/F		3E-03
Dermal Contact	Youth Trespasser	P/F		9E-05
			Total	3E-03

Notes:

* Hazard Index exceeds one (1).
a Subchronic HIs were calculated for this scenario.
(1) Summarized from BRA-TRC

TABLE 1.5

SUMMARY OF CUMULATIVE CARCINOGENIC RISK ESTIMATES (1)
NCR SITE
WHEATFIELD, NEW YORK

Scenario		*Cumulative Incremental Risk*
Cumulative Carcinogenic Risk Estimates for Each Receptor		
Future Youth Trespasser Living in Adjacent Residence:		
	Perimeter Ground Water Ingestion	2E-04**
	Surface Soil Ingestion	4E-06*
		2E-04**
	Perimeter Ground Water Ingestion	2E-04**
	Sediments Ingestion	5E-06*
		2E-04**
	Perimeter Ground Water Ingestion	2E-04**
	Leachate Soils Ingestion	9E-08
		2E-04**
Future Excavation Worker Living in Adjacent Residence:		
	Perimeter Ground Water Ingestion	2E-04**
	Sediments Ingestion	9E-07*
		2E-04**
	Perimeter Ground Water Ingestion	2E-04**
	Subsurface Soils Ingestion	7E-07*
		2E-04**

Notes:

Cumulative risks were calculated based on perimeter groundwater ingestion which showed a higher incremental risk than northern landfill cell ground water ingestion.

* Exceeds 10-6 risk
** Exceeds 10-4 risk
(1) Summarized from BRA-TRC

TABLE 1.6

SUMMARY OF CUMULATIVE NONCARCINOGENIC HAZARD INDICES (HI) (1) NCR SITE WHEATFIELD, NEW YORK

Scenario	*Cumulative Chronic HIs*
Cumulative Carcinogenic Hazard Indices for Each Receptor	
Future Youth Trespasser Living in Adjacent Residence:	
Perimeter Ground Water Ingestion	5E+00*
Surface Soil Ingestion	9E-02
	5E+00*
Perimeter Ground Water Ingestion	5E+00*
Sediments Ingestion	1E-01
Sediments Dermal Contact	2E-03
	5E+00*
Perimeter Ground Water Ingestion	5E+00*
Leachate Soil Ingestion	3E-03
Leachate Soil Dermal Contact	9E-05
	5E+00*
Future Excavation Worker Living in Adjacent Residence:	
Perimeter Ground Water Ingestion	5E+00*
Subsurface Soil Ingestion	7E-01a
	5E+00
Perimeter Ground Water Ingestion	5E+00*
Sediments Ingestion	7E-01a
Sediments Dermal Contact	1E-03a
	6E+00*

Notes:

* Hazard Index exceeds one (1).
a - Subchronic HIs were calculated for this scenario.
(1) Summarized from BRA-TRC

TABLE 2.1

POTENTIAL GROUNDWATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)* Maximum Contaminant Level (µg/L)	Maximum Contaminant Level Goal (µg/L)	Secondary Maximum Contaminant Level (µg/L)	*New York State Standards and Guidance (2)* Standard (µg/L)	Guidance (µg/L)
Volatile Organic Compounds					
Acetone	--	--	--	--	--
Benzene	5.0	0.0	--	0.7	--
2-Butanone	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--
Ethylbenzene	70	70	--	5.0	--
Methylene Chloride	5.0 (3)	--	--	5.0	--
Styrene	100	100	--	5.0	--
Toluene	1,000	1,000	--	5.0	--
Xylenes (Total)	10,000	10,000	--	5.0 (4)	--
Semi-Volatile Organic Compounds					
bis(2-Ethylhexyl)phthalate	4.0 (3)	0.0	--	50	--
Butylbenzylphthalate	--	--	--	--	50
Diethyl phthalate	--	--	--	--	50
2,4-Dimethylphenol	--	--	--	5.0 (5)	--
Di-n-Butylphthalate	--	--	--	50	--
2-Methylphenol	--	--	--	5.0	--
4-Methylphenol	--	--	--	5.0	--
Pentachlorophenol	1.0	0.0	--	1.0 (6)	--
Phenol	--	--	--	1.0 (7)	--

TABLE 2.1

POTENTIAL GROUNDWATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)* *Maximum Contaminant Level (µg/L)*	*Maximum Contaminant Level Goal (µg/L)*	*Secondary Maximum Contaminant Level (µg/L)*	*New York State Standards and Guidance (2)* *Standard (µg/L)*	*Guidance (µg/L)*
Pesticides					
Aldrin	–	–	–	ND	–
alpha-BHC	–	–	–	ND (8)	–
alpha-Chlordane	2.0	0.0	–	0.1	–
beta-BHC	–	–	–	ND (8)	–
4,4'-DDD	–	–	–	ND (9)	–
4,4'-DDE	–	–	–	ND (9)	–
4,4'-DDT	–	–	–	ND (9)	–
delta-BHC	–	–	–	ND (8)	–
Dieldrin	–	–	–	ND	–
Endosulfan Sulfate	–	–	–	–	–
Endrin Aldehyde	–	–	–	5.0	–
Endrin Ketone	–	–	–	–	–
gamma-BHC	0.2	0.2	–	ND (8)	–
gamma-Chlordane	2.0	0.0	–	0.1	–
Heptachlor	0.4	0.0	–	ND (10)	–
Heptachlor epoxide	0.2	0.0	–	ND (10)	–
Methoxyclor	40	40	–	35	–

TABLE 2.1

POTENTIAL GROUNDWATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)*			*New York State Standards and Guidance (2)*	
	Maximum Contaminant Level (µg/L)	*Maximum Contaminant Level Goal (µg/L)*	*Secondary Maximum Contaminant Level (µg/L)*	*Standard (µg/L)*	*Guidance (µg/L)*
Inorganics					
Aluminum	–	–	50 to 200	–	–
Antimony	6.0	6.0	–	–	3.0
Arsenic	50	–	–	25	–
Barium	2,000	2,000	–	1,000	–
Beryllium	4.0	4.0	–	–	3.0
Cadmium	5.0	5.0	–	10	–
Calcium	–	–	–	–	–
Chromium	100	100	–	50	–
Cobalt	–	–	–	–	–
Copper	1,300	1,300	1,000	200	–
Iron	–	–	300	300	–
Lead	50	0.0	–	25	–
Magnesium	–	–	–	–	35,000
Manganese	None	0.0	50	300	–
Mercury	2.0	2.0	–	2.0	–
Nickel	100	–	–	–	–
Potassium	–	–	–	–	–
Silver	–	–	100	50	–
Sodium	–	–	–	20,000	–
Vanadium	–	–	–	–	–
Zinc	–	–	–	300	–

TABLE 2.1

POTENTIAL GROUNDWATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Notes:

(1) Federal Maximum Contaminant Levels (MCLs) are derived from the following sources:

1. USEPA Quality Criteria for Water 1986, EPA 440/5-86-001, MAY 86 51 Federal Register 43665, Update Sept. 1987.
2. Federal Register 48-231 November 1980.
3. USEPA Ambient Water Quality Criteria 55 FR 19986, May 1980.
4. USEPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141-3 (56 FR NO. 20), July 17, 1992.
5. IRIS-EPA Integrated Risk Information System Database, Jan. 1993.

(2) New York State Standards and Guidance values are for Class GA Groundwater obtained from "Water Quality Standards and Guidance Values", Division of Water, New York State Department of Environmental Conservation, Albany, NY, November 1991.

(3) Effective date January 17, 1994.

(4) Standard applies to each isomer individually.

(5) Standard applies to sum of unchlorinated phenols.

(6) Standard applies to sum of chlorinated phenols.

(7) Standard applies to total phenol.

(8) Standard applies to sum of alpha-, beta-, delta- and gamma-BHC.

(9) Standard applies to sum of 4,4'-DDD,4,4'-DDE and 4,4'-DDT.

(10) Standard applies to sum of Heptachlor and Heptachlor Epoxide.

ND A standard defined by 'ND' means not detected by the analytical tests specified or approved pursuant to 6 NYCRR Part 700.3.

TABLE 2.2

POTENTIAL SURFACE WATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)*			*New York State Standards and Guidance (2)*	
	Maximum Contaminant Level (µg/L)	*Maximum Contaminant Level Goal (µg/L)*	*Secondary Maximum Contaminant Level (µg/L)*	*Standard (µg/L)*	*Guidance (µg/L)*
Volatile Organic Compounds					
Acetone	--	--	--	--	--
Benzene	5.0	0.0	--	0.7	--
2-Butanone	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--
Chlorobenzene	100	100	--	5.0	--
Ethylbenzene	70	70	--	--	5.0
2-Hexanone	--	--	--	--	5.0
Methylene Chloride	5.0 (3)	--	--	--	5.0
4-Methyl-2-Pentanone	--	--	--	--	--
Tetrachloroethene	5	0.0	--	--	0.7
Toluene	1,000	1,000	--	--	5.0
1,1,1-Trichloroethane	200	200	--	--	5.0
Xylenes (total)	10,000	10,000	--	--	5.0 (4)
Semi-Volatile Organic Compounds					
Acenaphthene	--	--	--	20	--
Anthracene	--	--	--	--	50
Benzo(a)anthracene	--	--	--	--	0.002
Benzoic Acid	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	4.0 (3)	0.0	--	0.6	--
Butylbenzylphthalate	--	--	--	--	50

TABLE 2.2

POTENTIAL SURFACE WATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	Federal MCLs (1) Maximum Contaminant Level (µg/L)	Maximum Contaminant Level Goal (µg/L)	Secondary Maximum Contaminant Level (µg/L)	New York State Standards and Guidance (2) Standard (µg/L)	Guidance (µg/L)
Semi-Volatile Organic Compounds (cont.)					
1,2-Dichlorobenzene	600	600	--	5.0 (5)	--
1,3-Dichlorobenzene	600	600	--	5.0 (5)	--
1,4-Dichlorobenzene	75	75	--	5.0 (5)	--
Diethylphthalate	--	--	--	--	50
2,4-Dimethylphenol	--	--	--	5.0 (6)	--
Di-n-butylphthalate	--	--	--	--	50
2,6-Dinitrotoluene	--	--	--	--	0.07
Fluoranthene	--	--	--	--	50
Fluorene	--	--	--	--	50
2-Methylnaphthalene	--	--	--	--	--
2-Methylphenol	--	--	--	5.0 (6)	--
4-Methylphenol	--	--	--	5.0(6)	--
Naphthalene	--	--	--	10	--
N-Nitrosodiphenylamine	--	--	--	--	50
Phenanthrene	--	--	--	--	50
Phenol	--	--	--	1 (7)	--
Pyrene	--	--	--	--	50

TABLE 2.2

POTENTIAL SURFACE WATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)* *Maximum Contaminant Level (µg/L)*	*Maximum Contaminant Level Goal (µg/L)*	*Secondary Maximum Contaminant Level (µg/L)*	*New York State Standards and Guidance (2)* *Standard (µg/L)*	*Guidance (µg/L)*
Pesticides					
Aldrin	--	--	--	0.001 (8)	--
delta-BHC	--	--	--	0.01 (9)	--
gamma-BHC	--	--	--	0.01 (9)	--
4,4'-DDD	--	--	--	0.001 (10)	--
4,4'-DDE	--	--	--	0.001 (10)	--
4,4'-DDT	--	--	--	0.001 (10)	--
Dieldrin	--	--	--	0.001 (8)	--
Heptachlor	0.4	0.0	--	0.001 (11)	--
Heptachlor Epoxide	0.2	0.0	--	0.001 (11)	--
Inorganics					
Aluminum	--	--	50 to 200	100	--
Arsenic	50	--	--	50	--
Barium	2,000	2,000	--	1,000	--
Beryllium	4.0	4.0	--	--	3
Cadmium	5.0	5.0	--	10	--
Calcium	--	--	--	--	--
Chromium	100	100	--	50	--
Cobalt	--	--	--	5	--
Copper	1,300	1,300	1,000	200	--

TABLE 2.2

POTENTIAL SURFACE WATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Parameter	*Federal MCLs (1)* Maximum Contaminant Level (µg/L)	Maximum Contaminant Level Goal (µg/L)	Secondary Maximum Contaminant Level (µg/L)	*New York State Standards and Guidance (2)* Standard (µg/L)	Guidance (µg/L)
Inorganics (cont.)					
Cyanide	200	200	--	5.2	--
Iron	--	--	300	300	--
Lead	50	0.0	--	50	--
Magnesium	--	--	--	35,000	--
Manganese	None	0.0	50	300	--
Nickel	100	--	--	(12)	--
Potassium	--	--	--	--	--
Sodium	--	--	--	--	--
Vanadium	--	--	--	14	--
Zinc	--	--	--	30	--

TABLE 2.2

POTENTIAL SURFACE WATER CHEMICAL - SPECIFIC STANDARDS AND CRITERIA

Notes:

(1) Federal Maximum Contaminant Levels (MCLs) are derived from the following sources:
1. USEPA Quality Criteria for Water 1986, EPA 440/5-86-001, MAY 86 51 Federal Register 43665, Update Sept. 1987.
2. Federal Register 48-231 November 1980.
3. USEPA Ambient Water Quality Criteria 55 FR 19986, May 1980.
4. USEPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141-3 (56 FR NO. 20), July 17, 1992.
5. IRIS-EPA Integrated Risk Information System Database, Jan. 1993.

(2) New York State Standards and Guidance values are for Class AA Surface Water obtained from "Water Quality Standards and Guidance Values", Division of Water, New York State Department of Environmental Conservation, Albany, NY, November 1991.

(3) Effective date January 17, 1994.

(4) Standard applies to each isomer individually.

(5) Standard apples to sum of 1,2-, 1,3- and 1,4-Dichlorobenzene.

(6) Standard applies to sum of unchlorinated phenols.

(7) Standard applies to total phenol.

(8) Standard applies to sume of aldrin and dieldrin.

(9) Standard applies to sum of delta- and gamma-BHC.

(10) Standard applies to sum of 4,4'-DDD,4,4'-DDE and 4,4'-DDT.

(11) Standard applies to sum of Heptachlor and Heptachlor Epoxide.

(12) Standard for Nickel = exp (0.76 [In{ppm hardness}] + 1.06).

ND A standard defined by 'ND' means not detected by the analytical tests specified or approved pursuant to 6 NYCRR Part 700.3.

TABLE 2.3

POTENTIAL LOCATION-SPECIFIC ARARs
NCR SITE
WHEATFIELD, NEW YORK

Location	*Title*	*Subtitle*	*Citation*	*Requirements*
	FEDERAL ARARs			
Wetland	Wetlands Construction & Management Procedures CERCLA Wetlands Assessment (11990) Clean Water Act	 Section 404	40 CFR 6, Appendix A 40 CFR Parts 230,231	Action to minimize the destruction, loss or degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without permit.
Area Affecting Stream, River, or Shoreline	Fish & Wildlife Coordination Act Endangered Species Act Coastal Zone Management Act	 Section 1451	16 USC 661 et seq. 16 USC 1531 40 CFR 6.302 16 USC Section 1451 et seq.	Action to protect fish or wildlife. Action to conserve endangered species or threatened species, including consultation with the Department of the Interior. Conduct activities in manner consistent with approved State Management Programs.
Historic Area	National Archaeological and Historic Preservation Act National Historic Preservation Act	Section 469 Section 106	16 USC et seq. 36 CFR Part 65 16 USC 470 et seq. 36 CFR Part 800	Action to recover and preserve artifacts Action to preserve historic properties. Planning of action to minimize harm to national historic landmarks.
Farming Area	Farmland Protection Policy Act of 1981 United States Department of Agriculture/Soil Conservation Service, Farmland Protection Policy		7 USC 4201 et seq. 7 CFR 658	Action to Protect Existing Farmland.

TABLE 2.3

POTENTIAL LOCATION-SPECIFIC ARARs
NCR SITE
WHEATFIELD, NEW YORK

Location	*Title*	*Subtitle*	*Citation*	*Requirements*
	NEW YORK STATE ARARs			
Wetland	Freshwater Wetlands Law		ECL Article 24,71 in Title 23	Action to minimize the destruction, loss or degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without permit.
	New York State Freshwater Wetlands Permit Requirements & Classification		6 NYCRR 663 & 664	
Area Affecting Stream or River	Endangered and Threatened Species of Fish and Wildlife Requirements		6 NYCRR 182	Action to protect fish or wildlife.
	New York State Water Pollution Control Requirements, Use & Protection of Waters		6 NYCRR 608	Action to conserve endangered species or threatened species. Conduct activities in manner consistent with approved State Management Programs.

TABLE 2.4

POTENTIAL ACTION-SPECIFIC ARARs
NCR SITE
WHEATFIELD, NEW YORK

Activity	*Title*	*Subtitle*	*Citation*	*Requirements*
		FEDERAL ARARs		
Capping	Criteria for Municipal Solid Waste Landfills (Municipal)	Construction, Closure & Post Closure Care, Monitoring	40 CFR 258	Placement of a cap over hazardous waste (e.g. closing a landfill) requires a cover designed and constructed to: - Provide long-term minimization of infiltration of liquids through the capped area - Function with minimum maintenance - Promote drainage and minimize erosion or abrasion of the cover - Accommodate settling and subsidence so that the cover's integrity is maintained - Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present Restrict Post Closure use of property as necessary to prevent damage to cover. Prevent run-on and run-off from damaging cover. Prevent and maintain surveyed benchmarks used to locate waste cells. Disposal of decontamination of equipment, structures, and soils.
	Standards for Owners & Operators of Hazardous Waste Treatment, Storage & Disposal Facilities	Construction, Closure & Post Closure Care, Monitoring	40 CFR 264	
	Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities		29 CFR 1904, 1910, 1926	
Direct Discharge of Treatment System Effluent	Administered Permit Programs: The National Pollutant Discharge Eliminations System	Establishing Limitations, Standards & Other Permit Conditions	40 CFR 122.44 & State Regulations Approved Under 40 CFR 131	Applicable federally approved or State Water quality Standards must be complied with. These standards may be in addition to more stringent than other Federal Standards under the Clean Water Act. The discharge must be consistent with the requirement of a Water Quality Management Plan approved by EPA under Section 208 (b) of the Clean Water Act. Use of best available technology economically achievable is required to control pollutants. Develop and implement a best management practices (BMP) program and incorporate in the NPDES Permit to prevent the release of toxic constituents to surface waters. Discharger must be monitored to assure compliance with permit. Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided. Permit application information must be submitted, including a description of activities, listing environmental permits, etc.
	Criteria & Standards for the National Pollutant Discharge Elimination Program	Best Management Practices Discharge to Waters in the U.S.	40 CFR 125.100 40 CFR 125.104	
	Guidelines Establishing Test Procedures for the Analysis of Pollutants	Identification of Test Procedures & Alternate Test Procedures	40 CFR 136.1-4	
	Clean Water Act	NPDES Permitting Requirements for Discharge of Treatment System Effluent	40 CFR 122-125	
Discharge to a POTW	Effluent Guidelines & Standards		40 CFR 403.5 40 CFR 264.71, 264.72	Pollutants that pass through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludges are prohibited. Discharge must comply with local POTW pretreatment program, including POTW specific pollutants, spill prevention program requirements, reporting and monitoring requirements. RCRA permit by rule requirements must be complied with for discharges of RCRA hazardous wastes to POTW's.

