FEASIBILITY STUDY REPORT

GOLDEN ROAD DISPOSAL SITE
SITE # 8-28-021
CHILI, NEW YORK

Prepared For:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL REMEDIATION
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ACRONYMS

ACM	asbestos-containing material
amsl	above mean sea level
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cm	centimeter
CPC	chemical of potential concern
E	east
EM	electromagnetic
FID	flame ionization detector
FM	fill material
FP	fill pile
FS	feasibility study
ft	foot
FWIA	fish and wildlife impact analysis
HDPE	high density polyethylene
Hg	mercury
hr	hour
HRA	health risk assessment
ID	inner diameter
kg	kilogram
Koc	organic carbon-water partition coefficient
Kow	octanol-water partition coefficient
L	liter
µg	microgram
MCDOH	Monroe County Department of Health
MEK	methyl ethyl ketone
mm	millimeters
mR	millirem
N	north

ACRONYMS (Continued)

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
P	palustrine
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
ppm	part per million
PVC	polyvinyl chloride
Q	quality assurance
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SARA	Superfund Amendments and Reauthorization Act
SCG	standards, criteria, and guidance values
sec	second
SVOC	semivolatile organic compound
TAGM	*Technical and Administrative Guidance Memorandum*
TAL	Target Analyte List
TCLP	toxicity characteristic leaching procedure
TCL	Target Compound List
TN	terrestrial natural
URS	URS Corporation
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

EXECUTIVE SUMMARY

The purpose of this Feasibility Study (FS) for the Golden Road Disposal Site is to identify and evaluate remedial alternatives that address site contamination in a manner consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), and 6 NYCRR Part 375. The nature and extent of site contamination, as well as its potential impact upon human health and the environment, were previously evaluated as part of a Remedial Investigation (RI) performed by URS Corporation for the New York State Department of Environmental Conservation (NYSDEC) during 1999 (URS, February 2000).

The Golden Road Disposal Site is a Class 2 site, listed on the NYSDEC Registry of Inactive Hazardous Waste Sites (NYSDEC Site No. 8-28-021). The site is located adjacent to Route 490 in the Town of Chili, Monroe County, New York. Conrail tracks run southwest to northeast through the site, separating it into a north parcel and south parcel. Both parcels lie immediately adjacent to designated wetlands and are characterized by poor drainage.

This FS addresses the south parcel only. The north parcel has been excluded because it is essentially a junkyard, rather than a hazardous waste disposal site. Although the fill material occurring across the north parcel has elevated levels of metals and, to a lesser extent, polynuclear aromatic hydrocarbons (PAHs), these are characteristic of the foundry sand and slag that was placed throughout the site. None of the samples collected from this fill material during the RI exhibited the characteristics of a Resource Conservation and Recovery Act (RCRA) hazardous waste. During the period from November 2000 through March 2001, remedial operations on the north parcel were performed by NYSDEC. The cleanup addressed primarily petroleum product contamination associated with the former operations of Chili Fuels and Great Western Construction Company at the site; but it also included the removal of the only known hazardous wastes (two 55-gallon drums of ignitable paint waste) on the north parcel.

The south parcel, approximately 7 acres in size, is the focus of this FS. The parcel is bounded by railroad tracks on the north, residential homes along Golden Road on the east, and a deciduous forested wetland on the south and west. Solid waste (e.g., metal pipes, framework, tanks, wood) is scattered at various locations across the south parcel, and is particularly concentrated in some areas near the outer edges of the fill material, adjacent to the wetland. The topography of the parcel is relatively flat, although the filled area that occupies a large portion of the site has a number of mounds and depressions, and is separated from the adjacent wetland by a pronounced berm. In most areas, this berm, which was formed by the placement of fill within a former wetland area, has become heavily overgrown with vegetation. The fill material itself, which is essentially the same as that found on the north parcel, consists primarily of foundry sand, ash and cinders. Beneath it lie, in descending order of depth: (a) a light reddish brown fine sand (upper sand) that ranges in thickness from approximately 3 to 7 feet; (b) a silty clay to clayey silt lacustrine deposit that ranges in thickness from approximately 3 to 10 feet; and (c) a gray silty sand to fine sand (lower sand), which contains bedrock fragments and ranges in thickness from approximately 2 to 4 feet. The total thickness of these unconsolidated deposits across the site ranges from approximately 11 to 25 feet. They overlie bedrock, which consists of the Oak Orchard Dolostone of the Lockport Group. Perched groundwater within the upper sand unit occurs seasonally under unconfined conditions, and discharges outward (primarily southward) into the adjacent wetland. The permanent aquifer at the site, located within the lower sand unit, contains groundwater under confined conditions that flows generally to the east and northeast.

In addition to the fill material occurring across the south parcel, there are several areas where contamination is different in nature or occurs at higher concentrations than elsewhere on the site, including:

- An area along the east bank ("east bank area"), near RI Test Pit #3, where numerous aerosol cans have been buried, soil is visibly discolored, surface and subsurface soil have been contaminated with high levels of PAHs and BTEX (benzene, toluene, ethylene, xylenes) compounds, and shallow (perched) groundwater in the upper sand unit has been contaminated with high levels of volatile and semivolatile organic compounds. The estimated extent of the east bank area is approximately 100 feet by 40 feet, and the estimated volume of contaminated soil within it is approximately 1,600 cubic yards.

- An excavated (usually dry) pond in the filled eastern portion of the parcel ("pond area"), where PAH concentrations are generally higher than elsewhere onsite. The estimated extent of surface soil/sediment contamination in the pond area is approximately 2,500 square feet, and the estimated volume of contaminated soil/sediment is approximately 100 cubic yards.

- An area near the west end of the parcel ("west end area"), in the vicinity of RI sampling station SS-02, where acetone and pentachlorophenol were detected at elevated concentrations. The estimated extent of shallow soil contamination in the west end area is approximately 100 square feet, and the estimated volume of contaminated soil is approximately 20 cubic yards.

- Asbestos-containing material (ACM) at two ground surface locations near the west end of the south parcel, in the vicinity of three discarded aboveground storage tanks (ASTs). This ACM, an insulation product, occupies an estimated area of approximately 400 square feet.

- A single non-empty drum, containing non-hazardous liquid waste, located adjacent to a wooded area near the center of the parcel.

The contaminants and contaminated media at the site present a number of potential human health and environmental health risks to existing and future users of the site. Under existing conditions, trespassers could be exposed to contamination in surface soils and wetland/pond sediments. In the future, construction workers and onsite residents could also be exposed to the contaminants in these media, and also to subsurface soil and shallow groundwater contamination.

In order to address the potential human health and ecological risks posed by contamination at the south parcel, the following medium- and feature-specific remedial action objectives have been developed for the south parcel of the Golden Road Disposal Site:

<u>Solid waste</u> – to handle the solid waste only as necessary to allow implementation of measures necessary to achieve remedial action objectives for other environmental media

Surface asbestos – to prevent disturbance of ACM or direct contact with it by trespassers, workers or future site residents

Soil/fill material (i.e., foundry sand and slag) – to prevent erosion and migration of fill material into the adjacent wetland

Wetland sediments – to leave as is, and avoid disturbance of existing wetland habitat

Pond area – to prevent direct human/ecological contact with contaminated pond soil/sediments and prevent migration of soil/sediments into the wetland

Waste drum – to prevent direct contact with waste material and prevent migration of waste-related contamination into the wetland

Soil in east bank area – to prevent direct contact with contaminated surface and subsurface soil, and prevent migration of contamination into the wetland

Soil in west end area – to prevent direct contact with contaminated shallow soil

Shallow groundwater in east bank area – to prevent the migration of shallow groundwater into the wetland

These remedial action objectives can be accomplished in a number of alternate ways. For each impacted environmental medium, general response actions, remedial technologies and process options have been identified and screened on the basis of effectiveness and implementability. The technologies and process options surviving this screening process have subsequently been combined into the following six sitewide remedial alternatives.

Alternative 1: No action

Alternative 2: Institutional controls and surface cleanup (waste drum and ACM)

Alternative 3: Surface cleanup and remediation of soil in "hot spots" (i.e., east bank, pond and west end areas) by excavation and offsite landfilling

Alternative 4: Surface cleanup and remediation of soil in hot spots by onsite (ex-situ) treatment

Alternative 5: Surface cleanup, remediation of soil in hot spots (landfilling or onsite treatment), and site regrading

Alternative 6: Surface cleanup, remediation of soil in hot spots (landfilling or onsite treatment), site regrading, and onsite treatment of shallow groundwater in east bank area .

In accordance with CERCLA and 6NYCRR Part 375, each of the six sitewide remedial alternatives have been evaluated individually and on a comparative basis using seven evaluation criteria: (1) overall protection of human health and the environment; (2) compliance with standards, criteria and guidance (SCGs); (3) short-term impacts and effectiveness; (4) long-term effectiveness and permanence; (5) reduction of toxicity, mobility and volume (TMV); (6) implementability; and (7) cost.

As part of the evaluation process, several intermediate evaluations have been performed to improve the efficiency of the process and, where appropriate, to reduce the number of alternative permutations under consideration. The results of these intermediate evaluations are as follows:

- The following process options were evaluated comparatively for the onsite (ex-situ) treatment of contaminated soils from the "hot spots" (i.e., from the east bank, pond and west end areas): biodegradation (composting), chemical oxidation, low-temperature thermal desorption, and solidification/stabilization. On the basis of this evaluation, biodegradation by windrow composting was determined to be the preferred soil treatment option, and was therefore included as the onsite treatment technology in Alternative 4.

- For contaminated soil, offsite landfilling (Alternative 3) was evaluated relative to onsite treatment by windrow composting (Alternative 4). The comparative evaluation between these two options indicated that offsite landfilling was the preferred option. Therefore, offsite landfilling was included as the method for dealing with contaminated soil from the hot spots in Alternatives 5 and 6.

- For treating shallow groundwater in the east bank area, carbon adsorption was evaluated relative to air stripping. Air stripping was found to be the preferred option, and was included as the groundwater treatment method in Alternative 6.

The results of the detailed alternative evaluation indicate that there is no single alternative that is "best" in terms of all evaluation criteria. Rather, the selection of a remedy for the site will require a balancing of evaluation factors that are in some cases aligned, and in others competing. From a very broad perspective, the six alternatives can be summarized comparatively as follows:

- <u>Alternative 1 – No Action:</u> This alternative involves long-term monitoring (also included with all other alternatives), but no active site remedial measures. It does nothing to address potential risks under existing or future conditions, nor does it bring the site any closer to compliance with presently exceeded SCGs. Its estimated total present worth is $71,000.

- <u>Alternative 2 – Institutional Controls and Surface Cleanup:</u> This alternative provides a minimum level of surface cleanup (asbestos and waste drum), with institutional controls to prevent future residential development or excavation at the site. It does not, however, address the most significantly contaminated (hot spot) areas of the site in an active manner, nor does it achieve compliance with any currently exceeded SCGs. The feasibility, permanence and implementability of institutional controls that would be required to provide a suitable level of protection are very uncertain. The estimated total present worth of Alternative 2 is $91,000.

- <u>Alternative 3 – Surface Cleanup and Hot Spot Remediation with Offsite Landfilling:</u> Alternative 3 includes surface cleanup plus remediation of the three hot spot areas by excavation and offsite landfilling. Hot spot remediation addresses the most significant contamination at the site, the greatest source of potential human and ecological risk, and the primary cause for current SCG exceedances. This alternative provides a reduction of waste volume onsite. It involves proven technologies, and is effective over both the short- and long-term, permanent and fully implementable. Since it leaves no residual waste materials onsite, ongoing residual waste management controls are not required. Its estimated total present worth is $433,000.

- Alternative 4 – Surface Cleanup and Hot Spot Remediation with Onsite Treatment: This alternative is identical to Alternative 3, except that contaminated soils from the hot spot excavations are treated onsite by windrow composting, rather than transported and disposed of offsite. Composting is an established technology, and provides significant reduction of TMV by biodegradation of soil organic contaminants to non-toxic end products. Although similar in many aspects to the offsite disposal alternative, onsite composting has several relative disadvantages. Since it is a temperature-dependent process and would require several seasons to achieve cleanup goals, exposure to contaminated soils on the surface during treatment is a concern, especially considering that access to the site would not be controlled except during biweekly tilling operations. Also, the composting process is labor intensive and requires ongoing oversight and adjustment, which could prove difficult on a part-time basis at a remote location. The estimated total present worth of Alternative 4 is $457,000.

- Alternative 5 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, and Site Regrading: This alternative is identical to Alternative 3, with the addition of site regrading. Regrading, which includes filling the onsite pond and smoothing the unwooded central area of the site, would provide a marginal advantage over Alternative 3 by reducing the probability of contact with any residual contaminated sediments in the pond, reducing the likelihood of infiltration by rainwater into the foundry sand/slag, and reducing the chance of erosion and migration of surface soil into the wetland. The estimated total present worth of this alternative is $456,000.

- Alternative 6 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, Site Regrading, and Shallow Groundwater Treatment: This alternative is the same as Alternative 5, with the addition of shallow groundwater collection in the east bank area, with treatment by air stripping. Following source (soil) remediation in the east bank area, it is anticipated that groundwater will continue to exceed Class GA groundwater standards for a period of time. During this period, shallow, seasonal groundwater in this area would be collected, treated and discharged to the existing sanitary sewer system. Because shallow (perched) groundwater occurs only seasonally at the site, and considering that it is presently unused and would be expected to improve over time following source remediation, the relative advantages of this alternative versus Alternative 5 are small. Its estimated total present worth is $1,293,000.

The selection of a remedy at the Golden Road Disposal Site will be based upon the detailed evaluation of alternatives in this FS report, but will also take into account public input and community acceptance of a recommended remedy.

1.0 INTRODUCTION

1.1 Purpose and Organization of Report

The purpose of this Feasibility Study (FS) for the Golden Road Disposal Site is to identify and evaluate remedial alternatives that address site contamination in a manner consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), and 6 NYCRR Part 375. The nature and extent of site contamination, as well as its potential impact upon human health and the environment, were previously evaluated as part of a Remedial Investigation (RI) performed by URS Corporation for the New York State Department of Environmental Conservation (NYSDEC) during 1999 (URS, February 2000).

The FS report is organized as follows. The remainder of Section 1.0 provides background information concerning the site, and consists primarily of a summary of the results and conclusions presented in the RI report. Section 2.0 indicates media-specific remedial action objectives for site cleanup, identifies general response actions to accomplish these objectives, and presents a listing and preliminary screening of specific remedial technologies that fall under the general response categories. Section 3.0 provides a rationale for alternative development and a listing of sitewide remedial alternatives. Section 4.0 includes a detailed analysis of alternatives, based on the seven evaluation criteria in NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4030, *Selection of Remedial Actions at Inactive Hazardous Waste Sites.*

1.2 Background Information

1.2.1 Site Description and History

The Golden Road Disposal Site is a Class 2 site, listed on the NYSDEC Registry of Inactive Hazardous Waste Sites (NYSDEC Site No. 8-28-021). The site is located adjacent to Route 490 in the Town of Chili, Monroe County, New York (Figure 1-1). Conrail tracks run southwest to northeast through the site, separating it into a north parcel and south parcel (Figure 1-2). Both parcels lie immediately adjacent to designated wetlands and are characterized by poor drainage.

The north parcel (approximately 12 acres) can be characterized primarily as a junk yard. The south parcel (approximately 7 acres) can be characterized as a hazardous waste disposal site, with access to the area by a gravel road and broken gate.

The Golden Road Disposal Site was privately run by Howard Fitzsimons, Jr. (now deceased) from 1955 through 1976. During this time period, Mr. Fitzsimons also operated Chili Fuels and Great Western Construction Company at the site. The site received a wide variety of wastes, including household refuse, metal slag, fly ash, foundry sand and junked vehicles. In addition, the south parcel was used for the disposal of drums, approximately 562 of which were removed from the site in 1985 as part of an emergency removal action. A portion of the wetland area to the west and south of the site was filled in during operation of the site.

A Remedial Investigation (RI) was performed at the Golden Road Disposal Site by URS Corporation from July to September, 1999. The results are presented in: *Remedial Investigation Report* (URS, February 2000). An additional Phase II RI was performed in April 2000, with the results included in a letter report from URS to NYSDEC dated June 6, 2000. Subsequent to the RI, NYSDEC secured the services of a remediation contractor, Nature's Way Environmental Consultants & Contractors, Inc., to perform remedial operations that addressed primarily petroleum product contamination, rather than hazardous waste, on the north parcel of the site. These operations, which commenced in November 2000, are described below in Section 1.2.6.

1.2.2 Site Characteristics

The topography of both the north and south parcels is relatively flat, although the filled area on the south parcel is separated from the adjacent deciduous forested wetland by a pronounced berm (Figure 1-3). The north parcel drains southward to the railroad ditch along the Conrail tracks via overland flow, through a shallow emergent marsh in the southwest area of the parcel, or via a drainage swale which runs in a southerly direction through the central part of the parcel, east of the fill pile area. The south parcel, which has no direct surface water connection with the north parcel, drains by overland flow northward to the railroad drainage ditch, and southward to the adjacent wetland. Like the overall site topography, the gradients of the drainage swales and drainage ditches onsite are generally quite low.

The site geology is characterized by dark colored fill material (primarily foundry sand, ash and cinders), which occurs over large portions of the north and south parcels, overlying the following three unconsolidated units, in descending order of depth: (a) a light reddish brown fine sand (upper sand) that ranges in thickness from approximately 3 to 7 feet; (b) a silty clay to clayey silt lacustrine deposit that ranges in thickness from approximately 3 to 10 feet; and (c) a gray silty sand to fine sand (lower sand), which contains bedrock fragments and ranges in thickness from approximately 2 to 4 feet. The total thickness of these unconsolidated deposits across the site ranges from approximately 11 to 25 feet. They overlie bedrock, which consists of the Oak Orchard Dolostone of the Lockport Group. Geologic cross-sections are shown on Figures 1-4 through 1-6.

Groundwater occurs seasonally, under unconfined conditions, within the upper sand unit. During the fall of 1999, when the initial RI field activities were performed, groundwater was largely absent from this unit. However, during the Phase II RI field operations in the spring of 2000, groundwater was consistently present, with saturated thicknesses ranging from approximately 8 to 10.5 feet. The discharge of perched water from the upper sand unit in the south parcel is generally outward (primarily southward) into the adjacent wetland and watercourses (Figure 1-7). The average hydraulic conductivity of the unit, based on Phase II RI slug test results, is approximately 2×10^{-3} centimeters per second (cm/sec).

The permanent aquifer at the site is located in the lower sand unit. Groundwater in this aquifer occurs under confined conditions. The average hydraulic conductivity of this unit is approximately 3×10^{-3} cm/sec. Flow direction within the aquifer is generally to the east and northeast, with an average hydraulic gradient of approximately 0.002 feet per foot (Figure 1-8). Because the aquifer is overlain by a continuous, low-permeability lacustrine unit, and because groundwater within it occurs under confined conditions, downward migration of surface site contaminants to groundwater is prevented or greatly retarded.

1.2.3 Nature and Extent of Contamination

The nature and extent of contamination on the north and south parcels may be summarized, by medium, as follows:

North Parcel

Soils and Fill Material – Throughout the central and western portion of the north parcel, where fill material was previously spread and a few fill piles still remain, soil has been impacted by metals and, to a lesser extent, polynuclear aromatic hydrocarbons (PAHs). Based upon analytical results from the RI and Phase II RI, metals that exceed NYSDEC soil cleanup goals (SCGs) at one or more locations include: arsenic, barium, beryllium, calcium, copper, chromium, iron, mercury, nickel, sodium, and zinc. (However, Phase II RI soil sampling results were consistently non-detect for hexavalent chromium, indicating that the chromium occurring within the fill material exists in the less toxic, trivalent form.) Also present at several soil sample locations at concentrations exceeding their SCGs are the following PAHs: benzo(a)anthracene, benzo(a)pyrene, and chrysene. Despite these exceedances, PAH concentrations throughout the filled area are relatively low (less than 1 part per million (ppm) for individual compounds), and they occur only sporadically throughout the parcel. In general, the nature and extent of contamination throughout the filled area of the north parcel is consistent with the foundry sand and ash which were deposited within and spread throughout the area. None of the fill pile or fill material samples from this area which were analyzed by the toxicity characteristic leaching procedure (TCLP) exceeded their criteria values, i.e., none of the samples would be characterized as a Resource Conservation and Recovery Act (RCRA) hazardous waste.

In addition to the relatively low-level contamination associated with the foundry sand and slag fill materials, PAHs were found at somewhat greater concentrations in the surface soil samples collected beneath the fill valves of the two large aboveground storage tanks (ASTs) located southwest of the former Chili Fuels building. Although several of the PAH concentrations in these samples exceeded 1 ppm (e.g., chrysene at 1.1 ppm beneath the east tank and 1.8 ppm beneath the west tank), the overall levels of metals and organics in these two samples were not very high. The elevated PAHs in this area appear to be the result of spills during the operation of the tanks; and the extent of contamination from this source appears to be very localized.

Groundwater - Groundwater data collected from onsite monitoring wells indicate that surface and subsurface soil contaminants have not significantly impacted groundwater quality in the confined, lower sand aquifer that underlies the site. Although several metals exceeded NYSDEC Class GA groundwater quality criteria in these onsite monitoring wells, they were found at equal or higher concentrations in the upgradient, background wells. Likewise, several metals exceeded Class GA standards in the samples collected from private wells at 240 Golden Road and the Fitzsimons residence. These private wells are developed within the bedrock aquifer and, like the overburden wells located onsite, appear to reflect generally elevated levels of metals in local groundwater, rather than an impact from the Golden Road Disposal Site.

Subsurface Soils Near the ASTs and USTs – During the RI, geoprobe soil borings from the area north of the former Chili Fuels building, in a location where two underground storage tanks (USTs) and two ASTs were formerly situated, revealed the presence of benzene, toluene, ethylbenzene and xylenes (BTEX), as well as naphthalene, at significantly elevated concentrations in subsurface soils. Also, a sample of shallow, perched water collected during the geoprobe installations in this area indicated the presence of these same petroleum-related compounds, plus a number of metals, at elevated concentrations. The contamination within this area has been addressed as part of a remedial action performed subsequent to the RI, as discussed in Section 1.2.6.

Sediments – Although the single sediment sample collected from the railroad ditch on the north parcel indicates the presence of several PAHs (benzo(a)anthracene, chrysene, benzo(a)pyrene) and a number of metals at concentrations exceeding soil SCGs, none of these occurred at very high concentrations. Furthermore, these types of contaminants are frequently associated with railroad operations and found along railroad rights-of-way. Therefore, although PAHs and metals are also site-related contaminants associated with the fill material in the north parcel, it is impossible to determine whether their relatively low-level presence in the railroad ditch is the result of onsite or offsite sources.

Containerized Waste Materials – Containerized waste materials, including the contents of ASTs and USTs, as well as the tanks themselves and the contaminated soil surrounding the USTs, were identified during the RI and subsequently remediated as part of the operations discussed in Section 1.2.6.

South Parcel

Surface Soils – Based upon the RI and Phase II RI results, surface soil contamination is widespread across the filled area of the south parcel, where foundry sand, ash and slag have been deposited. As on the north parcel, the primary contaminants associated with this fill material are metals and PAHs. However, there are several areas on the south parcel where surface soil contamination is different in nature or occurs at higher concentrations than elsewhere, including: (a) an area in the southwest part of the filled area (near surface soil sampling location SS-02), where acetone and pentachlorophenol were detected at significantly elevated concentrations; (b) a pond in the eastern portion of the parcel, where PAH concentrations were higher than in areas to the west; and (c) an area along the east bank of the south parcel (near Test Pit #3), where PAHs were detected at very elevated concentrations compared to elsewhere on the parcel.

Subsurface Soils - Subsurface soils within the filled area of the south parcel are affected by the same type of fill-related contaminants (metals and PAHs) as surface soils. However, their concentrations are generally higher in the subsurface, especially in the area along the east bank, where PAHs and BTEX were found at very high concentrations.

Groundwater - The contamination observed in surface and subsurface soils on the south parcel has not impacted groundwater quality within the confined, lower sand aquifer underlying the parcel. No organic compounds were detected in the onsite monitoring wells, and the levels of inorganics were within the range of background concentrations observed in monitoring wells upgradient from the site. On the other hand, very high concentrations of volatile and semi-volatile organic contaminants were detected in the perched groundwater occurring within the seasonally saturated, unconfined upper sand unit on the eastern portion of the south parcel, near Test Pit No. 3.

Surface Water – No organic compounds were detected in any of the surface water samples collected during the RI or Phase II RI at concentrations exceeding Class C criteria. However, the following metals exceeded criteria in one or more of the samples: aluminum, cobalt, copper, iron, nickel, silver and thallium. Their presence may be associated with the cinder and slag fill material that occurs across the site. However, exceedances of aluminum and iron criteria were also observed in a sample collected from a residential pond (206 Golden Road) located to the east of, and apparently unaffected by, the Golden Road Disposal Site.

Sediments - Sediment samples were collected from three separate subareas on the south parcel, with the following results:

- Within the deciduous forested wetland south of the fill area, benzo(a)pyrene (a PAH) exceeded its soil SCG in three of five samples and a variety of metals exceeded SCGs in all five samples. These contaminants are related to the onsite fill material and are apparently site-related.

- Within the railroad ditch on the north side of the south parcel, five PAHs and a variety of metals exceeded soil SCGs in both samples.

- Within the pond located in the eastern portion of the south parcel, benzo(a)pyrene and a variety of metals exceeded their respective criteria in the single sediment sample that was collected.

Waste Materials - The contents of a single non-empty drum on the south parcel were analyzed for TCLP/RCRA hazardous waste characteristics and found to be non-hazardous. Liquid waste material was also encountered and sampled from within a test pit (TP-3N) along the east bank. Extremely elevated concentrations of BTEX, ketones and methylene chloride were detected in these liquid waste samples. This is the same area where numerous aerosol spray cans were encountered within test pits, the soil was visibly discolored, and surface and subsurface soil samples were highly contaminated. It represents a distinctly contaminated area on the south parcel.

