EMPIRE
SOILS INVESTIGATIONS INC.

ENVIRONMENTAL STUDY
NIAGARA FRONTIER TRANSPORTATION AUTHORITY
DIKED DISPOSAL AREA
BUFFALO, NEW YORK

For

Niagara Frontier Transportation Authority
181 Ellicott Street
Buffalo, New York 14205

BTA-86-94
FEBRUARY 1987

S-5167 SOUTH PARK AVENUE, P.O. BOX 0913, HAMBURG, NY 14075, 716-649-8110

TABLE OF CONTENTS

ENVIRONMENTAL STUDY
NIAGARA FRONTIER TRANSPORTATION AUTHORITY
DIKED DISPOSAL AREA
BUFFALO, NEW YORK

I. INTRODUCTION

A. Project History

The environmental engineering investigation of the diked disposal area, which is located west of Fuhrmann Boulevard and south of the Small Boat Harbor in the City of Buffalo, was initiated by the Niagara Frontier Transportation Authority (NFTA) to (1) determine whether the dredged materials placed by the U.S. Army Corps of Engineers during the period of 1967 to 1979 have resulted in environmental degradation, (2) evaluate the need for site remediation prior to developing the area and (3) determine the extent of remediation required (if any).

The diked disposal area was used by the U. S. Army Corps of Engineers from 1967 to 1979 for placement of dredged materials from the Buffalo Harbor, as part of the Federal Clean Waters Act Project. The agreement between NFTA and the U. S. Army Corps of Engineers called for the diked disposal area to revert back to NFTA ownership when the site was no longer needed by the Corps of Engineers for placement of dredged materials. In 1979 the Corps of Engineers indicated that there would be no further need for the site and transferred the site to the NFTA. At that time, the Corps of

Engineers informed the NFTA that the general site grade was approximately five feet below the design elevation. For several years the site was inactive while the NFTA investigated ways to bring the site up to the design grade and prepare the site for future beneficial use.

It is not known whether any authorized or unauthorized filling of the site occurred between 1979 and the present. At the beginning of our field investigations on November 17, 1986, fill materials were being placed along the northern one-quarter of the diked disposal area. It is our understanding that the source of the fill material was the nearby Louisiana Street railroad embankment excavation. We further note that fill materials were placed above existing grades in an uncontrolled (i.e. non-engineered) manner.

B. Site Location and Description

The diked disposal site is located south of, and adjacent to, the Buffalo small boat harbor along Lake Erie (see Drawing No. A.1 in Appendix A). The site is accessed from Fuhrmann Boulevard (N.Y.S. Route 5) which runs along the eastern side of the site. The diked disposal area is surrounded on the north, west and south by water from the small boat harbor and the Buffalo Outer Harbor.

The site is approximately 1000 feet by 1000 feet (i.e. roughly 23 acres) in plan. The north, south and western sides of the diked disposal area, which are exposed to wave action, are heavily covered with limestone rip-rap for erosion protection and stabilization. The interior of the site is of fairly low relief, with localized elevation changes of less than 10 feet. Based on visual observations, the surface features of the northern one-quarter of the site appears to contain a large amount of recently placed demolition debris. The remaining three-quarters of the site appears to consist of dredge fill material, densely covered with swamp vegetation and small trees.

C. Purpose and Scope

The purpose of this investigation was to evaluate the environmental conditions of the diked disposal area to (1) determine whether previous filling activities at the site have caused environmental degradation, (2) evaluate whether remediation of the site is necessary prior to site development, (3) assess the extent of remediation required and possibility for migration of contaminants off the site and, (4) evaluate the possibility for migration of contaminants at the site due to placement of fill on top of the existing dredged fill materials.

The scope of this investigation was limited to the field investigation, data analysis and report preparation. The field investigation for this project included: (1) geophysical surveys using EM conductivity and magnetometer equipment, (2) monitoring well installation and soil sampling, (3) water sampling and (4) analysis of data from water and soil sample chemical testing.