TABLE 2.4

POTENTIAL ACTION-SPECIFIC ARARs
NCR SITE
WHEATFIELD, NEW YORK

Activity	*Title*	*Subtitle*	*Citation*	*Requirements*
Air Emissions Due to On-Site Wastewater Treatment	Standards for Owners & Operations of Hazardous Waste Treatment, Storage & Disposal Facilities	Design & Operation Requirements	40CRF 264.251	Proposed standards for control of emissions of volatile organics (CAA requirements to be provided). Design system to provide odor-free operation. File an Air Pollution Emission Notice (APEN) with State to include estimated of emission rates for each pollutant expected. Predict total emissions of VOC's to demonstrate emissions do not exceed allowable levels.
Gas Collection	EPA Regulations on Approval and Promulgation of Implementation Plans. EPA Regulations on national Emission Standards for Hazardous Air Pollutants		40 CFR 50 40 CFR 52, CAA Section 101 40 CFR 61 52 FR 3748	
Excavation	Land Disposal Restriction	Treatment Standards	40 CFR 264 40 CFR 268 (Subpart D)	Area from which materials are excavated may require cleanup to levels established by closure requirements. Develop fugitive and odor emission control plan for this action if existing site plan is inadequate. File an Air Pollution Emission Notice (APEN) with State to include estimation of emission rates for each pollutant expected. Predict total emissions of volatile organic compounds (VOC's) to demonstrate emissions do not exceed allowable levels.
Surface Water Control	Standards for Owners & Operators of Hazardous Waste Treatment, Storage & Disposal Facilities	Design & Operating Requirements for Waste Piles Design & Operating Requirements for Landfills	40 CFR 264.251 (c)(d) 40 CFR 264.271 40 CFR 264.221 40 CFR 264.301 (c)(d)	Prevent run-on and control and collect run-off from the landfill for a 24-hour, 25 year storm.
Transporting Hazardous Waste Off Site	Standards Applicable to Transporters of Hazardous Waste		40 CFR 263	DOT permits must be adhered to in the transport of any hazardous material.
	DOT Rules for Hazardous Materials Transport		49 CFR 107, 171.1-171.50	
Relocation Assistance & Property Acquisitions	Uniform Relocation Assistance & Real Property Acquisition Policies Act		40 CFR 4	Property acquisition to be carried out as per the Real Property Acquisition Policies Act.

TABLE 2.4

POTENTIAL ACTION-SPECIFIC ARARs
NCR SITE
WHEATFIELD, NEW YORK

Activity	*Title*	*Subtitle*	*Citation*	*Requirements*
		NEW YORK STATE ARARs		
Capping	Design, Construction, Operation, Closure & Post Closure of Solid Waste Landfills		6 NYCRR Part 360,373	(See Requirements for Federal ARARs for Capping.)
Direct Discharge of Treatment System Effluent	Implementation of NPDES Program in New York State, Technical & Operations Guidance Series		6 NYCRR Part 750-757	(See Requirements for Federal ARARs for Direct Discharge of Treatment System Effluent.)
	Technical & Operations Guidance Series		NYSDOH PWS 68	
	Blending Policy for Use of Sources of Drinking Water Supplies		Part 5 of State Sanitary Code	
	Use & Protection of Waters		6 NYCRR Part 608	
	Water Quality Regulations for Surface Waters & Groundwaters		10 NYCRRS 6 NYCRR Part 701, 702 & 703 6 NYCRR 373-2.6 (e)	
Surface Water Control	Solid Waste Treatment, Storage & Disposal Facility Permitting Requirements		6 NYCRR Part 360	Prevent run-on and control and collect run-off from a 24-hr., 25-yr. storm from the landfill.
	Standards for Stormwater Runoff, Surface Water and Groundwater Discharge		6 NYCRR 750-757	
Air Emissions Due to On-Site Wastewater Treatment	New York air pollution control regulations	General provisions Permits and certificates General prohibitions General process emission sources	6 NYCRR Part 200 6 NYCRR Part 201 6 NYCRR Part 211 6 NYCRR Part 212 6 NYCRR 256, 257	Proposed standards for control of emissions of volatile organics (CAA requirements to be provided). design system to provide odor-free operation. File an Air Pollution Emission Notice (APEN) with State to include estimated of emission rates for each pollutant expected. Predict total emissions of VOC's to demonstrate emissions do not exceed allowable levels.
	Hazardous waste treatment, storage and disposal facility permitting requirements		6 NYCRR Subpart 373-1	
	Interim status standards for owners and operators of hazardous waste facilities		6 NYCRR Subpart 373-3	
Transporting Hazardous Waste Off Site	Waste transport permits		6 NYCRR Part 364	DOT permits must be adhered to in the transport of any hazardous material.
	Hazardous waste manifest system and related standards for generators, transporters and facilities		6 NYCRR Part 372	

TABLE 3.1

IDENTIFICATION OF POTENTIAL GENERAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action		*Remedial Technologies*		*Process Options*
1. No Action		–		–
2. Limited Action		Institutional Controls	i)	Fencing
			ii)	Deed Restrictions
3. Containment Action	a)	Surface Controls	i)	Grading
			ii)	Revegetation
	b)	Capping with Perimeter Barrier Wall	i)	RCRA Cap
			ii)	NYS Solid Waste Standard Cap
			iii)	Low Permeable Soil Cap
4. Collection Action				
4.1 Leachate	a)	Passive Collection System	i)	Subsurface Perimeter Drains
	b)	Active Collection System	i)	Extraction Wells
4.2 Gas	a)	Passive Collection System	i)	Gas Venting Layer
			ii)	Gas Collection Trenches Beneath the Cap
			iii)	Perimeter Gas Collection Trenches
	b)	Active Collection System	i)	Gas Extraction Wells
5. Leachate Treatment Action				
	a)	On-Site Physical Treatment	i)	Carbon Adsorption
			ii)	Air Stripping
	b)	On-Site Biological Treatment	i)	Biological
	c)	Off-Site Treatment	i)	Discharge to POTW

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
1. No Action Alternative	--	- no remedial measures taken to improve environmental conditions at the Site - required by NCP	- does not achieve remedial action objectives - current acceptable risk as identified by BRA-CRA	--	- no capital cost	- retained for further evaluation as required by the NCP - to be used as a baseline against which other alternatives are judged
2. Limited Action - Institutional Controls						
	i) Fencing	- construction of a chain-link fence around the perimeter of the landfill to restrict access	- restricts access to the Site thereby preventing contact with landfill contents	- easily implemented - requires regular inspection and maintenance	- low capital and long-term costs	- retained for further evaluation - to be used in conjunction with other remedial actions
	ii) Deed Restrictions	- restrictive covenants on deeds to the property to limit or prevent Site use and development	- effectiveness is dependent on NYS and local laws, continued enforcement and maintenance	- easily implemented although some legal restrictions and exceptions may apply	- low capital cost and no long-term costs	- retained for further evaluation - to be used in conjunction with other remedial actions

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
3. Containment Action	a) Surface Controls					
	i) grading	- reshaping of topography to manage infiltration and runoff to control erosion - individual cells could be graded separately or in combination with other cells	- effective for channelling uncontaminated surface water off of and around the landfill thereby minimizing infiltration through the cap	- common construction technique and is easily implemented - significant amount of fill or off-Site clean demolition and construction debris will be required if the entire landfill is graded as one cell	- moderate capital and long term costs - capital costs are reduced by importing clean demolition and construction debris for fill	- retained for further evaluation - to be used in conjunction with capping alternatives
	ii) revegetation	- seeding, fertilizing and watering until a stand of vegetation has established itself	- effective for stabilizing the soil surface of the landfill cap - decreases erosion of cap by wind and water	- easily implemented - plant species can be selected to minimize maintenance after seeding	- low capital and long term costs	- retained for further evaluation - to be used in conjunction with capping alternatives

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
3. Containment Action	b) Capping with Perimeter Barrier Wall					
	i) RCRA Cap	- multi-layer cap consisting of vegetated top cover, middle drainage layer and low permeability layer consisting of a clay liner and synthetic membrane - clay barrier wall constructed around perimeter of landfill	- most effective cap design for reducing infiltration into the landfill - annual infiltration is estimated to be 9,000 gal/year - usually used for landfills containing RCRA hazardous wastes	- moderate level of implementation required - implementation would follow grading - stability problems may result with multi-layer caps - settlement of subgrade may be problematic	- high capital cost reduced by close proximity of clay source (1) - low long-term costs	- retained for further evaluation
	ii) NYS Solid Waste Standard Cap.	- multi-layer cap consisting of vegetated top cover and low permeability layers of fill and clay - clay barrier wall constructed around perimeter of landfill	- effective for reducing infiltration into the landfill - annual infiltration estimated to be 2.4 million gal/year - required by NYS (6 NYCRR Part 360) for municipal solid waste facilities	- relatively low level of implementation required - implementation would follow grading - settlement of subgrade may be problematic	- moderate capital cost reduced by close proximity of clay source (1) - low long-term costs	- retained for further evaluation

Note:

(1) - The close proximate clay source is anticipated to exist.

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
3. Containment Action	iii) Low Permeable Soil Cap	- multi-layer cap consisting of vegetated top cover and a low permeability fill layer - clay barrier wall constructed around perimeter of landfill	- least effective cap design - significantly more infiltration (estimated to be 8 million gal/year) compared to RCRA and NYS caps - does not meet ARAR requirements (6 NYCRR Part 360) for municipal solid waste facilities	- relatively low level of implementation required - implementation would follow grading - settlement of subgrade may be problematic	- moderate capital cost - low long-term costs	- eliminated from further evaluation
4. Collection Action 4.1 Leachate	a) Passive Collection System					
	i) Subsurface Perimeter Drains	- underground gravel-filled trenches equipped with perforated pipe to intercept and channel leachate to a sump for collection	- provides a reduction in the potential for migration of leachate to surface water and shallow silt unit	- easily implemented - will require ongoing maintenance to maintain effectiveness	- moderate capital and long term costs	- retained for further evaluation

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
4. Collection Action 4.1 Leachate (cont'd)	b) Active Collection System					
	i) Extraction Wells	- installation of extraction wells to the base of the landfill and/or installation of wells around the perimeter of the landfill - leachate is actively pumped from wells	- provides a reduction in the potential for migration of leachate to surface water and shallow silt unit - used in areas where there is highly contaminated leachate or leachate/ groundwater mix - not applicable to Site - due to low permeability of the subsurface units perimeter extraction wells would not be effective	- moderate level of implementation required - will require ongoing maintenance to maintain effectiveness	- low capital and moderate long-term costs	- eliminated from further evaluation

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
4. Collection Action 4.2 Gas	a) Passive Collection System					
	i) Gas Venting Layer	- minimum 12-inch soil gas venting layer installed beneath barrier layer of cap - vertical gas vent pipes installed at a minimum frequency of 1/acre	- low levels of gas production (126 cfm) do not warrant a gas venting layer.	- easily implemented with cap construction - implementation would follow grading - required by NYS for municipal solid waste facilities (6 NYCRR Part 360)	- moderate capital cost - low long-term costs	- eliminated from further evaluation
	ii) Gas Collection Trenches	- trench vents consisting of gravel tenches within and around the perimeter of the landfill - may be incorporated in design of perimeter leachate collection system	- effective for controlling landfill gas migration at low levels of gas production (126 cfm) - does not increase effectiveness of gas collection when used in conjunction with a gas venting layer - since landfill gas at the Site does not pose a threat to health, safety or property, a perimeter gas collection system may not be required	- moderate level of implementation required - may be installed in conjunction with leachate perimeter collection system	- low capital cost - cost reduced by installing system with leachate perimeter collection system (if installed)	- retained for further evaluation

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
4. Collection Action						
4.2 Gas	b) Active Collection System					
	i) Gas Extraction Wells	- gas extraction wells installed within refuse typically 100 to 300 feet apart - gas collection headers, vacuum blowers or compressors are used to create a negative pressure area which causes gases to be drawn up from the extraction wells	- effective for controlling subsurface migration of gases - typically used in landfills where severe odor problems exist and/or when significant risk to nearby structures is evident - low levels of gas production (126 cfm) at the Site do not warrant an active system	- moderate level of implementation required - more effort than passive systems due to complex design and mechanical equipment required	- moderate capital costs - regular O&M costs required for optimal performance	- eliminated from further evaluation
5. Leachate Treatment Action	a) On-Site Physical					
	i) Carbon Adsorption	- adsorption of organic compounds onto granular activated carbon (GAC)	- effectiveness is limited by carbon fouling and encrustation caused by high organic content and metals (calcium and iron)	- easily implemented - requires regular inspection and maintenance	- carbon cost would be high due to high TOC concentration at Site	- retained for further evaluation - to be used in conjunction with other on-Site treatment options

TABLE 3.2

SCREENING OF POTENTIAL REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology/ Process Options*	*Description*	*Effectiveness*	*Implementability*	*Cost*	*Recommendations*
5. Leachate Treatment Action (Cont'd)	ii) Air stripping	- contaminants are transferred from a liquid stream to an air stream.	- not effective for semi-volatile and non-volatile compounds - fouling and scale formation are problems due primarily to iron oxidation	- easily implemented - requires regular inspection and maintenance	- moderate capital and long term costs	- retained for further evaluation - to be used in conjunction with other on-Site treatment options
	b) On-Site Biological Treatment					
	i) Biological	- proven technology involving the oxidation of organic content of leachate through the use of microorganisms under aerobic conditions	- calcium and iron reduces efficiency of treatment due to precipitation and toxicity	- easily implemented - requires regular inspection and maintenance	- moderate capital and long term costs	- retained for further evaluation - to be used in conjunction with other on-Site treatment options
	c) Off-Site Treatment					
	i) Discharge to POTW	- direct discharge of leachate to sanitary sewer for treatment at City of North Tonawanda's POTW	- POTW is designated to treat industrial waste and is considered effective for the Site's leachate	- easily implemented - preliminary approval by POTW has been indicated	- low capital and long term costs	- retained for further evaluation

TABLE 3.3

SUMMARY OF CAP EFFECTIVENESS FOR REDUCING PERCOLATION NCR SITE WHEATFIELD, NEW YORK

	RCRA Cap	*NYS Cap for Sanitary Landfill*	*Low Permeable Soil Cap*
Precipitation (inches/year)	37.97	37.97	37.97
Runoff (inches/year)	5.87	8.63	5.87
Evapotranspiration (inches/year)	26.77	27.93	26.77
Lateral Drainage (inches/year)	5.77	--	--
Percolation (inches/year)	0.007	1.74	5.67
Net change in water storage (inches)	-0.45	-0.33	-0.34

Notes:

(1) Based upon HELP model results presented in Appendix B.
(2) Model results are for a five-year simulation period.