Asbestos - Two samples of friable insulation material, lying on the ground near two large ASTs on the west side of the south parcel, contained asbestos at high enough concentrations to be classified as regulated asbestos containing material (ACM).

1.2.4 Contaminant Fate and Transport

The primary contaminants found at the site are PAHs and metals, both of which tend to remain adsorbed onto soil or sediment particles. The general low mobility of these contaminants, coupled with the lack of strong soil and sediment transport mechanisms (e.g., flat topography, low channel gradients, ponded wetland areas), have resulted in a low potential for offsite contaminant migration. As a result, the primary potential for contact with site contaminants is by direct, onsite exposure.

1.2.5 Qualitative Risk Assessment

Based upon the RI data, a qualitative human health risk assessment and a fish and wildlife impact analysis have been performed for the Golden Road Disposal Site. The results are summarized below.

The north and south parcels at the Golden Road Disposal Site present a potential human health risk to existing and future populations using the site. Under existing conditions, trespassers on the site could be exposed to elevated contaminants in surface soils (both parcels) and wetland sediments (south parcel). Under future use conditions, construction workers and potential future residents could be exposed to contaminants in both of these media, and also to contaminated subsurface soils. Chemicals of potential concern (CPCs) were identified based upon their occurrence in the various media at concentrations exceeding health-based regulatory criteria, including soil Standards, Criteria and Guidance (SCGs). A total of 31 noncarcinogenic and 13 potentially carcinogenic CPCs were identified in soils and sediments. Primary among these were PAHs and metals, both of which are associated with onsite fill material. However, phenol and a number of VOCs also occurred as CPCs in some areas of the site. It should be noted that the classification of a chemical as a CPC does not necessarily imply that this chemical, alone or in combination with others found onsite, poses an unacceptable level of health risk or requires cleanup. Rather, CPCs are indicative of **potential** health risks. Their identification is based upon conservative assumptions regarding human exposure potential (e.g., future residential development of the site), and also upon the very conservative assumption that the health-based regulatory criteria to which contaminant concentrations are compared are relevant to the completed exposure pathways. For example, the health-based SCGs for soil are based upon long-term exposures and/or partitioning to groundwater, and are therefore extremely conservative when applied to trespassers or construction workers at the site.

A fish and wildlife impact analysis (Step I through Step IIA) was performed following the procedures in the NYSDEC Division of Fish and Wildlife's *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (NYSDEC, 1994b). Based upon this analysis, the most significant habitat located in close proximity to the site was found to be a New York State designated wetland, which occurs as a deciduous forested wetland on the north and south parcels of the site. Because of its proximity, this habitat has the greatest potential for impact from site-related contaminants. However, a comparison of surface water and sediment data from this wetland indicates that contaminant concentrations generally are not of sufficient magnitude to represent a significant threat to wildlife resources. The concentrations of several metals in wetland sediments could potentially represent a localized impact on breeding reproductive success of amphibians that use the seasonally saturated wetland habitat for breeding. However, additional sediment data and a more detailed level of analysis would be necessary to evaluate or quantify this potential impact.

1.2.6 <u>North Parcel Site Remedial Operations</u>

During the period from November 2000 through March 2001, remedial operations were performed on the north parcel of the Golden Road Disposal Site by Nature's Way Environmental Consultants and Contractors, Inc., under contract to the NYSDEC. These operations, which addressed primarily petroleum product contamination, included the following activities:

- Seven above-ground storage tanks (ASTs) were inserted, opened on one end, washed with a high-pressure water rinse and manually cleaned. Four of the ASTs, including one of the two 25,000-gallon tanks in the south central portion of the north parcel, contained residual petroleum product, which was disposed of offsite. The cleaned and open tanks were left onsite.

- Two 1,000-gallon underground storage tanks (USTs), located north of the former Chili Fuels metal building, were excavated, then opened and cleaned in the same fashion as the ASTs. These tanks likewise remain onsite.

- Approximately 1,000 tons of petroleum-contaminated soil from the UST excavation were loaded and transported to an offsite landfill by a licensed hauler.

- Approximately 250,000 gallons of petroleum-contaminated groundwater from the UST excavation were treated by carbon filtration, then discharged to the sanitary sewer system under permit with the Monroe County Department of Environmental Services – Division of Pure Waters (MCDPW).

- The contents of 10 drums were characterized, consolidated where appropriate, and disposed of offsite. Eight of these drums contained non-hazardous petroleum waste. Two of the drums contained ignitable (hazardous) paint waste. These two drums were placed into overpacks and disposed of at a hazardous waste disposal facility in Avon, Ohio.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 General Procedure

This section describes the general procedure used for the identification and screening of remedial technologies at the Golden Road Disposal Site. The procedure, which is applied separately to each environmental medium (e.g., soil/fill material, surface asbestos), includes the following three steps: (1) development of remedial action objectives; (2) establishment of general response actions; and (3) identification and screening of remedial technologies and, where applicable, process options. Each of these three steps is described in general terms below, and applied to specific environmental media in the following section.

In the remainder of this section and Feasibility Study report, the Golden Road Disposal Site is considered to consist of the south parcel only. The north parcel has been excluded from the evaluation for a number of reasons. Most importantly, the north parcel is essentially a junk yard, rather than a hazardous waste disposal site. Although the fill material occurring across this parcel has elevated levels of metals and, to a lesser extent, PAHs, the concentrations of these parameters are not exceptionally high. Rather, they are consistent with the foundry sand and slag that was placed throughout the site. None of the fill pile or fill material samples that were collected from the north parcel during the RI exhibited the characteristics of a RCRA hazardous waste. (Reference to the RI hereafter refers to both the RI and Phase II RI.) Furthermore, on the basis of RI sampling results, the elevated levels of total chromium measured within this fill material consist entirely of trivalent, rather than the more toxic hexavalent, chromium. Overall, the fill material throughout the north parcel has essentially the same chemical composition as that in the northwest corner of the parcel, which was delisted by NYSDEC on the basis of 1994 and 1995 sampling by KR Aplin & Associates. Although some residual petroleum soil contamination exists in the vicinity of the former USTs, the only known hazardous wastes on the north parcel (two 55-gallon drums of ignitable paint waste) were removed from the site during the November 2000- March 2001 site remedial operation.

2.1.1 Development of Remedial Action Objectives

Remedial action objectives are medium-specific goals for protecting human health and the environment. The primary potential human and ecological risks at the site derive from direct, at-source contact with surface contamination under existing land use conditions, and direct contact with surface or subsurface contamination under a future land use scenario. A secondary source of potential risk is the migration of contaminated surface soil or shallow groundwater into the adjacent wetlands, with subsequent contact by human or ecological receptors. The remedial action objectives for the site, as described subsequently, are intended to prevent or minimize the degree of these primary and secondary risks.

2.1.2 Establishment of General Response Actions

General response actions are broad remedial action categories that encompass general types of remedial technologies while satisfying the site-specific remedial action objectives. For example, at Golden Road, general response actions that have been identified for the various environmental media include: no action, removal/offsite disposal, containment, and treatment of soil and groundwater.

2.1.3 Identification of Remedial Technologies and Process Options

In this report, the term "technologies" refers to general remediation categories (e.g., ex-situ soil treatment); and "process options" refer to specific applications within the technology category (e.g., chemical oxidation). As part of the procedure for developing remedial alternatives, technologies have been identified under each general response action and, where further refinement is appropriate, broken down into process options.

2.2 Application to Site-Specific Environmental Media

In this section, the general technology/screening procedure described above is applied to the specific impacted environmental media at the Golden Road Disposal Site. The application is summarized in Table 2-1. As indicated by the table and discussed below, some remedial approaches have been screened out at various levels (e.g., remedial action objective, general response, technology) and for various reasons. The end result of the screening is a list of technologies and process options that, alone or in combination, has been incorporated into sitewide remedial alternatives (Section 3.0).

Solid Waste – Solid waste is scattered at various locations across the south parcel, and is particularly concentrated in some areas near the outer edges of the fill material, i.e., along the south, west and east edges of the fill where it drops off into the adjacent wetland. This solid waste includes metal pipes and framework, several large abandoned metal tanks, railroad ties, and a variety of discarded wood, plastic and metal objects. Because this material does not constitute a hazardous waste, and because it is similar (though on a much smaller scale) to the discarded material on the north parcel, no specific remedial action objective has been developed to deal with the solid waste as a primary source of contamination. However, to the extent that it may affect the implementation of other remedial measures at the site, the following secondary objective has been developed for it: *handle the solid waste as necessary to allow implementation of measures necessary to achieve remedial action objectives for other environmental media.* For example, solid waste that interferes with the implementation of other remedial measures could be: (a) simply moved out of the way to a different location on the south parcel; (b) contained by consolidation and onsite landfilling; or (c) removed from the site and disposed of at an offsite landfill.

Surface Asbestos – Asbestos-containing material (ACM) was encountered during the RI at two ground surface locations near the west end of the south parcel, in the vicinity of three discarded ASTs. Figure 1-2 indicates these two locations as ASB-2 and ASB-3. Because asbestos is a hazardous substance under CERCLA, and considering its known toxicity when inhaled, the following remedial action objective has been developed for surface asbestos at the site: *prevent disturbance of ACM or direct contact with it by trespassers, workers or future site residents.* "No action" is not considered to be a feasible approach from a public health perspective, and has therefore been screened out. Likewise, although onsite containment by capping or landfilling the ACM would be protective of existing site users, it would not protect future workers or future onsite residents, who could encounter and be exposed to asbestos fibers during excavation activities. Therefore, onsite containment by capping and/or landfilling has been eliminated from further consideration. On the other hand, removal and offsite disposal in a properly permitted landfill is a viable approach, and has therefore been carried forward.

Soil/Fill Material – A large amount of fill material, consisting primarily of foundry sand and slag, were placed within the wetland on the south parcel of the Golden Road Disposal Site. The estimated volume of this fill material, relative to an estimated "base" wetland elevation of 559 feet above mean sea level (AMSL), is approximately 35,000 cubic yards. With the exception of several hot spots, which are discussed below as a separate environmental medium, this fill material has essentially the same physical and chemical characteristics as the foundry sand and slag that were placed on the north parcel. However, because this fill material could potentially impact the remaining wetland area on the south parcel, the following remedial action objective has been identified for it: *prevent erosion and migration of fill material into the adjacent wetland.* Although wetland sediments sampled during the RI indicate some impact from the adjacent fill material, the degree of this impact appears to be low (see discussion below under wetland sediments.) Therefore, "no action" with respect to onsite soil/fill material is considered to be one of several feasible general response actions. Another general response, excavation and disposal by offsite landfilling, is not considered to be feasible due to the very large volume of the fill material. The third general response, containment, includes two alternate technologies: regrading and capping. Onsite regrading is a feasible means for achieving the remedial action objective for this medium. Moreover, regrading could be combined with other measures (onsite landfilling of solid waste, hot spot remediation) as part of an overall site remedial approach. For example, sediment within the pond located in the eastern portion of the south parcel (see Figure 1-3) contains elevated PAH and metal concentrations. This pond, which appears to have been excavated out of the fill material after it was placed, could be filled and regraded, thereby providing a means to address the objectives for several different environmental media simultaneously. On the other hand, capping of the south parcel is not considered to be a feasible or cost-effective technology for the prevention of erosion and fill migration into the adjacent wetland. The areas on the south parcel most susceptible to erosion are the steep fill slopes abutting the wetland. In these locations, the placement of a soil cap would be impractical without uprooting existing, established vegetation and cutting the slopes back to a considerable degree. Moreover, as compared to regrading, capping would be an expensive technology to implement relative to the potential for marginally increased level of environmental protection that it provides. For these reasons, it is not considered further.

Wetland Sediments – Sediments from the deciduous forested wetland adjacent to the fill area in the south parcel contain some metals and PAHs at concentrations exceeding NYSDEC sediment criteria. Although the concentrations of these parameters are not exceptionally high, they do indicate that wetland sediments have been impacted to some degree by the fill material. Nevertheless, no remedial action for wetland sediments is considered to be necessary, and therefore no remedial action objective has been developed for this medium, for the following reasons. The wetland is saturated on a seasonal basis only and does not represent a quality habitat for benthic aquatic life. Furthermore, human consumption of aquatic species from this habitat is not a practical concern. Finally, any remediation effort addressing wetland sediments would most likely have a greater impact on the wetland habitat than leaving the sediments in place. Further discussion of the wetland sediments and wetland habitat is provided in the Fish and Wildlife Impact Analysis, Section 6.2 of the RI Report.

Onsite Pond Sediments – The single RI sediment sample collected from the pond in the eastern portion of the south parcel indicated higher PAH concentrations than in the sediment samples from the adjacent wetland, and also indicated the presence of several pesticides and PCB Aroclors, albeit it at relatively low concentrations (less than NYSDEC sediment criteria.) The following remedial action objectives are considered to be appropriate for this medium: *prevent direct human/ecological contact with contaminated pond sediments and prevent migration of sediments into the wetland.* (Note that the pond was apparently excavated out of the fill material placed on the south parcel, and that it drains southward into the wetland.) Considering the elevated but still relatively low levels of contamination within the pond sediments, "no action" is considered to be a marginally feasible response. In addition, the following three active responses have been identified for this medium:

- Removal and disposal of contaminated pond sediments by excavation and offsite landfilling

- Ex-situ treatment of pond sediments onsite after excavation and consolidation with excavated materials from other hot spots at the site (see discussion below)

- Containment by regrading and filling, separately or in combination with other response actions (e.g., onsite landfilling of solid waste), as discussed previously

Waste Drum – A single waste drum was encountered in the south parcel and sampled during the RI (Sample S-D1, Figure 1-2). Although the contents of the drum were found to be non-hazardous, the following remedial action objectives have been developed for the liquid waste material within the drum: *prevent direct contact with waste material and prevent migration of waste-related contamination into the adjacent wetland.* Because of the easy access to the drum, and considering the very mobile (liquid) nature of its contents, both "no action" and onsite containment have been screened out as response actions. Instead, the only feasible response action for this waste drum is considered to be removal with offsite disposal at a properly permitted facility.

Hot Spots – In addition to the pond area discussed above, two distinct "hot spots" were encountered on the south parcel during the RI. These hot spots are discussed separately in the following paragraphs.

The first and most significant hot spot is an area along the east bank of the south parcel, near Test Pit #3, where very high levels of contamination were detected in surface soils, subsurface soils and shallow groundwater. Within this area, a total of six test pits were excavated, as indicated on Figure 1-2 (TP-03, TP-3S, TP-3W, TP-3NW, TP-3N, TP-3N1). Also, two groundwater monitoring wells were installed in the area (GW-12, GW-13). The test pits revealed the presence of numerous aerosol spray cans, liquid waste material, and visibly discolored (typically purple) soil. High concentrations of volatile organic compounds (VOCs) and PAHs were detected in the test pit soil samples from the area. For example, maximum detected soil contaminant concentrations in the area included: methylene chloride (5.4 milligrams per kilogram (mg/kg)); toluene (97 mg/kg); ethylbenzene (81 mg/kg); total xylenes (610 mg/kg); benzo(a)anthracene (8.2 mg/kg); chrysene (13 mg/kg); benzo(b)fluoranthene (12 mg/kg); benzo(k)fluoranthene (11 mg/kg); benzo(a)pyrene (8.1 mg/kg); indeno(1,2,3-cd)pyrene (11 mg/kg); and dibenz(a,h)anthracene (5.6 mg/kg). In the groundwater sample from GW-12, numerous VOCs also occurred at very high concentrations, including: methylene chloride (600 milligrams per liter (mg/L)); methyl ethyl ketone (24 mg/L); toluene (170 mg/L); and total xylenes (27.6 mg/L). A liquid sample of waste material collected from one of the aerosol cans in TP-3N indicated the presence of toluene at approximately 22 percent, methylene chloride at 17 percent, total xylenes at 15 percent, and ethylbenzene at 3.2 percent.

Although the extent of contamination in the east bank area of the site has not been determined by "sampling to clean" in all directions, several conclusions can be drawn in this regard. The contaminated area is bounded on the south by the northernmost of two discarded ASTs along the east side of the parcel (see Figure 1-2), as indicated by the absence of contamination in TP-3S and TP-3W. The area probably does not extend much farther west than TP-3NW, in which a single aerosol can and relatively low PID readings were encountered. The area extends to the north at least as far as TP-3N1, in which significant contamination was found. The area does not extend farther to the east than the edge of fill, which drops off into the adjacent wetland approximately 30 feet east of TP-03. In summary, the contaminated area appears to occur within a band approximately 30-50 feet wide along the east edge of the fill material, extending for at least 100 feet northward from the northernmost abandoned AST. Within this area, the test pits logs indicate that contamination extends through the fill material to the underlying, native material, which occurs at a depth varying from approximately 6 to 9 feet below ground surface.

A second hot spot was encountered on the west end of the south parcel at sampling location SS-02 (Figure 1-2). At this location, a surface soil sample indicated the presence of acetone at 0.49 mg/kg and pentachlorophenol at 360 mg/kg. Although the extent of contamination at this location has not been determined by "sampling to clean," it appears to be localized based upon the absence of any apparent contamination (visual or PID readings) in test pit TP-12, which was located several feet to the northeast of SS-02, or in GW-05, which was installed in 1989 approximately 25 feet to the northwest of SS-02.

The following remedial action objectives have been developed for the two known hot spots on the south parcel: *prevent direct contact with contaminated materials and prevent migration of contamination into the adjacent wetland on the west and east ends of the parcel.* Considering the high levels of contamination at the east hot spot, and the presence of contamination in surface soils on the west, "no action" is not considered to be a feasible response, and has been eliminated from further consideration. Likewise, the high levels of contamination and the existence of liquid waste material in pure product form within aerosol cans on the east side of the site rule out the option of containment by capping and/or onsite landfilling. (Although TCLP tests of the material near TP-03 have not been performed, it is considered highly likely that this material would classify as a characteristic RCRA hazardous waste.) In-situ treatment of contaminated soil is feasible on the west, but not the east side of the site, due to the abundance of buried aerosol cans in that area. Therefore, in-situ treatment has been eliminated from further consideration. The two response actions and technologies that are considered to be feasible for these hot spots are: (a) removal and disposal by offsite landfilling; and (b) excavation and ex-situ (onsite) treatment using one of several potential treatment process options, including biodegradation, chemical oxidation, thermal desorption, and solidification/stabilization. Ex-situ treatment would require physical screening of excavated materials on the east side of the site, in order to sift out buried containers (aerosol cans) and their contents for offsite disposal. If ex-situ treatment were determined to be feasible and cost-effective, it would be applied to excavated soils from both the east and west hot spots on the south parcel.

Shallow (Perched) Groundwater – The uppermost permanent aquifer, which consists of the lower confined sand unit, has not been impacted by contamination at the Golden Road site. However, perched groundwater within the seasonally saturated, unconfined upper sand unit has been affected by the presence of waste material and related contamination, especially in the contaminated area near the east end of the site. However, despite the seasonal occurrence of shallow contaminated groundwater and its known discharge into the adjacent wetlands, none of the surface water samples collected from within the wetland during the RI had organic compound concentrations exceeding NYSDEC Class C criteria. The remedial action objective for this environmental medium is: *prevent the migration of contaminated shallow (perched) groundwater into the wetland.* Considering the lack of any apparent impact to date upon the wetland, and the seasonal nature of the groundwater medium, "no action" (with long-term monitoring) is considered to be one feasible response for groundwater, especially if the source of groundwater contamination is removed during hot spot remediation. Another feasible response is the collection and treatment of groundwater from the source (hot spot) areas, using air stripping and/or carbon adsorption as treatment process options.

3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

3.1 Rationale for Alternative Development

In this section, the general response actions and remedial technologies that survived the preliminary screening in Section 2.0 have been combined into sitewide remedial alternatives for the Golden Road Disposal Site. These alternatives span a range of options for the management of onsite waste materials. Although all of the alternatives (except "no action") are generally intended to be protective of human health and the environment, they accomplish this intent using different approaches and to different degrees. For example, for the different impacted environmental media, the alternatives include a broad range of response types, such as: engineering controls, treatment of soil and groundwater, excavation with offsite disposal, and institutional controls.

As indicated by Table 3-1, six remedial alternatives have been identified for detailed analysis as part of this Feasibility Study. The "No Action" alternative (Alternative 1) serves as a baseline for comparison with the other, pro-active alternatives. In general, the alternatives represent sequentially (i.e., from No. 1 to No. 6) more comprehensive sitewide remedial approaches, increasing levels of detail and complexity, higher overall levels of health and environmental protection, and greater cost. These progressive alternatives are described briefly below, then evaluated in detail in Section 4.0.

3.2 Identification of Remedial Alternatives

3.2.1 Alternative 1 – No Action

Evaluation of the "no action" alternative is required by CERCLA, and serves as an indicator of site conditions in the absence of remediation, and a baseline for comparison with the other active remedial alternatives. Because of the site's location adjacent to a wetland, and because shallow (perched) groundwater is known to have been impacted by onsite contamination, a program for long-term monitoring of groundwater and surface water is considered to be a necessary component of each remedial alternative, including "no action." Therefore, groundwater and surface water monitoring have been included as part of all six remedial alternatives. A preliminary monitoring program scope is presented in the detailed analysis of alternatives.

3.2.2 Alternative 2 – Institutional Controls and Surface Cleanup

The south parcel of the Golden Road Disposal Site is bordered by heavily used railroad tracks on the north, a wetland on the west, a wetland and Interstate Route 490 on the south, and residential homes on the east. The location, size and configuration of the site make it an unlikely candidate for development in the foreseeable future. Although the foundry sand and slag fill that occupy essentially the entire non-wetland area of the site do not, of themselves, necessarily preclude future site development, contamination within several areas of the site would have to be remediated before many types of development could proceed. An alternative method for preventing exposure to these contaminated areas would be to impose development restrictions on the site, including restrictions against future residential development.

In addition to institutional controls restricting future residential development, this alternative involves the limited cleanup of surface waste materials at the site, including the surface asbestos on the west side of the south parcel and the single, non-empty waste drum found during the RI near the center of the parcel. This surface cleanup, which would be intended to protect persons walking across or using the site under existing and future conditions, could be classified as a removal action. It would not address the solid waste scattered elsewhere across the site, the contaminated sediments within the pond, nor the hot spots on the east and west sides of the site.

3.2.3 Alternative 3 – Surface Cleanup and Hot Spot Remediation by Excavation and Offsite Landfilling

Alternative 3 includes surface cleanup (as in Alternative 2) plus remediation of contaminated soils in the east hot spot (near Test Pits 3), the west hot spot (near surface soil sample SS-02), and contaminated sediments from the onsite pond. Remediation under this alternative would involve excavating the full area and depth of contamination in the above three locations, with subsequent disposal by offsite landfilling. After its implementation, Alternative 3 would leave the south parcel of the site in a condition very similar to that of the north parcel, i.e., hazardous wastes removed or treated, remaining fill characterized as foundry sand and slag, solid (non-hazardous) waste remaining scattered across the site (though much less abundant than on the north parcel.)

3.2.4 Alternative 4 – Surface Cleanup and Hot Spot Remediation by Excavation and Onsite (Ex-Situ) Treatment

Alternative 4 is identical to Alternative 3 except that, instead of disposal by offsite landfilling, the excavated material would be treated onsite. The ex-situ treatment technologies that will be considered in the following section for contaminated soil and sediment are biodegradation, chemical oxidation, low-temperature thermal treatment and solidification/stabilization. As previously discussed, the presence of numerous aerosol cans and containers in the east hot spot location will require sifting or other means of physical separation, with offsite disposal of the containers and whatever portion of their contents remain and can be separated from the surrounding contaminated soil.

3.2.5 Alternative 5 – Surface Cleanup, Hot Spot Remediation, and Site Regrading

As part of the detailed evaluation in Section 4.0, Alternatives 3 and 4 will be evaluated comparatively, and a determination will be made regarding whether excavated materials should most effectively be removed from the site for offsite disposal (Alternative 3) or treated onsite (Alternative 4). This selection will be applied to Alternatives 5 and 6. Alternative 5 includes Alternative 3 or 4 (based on the above comparison), plus limited site regrading. Regrading of the south parcel would include: (a) filling and grading the pond within the interior of the parcel; and (b) regrading of any flat areas across the fill surface to provide positive overland drainage throughout the filled area.

3.2.6 Alternative 6 – Surface Cleanup, Hot Spot Remediation, Site Regrading, and Shallow Groundwater Treatment

Alternative 6 includes all the components of Alternative 5, plus treatment of shallow, perched groundwater near the east edge of the fill. The waste materials and contaminated soil occurring in the hot spot area near Test Pits 3 have impacted this groundwater, which occurs on a seasonal basis. In addition to removing the contaminated source, Alternative 6 would provide for the collection and treatment of this shallow groundwater, by air stripping and/or carbon adsorption, prior to its discharge into the existing sanitary sewer on Golden Road.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 Description of Evaluation Criteria

In Section 4.2, each of the remedial alternatives developed for the Golden Road Disposal Site is analyzed with respect to the following seven evaluation criteria, as required by 6 NYCRR Part 375.

Overall Protection of Human Health and the Environment: This criterion serves as a final check to assess whether each alternative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria, including: long-term effectiveness and permanence, short-term effectiveness, and compliance with New York State Standards, Criteria and Guidelines (SCGs). This evaluation focuses on how each alternative achieves protection over time and how site risks are reduced.

Compliance with SCGs: This evaluation criterion is used to determine how each alternative complies with applicable or relevant and appropriate New York State Standards, Criteria and Guidelines. Standards and criteria are cleanup standards, standards of control and other substantive environmental protection requirements, criteria or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance. Guidelines include non-promulgated criteria and guidance that are not legal requirements, but should be considered in terms of applicability to the site, based on professional judgement. The actual determination of which requirements are applicable or relevant and appropriate is made by the NYSDEC in consultation with the NYSDOH.