II. METHODOLOGY

A. Borings and Wells

Thirteen borings were drilled using hollow stem augers. Monitoring wells were installed in each of the borings upon completion. The boring locations are shown on Drawing No. A.2 in Appendix A. Borehole locations and elevations were established at the site by a survey crew from Larsen Engineers of Rochester, New York.

During drilling, continuous soil samples were taken in each boring. The borings were advanced to depths of 10 to 28 feet below the existing ground surface (see Appendix B for boring logs). The borings were terminated at least 2 feet below the approximate mean lake elevation of 573, with the deepest boring (EW-9) extending 18.4 feet below the approximate mean lake elevation.

Monitoring wells were installed in each boring. The wells were constructed using 2-inch I.D., flush joint, threaded PVC riser pipe and well screen. The well screens are 5 feet long with 0.01 inch machine slotted openings. Sand was placed in the annular space around the well screen to a height of at least 1 foot above the top of the well screen. A seal of bentonite pellets, approximately 2 feet thick, was placed above the filter sand backfill. The remaining annular space was filled with cement grout to minimize surface water infiltration. A locking metal protector pipe was grouted over each well. Well details are given on Drawing C.1 in Appendix C. The augers and soil sampling equipment were decontaminated by steam cleaning between borings.

B. EM Conductivity Survey

The EM conductivity survey was performed at the NFTA diked disposal area using a Geonics EM34-3 electromagnetic terrain conductivity instrument. Field measurements were taken along a 50 feet by 50 feet grid system established at the site by Larsen Engineers (see Drawing No. A.2 in Appendix A for grid locations). Conductivity readings were taken along base lines A through T at grid lines 1 through 20. This would ideally provide 400 grid points at 50 foot centers across the site. However, 10 grid points could not be measured due to (1) perimeter rip rap dike along base line T beyond grid line 14, (2) inaccessible areas due to demolition debris and (3) heavy equipment working on the site. The EM conductivity survey readings were not obtained at grid intersections J-4, N-2, O-2 and T-2 due to demolition debris and locations T-15 through T-20 due to the perimeter rip rap dike. Thus, a total of 390 grid points were measured.

The apparent conductivity was measured directly along the grid system at the 50 foot centers using a 10 meter coil separation spacing. The instrument null was checked daily and corrected for any instrument drift. The instrument sensitivity range was adjusted during the survey to optimize readings of high and low apparent conductivity and to obtain the most accurate conductivity reading.

Based on the direct apparent conductivity values obtained in the field, the conductivity values along grid line 1 at base lines F through T were interpreted to represent background values for the site. These 15 values were used to determine the mean background conductivity value. The mean background conductivity, calculated using these 15 data points, was 16.7 millimhos/meter. Using a mean background conductivity of 16.7 millimhos/meter the field data was normalized using equation 1.

$$\begin{array}{l}\text{Normalized}\\ \text{Conductivity}\\ \text{(Decibels)}\end{array} = 20\ \text{Log}_{10}\ \frac{\text{Apparent Conductivity}}{\text{Background Conductivity}} \qquad \text{(Eqn.1)}$$

The units for the normalized conductivity are decibels, which are a dimensionless unit. Normalizing the values of the apparent conductivity, using decibels for contouring, enhances the areas of high apparent conductivity at the site. Table D.1 in Appendix D contains the apparent conductivity readings and the normalized values for each grid intersection. The normalized values for each location were input into a computer program, gridded, plotted and contoured to produce the the apparent conductivity contour map given on Drawing A.4 in Appendix A. On Drawing No. A.4, the contour interval is one decibel, with minimum and maximum contours of 9.5 and 23.5, respectively.