TABLE 3.4

REMEDIAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS
RETAINED FOR FURTHER EVALUATION
NCR SITE
WHEATFIELD, NEW YORK

General Response Action	*Remedial Technology*	*Process Options*
1. No Action	--	--
2. Limited Action	a) Institutional Controls	i) Fencing ii) Deed Restrictions
3. Containment Action	a) Surface Controls	i) Grading ii) Revegetation
	b) Capping with Perimter Barrier Wall	i) RCRA Cap ii) NYS Solid Waste Standard Cap
4. Collection Action		
4.1 Leachate	a) Passive Collection System	i) Subsurface Perimeter Drains
4.2 Gas	a) Passive Collection System	i) Gas Collection Trenches in the Cap
5. Treatment Action		
5.1 Leachate	a) On-Site Physical Treatment	i) Carbon Adsorption ii) Air Stripping
	b) On-Site Biological Treatment	i) Biological
	c) Off-Site Treatment	i) Discharge to POTW

TABLE 4.1

DETAILED ANALYSIS CRITERIA AND FACTORS
NCR SITE
WHEATFIELD, NEW YORK

Evaluation Criteria	*Evaluation Factors*
Short-Term Effectiveness	• Protection of community during remedial action • Protection of workers during remedial action • Time until objectives are achieved • Environmental impacts
Long-Term Effectiveness and Permanence	• Magnitude of residual risk • Adequacy of controls imposed after remedial action • Reliability of controls imposed after remedial action
Reduction of Toxicity, Mobility and Volume Through Treatment	• Treatment process used and materials treated • Amounts of hazardous materials destroyed or treated • Type and quantity of residuals remaining after treatment • Degree of expected reductions in toxicity, mobility and volume • Degree to which treatment is irreversible
Implementability	• Technical feasibility • Administrative feasibility • Availability of services and materials
Costs	• Total capital costs • Operating and maintenance costs • Total present worth cost at 6 percent discount factor for 30-year period
Compliance with ARARs	• Compliance with chemical-specific ARARs • Compliance with action-specific ARARs • Compliance with location-specific ARARs
Overall Protection of Human Health and the Environment	• Elimination, reduction or control of risks
State Acceptance	• At public comment review stage, not addressed in FS
Community Acceptance	• At public comment review stage, not addressed in FS

TABLE 4.2

LIST OF POTENTIAL REMEDIAL ALTERNATIVES
NCR SITE
WHEATFIELD, NEW YORK

Alternative	*Description*
1.	No Action
2.	Deed Restrictions, Access Control, Monitoring
3.	Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection
4.	Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection
5.	Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment
6.	Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment

TABLE 4.3

REMEDIAL ALTERNATIVE GROUNDWATER AND SURFACE WATER MONITORING PROGRAM NCR SITE WHEATFIELD, NEW YORK

	Baseline Parameters	*Ground and Surface Water Routine Parameters*	*Expanded Parameters*
Field Parameters			
Static water level (in wells and sumps)	X	X	X
Specific Conductance	X	X	X
Temperature	X	X	X
Floaters or Sinkers (1)	X		X
pH	X	X	X
Eh	X	X	X
Dissolved Oxygen (2)	X	X	X
Field Observations (3)	X	X	X
Leachate Indicators			
Total Kjeldahl Nitrogen (TKN)	X		X
Ammonia	X	X	X
Nitrate	X	X	X
Chemical Oxygen Demand (COD)	X	X	X
Biochemical Oxygen Demand (BOD_5)	X		X
Total Organic Carbon (TOC)	X	X	X
Total Dissolved Solids (TDS)	X	X	X
Sulfate	X	X	X
Alkalinity	X	X	X
Phenols	X	X	X
Chloride	X	X	X
Total Hardness as $CaCO_3$	X	X	X
Turbidity	X	X	X
Color	X		X
Boron	X		X
Metals			
Potassium	X	X	X
Sodium	X	X	X
Iron	X	X	X
Manganese	X	X	X
Magnesium	X	X	X
Lead	X	X	X
Cadmium	X	X	X
Aluminum	X		X
Calcium	X	X	X
Toxic Metals (4) and Cyanide	X		X
Volatile Organics	X		X
All constituents listed in 6 NYCRR Part 373-2, Appendix 33 (6)			X

TABLE 4.3

**REMEDIAL ALTERNATIVE GROUNDWATER
AND SURFACE WATER MONITORING PROGRAM
NCR SITE
WHEATFIELD, NEW YORK**

Notes:

The New York State Department of Environmental Conservation (NYSDEC) may modify this list as needed.

All samples must be whole and unfiltered except as otherwise specified by the NYSDEC.

(1) Any floaters or sinkers found must be analyzed separately for baseline parameters.

(2) Surface water only.

(3) Any unusual conditions (colors, odors, surface sheens, etc.) noticed during well development, purging, or sampling must be reported.

(4) Toxic metals include: Antimony, Arsenic, Beryllium, Barium, Cadmium, Chromium (total and hexavalent)*, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium and Zinc.

(5) Volatile organics are to be analyzed using EPA Methods 601 and 602 as described in 40 CFR Part 136 (see Section 360-1.3 of this Part).

(6) Upon request of the applicant, the NYSDEC may waive the requirement to analyze for dioxins and furans (suggested Method 8280), where appropriate.

* The NYSDEC may waive the requirement to analyze Hexavalent Chromium provided that Total and Hexavalent and Trivalent Chromium values do not exceed 0.05 mg/L.

TABLE 4.4

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 1
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual Cost(2)*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	5-Year Reviews ($10,000/5 years)	$ 0	$ 2,220	$ 30,500	$ 30,500
			Total Implementation Cost for Alternative 1		$ 30,500

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years (Based on an average annual inflation rate of 6%).

TABLE 4.5

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 2
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual(2) Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
3.	5-Year Reviews ($10,000/5 years)	$ 0	$ 2,220	$ 30,500	$ 30,500
				Total Implementation Cost for Alternative 2	**$ 2,501,900**

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years.

TABLE 4.6

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 3
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual(2) Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
3.	5-Year Review	$ 0	$ 2,220	$ 30,500	$ 30,500
4.	RCRA Cap (with perimeter barrier wall)	$ 19,975,800 - $ 21,881,500	$ 20,000	$ 344,000	$ 20,319,800 - $ 22,225,500
	Total Implementation Cost for Alternative 3				**$ 22,821,700 - $ 24,727,400**

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years.

TABLE 4.7

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 4
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual(2) Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
3.	5-Year Review	$ 0	$ 2,220	$ 30,500	$ 30,500
4.	NYS Standard Cap (with perimeter barrier wall)	$ 14,679,300 - $ 16,344,300	$ 20,000	$ 344,000	$ 15,023,000 - $ 16,688,300
	Total Implementation Cost for Alternative 4				**$ 17,524,900 - $ 19,190,200**

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years.

TABLE 4.8

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 5
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual(2) Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
3.	5-Year Review	$ 0	$ 2,220	$ 30,500	$ 30,500
4.	NYS Standard Cap (with perimeter barrier wall)	$ 14,679,300 - $ 16,344,300	$ 20,000	$ 344,000	$ 15,023,300 - $ 16,688,300
5.	Leachate Subsurface Perimeter Drain	$ 930,200	$ 10,000	$ 172,000	$ 1,102,200
6.	On-Site Leachate Treatment	$ 750,000	$ 200,000	$ 3,441,000	$ 4,191,000
				Total Implementation Cost for Alternative 5	**$ 22,818,400 - $ 24,483,400**

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years.

TABLE 4.9

COST ESTIMATE FOR REMEDIAL ALTERNATIVE 6
NCR SITE
WHEATFIELD, NEW YORK

		Estimated Cost (1)			
Item	*Description*	*Capital Cost*	*Annual(2) Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
3.	5-Year Review	$ 0	$ 2,220	$ 30,500	$ 30,500
4.	NYS Standard Cap (with perimeter barrier wall)	$ 14,679,300 - $ 16,344,300	$ 20,000	$ 344,000	$ 15,023,300 - $ 16,688,300
5.	Leachate Subsurface Perimeter Drain	$ 930,200	$ 10,000	$ 172,000	$ 1,102,200
6.	Leachate Treatment at POTW	$ 30,800	$ 38,400	$ 660,000	$ 691,400
	Total Implementation Cost for Alternative 6				$ 19,318,800 - $ 20,983,800

Notes:

(1) See Appendix D for detailed cost.
(2) Average annual costs over 30 years, actual costs may vary for specific years.

TABLE 4.10

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES
NCR SITE
WHEATFIELD, NEW YORK

Evaluation Criteria	*Alternative 1* *No Action*	*Alternative 2* *Deed Restrictions, Access Control, Monitoring*	*Alternative 3* *Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection*	*Alternative 4* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection*	*Alternative 5* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment*	*Alternative 6* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment*
Short-Term Effectiveness	• No additional benefits or risks to community, workers or the environment	• No additional short term impacts to the community, workers or the environment	• Short-term benefits include eliminating potential contact with leachate seeps and landfill contents • Potential exposure to leachate and potentially contaminated airborne particles to samplers and construction workers would be controlled by Health and Safety Plan • No unacceptable risk to community or environment	• Short-term benefits include eliminating potential contact with leachate seeps and landfill contents • Potential exposure to leachate and potentially contaminated airborne particles to samplers and construction workers would be controlled by Health and Safety Plan • No unacceptable risk to community or environment	• Short-term benefits include eliminating potential contact with leachate seeps and landfill contents • Potential exposure to leachate and potentially contaminated airborne particles to samplers and construction workers would be controlled by Health and Safety Plan • No unacceptable risk to community or environment	• Short-term benefits include eliminating potential contact with leachate seeps and landfill contents • Potential exposure to leachate and potentially contaminated airborne particles to samplers and construction workers would be controlled by Health and Safety Plan • No unacceptable risk to community or environment

TABLE 4.10

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES
NCR SITE
WHEATFIELD, NEW YORK

Evaluation Criteria	*Alternative 1* *No Action*	*Alternative 2* *Deed Restrictions, Access Control, Monitoring*	*Alternative 3* *Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection*	*Alternative 4* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection*	*Alternative 5* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment*	*Alternative 6* *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment*
Long-Term Effectiveness and Permanence	• Existing cap may further deteriorate resulting in leachate contaminating surface water and sediment • Alternative is not effective in long term and is not permanent	• Existing cap may further deteriorate resulting in leachate contaminating surface water and sediment • Alternative is not effective in long term and is not permanent	• Eliminates direct contact with landfill contents and leachate seeps • Provided that the integrity of the cap is maintained this alternative would be effective and permanent in the long term • Leachate generation and migration significantly reduced minimizing potential for surface water and sediment contamination • Lateral landfill gas migration would be effectively controlled	• Eliminates direct contact with landfill contents and leachate seeps • Provided that the integrity of the cap is maintained this alternative would be effective and permanent in the long term • Leachate generation and migration significantly reduced minimizing potential for surface water and sediment contamination • leachate seeps may still occur in absence of a collection system • Lateral landfill gas migration would be effectively controlled	• Eliminates direct contact with landfill contents and leachate seeps • Provided that proper operation and maintenance for the on-Site treatment facility is provided & the integrity of the cap is maintained this alternative would be effective and permanent in the long term • Leachate generation and migration significantly reduced minimizing potential for surface water and sediment contamination • Lateral landfill gas migration would be effectively controlled	• Eliminates direct contact with landfill contents and leachate seeps • Provided that the integrity of the cap is maintained and that treatment at the POTW is viable for the duration of remediation, this alternative is effective and permanent in the long term • Leachate generation and migration significantly reduced minimizing potential for surface water and sediment contamination • Lateral landfill gas migration would be effectively controlled

TABLE 4.10

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES
NCR SITE
WHEATFIELD, NEW YORK

Evaluation Criteria	Alternative 1 *No Action*	Alternative 2 *Deed Restrictions, Access Control, Monitoring*	Alternative 3 *Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection*	Alternative 4 *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection*	Alternative 5 *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment*	Alternative 6 *Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment*
Reduction of Toxicity, Mobility or Volume Through Treatment	• No reduction of toxicity, mobility or volume of contaminants through treatment	• No reduction of toxicity, mobility or volume of contaminants through treatment	• Volume of contaminants significantly reduced due to RCRA cap	• Volume of contaminants significantly reduced due to NYS Standard cap	• Substantial reduction in toxicity, mobility and volume of contaminants through on-Site treatment of leachate and NYS Standard cap	• Substantial reduction in toxicity, mobility and volume of contaminants through off-Site treatment of leachate and NYS Standard cap
Implementibility	• 5 year reviews administratively feasible but technically difficult without a quantitative database	• Can be readily implemented with demonstrated, available construction techniques • 5 year review administratively and technically feasible	• Can be readily implemented with demonstrated, available construction techniques • 5 year review administratively and technically feasible	• Can be readily implemented with demonstrated available construction techniques • 5 year review administratively and technically feasible	• Can be readily implemented with demonstrated, available construction techniques • Requires completion of treatability and bench scale studies to select appropriate on-site treatment	• Can be readily implemented with demonstrated, available construction techniques • 5 year review administratively and technically feasible • requires approval by POTW subject to periodic review
Compliance With ARARs	• Non-compliance with action specific and location specific ARARs concerning closure and post-closure care of closed municipal landfills	• Non-compliance with action specific and location specific ARARs concerning closure and post-closure care of closed municipal landfills	• May be in non-compliance with action specific and location specific ARARs concerning requirement for leachate collection system landfills	• May be in non-compliance with action specific and location specific ARARs concerning requirement for leachate collection system	• Compliance with action specific and location specific ARARs	• Compliance with action specific and location specific ARARs • Leachate must meet requirements of 40CFR Part 403 and City Sewer Use Ordinance

TABLE 4.10

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES
NCR SITE
WHEATFIELD, NEW YORK

Evaluation Criteria	*Alternative 1*	*Alternative 2*	*Alternative 3*	*Alternative 4*	*Alternative 5*	*Alternative 6*
	No Action	*Deed Restrictions, Access Control, Monitoring*	*Deed Restrictions, Access Control, Monitoring, RCRA Cap, Gas Collection*	*Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection*	*Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With On-Site Treatment*	*Deed Restrictions, Access Control, Monitoring, NYS Standard Cap, Gas Collection, Leachate Collection With Off-Site Treatment*
Overall Protection of Human Health and the Environment	• Presently there are no unacceptable risks to human health or the environment • Future conditions may increase potential risks to human health and the environment on and off Site • Future uses of the site would be restricted	• Presently there are no unacceptable risks to human health or the environment • Future conditions may increase risks to future human health and the environment on and off the Site • Future uses of the site would be restricted	• Presently there are no unacceptable risks to human health or the environment • Contact with the landfilled wastes and leachate seeps would be eliminated • Protective of human health and the environment in the long term	• Presently there are no unacceptable risks to human health or the environment • Contact with the landfilled wastes would be eliminated • Leachate seeps may still occur potentially contaminating surface soils and surface water causing potential future risks to human health and the environment on and off the Site	• Presently there are no unacceptable risks to human health or the environment • Contact with landfilled wastes and leachate seeps are eliminated. • Protective of human health and the environment in the long term	• Presently there are no unacceptable risks to human health or the environment • Contact with landfilled wastes and leachate seeps are eliminated. • Protective of human health and the environment in the long term
<u>Costs (1)</u>						
Capital Costs	-	$267,400	$20,243,200- $22,148,900	$14,946,700- $16,611,700	$16,626,900- $18,291,900	$15,907,700- $17,572,700
O&M Costs	$2,200	$130,300	$150,300	$150,300	$360,300	$198,700
Total Present Worth (30 years, 6% discount factor)	$30,500	$2,501,900	$22,821,700- $24,727,400	$17,524,900- $19,190,200	$22,818,400- $24,483,400	$19,318,800- $20,983,800

Note:

(1) See Tables 4.5 through 4.9 and Appendix D for detailed costs.

APPENDICES

A

APPENDIX A

LEACHATE LABORATORY DATA REPORTS

ENVIRONMENTAL ANALYTICAL REPORT

REPORT NUMBER: 93-0366

PREPARED FOR:

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RE: 3967; NCR SITE

PREPARED BY:

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MARCH 23, 1993

Huntingdon Analytical Laboratory

Analytical Services Division

HUNTINGDON ANALYTICAL SERVICES
ELAP #10833
ENVIRONMENTAL REPORT

REPORT NUMBER: 93-0366

STATEMENT OF WORK PERFORMED

I HEREBY DECLARE THAT THE WORK WAS PERFORMED UNDER MY SUPERVISION ACCORDING TO THE PROCEDURES OUTLINED BY THE FOLLOWING REFERENCES AND THAT THIS REPORT PROVIDES A CORRECT AND FAITHFUL RECORD OF THE RESULTS OBTAINED.

- 40 CFR PART 136, "GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS UNDER THE CLEAN WATER ACT", OCTOBER 26, 1984 (FEDERAL REGISTER) U. S. ENVIRONMENTAL PROTECTION AGENCY.

- U.S. ENVIRONMENTAL PROTECTION AGENCY, "TEST METHODS OF EVALUATING SOLID WASTE - PHYSICAL/CHEMICAL METHODS", OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, SW-846, 2ND EDITION AND 3RD EDITION.

THIS REPORT CONTAINS ANALYTICAL DATA BASED ON OUR EXAMINATION OF THE SAMPLE(S) PRESENTED TO US. THIS REPORT CONTAINS (EXCEPT WHERE EXPLICITLY STATED) A COMPLETE ACCOUNT OF THE ANALYSES REQUESTED TO BE PERFORMED ON THE SAMPLE(S). INFORMATION WHICH WAS NOT REQUESTED TO BE REPORTED IS NOT INCLUDED.

ANDREW P. CLIFTON — MARCH 23, 1993
ENVIRONMENTAL LABORATORY DIRECTOR

REPORT CODE LEGEND:

<DL = LESS THAN DETECTION LIMIT
ND = NOT DETECTED
NA = NOT APPLICABLE
INP = INFORMATION NOT PROVIDED
MB = METHOD BLANK

Huntingdon
Analytical Laboratory

Analytical Services Division

HUNTINGDON ANALYTICAL SERVICES

WET CHEMISTRY

SAMPLE IDENTIFICATION :			EAST- A	EAST- B	EAST- C	EAST- D	METHOD BLANK
HAS SAMPLE #930366			01	02	03	04	--
ANALYTE	EPA METHOD	DATE ANALYZED	RESULT mg/L	RESULT mg/L	RESULT mg/L	RESULT mg/L	RESULT mg/L
OIL AND GREASE --------------------------	413.1	3/20/93	3.2	18.9	1,670	558	<1.0
pH (STANDARD UNITS) ------------------	150.1	3/12/93	6.59	7.28	6.3	6.52	----
CONDUCTIVITY (umhos/cm @25 C) ---	120.1	3/12/93	1,660	6,860	24,600	11,800	----
TOTAL SUSPENDED SOLIDS -----------	160.2	3/15/93	24.5	4,300	140	122	<1.0
ALKALINITY (mg CaCO3/L) ------------	310.1	3/16/93	831	3,520	11,300	5,740	1.05
TOTAL PHOSPHORUS -------------------	365.2	3/15/93	0.254	0.31	<0.01	<0.01	<0.01
SOLUBLE PHOSPHORUS ---------------	365.2	3/15/93	0.014	0.135	<0.01	<0.01	<0.01
NITRATE ------------------------------------	353.2	3/12/93	<0.2	<0.2	<2.0	<2.0	<0.2
NITRITE -------------------------------------	355.2	3/12/93	<0.2	<0.2	<2.0	<2.0	<0.2
BIOLOGICAL OXYGEN DEMAND ----	SM 16th 507	3/12/93	20.4	695	>4,520	>1,600	----
AMMONIA (AS N) ------------------------	350.2	3/16/93	3.01	195	1,940	525	<0.05
CHLORIDE ----------------------------------	325.2	3/17/93	38.6	1,030	4,500	1,110	<1.00
SULFATE ------------------------------------	375.2	3/18/93	36.4	20.1	4,120	779	<10.0
TOTAL DISSOLVED SOLIDS -----------	160.1	3/17/93	973	4,950	43,500	4,920	<1.0
CHEMICAL OXYGEN DEMAND -------	410.2	3/19/93	95.4	1,930	63,000	21,500	----
TOTAL ORGANIC CARBON -----------	350.3	3/22/93	26.3	269	20,900	6,700	<1.0
DISSOLVED ORGANIC CARBON -----	350.3	3/22/93	13.4	185	20,400	6,640	<1.0
DATE SAMPLED:			3/11/93	3/11/93	3/11/93	3/11/93	---

Unable to determine Bicarbonate Alkalinity due to starting pH lower than 8.3.

