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ASBESTOS DUMP SITES
OPERABLE UNIT 2

MEYERSVILLE, LONG HILL TOWNSHIP
MORRIS COUNTY, NEW JERSEY

FINAL DESIGN REPORT

January 1993

REGION II
Alternative Remedial Contraction Strategy (ARCS)
for
Hazardous Waste Remedial Services

TAMS Consultants, Inc./TRC Environmental Corp.
Contract No. 68-S9-2001
EPA Work Assignment No. WA-026-2N8J

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EXECUTIVE SUMMARY

The Asbestos Dump Site is on the National Priority List (NPL) in the United States Environmental Protection Agency (EPA) National Superfund Program. Two of the sites, at New Vernon Road and White Bridge Road located in Long Hill Township, Morris County, New Jersey, are contaminated with asbestos containing material (ACM). The ACM was historically used to fill in topographical depressions, wetlands, and to cover roads. Most of the ACM has been graded, covered and seeded so that the majority of contamination is subsurface. In the Record of Decision (ROD) it was stipulated that in-situ solidification/stabilization be utilized to remediate the sites. In this design report is presented a summary of the information compiled and analyzed; the approach utilized to achieve the final remedial design; and a summary description of various aspects of the design. The report does not include every design decision and minor detail, as these have been covered throughout the design process in interim reports, detailed correspondence and design meetings. It should be noted that extensive coordination efforts are expected between the parties involved in completing the remedial activities because this proposed design is based on detail and performance oriented approaches.

The White Bridge Road property contains approximately 31,000 cubic yards (cy) of ACM, and the New Vernon Road property approximately 48,000 cy. The Great Swamp National Wildlife Refuge abuts both sites and the ground water table is near the ground surface throughout most of the year. The soils are mostly poorly to very poorly drained. These physical characteristics make the sites environmentally sensitive. Other design concerns address the effect remediation may have on the breeding and migratory patterns of wildlife during the construction, potential chemical alterations of the wetland conditions affecting local vegetation and fauna habitat, loss of flood storage volume, potential for settlement and changing surface water runoff patterns. Residents currently occupy both sites. In addition a tree servicing business is operated at the New Vernon

Road property and a horse boarding business is managed at the White Bridge Road property.

Several site investigations and sampling events were conducted at both sites. Results of these analyses were used to determine the lateral and vertical extent of asbestos contamination. The asbestos material was found to be present in three forms: tile, slurry, and a composite mixture of tile fragments and soil. A Treatability Study was performed to assess the relative effectiveness of various stabilizing reagents on these forms of ACM. In general, it was found the materials could be solidified successfully in compliance with minimum physical test requirements. The stabilization of the slurry, however, did present difficulties due to the presence of high water content. A final recommended reagent concentration of 30% of a 50:50, by weight, mixture of Type I Portland Cement and cement kiln dust (CKD) was selected for the remedial action.

At each site, one large "Landfill" area containing asbestos was encountered. Several smaller "satellite" contaminated areas were also found to exist and these are to be excavated and transported to the main landfill area. The reasons to consolidate the ACM in one area include; minimizing construction costs, simplifying treatment, minimizing remediation time, and reducing the land area requiring deed restrictions, thereby allowing the property owners more flexibility in future usage of their land.

The main landfill areas will be solidified/stabilized in-situ above the ground water table, by a method to be selected by the Subcontractor and approved by the Contractor. Performance criteria of unconfined compressive strength and durability testing have been specified to ensure satisfactory remediation of the ACM.

The solidification/stabilization above the groundwater table should not affect the existing ground water flow patterns. This should also minimize chemical impacts to the wetlands and reduce the remedial action construction time. The solidified/stabilized ACM will be covered with a final soil cap composed of a geomembrane, stone, geotextile, fill and topsoil and seeding. To collect excess runoff, as a result of the impervious stabilized landfill and to allow infiltration into the subsurface, drainage and infiltration structures around the perimeter of the stabilized mass will be constructed. These features have been designed to cause no net change between pre- and post-development flows.

The major construction features contained in the final design include: site preparation, excavation, erosion control, in-situ solidification/stabilization, drainage, grading, and capping of the solidified mass with a geomembrane and vegetated soil cover. The process is expected to be completed within nine months from notice to proceed, depending upon the starting date for construction. Should the construction start later in the year, the soil cover and seeding would have to be placed during the winter. This cannot be done because the seed could not germinate and thus provide erosion protection. Construction of the cover would have to be delayed until the spring of the following year. The estimated cost to implement the remedial action at both properties is $7.1 million (+15%, -10%).

1.0 INTRODUCTION

1.1 General

This design report is prepared as part of the 100 percent submittal of documents for the remediation of asbestos contaminated materials at the New Jersey Asbestos Dump Site, New Vernon Road and White Bridge Road properties, located in Long Hill Township, Morris County, New Jersey. This work is prepared for the U.S. Environmental Protection Agency (EPA) by TAMS Consultants, Inc. (TAMS) and TRC Environmental Corporation (TRC).