C. Magnetometer Survey

The magnetometer survey was performed using a Geometrics G-826 portable proton magnetometer. Measurements were taken along the same grid system as the EM conductivity survey. The locations which were inaccessible for the magnetometer survey were K-1 and L-1 due to heavy equipment, N-2, O-2 and T-2 due to demolition debris and T-15 through T-20 due to the perimeter rip rap dike. Thus, a total of 389 grid points were measured. A base station was maintained at location A-1 and periodic readings (usually hourly) were taken during the survey to correct and remove daily variations.

The normal magnetic field intensity for the NFTA diked disposal area was estimated at 56 kilogammas (as per EG & G Geometrics). The magnetometer was tuned to this intensity for the field survey to eliminate the effect of the earth's magnetic field for this region. Three or four readings were taken at each grid point to provide an average reading for each intersection.

The field readings were converted to total magnetic intensity of the site as explained in Table D.3, in Appendix D. The time variation correction factor was then determined from the base station location (A-1) and the total field intensity values were corrected for the daily time variations (see Table D.2 in Appendix D). The total magnetic field intensity was plotted and contoured using the same program as the EM conductivity survey and is presented as Drawing No. A.5 in Appendix A. The contour interval is 0.25 kilogammas (250 gammas) and the minimum and maximum contours are 81.5 and 83.0 kilogammas, respectively. The EM Conductivity Survey on Drawing No. A.4 and the Magnetometer Survey on Drawing No. A.5 are at the same scale as the Monitoring Well Locations given on Drawing No. A.2 in Appendix A.

D. Soil Sampling

Soil samples for chemical analyses were obtained from nine borings (EW-1 through EW-9) and nine surface sampling areas (SS-1 through SS-9). The locations of the boring and surface sampling areas are shown on

Drawing No. A.2 in Appendix A. The soil samples from the borings are composite depth samples. The composite soil samples were prepared by placing half of each split spoon sample taken at the boring in a new plastic bag or plastic bucket. After the boring was completed the samples which were placed in the bucket or bag were blended. A portion of the thoroughly blended mixture was placed in precleaned jars supplied by the laboratory for chemical analysis.

The surface soil samples were also composite samples. Each surface soil sample was a composite of four locations surrounding the similarly numbered boring location shown on Drawing No. A.2 in Appendix A (i.e. SS-1 is a composite of four locations in the vicinity of EW-1). The four locations used to prepare each of the nine surface soil composite samples are listed on the chain of custody records in Appendix E.5.

The surface soil samples were taken after removing the vegetative layer. The top four to six inches of soil was removed before the sample was taken. The four samples for each composite surface soil sample were placed in a clean plastic bag and blended. A portion of the mixture was placed in precleaned jars supplied by the laboratory.

All equipment used to obtain and blend the soil samples (shovel, bucket, split-spoon sampler) was decontaminated between samples by washing with soap and water, followed by a distilled water rinse, hexane rinse, then final distilled water rinse. All soil samples except for composite surface soil samples SS-1 and SS-2 were delivered to the laboratory the same day of sampling. Samples from SS-1 and SS-2 were stored overnight before delivery to the laboratory the following day.

E. Water Sampling

Water samples were taken between December 2 and December 8, 1986 at 15 sampling points; 9 environmental wells (EW-1 through EW-9), 4 perimeter observation wells (POW-1 through POW-4), an area of ponded water (near grid intersection C-5), and a lake sample from the small boat harbor (near grid intersection M-1). The sampling locations are shown on Drawing No. A.2 in Appendix A.

The wells were purged before sampling to remove stagnant water. The quantity of water purged from each well prior to sampling is given on Table C.1 in Appendix C.

A teflon bailer with a teflon coated stainless steel wire was used to purge the wells and obtain the water samples (including the lake and surface water sample). The bailer and line were cleaned with soap and water, then rinsed with distilled water, hexane, and a final distilled water rinse between each sample.

Water samples were placed in precleaned bottles supplied by the laboratory. All water samples were delivered to the laboratory the same day of sampling.