Sample ID: EAST-A
HAS Sample #93-0366-01
Date Sampled: 3/11/93
Date Prepared: 3/12/93

ANALYTE	EPA METHOD	DATE ANALYZED	DET.LIMIT (ug/L)	RESULT ug/L
ALUMINUM	6010	3/16/93	300	1,500
ANTIMONY	6010	3/16/93	500	<500
ARSENIC	7060	3/16/93	10.0	<10.0
BARIUM	6010	3/16/93	100	414
BERYLLIUM	6010	3/16/93	50.0	<50.0
CADMIUM	6010	3/16/93	50.0	<50.0
CALCIUM	6010	3/16/93	200	191,000
CHROMIUM	6010	3/16/93	100	<100
COBALT	6010	3/16/93	100	<100
COPPER	6010	3/16/93	100	<100
IRON	6010	3/16/93	200	12,300
LEAD	7421	3/15/93	50.0	<50.0
MAGNESIUM	6010	3/16/93	400	80,000
MANGANESE	6010	3/16/93	100	518
MERCURY	7470	3/15/93	0.20	<0.20
NICKEL	6010	3/16/93	400	<400
POTASSIUM	6010	3/16/93	30000	<30000
SELENIUM	7740	3/17/93	5.00	<5.00
SILVER	6010	3/16/93	100	<100
SODIUM	6010	3/16/93	500	47,000
THALLIUM	7841	3/16/93	100	<100
VANADIUM	6010	3/16/93	200	<200
ZINC	6010	3/16/93	200	264

HUNTINGDON ANALYTICAL SERVICES

Sample ID: EAST-B
HAS Sample #93-0366-02
Date Sampled: 3/11/93
Date Prepared: 3/12/93

ANALYTE	EPA METHOD	DATE ANALYZED	DET.LIMIT (ug/L)	RESULT ug/L
ALUMINUM	6010	3/16/93	300	4,270
ANTIMONY	6010	3/16/93	500	<500
ARSENIC	7060	3/16/93	100	<100
BARIUM	6010	3/16/93	100	1,550
BERYLLIUM	6010	3/16/93	50.0	<50.0
CADMIUM	6010	3/16/93	50.0	<50.0
CALCIUM	6010	3/16/93	200	292,000
CHROMIUM	6010	3/16/93	100	<100
COBALT	6010	3/16/93	100	150
COPPER	6010	3/16/93	100	<100
IRON	6010	3/16/93	200	428,000
LEAD	7421	3/15/93	50.0	504
MAGNESIUM	6010	3/16/93	400	191,000
MANGANESE	6010	3/16/93	100	1,600
MERCURY	7470	3/15/93	0.20	0.49
NICKEL	6010	3/16/93	400	<400
POTASSIUM	6010	3/16/93	30000	509,000
SELENIUM	7740	3/17/93	50.0	<50.0
SILVER	6010	3/16/93	100	<100
SODIUM	6010	3/16/93	500	757,000
THALLIUM	7841	3/16/93	100	<100
VANADIUM	6010	3/16/93	200	<200
ZINC	6010	3/16/93	200	12,100

HUNTINGDON ANALYTICAL SERVICES

Sample ID: EAST-C
HAS Sample #93-0366-03
Date Sampled: 3/11/93
Date Prepared: 3/12/93

ANALYTE	EPA METHOD	DATE ANALYZED	DET.LIMIT (ug/L)	RESULT ug/L
ALUMINUM	6010	3/16/93	3000	51,600
ANTIMONY	6010	3/16/93	5000	<5000
ARSENIC	7060	3/16/93	40.0	47.6
BARIUM	6010	3/16/93	1000	1,660
BERYLLIUM	6010	3/16/93	500	<500
CADMIUM	6010	3/16/93	500	<500
CALCIUM	6010	3/16/93	2000	2,890,000
CHROMIUM	6010	3/16/93	1000	1,070
COBALT	6010	3/16/93	1000	<1000
COPPER	6010	3/16/93	1000	<1000
IRON	6010	3/16/93	2000	1,120,000
LEAD	7421	3/15/93	250	495
MAGNESIUM	6010	3/16/93	4000	1,430,000
MANGANESE	6010	3/16/93	1000	21,000
MERCURY	7470	3/15/93	0.20	0.27
NICKEL	6010	3/16/93	4000	<4000
POTASSIUM	6010	3/16/93	300000	889,000
SELENIUM	7740	3/17/93	100	<100
SILVER	6010	3/16/93	1000	<1000
SODIUM	6010	3/16/93	5000	3,470,000
THALLIUM	7841	3/16/93	200	<200
VANADIUM	6010	3/16/93	2000	<2000
ZINC	6010	3/16/93	2000	84,400

HUNTINGDON ANALYTICAL SERVICES

Sample ID: EAST-D
HAS Sample #93-0366-04
Date Sampled: 3/11/93
Date Prepared: 3/12/93

ANALYTE	EPA METHOD	DATE ANALYZED	DET.LIMIT (ug/L)	RESULT ug/L
ALUMINUM	6010	3/16/93	300	<300
ANTIMONY	6010	3/16/93	500	<500
ARSENIC	7060	3/16/93	10.0	<10.0
BARIUM	6010	3/16/93	100	476
BERYLLIUM	6010	3/16/93	50.0	<50.0
CADMIUM	6010	3/16/93	50.0	<50.0
CALCIUM	6010	3/16/93	200	1,230,000
CHROMIUM	6010	3/16/93	100	161
COBALT	6010	3/16/93	100	135
COPPER	6010	3/16/93	100	<100
IRON	6010	3/16/93	200	930,000
LEAD	7421	3/15/93	50.0	<50.0
MAGNESIUM	6010	3/16/93	400	470,000
MANGANESE	6010	3/16/93	100	15,800
MERCURY	7470	3/15/93	0.20	<0.20
NICKEL	6010	3/16/93	400	<400
POTASSIUM	6010	3/16/93	30000	335,000
SELENIUM	7740	3/17/93	100	<100
SILVER	6010	3/16/93	100	<100
SODIUM	6010	3/16/93	500	799,000
THALLIUM	7841	3/16/93	100	<100
VANADIUM	6010	3/16/93	200	248
ZINC	6010	3/16/93	200	15,700

HUNTINGDON ANALYTICAL SERVICES

Sample ID: METHOD BLANK
HAS Sample #93-0366-MB
Date Sampled: NA
Date Prepared: 3/12/93

ANALYTE	EPA METHOD	DATE ANALYZED	DET.LIMIT (ug/L)	RESULT ug/L
ALUMINUM	6010	3/16/93	30.0	<30.0
ANTIMONY	6010	3/16/93	50.0	<50.0
ARSENIC	7060	3/16/93	10.0	<10.0
BARIUM	6010	3/16/93	10.0	<10.0
BERYLLIUM	6010	3/16/93	5.00	<5.00
CADMIUM	6010	3/16/93	5.00	<5.00
CALCIUM	6010	3/16/93	20.0	<20.0
CHROMIUM	6010	3/16/93	10.0	<10.0
COBALT	6010	3/16/93	10.0	<10.0
COPPER	6010	3/16/93	10.0	<10.0
IRON	6010	3/16/93	20.0	<20.0
LEAD	7421	3/15/93	5.00	<5.00
MAGNESIUM	6010	3/16/93	40.0	<40.0
MANGANESE	6010	3/16/93	10.0	<10.0
MERCURY	7470	3/15/93	0.2	<0.20
NICKEL	6010	3/16/93	40.0	<40.0
POTASSIUM	6010	3/16/93	3000	<3000
SELENIUM	7740	3/17/93	5.00	<5.00
SILVER	6010	3/16/93	10.0	<10.0
SODIUM	6010	3/16/93	50.0	<50.0
THALLIUM	7841	3/16/93	10.0	<10.0
VANADIUM	6010	3/16/93	20.0	<20.0
ZINC	6010	3/16/93	20.0	<20.0

HUNTINGDON ANALYTICAL SERVICES

EPA METHOD 8240
VOLATILE ORGANICS

SAMPLE IDENTIFICATION :	EAST-A	EAST-B	EAST-C	EAST-D	METHOD BLANK#1	METHOD BLANK#2	
HAS SAMPLE #930366	01	02	03	04	–	–	
COMPOUND	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	DL ug/L
CHLOROMETHANE	<10	<10	<500	<500	<10	<10	<10
BROMOMETHANE	<10	<10	<500	<500	<10	<10	<10
VINYL CHLORIDE	<10	<10	<500	<500	<10	<10	<10
CHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
METHYLENE CHLORIDE	<10	<10	3,700	770	<10	<10	<10
ACETONE	<10	26	7,000	13,000	<10	8*	<10
TRICHLOROFLUOROMETHANE	<10	<10	<500	<500	<10	<10	<10
CARBON DISULFIDE	<10	<10	<500	<500	<10	<10	<10
1,1-DICHLOROETHENE	<10	<10	<500	<500	<10	<10	<10
1,1-DICHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
1,2-DICHLOROETHENE (TOTAL)	<10	<10	<500	<500	<10	<10	<10
CHLOROFORM	<10	<10	<500	<500	<10	<10	<10
1,2-DICHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
2-BUTANONE	<10	<10	4,300	4,100	<10	<10	<10
1,1,1-TRICHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
CARBON TETRACHLORIDE	<10	<10	<500	<500	<10	<10	<10
VINYL ACETATE	<10	<10	<500	<500	<10	<10	<10
BROMODICHLOROMETHANE	<10	<10	<500	<500	<10	<10	<10
1,2-DICHLOROPROPANE	<10	<10	<500	<500	<10	<10	<10
cis-1,3-DICHLOROPROPENE	<10	<10	<500	<500	<10	<10	<10
TRICHLOROETHENE	<10	<10	<500	<500	<10	<10	<10
DIBROMOCHLOROMETHANE	<10	<10	<500	<500	<10	<10	<10
1,1,2-TRICHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
BENZENE	42	310	100*	<500	<10	<10	<10
trans-1,3-DICHLOROPROPENE	<10	<10	<500	<500	<10	<10	<10
2-CHLOROETHYLVINYL ETHER	<10	<10	<500	<500	<10	<10	<10
BROMOFORM	<10	<10	<500	<500	<10	<10	<10
4-METHYL-2-PENTANONE	<10	<10	<500	180*	<10	<10	<10
2-HEXANONE	<10	<10	<500	<500	<10	<10	<10
TETRACHLOROETHENE	<10	<10	<500	<500	<10	<10	<10
1,1,2,2-TETRACHLOROETHANE	<10	<10	<500	<500	<10	<10	<10
TOLUENE	<10	51	1,800	580	<10	<10	<10
CHLOROBENZENE	20	180	<500	<500	<10	<10	<10
ETHYL BENZENE	67	170	<500	<500	<10	<10	<10
STYRENE	<10	<10	<500	<500	<10	<10	<10
XYLENE (TOTAL)	9*	560	220*	<500	<10	<10	<10
1,3-DICHLOROBENZENE	3*	<10	<500	<500	<10	<10	<10
1,2-DICHLOROBENZENE	3*	6*	110*	<500	<10	<10	<10
1,4-DICHLOROBENZENE	<10	18	290*	<500	<10	<10	<10
SURROGATES (LCL/UCL)	%REC.	%REC.	%REC.	%REC.	%REC.	%REC.	
1,2-DICHLOROETHANE-d4 (78/113)	98	109	90	89	99	86	
TOLUENE-d8 (47/136)	92	96	129	129	129	123	
BROMOFLUOROBENZENE (67/115)	88	114	82	80	80	78	
DATE ANALYZED:	3-16-93	3-16-93	3-16-93	3-16-93	3-16-93	3-16-93	

* ESTIMATED VALUE, BELOW QUANTIFICATION LIMIT.

METHOD 8270
SEMI-VOLATILE ORGANICS

SAMPLE IDENTIFICATION :	EAST-A	EAST-B	EAST-C	EAST-D	METHOD BLANK	
HAS SAMPLE #930366	01	02	03 **	04 **	----	
BASE/NEUTRAL COMPOUNDS	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	MDL ug/L
ACENAPHTHENE	<10	<10	<10	<10	<10	<10
ACENAPHTHYLENE	<10	<10	<10	<10	<10	<10
ANTHRACENE	<10	<10	<10	<10	<10	<10
BENZO(a)ANTHRACENE	<10	<10	<10	<10	<10	<10
BENZO(b)FLUORANTHENE	<10	<10	<10	<10	<10	<10
BENZO(k)FLUORANTHENE	<10	<10	<10	<10	<10	<10
BENZO(a)PYRENE	<10	<10	<10	<10	<10	<10
BENZO(g,h,i)PERYLENE	<10	<10	<10	<10	<10	<10
BENZYL ALCOHOL	<10	<10	53	200	<10	<10
BIS(2-CHLOROETHOXY)METHANE	<10	<10	<10	<10	<10	<10
BIS(2-CHLOROETHYL)ETHER	<10	<10	<10	<10	<10	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10	<10	<10	<10	<10	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10	5 *	14	4 *	<10	<10
BUTYLBENZYL PHTHALATE	<10	<10	<10	<10	<10	<10
4-BROMOPHENYL-PHENYL ETHER	<10	<10	<10	<10	<10	<10
4-CHLOROANILINE	<10	<10	<10	<10	<10	<10
2-CHLORONAPHTHALENE	<10	<10	<10	<10	<10	<10
4-CHLOROPHENYL-PHENYL ETHER	<10	<10	<10	<10	<10	<10
CHRYSENE	<10	<10	<10	<10	<10	<10
DIBENZ(a,h)ANTHRACENE	<10	<10	<10	<10	<10	<10
DIBENZOFURAN	<10	<10	<10	<10	<10	<10
DI-N-BUTYLPHTHALATE	<10	<10	<10	<10	<10	<10
1,2-DICHLOROBENZENE	2 *	<10	71	<10	<10	<10
1,3-DICHLOROBENZENE	<10	<10	<10	<10	<10	<10
1,4-DICHLOROBENZENE	3 *	5 *	160	<10	<10	<10
3,3-DICHLOROBENZIDINE	<20	<20	<20	<20	<20	<20
DIETHYL PHTHALATE	<10	6 *	<10	<10	<10	<10
DIMETHYL PHTHALATE	<10	<10	<10	<10	<10	<10
2,4-DINITROTOLUENE	<10	<10	<10	<10	<10	<10
2,6-DINITROTOLUENE	<10	<10	<10	<10	<10	<10
DI-N-OCTYL PHTHALATE	<10	<10	<10	<10	<10	<10
FLUORANTHENE	<10	<10	<10	<10	<10	<10
FLUORENE	<10	<10	<10	<10	<10	<10
HEXACHLOROBENZENE	<10	<10	<10	<10	<10	<10
HEXACHLOROBUTADIENE	<10	<10	<10	<10	<10	<10
HEXACHLOROCYCLOPENTADIENE	<10	<10	<10	<10	<10	<10
HEXACHLOROETHANE	<10	<10	<10	<10	<10	<10
INDENO(1,2,3-cd)PYRENE	<10	<10	<10	<10	<10	<10

METHOD 8270
SEMI-VOLATILE ORGANICS

SAMPLE IDENTIFICATION :	EAST-A	EAST-B	EAST-C	EAST-D	METHOD BLANK	
HAS SAMPLE #930366	01	02	03 **	04 **	----	
BASE/NEUTRAL COMPOUNDS	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	MDL ug/L
ISOPHORONE	< 10	6 *	22	24	< 10	< 10
2-METHYL NAPHTHALENE	< 10	< 10	< 10	< 10	< 10	< 10
NAPHTHALENE	< 10	8 *	84	11	< 10	< 10
2-NITROANILINE	<50	<50	<50	<50	<50	<50
3-NITROANILINE	<50	<50	<50	<50	<50	<50
4-NITROANILINE	<50	<50	<50	<50	<50	<50
NITROBENZENE	< 10	< 10	< 10	< 10	< 10	< 10
N-NITROSODIPHENYLAMINE	< 10	< 10	< 10	< 10	< 10	< 10
N-NITROS-DI-N-PROPYLAMINE	< 10	< 10	< 10	< 10	< 10	< 10
PHENANTHRENE	< 10	< 10	< 10	< 10	< 10	< 10
PYRENE	< 10	< 10	< 10	< 10	< 10	< 10
1,2,4-TRICHLOROBENZENE	6 *	< 10	< 10	< 10	< 10	< 10
CARBAZOLE	< 10	< 10	< 10	< 10	< 10	< 10

ACID COMPOUNDS	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	RESULT ug/L	MDL ug/L
BENZOIC ACID	<50	<50	11,000	46,000	<50	<50
4-CHLORO-3-METHYLPHENOL	< 10	< 10	< 1,100	<600	< 10	< 10
2-CHLOROPHENOL	< 10	< 10	< 1,100	<600	< 10	< 10
2,4-DICHLOROPHENOL	< 10	< 10	< 1,100	<600	< 10	< 10
2,4-DIMETHYL PHENOL	< 10	84	< 1,100	<600	< 10	< 10
2,4-DINITROPHENOL	<50	<50	<5,500	<3,000	<50	<50
4,6-DINITRO-2-METHYLPHENOL	<50	<50	<5,500	<3,000	<50	<50
2-METHYL PHENOL	< 10	4 *	7,400	23,000	< 10	< 10
4-METHYL PHENOL	< 10	8 *	4,300	16,000	< 10	< 10
2-NITROPHENOL	< 10	< 10	< 1,100	<600	< 10	< 10
4-NITROPHENOL	<50	<50	<5,500	<3,000	<50	<50
PENTACHLOROPHENOL	<50	<50	<5,500	<3,000	<50	<50
PHENOL	< 10	< 10	370,000	270,000	< 10	< 10
2,4,5-TRICHLOROPHENOL	<50	<50	<5,500	<3,000	<50	<50
2,4,6-TRICHLOROPHENOL	< 10	< 10	< 1,100	<600	< 10	< 10

DATE EXTRACTED:	3-12-93	3-12-93	3-12-93	3-12-93	3-12-93
DATE ANALYZED:	3-15-93	3-15-93	3-15-93	3-15-93	3-15-93

* ESTIMATED VALUE, BELOW QUANTITATION LIMIT.