This proposed design is a combination of detailed and performance based approaches. There are some areas of the proposed design which will require extensive coordination between the parties involved during remedial action activities.

1.2 Purpose

The purpose of this report is to provide the reviewing agencies with the rationale and basis of design used in preparing the submitted final remedial design documents.

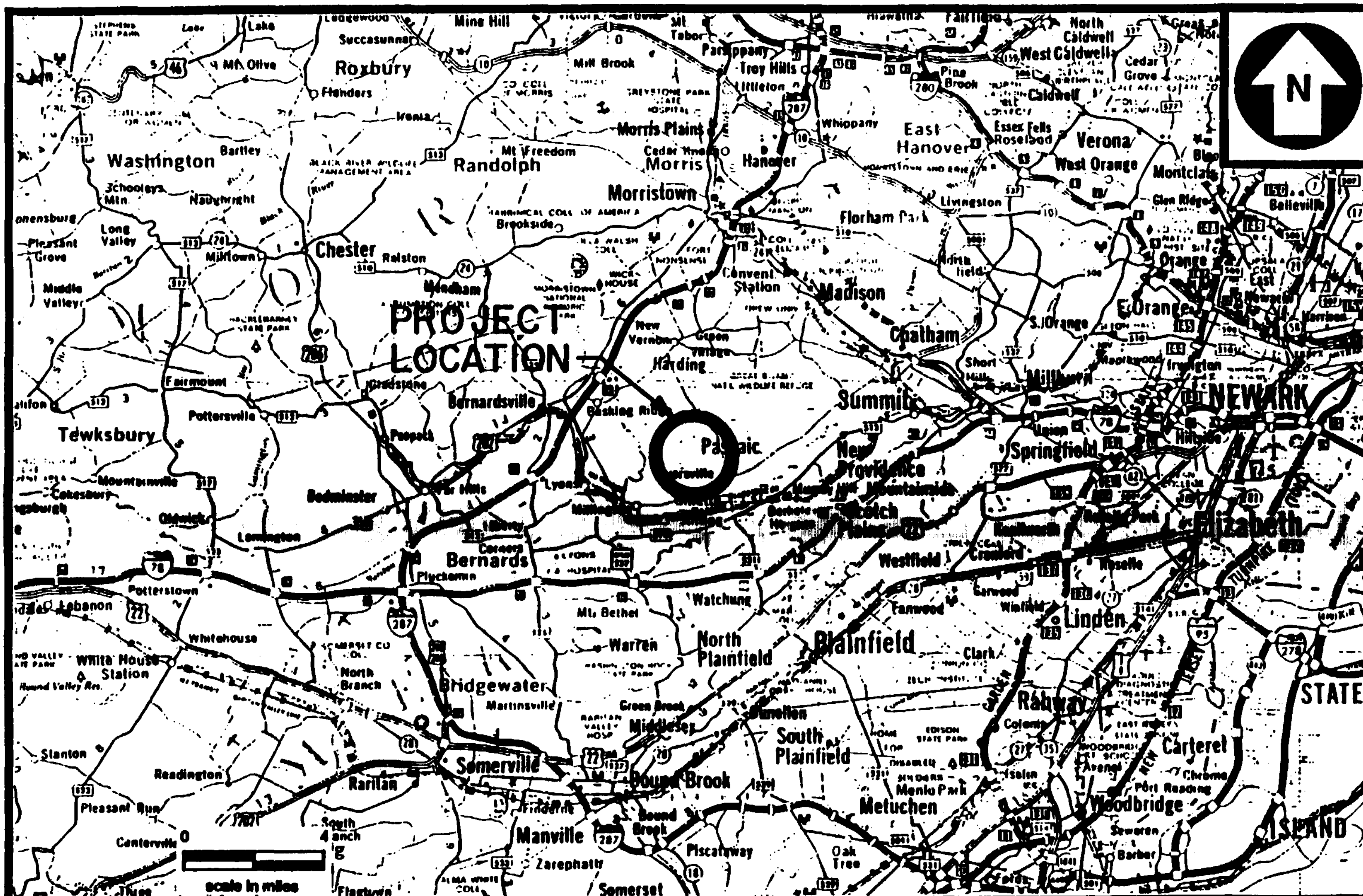
1.3 Project Description and Background

The Asbestos Dump Site is on the National Priority List (NPL) in the EPA National Superfund Program. The Asbestos Dump Site is comprised of four separate properties which are located next to or close to the former National Gypsum Plant in southeastern Morris County, New Jersey. The four properties include the Millington Site (the site of the former National Gypsum Plant), the Dietzman Tract, the New Vernon Road Site and the White Bridge Road Site. The latter three sites are collectively referred to as the satellite sites. The sites are not related except for the fact, that at one time, all had fill placed on-site composed of asbestos containing materials from the National Gypsum Plant. The Asbestos Dump Site project was divided into three operable units. A Record of Decision (ROD) for the first operable unit, the Millington Site, was signed on September 30, 1988. Negotiations for implementation of the remedial action were unsuccessful and EPA issued a unilateral order to the potentially responsible party (PRP), National Gypsum. National Gypsum is currently conducting a remedial design for this operable unit. The properties of the second operable unit, the New Vernon Road and White Bridge Road sites are the subject of this Remedial Design effort. The third operable unit is the Dietzman Tract, where remedial design has not yet commenced.