F. Chemical Analysis

All water and soil samples were analyzed by RECRA Environmental, Inc. in Amherst, New York. The samples were analyzed for priority pollutants, pesticides, volatile organics, extractable organics and inorganic priority pollutants. The chemical laboratory test results are presented in Appendix E. Appendix F contains summary tables of the chemical test results.

III. FINDINGS OF THE INVESTIGATION

A. Subsurface Deposits

The borings encountered a variety of fill materials. The fill varied from slag fill to silty clay fill. Only four borings, EW-2, EW-7, EW-8 and EW-9, encountered the original lake deposits. The original lake deposits, found at the bottom of these borings, consisted primarily of sandy silts and silty sands. Between 14.5 and 21 feet of fill was encountered in the borings which extended to the lake bottom. Three borings on the outer periphery of the site, POW-2, POW-3 and POW-4, encountered slag fill. Borehole location EW-1 also encountered slag fill.

B. Ground Water

The water levels measured in the monitoring wells were between 1.9 and 10.5 feet below the ground surface (see Table C.1 Appendix C). Water levels measured after developing the thirteen monitoring wells were used to construct the water table contour map, given on Drawing No. A.3 in Appendix A. The water table contours indicate that there is a mound in the center of the site, with flow toward the lake and small boat harbor.

C. Geophysical Survey

1. EM Conductivity Survey

The EM conductivity survey identified areas of high apparent conductivity at the diked disposal area (see Drawing No. A.4 in Appendix A). Interpretation of this data, based on site conditions at the time of the survey, has resulted in the division of the conductivity anomalies into two groups; (1) conductivity anomalies due to demolition debris or fill with high metal content visible at the ground surface and (2) conductivity anomalies from unknown sources. Tables D.4a and D.4b in Appendix D list these two groups of anomalies and their locations.

The first group of conductivity anomalies was located essentially along the northern one-quarter of the site. This was an area of the site which was filled with a large amount of demolition debris with a high metal content visible at the surface. This fill area generally extended from grid lines 1 through 6 along baselines A through J and from grid lines 1 through 4 along baselines K through T. Not all of the anomalies encountered in this area could be directly associated with the demolition debris anomalies of Group I (Table D.4a, Appendix D). Two fairly large anomalies were encountered around grid locations B-6 and C-6. Since these anomalies could not be directly associated with demolition debris or metal rubble at the surface, as the Group I anomalies were, they have been placed in Group II.

The anomalies listed with Group II, (Table D.4b in Appendix D), are from unknown sources. They represent areas of higher apparent conductivity which lie outside the zone of demolition debris and fill with a high metal content. These areas have apparent conductivities of 9.5 decibels or higher, which represent areas where the measured apparent conductivity is approximately 3 times the background conductivity.

2. <u>Magnetometer Survey</u>

The proton magnetometer survey was used to measure variations of the total magnetic field intensity at the diked disposal area to define areas of high iron content. Field measurements were taken along the same grid system as the EM conductivity survey. In order to assist data interpretation, two statistical analyses were performed; (1) an analysis to determine if there was a statistical difference between magnetic measurements within the area of demolition debris and magnetic measurements outside this area, and (2) an analysis to determine which values would be outside the normal distribution of measurements.

The first statistical analysis compared the population means of data points located within the area of demolition debris and data points located outside the area of demolition debris. It was determined that there is no significant statistical difference between the means for these two areas using:

- 1% level of significance
- The assumption that the two population means are normally distributed.
- The hypothesis (H_1): $u_1 \neq u_2$ where u_1 and u_2 are the mean of the distribution of values for the area outside the demolition debris area and within the demolition debris area, respectively.

Since the first analysis showed that there was no statistical difference between measurements in the area of demolition debris and outside this area, all 389 data points were used in the second analysis to evaluate what the normal distribution of measurements should be. Using a 99 percent level of confidence for determination of a confidence interval for the population mean (u), it was determined that values which were greater than 81.7 kilogammas could be interpreted as magnetic anomalies for the diked disposal area. A contour map of the values which are greater than 81.7 kilogammas is presented as Drawing No. A.5 in Appendix A. This drawing shows probable magnetic anomalies for the site.