** BASE NEUTRAL AND ACID PHENOL EXTRACTS WERE RAN SEPARATELY TO ACHIEVE THE MINIMUM DETECTION LIMITS POSSIBLE FOR ALL COMPOUNDS.

METHOD 8270
SEMI-VOLATILE ORGANICS

SAMPLE IDENTIFICATION :	EAST-A	EAST-B	EAST-C	EAST-D	METHOD BLANK	
HAS SAMPLE #930366	01	02	03 **	04 **	----	
SURROGATE % RECOVERY	% REC	% REC	% REC	% REC	% REC	CONTROL LIMITS
NITROBENZENE (d5)	106	59	21	17	110	16 -- 146
2-FLUOROBIPHENYL	87	63	56	32	81	21 -- 113
TERPHENYL (d14)	47	28	35	14	88	12 -- 146
PHENOL (d5)	48	33	DO	DO	48	11 -- 104
2-FLUOROPHENOL	67	46	DO	DO	69	17 -- 117
2,4,6-TRIBROMOPHENOL	63	38	DO	DO	96	22 -- 144

DO - DILUTED OUT

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): HUNTINGDON ANALYTICAL SVCE MIDDLEPORT, NY 1 of 3

CHAIN OF CUSTODY RECORD

PROJECT №: 3967

PROJECT NAME: NCR SITE 93-0366

SAMPLER'S SIGNATURE [signature] (SIGN)

SEQ. №	SAMPLE №	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
1	EAST-A	3/11/93	1600	EAST-A	GROUNDWATER	2	8240 VOCs
	↓	↓	↓	↓	↓	1	8270 BNAs
						1	O+G
						1	NH3
						1	TOC, COD, T. Phos.
						1	SO4, NO3, NO2, Chloride
						1	Metals
						1	DOC (NOT FILTERED)
						1	Alkalinity
						1	Sol. Phos. (NOT FILTERED)
						1	TSS, TDS, BOD, pH, Conductivity
2	EAST-B	3/11/93	1330	EAST-B	GROUNDWATER	2	8240 VOCs
	↓	↓	↓	↓	↓	1	8270 BNAs
						1	O+G
						1	NH3
						1	TOC, COD, T. Phos.
						1	SO4, NO3, NO2, Chloride
						1	Metals
				TOTAL NUMBER OF CONTAINERS		20	SUBTOTAL

ANTICIPATED CHEMICAL HAZARDS: SAMPLES PRESERVED WITH ACID MAY BE UNDER PRESS. SAMPLES ARE LANDFILL CELL LIQUID - EXPECT CHEMISTRY

RELINQUISHED BY	DATE/TIME	RECEIVED BY
1 [signature] (SIGN)	3/11/93 / 1630	2 [signature] (SIGN)
2 (SIGN)	/	3 (SIGN)
3 (SIGN)	/	4 (SIGN)

ADDITIONAL SIGNATURE SHEET REQUIRED ☐

METHOD OF SHIPMENT:	SHIPPED BY:	RECEIVED FOR LABORATORY BY:	DATE/TIME
AUTO	H.A.S pickup	(SIGN) [signature]	3/11/93 1615
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN) [signature]	3/12/93 800

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY

№ 20318

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): HUNTINGDON ANALYTICAL SVCE. MIDDLEPORT, NY

2 of 3

CHAIN OF CUSTODY RECORD

PROJECT Nº: 3967

PROJECT NAME: NCR SITE 93-0366

SAMPLER'S SIGNATURE (SIGN)

SEQ. Nº	SAMPLE Nº	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	Nº OF CONTAINERS	REMARKS
02	EAST-B	3/11/93	1330	EAST-B	GROUNDWATER	1	DOC (not filtered)
	↓	↓	↓	↓	↓	1	Alkalinity
						1	Sol. Phos. (Not filtered)
						1	TSS, TDS, BOD, pH, Conductivity
03	EAST-C	3/11/93	1100	EAST-C	GROUNDWATER	2	8240 VOCs
	↓	↓	↓	↓	↓	1	8270 BNAs
						1	O+G
						1	NH_3
						1	TOC, COD, T. Phos.
						1	SO_4, NO_3, NO_2, Chloride
						1	Metals
						1	DOC (not filtered)
						1	ALKALINITY
						1	Sol. PHOS. (Not filtered)
						1	TSS, TDS, BOD, pH, Conductivity
	EAST-D	3/11/93		EAST-D	GROUNDWATER	2	8240 VOCs
	↓	↓		↓	↓	1	8270 BNAs
				TOTAL NUMBER OF CONTAINERS		19	SUBTOTAL

ANTICIPATED CHEMICAL HAZARDS:
SAMPLES ARE LANDFILL CELL LIQUID - EXPECT CHEMISTRY

RELINQUISHED BY: 1 (SIGN)	DATE/TIME 3/11/93 1630	RECEIVED BY: 2 (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME	RECEIVED BY: 3 (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME	RECEIVED BY: 4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: AUTO	SHIPPED BY: H.A.S. Pickup	RECEIVED FOR LABORATORY BY: (SIGN)	DATE/TIME 3/11/93 1615
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN)	DATE/TIME 3/12/93 800

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PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

Nº 20319

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

SHIPPED TO (Laboratory name): HUNTINGDON ANALYTKAL SVCE. MIDDLEPORT

CHAIN OF CUSTODY RECORD

PROJECT №: 3967

PROJECT NAME: NCR SITE 93-0366

SAMPLER'S SIGNATURE: [signature] (SIGN)

SEQ. №	SAMPLE №	DATE	TIME	SAMPLE LOCATOIN	SAMPLE TYPE	№ OF CONTAINERS	REMARKS
	EAST-D	3/11/93	1145	EAST-D	GROUNDWATER	1	O+G
	↓	↓	↓	↓	↓	1	NH_3
						1	TOC, COD, T. Phos.
						1	SO_4, NO_3, NO_2, Chlorid
						1	Metals
						1	DOC (not filtered)
						1	Alkalinity
						1	Sol. Phos. (not filtered)
						1	TSS, TDS, BOD, pH Conductivity
						9	SUBTOTAL
				TOTAL NUMBER OF CONTAINERS		48	TOTAL

04

NOTES: 1. DOC and Soluble Phosphorus Samples are not field filtered and must be filtered at the Laboratory.

2. ~~2 week~~ FAST turnaround required - hard copy to Lisa Reyes at CRA on 3/22/93. FAX # 283-6724

3. ALKALINITY TO BE REPORTED AS BICARBONATE + CARBONATE ALKALINITY.

ANTICIPATED CHEMICAL HAZARDS: SAMPLES ARE LANDFILL CELL LIQUID - EXPECT CHEMISTRY

RELINQUISHED BY: 1 [signature] (SIGN)	DATE/TIME 3/11/93 / 1630	RECEIVED BY: 2 [signature] (SIGN)
RELINQUISHED BY: 2 (SIGN)	DATE/TIME /	RECEIVED BY: 3 (SIGN)
RELINQUISHED BY: 3 (SIGN)	DATE/TIME /	RECEIVED BY: 4 (SIGN)
ADDITIONAL SIGNATURE SHEET REQUIRED ☐		

METHOD OF SHIPMENT: AUTO	SHIPPED BY: HAS pickup	RECEIVED FOR LABORATORY BY: (SIGN) [signature]	DATE/TIME 3/11/93 615
CONDITION OF SEAL UPON RECEIPT: GENERAL CONDITION OF COOLER:		COOLER OPENED BY: (SIGN) [signature]	DATE/TIME 3/12/93 800

WHITE - CRA OFFICE COPY
YELLOW - RECEIVING LABORATORY COPY
PINK - CRA LABORATORY COPY
GOLDEN ROD - SHIPPERS

№ 20320

B

APPENDIX B

HELP MODEL RESULTS

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NCR SITE, NYSDEC CAP (MODIFIED), (6NYCRR 360.2), PROJECT# 2677
WHEATFIELD, NY.
MARCH 10, 1993

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GOOD GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4630 VOL/VOL
FIELD CAPACITY	=	0.2320 VOL/VOL
WILTING POINT	=	0.1157 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2320 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001553999959 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4219 VOL/VOL
FIELD CAPACITY	=	0.3412 VOL/VOL
WILTING POINT	=	0.2505 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3412 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000001250000 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL

WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	72.00
TOTAL AREA OF COVER	=	2178000. SQ FT
EVAPORATIVE ZONE DEPTH	=	28.00 INCHES
UPPER LIMIT VEG. STORAGE	=	12.0598 INCHES
INITIAL VEG. STORAGE	=	12.0572 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	17.3208 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX	=	3.30
START OF GROWING SEASON (JULIAN DATE)	=	138
END OF GROWING SEASON (JULIAN DATE)	=	279

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.24	2.78	3.00	3.10	3.22	2.52
	2.97	3.67	2.91	2.87	4.35	3.33
STD. DEVIATIONS	0.56	0.64	1.20	0.97	0.86	0.72
	0.91	1.47	1.29	1.38	1.52	0.34

RUNOFF

TOTALS	1.824	1.873	2.145	0.441	0.003	0.000
	0.000	0.004	0.000	0.045	1.140	1.158
STD. DEVIATIONS	0.912	0.538	1.515	0.713	0.007	0.000
	0.000	0.009	0.000	0.100	1.643	0.917

EVAPOTRANSPIRATION

TOTALS	0.426	0.557	2.132	2.600	3.472	4.411
	5.029	3.600	2.403	2.030	0.790	0.474
STD. DEVIATIONS	0.102	0.126	0.182	0.664	0.932	0.479
	1.214	0.881	0.484	0.225	0.070	0.158

PERCOLATION FROM LAYER 3

TOTALS	0.2411	0.2549	0.2760	0.2516	0.2499	0.2096
	0.1246	0.0817	0.0000	0.0000	0.0000	0.0464
STD. DEVIATIONS	0.0590	0.0049	0.0020	0.0099	0.0087	0.0043
	0.0055	0.0117	0.0000	0.0000	0.0001	0.0839

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.97	(1.831)	6891191.	100.00
RUNOFF	8.634	(1.964)	1567027.	22.74
EVAPOTRANSPIRATION	27.925	(1.342)	5068327.	73.55
PERCOLATION FROM LAYER 3	1.7358	(0.1040)	315040.	4.57
CHANGE IN WATER STORAGE	-0.326	(1.362)	-59202.	-0.86

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.53	459195.0
RUNOFF	1.764	320215.7

PERCOLATION FROM LAYER 3	0.0091	1653.4
HEAD ON LAYER 3	30.3	
SNOW WATER	3.08	558429.6

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4307

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2216

****

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.40	0.3997
2	8.87	0.3698
3	7.74	0.4300
SNOW WATER	0.00	

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NCR SITE, RCRA CAP, PROJECT# 2677
WHEATFIELD, NY.
MARCH 10, 1993

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****

GOOD GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4630 VOL/VOL
FIELD CAPACITY	=	0.2320 VOL/VOL
WILTING POINT	=	0.1157 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2320 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001553999959 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4219 VOL/VOL
FIELD CAPACITY	=	0.3412 VOL/VOL
WILTING POINT	=	0.2505 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3412 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000001250000 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.0624 VOL/VOL

```
WILTING POINT                          =       0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT             =       0.0624 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =       0.005799999926 CM/SEC
SLOPE                                  =       5.00 PERCENT
DRAINAGE LENGTH                        =     100.0 FEET
```

LAYER 4

```
         BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER
THICKNESS                              =      24.00 INCHES
POROSITY                               =       0.4300 VOL/VOL
FIELD CAPACITY                         =       0.3663 VOL/VOL
WILTING POINT                          =       0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT             =       0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =       0.000000100000 CM/SEC
LINER LEAKAGE FRACTION                 =       0.00500000
```

GENERAL SIMULATION DATA

```
SCS RUNOFF CURVE NUMBER                =       72.00
TOTAL AREA OF COVER                    =  2178000. SQ FT
EVAPORATIVE ZONE DEPTH                 =       28.00 INCHES
UPPER LIMIT VEG. STORAGE               =       12.0598 INCHES
INITIAL VEG. STORAGE                   =       12.0267 INCHES
INITIAL SNOW WATER CONTENT             =        0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
  SOIL AND WASTE LAYERS                =       20.6496 INCHES

           SOIL WATER CONTENT INITIALIZED BY PROGRAM.
```

CLIMATOLOGICAL DATA

```
SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR      BUFFALO                NEW YORK

MAXIMUM LEAF AREA INDEX                   = 3.30
START OF GROWING SEASON (JULIAN DATE)     =  138
END OF GROWING SEASON (JULIAN DATE)       =  279
```

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

SNOW WATER 0.00

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****

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NCR SITE, LOW PERMEABILITY SOIL CAP
WHEATFIELD, NY.
MARCH 10, 1993

*************************************************************************
*************************************************************************


                              GOOD GRASS

                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                                =      6.00 INCHES
  POROSITY                                 =      0.4630 VOL/VOL
  FIELD CAPACITY                           =      0.2320 VOL/VOL
  WILTING POINT                            =      0.1157 VOL/VOL
  INITIAL SOIL WATER CONTENT               =      0.2320 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY         =      0.001553999959 CM/SEC


                               LAYER  2
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                                =     24.00 INCHES
  POROSITY                                 =      0.4219 VOL/VOL
  FIELD CAPACITY                           =      0.3412 VOL/VOL
  WILTING POINT                            =      0.2505 VOL/VOL
  INITIAL SOIL WATER CONTENT               =      0.3412 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY         =      0.000001250000 CM/SEC


                        GENERAL SIMULATION DATA
                        -----------------------

  SCS RUNOFF CURVE NUMBER                  =      72.00
  TOTAL AREA OF COVER                      = 2178000. SQ FT
  EVAPORATIVE ZONE DEPTH                   =      28.00 INCHES
```

```
******************************************************************************

    AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH     5
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  3.24     2.78     3.00     3.10     3.22     2.52
                            2.97     3.67     2.91     2.87     4.35     3.33

    STD. DEVIATIONS         0.56     0.64     1.20     0.97     0.86     0.72
                            0.91     1.47     1.29     1.38     1.52     0.34

  RUNOFF
  ------
    TOTALS                  1.186    0.815    1.511    0.152    0.000    0.000
                            0.000    0.004    0.000    0.039    1.127    1.037

    STD. DEVIATIONS         0.698    0.595    1.398    0.340    0.000    0.000
                            0.000    0.009    0.000    0.088    1.640    0.811

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                  0.428    0.557    2.142    2.623    3.479    4.385
                            3.814    3.599    2.407    2.056    0.799    0.477

    STD. DEVIATIONS         0.103    0.127    0.180    0.675    0.940    0.427
                            1.245    0.877    0.483    0.231    0.072    0.161

  LATERAL DRAINAGE FROM LAYER  3
  ------------------------------
    TOTALS                  0.4416   0.7245   1.0115   1.0751   0.9674   0.6905
                            0.4884   0.2243   0.0679   0.0239   0.0100   0.0493

    STD. DEVIATIONS         0.2472   0.1386   0.0931   0.0585   0.1527   0.1642
                            0.0914   0.1087   0.0351   0.0094   0.0023   0.0952

  PERCOLATION FROM LAYER  4
  -------------------------
    TOTALS                  0.0006   0.0005   0.0006   0.0006   0.0006   0.0006
                            0.0006   0.0005   0.0005   0.0005   0.0005   0.0005

    STD. DEVIATIONS         0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                            0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