1.3.1 New Vernon Road Property

The New Vernon Road property consists of approximately 30 acres of land located at 237 and 257 New Vernon Road in Meyersville, New Jersey. The property is bounded to the north by a portion of the Great Swamp National Wildlife Refuge, tracts of wooded and wetland areas to the east and south, and New Vernon Road to the west (Figures 1 and 2). There are two residences located on-site, one is unoccupied and the other is occupied by the property owners. Other properties near the site include; a private residence located directly south of the site, and another residence southwest of the site which is to the south of a tennis court. Both residences are located on the opposite side of the New Vernon Road property.

An asphalt driveway is located in the northwestern portion of the property, directly south of the occupied dwelling, beginning at New Vernon Road. The driveway extends east from New Vernon Road for approximately 600 feet into an open area. In the Fall of 1990, the EPA conducted preliminary remedial actions to clean up several highly contaminated areas at the site. As part of this work, a portion of this driveway, extending to the open area, was asphalted; the remainder

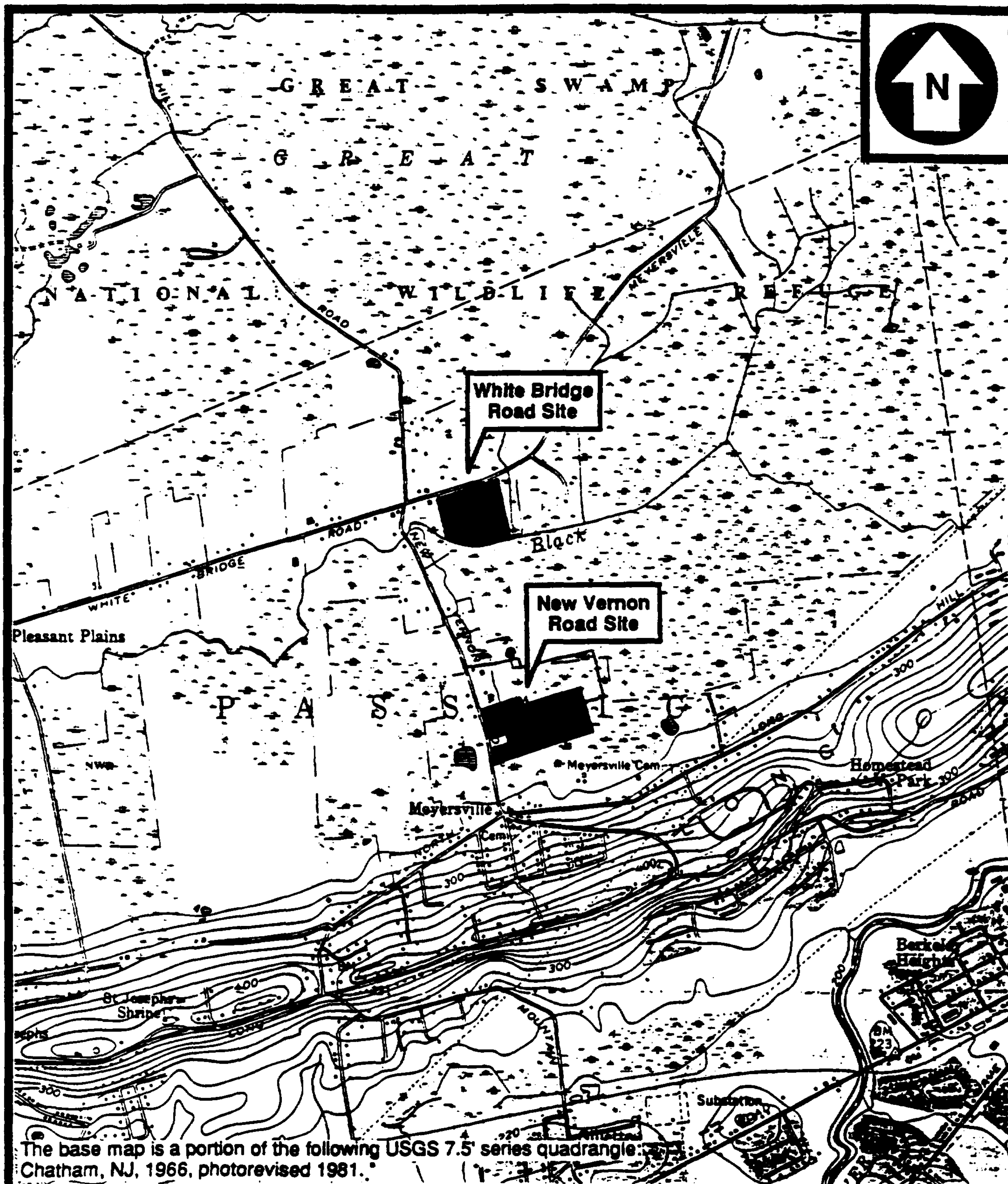


SITE VICINITY MAP

WHITE BRIDGE ROAD AND NEW VERNON ROAD SITES
LONG HILL, NEW JERSEY

TRC

Figure 1.