As with the EM conductivity survey, the magnetometer data has been interpreted, based on site conditions at the time of the survey, and divided into two groups of anomalies (see Tables D.5a and D.5b in Appendix D). Group I (Table D.5a) lists the magnetic anomalies due to demolition debris or fill with a high metal content visible at the ground surface. Group II (Table D.5b) lists the magnetic anomalies from unknown sources.

The Group I magnetic anomalies were found primarily along the northern one-quarter of the site. As described previously, this was the area of the site which was filled with a large amount of demolition debris with a high metal content visible at the surface. The approximate extent of this fill area is shown on Drawing No. A.6 in Appendix A. The location of the Group I anomalies, along with a brief description of the nature of the magnetic anomaly is given in Table D.5a, Appendix D. A fairly large magnetic anomaly was identified at grid location B-5 and B-6. This is within the area of demolition debris and the anomalies associated with this area. Since there was no visible debris of metal at the surface at this location, this anomaly is placed in Group II.

The Group II anomalies are magnetic anomalies from unknown sources. All of these anomalies, with the exception of B-5 and B-6, are located outside the area of demolition debris.

D. Ground Water Contamination

Water samples from the thirteen monitoring wells, ponded water (grid intersection C-5) and lake water were analyzed for four general groups of priority pollutants; (1) volatile organics, (2) extractable organics, (3) pesticides and (4) inorganics. The results of the analysis are presented in Appendices E and F. Appendix E contains the laboratory chemical results and Appendix F contains summary tables of chemical test results.

Tables F.1 through F.4 in Appendix F contain a summary of the parameters detected in each sample and the relevant guidance and regulatory criteria. The regulatory criteria are from New York State Codes, Rules and Regulations, Title 6, Chapter X, Part 703 "Ground Water Classifications, Quality Standards and Effluent Standards and/or Limitations". The regulatory criteria are enforceable water quality standards. The guidance criteria are from the New York State Department of Environmental Conservation Division of Water Technical and Operational Guidance Series

85-W-38, Ambient Water Quality Standards and Guidance Values, July 24, 1985. The guidance criteria have not yet been adopted as regulations, but are used by the NYSDEC in evaluating water quality.

Four pesticides, Endosulfan I, Endosulfan II, Hexachlorocychlohexane (BHC) and, Dieldrin, were found in concentrations in excess of 10 times the guidance criteria. However, 11 of the 13 wells had at least one of the above compounds in concentrations in excess of ten times the guidance criteria. One well, POW-1, had hexachlorocyclohexane in excess of 100 times the guidance criteria.

Volatile organics in concentrations exceeding 10 times the guidance criteria were found in 11 of the 13 monitoring wells. Eight of the 13 wells had one or more parameters with concentrations exceeding 100 times the guidance criteria (see Table F.6, Appendix F). Benzene, chlorobenzene and 1,2-dichlorobenzene were found in concentrations exceeding 100 times the guidance criteria. Toluene was found in concentrations exceeding 10 times the guidance criteria.

Extractable organics in concentrations exceeding 10 times the guidance criteria were found in 9 of 13 wells, and 3 wells had one or more parameters with concentrations exceeding 100 times the guidance criteria. Fourteen extractable organic parameters were found in one or more wells in concentrations in excess of 10 times the guidance criteria. The compounds most frequently found in concentrations in excess of 10 times the guidance criteria were Naphthalene and 1,2-Dichlorobenzene. (Dichlorobenzene was also reported under the volatile priority pollutant analysis. The reported concentrations of Dichlorobenzne by the two methods of analysis are not similar, see Table F.2 and F.4 in Appendix F.) The compounds found in concentrations exceeding 100 times the guidance criteria were Naphthalene, 2,4-Dinitrophenol, Benzo(a)anthracene, and Chyrysene.