******************************************************************************


******************************************************************************

 AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS     1 THROUGH     5
------------------------------------------------------------------------------
                                  (INCHES)          (CU. FT.)     PERCENT
                               ---------------     ----------    -------
```

PRECIPITATION	37.97	(1.831)	6891191.	100.00
RUNOFF	5.872	(1.694)	1065769.	15.47
EVAPOTRANSPIRATION	26.766	(1.344)	4858011.	70.50
LATERAL DRAINAGE FROM LAYER 3	5.7744	(0.7767)	1048054.	15.21
PERCOLATION FROM LAYER 4	0.0067	(0.0001)	1211.	0.02
CHANGE IN WATER STORAGE	-0.451	(1.449)	-81854.	-1.19

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.53	459195.0
RUNOFF	1.670	303081.8
LATERAL DRAINAGE FROM LAYER 3	0.0393	7140.3
PERCOLATION FROM LAYER 4	0.0000	3.7
HEAD ON LAYER 4	5.0	
SNOW WATER	3.07	557682.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4307

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2216

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.36	0.3941
2	8.85	0.3688
3	0.75	0.0627
4	10.32	0.4300

UPPER LIMIT VEG. STORAGE	=	12.0598 INCHES
INITIAL VEG. STORAGE	=	12.0267 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	9.5808 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR BUFFALO NEW YORK

MAXIMUM LEAF AREA INDEX	=	3.30
START OF GROWING SEASON (JULIAN DATE)	=	138
END OF GROWING SEASON (JULIAN DATE)	=	279

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
23.50	24.50	33.00	45.40	56.10	66.00
70.70	68.90	62.10	51.50	40.30	28.80

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.24	2.78	3.00	3.10	3.22	2.52
	2.97	3.67	2.91	2.87	4.35	3.33
STD. DEVIATIONS	0.56	0.64	1.20	0.97	0.86	0.72
	0.91	1.47	1.29	1.38	1.52	0.34
RUNOFF						
TOTALS	1.186	0.815	1.511	0.153	0.000	0.000
	0.000	0.004	0.000	0.039	1.127	1.037
STD. DEVIATIONS	0.698	0.595	1.399	0.340	0.000	0.000
	0.000	0.009	0.000	0.088	1.640	0.811
EVAPOTRANSPIRATION						
TOTALS	0.428	0.557	2.142	2.622	3.479	4.385
	3.814	3.599	2.406	2.056	0.799	0.477

STD. DEVIATIONS	0.103	0.127	0.180	0.675	0.940	0.427
	1.245	0.877	0.483	0.231	0.072	0.161

PERCOLATION FROM LAYER 2

TOTALS	1.0751	1.1990	1.3181	1.0239	0.5811	0.2117
	0.0464	0.0164	0.0097	0.0072	0.0055	0.1736
STD. DEVIATIONS	0.3464	0.0190	0.0000	0.2271	0.3637	0.0806
	0.0020	0.0003	0.0001	0.0001	0.0000	0.3455

****

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	37.97	(1.831)	6891191.	100.00
RUNOFF	5.873	(1.694)	1065873.	15.47
EVAPOTRANSPIRATION	26.764	(1.344)	4857715.	70.49
PERCOLATION FROM LAYER 2	5.6676	(0.7892)	1028676.	14.93
CHANGE IN WATER STORAGE	-0.336	(1.376)	-61071.	-0.89

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.53	459195.0
RUNOFF	1.670	303057.4
PERCOLATION FROM LAYER 2	0.0425	7717.2
SNOW WATER	3.07	557693.8
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4307	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2216	

****

****

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.37	0.3942
2	8.85	0.3688
SNOW WATER	0.00	

****
****

C

APPENDIX C

GAS GENERATION MODELLING

TABLE OF CONTENTS

C.1.0 INTRODUCTION

This appendix serves to provide:

- a brief review of three gas generation rate models; and
- the estimated landfill gas generation rate for the Niagara County Refuse (NCR) Site.

The generation of methane in a landfill is the result of a naturally occurring biological degradation process. Over an extended period of time the organic fraction of the landfilled refuse is transformed, under anaerobic conditions, to landfill gas (biogas) containing approximately equal fractions of methane and carbon dioxide. Numerous compounds are also present in trace concentrations resulting from the variety of substances contained in the refuse. Table 1 presents a summary of typical landfill gas composition.

The kinetics of the biogas generation process is influenced by a number of site-specific conditions. The factors which will ultimately affect the estimated gas generation yield and rate of recovery from a particular landfill include:

- moisture level in the landfill (most important);
- composition of the refuse (i.e. percentage of organic content and nature of organics);
- biodegradability characteristics of the organics;

- presence of inhibiting chemicals;
- pH;
- surface area and depth of the landfill;
- gas collection efficiency and operation protocol; and
- gas management practice.

Modelling of landfill gas generation rates is typically best considered from a macroscopic point of view. Landfill cores are typically non-homogeneous and biogas generation rate estimates cannot be made accurately for one cell of the landfill nor for a small window in time. The models available usually attempt to predict an average gas generation for large portions of the landfill and over relatively long periods of time.

The main goals of landfill gas generation models are:

- to estimate the total amount of biogas that a given landfill will generate; and
- to estimate the biogas generation rate as a function of the life of the landfill (in other words, the kinetics of the biodegradation process).

In general, the accepted approach is to use the most simplified model available, derived from relevant theories and biological processes and to empirically adjust the kinetic rate constant(s) to account for site-specific conditions.

Three commonly used models available for estimating the gas generation rate in a landfill are presented and discussed in the following subsections. The three models include:

- the Palos Verdes Model;
- the Sheldon-Arleta Model; and
- the Scholl-Canyon Model.

Reference material for these models include the following:

- EPA Air Emissions from Solid Waste Landfill, March 1988; and
- Methane Gas Generation and Recovery from Landfills, EMCON Associates, 1982.

1.1 PALOS VERDES KINETIC MODEL

The Palos Verdes Kinetic Model is a two stage order model. It is assumed that the first stage gas generation rate increases exponentially with time and the second stage gas generation rate decreases exponentially with time. It is also assumed that the maximum gas generation rate and transition from the first stage to the second occurs at the time when half of the ultimate gas production has been reached. The governing model equations are as follows:

Equation #1(a)

$$\frac{dL}{dt} = \frac{k_1 L_o}{2} \exp\left[-k_1(t_{1/2} - t)\right]$$

(gas generation rates during first stage ($t<t_{1/2}$))

Equation #1(b)

$$L = L_o(1-t/2 \exp\left[-k_1 (t\ 1/2 - t)\right]$$

(total gas yet to be generated during first stage ($t<t_{1/2}$)

Equation #2(a)

$$\frac{dL}{dt} = \frac{k_2 L_o}{2} \exp\left[-k_2 (t - t_{1/2})\right]$$

(gas generation rate during second stage ($t>t_{1/2}$)

Equation 2(b)

$$L = \frac{L_0}{2} \exp\left[-k_2 (t - t_{1/2})\right]$$

(total gas yet to be generated during second stage ($t<t_{1/2}$)

$$K_1 = \frac{Ln(50)}{t_{1/2}}$$

$$K_2 = \frac{Ln(50)}{t_{99/100} - t_{1/2}}$$

where

$\frac{dL}{dt}$ = gas generation rate (ft^3/lb of refuse/yr)
Ln = natural logarithm
L = volume of gas yet to be generated after time t per unit weight of refuse (ft^3/lb)
L_o = ultimate volume of gas generated (ft^3/lb of refuse
K_1 = first stage rate constant (1/yr)

K_2	=	second stage rate constant (1/yr)
$t_{1/2}$	=	time when half of the total methane is generated (years)
$t_{99/100}$	=	time required to achieve 99 percent of ultimate methane generation (years)
t	=	time (years)

Therefore, if $t_{1/2}$, $t_{99/100}$, and Lo are known or assumed for a given refuse composition, the gas generation rate can be calculated. Values of $t_{1/2}$ and $t_{99/100}$ suggested in the literature are presented below:

<u>Suggested values for Selected Kinetic Factors (from Palos Verdes Study)</u>

	Assumed Percentage of Total Organic Fraction (Wet basis)[1]	*Assumed $t_{1/2}$ (years)*	*Assumed $t_{99/100}$ (years)*
Readily Decomposable Organics	35.4	1	3.5
Moderately Decomposable Organics	61.0	2	6
Slowly Decomposable Organics	3.6	20	60

Note:

(1) Percent composition is based on data from "Municipal Refuse Disposal", Institute for Solid Wastes, American Public Works Association, 1970.

C.1.2 SHELDON-ARLETA MODEL

The Sheldon-Arleta model is identical to the Palos Verdes Model except for the assumption of half time (i.e. period when half the ultimate gas generation is reached). In this case the assumption is made that the maximum gas generation rate occurs at half time but the half time is equal to 35 percent of the total production time. The half times and total production times suggested in the literature for the Sheldon-Arleta model are as follows:

Refuse Type	$t_{1/2}$ *(yr)*	*Total (yr)*	*% Carbon of Total Refuse*
Readily Decomposable	9	26	31
Slowly Decomposable	36	103	66

Thus, the Sheldon-Arleta model predicts that a landfill reaches half its total generation capacity after about nine years for readily decomposable refuse and about 36 years for slowly decomposable refuse.

This modelling approach is based on gas generation data observed in sewage sludge digesters under biodegradation conditions. In the latter case it is reported that peak production of gas occurs after 14 days of biodegradation and the process is 99 percent complete at 40 days. This profile served as the basis for the development of this model. However, the basic assumption that the biodegradation profile observed in a sludge digester (under optimal conditions) is similar to that observed in a landfill may be inaccurate. It is probable that the maximum rate generation in a landfill occurs at a time much shorter than $t_{1/2}$.

C.1.3 SCHOLL-CANYON MODEL

In the two previous models, the gas production profile is based on assumptions that relate to data observed in the sludge digestion process. This degradation process occurs over a period of 20 to 40 days and may not be valid when related to landfill applications which have less than optimal conditions for anaerobic digestion (i.e. much less moisture).

The Scholl-Canyon model is based on the assumptions that the bacterial growth is established early in the life of a landfill. The biodegradation rate is thereafter limited by the amount of dissolved substrate required by the acid and methane forming bacteria. It is noted that the levels of moisture present in a given landfill will play a key factor in the kinetics of the process.

The Scholl-Canyon model is a single stage, first order kinetic model. In general terms, the results of the model indicates that after a negligible time lag during which anaerobic conditions are established, the gas generation rate will peak for a newly landfilled portion. The gas generation rate will decrease exponentially thereafter as the organic fraction of the landfill refuse decreases. The governing model equations are as follows:

Equation #3

$$\frac{dL}{dt} = -kL_o \exp[-k(t - t_o)]$$

(gas generation rate at time t)

where

L	=	amount of gas yet to be generated per unit weight of refuse (ft^3/lb)
k	=	delay constant of biogas generation(1/yr)
t	=	time (years)
L_o	=	ultimate volume of gas to be generated (ft^3/lb)
t_o	=	initial time of landfilling (years)

Equation #4

$$L = Lo \exp[-k(t - t_o)]$$

(gas yet to be generated at time t)

If the refuse is broken down into sub-masses which are placed during each year of landfilling, the total gas generation is as follows:

Equation #5

$$\frac{dL}{dt} = -kL_o \sum_{i=i}^{n} X_i \exp[-k(t - t^o_i)]$$

(gas generation rate at time t)

where

n	=	total number of years of landfilling
i	=	year i of landfilling
X_i	=	sub-mass landfilled in year i (express as a fraction of total weight)
t	=	time (years)
t_i	=	time of landfilling of submass i (years)

To calculate the gas generation at any time (t) using the Scholl-Canyon model the ultimate volume of gas to be generated (L_0) and decay constant for biogas generation (k) must be estimated.

C.1.4 MODEL SELECTION FOR THE NCR SITE

The Scholl-Canyon Model is generally accepted in the industry as the most suitable model of the three. This model is the simplest of the models presented and requires the least number of variables to be estimated. Although no single model has been demonstrated to date, to conclusively reflect the process which occurs in a landfill, utilization of the Scholl-Canyon Model should give an average representation of the gas generation expected for the NCR Site.