SITE LOCATION MAP

WHITE BRIDGE ROAD AND NEW VERNON ROAD SITES
LONG HILL, NEW JERSEY

TRC

Figure 2.

of this road was covered with a geotextile fabric. The open area is reportedly the main landfill, and is approximately 400 feet in length and cluttered with tree debris. Prior to reaching the open area, the driveway splits and extends north for approximately 200 feet to a tree servicing business which is owned and operated by the property owner. The owner maintains a two story garage as his place of business. A second driveway located in the northwest corner of the property provides direct access to this business from New Vernon Road.

Chronology of Events

From 1945 through 1980, the property was used for farming (i.e., corn and dairy cattle). For a period of two years during the late 1960's, refuse from National Gypsum was disposed of on-site. Initially, this refuse, which included asbestos fibers, broken asbestos tiles and siding, was reportedly disposed of in a small depression in the westernmost section of the property. Land disposal then took place toward the central portion of the property in a larger depression (i.e., main landfill area). During 1980, asbestos was observed in various soil and grassy areas throughout the property. Subsequently, the property was graded and seeded after being purchased in 1980 by the current owners.

1.3.2 White Bridge Road Property

This site is located at 651 White Bridge Road in Meyersville, New Jersey. It consists of approximately 12 acres of land south of White Bridge Road, bounded by the Great Swamp National Wildlife Refuge to the east and south, and private residences to the west, (Figure 2). At the site there is one residence and stables to board horses. There are five residences along White Bridge Road (between New Vernon Road and the Great Swamp), within approximately 700 feet of the site. One of them is directly across the road, from the site.

The site consists of a two story building where the owners reside, a garage, and two sheds and three stables. The roadway on the northwest side of the site, leading to all of the above structures, is paved with asphalt. There is a large pasture for the horses, which occupies the majority of the property that is divided into four sections by post and rail fencing. A pond, approximately 100 feet in diameter, is situated in the northern portion of the grazing field. Trees line the property along White Bridge Road. A riding track is also located on-site and is approximately 250 feet long by 125 feet wide and is situated approximately 350 feet from the house and stables. The riding track area is located predominantly over a wetland filled in with asbestos containing material. An approximately 250 foot long dirt roadway extending from White Bridge Road, is located along the northeast border of the property. The riding track and portions of the access road were covered with geotextile fabric during the EPA's removal actions conducted in the Fall of 1990.

Chronology of Events

From 1945 through 1969, the White Bridge Road property was used for farming. From 1970 to 1975, refuse consisting of asbestos tiles and siding from National Gypsum was disposed of on the property. The disposal operations appear to have taken place primarily in a wetland area and has thus created an upland area. Following the termination of landfilling, the current owner converted the property into a horse farm consisting of stables, a horse riding track, and grazing fields.

1.3.3 Previous Investigations

Previous investigations at these sites were conducted by the potentially responsible party and the EPA. Fred C. Hart Associates completed a remedial investigation of the NPL Asbestos Waste Site for National Gypsum Company and summarized their findings in a draft report dated May 29, 1987. The draft RI contained limited information directly relevant to asbestos contamination.

EPA conducted an investigation during August and September 1990 which consisted of a site walkover and the collection of several types of samples for subsequent asbestos analyses. It was from this effort that EPA concluded that additional information relevant to asbestos in soil should be collected. The results of subsequent site investigations and sampling activities as a part of predesign activities are discussed in further detail in Section 3.0 of this Report.

2.0 GENERAL ENVIRONMENTAL CONDITIONS

2.1 Geology

The New Vernon Road and White Bridge Road sites are located in areas exhibiting similar geological characteristics. The subsurface conditions include bedrock of Triassic age and glacial deposits having variable thickness which are generally unconsolidated. The Project Sites are underlain with sand, gravel and clay deposits of the former glacial Lake Passaic. The glacial lacustrine deposits also underlie the bulk of the Great Swamp. The towns of Morristown, Madison, and Chatham (to the north of the Project Sites) are situated on a terminal moraine of Wisconsin age.