The inorganic priority pollutants analyzed include cyanide and metals. Eleven of the 13 wells had one or more metals with concentrations exceeding 10 times the guidance criteria and 3 wells had one or more parameters with concentrations in excess of 100 times the drinking water standard. All inorganic priority pollutant parameters, with the exception of silver and thallium, were found in one or more wells in concentrations in excess of 10 times the guidance criteria. Lead, chromium and arsenic are the most ubiquitous metals found in concentrations in excess of 10 times the guidance criteria. Ten wells had concentrations of chromium or lead in excess of 10 times the guidance criteria, and 8 wells had concentrations of arsenic or nickel in concentration in excess of 10 times the guidance criteria.

In order to evaluate the data, the number of parameters which exceeded 10 times the regulatory or guidance criteria at each well were tabulated for each of the four groups of parameters. Then each well was ranked with 1 being assigned to the well which had the greatest number of parameters which exceeded 10 times the guidance or regulatory criteria and 13 being assigned to the well with the least number of parameters exceeding 10 times the guidance criteria (see Table F.5, Appendix F).

Based on their ranking, the four wells which had the largest number of volatile organics, extractable organics, and inorganic priority pollutants in concentrations in excess of 10 times the guidance criteria were wells EW-2, POW-4, EW-6 and EW-9. The wells with the fewest number of inorganic priority pollutants, volatile organics and extractable organics in concentrations in excess of 10 times the guidance criteria were wells POW-3, POW-2 and EW-8. Examining the location of the wells where water samples indicate the greatest number of parameters with concentrations exceeding 10 times the guidance criteria with those indicating the least number of parameters with concentrations exceeding 10 times the guidance criteria

Agreed LOC

indicates that there is no pattern to the observed ground water contamination. Monitoring well POW-2, which had very few parameters with high concentrations, is within 150 feet of EW-2 which had the greatest number of parameters with high concentrations. A similar discrepancy is found between wells POW-4 which had the second highest ranking in terms of the number of parameters with concentrations in excess of 10 times the guidance criteria and EW-8 which had one of the lowest rankings.

E. Soil Contamination

Composite soil samples were taken to evaluate the surficial concentrations of contaminants in 9 areas and composite concentrations of contaminants at the 9 boring locations. The samples were analyzed for four general classes of priority pollutants; (1) pesticides, (2) volatile organics, (3) extractable organics and (4) inorganics (metals and cyanide). The results of the analysis are found in Appendices E and F. Appendix E contains the laboratory chemical data while Appendix F contains summary tables which list the contaminants that were found in each sample and their concentrations.

In evaluating the laboratory results for soil samples, there are no regulatory or guidance criteria with which to compare concentrations. However, a qualitative analysis can be made by comparing soil and groundwater concentrations.

In examining the pesticide concentrations found in the soil samples, there appears to be no correlation between the composite surface soil samples taken at a given location (SS-1 through SS-9) and the composite soil samples taken at borehole locations (EW-1 through EW-9). For example, Beta-BHC and PCB-1248 were detected in the composite soil sample at borehole location EW-2, while the compounds detected in the composite surface soil sample composite for that area, SS-2, were Aldrin, Endosulfan Sulfate, Heptachlor and PCB-1254. In addition, there appears to be no correlation between the groundwater results and soil results. PCB's were detected in half the soil samples, while no PCB's were detected in water. The chemical 4'4-DDD was detected in water samples from EW-1, EW-2, EW-4, EW-6, EW-7 and EW-8 but was only found in soil samples at boreholes EW-4 and EW-6. Similar results are found with other pesticides.

Only four volatile organics were detected in soil samples; Chlorobenzene, 2,4-Dichlorobenzene, 1,3-Dichlorobenzene and Toluene (see Table F.10, Appendix F). These compounds were detected in only 3 borings, EW-2, EW-1 and EW-6. Boring EW-2 had the greatest number of volatile organics detected. The water sample from this well (EW-2) also had the worst water quality in terms of volatile organics.