SCGs are classified as chemical-specific, action-specific or location-specific. Chemical-specific SCGs apply to the nature of the contaminants, irrespective of the remedial actions considered to address them. Action-specific SCGs, on the other hand, represent requirements that correspond to specific remedial actvities. Location-specific SCGs are similar to action-specific SCGs, and address requirements or limitation that may be necessary for certain remedial activities due to the presence of nearby features, such as (for example) points of historical interest, or habitat for endangered species.

The following list contains the principal chemical- and action-specific SCGs that have been identified for the Golden Road Disposal Site. No location-specific SCGs have been identified.

Chemical-Specific SCGs

- NYSDEC Division of Hazardous Waste Remediation, Technical and Administrative Guidance Memorandum (TAGM) 4046, Determination of Soil Cleanup Objectives and Cleanup Levels
- 6 NYCCR Parts 700-706, Water Quality Regulations for Surface Water and Groundwater
- NYSDEC Division of Water, Technical and Operations Guidance Series (TOGS) 1.1.1, Ambient Water Quality Standards and Guidance values and Groundwater Effluent Limitations
- NYSDEC Division of fish, Wildlife, and Marine Resources, Technical Guidance for Screening Contaminated Sediments
- 40 Code of Federal Regulations (CFR) 141, Safe Drinking Water Act Maximum Contaminant Levels
- 40 CFR 131, Clean Water Act, Water Quality Standards

Action-Specific SCGs

- 6 NYCRR Parts 200, 201, 212, 257 Prevention and Control of Air Contamination
- 6 NYCRR Parts 364, 371, 372, 375, 376, Hazardous Waste Identification, Transportation, and Disposal
- 6 NYCRR Part 663, Freshwater Wetlands Permit Requirements
- 6 NYCRR Parts 750 – 758, State Pollutant Discharge Elimination System
- NYSDEC New York State DAR-1, Guidelines for the Control of Toxic Ambient Air Contaminants

- NYSDEC Division of Water TOGS 1.3.8, New Discharges to POTWs
- 40 CFR 400-469, Clean Water Act
- 40 CFR 61, Asbestos Waste Disposal
- 33 CFR Parts 320-330, USACE Wetlands regulations

Short-Term Impacts and Effectiveness: This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to their effects on human health and the environment during the implementation of the remedial action. The factors considered under this criterion include: protection of the community during remedial actions; environmental impacts as a direct result of remedial actions; time until the remedial response objectives are achieved; and protection of workers during the remedial actions.

Long-Term Effectiveness and Permanence: This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this criterion is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site, and the operating system necessary for the remedy to remain effective. The factors considered under this criterion include: magnitude of remaining risk; adequacy of controls used to manage residual waste; and reliability of controls used to manage residual waste.

Reduction of Toxicity, Mobility and Volume: This evaluation criterion assesses each remedial alternative's use of technologies that provide a permanent and significant onsite reduction of toxicity, mobility or volume of hazardous wastes. It considers: the amount of hazardous materials that will be destroyed or treated; the degree of expected reduction in toxicity, mobility or volume; the degree to which the treatment will be irreversible; and the type and quantity of residuals that will remain following treatment.

Implementability: This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage and disposal services; availability of equipment; and the availability of services and materials.

Cost: This criterion addresses the cost of each alternative, expressed in terms of capital costs (direct and indirect), annual operation and maintenance (O&M) costs, and total present worth.

In addition to the above seven evaluation criteria, community acceptance will also be considered prior to the selection of a final remedy for the site.

4.2 Detailed Analysis of Alternatives Individually

In this section, each of the alternatives developed for the Golden Road Disposal Site is analyzed in terms of the seven evaluation criteria identified in Section 4.1. Each subsection below begins with a description of the alternative, including its physical layout, primary system components, and key assumptions related to configuration and cost of implementation. This description is followed by an assessment of how the alternative "measures up" to each of the evaluation criteria. The results of each individual alternative analysis are applied in Section 4.3 to evaluate all of the alternatives on a comparative basis, leading ultimately to the selection of a single recommended alternative for the site.

4.2.1 Analysis of Alternative 1 – No Action

Description: The "no action" alternative, as well as each of the other pro-active alternatives, includes long-term monitoring of groundwater and surface water. The purpose of this monitoring is to evaluate the quality of groundwater migrating away from the site, and surface water in the wetland adjacent to the site, and thereby insure that the selected remedy will remain protective of human health and the environment in the future. Groundwater will be monitored using three existing monitoring wells, GW-02, GW-10 and GW-11, which are located to the east and downgradient from the south parcel (Figure 1-2). Surface water in the wetland adjacent to the south parcel will be sampled on an ongoing basis at two locations, which will be established after the final remedy has been selected.

Each of the five (total) groundwater and surface water sampling locations will be sampled semi-annually in years 1 to 3, and annually thereafter (years 4 through 30). Aqueous samples will be analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and Target Analyte List (TAL) metals. For cost analysis purposes, it has been assumed that each of the three existing monitoring wells used for long-term monitoring will be closed and replaced with new wells after 15 years.

Overall Protection of Human Health and the Environment: Alternative 1 provides no change to existing conditions at the site and, therefore, results in a continuation of the existing potential human and ecological exposures to site-related contamination. Specifically, under existing conditions, trespassers or persons using the site casually are exposed to surface contamination, including surface soil, asbestos and one waste drum. Existing site users are also exposed to relatively low-level sediment contamination within the wetland and the onsite, excavated pond in the south parcel. In the future, residents and/or workers at the site could be exposed to contamination from the same media, and also to the relatively higher levels of subsurface contamination occurring in site hot spot areas, including the east bank (TP-3) area and the west end (SS-02) area. Shallow, seasonally perched groundwater in the east bank area is also contaminated, and represents a potential future exposure route.

Compliance with SCGs: The "no action" alternative would result in the continued exceedance of some SCGs, as described below:

- Under existing conditions, TAGM 4046 values are exceeded for surface soils on the south parcel. Exceedances include acetone and pentachlorophenol in the west end (SS-02) area, and both PAHs and metals at numerous locations. In general, the occurrence and concentration of PAHs and metals are similar to those on the north parcel, and probably associated with the foundry sand and slag that exist across the site. PAH concentrations are, however, higher in the east bank (TP-3) area.

- TAGM 4046 values are also exceeded in subsurface soils, particularly in the east bank area. Exceedances in this area include VOCs at high concentrations and 2-methylphenol. In addition, concentrations of PAHs and metals exceed SCGs in subsurface soils across the site. Again, PAH concentrations are higher in subsurface soils near the east bank.

- Class GA groundwater standards are exceeded for shallow, seasonal groundwater in the east bank area. Exceedances in this area include high levels of VOCs, lower levels of SVOCs, and metals. Although some metals appear to be higher in the east bank area, upgradient and offsite wells also indicate exceedances of Class GA standards, reflecting generally elevated levels of metals in local groundwater.

- Because the onsite pond and adjacent wetland are dry much of the time, sediment samples from these areas were compared to TAGM 4046 criteria for soils. A number of PAHs and metals exceeded TAGM 4046 values in wetland sediments, although at relatively low concentrations. However, the single RI sediment sample collected from the pond on the south parcel had higher PAH concentrations than samples from the adjacent wetland, and also indicated the presence of several pesticides and PCB Aroclors at low (less than SCG) concentrations.

- Although no organic compounds were detected in surface water samples from the adjacent wetland, several metals exceeded NYSDEC Class C surface water criteria (TOGS 1.1.1). Their presence appears to reflect both elevated metals concentrations in local surface water (including offsite background) and the effect of onsite foundry sand and slag. (Note that water in the wetland occurs on a seasonal basis only, and was absent throughout the initial phase of the RI.)

Short-Term Impacts and Effectiveness: Since this alternative involves no active remedial measures, there are no short-term impacts to the community, environment or remediation workers associated with its implementation. It does not provide a short-term remedy for any of the existing, potential human/ecological exposures to contaminated media, and does not affect the existing exceedance of SCGs.

Long-Term Effectiveness and Permanence: Alternative 1 provides no active remediation of onsite contamination. Other than as a result of natural attenuation over long time periods, the nature and extent of contamination at the site are unchanged, and the risk remaining after implementation of the remedy is equal to the existing risk. No controls are employed to manage this residual (i..e., existing) risk, so the reliability of controls is not relevant.

Reduction of Toxicity, Mobility and Volume: The alternative provides no treatment of contaminated media, and therefore no reduction of toxicity, mobility and volume (TMV).

Implementability: The "no action" alternative is, for obvious reasons, fully implementable.

Cost: The cost of Alternative 1 consists of the cost for long-term groundwater and surface water monitoring only. Appendix A provides a detailed cost estimate for each of the remedial alternatives at Golden Road, including this one. As indicated by Appendix A, the cost for monitoring well replacement after 15 years has been represented as an equivalent "capital" cost. The estimated cost for implementation of Alternative 1 is as follows:

- Capital Cost = $2,000
- Annual O&M Cost = $4,500
- Total Present Worth = $71,000

4.2.2 Analysis of Alternative 2 – Institutional Controls and Surface Cleanup

Description: In addition to long-term monitoring, Alternative 2 includes institutional controls and surface cleanup of asbestos-containing material (ACM) and a single, non-empty waste drum on the south parcel. The purpose of institutional controls is to prevent future human exposure to the relatively high levels of soil and groundwater contamination found in some areas of the site. This will be accomplished by the preparation and enactment of enforceable deed restrictions prohibiting future residential development of the south parcel or other activities that might potentially result in exposure through excavation or disturbance of contaminated subsurface soil and groundwater. Surface cleanup is intended to prevent incidental exposure to hazardous materials currently existing on the surface of the site by trespassers or persons walking across or using the site casually. Surface cleanup includes the collection, bagging and offsite disposal of surface ACM occupying an estimated 400 square feet on the west end of the site and the overpacking and offsite disposal of one partially-full waste drum near the center of the site (Figure 4-1).

Overall Protection of Human Health and the Environment: Surface cleanup would permanently eliminate the potential for human exposure, by trespassers or casual site users, to surface asbestos and the contents of one partially-full drum on the south parcel. It would not, however, address potential existing or future exposures to contaminated soil or groundwater. Although institutional controls would reduce the likelihood of future contact with soil and groundwater contaminants, they are not as certain a method of protection, and therefore not as protective an approach, as actual site cleanup measures.

Compliance with SCGs: Neither surface cleanup of ACM nor institutional controls would reduce the SCG exceedances described under Alternative 1 – No Action.

Short-Term Impacts and Effectiveness: Surface cleanup would involve no significant impacts to the community or environment. Worker risk during remediation would be minimal, and manageable through the development and implementation of a health and safety plan (HASP). The response objectives for surface cleanup are very limited, and achievable immediately. The length of time required for cleanup is not expected to exceed one week. The time frame for institutional controls, however, is much less certain. It depends upon the time required to enact them from an administrative and legal standpoint, and, subsequently, upon the degree to which they are enforced.

Long-Term Effectiveness and Permanence: Surface cleanup of asbestos and the partially-full waste drum would be immediately and permanently effective at removing potential contact with these media. However, the long-term effectiveness and permanence of institutional controls is doubtful. The legal and administrative feasibility of preventing future site development, as well as subsurface excavation activities that would result in exposure to contaminated soil and groundwater, is uncertain even at the present time, and even more so into the future. Contaminated soil and groundwater would not be affected by such controls, and would remain at the site indefinitely as residual contamination.

Reduction of Toxicity, Mobility and Volume: Alternative 2 involves no significant reduction of TMV.

Implementability: Surface cleanup is fully implementable. However, the type of institutional controls required to prevent future development or excavation at the site, and the indefinite period of time over which these controls would be required, make implementation of this measure very uncertain from both administrative and legal standpoints.

Cost: As presented in Appendix A, the estimated cost for implementation of Alternative 2 is:

- Capital Cost = $22,000
- Annual O&M Cost = $4,500
- Total Present Worth = $91,000

4.2.3 Analysis of Alternative 3 – Surface Cleanup and Hot Spot Remediation by Excavation and Offsite Landfilling

Description: In addition to long-term monitoring and surface cleanup, as described previously, this alternative includes the excavation and offsite disposal by landfilling of contaminated soil from three "hot spot" areas on the south parcel (Figure 4-1):

- East bank (TP-3) area, where an estimated 1,600 cubic yards (CY) of heavily contaminated soil, comingled with aerosol cans and other debris, are buried.

- Pond area, where an estimated 100 CY of contaminated soil/sediment are located.

- West end (SS-02) area, where an estimated 20 CY of contaminated soil exists at shallow depths.

Remediation of these hot spots will eliminate the potential for future human exposure, by residents or onsite workers, to the relatively high levels of soil contamination in these areas – particularly the east bank area. The contaminated soil will be excavated and hauled to an onsite, portable screening plant where debris (primarily aerosol cans) will be separated from the soil for purposes of disposal. The contaminated materials will then be loaded into transport vehicles and shipped offsite for disposal. Based upon results and field observations during the RI, it is estimated that these contaminated materials will include approximately 340 CY (20%) of hazardous (RCRA characteristic) soil waste, 1,380 CY (80%) of non-hazardous soil waste, and (10) 55-gallon drums of aerosol cans to be disposed of as hazardous waste. Following soil excavation, the excavated areas will be filled with offsite borrow material and graded to drain.

Overall Protection of Human Health and the Environment: The benefits of surface cleanup are the same as discussed under Alternative 2. In addition, hot spot remediation by excavation and offsite landfilling would permanently eliminate the most significant health and environmental risks at the Golden Road site – potential exposure to surface (soil) and subsurface (soil and groundwater) contamination in the east bank (TP-3), pond and west end (SS-02) areas. In doing so, this alternative would provide a very significant improvement to existing conditions at the site and a relatively high level of protection. However, as previously discussed, the Golden Road Disposal Site has been extensively filled, on both the north and south parcels, with foundry sand and slag. This material contains elevated levels of PAHs and metals, some of which exceed SCGs for soil and groundwater throughout the site. None of the remedial alternatives considered in this Feasibility Study include the removal of this fill material, for reasons discussed in Section 2.2. Therefore, none of the alternatives provide a level of protection greater than that associated with a site containing the foundry sand and slag that characterizes Golden Road.

Compliance with SCGs: Through excavation and offsite disposal of contaminated surface and subsurface soil in the three hot spot areas, Alternative 3 would eliminate the most significant SCG exceedances at the site.

Short-Term Impacts and Effectiveness: For surface cleanup, the short-term impacts and effectiveness are the same as discussed under Alternative 2. Because Alternative 3 involves the excavation of some highly contaminated soil and debris, and considering that this excavation would occur on the east bank directly adjacent to the wetland, there is a potential for worker risk and environmental impacts during remediation. However, these risks are manageable through the development and implementation of an effective HASP, as well as an erosion and sediment control plan. (The erosion and sediment control plan is also important during the excavation of contaminated sediments from the onsite pond, which discharges directly into the wetland.) In addition to the above concerns, this alternative involves the transportation of over 1,700 cubic yards of contaminated sediments from the site using local roads. The potential risks to the community associated with this activity could be controlled through the use of standard transportation safety practices during hauling, and through the development of a community awareness and protection plan. The duration of the transportation activities is very short (estimated several weeks), and the total time to achieve the objectives for hot spot remediation would probably be less than one month, i.e., the total time required from mobilization to demobilization.

Long-Term Effectiveness and Permanence: The long-term effectiveness and permanence of surface cleanup were discussed under Alternative 2. Hot spot remediation by excavation and offsite landfilling provides a permanent and effective remedy for the hot spot areas that would be addressed by this alternative. After its implementation, excavation and offsite disposal would leave no residual waste onsite. Therefore, there would be no remaining risk or required controls associated with residual materials.

Reduction of Toxicity, Mobility and Volume: This alternative provides a reduction of onsite volume of hazardous waste, by excavation and offsite disposal of contaminated soils at a permitted landfill facility.

Implementability: Excavation and offsite disposal of contaminated soils from the hot spot areas is easily implemented. There is ample availability and capacity of equipment, contractors and offsite disposal facilities necessary for the implementation of this measure. The earthwork and transportation technologies necessary for its implementation are proven and reliable, and agency coordination and approvals are not expected to be an issue.

Cost: As presented in Appendix A, the estimated cost for implementation of Alternative 3 is:

- Capital Cost = $364,000
- Annual O&M Cost = $4,500
- Total Present Worth = $433,000

4.2.4 Analysis of Alternative 4 – Surface Cleanup and Hot Spot Remediation by Onsite (Ex-Situ) Treatment

Description: This alternative is identical to Alternative 3 except that, instead of offsite disposal by landfilling, contaminated soil is treated onsite. Appendix B provides an evaluation of alternative treatment options for this soil. Based upon this evaluation, the recommended form of treatment is biodegradation by windrow composting. Figure 4-2 shows a conceptual layout of the composting system, which would occupy a large portion of the unwooded western half of the south parcel. Under this alternative, contaminated soil is placed in windrows (with a maximum height of 3 feet), amended with bulking agents and organic material, and turned periodically with a loader or excavator to provide aeration and maintain suitable rates of biodegradation. Because the composting process is temperature-dependent, and considering the relatively high levels of organic contamination in the east bank soils, it is estimated that treatment will be required for at least two, six-month summer seasons. A cover will be placed over the windrows at the end of the microbially active season (i.e., in the fall) to prevent excessive infiltration and erosion during the inactive winter season. After soil treatment is completed, the windrows will be spread uniformly across the site surface and graded to drain.

Overall Protection of Human Health and the Environment: This alternative provides essentially the same level of health and environmental protection as Alternative 3. The difference between treating contaminated soil from the hot spot areas onsite by composting (Alt. 4), versus transporting and disposing of it offsite (Alt. 3), is not significant in terms of overall protectiveness, provided that the treatment is effective, as anticipated at this site.

Compliance with SCGs: Through excavation and onsite treatment of contaminated surface and subsurface soil in the three hot spot areas, Alternative 4 would eliminate the most significant SCG exceedances at the site.

Short-Term Impacts and Effectiveness: With respect to surface cleanup and onsite excavation in the hot spot areas, this alternative has essentially the same short-term impacts and expected effectiveness as Alternative 3. However, although offsite transport of contaminated soil is not required and the potential risks associated with this activity are not applicable to Alternative 4, the use of onsite composting will require a considerably longer period of time than offsite transport and disposal. It is estimated that composting, a temperature-dependent process, will require at least two summer seasons to achieve cleanup goals.

The composting process itself poses some relatively minor potential physical health hazards to onsite workers, including the use of heavy equipment, and trip/fall hazards associated with the liner and irrigation piping. These are typical of earthwork and remedial construction activities, and readily addressed by implementation of proper health and safety procedures. During composting operations, workers may also be exposed to soil contaminants and their degradation products, as well as pathogenic microbes, via inhalation (especially on windy days), dermal and ingestion routes. Again, however, these can be addressed through implementation of a health and safety program, including the use of protective equipment as necessary. Although air emissions during composting are not anticipated to pose a significant risk to residential neighbors, these emissions will be monitored during the initial phases of the treatment operation for compliance with appropriate regulatory limits. If required, though not expected, a cover could be placed over the composting operation, or a modular treatment building could be constructed to treat contaminated soil indoors in a batch mode. A more significant concern than air emissions during the actual composting operations is the potential for exposure to soil contaminants during the intervals between operations. Except during the estimated biweekly tilling operations throughout the microbially active season, site access would be unrestricted. During these periods, the potential for human and ecological exposure to contaminated soil would be increased over existing conditions.

<u>Long-Term Effectiveness and Permanence:</u> The long-term effectiveness and permanence of surface cleanup were discussed under Alternative 2. Onsite windrow composting would require the transfer of contaminated subsurface soils to the surface for treatment over a period of time estimated to be at least two summer seasons. During the treatment process, there would be a significantly increased risk of direct contact with this contaminated soil by trespassers or casual site users. Although soil contaminant concentrations would be expected to decrease significantly over time, as treatment progresses, the initial levels of contamination would be high – especially for soils excavated from the east bank area. Access to the site would be uncontrolled except during tilling operations, which are estimated to occur every other week throughout a six-month summer season. The above concerns with residual waste materials, and the management of risk associated with them, apply only

during the treatment period. Once treatment is completed, the soil would be expected to meet cleanup goals and be spread across the site, allowing unrestricted future access and no need for future controls.

Reduction of Toxicity, Mobility and Volume: Composting results in the onsite reduction of TMV of organic soil contaminants through the process of biodegradation, in which organic soil contaminants are converted by microorganisms to non-toxic end products. The process is irreversible and has been demonstrated to produce contaminant removal efficiencies in excess of 95 percent.

Implementability: Composting is an easy technology to implement, and requires equipment and services that are readily available. However, the process is labor intensive. In order to be effective, it must be monitored and adjusted on an ongoing basis, since the biodegradation process is very sensitive to factors such as soil pH, microbial presence, moisture content, temperature, etc. It may be difficult, on a practical basis, to effectively operate, or optimize the performance of, a composting facility at a relatively remote site such as Golden Road on a part-time basis.

Cost: As presented in Appendix A, the estimated cost for implementation of Alternative 4 is:

- Capital Cost = $388,000
- Annual O&M Cost = $4,500
- Total Present Worth = $457,000

4.2.4.1 Comparison of Offsite Disposal Versus Onsite Treatment

Up to this point, two separate alternatives have been considered for dealing with contaminated soil excavated from the site hot spots. Alternative 3 (presented in Section 4.2.3) provides for the transportation and offsite disposal (by landfilling) of this soil. Alternative 4 (presented in Section 4.2.4), which is otherwise identical to Alternative 3, provides for its onsite treatment by windrow composting. Alternatives 3 and 4 may be summarized on a comparative basis as follows:

- Both offsite disposal by landfilling (Alt. 3) and onsite treatment by composting (Alt. 4) provide very similar benefits in terms of overall protection of human and the environment, and compliance with SCGs.

- Alternatives 3 and 4 are also similar in terms of short-term impacts and effectiveness. Both involve potential risks to the community, environment and onsite workers during soil excavation activities. However, these risks are readily manageable through the implementation of effective work plans (e.g., erosion and sediment control plan, worker health and safety plan). The offsite disposal of contaminated soil under Alternative 3 would involve a considerable amount of truck traffic on local roads. However, the time interval for this activity is very short (several weeks), and the associated risks are controllable through use of standard transportation safety protocols and implementation of a community awareness and protection plan. Remedial action objectives with respect to the hot spot areas would be achieved immediately (within less than one month) under Alternative 3, as opposed to an estimated onsite treatment period of at least two summer seasons for Alternative 4.

- Alternative 3 is superior in terms of long-term effectiveness and permanence. Insofar as hot spot remediation is concerned, it is entirely effective and permanent. It would involve no residual wastes and, therefore, no associated risks or required controls for residual waste material. On the other hand, windrow composting (Alt. 4) is estimated to take at least two summer seasons, during which soil with relatively high (though decreasing) levels of contamination would be exposed on the ground surface. In addition, except during the estimated biweekly tilling operations, site access would continue to be unrestricted, and potential human/ecological exposure to this increased level of surface contamination would be difficult to control.

- Alternative 4 provides reduction of TMV through treatment by composting, in which organic soil contaminants would be biodegraded onsite to non-toxic end products, with achievable removal efficiencies in excess of 95%. Alternative 3 provides reduction of onsite waste volume, by excavation of contaminated soil and offsite landfilling. .

- Alternative 3 is more easily implementable. Offsite disposal poses no problems in this regard, and there is ample availability and capacity of equipment, contractors and disposal facilities for the implementation of this alternative. Although onsite composting (Alt. 4) is easy to implement on a conceptual basis, and the required equipment and personnel are available, the process is labor intensive and requires ongoing field adjustments (pH, nutrients, etc.) to optimize performance. Effective implementation of composting could prove difficult on a part-time basis at a relatively remote location like the Golden Road Disposal Site.

- The estimated cost of Alternative 3 (Present Worth = $433,000) is marginally lower than that of Alternative 4 (Present Worth = $457,000).

Based upon the above comparison, and balancing the different evaluation criteria, the recommended option for dealing with contaminated soil in the hot spot areas at the Golden Road site is by excavation and offsite landfilling (Alt. 3). Therefore, this option is the only one that has been included in Alternatives 5 and 6.

4.2.5 Analysis of Alternative 5 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, and Site Regrading

Description: This alternative includes surface cleanup, as described under Alternative 2, hot spot remediation by excavation and offsite landfilling, as described under Alternative 3, and site regrading as described below.

Site regrading is intended to: (a) further reduce the potential for exposure to residual contamination in the onsite pond, and (b) provide for a free-draining surface across the south parcel, thereby minimizing the ponding and infiltration of surface water following rainfall events. Site regrading involves filling the existing, excavated pond in the south parcel with clean offsite borrow, then grading the surface to drain into the adjacent wetland. It also includes the use of a bulldozer or excavator to flatten existing mounds and fill low spots in the unwooded areas of the site. The wooded areas of the south parcel, including the sideslopes adjacent to the wetland, will not be regraded. Although these sideslopes are relatively steep in places, the stabilizing effect of existing, established vegetation would be lost as a result of regrading operations.

Overall Protection of Human Health and the Environment: This alternative provides a marginally higher level of protection than Alternatives 3 or 4. The addition of site regrading as a component measure reduces even further the potential for human or environmental exposures to contaminated soil/sediment in the onsite pond. Also, regrading the unwooded portion of the south parcel reduces the possibility of erosion and offsite migration of contaminated surface soil into the wetland, as well as the possibility of onsite ponding, infiltration and groundwater contamination following rainfall events.