The bedrock consists primarily of the Triassic Group - soft red shale with sandstone beds. The depths to bedrock at both properties are unknown. However, discussions with the two property owners indicate that the depths to bedrock, based on boring logs completed for the drilling of drinking water wells, are in excess of 100 feet. A review of these logs indicate that the overburden is predominantly silty clays.

Igneous rocks are present as basaltic flows, and also in the region, as fine-grained trap rock in extensive flows. These rocks form the bases of the Wachung Mountains, located to the south of the Project Sites, and which also form part of the Great Swamp basin.

2.2 Soils

The soils on the two properties are generally classified as poorly to very poorly drained. The main soil groups (classifications) are the Parsippany and Muck with minor groups, the Biddeford and Whippany, also being found. A summary of the soil groups and their main characteristics is presented in Table 2-1.

2.2.1 Parsippany

The Parsippany series consists of poorly drained soils. The White Bridge Road property and the stream bed of nearby Black Brook consist predominantly of this soil series. Permeability is low and water capacity is high. The soils have a high content of silt and clay and therefore, have poor workability, are unstable, and have poor compaction characteristics, especially when wet. The water table elevation is at or near the ground surface during the winter, early spring and after heavy rains. During the summer it may drop to 3 or 4 feet below ground surface.

2.2.2 Muck

Muck is decomposed organic matter present in thick layers. Drainage is poor, although permeability in the organic layer is high. The water table is at the surface for most of the year and is subject to frequent flooding.

2.2.3 Biddeford

Biddeford soils are very poorly drained soils and are generally found in the swales located on the New Vernon Road property. Permeability is low. The water table is at or near the surface, except during the summer. These soils are frequently flooded.

TABLE 2-1. SOIL CHARACTERISTICS SUMMARY FOR WHITE BRIDGE ROAD AND NEW VERNON ROAD

Soil Type	Depth to Bedrock (feet)	Seasonal High Water Table (feet)	Depth from Surface (inches)	Dominant USDA Feature	Permeability (inches per hour)	Available Water Capacity (inches per inches of depth)	Reaction (pH)
Parsippany	>10	0-1	0-7	silt loam	0.2-0.6	0.18-0.22	5.6-6.0
			7-34	clay loam silty clay loam silt loam	<0.2	0.18-0.22	5.1-6.5
			34-60	fine sandy loam silt loam	0.6-0.2	0.14-0.20	6.1-7.3
Muck	>10	0*	0-25	muck	>6.0	0.3-0.35	5.6-6.5
			25-60	loam	0.2-2.0	0.18-0.22	5.6-7.3
Biddeford	>10	0	0-8	muck	2.0-6.0	0.28-0.35	5.6-6.5
			8-18	silt loam	0.2-0.6	0.22-0.26	5.6-6.5
			18-44	silty clay loam	<0.2	0.14-0.18	5.6-6.5
			44-60	silt loam	0.2-0.6	0.14-0.18	6.1-7.3
Whippany	>10	0.5-1.5	0-9	silt loam	0.6-2.0	0.2-0.26	5.6-6.0
			9-40	silt loam, silty clay loam	<0.2	0.18-0.24	5.6-6.0
			40-60	silt loam	<0.2	0.16-0.2	6.1-7.3

*Flooding in places

2.2.4 Whippany

New Vernon Road property consists of the Whippany series, in addition to those series previously mentioned. The Whippany series is gently sloping, somewhat poorly drained soils. The soil has low permeability and poor workability characteristics due to the high content of silt and clay. The water table is usually 0.5 to 1.5 feet below ground surface in late winter, early spring and after heavy rains. During the summer it may drop to 3 to 4 feet below ground surface. These soils are subject to moderate erosion.

2.3 Hydrology

2.3.1 Local

Survey and ground water elevation data for the White Bridge and New Vernon Road sites suggest a rather complex hydrology. At the New Vernon Road Site, a general radial ground water flow pattern exists, which appears to be affected by fluctuating water levels in the adjacent wetlands. The direction of ground water flow is generally towards the east (the wetlands).

Ground water flow at White Bridge Road is also generally radial. It appears, from the limited data collected, that the ground water flow is to the southeast. There appears to be a zone of stagnation at the perimeter of the site, where fluctuating water levels in the wetlands and Black Brook, at times, may be higher than ground water levels on-site. This may at times reverse the hydraulic gradient at the wetlands boundary. This effect may cause problems in achieving effective subsurface drainage.

2.3.2 Great Swamp National Wildlife Refuge

The Great Swamp National Wildlife Refuge (Great Swamp) directly abuts both properties. The topography of the sites is generally flat, but slopes slightly higher (approximately 0.5%) towards the roads. The elevations of the sites rise slightly above the swamp elevations. Surface water runoff, snow melt, and ground water are collected and discharged from the surrounding watershed into the Great Swamp. The Great Swamp drains through a few tributaries to the Passaic River. The swamp currently floods over properties and roadways and has recorded increasing water levels and reduced flood storage over the past several years.