C.2.0 ESTIMATION OF LANDFILL GAS GENERATION FOR THE NCR SITE

Utilizing the Scholl-Canyon Model requires the estimation of the ultimate volume of gas to be generated (L_0) and the decay constant of biogas generation (k).

The ultimate gas generation volume (L_0) depends on the refuse composition and site-specific conditions of the landfill. Landfills with lower organic fraction will have lower gas yields. The decay constant of biogas generation (k) determines the time dependency of the gas generation rates and will vary for each site. A low value indicates low initial gas generation rates, while a high value indicates high initial gas generation rates. The value of the rate constant also determines the half life point of gas generation. The following constant values were assumed for this analysis:

Ultimate biogas yield (L_0); 3.0 ft^3/lb. of refuse; and
Decay constant of biogas generation (k); 0.070/yr.

These assumed values for the constants L_0 for municipal landfills and k were based on the characterization of waste reported at the NCR Site in a report by Krehbiel et al, 1973 (see Table 2).

Typical values for the ultimate biogas yield (L_0) range from 2.0 to 4.0 ft^3/lb of refuse. As shown in Table 2, household wastes account for 42 percent of the total waste disposed of at the NCR Site. A typical ultimate biogas yield of 3.0 ft^3/lb of refuse is representative for this type of waste.

An average decay rate for biogas generation (k) of 0.070/yr represents a half life of 10 years for the landfill's potential gas generation, which is typical for this region's climatic conditions.

Refuse landfilled at the NCR Site was assumed to be 158 million pounds of refuse per year during the active period of 1969 to 1976, based on the Krehbiel et al report, 1973. The maximum gas generated from each year's portion of refuse was assumed to occur once all of the refuse for that year had been landfilled. The gas produced from each yearly portion of refuse after being landfilled would then begin to decrease according to the Scholl-Canyon Model, equation #4.

Estimated quantities of gas generated due to the yearly portion of refuse landfilled were calculated during the active period of the NCR Site of 1969 to 1976 and the post-closure period of 1977 to 2010, as shown in Table 3.

Estimated gas generated as shown in Table 3 was plotted versus time and is shown on Figure 1. The maximum gas generated at the NCR Site was estimated at 7.5 million cubic yards of biogas per year and was found to occur immediately after the landfill was closed in 1976. Biogas generation was found to decrease after 1977 until an estimated steady-state biogas generation rate of 1.0 million cubic yards of biogas per year occurs after the year 2005, as shown on Figure 1.

C.3.0 CONCLUSIONS

The gas generated from the Site in 1993, as estimated by using the Scholl-Canyon Model is approximately 2.46 million cubic yards of gas per year or approximately 126 cubic feet per minute. An active gas collection system generally requires a minimum of 500 cubic feet per minute of gas to work effectively.

Therefore, the relatively small volume of landfill gas generated from the Site, combined with no documented odor problems and no nearby structures, do not warrant an active gas collection system at the site.

TABLE 1

TYPICAL LANDFILL GAS COMPOSITION (1)

Parameter		*Full Range % by Volume*	*Anaerobic Decomposition Range % by Volume*
1.	methane	0% - 70%	40% - 70%
2.	carbon dioxide	0% - 90%	30% - 50%
3.	hydrogen	0% - 90%	trace
4.	oxygen	<1.0%	
5.	nitrogen	<2.0%	
6.	trace gases a) mercaptans b) hydrocarbons (e.g. ethylbenzene, toluene, xylenes) c) solvents (e.g. trichloroethene, acetone, 1,1-dichloroethane) d) water vapor e) hydrogen sulphide	<5%	<5%

Note:

(1) From "Hunt's Disposal Landfill Site, Racine County, Wisconsin", CRA, April 1992.

TABLE 2

1972 SOLID WASTE CHARACTERIZATION QUANTITIES
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK (1)

Description		*Weight* lbs	*Percent of Total* %
Basic Wastes			
Household Wastes		66,647,780	42.2
InstitutionalWastes		1,816,760	1.2
Commercial Wastes		29,208,430	18.5
Industrial Wastes		58,179,700	36.8
Special Wastes		2,286,360	1.3
	Subtotal	158,139,030	100.0

Special Wastes includes;

Trees, Brush and Yard Wastes

Street Sweeping

Bulky Wastes

Demolition and Construction Wastes

Discarded Tires

Residues from Water and Sewage Treatment Plants

Note:

From "Operating Plan for Wheatfield Refuse Disposal Site, Niagara County Refuse Disposal District" Krehbiel-Guay-Rugg-Hall, Engineers & Surveyors, Oct. 5, 1973.

Table 3 Estimation of Landfill Gas Generation

Niagara County Refuse Site

Wheatfield, New York

Year	Gas Produced Per Year (*) (yd3)	Year	Gas Produced Per Year (*) (yd3)
1969	0	1988	3,485,406
1970	1,186,864	1989	3,249,771
1971	2,293,489	1990	3,030,067
1972	3,325,299	1991	2,825,216
1973	4,287,352	1992	2,634,213
1974	5,184,365	1993	2,456,124
1975	6,020,734	1994	2,290,075
1976	6,800,559	1995	2,135,252
1977	7,527,663	1996	1,990,896
1978	7,018,747	1997	1,856,299
1979	6,544,236	1998	1,730,802
1980	6,101,805	1999	1,613,789
1981	5,689,285	2000	1,504,687
1982	5,304,655	2001	1,402,961
1983	4,946,027	2002	1,308,112
1984	4,611,645	2003	1,219,675
1985	4,299,869	2004	1,137,218
1986	4,009,172	2005	1,060,335
1987	3,738,127	2006	988,650

(*) Notes: Based on the Scholl - Canyon Model

$L = L_o \exp(-k(t - t_o))$ Where:

- Landfill gas to be generated from refuse: L (ft3/yr)
- Refuse disposal per year: 158 million lbs. per year (1972 disposal rate)
- Biomass Gas Yield Constant: 3 ft3/lb of refuse
- Ultimate Biomass Gas Yield: Lo= 3 ft3/lb 158,000,000 lb/yr, Lo=474,000,000 ft3/yr
- Decay Constant of Biogas Generation: k=0.070/yr
- Initial time of placement of refuse: to (yr) & time after placement of refuse: t (yr)

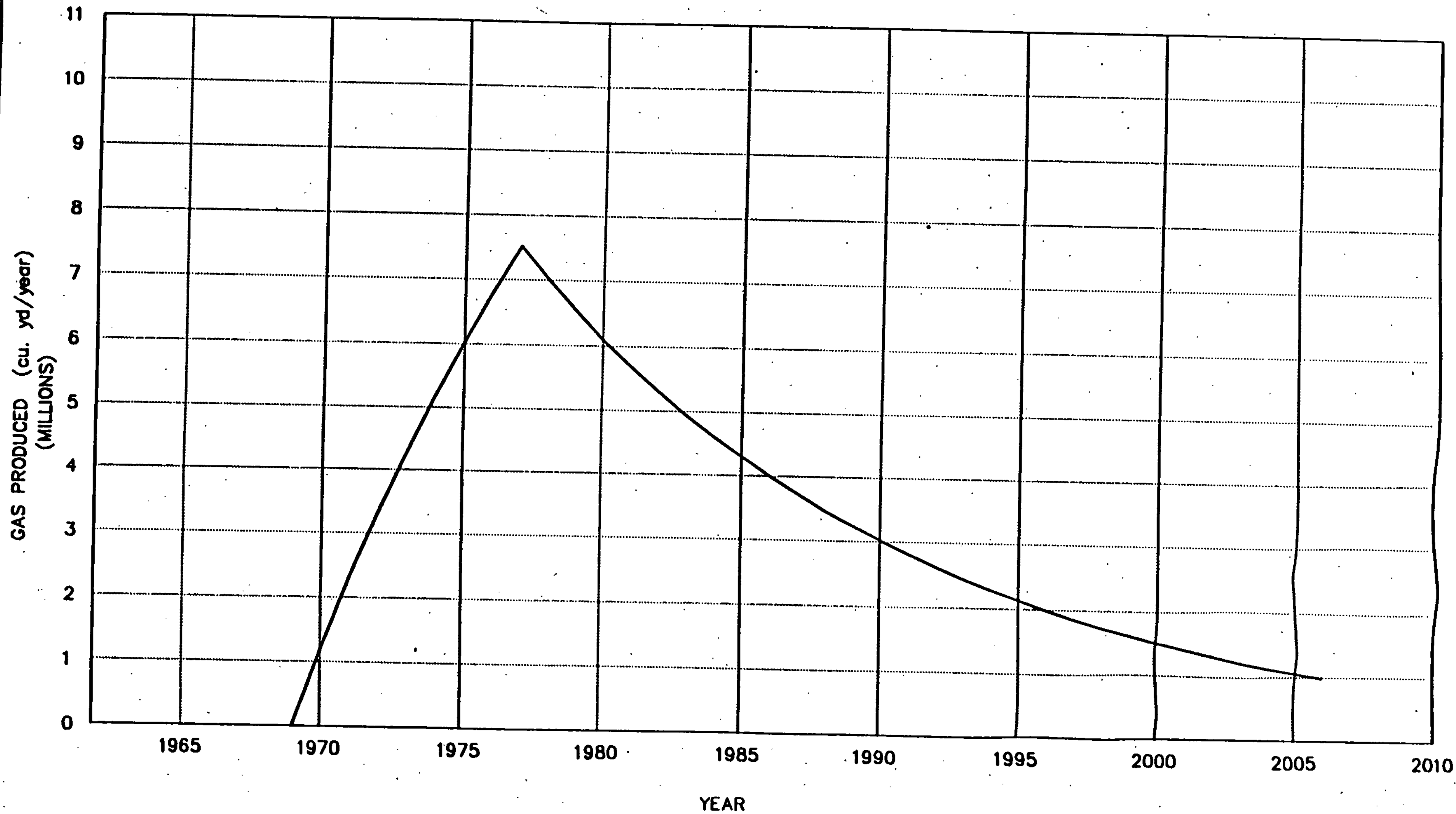

figure 1
ESTIMATED LANDFILL GAS GENERATION
NIAGARA COUNTY REFUSE SITE
Wheatfield, N.Y.

CRA

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D

APPENDIX D

DETAILED COST ESTIMATES

Note: Abbreviations used in this Appendix:

L.S.	-	Lump Sum
Ea.	-	Each
L.F.	-	Linear Foot
gal	-	Gallon
S.Y.	-	Square Yard
C.Y.	-	Cubic Yard

<u>LIST OF TABLES</u>

TABLE D.1

SUMMARY OF REMEDIAL COMPONENT COST ESTIMATES
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

	Remedial Component	*Capital Cost*	*Annual Cost*	*Present Worth of Annual Cost*	*Total Present Worth*
1.	Deed Restrictions/ Fencing	$ 183,800	$ 0	$ 0	$ 183,800
2.	Leachate Subsurface Perimeter Drain	$ 930,200	$ 10,000	$ 172,000	$ 1,102,200
3.	Leachate Treatment at POTW	$ 30,800	$ 38,400	$ 660,000	$ 691,400
4.	On-Site Leachate Treatment	$ 750,000	$ 200,000	$ 3,441,000	$ 4,191,000
5.	RCRA Cap	$ 19,228,900 - $ 21,063,500	$ 20,000	$ 344,000	$ 19,572,900- $ 21,407,500
6.	NYS Standard Cap	$ 14,130,300 - $ 15,733,300	$ 20,000	$ 344,000	$ 14,474,300- $ 16,077,300
7.	Groundwater and Surface Water Monitoring	$ 83,600	$ 128,100	$ 2,204,000	$ 2,287,600
8.	5-Year Review	$ 0	$ 2,220	$ 30,500	$ 30,500

TABLE D.2

REMEDIAL COMPONENT COST ESTIMATE
DEED RESTRICTION AND FENCING
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Deed Restriction	-	L.S.	-	$ 10,000
I.2	Fencing	10,000	L.F.	$ 13	$ 130,000
	Sub-Total - Direct Capital Costs				$ 140,000
II.	INDIRECT CAPITAL COST				
II.1	Administration and Legal (nil)	-	-	-	Incl. in I.1
II.2	Engineering/Surveying (5% of Direct Capital Costs)				$ 7,000
II.3	Construction Supervision (nil)				0
II.4	Health and Safety (nil)				0
	Sub-Total - Indirect Capital Costs				$ 0
	Sub-Total - Capital Costs (Direct and Indirect)				$ 147,000
	Contingency (25%)				$ 36,800
	TOTAL ESTIMATED CAPITAL COSTS				$ 183,800
III.	OPERATION AND MAINTENANCE (6% DISCOUNT RATE)				
	Nil				$ 0
	Sub-Total - Present Worth Operation and Maintenance Costs				$ 0
	Contingency (25%)				0
	TOTAL ESTIMATED O&M COSTS				$ 0
	TOTAL ESTIMATED COMPONENT COSTS				$ 183,750

TABLE D.3

REMEDIAL COMPONENT COST ESTIMATE
LEACHATE SUBSURFACE PERIMETER DRAIN COLLECTION SYSTEM
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Installation of Perimeter Collection Trench (includes excavation, relocating and regrading excavated refuse, backfilling, filter fabric, clean stone, 6-inch diameter perforated HDPE collector pipe)	10,000	L.F.	$ 45	$ 450,000
I.2	Manholes	34	each	$ 2,500	$ 85,000
I.3	Leachate Pumping Stations (includes pump, appurtenances, control panel, electrical supply)	4	each	$ 20,000	$ 80,000
	Sub-Total - Direct Capital Costs				$ 615,000
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (3% of Direct Capital Cost)				$ 18,450
II.2	Engineering (10% of Direct Capital Cost)				$ 61,500
II.3	Construction Supervision (5% of Direct Capital Cost)				$ 30,750
II.4	Health and Safety (3% of Direct Capital Cost)				$ 18,450
	Sub-Total - Indirect Capital Costs				$ 129,150
	Sub-Total - Capital Costs (Direct and Indirect)				$ 744,150
	Contingency (25%)				$ 186,050
	TOTAL ESTIMATED CAPITAL COSTS				$ 930,200

TABLE D.3

REMEDIAL COMPONENT COST ESTIMATE
LEACHATE SUBSURFACE PERIMETER DRAIN COLLECTION SYSTEM
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
III.	OPERATION AND MAINTENANCE				
III.1	Annual Extraction system monitoring, operation and maintenance costs	--	L.S.	--	$ 10,000
	Sub-Total - Annual O & M				$ 10,000
	Sub-Total - Present Worth Annual O & M (30 years, 6% discount rate)				$ 137,600
	Contingency (25%)				$ 34,400
	TOTAL ESTIMATED O & M COSTS				$ 172,000
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 1,102,200

TABLE D.4

REMEDIAL COMPONENT COST ESTIMATE
LEACHATE TREATMENT AT POTW
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Installation of Forcemain to Municipal Sanitary Sewer System	--	L.S.	--	$ 20,000
	Sub-Total - Direct Capital Costs				$ 20,000
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (5% of Direct Capital Cost)				$ 1,000
II.2	Engineering (10% of Direct Capital Cost)				$ 2,000
II.3	Construction Supervision (5% of Direct Capital Cost)				$ 1,000
II.4	Health and Safety (3% of Direct Capital Cost)				$ 600
	Sub-Total - Indirect Capital Costs				$ 4,600
	Sub-Total - Capital Costs (Direct and Indirect)				$ 24,600
	Contingency (25%)				$ 6,200
	TOTAL ESTIMATED CAPITAL COSTS				$ 30,800

TABLE D.4

REMEDIAL COMPONENT COST ESTIMATE
LEACHATE TREATMENT AT POTW
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
III.	OPERATION AND MAINTENANCE				
III.1	Treatment @ POTW (5 gpm @ $0.016/gallon)	2,400,000	gallon	$ 0.016	$ 38,400
III.2	NPDES monitoring and reporting (already performed by POTW)				0
	Sub-Total - Annual O & M				$ 38,400
	Sub-Total - Present Worth Annual O & M (30 years, 6% discount rate)				$ 528,500
	Contingency (25%)				$ 132,100
	TOTAL ESTIMATED O & M COSTS				$ 660,600
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 691,400

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TABLE D.5

REMEDIAL COMPONENT COST ESTIMATE
ON-SITE LEACHATE TREATMENT
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Treatment System Design and Construction	--	L.S.		$ 600,000
	Sub-Total - Direct Capital Costs				$ 600,000
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (nil)	--			Incl. in I.1
II.2	Engineering (nil)				$ 0
II.3	Construction Supervision (nil)				0
II.4	Health and Safety (nil)				0
	Sub-Total - Indirect Capital Costs				$ 0
	Sub-Total - Capital Costs (Direct and Indirect)				$ 600,000
	Contingency (25%)				$ 150,000
	TOTAL ESTIMATED CAPITAL COSTS				$ 750,000
III.	OPERATION AND MAINTENANCE				
III.1	System Operation, Monitoring and Maintenance	--	L.S.	--	$ 200,000
	Sub-Total - Present Worth Annual Operation and Maintenance Costs (30 years, 6% discount rate)				$ 2,753,000
	Contingency (25%)				$ 688,000
	TOTAL ESTIMATED O & M COSTS				$ 3,441,000
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 4,191,000

TABLE D.6

REMEDIAL COMPONENT COST ESTIMATE
RCRA CAP
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Cap Construction				
	i) Preparation of Subgrade	45,000- 330,000	C.Y.	$ 5.00	$ 225,000 - $ 1,650,000
	ii) Clay	200,000	C.Y.	$ 22.00	$ 4,400,000
	iii) Sand	100,000	C.Y.	$ 24.00	$ 2,400,000
	iv) Fill	200,000	C.Y.	$ 21.00	$ 4,200,000
	v) Topsoil	50,000	C.Y.	$ 25.00	$ 1,250,000
	vi) HDPE Liner	300,000	S.Y.	$ 3.80	$ 1,140,000
	vii) Filter Fabric	300,000	S.Y.	$ 2.00	$ 600,000
	viii) Seed and mulch	300,000	S.Y.	$ 1.10	$ 330,000
	Item I.1 Subtotal				$ 14,545,000 - $ 15,970,000
I.2	Gas Collection Trenches Beneath Cap	--	L.S.	--	$ 200,000
I.3	Perimeter Clay Barrier Wall	10,000	L.F.	$ 19.00	$ 190,000