Compliance with SCGs: In terms of compliance with SCGs, Alternative 5 provides a slight and non-quantifiable improvement over Alternatives 3 and 4. To the extent that site regrading minimizes infiltration and the production of contaminated groundwater, which ultimately discharges into the adjacent wetland, this alternative would tend to improve the quality of seasonal surface water within the wetland and reduce the exceedance of surface water SCGs by metals.

Short-Term Impacts and Effectiveness: Under this evaluation criterion, Alternative 5 is identical to Alternative 3 in terms of surface cleanup and hot spot remediation. Site regrading, especially the filling of the pond, poses some risk of erosion and sedimentation to the adjacent wetland. However, this is manageable through the implementation of an effective erosion and sediment control plan. Regrading poses no significant risks to the adjacent community or to onsite workers. The objectives for this action would be achieved immediately after its implementation, which is estimated to require no longer than several weeks.

Long-Term Effectiveness and Permanence: Under this evaluation criterion, Alternative 5 is identical to Alternative 3 in terms of surface cleanup and excavation/offsite disposal of soil from the hot spot areas. Surface regrading would be immediately and permanently effective at achieving its limited remedial objective, and would produce no residual waste and require no ongoing controls after implementation.

Reduction of Toxicity, Mobility and Volume: Like Alternative 3, this alternative provides the reduction of onsite waste volume by excavation and disposal of contaminated soils at an offsite permitted landfill.

Implementability: Like Alternative 3, this alternative is fully implementable. The addition of site regrading to the alternative (versus Alternative 3) causes no significant implementation issues.

Cost: As presented in Appendix A, the estimated cost for implementation of Alternative 5 is:

- Capital Cost = $387,000
- Annual O&M Cost = $4,500
- Total Present Worth = $456,000

4.2.6 Analysis of Alternative 6 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, Site Regrading, and Shallow Groundwater Treatment

Description: This alternative is identical to Alternative 5, with the addition of collection / treatment of shallow groundwater in the east bank (TP-3) area of the site. The purpose of groundwater treatment is to temporarily prevent contaminated groundwater in this area from discharging into the adjacent wetland, as it does on a seasonal basis under existing conditions. Although the excavation and offsite disposal of contaminated soil in the east bank area will remove the source of this groundwater contamination, residual effects would be expected for a period of time following source removal. For this reason, the beneficial effects of groundwater collection and treatment are anticipated to be temporary. Under Alternative 6, groundwater would be collected using three shallow, stainless steel wells with submersible pumps located along the edge of the east bank (Figure 4-3). Groundwater collected from these wells would be pumped to an onsite, air stripping treatment facility. (Based upon the RI characterization of groundwater in this area, different treatment options are evaluated comparatively in Appendix C, and air stripping has been determined to be the most cost-effective technology.) Following onsite treatment, effluent would be discharged to the existing sanitary sewer in Golden Road via a PVC gravity line, to be constructed along the exiting site entrance roadway.

Overall Protection of Human Health and the Environment: This alternative provides a marginally higher level of protection than Alternative 5. Following hot spot remediation in the east bank area, it is likely that residual groundwater contamination exceeding Class GA groundwater standards will remain in the area for some period of time. During this period, the collection and treatment of shallow, seasonal groundwater along the east bank would prevent its migration into the adjacent wetland, and possibly prevent future exposure to shallow groundwater contamination by residents or onsite workers. However, the benefit provided by this additional component is temporary, and less significant if future development of the site does not occur before the effect of source (soil) removal has become established.

Compliance with SCGs: Alternative 6 provides a marginal improvement over Alternative 5 in terms of SCG compliance. In addition to the benefits provided by Alternative 5, the collection and treatment of shallow groundwater would prevent the continued exceedance of Class GA groundwater standards in the east bank area during the time interval between source removal and the eventual establishment of stable groundwater characteristics in the source area.

Short-Term Impacts and Effectiveness: This alternative is essentially the same as Alternative 5, in terms of short-term effectiveness, except for the addition of shallow groundwater collection and treatment. The construction of a groundwater collection and treatment system would not be expected to pose any significant short-term risks to the community, environment or onsite workers. A properly designed collection and treatment system would immediately be able to prevent the migration of contaminated groundwater into the adjacent wetland, and would be operated for only as long as necessary after the removal of the contaminant source (soil) in the east bank area.

Long-Term Effectiveness and Permanence: This alternative is essentially the same as Alternative 5 with respect to surface cleanup, hot spot remediation and site regrading. Groundwater collection and treatment would be employed as a temporary measure in the east bank area. While in operation, it would involve a relatively high level of O&M, and would produce a treated effluent to be discharged to the sanitary sewer system, and off-gas to be discharged onsite. (As discussed in Appendix C, it has been assumed in developing this alternative that off-gas treatment would not be required at the site. If it were, the costs for groundwater treatment would increase substantially, and spent carbon would be produced as a waste residual.) Despite the O&M requirements, air stripping is a very established technology. Its effectiveness has been well documented, and the required controls associated with its implementation are adequate and reliable.

Reduction of Toxicity, Mobility and Volume: Excavation and offsite disposal of contaminated soils involves the reduction of waste volume onsite. Also, the treatment of shallow groundwater by air stripping involves the mass transfer of VOCs from water to air. Treated effluent would be discharged to the sanitary sewer system, with onsite release of the off-gas.

Implementability: The implementability aspects of this alternative are the same as those for Alternative 5, with the addition of shallow groundwater collection and treatment. However, although groundwater treatment requires relatively high levels of ongoing O&M, the air stripping technology proposed is proven and reliable. Required materials, services and supplies are readily available. Although it would be necessary to obtain a discharge permit to the existing sanitary sewer on Golden Road, agency coordination problems are not anticipated. As mentioned above, it has been assumed that off-gas treatment will not be required. If this proves not to be the case, the recommendation of treatment process (air stripping versus carbon adsorption) would need to be revisited.

Cost: As presented in Appendix A, the estimated cost for implementation of Alternative 6 is:

- Capital Cost = $542,000
- Annual O&M Cost = $48,800
- Total Present Worth = $1,293,000

4.3 Comparative Analysis of Alternatives

Table 4-1 presents a comparative evaluation of the six remedial alternatives considered for the Golden Road Disposal site, in terms of the seven evaluation criteria that were described in Section 4.1 and utilized in Section 4.2 as part of the detailed evaluation process. As indicated by the table, there is no single alternative that is "best" in terms of all evaluation criteria. Rather, the selection of a remedy for the site will require a balancing of evaluation factors that are in some cases aligned, and in others competing. From a very broad perspective, the six alternatives can be summarized comparatively as follows:

- Alternative 1 – No Action: This alternative involves long-term monitoring (also included with all other alternatives), but no active site remedial measures. It does nothing to address potential risks under existing or future conditions, nor does it bring the site any closer to compliance with presently exceeded SCGs. Its estimated total present worth is $71,000.

- Alternative 2 – Institutional Controls and Surface Cleanup: This alternative provides a minimum level of surface cleanup (asbestos and waste drum), with institutional controls to prevent future residential development or excavation at the site. It does not, however, address the most significantly contaminated (hot spot) areas of the site in an active manner, nor does it achieve compliance with any currently exceeded SCGs. The feasibility, permanence and implementability of institutional controls that would be required to provide a suitable level of protection are very uncertain. The estimated total present worth of Alternative 2 is $91,000.

- Alternative 3 – Surface Cleanup and Hot Spot Remediation with Offsite Landfilling: Alternative 3 includes surface cleanup plus remediation of the three hot spot areas by excavation and offsite landfilling. Hot spot remediation addresses the most significant contamination at the site, the greatest source of potential human and ecological risk, and the primary cause for current SCG exceedances. This alternative provides a reduction of waste volume onsite. It involves proven technologies, and is effective over both the short- and long-term, permanent and fully implementable. Since it leaves no residual waste materials onsite, ongoing residual waste management controls are not required. Its estimated total present worth is $433,000.

- Alternative 4 – Surface Cleanup and Hot Spot Remediation with Onsite Treatment: This alternative is identical to Alternative 3, except that contaminated soils from the hot spot excavations are treated onsite by windrow composting, rather than transported and disposed of offsite. Composting is an established technology, and provides significant reduction of TMV by biodegradation of soil organic contaminants to non-toxic end products. Although similar in many aspects to the offsite disposal alternative, onsite composting has several relative disadvantages. Since it is a temperature-dependent process and would require several seasons to achieve cleanup goals, exposure to contaminated soils on the surface during treatment is a concern, especially considering that access to the site would not be controlled except during biweekly tilling operations. Also, the composting process is labor intensive and requires ongoing oversight and adjustment, which could prove difficult on a part-time basis at a remote location. A more detailed comparison between Alternative 3 and Alternative 4 is presented in Section

4.2.4.1. On the basis of this comparison, offsite disposal (Alternative 3) has been recommended over onsite composting (Alternative 4) for inclusion in Alternatives 5 and 6. The estimated total present worth of Alternative 4 is $457,000.

- Alternative 5 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, and Site Regrading: This alternative is identical to Alternative 3, with the addition of site regrading. Regrading, which includes filling the onsite pond and smoothing the unwooded central area of the site, would provide a marginal advantage over Alternative 3 by reducing the probability of contact with any residual contaminated sediments in the pond, reducing the likelihood of infiltration by rainwater into the foundry sand/slag, and reducing the chance of erosion and migration of surface soil into the wetland. The estimated total present worth of this alternative is $456,000.

- Alternative 6 – Surface Cleanup, Hot Spot Remediation by Excavation and Offsite Landfilling, Site Regrading, and Shallow Groundwater Treatment: This alternative is the same as Alternative 5, with the addition of shallow groundwater collection and treatment by air stripping in the east bank area of the site. Following source (soil) remediation in the east bank area, it is anticipated that groundwater will continue to exceed Class GA groundwater standards for a period of time. During this period, shallow, seasonal groundwater in this area would be collected, treated and discharged to the existing sanitary sewer system. Because shallow (perched) groundwater occurs only seasonally at the site, and considering that it is presently unused and would be expected to improve over time following source remediation, the relative advantages of this alternative versus Alternative 5 are small. Its estimated total present worth is $1,293,000.

TABLE 2-1
SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
GOLDEN ROAD DISPOSAL SITE

Environmental Medium	Remedial Action Objective	General Response Action	Remedial Technology	Process Option
Solid Waste	Primary – None And Secondary – Handle as necessary to allow implementation of measures necessary to achieve objectives for other media	No Action Onsite Relocation Removal / Disposal Containment	No Action Movement as Necessary Offsite Landfilling Consolidation and Onsite Landfilling	
Surface Asbestos	Prevent disturbance or direct contact by workers or future site users	No Action Removal / Disposal Containment	Offsite Landfilling Capping / Onsite Landfilling	
Soil / Fill Material	Prevent erosion and migration into wetland	No Action Excavation / Disposal Containment	No Action Offsite Landfilling Regrading Capping	
Wetland Sediments	None			
Onsite Pond Sediments	Prevent direct contact & Prevent migration into wetland	No Action Removal / Disposal Treatment Containment	No Action Offsite Landfilling Consolidation with materials from Hot Spots for ex-situ treatment Regrading and Filling	
Waste Drum	Prevent direct contact & Prevent migration into wetland	No Action Containment Removal / Disposal	Offsite Landfilling	
Hot Spots – Surface and Subsurface Soil	Prevent direct contact & Prevent migration into wetland	No Action Removal / Disposal Containment Treatment	Offsite Landfilling Capping./Onsite Landfilling In-Situ Treatment Ex-Situ Treatment	Biodegradation Chemical Oxid. Lo-Temp Thermal Solid./Stabilization
Shallow (Perched) Groundwater	Prevent migration into wetland	No Action Treatment	No Action Ex-Situ Treatment	Carbon Adsorption Air Stripping

Shading – indicates that response or technology was screened out

TABLE 3-1
IDENTIFICATION OF REMEDIAL ALTERNATIVES
GOLDEN ROAD DISPOSAL SITE

Alternative	Description	Comments
No. 1	No Action	Groundwater and surface water monitoring included in Alt. #1 and all other alternatives
No. 2	Institutional Controls and Surface Cleanup	Development restrictions, with removal and offsite landfilling of waste drum and surface asbestos
No. 3	Surface Cleanup & Hot Spot Remediation by Excavation and Offsite Landfilling	Hot spots include surface/subsurface soils, sediments and waste materials at locations near TP-3, SS-02 and onsite pond; wastes from these areas to be excavated and landfilled offsite
No. 4	Surface Cleanup & Hot Spot Remediation by Excavation and Onsite (Ex-Situ) Treatment	Ex-situ treatment process to be selected by a comparative evaluation of biodegradation, chemical oxidation, low-temperature thermal treatment, and solidification/stabilization
No. 5	Surface Cleanup & Hot Spot Remediation (Landfilling or Treatment) & Site Regrading	Alternatives #3 and #4 to be compared and a selection made between offsite landfilling and onsite (ex-situ) treatment of materials from Hot Spots. This selection to apply and be included within Alternatives #5 and #6. Site regrading to include filling and regrading of pond, and flat areas within interior of south parcel.
No. 6	Surface Cleanup & Hot Spot Remediation (Landfilling or Treatment) & Site Regrading & Shallow Groundwater Treatment	Treatment of shallow groundwater, after hot spot (source) remediation, by air stripping and/or carbon adsorption

TABLE 4-1
COMPARATIVE ANALYSIS OF ALTERNATIVES
GOLDEN ROAD DISPOSAL SITE

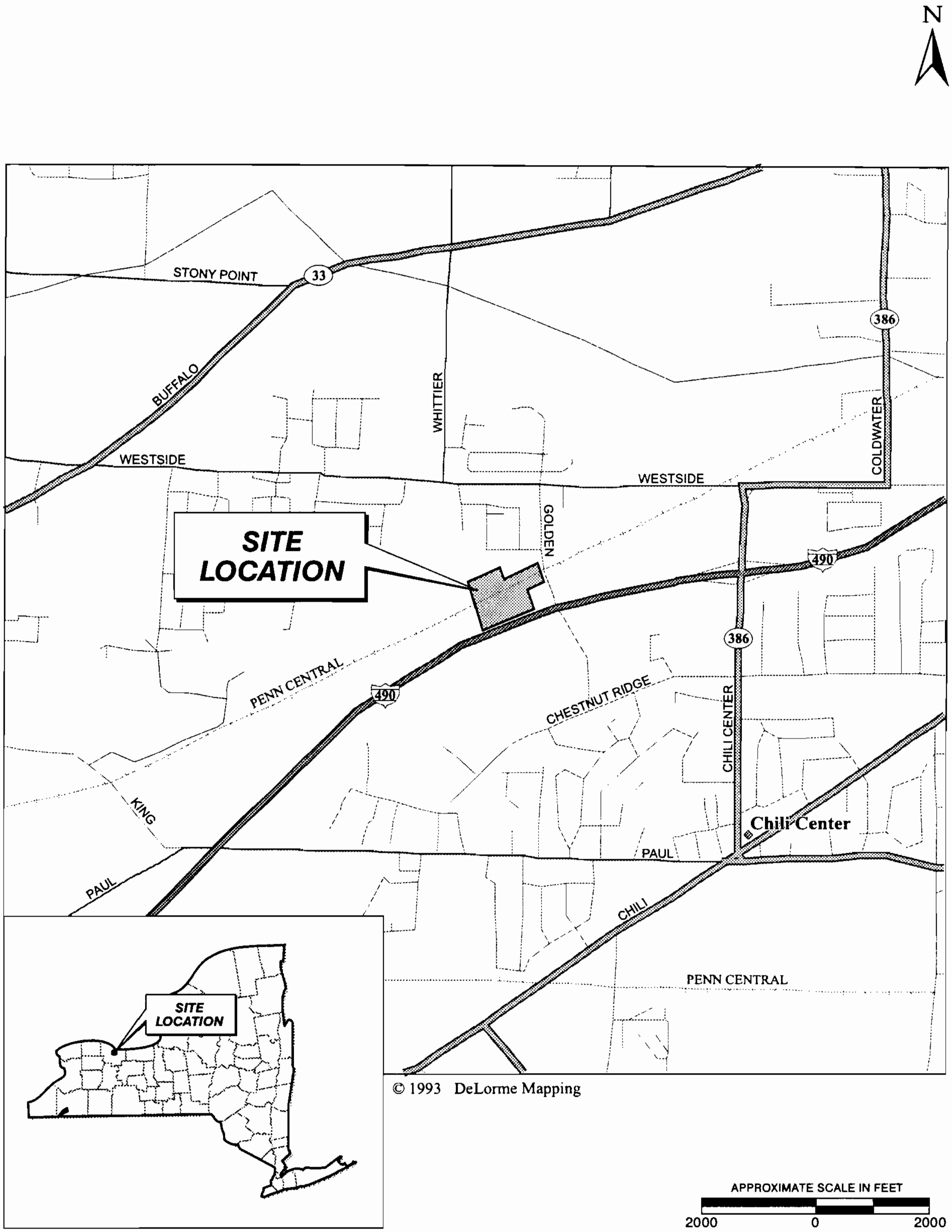
EVALUATION CRITERION	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 INSTITUTION CONTROLS + SURFACE CLEANUP	ALTERNATIVE 3 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING	ALTERNATIVE 4 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH ONSITE TREATMENT	ALTERNATIVE 5 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING + SITE REGRADING	ALTERNATIVE 6 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING + SITE REGRADING + SHALLOW GROUNDWATER TREATMENT
Overall Protection of Human Health and the Environment	No change in potential human exposures (existing) to contaminated surface soil/sediment, surface asbestos and waste drum, or to potential human exposure (future) to more highly contaminated subsurface soil and GW in east bank (TP-3) and west end (SS-02) areas. No change to potential environmental exposure to low-level wetland sediment contamination.	Surface cleanup permanently eliminates potential human exposure (existing) to asbestos and waste drum. Institutional controls reduce likelihood for potential future human contact by residents or onsite workers with more highly contaminated subsurface soils and GW in hot spot areas.	Same as Alt. 2 wrt surface cleanup. Hot spot remediation permanently eliminates potential future human contact by residents or onsite workers with more highly contaminated subsurface soil in hot spot areas.	Same as Alt. 2 wrt surface cleanup. Hot spot remediation permanently eliminates potential future human contact by residents or onsite workers with more highly contaminated subsurface soil in hot spot areas.	Same as Alt. 3 wrt surface cleanup and hot spot remediation. Site regrading (especially pond filling) reduces even further the potential for human or environmental contact with contaminated sediments, and reduces possibility of onsite ponding, infiltration and groundwater contamination following rainfall events., as well as contaminated surface soil migration into wetland.	Same as Alt. 5 wrt surface cleanup, hot spot remediation and site regrading. Collection/treatment of shallow GW prevents short-term discharge of contaminated GW into wetland adjacent to east bank area, and prevents future residential/worker contact with contaminated GW in this area of site (to the extent that residual GW contamination remains after source (soil) remediation).
Compliance with Standards, Criteria and Guidance (SCGs)	Continued exceedance of following SCGs: TAGM 4046 criteria for surface soil (acetone and pentachlorophenol in west end (SS-02) area, and PAHs/metals at numerous locations); TAGM 4046 criteria for subsurface soils (VOCs and 2-methylphenol in east bank (TP-3) area, and PAHs/metals at numerous locations); Class GA standards for shallow, seasonal GW in east bank area (VOCs, SVOCs, metals); TAGM 4046 criteria for frequently dry sediments in wetland and onsite pond (PAHs, metals); TOGS 1.1.1 criteria for seasonal surface water in wetland (metals).	Surface cleanup eliminates exposure to asbestos and waste drum, but does not directly affect chemical-specific SCG exceedances. Institutional controls likewise reduce exposure potential, but do not address SCG exceedances.	Same as Alt. 2 wrt surface cleanup. Hot spot remediation eliminates the most important SCG (TAGM 4046) exceedances at the site – surface and subsurface soil/sediment contamination in the east bank, onsite pond and west end areas.	Same as Alt. 2 wrt surface cleanup. Hot spot remediation eliminates the most important SCG (TAGM 4046) exceedances at the site – surface and subsurface soil/sediment contamination in the east bank, onsite pond and west end areas.	Same as Alt. 3 wrt surface cleanup and hot spot remediation. Regrading somewhat reduces infiltration and resulting production of leachate, with discharge to wetland. Minor exceedances of Class C surface water criteria by metals potentially improved.	Same as Alt. 5 wrt surface cleanup, hot spot remediation and site regrading. GW collection/treatment prevents seasonal migration into wetland of GW exceeding Class GA standards in east bank area, which would otherwise be expected to continue for some period of time following source removal in that area.
Short-Term Impacts and Effectiveness	No short-term impacts. No effective short-term remedy for existing health risks or SCG exceedances.	Surface cleanup involves no significant impacts to community or environment during implementation. Risk to trained onsite workers manageable through conformance with health and safety plan (HASP). Response objectives to be obtained immediately (one week) for surface cleanup, and as soon as institutional controls can be enacted and enforced.	Same as Alt. 2 wrt surface cleanup. Excavation of contaminated soils in east bank area and sediments within pond pose potential risk to adjacent wetland, which can be managed through erosion and sediment control plan. Onsite excavation also creates potential exposure by remediation workers to high levels of contamination – manageable through HASP implementation. Extensive, short-term truck transport for offsite disposal requires community awareness and protection plan for heavy truck traffic on local roads. Remedial action objectives wrt hot spot remediation achieved immediately after implementation (less than one month).	Same as Alt. 3 wrt surface cleanup and excavation of hot spots. Time to achieve soil cleanup goals for composting estimated to be at least 2 summer seasons.	Same as Alt. 3 wrt surface cleanup and hot spot remediation. Site regrading, especially filling of pond, poses potential ecological risk to adjacent wetland, manageable through an effective erosion & sediment control plan. Regrading poses no significant risks to community or onsite workers, and objectives for this action achieved immediately after implementation (several weeks).	Same as Alt. 5 except for addition of shallow GW treatment. Construction of collection/treatment system poses no significant short-term risks to community, environment or onsite workers. GW treatment will achieve objectives immediately (prevention of contaminated GW migration into wetland), and will operate only until effect of soil remediation in east bank area becomes established wrt GW.

Note: wrt = with respect to

TABLE 4-1 (Continued)

EVALUATION CRITERION	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 INSTITUTION CONTROLS + SURFACE CLEANUP	ALTERNATIVE 3 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING	ALTERNATIVE 4 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH ONSITE TREATMENT	ALTERNATIVE 5 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING + SITE REGRADING	ALTERNATIVE 6 SURFACE CLEANUP + HOT SPOT REMEDIATION WITH OFFSITE LANDFILLING + SITE REGRADING + SHALLOW GROUNDWATER TREATMENT
Long-Term Effectiveness and Permanence	No long-term effectiveness except over long time periods by natural attenuation. Risk after implementation is equal to existing risk. No controls utilized to address contamination or manage residual risk.	Surface cleanup is immediately and permanently effective wrt the media it addresses (asbestos, waste drum). Long-term effectiveness of institutional controls, especially extreme ones proposed under this alternative, is doubtful. Existing soil/GW contamination would remain as residual contamination, with no controls.	Same as Alt. 2 wrt surface cleanup. Excavation & offsite landfilling of contaminated soil provides a permanent, effective remedy for hot spot areas. No residual wastes remaining in the areas remediated; therefore, no residual risk or controls necessary to manage risk associated with these soils.	Same as Alt. 2 wrt surface cleanup. Composting transfers subsurface soil contaminants to surface for treatment by biodegradation. During treatment process (at least 2 summer seasons), risk of direct contact with surface contaminants by trespassers or casual site users is increased. Site access controlled only periodically, during tilling operations required for windrow composting. Concern for increased exposure decreases with time, as treatment progresses.	Same as Alt. 3 wrt surface cleanup and hot spot remediation (w/ offsite landfilling). Surface regrading is immediately and permanently effective, with no waste residuals or required controls.	Same as Alt. 5 wrt surface cleanup, hot spot remediation (w/landfilling) and regrading. GW collection and treatment in east bank area is temporary measure, pending establishment of source control (soil excavation) effect on GW quality. During treatment, O&M is required for treatment process, to monitor air dishcarge and water effluent. Technology is very common; required controls are adequate and reliable.
Reduction of Toxicity, Mobility and Volume	No reduction of TMV.	No significant reduction of TMV.	Reduces onsite waste volume by excavation and offsite landfilling of contaminated soils.	Composting results in onsite reduction of TMV of organic contaminants in soil through biodegradation, i.e., conversion by microorganisms to non-toxic end products. Contaminant removal efficiencies exceeding 95% are achievable.	Same as Alt. 3 wrt excavation and offsite landfilling of hot spots. Regrading offers no reduction of TMV.	Same as Alt. 5 wrt excavation and offsite landfilling of hot spots. Regrading does not reduce TMV. Shallow GW treatment by air stripping involves mass transfer of VOCs from GW to air. Liquid effluent discharged to sanitary sewer, from where residual aqueous contamination is treated at POTW.
Implementability	Implementation not applicable except wrt to long-term monitoring, which poses no significant implementation issues.	Surface cleanup is easily implementable. Administrative and legal feasibility of institutional controls prohibiting residential development of site, or future excavation into contaminated soils, is very questionable, especially considering indefinite time period over which controls would be required.	Same as Alt. 2 wrt surface cleanup. Excavation and offsite landfilling is fully implementable, with ample availability and capacity of equipment, contractors and offsite disposal facilities. Technology is proven, reliable and permanent. Agency coordination is not an issue.	Same as Alt. 3 wrt surface cleanup and onsite soil excavation. Composting process simple to implement, but can be labor intensive and require considerable adjustments in the field as part of O&M. May be difficult to effectively implement (or optimize) in a passive mode, on a part-time basis, at a remote location. Equipment and services required are readily available.	Same as Alt. 3 wrt surface cleanup and hot spot remediation by excavation/offsite landfilling. Site regrading offers no implementation issues.	Same as Alt. 5 wrt surface cleanup, hot spot remediation and site regrading. Although GW collection and treatment requires ongoing O&M, technology is proven and reliable, materials and services are readily available, and no difficulties are anticipated in regard to agency coordination (e.g., permit to discharge to existing sanitary sewer).
Cost	Capital Cost = $2,000 Annual O&M Cost = $4,500 Total Present Worth = $71,000.	Capital Cost = $22,000 Annual O&M Cost = $4,500 Total Present Worth = $91,000.	Capital Cost = $364,000 Annual O&M Cost = $4,500 Total Present Worth = $433,000.	Capital Cost = $388,000 Annual O&M Cost = $4,500 Total Present Worth = $457,000.	Capital Cost = $387,000 Annual O&M Cost = $4,500 Total Present Worth = $456,000.	Capital Cost = $542,000 Annual O&M Cost = $48,800 Total Present Worth = $1,293,000.