Extractable organics were found in 10 of the 18 soil samples; 5 borings (EW series)and 5 surface soil samples (SS series). (See Table F.11, Appendix F). The extractable organics were not as common in the soil samples as in the water samples where extractable organics were found in 11 of the 13 wells. The compounds most frequently found in the soil samples were Naphthalene and Fluoranthene. Naphthalene was the most frequently found compound in concentrations greater than 10 times the guidance criteria for water samples. However, Fluoranthene was only found in composite soil samples from 2 of the 13 wells. The second most frequently found extractable organics were Pyrene and Phenanthrene. Phenanthrene was detected in water samples from 7 wells, but Pyrene was only detected in samples from 2 wells (see Table F.4, Appendix F).

There does not seem to be any correlation between the composite surface soil sample results for extractable organics (SS series) and composite boring soil sample results (EW series). In some areas compounds were detected in the surface sample and not in the boring sample and in other areas the reverse was found (see Table F.11, Appendix F).

The inorganic parameters analyzed in the soil samples included cyanide and the priority pollutant metals. In evaluating the results from the soil samples, the concentrations of compounds found in surface soil samples and boring soil samples were compared. Unlike the organic compounds where there was no correlation between the surface samples and boring samples, the inorganic results indicate that for most compounds the concentrations in the composite boring samples are greater than the composite surface samples.

A comparison of the concentrations of the various inorganic compounds found in the composite boring soil samples, with water samples from the same location, indicates that for some compounds there is a correlation between high soil concentrations and high water concentrations, while for others there is no correlation. For cadmium, chromium, copper and mercury there appears to be a correlation between borings where there is a high concentration of the compound in the soil and the concentration found in ground water at that boring. For arsenic, cyanide, lead, nickel and zinc there appears to be very little correlation between soil concentrations and groundwater concentrations.

On a site wide basis, there also appears to be a correlation between metals found in high concentrations in the soil and high concentrations found in ground water. The compounds found in soil in the highest concentrations, in relationship to the guidance criteria, were lead and chromium. These two compounds were also found in the greatest number of wells in concentrations exceeding 10 times the guidance criteria.

High concentrations of inorganic priority pollutant compounds were more widespread in soil samples than concentrations of any of the organic priority pollutant compounds.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The EM conductivity and magnetometer surveys have identified the anomalies listed in Tables D.4a, D.4b, D.5a and D.5b in Appendix D. The EM conductivity survey anomalies are divided into two groups of conductive anomalies; Group I (Table D.4a) for the anomalies which can be attributed to demolition debris and Group II (Table D.4b) for anomalies of unknown sources. The magnetometer survey anomalies are similarly divided (i.e. Group I and II anomalies in Tables D.5a and D.5b, respectively). The results of the EM conductivity survey and the magnetometer survey generally correlate with each other.

Most of the Group I anomalies for the EM conductivity and magnetometer surveys were correlated with demolition debris or metal visible in the fill at the ground surface. The Group II anomalies for the EM conductivity and magnetometer surveys, based on the survey data and the boring logs for wells installed at the site, indicate that slag fill is probably responsible for anomalies at grid locations: E-7 through E-19, F-7 through F-20, G-8 through G-20, H-8 through H-20, I-8 through I-20, J-8 through J-20, L-9, R-20, S-12, S-13, S-17, S-19, S-20, T-13 and T-14. The other anomalies of unknown sources for the EM conductivity and magnetometer surveys may be due to underground pipes, buried metal or more intensive iron or slag fill areas.

The soil and water chemical test results indicate that high concentrations of both organic and inorganic priority pollutants are found at the diked disposal area. The compounds found in the highest concentrations throughout the site are Naphthalene, Benzene, Chlorobenzene, 1,2-Dichlorobenzene, Lead, Chromium, Arsenic and Nickel. These compounds are found in concentrations in excess of 10 times the guidance criteria in at least 7 of the 13 wells.