The total watershed drainage area is approximately 55.4 square miles. The Great Swamp has a drainage area of approximately 19 square miles. The drainage area is confined by the surrounding roads; Long Hill Road, Green Village Road and Southern Boulevard. Meyersville Road which is shown on the USGS topographical map as dividing the Great Swamp into two sections, has been closed; the old asphalt surface has been removed, and the road is now used only as a foot path. No houses are located within the Great Swamp.

2.3.3 Black Brook

Black Brook originates from the Great Swamp and channels the runoff flow from the swamp and surrounding properties, including the New Vernon Road and White Bridge Road sites, towards the Passaic River. It flows along the southern boundary of the White Bridge Road Property, in a westerly direction for approximately 1,000 feet, where it is channeled under New Vernon Road; then for approximately another 8,000 feet to under Pleasant Plains Road; and from there the flow is in a north-westerly direction until the Brook's confluence with the Passaic River.

Black Brook has an average flow of 13 cubic feet per second (cfs) and has a drainage area of 9.9 square miles at the point at which it flows under the bridge at New Vernon Road. Treated wastewater discharge from the Town of Chatham's Wastewater Treatment Plant empties into the Brook.

2.3.4 Passaic River

Two gaging stations, located in Millington and Chatham, monitor the flow of the Passaic River. The drainage area which contributes water to the river at the Millington station is 55.4 square miles with an average flow of 91.3 cfs. The drainage area which contributes water to the river at the Chatham station is 100 square miles with an average flow of 173 cfs.

2.3.5 Flood Plain

The New Vernon Road and the White Bridge Road properties are located within a 100-year flood plain.

Surface and subsurface soils at the properties are considered poorly to very poorly drained and possess a high potential for flooding in the winter, early spring and during heavy summer rains. The White Bridge Road property owners have stated that significant portions of the property are frequently inundated during storm events. This occurrence is annual for portions of the property, and for larger, several year storm intervals, greater areas of the site may be affected. The New Vernon Road property has a shallow water table with wetland encroachment on three sides. Discussions with other residents and members of U.S. Fish and Wildlife Service indicate that flooding of New Vernon Road, Long Hill Road and Pleasant Plains Road is a common occurrence.

2.3.6 Ground Water Usage

There is no municipal water supply distribution system in the area. Residents of the New Vernon Road and White Bridge Road properties obtain their water supply from private wells located on their respective properties. Since the subsurface soils are primarily clay and silty clays, the well screens are positioned in the underlying bedrock formations.

2.3.7 Surface Water Usage

Surface water sources in the area of the sites are not used for potable water supply. However, the area is critical for flood control. Various studies are being conducted to ensure preservation of the Great Swamp as a natural habitat for various ecological systems.

- The Great Swamp is currently the subject of a 5-year United States Department of Agriculture (USDA) study to evaluate surface water usage. The USDA Great Swamp Hydrologic Unit Area Project has funding until 1995 to help better understand the effects of increasing storm water runoff on nutrients and sediment. One of the primary tasks of the Project is to examine storm water impacts on the Swamp's biological productivity and diversity as well as its capacity to moderate flood waters, filter pollutants, absorb nutrients, and provide unique natural habitats for a diversity of species.

- Another major study is also being conducted by the New Jersey Department of Environmental Protection and Energy (NJDEPE) Great Swamp Watershed Advisory Committee (GSWAC). This committee was set up following a controversy over a proposed expansion of the wastewater plants in Morris and Chatham Townships, which discharge treated effluent into Black Brook (which in turn flows through the Great Swamp). The committee will study the natural resources and public lands management conflicts so as to make recommendations for the protection of the Great Swamp's natural resources.

2.4 Cultural

2.4.1 White Bridge Road

White Bridge Road is a "private" 15 foot wide asphalt road bordering the site property on the north. A ditch runs along the road to divert runoff through a culvert. Black Brook runs along the southern boundary of the site and flows under New Vernon Road (See Figure 2). The residence on the property has its own private septic system with the leaching field located between the stables and Black Brook. A private drinking water well also exists on-site.

2.4.2 New Vernon Road

The property located at New Vernon Road has the Great Swamp located to the north of the property, and wooded wetlands to the east and south. New Vernon Road creates the western property boundary. The occupied and unoccupied residences on the property have their own private septic systems. The occupied residence has two leaching fields. The leaching fields are located behind (to the east of) and between the houses. The occupied residence has two underground oil storage tanks located beneath the front lawn, adjacent to the house. Both houses have private drinking water wells located to the west of the houses.

The topography of the New Vernon Road site slopes gently from the north-central area towards the south and east. Surface runoff drains towards the Great Swamp located south and east of the site. A long, narrow stretch of standing water extends in a north-south direction towards the west side of the property. Two small submerged drainage pipes are located beneath the driveways. These drainage pipes direct the runoff from the site and channels the standing water from a small pond on the south side of the property to the Great Swamp in the north. However, the water, when last observed, did not appear to be flowing but was stagnant probably as a result of cessation of drainage ditch maintenance downstream. The two houses are situated at a higher elevation on the west side of the property, adjacent to New Vernon Road.