Note: wrt = with respect to



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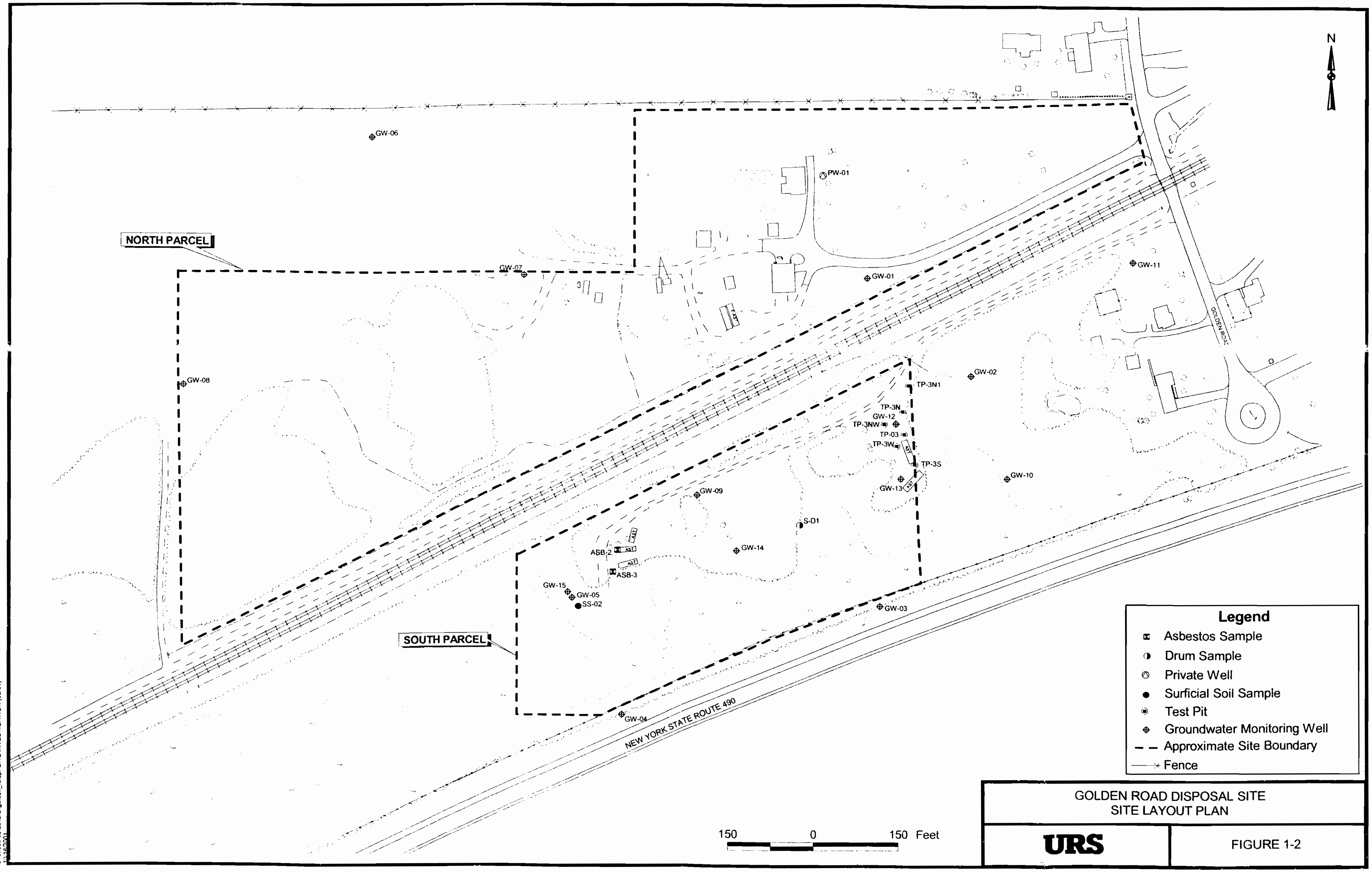
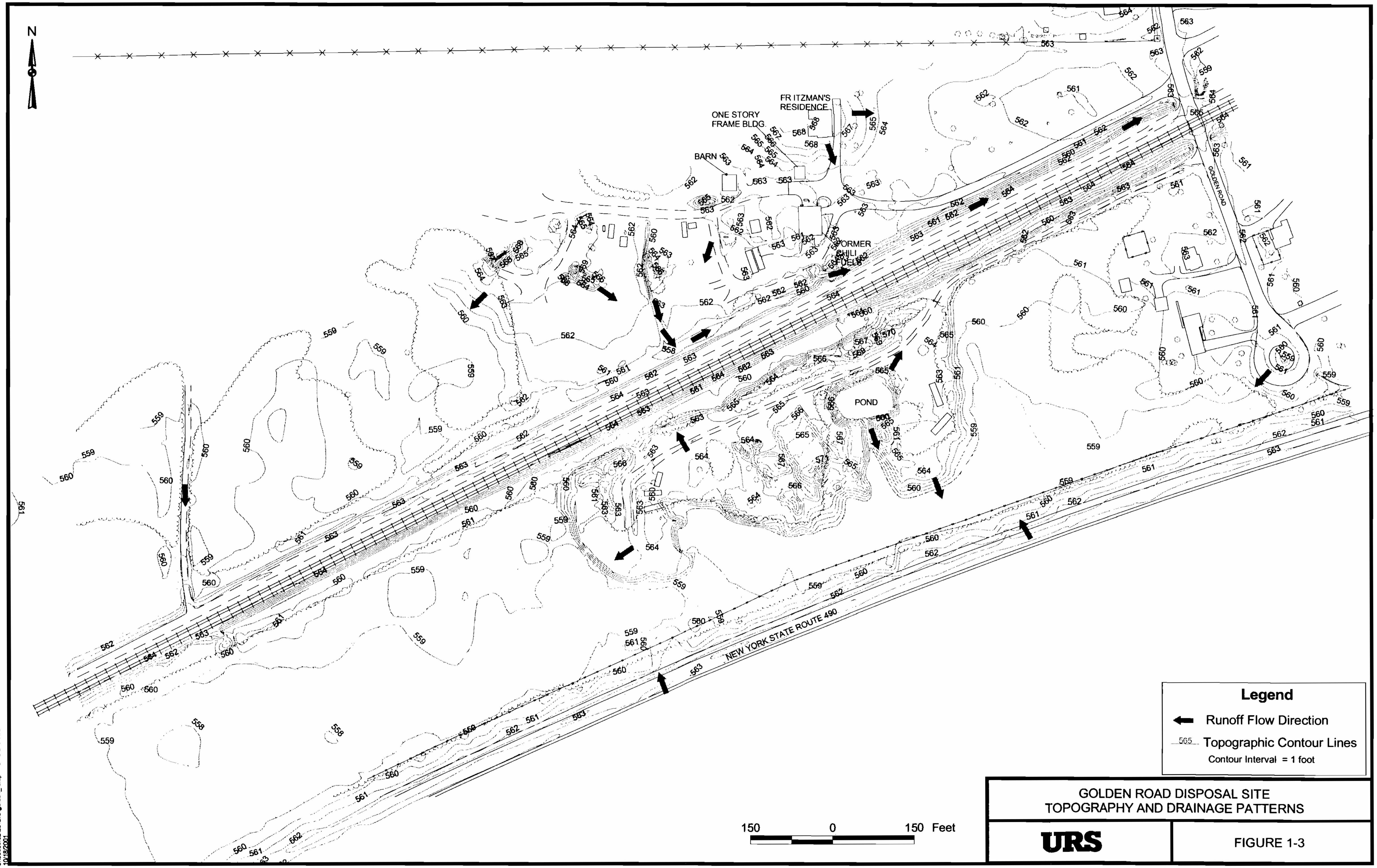
GOLDEN ROAD DISPOSAL SITE
SITE LOCATION MAP

FIGURE 1-1

AG13888-35650.01-041699-GCM


N
NORTH PARCEL
SOUTH PARCEL
GW-01
GW-02
GW-03
GW-04
GW-05
GW-06
GW-07
GW-08
GW-09
GW-10
GW-11
GW-12
GW-13
GW-14
GW-15
PW-01
TP-3N1
TP-3N
TP-3NW
TP-03
TP-3W
TP-3S
S-01
SS-02
ASB-2
ASB-3
GOLDEN ROAD
NEW YORK STATE ROUTE 490
150 0 150 Feet
Legend
Asbestos Sample
Drum Sample
Private Well
Surficial Soil Sample
Test Pit
Groundwater Monitoring Well
Approximate Site Boundary
Fence
GOLDEN ROAD DISPOSAL SITE
SITE LAYOUT PLAN
URS
FIGURE 1-2



GOLDEN ROAD DISPOSAL SITE
TOPOGRAPHY AND DRAINAGE PATTERNS

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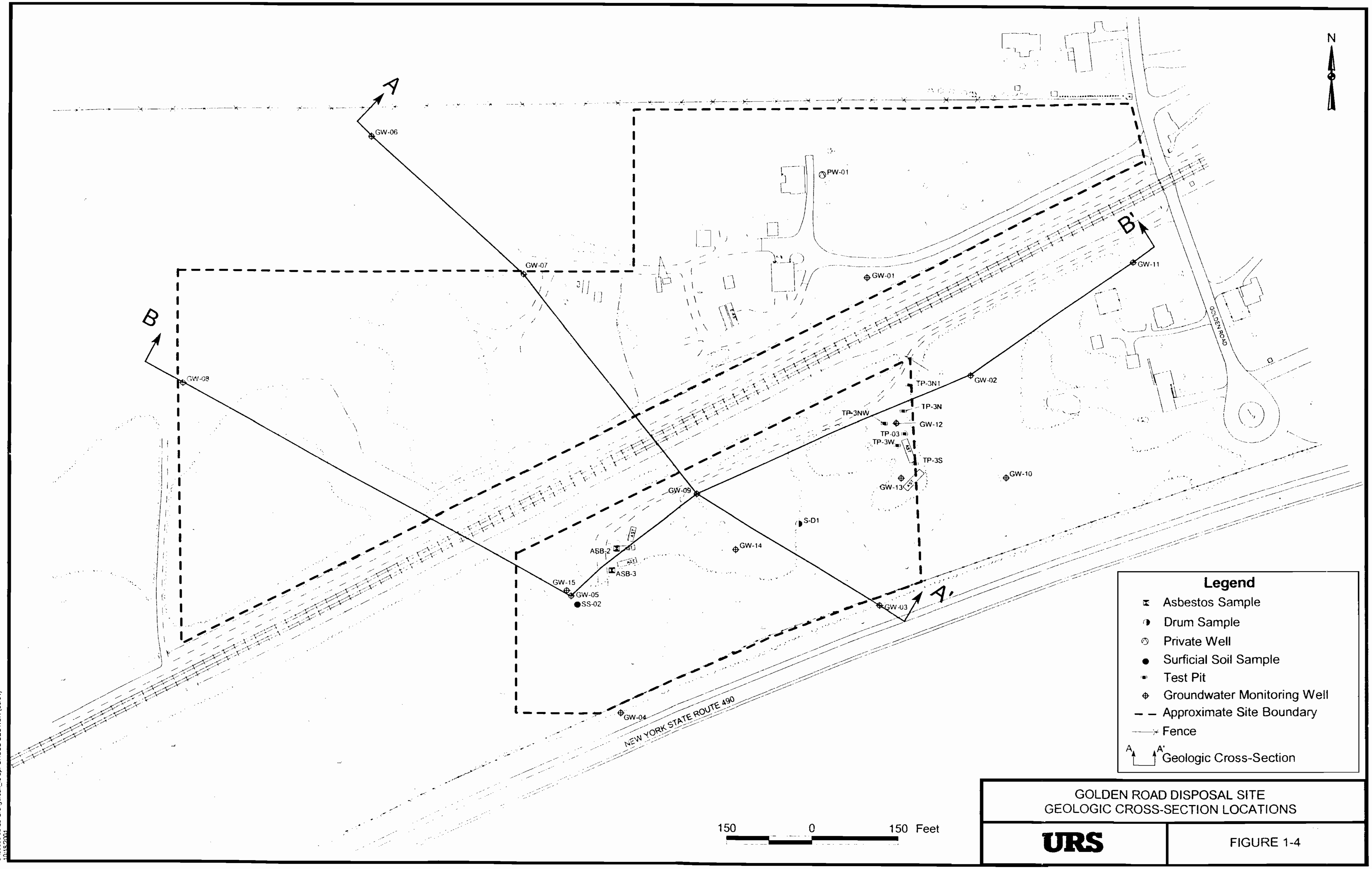
FIGURE 1-3

J:\35650.02\db\GIS\golden_fs.apr TOPOGRAHIC
10/18/2001

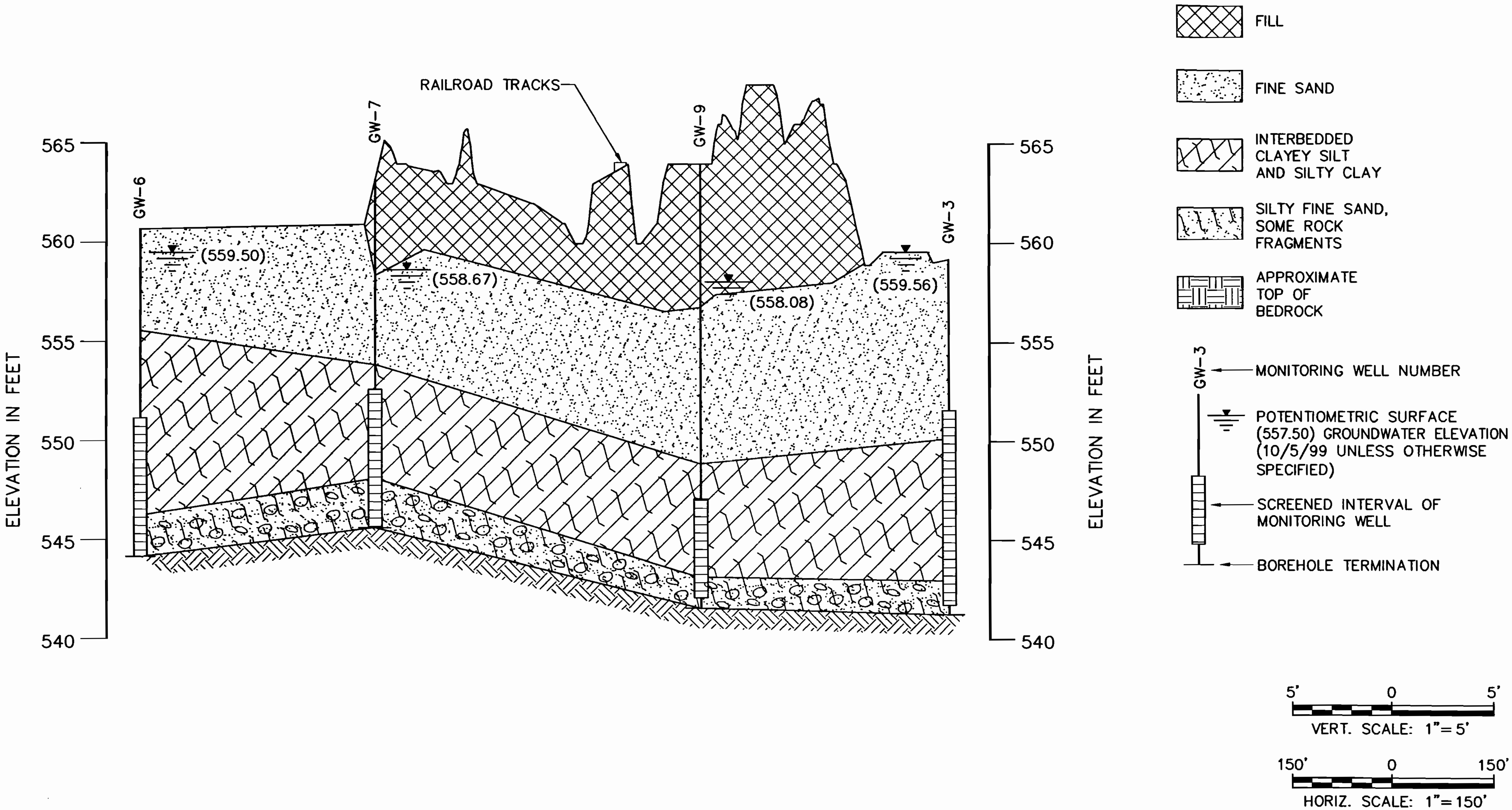


GOLDEN ROAD DISPOSAL SITE
GEOLOGIC CROSS-SECTION LOCATIONS

URS

FIGURE 1-4

J:\35650.02\CAD\ 1=150 10/18/01-10 KAH



NOTES:

1. GEOLOGIC CONDITIONS SHOWN ARE REPRESENTATIVE OF CONDITIONS ENCOUNTERED AT EACH BORING LOCATION TO THE DEPTH DRILLED. EXTRAPOLATIONS BETWEEN BORINGS HAVE BEEN INTERPRETED USING STANDARDLY ACCEPTED GEOLOGIC PRACTICES AND PRINCIPLES. ACTUAL CONDITIONS MAY VARY BETWEEN BORINGS FROM THOSE SHOWN.

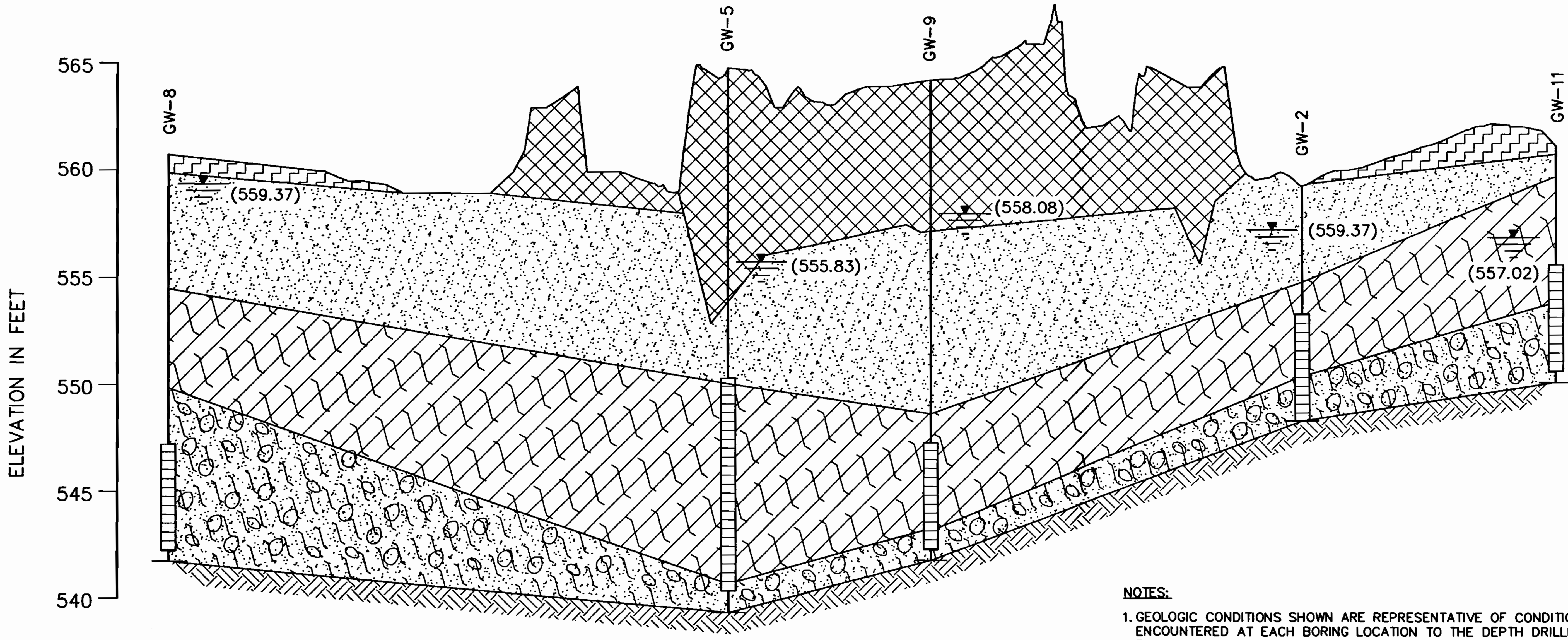
2. ELEVATIONS BASED ON THE NORTH AMERICAN VERTICAL DATUM, 1988.

GOLDEN ROAD DISPOSAL SITE
GEOLOGIC CROSS-SECTION A-A'

URS

FIGURE 1-5

CC-6267

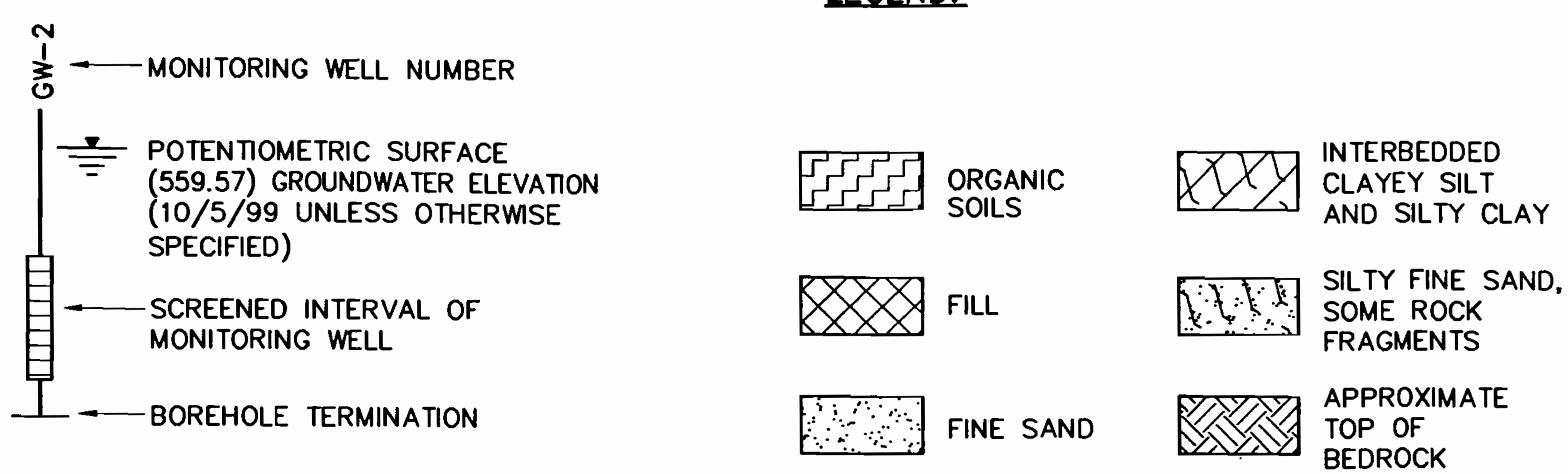


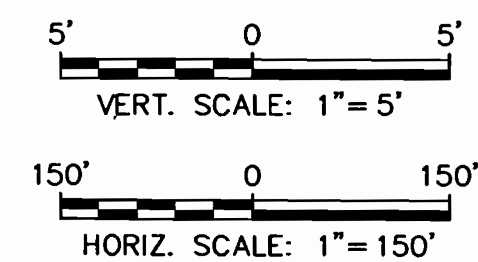
NOTES:

1. GEOLOGIC CONDITIONS SHOWN ARE REPRESENTATIVE OF CONDITIONS ENCOUNTERED AT EACH BORING LOCATION TO THE DEPTH DRILLED. EXTRAPOLATIONS BETWEEN BORINGS HAVE BEEN INTERPRETED USING STANDARDLY ACCEPTED GEOLOGIC PRACTICES AND PRINCIPLES. ACTUAL CONDITIONS MAY VARY BETWEEN BORINGS FROM THOSE SHOWN.