	Subtotal - Direct Capital Costs				$ 14,935,000 - $ 16,360,000
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (1% of Direct Capital Cost)				$ 149,400 - $ 163,600
II.2	Engineering (3% of Direct Capital Cost)				$ 448,100 - $ 490,800
II.3	Construction Supervision (3% of Direct Capital Cost)				$ 448,100 - $ 490,800
II.4	Health and Safety (nil)				0

TABLE D.6

REMEDIAL COMPONENT COST ESTIMATE
RCRA CAP
NIAGARA COUNTY REFUSE SITE

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
	Sub-Total - Indirect Capital Costs				$ 1,045,600 - $ 1,145,200
	Sub-Total - Capital Costs (Direct and Indirect)				$ 15,980,600 - $ 17,505,200
	Contingency (25%)				$ 3,995,200 - $ 4,376,300
	TOTAL ESTIMATED CAPITAL COSTS				$ 19,975,800 - $ 21,881,500
III	OPERATION AND MAINTENANCE				
III.1	Annual inspections and Maintenance costs	--	L.S.		$ 20,000
	Sub-Total - Annual O & M				$ 20,000
	Sub-Total - Present Worth O & M (30 years 6% discount rate)				$ 275,200
	Contingency (25%)				$ 68,800
	TOTAL ESTIMATED O & M COSTS				$ 344,000
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 20,319,800 - $ 22,225,500

TABLE D.7

REMEDIAL COMPONENT COST ESTIMATE
NYS STANDARD CAP
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
I.	DIRECT CAPITAL COST				
I.1	Cap Construction				
	i) Preparation of Subgrade	45,000- 330,000	C.Y.	$ 5.00	$ 225,000 - $ 1,650,000
	ii) Clay	140,000	C.Y.	$ 22.00	$ 4,400,000
	iii) Fill	200,000	C.Y.	$ 24.00	$ 4,200,000
	iv) Topsoil	50,000	C.Y.	$ 25.00	$ 1,250,000
	v) Seed and mulch	300,000	S.Y.	$ 1.10	$ 330,000
	Item I.1 Subtotal				$ 10,405,000- $ 11,830,000
I.2	Gas Collection Trenches Beneath Cap	--	L.S.	--	$ 200,000
I.3	Perimeter Clay Barrier Wall	10,000	L.F.	$ 19.00	$ 190,000
	Subtotal - Direct Capital Costs				$ 10,975,000 - $ 12,220,000
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (1% of Direct Capital Cost)				$ 109,800 - $ 122,200
II.2	Engineering (3% of direct Capital Cost)				$ 329,300 - $ 366,600
II.3	Construction Supervision (1% of Direct Capital Cost)				$ 329,300 - $ 366,600
II.4	Health and Safety (nil)				

TABLE D.7

REMEDIAL COMPONENT COST ESTIMATE
NYS STANDARD CAP
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
	Sub-Total - Indirect Capital Costs			$	768,400 -
				$	855,400
	Sub-Total - Capital Costs (Direct and Indirect)			$	11,743,400-
				$	13,075,400
	Contingency (25%)			$	2,935,900 -
				$	3,268,900
	TOTAL ESTIMATED CAPITAL COSTS			$	14,679,300 -
				$	16,344,300
III.	OPERATION AND MAINTENANCE				
III.1	Annual inspections and Maintenance costs	--	L.S.	$	20,000
	Sub-Total - Annual O & M			$	20,000
	Sub-Total - Present Worth O & M (30 years 6% discount rate)			$	275,200
	Contingency (25%)			$	68,800
	TOTAL ESTIMATED O & M COSTS			$	344,000
	TOTAL ESTIMATED REMEDIAL COMPONENT COST			$	15,023,300 -
				$	16,688,300

TABLE D.8

REMEDIAL COMPONENT COST ESTIMATE
GROUNDWATER AND SURFACE WATER MONITORING
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
I.	DIRECT CAPITAL COST				
I.1	Purchase Sampling Equipment				
	i) bladder pump (s.s.)	4	Each	$ 600	$ 2,400
	ii) control box/driver	2	Each	$ 3,200	$ 6,400
	iii) bailer (s.s.)	4	Each	$ 250	$ 1,000
	iv) water level meter	1	Each	$ 400	$ 400
I.2	Installation of Monitoring Wells	12	Each	$ 4,000	$ 48,000
	Subtotal - Direct Capital Costs				$ 58,200
II.	INDIRECT CAPITAL COSTS				
II.1	Administration and Legal (5% of Direct Capital Cost)				$ 2,900
II.2	Engineering (10% of direct Capital Cost)	--		--	$ 5,800
II.3	Construction Supervision (nil)				$ 0
II.4	Health and Safety (nil)				0
	Sub-Total - Indirect Capital Costs				$ 8,700
	Sub-Total - Capital Costs (Direct and Indirect)				$ 66,900
	Contingency (25%)				$ 16,700
	TOTAL ESTIMATED CAPITAL COSTS				$ 83,600

TABLE D.8

REMEDIAL COMPONENT COST ESTIMATE
GROUNDWATER AND SURFACE WATER MONITORING
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	*Description*	*Estimated Quantity*	*Unit*	*Unit Cost*	*Total Cost*
III.	OPERATION AND MAINTENANCE				
III.1	Baseline Parameters 38 samples (24 gw wells, 4 SW samples, 10 QA/QC samples)	38	each	$ 900	$ 34,200
III.2	Routine Parameters 38 samples (24 gw wells, 4 SW samples, 10 QA/QC samples)	114	each	$ 350	$ 39,900
III.3	Sample Collection	4	Round	$ 11,000	$ 44,000
III.4	Annual Management and Reporting				
	i) Data quality review	--	L.S.	--	$ 5,000
	ii) Data Management and Reporting	--	L.S.	--	$ 5,000
	Sub-Total - Annual O & M				$ 128,100
	Sub-Total - Present Worth O & M (30 years 6% discount rate)				$ 1,763,000
	Contingency (25%)				$ 441,000
	TOTAL ESTIMATED O & M COSTS				$ 2,204,000
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 2,287,600

TABLE D.9

REMEDIAL COMPONENT COST ESTIMATE
5-YEAR REVIEW
NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

Item	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
I.	DIRECT CAPITAL COST				$ 0
II.	INDIRECT CAPITAL COSTS				0
	TOTAL ESTIMATED CAPITAL COSTS				$ 0
III.	OPERATION AND MAINTENANCE				
III.1	Six 5-year reviews, present worth (30 years, 6% discount rate) (10,000 each)				$ 24,400
	Sub-Total - Present Worth Annual O & M				$ 24,400
	Contingency (25%)				$ 6,100
	TOTAL ESTIMATED O & M COSTS				$ 30,500
	TOTAL ESTIMATED REMEDIAL COMPONENT COST				$ 30,500

SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

× 573.2 SPOT ELEVATION
× 575.5 INDISTINCT SPOT ELEVATION

NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE WHEATFIELD, NEW YORK

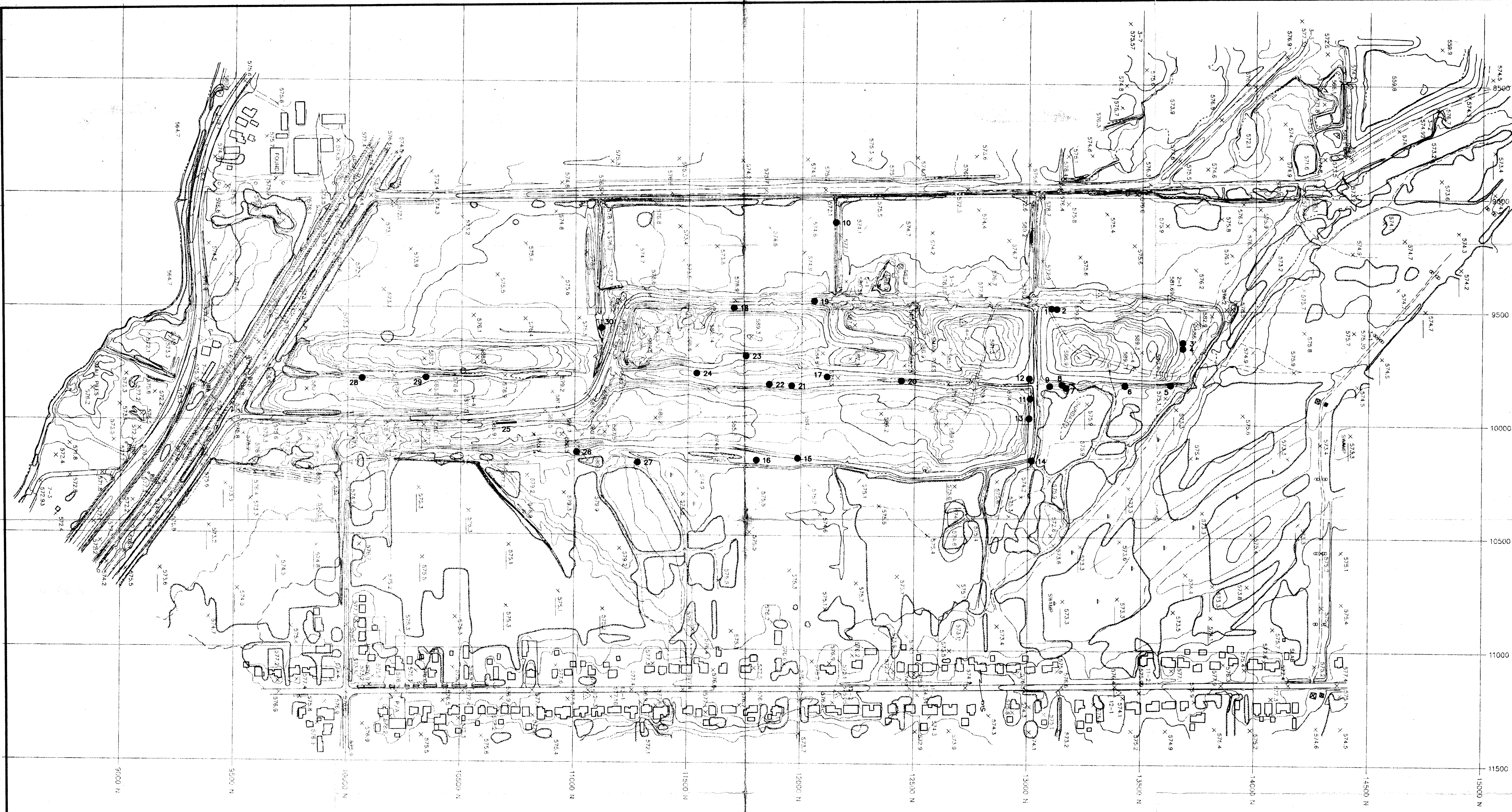
FEASIBILITY STUDY

TOPOGRAPHIC SITE PLAN

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: L.D.M.	Scale: 1"=200'	Date: MARCH 1993	File Nº: P-24	Rev.Nº: 0
Designed by: P.D.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 1	

JULY 08/93(W)



NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

0 100 200ft

SOURCE:

ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

● 10 LEACHATE SEEP

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

LEACHATE SEEPS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B./L.D.M.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-31	Rev.Nº: -
Designed by: E.R.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 2	

JULY 08/93(W)

NOTES:

1) Azimuths (directions) shown along property lines are referenced to an assumed north.

2) The survey baseline shown on this map was established for CRA Engineers. The purpose was to provide sufficient ground control for scientific measurements prior to determination of the property lines.

3) Refer to sketch 1 & 2 for landfill limit locations. The limit as shown is the most outward extent of the man-made "improvements" created during construction of said landfill. Limits are measured at right angles to the property line.

MAP SHOWING SURVEY OF PROPERTY OWNED BY

THE TOWN OF WHEATFIELD

(FORMERLY NIAGARA COUNTY REFUSE DISPOSAL DISTRICT)

PREPARED FOR:

C.R.A. ENGINEERS, NIAGARA FALLS, N.Y.

FEASIBILITY STUDY SITE PROPERTY MAP PLAN 3

NIAGARA BOUNDARY AND MAPPING SERVICES, L.S.P.C.
FORMERLY FRANK T. TRIPI & ASSOCIATES P.C.
765 CAYUGA STREET LEWISTON, NEW YORK 14092 TEL (716) 754-8330

RESURVEYED	DATE

REFERENCE:

"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES."

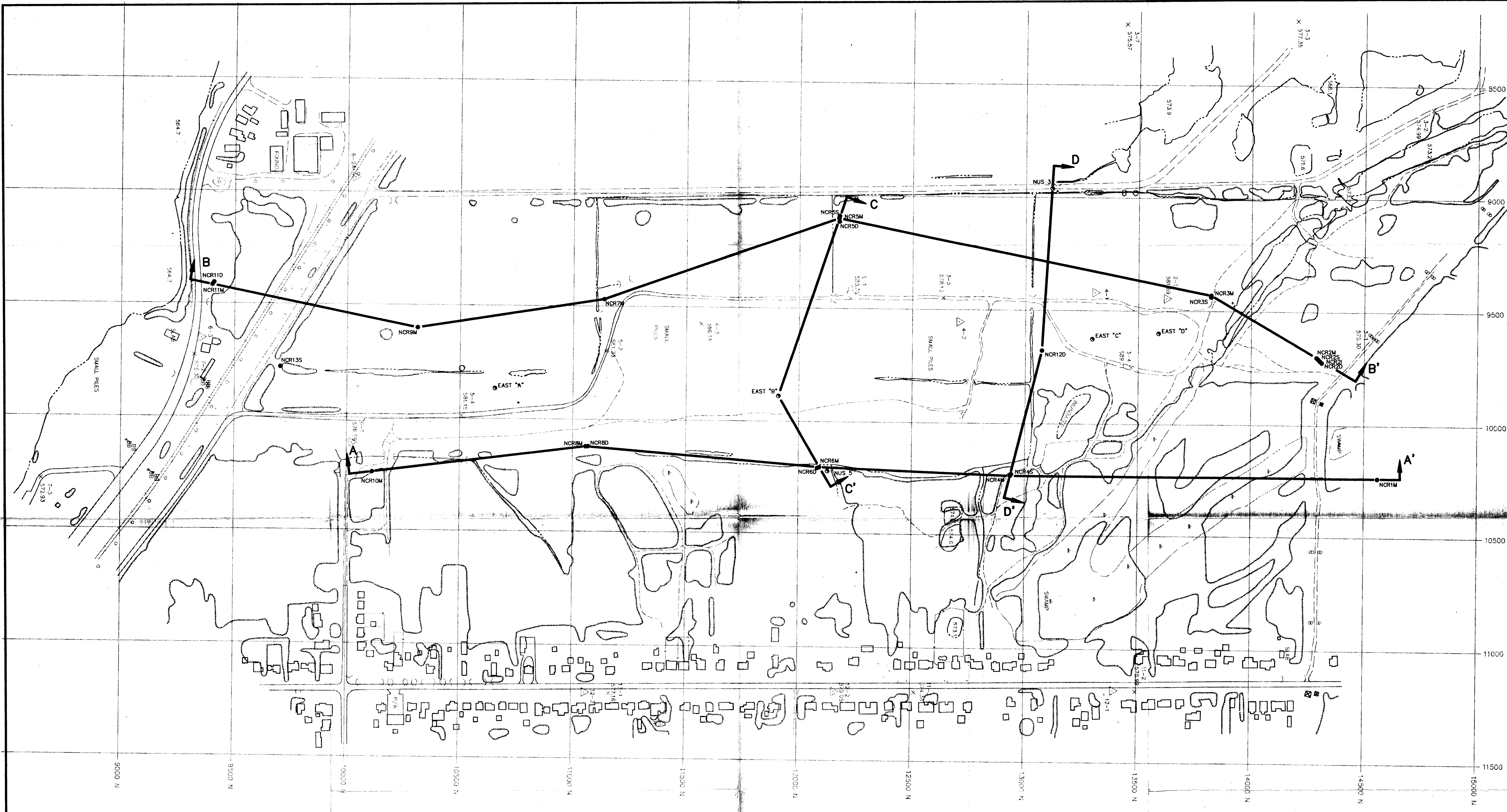
BARRY N NICHOLS Lic No 49890

LOT 68 M.R. & 69 M.R.	SEC.	TWP.	RNG.
CITY/TOWN	N TONAWANDA/WHEATFIELD		
COUNTY	NIAGARA		
STATE	NEW YORK		
DATE	6/4/90		
SCALE	1" = 200'		
JOB NO.	3833-90		

NOTE: UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY MAP IS A VIOLATION OF SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

NOTE: THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF AN ABSTRACT OF TITLE AND IS SUBJECT TO ANY STATE OF FACTS ...

CRA PROJECT NO. ... FILE NO. 18



<u>NOTES CONCERNING SITE GRID</u>

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

<u>SOURCE:</u>
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

<u>LEGEND</u>
- EXISTING MONITORING WELLS
- CRA RI MONITORING WELLS
- CROSS-SECTION LOCATIONS

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

MONITORING WELL LOCATIONS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-32	Rev.Nº: -
Designed by: J.B.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 4	

<u>NOTES CONCERNING SITE GRID</u>

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

0 100 200ft

<u>SOURCE:</u>
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

<u>LEGEND</u>

- EXISTING MONITORING WELL
- CRA RI MONITORING WELL
- TEST PIT
- SEDIMENT SAMPLE
- LEACHATE SEEP SAMPLE
- WEIR
- SURFACE WATER SAMPLE
- AIR SAMPLE
- HAND AUGER SAMPLE

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

SAMPLING LOCATIONS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: DCR	Scale: 1"=200'	Date: JULY 1991	File Nº: 18	Rev.Nº: –
Designed by: J.B.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 5	
Checked by: E.R.				

NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

0 100 200ft

SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

- EXISTING MONITORING WELLS
- CRA RI MONITORING WELLS
- (573.2) TOP OF CLAY/UPPER TILL ELEVATIONS (ft.AMSL)
- 569 TOP OF CLAY/UPPER TILL CONTOUR (ft. AMSL)

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

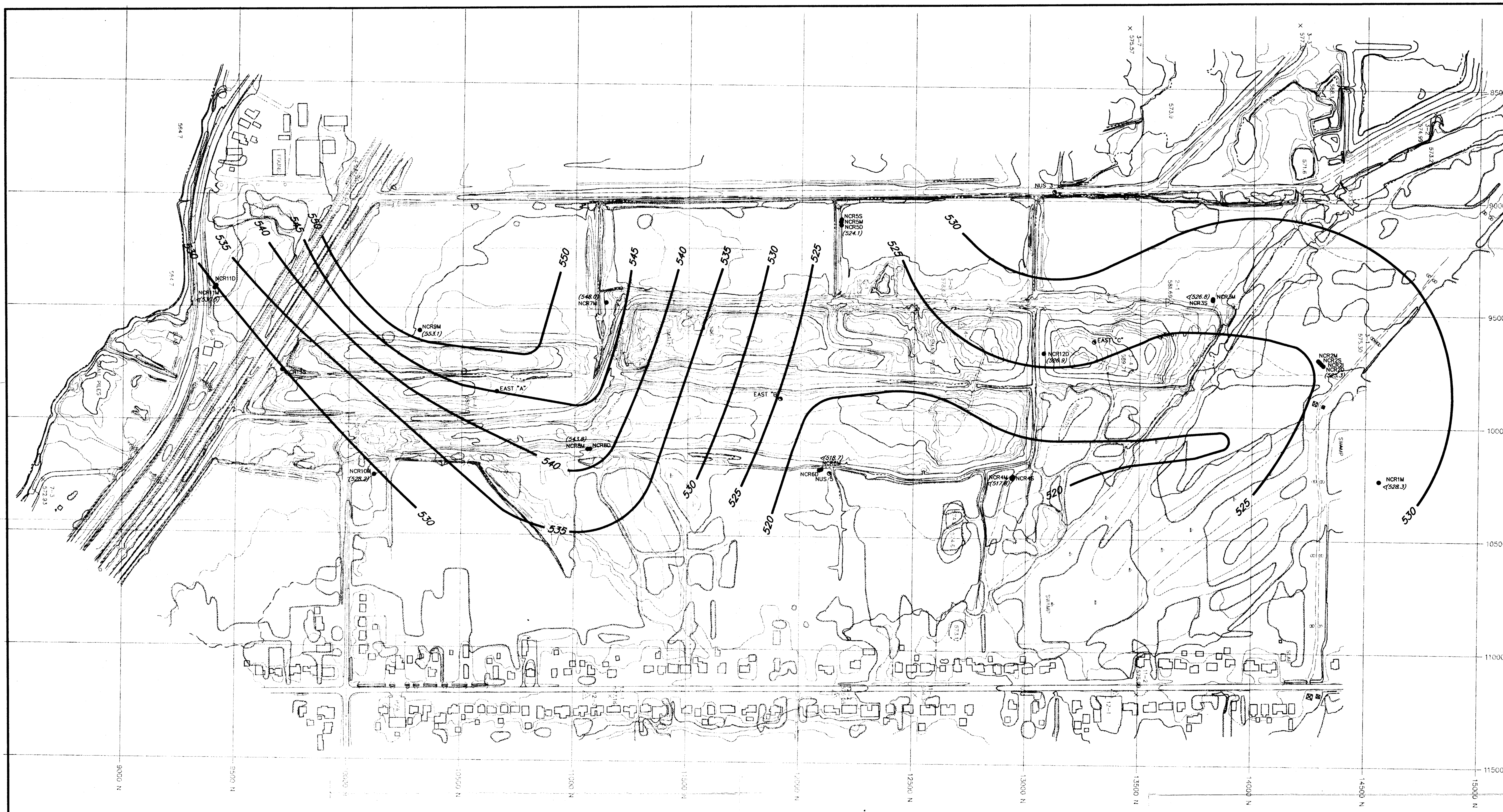
FEASIBILITY STUDY

TOP OF CLAY/UPPER TILL CONTOURS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B/K.S.W.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-33	Rev.Nº: 0
Designed by: J.B.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 6	

JULY 06/93(W)



NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

0 100 200ft

SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

- ◉ EXISTING MONITORING WELLS
- ● CRA RI MONITORING WELLS
- (528.3) TOP OF BEDROCK ELEVATION (ft. AMSL)
- ▬ TOP OF BEDROCK CONTOUR (ft. AMSL)

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

TOP OF BEDROCK CONTOURS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B./K.S.W.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-34	Rev.Nº: 0
Designed by: J.B.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 7	
Checked by: E.R.				

NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

0 100 200ft

SOURCE:
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

- EXISTING MONITORING WELLS
- CRA RI MONITORING WELLS
- (564.71) GROUNDWATER ELEVATION TAKEN ON 04/19/91 (ft. AMSL)
- DIRECTION OF GROUNDWATER FLOW

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

LOWER TILL GROUNDWATER CONTOURS (04/19/91)

CRA
CONESTOGA-ROVERS & ASSOCIATES

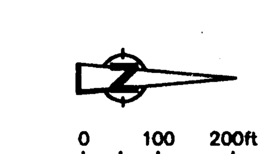
Drawn by: R.B.B./K.S.W.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-35	Rev.Nº: -
Designed by: J.B.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 8	

NOTES CONCERNING SITE GRID

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.



SOURCE:

ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

LEGEND

- ● EXISTING MONITORING WELLS
- ● CRA RI MONITORING WELLS
- (564.71) GROUNDWATER ELEVATION TAKEN ON 04/19/91 (ft. AMSL)
- ⟶ DIRECTION OF GROUNDWATER FLOW
- ▬ BEDROCK GROUNDWATER CONTOUR

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

BEDROCK GROUNDWATER CONTOURS (04/19/91)

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B./K.S.W.	Scale: 1"=200'	Date: JUNE 1993	File Nº: P-36	Rev.Nº: –
Designed by: J.B.				
Checked by: E.R.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 9	

JULY 06/93(W)

<u>NOTES CONCERNING SITE GRID</u>

THE GRID SYSTEM IS BASED ON AN ASSUMED COORDINATE OF 10000N / 10000E ON AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE OF WARNER RD. AT ITS INTERSECTION WITH THE APPROX. CENTERLINE OF BOSTON AVENUE.

THE DIRECTION OF THE FIRST GRID LINE WAS ESTABLISHED HOLDING AN EXISTING RR SPIKE IN THE APPROX. CENTERLINE INTERSECTION OF WARNER & WITMER RD.

ALL GRID LINES ARE REFERENCED PARALLEL OR PERPENDICULAR TO THE ABOVE DESCRIBED LINE.

<u>SOURCE:</u>
ABRAMS AERIAL SURVEY CORP.
124 NORTH LARCH, LANSING, MI 48933
A.A.S.C. #22886

<u>LEGEND</u>

- ◑ EXISTING MONITORING WELLS
- ● CRA RI MONITORING WELLS
- *(564.79)* LEACHATE ELEVATION (10/30/90) –FILL MATERIAL (ft. AMSL)
- *574* LEACHATE CONTOUR (10/30/90) –FILL MATERIAL
- [571.43] WATER LEVEL ELEVATION (10/30/90) –SHALLOW SILTY SAND UNIT

Nº	Revision	Date	Initial

Approved

NIAGARA COUNTY REFUSE SITE
WHEATFIELD, NEW YORK

FEASIBILITY STUDY

LEACHATE ELEVATION (10/30/90)
FILL MATERIAL

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: R.B.B./K.S.W.	Scale: 1"=200'	Date: NOVEMBER 1990	File Nº: 11 (P–08)	Rev.Nº: –
Designed by: J.B.	Field book:	Project Nº: 2677	Drawing Nº: PLAN 10	
Checked by: E.R.				