New Vernon Road is a very highly traveled commuter highway. Additionally, a tennis club and several residences are located in close proximity to the site.

2.5 Ecology

The local ecology is dominated by the presence of the Great Swamp. Part of the area of contamination at the White Bridge site is within the boundary of the Great Swamp.

The Great Swamp National Wildlife Refuge is divided into two sections for management purposes; the Wildlife Management Area and the Wilderness Area. The Wildlife Management Area includes the area west of New Vernon Road/Long Hill Road and the small area east of New Vernon Road which includes both properties to be remediated. This area is intensively managed: water levels are regulated; grasslands and brush are mowed periodically to maintain habitat and species diversity; shrubs are planted; nesting structures for wood ducks, bluebirds, and other fowl are provided; other habitat management practices are also employed; and research studies are conducted. Public access to this area is limited to avoid disturbance of the wildlife.

The eastern half of the Great Swamp, known as the Wilderness Area, is undeveloped and public access is limited to recreational hikers only. This has allowed the area to become an established migration, nesting, and feeding habitat for migratory birds.

Twenty-seven species of animals are threatened with extinction due to the change in the habitat, loss of nesting places and chemical contamination. The Somerset County Park Commission Environmental Education Center has developed a list of threatened and endangered species located within the Great Swamp National Wildlife Refuge. The list includes birds, reptiles, amphibians and plants. Table 2-2 presents the 27 species listed as being on the verge of extinction.

The Great Blue Heron has nesting grounds in the vicinity of the White Bridge Road property and is of great concern to the Commission. The Great Blue Heron breeds between April 1 and July 31 each year. To avoid disturbing these birds, remediation construction activities at the White Bridge Road site during this period will be limited.

TABLE 2-2. ENDANGERED & THREATENED SPECIES OF THE GREAT SWAMP NATIONAL WILDLIFE REFUGE

Birds

Pied-billed Grebe
Great Blue Heron
Little Blue Heron
Yellow-Crowned Night Heron
Osprey
Bald Eagle
Northern Harrier
Cooper's Hawk
Northern Goshawk
Red-shouldered Hawk
Peregrine Falcon
Upland Sandpiper
Barred Owl
Short-eared Owl
Red-headed Woodpecker
Cliff Swallow
Loggerhead Shrike
Vesper Sparrow
Savannah Sparrow
Grasshopper Sparrow
Bobolink

Reptiles

Bog Turtle
Wood Turtle

Amphibians

Blue-Spotted Salamander

Plants

Feather Foil
Virginia Bunch Flower
Downy Phlox

3.0 EXTENT OF CONTAMINATION AT PROJECT SITES

During the Focused Remedial Investigation (RI) sampling program, conducted in November 1990, a total of 170 and 111 borings were advanced at New Vernon Road and White Bridge Road properties, respectively. Most of these borings were limited to a depth of approximately 3 feet, unless asbestos was observed. In this case, borings were extended to approximately 6 to 10 feet in depth.

A total of 41 additional borings, 25 at the New Vernon Road property and 16 at White Bridge Road, were advanced during the predesign field investigation program conducted by TRC during August 1992. These borings, whether asbestos was observed or not, were sampled every two feet to a depth of 10 feet with selected samples sent to a laboratory for Transmission Electron Microscopy (TEM) analyses. In borings where asbestos was observed, a 6 inch sample was collected at 12 inches and 18 inches below the last observed asbestos, since it is possible to observe material containing approximately one percent asbestos. A total of 83 samples were sent for TEM analyses. Of these, 15% showed a presence of asbestos above 0.5% by weight, the selected action limit.

The extent of asbestos contamination, as determined by the Focused RI laboratory data results, the visual observations made during the 1992 predesign field investigation program and the TEM analyses, was plotted on working drawings to delineate the lateral and vertical extent of contamination for remedial design purposes.

Subsections 3.1 and 3.2 contain a description of the extent and type of asbestos contamination (tile, tile fragments mixed with soil, or slurry) encountered at each of the two properties.