2. ELEVATIONS BASED ON THE NORTH AMERICAN VERTICAL DATUM, 1988.

LEGEND:





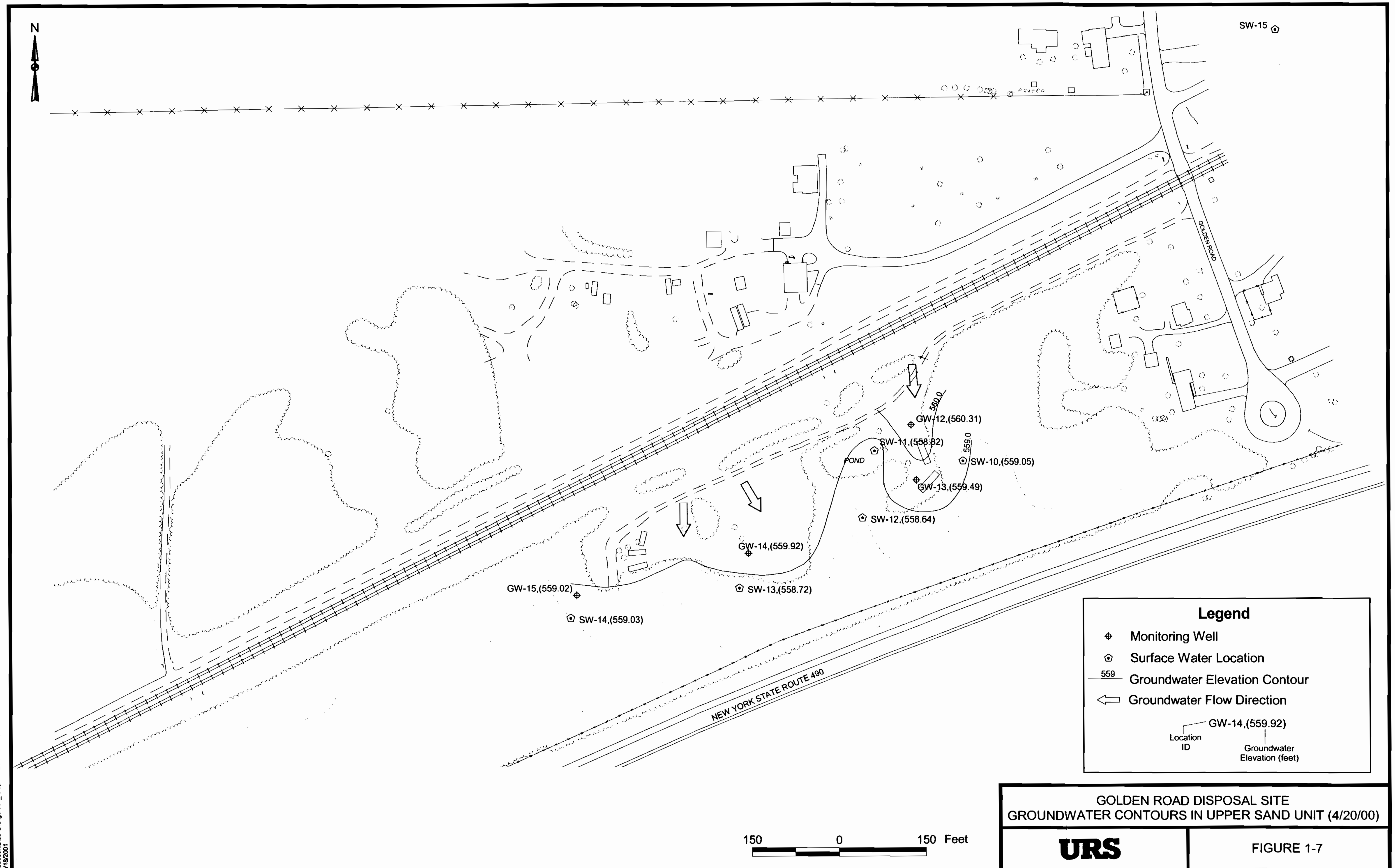
GOLDEN ROAD DISPOSAL SITE
GEOLOGIC CROSS-SECTION B-B'

URS

FIGURE 1-6

J:\35650.02\CAD\ 1=150 10/18/01-6 KAH

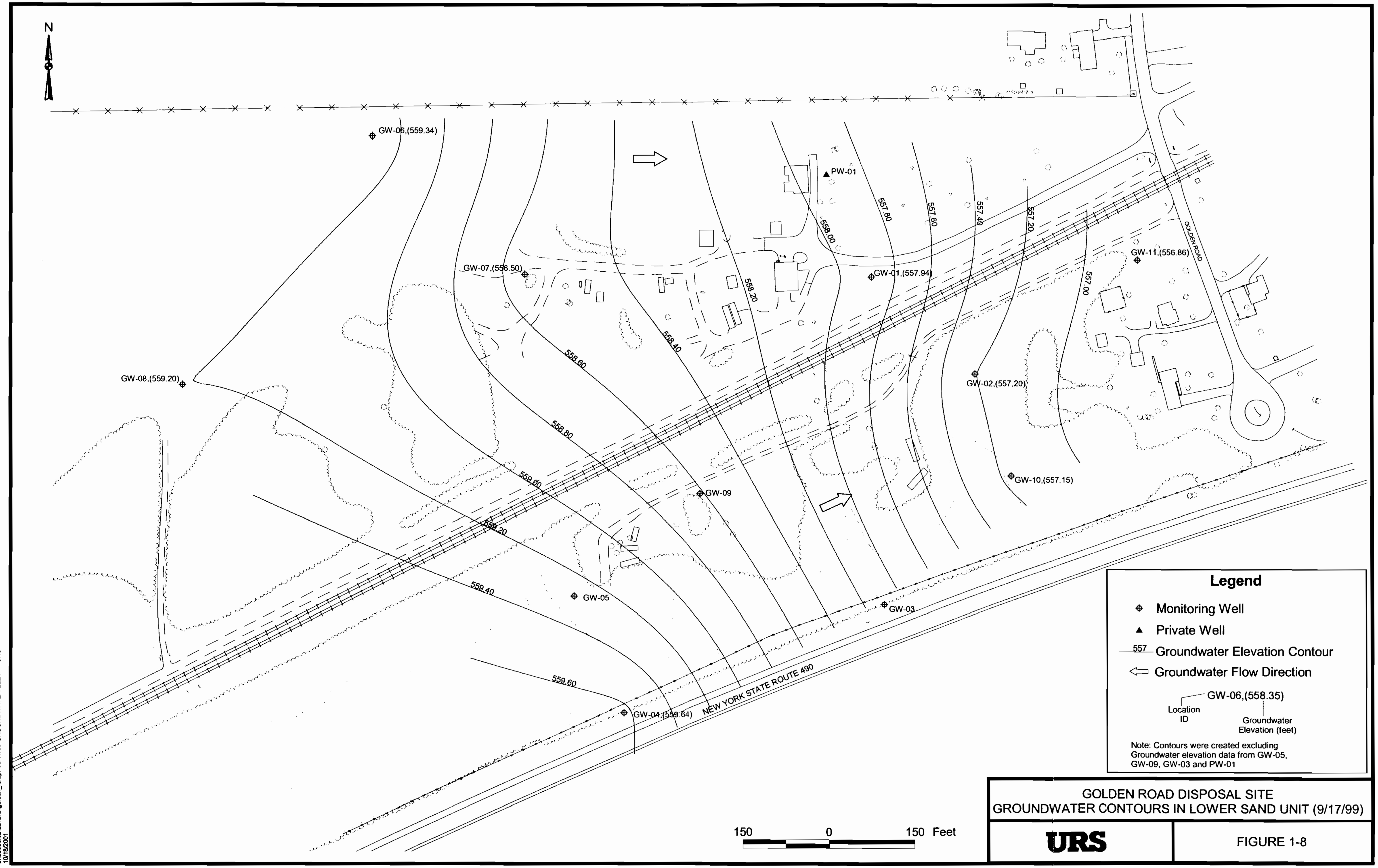
CC-6268



GOLDEN ROAD DISPOSAL SITE
GROUNDWATER CONTOURS IN UPPER SAND UNIT (4/20/00)

FIGURE 1-7

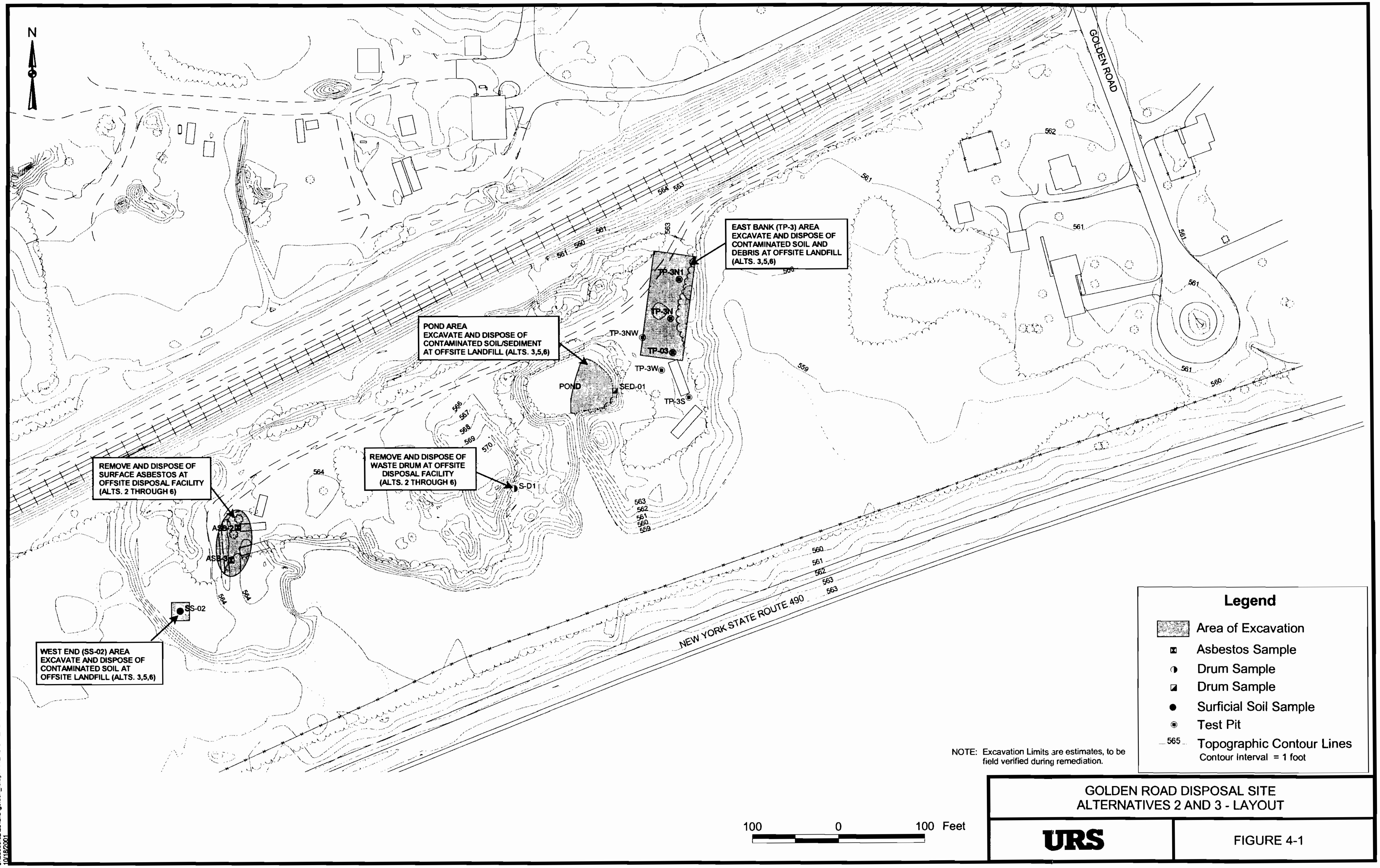
J:\35650.02\db\GIS\golden_fs.apr 04/20/00 GROUNDWATER ELEVATIONS
10/18/2001



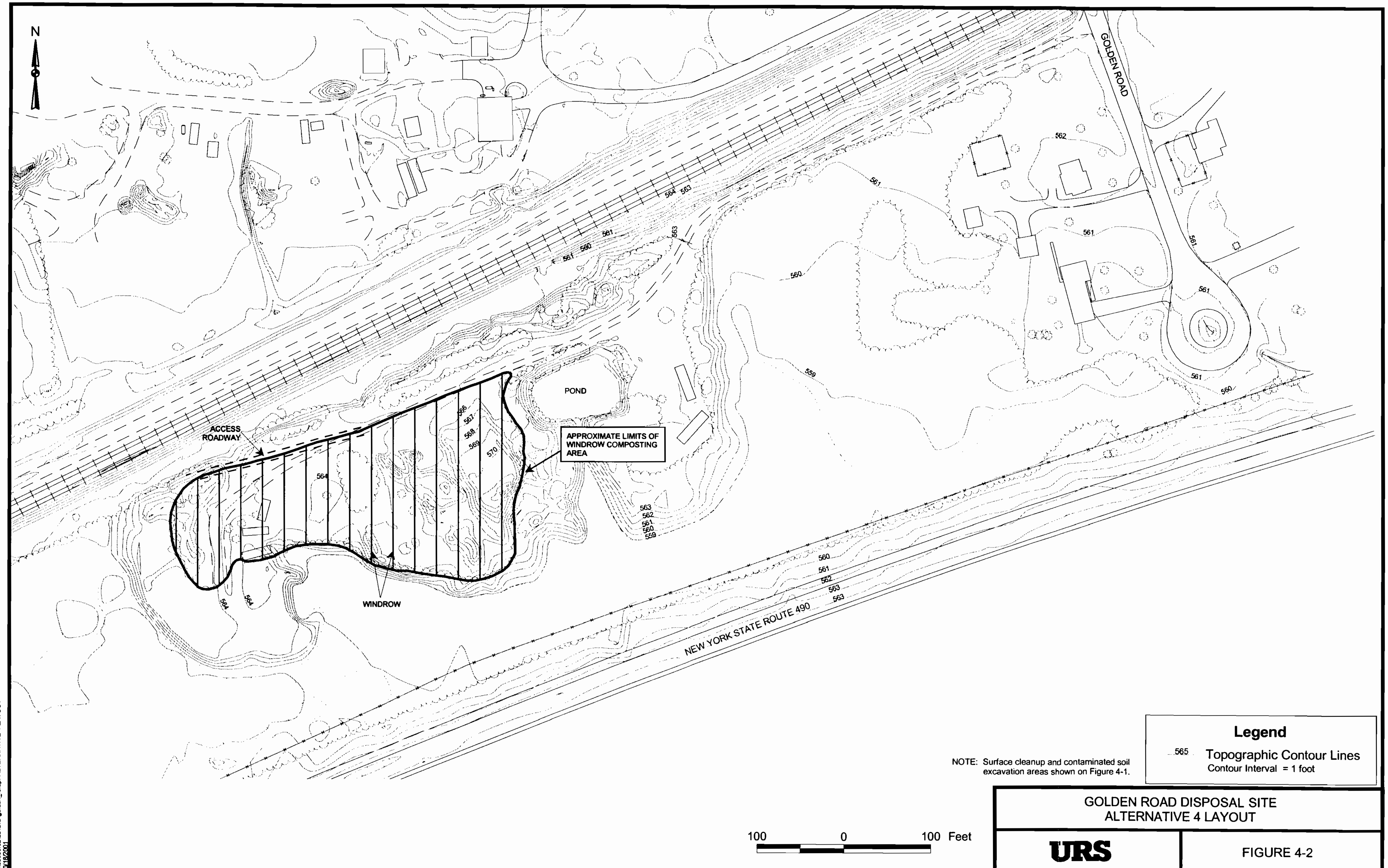
GOLDEN ROAD DISPOSAL SITE
GROUNDWATER CONTOURS IN LOWER SAND UNIT (9/17/99)

FIGURE 1-8

J:\35650.02\db\GIS\golden_fs.apr 09/17/99 GROUNDWATER ELEVATIONS
10/18/2001



J:\35650.02\db\GIS\golden_fs.apr AREAS OF EXCAVATION
10/18/2001

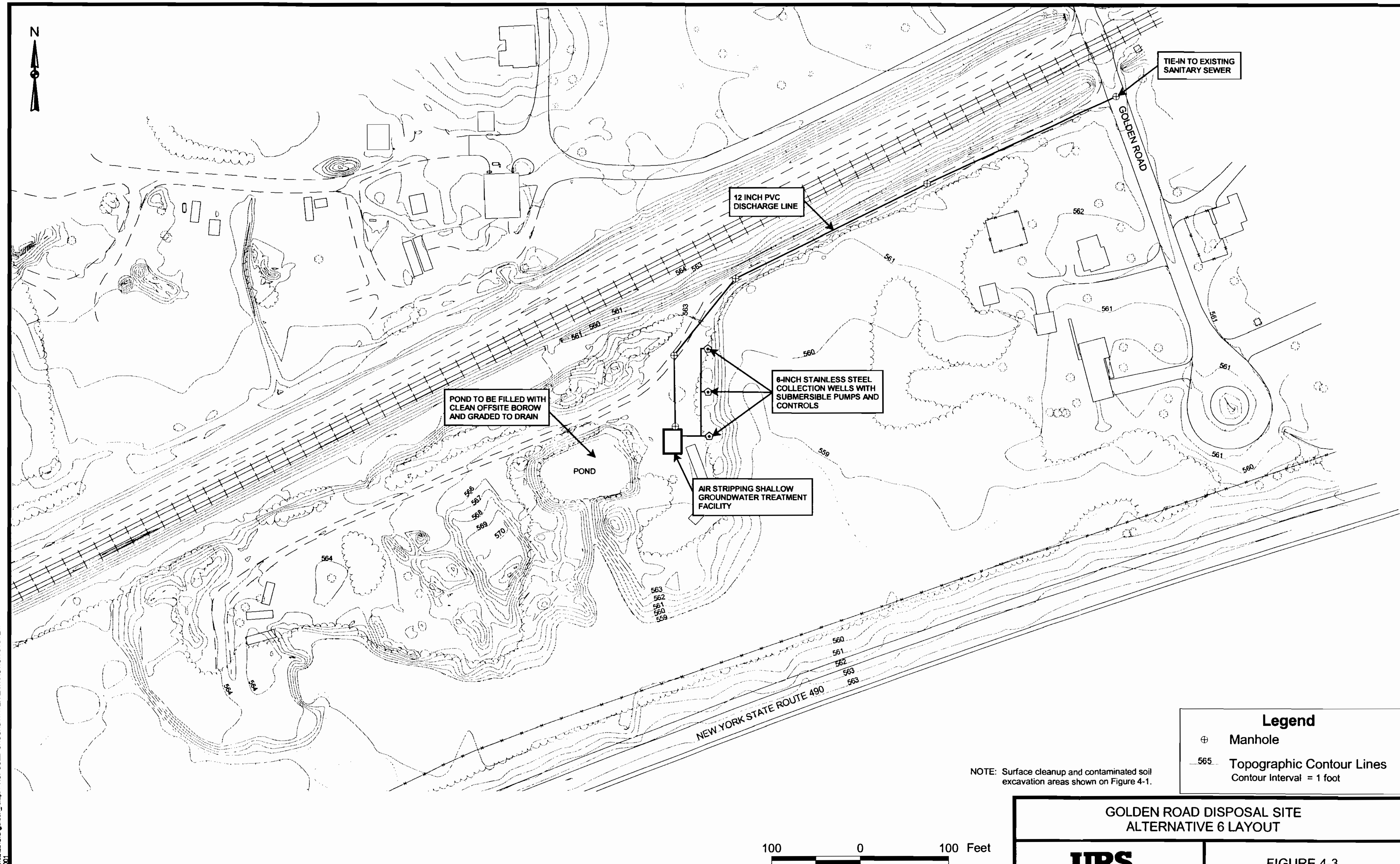


GOLDEN ROAD DISPOSAL SITE
ALTERNATIVE 4 LAYOUT

URS

FIGURE 4-2

J:\35850.02\db\GIS\golden_fs.apr ALTERNATIVE 4 LAYOUT
10/18/2001



NOTE: Surface cleanup and contaminated soil excavation areas shown on Figure 4-1.

Legend

⊕ Manhole

565 Topographic Contour Lines
Contour Interval = 1 foot

GOLDEN ROAD DISPOSAL SITE
ALTERNATIVE 6 LAYOUT

URS

FIGURE 4-3

J:\35650.02\db\GIS\golden_fs.apr PROPOSED GROUNDWATER EXTRACTION SYSTEM
10/18/2001

Appendix A
Remedial Alternative Cost Estimates
Golden Road Disposal Site

This appendix provides estimated costs for each of the alternatives considered in the Feasibility Study (FS) for the Golden Road Disposal Site. In general, the cost estimates are expected to provide an accuracy of approximately +50 percent to –30 percent (i.e., more likely to err on the high side). The estimated costs for each alternative include the following:

- **Capital Costs:** Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and materials necessary to install remedial actions. Examples of direct costs applicable to this project include: construction costs, equipment costs, and transportation/offsite disposal costs. Indirect costs include costs expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Examples of indirect costs applicable to this project include: engineering design and construction management costs (estimated to be 15% of total direct capital costs), construction contingency allowances (estimated to be 25% of total direct capital costs), and legal/administrative costs (estimated to be 5% of total direct capital costs).

- **Annual Operation and Maintenance (O&M) Costs:** Annual O&M costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. They include long-term monitoring costs (labor and laboratory analytical), operating labor costs, maintenance costs and residue disposal costs.

- **Present Worth:** Present worth represents the amount of money that, if invested in the current year and disbursed as needed, would be sufficient to cover all costs associated with the remedial alternative over its planned life, including capital costs and the discounted value of future O&M costs. In discounting the value of future costs for this FS, a discount rate of 5 percent has been assumed, and a performance life of 30 years.

Each of the alternatives evaluated in this FS consists of one or more separate components. Table A-1 summarizes the total cost of each alternative and the components that it comprises. The following tables (Tables A-2 through A-8) provide a detailed breakdown of the costs for each individual component.

Table A-1
Remedial Alternative Cost Summary
Golden Road Disposal Site

Alt. No.	Component (Table)	Capital Cost	Annual O&M Cost	Total Present Worth
1	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Total	$2,400.	$4,500.	$71,400.
2	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Institutional Controls (A-3)	$10,000.	$0.	$10,000.
	Surface Cleanup (A-4)	$9,700.	$0.	$9,700.
	Total	$22,100.	$4,500.	$91,100.
3	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Surface Cleanup (A-4)	$9,700.	$0.	$9,700.
	Hot Spot Remediation/Landfilling (A-5)	$351,900.	$0.	$351,900.
	Total	$364,000.	$4,500.	$433,000.
4	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Surface Cleanup (A-4)	$9,700.	$0.	$9,700.
	Hot Spot Remediation/Treatment (A-6)	$375,900.	$0.	$375,900.
	Total	$388,000.	$4,500.	$457,000.
5	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Surface Cleanup (A-4)	$9,700.	$0.	$9,700.
	Hot Spot Remediation/landfilling (A-5)	$351,900.	$0.	$351,900.
	Site Regrading (A-7)	$23,200.	$0.	$23,200.
	Total	$387,200.	$4,500.	$456,200.
6	Long-Term Monitoring (A-2)	$2,400.	$4,500.	$71,400.
	Surface Cleanup (A-4)	$9,700.	$0.	$9,700.
	Hot Spot Remediation/Landfilling (A-5)	$351,900.	$0.	$351,900.
	Site Regrading (A-7)	$23,200.	$0.	$23,200.
	Shallow Groundwater Treatment (A-8)	$155,000.	$44,300.	$836,500.
	Total	$542,200.	$48,800.	$1,292,700.

Notes:

1) For long-term monitoring, present worth of well replacement cost after 15 years is shown as an equivalent capital cost.

2) For hot spot remediation with treatment (by composting), operating costs for assumed two-season treatment period are included in capital cost.

Table A-2
Component Cost Estimate: Long-Term Monitoring
Golden Road Disposal Site

Item	**Units**	**Quantity**	**Unit Cost**	**Total Cost**
Well Replacement Costs (after 15 years)				
Mob/Demob	EA	1	$1,000.00	$1,000.
6.25" HSA Drilling	LF	45	$16.00	$720.
Continuous Split Spoon Sampling	EA	22	$6.00	$132.
Furnish & Install 2" PVC Casing	LF	36	$13.00	$468.
Furnish & Install 2" PVC Screen	LF	15	$14.00	$210.
Furnish & Install Protective Casing	EA	3	$150.00	$450.
Well Development	EA	3	$140.00	$420.
Close Existing Wells	EA	3	$500.00	$1,500.
Total Well Replacement Cost				$4,900.
Present Worth of Well Replacement Cost (i = 5%, N = 15 yrs)				$2,400.
O&M Costs				
Per Event				
Labor (Sampling, Reporting)	HR	24	$50.00	$1,200.
Expenses	EA	1	$100.00	$100.
Lab Analytical (5 aqueous samples)	EA	5	$500.00	$2,500.
Total Cost Per Event				$3,800.
Annual O&M (Years 1-3)				$7,600.
Annual O&M (Years 4-30)				$3,800.
Equivalent Annual O&M (Years 1-30) (i = 5%, N = 30 yrs)				$4,500
Present Worth of Equivalent Annual **O&M Costs (i = 5%, N = 30 yrs)**				$69,000.
Total Present Worth				$71,400.

Summary: Use 3 existing downgradient monitoring wells (GW-02, GW-10, GW-11) and 2 surface water sampling stations at locations to be determined within wetland. Assume wells will be replaced in 15 years. Sample all locations semi-annually for years 1-3, and annually for years 4-30. Perform laboratory analysis of all samples for TCL (VOCs and SVOCs) and TAL (metals).

Table A-3
Component Cost Estimate: Institutional Controls
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Total DCC				$0.
Indirect Capital Costs (ICC)				
Legal / Administrative Expenses	EA	1	$10,000.	$10,000.
Total ICC				
Total Capital Costs (DCC + ICC)				$10,000.
Annual O&M Costs				
Total Annual O&M Costs				$0.
Present Worth of O&M Costs				$0.
(i = 5%, N = 30 yrs)				
Total Present Worth				$10,000.

Summary: Prepare and establish enforceable restrictions prohibiting future development of the south parcel for residential use, or in any way that might involve excavation, disturbance or exposure to subsurface contamination at the site.

Table A-4
Component Cost Estimate: Surface Cleanup
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Asbestos				
Mobilization/demobilization	EA	1	$1,500.00	$1,500.
Collect and bag bulk material	BAGS	133	$5.85	$778.
Cart bags 50' to dumpster	BAGS	133	$0.81	$108.
Transport to disposal facility	MI	100	$1.70	$170.
Disposal	CY	15	$168.92	$2,534.
Oversight	HR	16	$40.00	$640.
Subtotal				$5,730.
Waste Drum				
Mobilization/demobilization	EA	1	$300.00	$300.
Provide 85-gallon overpack drum	EA	1	$66.17	$66.
Recontainerize drum	EA	1	$46.09	$46.
Load drum on transport vehicle	EA	1	$2.89	$3
Transport to disposal facility	MI	100	$1.70	$170.
Disposal (minimum)	EA	1	$231.75	$232.
Oversight	HR	8	$50.00	$400.
Subtotal				$932.
Total DCC				$6,662.
Indirect Capital Costs (ICC)				
Engrg. Design/Const. Mgmt. (15% DCC)				$999.
Construction Contingency (25% DCC)				$1,666.
Legal / Admin (5% DCC)				$333.
Total ICC				$2,998.
Total Capital Costs (DCC + ICC)				$9,660.
Total Present Worth				$9,660.