Three wells also had concentrations of metals exceeding the maximum concentration specified for determining EP Toxicity (40 CFR Part 261). Arsenic, Chromium, Lead and Mercury were found in one or more wells in concentrations exceeding the concentration specified for determining EP Toxicity.

(Significance ?
pH ?

Although soil sample chemical test results for most compounds do not correlate directly to water sample chemical test results from the same borings, chemical testing of soil samples also indicates that both organic and inorganic contamination is found throughout the site. Ranking the soil and water sample chemical test results, indicates that the highest concentrations of priority pollutants for both soil and water samples was at monitoring well location EW-2.

Ground water contours indicate there is a mound beneath the site; groundwater is flowing radially from the center of the site toward the outer harbor and small boat harbor. Water levels also indicate POW-2 is down-gradient of EW-2. The water sample chemical test results from POW-2 indicate some attenuation may be occurring before groundwater discharges into the small boat harbor. Water quality at POW-2 was ranked second best in terms of a statistical ranking of the number of compounds detected in water samples exceeding 10 times the guidance criteria, while upgradient at EW-2 the water quality was ranked the worst. The water sample taken in the small boat harbor also did not have any detectable organic priority pollutants, and only nickel was in concentrations exceeding the guidance criteria for water. However, it must be emphasized that these are very preliminary conclusions based on one set of water samples.

Since the soil and water chemical test results indicate that organic and inorganic priority pollutants are found throughout the site, in both soil and water, any remediation will have to address the entire site.

B. Recommendations

Based on the results of our investigation we recommend the following:

1) Obtain and test one more set of water samples from the monitoring wells and boat harbor
2) analyze selected soil samples for EP Toxicity
3) Place a relatively impervious cap over the entire site
4) Monitor water quality in perimeter wells during placement of the cap

In order to more accurately assess the environmental concerns associated with the site we recommend additional soil and water sampling. The additional sampling and chemical testing should be performed prior to or during filling operations. The EP extraction test should be performed on soil samples from the vicinity of EW-2, EW-7, EW-6 and EW-8 to evaluate the potential release into groundwater of the priority pollutants detected in soil samples at these locations. Additional water samples should be taken from the small boat harbor and outer harbor (both west and south of the site) to evaluate the extent of migration of priority pollutants from the site. We recommend taking two water samples from each of the three sides of the site bounded by water. In addition, water samples should be taken from each of the 13 wells.

Based on our evaluation of chemical testing to date and the proposed future use of the site as a parking lot, we recommend capping the site with relatively impervious fill materials to minimize surface water infiltration. We anticipate that the cap will need to be on the order of 2 to 3 feet thick to effectively eliminate surface water infiltration. The thickness of the "cap" is dependent on the fill material available for capping. No organic priority pollutants were found in the lake sample and concentrations of inorganic parameters were low. Since the site will only be used as a parking lot, the principal health concern is limiting contact with contaminated soil and ground water. A cap of relatively impervious fill over the site will eliminate any contact with contaminated soil or ground water.

We also recommend monitoring the four perimeter wells (POW-1, POW-2, POW-3 and POW-4) while the cap is being constructed, to evaluate whether the additional loadings on the site from the fill result in increased concentrations of priority pollutants in these wells. We recommend taking samples from these wells immediately before construction begins, then after the first two lifts of the cap (approximately 1 foot of cover) have been placed.

Respectfully submitted,

EMPIRE-THOMSEN

Raymond A. Wagner B.

Raymond A. Wagner
Geologist

Marjory Rinaldo-Lee B.

Marjory Rinaldo-Lee, C.P.G.S.
Hydrogeologist

Steve R. Pulley

Steve R. Pulley, P.E.
Geotechnical Engineer

map