Summary: Remove approximately 400 cubic feet (15 CY) of loose asbestos-containing material scattered over an estimated area of approximately 20' x 20' x 1', and one uncontained and non-empty drum. Transport and dispose of offsite at a licensed facility.

Table A-5
Component Cost Estimate: Hot Spot Remediation with Offsite Landfilling
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Mobilization/Demobilization	EA	1	$5,000.00	$5,000.
Health & Safety	EA	1	$6,000.00	$6,000.
Field Office	MO	1	$700.00	$700.
Utilities	MO	1	$600.00	$600.
Site Supervision	HR	120	$55.00	$6,600.
Soil Excavation (Excavator & Operator)	CY	1,720	$5.55	$9,546.
Onsite Hauling (Dump Truck & Operator)	CY	1,720	$4.25	$7,310.
Screening (Portable Plant & Operator)	CY	1,720	$3.55	$6,106.
Loading (Tractor Loader & Operator)	CY	1,720	$6.55	$11,266.
Replacement Fill (Provide and Apply)	CY	1,720	$11.70	$20,124.
Transportation & Offsite Disposal				
Haz Waste (Characteristic/Landfill)	CY	344	$270.00	$92,880.
Non-Haz Waste	CY	1,376	$53.00	$72,928.
Drums (containing aerosol cans/debris)	EA	10	$365.00	$3,650.
Total DCC				$242,710.
Indirect Capital Costs (ICC)				
Engrg. Design/Const. Mgmt. (15% DCC)				$36,410.
Construction Contingency (25% DCC)				$60,680.
Legal / Admin (5% DCC)				$12,140.
Total ICC				$109,230.
Total Capital Costs (DCC + ICC)				$351,940.
Annual O&M Costs				
Total Annual O&M Costs				$0.
Present Worth of O&M Costs				$0.
(i = 5%, N = 30 yrs)				
Total Present Worth				$351,940.

Summary: Excavate 1,720 CY of contaminated soil from 3 hot spot areas. Haul to a portable onsite screening plant to separate aerosol cans/debris. Load bulk soil into trucks for offsite disposal. Assume 80% of soil is non-hazardous and able to be landfilled at a Subtitle D facility; and 20% is hazardous by TCLP (characteristic), and able to be landfilled at a Subtitle C facility. Assume (10) 55-gallon drums of aerosol cans to be transported offsite for disposal as hazardous waste.

Table A-6
Component Cost Estimate: Hot Spot Remediation with Onsite Treatment
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Mobilization/Demobilization	EA	1	$5,000.00	$5,000.
Health & Safety	EA	1	$6,000.00	$6,000.
Field Office	MO	1	$700.00	$700.
Utilities	MO	1	$600.00	$600.
Site Supervision	HR	120	$55.00	$6,600.
Soil Excavation (Excavator & Operator)	CY	1,720	$5.55	$9,546.
Onsite Hauling (Dump Truck & Operator)	CY	1,720	$4.25	$7,310.
Screening (Portable Plant & Operator)	CY	1,720	$3.55	$6,106.
Loading (Tractor Loader & Operator)	CY	1,720	$6.55	$11,266.
Replacement Fill (Provide and Apply)	CY	1,720	$11.70	$20,124.
Transportation & Offsite Drum Disposal	EA	10	$365.00	$3,650.
Onsite Treatment (Windrow Composting)				
Combined Unit Cost (incl. liner, appli-	CY	1,720	$106.00	$182,320.
cation, soil amendments, tilling,				
sampling, analysis, final spreading)				
Total DCC				$259,222.
Indirect Capital Costs (ICC)				
Engrg. Design/Const. Mgmt. (15% DCC)				$38,880.
Construction Contingency (25% DCC)				$64,810.
Legal / Admin (5% DCC)				$12,690.
Total ICC				$116,650.
Total Capital Costs (DCC + ICC)				$375,872.
Annual O&M Costs				
Included in Combined Unit Cost				$0
Total Present Worth				$375,872.

Summary: Perform soil excavation, handling, screening and fill replacement as with "Excavation and Offsite Landfilling" (Table A-5). After screening, load soil and deliver to onsite composting area. Apply soil in lined windrows and mix with bulking agents and organic amendments. Till soil on an assumed biweekly basis for an estimated two-season treatment period (6 months per season), then spread treated soil across site surface.

Table A-7
Component Cost Estimate: Site Regrading
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Mobilization/Demobilization	EA	1	$500.00	$500.
Deliver & apply fill / Regrade pond	CY	940	$11.70	$10,998.
Site Regrading (Tractor/Dozer)	DAY	3	$1,500.00	$4,500.
Total DCC				$15,998.
Indirect Capital Costs (ICC)				
Engrg. Design/Const. Mgmt. (15% DCC)				$2,400.
Construction Contingency (25% DCC)				$4,000.
Legal / Admin (5% DCC)				$800.
Total ICC				$7,200.
Total Capital Costs (DCC + ICC)				$23,198.
Annual O&M Costs				
Total Annual O&M Costs				$0.
Present Worth of O&M Costs				$0.
(i = 5%, N = 30 yrs)				
Total Present Worth				$23,198.

Summary: Fill the pond in the eastern portion of the south parcel with offsite borrow material. Grade the pond area to drain toward the wetland. Also, flatten the several mounds and grade the few low spots in the unwooded sections of the south parcel to provide a freely draining surface.

Table A-8
Component Cost Estimate: Shallow Groundwater Treatment
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Direct Capital Costs (DCC)				
Collection System				
F&I 6" SS Collection Wells	EA	3	$2,700.00	$8,100.
F&I 4" Submersible Pumps (2 HP)	EA	3	$2,900.00	$8,700.
Electrical, piping, surface controls	EA	1	$6,000.00	$6,000.
Discharge to Sanitary Sewer System				
12" PVC Sewer Pipe	LF	750	$12.20	$9,150.
Excavation and Backfill	LF	750	$4.00	$3,000.
Bedding	LF	750	$2.00	$1,500.
Precast Manhole, 6'deep, 4' diameter	EA	4	$965.00	$3,860.
Tie-in to Existing Sewer on Golden Rd	EA	1	$1,000.00	$1,000.
Treatment System (Air Stripping)				
Equalization/Storage Tank	GAL	720	$0.63	$450.
Air Stripper with Blower	EA	1	$9610	$9,610.
Control Panel	EA	1	$9000	$9,000.
Process Pumps	EA	2	$2175	$4,350.
Subtotal Equipment ($23,410)				
Equipment Installation (50% x Equip)				$11,710.
Instrument & Controls (20% x Equip)				$4,680.
Piping (60% x Equip)				$14,050.
Electrical (10% x Equip)				$2,340.
Buildings (40% x Equip)				$9,360.
Total DCC				$106,860.
Indirect Capital Costs (ICC)				
Engrg. Design/Const. Mgmt. (15% DCC)				$16,030.
Construction Contingency (25% DCC)				$26,720.
Legal / Admin (5% DCC)				$5,340.
Total ICC				$48,090.
Total Capital Costs (DCC + ICC)				$154,950.
Annual O&M Costs				
O&M Labor	HRS	480	$65	$31,200.
Maintenance (3% x Total Capital Cost / Treatment System = 3% x $95,000)				$2,850.
Insurance and Taxes (1% x $95,000)				$950.
Maintenance Reserve and Contingency (1% x $95,000)				$950.
Electricity	KWhr	11,000	$0.10	$1,100.

Table A-8 (Continued)

Discharge to Sewer	1000 gal	62.4	$1.45	$90.
Monitoring (Samples/Analyses)	EA	24	$300	$7,200.
Total Annual O&M Costs				$44,340.
Present Worth of O&M Costs				$681,590.
(i = 5%, N = 30 yrs)				
Total Present Worth				$836,540.

Summary: Install three (3) 6-inch stainless steel collection wells along the east bank of the south parcel, each equipped with a 4-inch submersible pump. Tie collection wells into an air stripping groundwater air stripping treatment plant, to be constructed for the treatment of shallow groundwater from the area around TP-03 on the east bank. Detailed cost estimate and assumptions for treatment by air stripping is provided in Appendix C. Following treatment, discharge effluent through a 12-inch PVC sewer line, to be constructed along the existing dirt entrance roadway and connecting to the existing sanitary sewer in Golden Road.

Appendix B
Evaluation of Soil Remediation Alternatives
Golden Road Disposal Site

The purpose of this appendix is to evaluate alternative treatment options for the ex-situ treatment of surface and subsurface soil from three "hot spot" areas at the Golden Road Disposal Site: (1) an area along the east bank of the south parcel near Test Pit #3 (see Figure 1-2 in text); (2) an area near the west end of the south parcel at surface soil sample location SS-02; and (3) the excavated pond in the east part of the south parcel. The appendix consists of the following sections:

- **Section B-1: Description of Contaminated Areas –** Each of the three contaminated areas listed above is described in terms of physical dimensions and chemical characterization.

- **Section B-2: Evaluation of Treatment Options –** The following treatment options for the ex-situ treatment of contaminated soil are evaluated comparatively: biodegradation (composting); chemical oxidation; low-temperature thermal desorption; and solidification/stabilization. The factors considered in this comparative evaluation are: (a) effectiveness in providing protection by reduction in toxicity, mobility or volume of contaminants; (b) implementability from both technical and administrative standpoints; and (c) cost. For all treatment options, it is assumed that treatment will be performed onsite (ex-situ), that the contaminated soil excavated for treatment will be replaced with clean fill (to avoid potential fall hazards during the period of treatment), and that the treated soil will ultimately be spread across a portion of the site in a one-foot layer and graded to drain.

- **Section B-3: Description of Recommended Treatment Option –** Based upon the foregoing evaluation, the recommended soil treatment option is described in terms of physical layout, construction/implementability aspects, operation and maintenance (O&M) requirements during the treatment period, and estimated time to achieve treatment objectives. The estimated cost of the recommended option is presented in Appendix A.

B.1 Description of Contaminated Areas

The three contaminated "hot spot" areas on the south parcel of the Golden Road Disposal Site are described as follows. Note that the dimension of these areas are estimates only, based upon existing RI data, and that the final dimensions will be determined during remedial excavation using a combination of observations, field measurements and confirmatory soil sampling.

East Bank (Test Pit #3) Area – This is the most significant of the site "hot spots" in terms of both extent and contamination levels. It occurs within a band approximately 30-50 feet wide along the east edge of the fill, extending for at least 100 feet northward from the northernmost of the two abandoned ASTs in the area (see Figure 1-2 in text). Soil contamination within this area appears to extend vertically through the depth of fill material, varying from approximately 6 to 9 feet. The estimated volume of contaminated soil in the area is approximately 1,400 cubic yards (40 ft. x 120 ft. x 8 ft.). Allowing for 15 percent over-excavation during remediation, the estimated soil volume to be excavated for treatment in this area is approximately 1,600 cubic yards (2,500 tons).

Test pits in the east bank area revealed the presence of numerous aerosol spray cans (some still containing product), liquid waste material, and visibly discolored (typically purple) soil. A liquid sample of waste material collected from within one of the aerosol cans indicated the presence of toluene at approximately 22 percent, methylene chloride at 17 percent, total xylenes at 15 percent, and ethylbenzene at 3.2 percent. In addition, high contaminant concentrations were detected in the four soil samples collected from within the test pits, as indicted by the following summary of parameters that exceeded TAGM 4046 (SCG) values in one or more of the soil samples:

Class – Parameter		Concentration Range (mg/kg)		
VOC -	Methylene chloride	ND	-	5.4
	Tetrachoroethene	ND	-	0.084
	Toluene	0.033	-	97
	Ethylbenzene	0.092	-	81
	Total xylenes	4.1	-	610
SVOC-	2-Methylphenol	ND	-	0.88
	Benzo(a)anthracene	2.8	-	8.2
	Chrysene	4.5	-	13
	Benzo(b)fluoranthene	6.3	-	12
	Benzo(k)fluoranthene	2.5	-	11
	Benzo(a)pyrene	2.5	-	8.1
	Indeno(1,2,3-cd)pyrene	2.8	-	11
	Dibenz(a,h)anthracene	1.4	-	5.6
Metal -	Beryllium	0.14	-	0.34
	Chromium	27.9	-	386
	Copper	10.0	-	31.9
	Iron	8,320	-	11,200
	Nickel	172	-	361
	Zinc	14.4	-	114

West End (SS-02) Area – Contamination within this area is believed to be very localized, and to occur near the surface. Based upon data from the RI and previous investigations, the estimated extent of contamination in the area is approximately 10 feet by 10 feet, centered around SS-02 (see Figure 1-2 in text), with an estimated depth of approximately 4 feet. Allowing for 15 percent over-excavation during remediation, this results in an estimated volume of approximately 20 cubic yards (30 tons) of soil to be excavated for remediation from this area.

In the single surface soil sample collected from the area (SS-02), the parameters exceeding TAGM 4046 criteria were:

VOC -	Acetone	0.49 mg/kg
SVOC-	Pentachlorophenol	360 mg/kg
Metal -	Cobalt	295 mg/kg
	Lead	2,680 mg/kg
	Manganese	2,100 mg/kg
	Nickel	49.0 mg/kg
	Sodium	228 mg/kg

Zinc	763 mg/kg

Pond – The single surface soil (sediment) sample collected from the excavated, seasonally dry pond near the east end of the south parcel (SED-01) indicted exceedances of TAGM 4046 values for a number of polynuclear aromatic hydrocarbons (PAHs) and metals. Assuming that this contamination extends over approximately one-half of the pond bottom area (i.e., approximately one-half times 5,000 square feet), and to a depth of one foot, the estimated soil volume to be excavated for ex-situ treatment is approximately 100 cubic yards (150 tons).

The following TAGM 4046 exceedances were detected in the sample (SED-01) from this area:

SVOC-	Benzo(a)anthracene	2.6 mg/kg
	Chrysene	4.2 mg/kg
	Benzo(b)fluoranthene	6.7 mg/kg
	Benzo(k)fluoranthene	3.3 mg/kg
	Benzo(a)pyrene	4.5 mg/kg
	Indeno(1,2,3-cd)pyrene	3.3 mg/kg
Metal -	Antimony	1.8 mg/kg
	Chromium	390 mg/kg
	Copper	34.3 mg/kg
	Nickel	476 mg/kg
	Sodium	101 mg/kg

B.2 Evaluation of Treatment Options

B.2.1 Biodegradation

A. Description

Ex-situ biodegradation, which at the Golden Road Disposal Site would be accomplished by composting, involves the excavation of contaminated soils and addition of proper soil amendments, such as bulking agents, nutrients, oxygen and moisture, that maintain optimum conditions and provide energy to soil microbes, thereby enhancing biodegradation of contaminants. Excavated soils are placed on an impermeable liner, and composting is usually achieved by putting soil and amendments in piles that are aerated with blowers or vacuum pumps (static piles), or in a mechanically agitated vessel, or in long piles that are periodically mixed with mobile equipment (windrow composting).

B. Evaluation

Effectiveness: Biodegradation is a proven technology, used primarily for treating organic non-halogenated contaminants in soil. Halogenated organics can also be treated with biodegradation, though possibly with reduced effectiveness. Volatile organics may volatilize into the air stream during the soil excavation. This process will not treat soil metals detected at the site, although their concentration may be reduced during soil mixing. Therefore, use of biodegradation for treating site soils will reduce the toxicity, mobility and volume of the organic contaminants only, which are the primary contaminants of concern at the hot spot areas of the Golden Road Disposal site.

Implementability: Before implementing ex-situ biodegradation at the Golden Road site, all the debris (e.g., aerosol spray cans) will be removed for appropriate offsite disposal. If the excavation of contaminated soils extends below the water table, dewatering may be required. This water would need to be appropriately treated and/or disposed. However, since soil contamination is confined to the fill layer, which was dry during the initial RI activities, it is assumed that the soil excavation during remediation could be timed so as to eliminate the need for construction dewatering and treatment. This technology would include the excavation and handling of contaminated soils, backfill with uncontaminated fill material, screening for debris removal, and treatment of the contaminated soils by onsite composting. After treatment, the soils will be spread and graded on site. Equipment needed for implementing this process is readily available. The south parcel includes sufficient space, outside the contaminated area, that can be used for the required spreading and composting of the soils.

The amount of time required for engineering design and contractor procurement would be approximately six months. Composting itself is a temperature-dependent process that (without the addition of heat) is primarily effective in the warm summer months. For this reason, and considering the time required for organic contaminants to biodegrade, it is estimated that composting will require at least two years to achieve soil cleanup criteria for organics.

Cost: Representative costs for ex-situ biodegradation are approximately $200/cubic yard for windrow composting, $236/cubic yard for static pile composting and $290/cubic yard for mechanically agitated in vessel composting (Federal Remediation Technologies Roundtable, Remediation Technologies Screening Matrix and Reference Guide Version 3.0, http://www.frtr.gov/matrix2). Therefore, the estimated total cost, including operation and maintenance, for treating contaminated soil (1,720 cubic yards) at the Golden Road site with ex-situ biodegradation would range from approximately $345,000 to $500,000, depending upon the type of composting utilized.

B.2.2 Chemical Oxidation

A. Description

Chemical oxidation chemically converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert. Chemical oxidation involves the transfer of electrons from one compound to another. Thus, one chemical is oxidized (loses electrons) and one is reduced (gains electrons). The most common oxidizing agents are ozone, hydrogen peroxide, hypochlorites, chlorine and chlorine dioxide.

B. Evaluation

Effectiveness: Chemical oxidation is a proven technology that is most effective in treating inorganic chemicals in contaminated soils. Although it can also be effective in treating volatile and semivolatile organics, and is frequently used for this purpose, treatment for organics by chemical oxidation is usually applied in-situ.

Implementability: Before implementing chemical oxidation at the Golden Road site, all the debris (e.g., aerosol spray cans) will be screened and removed for appropriate offsite disposal. Chemical oxidation would include the excavation and handling of contaminated soils, backfill with uncontaminated fill material, screening for debris removal, and treatment of the contaminated soils before they are left onsite. Water would be added to the excavated soils to create a slurry that is transferred to a reactor where chemical reagents would be added to react with the contaminants.

Treated soil would be washed and dewatered, and water from the dewatering process would be recycled back to the reactor. After treatment, the soils would be spread and graded on site. Equipment needed for implementing this process is readily available. The site includes sufficient space, outside the contaminated area, that could be used for the reactor and associated equipment required for ex-situ oxidation.

The amount of time required for engineering design and contractor procurement would be approximately six months. Although the chemical oxidation process itself is rapid, its application for treating organic soil contaminants ex-situ in a reactor has not been established. Therefore, chemical oxidation may require more than one construction season for the organic contaminants to degrade and meet soil cleanup criteria.

Cost: Representative costs for chemical oxidation of contaminated soils range from approximately \$150 to \$500/cubic yard. Therefore, the total estimated cost for treating the soil contamination at the Golden Road site by chemical oxidation would range from approximately \$260,000 to \$860,000.

B.2.3 Low-Temperature Thermal Desorption

A. Description

Low-temperature thermal desorption is a technology that uses temperatures between 90 and 320° C to volatilize water and contaminants. Contaminated soils are excavated and placed in a heated chamber consisting of a rotating drying unit. Volatilized contaminants are transported via a carrier gas to a gas treatment unit, where they are removed with carbon adsorption or catalytic oxidation prior to off-gas discharge. Particulates are removed from the off-gas stream by using baghouses. Volatile metals may also be removed by low-temperature thermal desorption systems. Treated soils are able to support future biological activity because organic components of the soil are not damaged by use of this process.

B. Evaluation

Effectiveness: Low-temperature thermal desorption is a proven and well-established technology for removing organics from soil. If the water content of contaminated soil is higher than 20 to 25%, a dryer may be used in the feed system to facilitate the process. Volatilized contaminants from the dryer are routed to the off-gas treatment section of the process. Metals in the feed will not be removed from the soil. However the primary contaminants of concern in the hot spot areas at the Golden Road Disposal Site are organics. Therefore, the use of low-temperature thermal desorption would effectively reduce the toxicity, mobility and volume of the important site contaminants.

Implementability: Application of low-temperature thermal desorption at Golden Road would include the excavation and handling of contaminated soils, backfill with uncontaminated fill material, and treatment of the contaminated soils before they are left onsite. To implement low-temperature thermal desorption at the Golden Road site, all the debris (aerosol cans, etc.) would be physically screened and separated, then removed for appropriate offsite disposal, before the soil is introduced into the treatment system. After treatment, the soils would be spread and graded on site. Most of the components required for this treatment process are readily available off the shelf, or are skid-mounted. Adjusting the feed rate, the dryer temperature, or the residence time of the materials in the heated chamber controls the degree of contaminant removal.

The amount of time required for engineering design and contractor procurement is approximately six months. Soil treatment by low-temperature thermal desorption could be completed within one construction season.

Cost: Representative costs for low-temperature thermal desorption range from approximately $40 to $300/ton (or $60 to $450/cubic yard). Therefore, the total cost for treating the soil contamination at the Golden Road site with low-temperature thermal desorption would range from approximately $103,000 to $774,000.

B.2.4 Solidification/Stabilization

A. Description

Ex-situ solidification/stabilization involves the excavation of contaminated soils, and the addition of reagents to bind the contaminants to a solid matrix and render them immobile. The stabilizing agents that are mixed with contaminated soil may be cement-based, thermoplastic-based, organic-polymer based, pozzolanic-based or silicate-based. These reagents are typically added to contaminated soils in mixing pits, with the stabilizing mixture subsequently moved to curing and final disposal or placement areas. Suitability of a given process for a given site is a function of site soil and contaminant characteristics. Vitrification is another solidification method during which contaminated soils are heated to approximately 1200°C, to melt and convert waste materials to molten glass. High temperatures destroy organic chemicals while metals are incorporated into the glass structure.

B. Evaluation

Effectiveness: Stabilization is a proven and well-established technology for the immobilization of inorganic contaminants in soil. Chemical additives for the immobilization of organic contaminants have also been developed and have shown limited effectiveness against semivolatiles and pesticides, although there is little expected effectiveness against volatile organics (except in the case of vitrification.) Since volatile organics are significant contaminants of concern at Golden Road, this technology is feasible but not well suited for application at the site.

Implementability: There are no technical concerns regarding the implementability of ex-situ stabilization/solidification at the Golden Road site. This technology would include the excavation and handling of contaminated soils, backfill with uncontaminated fill material, and treatment of the contaminated soils before they are left onsite. Before implementing ex-situ stabilization/ solidification at the Golden Road site, all the debris (e.g., aerosol spray cans) would be removed for appropriate disposal. Stabilization/solidification produces monoliths of treated soil, which, if left onsite, might impede future use of the site. Soil stabilization/solidification produces increased volume of treated soils that results in increased space requirements for disposal of the treated soils.

The amount of time required for engineering design and contractor procurement would be approximately six months. Soil treatment with stabilization/solidification is expected to be completed within one construction season.

Cost: Representative costs for stabilization/solidification range from approximately $100 to $200/ton ($150 to $300/cubic yard.) Therefore, the total estimated cost for treating contaminated soil at the Golden Road site using this technology would range from approximately $258,000 to $516,000.

B.2.5 Comparative Evaluation of Treatment Options

Of the four treatment options considered above, two are considered to be the most effective for treating the primary contaminants of concern at the Golden Road Disposal Site, volatile and semivolatile organic compounds. These two treatment options are biodegradation (by composting) and low-temperature thermal desorption. Although chemical oxidation has the potential to effectively treat both organic and inorganic contaminants, its application to date for the treatment of organics has been limited primarily to in-situ treatment. (In-situ treatment at Golden Road is not feasible due to the large amount of debris (e.g., aerosol cans) that are buried with the contaminated soil.) Solidification/stabilization is also not considered to be an optimum technology, since it is most effective for the treatment of metals and "heavy" organic compounds such as pesticides and semivolatile organics.

Low-temperature thermal desorption has several potential advantages over composting. It requires less room and can be completed more quickly, typically within one construction season. However, at Golden Road, neither of these advantages is especially important. The south parcel is unused, relatively isolated, and has sufficient area to permit the implementation of either treatment option. Since both have similar degrees of effectiveness for treating the contaminants of concern at the site, and since both can be readily implemented, the primary basis for choosing between them is their relative cost.

The cost ranges prevented in the previous sections for different treatment options are generally quite broad. Therefore, for the purpose of comparing the cost of biodegradation and low-temperature thermal desorption at the Golden Road site, the cost of these two options have been evaluated in greater detail. The results are presented in Table B-1. In reviewing the costs on this table, note the following:

- The costs presented are for treatment only, including the final spreading of soil on the site after treatment. Since the excavation, handling and screening of contaminated soil are the same regardless of the treatment option, they have been omitted from the cost comparison in Table B-1, along with the cost for all other items performed prior to the actual treatment process itself.

- The costs for biodegradation assume windrow composting. There is sufficient area on the south parcel to permit the application of this least expensive form of composting.

Based upon the cost comparison in Table B-1, biodegradation by (windrow) composting is the most cost-effective option for the treatment of contaminated soils from the hot spot areas at the Golden Road Disposal Site. Therefore, it is the recommended soil treatment option for the site. The following section provides additional information and detail concerning the application of windrow composting at the site.

Table B-1
Comparative Cost Estimate: Soil Treatment Options
Biodegradation (Composting) Versus Low-Temperature Thermal Desorption
Golden Road Disposal Site

Item	Units	Quantity	Unit Cost	Total Cost
Biodegradation				
Combined Unit Cost (1)	CY	1,720	$106.00	$182,320.
TOTAL				$182,320
Low-Temp Thermal Desorption (2)				
Mob/Demob	LS	1	$16,000.00	$16,000.
Processing	TON	2,580	$75.00	$193,500.
Additives	TON	2,580	$6.00	$15,480.
TOTAL				$224,980.

Notes:

1) Combined unit cost for biodegradation by windrow composting includes mob/demob, installation of liner and initial placement of soils, addition of bulking agents and organic amendments, periodic tilling, sampling and analysis, and all related operational costs for an assumed two-season operating period, and final spreading of treated soils after completion of composting process. Cost is based upon an average of combined unit costs incurred on multiple composting projects in U.S.

2) Unit costs for low-temperature thermal desorption are based upon vendor quotes.

B.3 Description of Recommended Treatment Option – Windrow Composting

For the reasons discussed above, the recommended soil treatment option at Golden Road is windrow composting. Following is a brief discussion of how this technology would actually be applied at the site, from the point of soil receipt at the composting area (following screening for debris removal), to the final spreading of treated soils across the surface of the site following composting. The cost estimate for this alternative is presented in Appendix A.

To implement this treatment option, an impermeable liner will be placed on top of non-contaminated soils at the Golden Road Disposal Site in the area shown in Figure 4-2 to separate contaminated soils from indigenous soils. A layer of bulking agent will be placed on the liner and the excavated soils will be placed in long rows (windrows) on top of it. For the purposes of this analysis, each windrow is assumed to be three feet high, fifteen feet wide at the bottom, with a 2:1 slope, and to have varying length based on space availability (Figure 4-2). Windrows will be separated from each other by ten-foot wide aisles though which a front-end loader or specially designed composting vehicle will move and mechanically till the windrows.

Various amendments (e.g., manure, sawdust, hay, water) will be added to the windrows as needed, to maintain the biological degradation of contaminants. It is assumed that microbes will not be added to the contaminated soils because the indigenous microbial population will be effective in degrading the site contaminants. Moisture, pH, oxygen content, and temperature are important factors in the implementation of windrow composting. Moisture is usually between 10 and 60 percent, and pH varies between 5 and 9. Depending on the contaminants, aerobic or anaerobic conditions may be preferred. Specifically, BTEX chemicals will better degrade under aerobic conditions whereas chlorinated organics will be treated more successfully under anaerobic conditions. Biological activity is dormant during the cold winter months. For the purposes of this report, it has been assumed that tilling will be performed every two weeks during the six-month summer season, for two consecutive seasons.

Nutrient, moisture and oxygen control at biopiles during windrow composting will not require a liner cover during the active composting season. Tilling at regular time intervals will provide enough moisture and oxygen to the microbes and will allow them to degrade the soil contaminants. The biopiles need to remain uncovered to maintain aerobic conditions. Soil erosion control from wind or water during the microbially active season will be accomplished by terracing the soils into windrows and spraying them as necessary to minimize dust. However, a cover will be placed over the contaminated soils at the end of the microbially active season (i.e., in the fall), when the ambient temperatures are low and biological activity effectively ceases. The cover will be anchored on the piles. Its purpose will be to mitigate excessive infiltration of precipitation and potential erosion of the piles during the inactive season.

Once soils have reached the remediation goals, as verified by confirmatory sampling, they will be gradually transported to areas of the site that are not covered by the liner and will be graded. Meanwhile, the exposed liner will be removed to create space for additional placement of remediated soils. At the end, the liner will be disposed off site.

Appendix C
Evaluation of Shallow Groundwater Treatment Alternatives
Golden Road Disposal Site

The purpose of this appendix is to evaluate alternative process options for treating shallow contaminated groundwater in an area along the east bank of the south parcel at the Golden Road Disposal Site, near Test Pit #3. The shallow groundwater in this area occurs seasonally, under unconfined conditions, within the upper sand unit. (Groundwater in the lower sand unit, which is confined and represents the permanent aquifer underlying the site, has not been affected by site contamination.) Treatment of shallow groundwater along the east bank would accompany the remediation of source (soil) contamination in this area. Appendix C is broken down into the following sections:

- **Section C-1: Description of Shallow Groundwater** – Shallow groundwater along the east bank of the site is described in terms of hydrogeology, estimated flow rates, and chemical characteristics.

- **Section C-2: Evaluation of Groundwater Treatment Options** – Treatment options for shallow groundwater are identified and evaluated on a comparative basis in terms of effectiveness, implementability and cost. Because the wetland adjacent to the south parcel is periodically dry, it has been assumed that discharge from a groundwater treatment system would be piped eastward to Golden Road, and there discharged into the existing sanitary sewer system.

- **Section C-3: Description of Recommended Groundwater Treatment Option** – Based upon the above evaluation, a single treatment option is recommended and described in terms of conceptual layout and design. The estimated cost for this recommended option is presented in Appendix A.

C.1 Description of Shallow Groundwater

The site geology in the area of interest consists of the following strata, listed from the ground surface downward:

- A dark colored fill material, consisting primarily of foundry sand, ash and cinders, extends to a depth varying from approximately 6 to 9 feet below ground surface (bgs). The fill material along the east bank includes numerous aerosol cans and containers, extending over an estimated length of approximately 120 feet northward from two large, abandoned above-ground storage tanks (ASTs) (see Figure 1-2 in text).

- Beneath the fill material, a silty sand stratum extends to a depth of approximately 12 feet bgs. The silty sand and fill material is in direct hydraulic contact with one another, and together make up the upper sand unit in which shallow groundwater occurs on a seasonal basis.

- A silty clay lacustrine stratum underlies the silty sand, and acts as an aquitard, separating the upper sand unit from the lower sand unit. The former contains unconfined groundwater on a seasonal basis; the latter represents a confined, permanent aquifer.

During the initial RI, performed during the fall of 1999, the upper sand unit was essentially dry. However, during the Phase II RI activities in April 2000, seasonally perched groundwater resulted in a saturated thickness of approximately 8 feet in the upper sand unit, extending 2 to 3 feet upward into the previously dry fill material and creating a groundwater flow pattern outward (eastward) into the adjacent wetland. The hydraulic conductivity of the upper sand unit, as determined by slug testing, is approximately 2.3×10^{-3} centimeters per second (or 6.5 feet per day). In April 2000, the hydraulic gradient of groundwater in the upper sand unit was determined to be approximately 0.013 feet per foot in the east bank area. Using the above values, the calculated groundwater discharge from the east bank to the adjacent wetland, over a north-south length of approximately 120 feet, was approximately 80 cubic feet per day, or 0.42 gallons per minute (gpm). Therefore, based upon the range of flow conditions encountered during the initial and Phase II RI, the shallow groundwater flow rate from the east area of the south parcel into the adjacent wetland is estimated to range from zero to approximately 0.5 gpm.

During the Phase II RI, two groundwater monitoring wells (GW-12 and GW-13) were installed near the east bank of the south parcel (see Figure 1-2 in text). One of these wells (GW-13) is located outside (south) of the impacted area near Test Pit #3. However, monitoring well GW-12 is located within the impacted area. The groundwater sample collected from this well, which is considered to be representative of shallow groundwater in the area, exhibited numerous exceedances of NYSDEC Class GA groundwater standards, as listed below.

Class – Parameter		Concentration in GW-12 (µg/L)
VOC -	Methylene chloride	600,000
	Acetone	4,900
	1,1-Dichloroethane	750
	Methyl ethyl ketone	24,000
	Benzene	780
	Toluene	170,000
	Ethylbenzene	8,800
	Total Xylenes	27,600
SVOC-	2-Methylpheno l	43
	2,4-Dimethylphenol	26
	3 & 4-Methylphenol	83
	Naphthalene	13
Metal -	Iron	2,570
	Magnesium	41,100
	Manganese	777
	Mercury	0.93
	Sodium	51,600
	Thallium	1.3

C.2 Evaluation of Groundwater Treatment Options

Based upon groundwater characteristics described in the previous section, carbon adsorption and air stripping are considered to be the two most appropriate groundwater treatment options for shallow groundwater at the Golden Road Disposal Site. They are described and evaluated below.

C.2.1 Activated Carbon Adsorption

A. Description

Liquid phase activated carbon adsorption involves the pumping of contaminated groundwater through one or a series of canisters or columns containing activated carbon, to which dissolved organic chemicals adsorb. When the contaminant concentrations in the carbon effluent stream exceed a certain level, periodic replacement or regeneration of carbon is required. A water collection/ equalization tank would be required before the activated carbon unit at the Golden Road site, since the groundwater extraction rate is estimated to be less than 0.5 gpm.

B. Evaluation

Effectiveness: Activated carbon adsorption is a proven technology with documented performance data. It is used primarily for treating organic contaminants in groundwater. However, some inorganic chemicals are also removed by carbon adsorption. Not all of the contaminants detected in shallow groundwater at the Golden Road site can be effectively removed using this technology. Specifically, it will not effectively remove methylene chloride, methyl ethyl ketone or acetone. Nevertheless, carbon adsorption is very effective at removing most organics, including VOCs, which are the primary contaminants of concern in the east bank area.

Implementability: There are no technical problems with implementing activated carbon adsorption for treating shallow groundwater at the Golden Road site. Equipment needed for implementing this process is readily available. A potential problem encountered with activated carbon units is fouling. This is caused by iron oxidation, biological growth or suspended solids accumulation, and requires periodic column cleaning, for example by backwashing.

The amount of time required for engineering design of a carbon adsorption treatment facility and contractor procurement would be approximately six months. Carbon adsorption would then be operated on a temporary basis, following soil excavation in the east bank area, until groundwater quality in the area had achieved Class GA standards or stabilized in response to this source control measure.

Cost: Based on information from vendors and URS experience on other similar projects, representative costs for liquid phase activated carbon were estimated and are presented in Tables C-1 to C-4. As indicated by these tables, the estimated capital cost for the treatment facility is $105,000; the estimated annual O&M cost is $61,000; and the total estimated present worth of the option is $1,050,000.

C.2.2 Air Stripping

A. Description

Air stripping is a technology in which contaminated groundwater is exposed to air and volatile organics partition from groundwater to the air stream. Extracted groundwater is sent to the air-stripping unit, where bubbling air strips volatile organics from the water. A blower forces the air through the unit. The off-gas from the air stripper may require treatment, (e.g., vapor phase carbon adsorption), before discharge to the atmosphere. A water collection/equalization tank would be required before the air stripper at Golden Road, since the groundwater extraction rate is estimated to be less than 0.5 gpm.

B. Evaluation

Effectiveness: Air stripping is a proven technology, used primarily for treating volatile organic contaminants (i.e., those chemicals that have a dimensionless Henry's Law constant greater than 0.01) in groundwater. Heating of the water can improve treating of compounds with low volatility at ambient temperature. Air stripping is not very effective in removing methylene chloride or methyl ethyl ketone, and it will not remove acetone from groundwater at the site. It will not remove metals, and is generally not as effective as carbon adsorption for the removal of semivolatile organic compounds. However, air stripping is very effective at removing most VOCs, which are the primary contaminants of concern in the east bank area groundwater.

Implementability: There are no technical problems with implementing air stripping for treating shallow groundwater at the Golden Road site. Contaminants in the air stream may require treatment (e.g., by carbon adsorption) before discharge to the ambient air. Equipment needed for implementing this process is readily available. A potential problem encountered with air strippers is fouling. This is caused by iron oxidation or biological growth and requires periodic column cleaning.

The amount of time required for engineering design and contractor procurement would be approximately six months. The air stripper would then be operated on a temporary basis, following soil excavation in the east bank area, until groundwater quality in the area had achieved Class GA standards or stabilized in response to this source control measure.

Cost: Based on information from vendors and URS experience on other similar projects, representative costs for air stripping were estimated and are presented in Tables C-5 to C-8, (assuming no off-gas treatment), and in Tables C-5a to C-8a (with off-gas treatment). The estimated capital cost for the treatment facility is $95,000 (or $205,000 if off-gas treatment is required); the estimated annual O&M cost is $44,000 (or $60,000 with off-gas treatment); and the total present worth of the option is $777,000 (or $1,124,000 with off-gas treatment).

C.2.3 Comparative Evaluation of Shallow Groundwater Treatment Options

In terms of effectiveness, carbon adsorption and air stripping are similar. Both will effectively treat most of the VOCs in groundwater, which are the primary contaminants of concern in the east bank area. However, neither option will effectively remove acetone. Although neither is typically designed for the treatment of methylene chloride or methyl ethyl ketone, air stripping is more effective for the removal of these two contaminants. On the other hand, carbon adsorption has a marginal advantage in terms of its ability to treat a broader range of SVOCs, and to achieve some incidental metals removal. The presence of these contaminants in site groundwater will therefore require relatively large treatment units using either option.

In terms of implementability, there is little to choose between carbon adsorption and air stripping. Both are very well established technologies, both use readily available services and equipment, and neither would be difficult to implement or involve any special design, construction or permitting issues.

Without off-gas treatment, the cost of air stripping is considerably less than that of carbon adsorption (total present worth of $777,000 for air stripping versus $1,050,000 for carbon adsorption). However, if off-gas treatment is required, the cost for air stripping becomes somewhat greater than that of carbon adsorption (total present worth of $1,124,000).

Considering the site location, it is not certain that off-gas treatment would be required. On this basis, air stripping is the recommended treatment option for shallow groundwater. If off-gas treatment were to prove necessary, the recommendation would need to be reconsidered in terms of a more detailed cost estimate.

C.3 Description of Recommended Groundwater Treatment Option

The recommended shallow groundwater treatment option for the Golden Road Disposal Site is air stripping. The treatment facility will be designed for a capacity of 0.5 gpm. It will include an equalization / storage tank with a 3-day retention time, a diffuser-style air stripper with blower and heater, and two process pumps. The cost estimate for this alternative (Appendix A, and Tables C-5 to C-8) assumes that off-gas treatment will not be required. Also, it has been assumed in the cost analysis that the treatment plant will be operated for 30 years. However, as described previously, it is likely that the actual operating period will be considerably less.

TABLE C-1
GOLDEN ROAD DISPOSAL SITE
EQUIPMENT SIZING & DESIGN CRITERIA
GROUNDWATER TREATMENT WITH CARBON ADSORPTION (0.5 GPM)

Equipment Description	Design Criteria	Size
Equalization/Storage Tank	3 Day Retention Time	720 gal
3 Process pumps (1 standby)		1 gpm
Liquid phase carbon	Replace carbon 5 times / year	1700 lb vessel

TABLE C-2
GOLDEN ROAD DISPOSAL SITE
CAPITAL COST ESTIMATE
GROUNDWATER TREATMENT WITH CARBON ADSORPTION (0.5 GPM)

Item	Unit	Quantity	Unit Cost	Source	Total Cost
A. Direct Capital Costs					
1. EQUIPMENT COSTS					
Equalization/Storage Tank	GAL	720	$0.63	2	$450
Bag-type Prefilter	EA	1	$860	1	$860
Liquid Phase Carbon Adsorption	EA	2	$9,068	1	$18,140
Process Pumps	EA	3	$2,175	1	$6,530
SUBTOTAL EQUIPMENT					$25,980
2. ADDITIONAL DIRECT COSTS					
Equipment Installation (50% of Equipment)					$12,990
Instrumentation and Controls (20% of Equipment)					$5,200
Piping (60% of Equipment)					$15,590
Electrical (10% of Equipment)					$2,600
Buildings (40% of Equipment)					$10,390
3. FORCEMAIN TO SANITARY SEWER					
This forcemain will be constructed regardless of the groundwater treatment method, therefore its cost is not included here.					$0
			SUBTOTAL DIRECT COSTS		$72,750

B. Indirect Capital Costs

Legal and Administration	5%	of Direct cost		$3,640
Engineering and Design	15%	of Direct cost		$10,910
Contingencies	25%	of Direct cost		$18,190
			SUBTOTAL INDIRECT CAPITAL COSTS	$32,740
			TOTAL CAPITAL COSTS	**$105,490**
			SAY	**$105,000**

Source:

1 - Vendor quote

2 - URS Estimate based on similar projects and vendors' bids

TABLE C-3
GOLDEN ROAD DISPOSAL SITE
O&M COST ESTIMATE BASIS
GROUNDWATER TREATMENT WITH CARBON ADSORPTION (0.5 GPM)

Item	Basis
O & M Labor	1 man 8 hours per day 6 days per month
Maintenance	3% of Capital Costs
Insurance and Taxes	1% of Capital Costs
Maintenance Reserve and Contingency Costs	1% of Capital Costs
Energy	
-Electricity	HP x .747 x Hours of Operation
Activated Carbon	130 lbs per 1,000 gallons
Monitoring Costs VOC Parameters	 2 samples/month

TABLE C-4
GOLDEN ROAD DISPOSAL SITE
O&M COST ESTIMATE
GROUNDWATER TREATMENT WITH CARBON ADSORPTION (0.5 GPM)

Item	Units	Quantity	Unit Cost	Total Cost
O&M Labor	HRS	576	$65	$37,440
Maintenance		Capital Cost	3%	$3,150
Insurance and Taxes		Capital Cost	1%	$1,050
Maintenance Reserve & Contingency Cost		Capital Cost	1%	$1,050
Energy -Electricity	kWhr	4,500	$0.10	$450
Activated Carbon Reactivation+Transport	LB	8,100	$1.36	$11,020
Discharge to Sewer	1000 GAL	62400	$1.45	$90
Monitoring Costs				
VOC Parameters	EA	24	$300	$7,200
			TOTAL	**$61,450**
			SAY	**$61,000**

Present Worth of O & M	**$945,000**
Capital Cost - Treatment	**$105,000**
Present Worth of [Capital + O & M]	**$1,050,000**

Note:
In calculating the present worth cost, 30 years of operation and 5% interest have been assumed.

TABLE C-5
GOLDEN ROAD DISPOSAL SITE
EQUIPMENT SIZING & DESIGN CRITERIA
GROUNDWATER TREATMENT WITH AIR STRIPPING (0.5 GPM)

Equipment Description	Design Criteria	Size
Equalization/Storage Tank	3 Day Retention Time	720 gal
Air Stripper	Water Temp = 50°F Air to Water Ratio = 750:1	Column Base=4'-0" x 5'-4" Column Ht =3' 6"
Blower	Same as Above	100 cfm
Air Preheater	Preheat air to = 40°F	100 cfm
2 Process pumps (1 standby)		1 gpm

TABLE C-6
GOLDEN ROAD DISPOSAL SITE
CAPITAL COST ESTIMATE
GROUNDWATER TREATMENT WITH AIR STRIPPING (0.5 GPM)

Item	Unit	Quantity	Unit Cost	Source	Total Cost
A. Direct Capital Costs					
1. EQUIPMENT COSTS					
Equalization/Storage Tank	GAL	720	$0.63	2	$450
Air Stripper with Blower and Heater	EA	1	$9,608	1	$9,610
Control Panel	EA	1	$9,000	1	$9,000
Process Pumps	EA	2	$2,175	1	$4,350
SUBTOTAL EQUIPMENT					$23,410
2. ADDITIONAL DIRECT COSTS					
Equipment Installation (50% of Equipment)					$11,710
Instrumentation and Controls (20% of Equipment)					$4,680
Piping (60% of Equipment)					$14,050
Electrical (10% of Equipment)					$2,340
Buildings (40% of Equipment)					$9,360
3. FORCEMAIN TO SANITARY SEWER					
This forcemain will be constructed regardless of the groundwater treatment method, therefore its cost is not included here.					$0
		SUBTOTAL DIRECT CAPITAL COSTS			$65,550

B. Indirect Capital Costs

Legal and Administration	5%	of Direct cost		$3,280
Engineering and Design	15%	of Direct cost		$9,830
Contingencies	25%	of Direct cost		$16,390
			SUBTOTAL INDIRECT CAPITAL COSTS	$29,500
			TOTAL CAPITAL COSTS	**$95,050**
			SAY	**$95,000**

Source:
1 - Vendor quote
2 - URS Estimate based on similar projects and vendors' bids

TABLE C-7
GOLDEN ROAD DISPOSAL SITE
O&M COST ESTIMATE BASIS
GROUNDWATER TREATMENT WITH AIR STRIPPING (0.5 GPM)

Item	Basis
O & M Labor	1 man 8 hours per day 5 days per month
Maintenance	3% of Capital Costs
Insurance and Taxes	1% of Capital Costs
Maintenance Reserve and Contingency Costs	1% of Capital Costs
Energy	
-Electricity	HP x .747 x Hours of Operation
Monitoring Costs VOC Parameters	 2 samples/month

TABLE C-8
GOLDEN ROAD DISPOSAL SITE
O&M COST ESTIMATE
GROUNDWATER TREATMENT WITH AIR STRIPPING (0.5 GPM)

Item	Units	Quantity	Unit Cost	Total Cost
O&M Labor	HRS	480	$65	$31,200
Maintenance		Capital Cost	3%	$2,850
Insurance and Taxes		Capital Cost	1%	$950
Maintenance Reserve & Contingency Cost		Capital Cost	1%	$950
Energy				
-Electricity	kWhr	11,000	$0.10	$1,100
Discharge to Sewer	1000 GAL	62400	$1.45	$90
Monitoring Costs				
VOC Parameters	EA	24	$300	$7,200
			TOTAL	**$44,340**
			SAY	**$44,000**

Present Worth of O & M	**$682,000**
Capital Cost - Treatment	**$95,000**
Present Worth of [Capital + O & M]	**$777,000**

Note:
In calculating the present worth cost, 30 years of operation and 5% interest have been assumed.

TABLE C-5a

GOLDEN ROAD DISPOSAL SITE

EQUIPMENT SIZING & DESIGN CRITERIA

GROUNDWATER TREATMENT WITH AIR STRIPPING AND OFF-GAS TREATMENT(0.5 GPM)

Equipment Description	Design Criteria	Size
Equalization/Storage Tank	3 Day Retention Time	720 gal
Air Stripper	Water Temp = 50°F Air to Water Ratio = 750:1	Column Base=4'-0" x 5'-4" Column Ht =3' 6"
Blower	Same as Above	100 cfm
Air Preheater	Preheat air to = 40°F	100 cfm
2 Process pumps (1 standby)		1 gpm
Vapor phase carbon	Same as Above	100 cfm

TABLE C-6a

GOLDEN ROAD DISPOSAL SITE

CAPITAL COST ESTIMATE

GROUNDWATER TREATMENT WITH AIR STRIPPING AND OFF-GAS TREATMENT(0.5 GPM)

Item	Unit	Quantity	Unit Cost	Source	Total Cost
A. Direct Capital Costs					
1. EQUIPMENT COSTS					
Equalization/Storage Tank	GAL	720	$0.63	2	$450
Air Stripper with Blower and Heater	EA	1	$9,608	1	$9,610
Control Panel	EA	1	$9,000	1	$9,000
Vapor Phase Carbon Adsorption	EA	2	$13,575	1	$27,150
Process Pumps	EA	2	$2,175	1	$4,350
SUBTOTAL EQUIPMENT					$50,560
2. ADDITIONAL DIRECT COSTS					
Equipment Installation (50% of Equipment)					$25,280
Instrumentation and Controls (20% of Equipment)					$10,110
Piping (60% of Equipment)					$30,340
Electrical (10% of Equipment)					$5,060
Buildings (40% of Equipment)					$20,220
3. FORCEMAIN TO SANITARY SEWER					
This forcemain will be constructed regardless of the groundwater treatment method, therefore its cost is not included here.					$0
			SUBTOTAL DIRECT COSTS		**$141,570**

B. Indirect Capital Costs

Legal and Administration	5%	of Direct cost	$7,080
Engineering and Design	15%	of Direct cost	$21,240
Contingencies	25%	of Direct cost	$35,390
		SUBTOTAL INDIRECT CAPITAL COSTS	**$63,710**
		TOTAL CAPITAL COSTS	**$205,280**
		SAY	**$205,000**

Source:

1 - Vendor quote

2 - URS Estimate based on similar projects and vendors' bids

TABLE C-7a

GOLDEN ROAD DISPOSAL SITE

O&M COST ESTIMATE BASIS

GROUNDWATER TREATMENT WITH AIR STRIPPING AND OFF-GAS TREATMENT(0.5 GPM)

Item	Basis
O & M Labor	1 man 8 hours per day 6 days per month
Maintenance	3% of Capital Costs
Insurance and Taxes	1% of Capital Costs
Maintenance Reserve and Contingency Costs	1% of Capital Costs
Energy	
-Electricity	HP x .747 x Hours of Operation
Activated Carbon	30 lbs per 100,000 cf air (1,000 gal water)
Monitoring Costs VOC Parameters	 2 samples/month

TABLE C-8a

GOLDEN ROAD DISPOSAL SITE

O&M COST ESTIMATE

GROUNDWATER TREATMENT WITH AIR STRIPPING AND OFF-GAS TREATMENT(0.5 GPM

Item	Units	Quantity	Unit Cost	Total Cost
O&M Labor	HRS	576	$65	$37,440
Maintenance		Capital Cost	3%	$6,150
Insurance and Taxes		Capital Cost	1%	$2,050
Maintenance Reserve & Contingency Cost		Capital Cost	1%	$2,050
Energy -Electricity	kWhr	11,000	$0.10	$1,100
Activated Carbon Reactivation+Transport	LB	2,700	$1.36	$3,670
Discharge to Sewer	1000 GAL	62400	$1.45	$90
Monitoring Costs				
VOC Parameters	EA	24	$300	$7,200
			TOTAL	$59,750
			SAY	$60,000

Present Worth of O & M	$919,000
Capital Cost - Treatment	$205,000
Present Worth of [Capital + O & M]	$1,124,000

Note:

In calculating the present worth cost, 30 years of operation and 5% interest have been assumed.

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