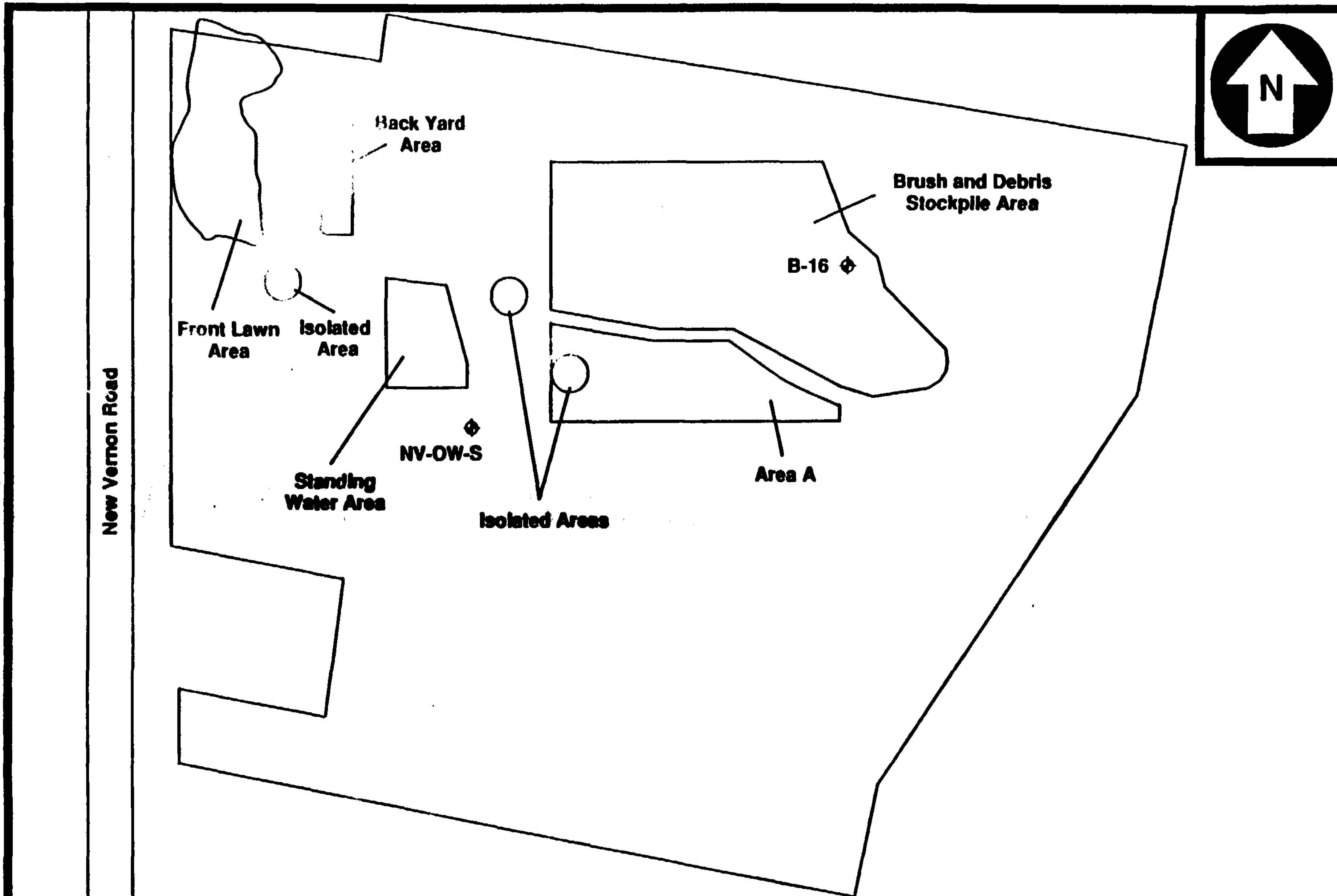
3.1 New Vernon Road

Based upon data from field investigations, the New Vernon Road site has been subdivided into four major areas of contamination which will be remediated. These areas have been designated as the "Front Lawn Area", the "Back Yard Area", the "Standing Water Area" and the "Brush and Debris Stockpile Area" (Figure 3). The area designated as Area "A" on the figure is to be excavated in a clean area, the clean material to be temporarily stockpiled and to receive the excavated, consolidated waste. These areas are discussed individually in the following subsections.

Two additional ground water monitoring wells were installed at the New Vernon Road site during the 1992 field investigation. A shallow well was installed approximately 50 feet south of the Standing Water Area. The well boring was completed to a depth of 10 feet. Water was encountered at 6 feet and the well was installed at 8 feet with a 4" diameter, 10-slot, stainless steel 5 foot screen. The deep well was installed at the eastern end of the Brush and Debris Stockpile Area. The well was set to 37 feet with a 5 foot screen (Figure 3). Shelby Tube samples were taken at the 18-20 and the 28-30 foot depths. Soil samples from Shelby Tubes were tested including grain size distribution, permeability and Atterberg Limits.

3.1.1 Front Lawn Area

A total of 16 borings advanced during the Focused RI within this area (0.75 acres) encountered asbestos material. The type of asbestos waste present is consistently described as "tile" or "ACM fragments". The tile fragments are mixed with silt, sand, some clay, and in one area, with little gravel. These mixtures are suitable for excavation and solidification. The depths of tile waste encountered ranged



SITE MAP

NEW VERNON ROAD SITE
LONG HILL, NEW JERSEY

TRC

Figure 3.

from 0 to 8.25 feet below ground surface. The total volume of ACM within this area has been estimated at 6,900 cubic yards (cy).

3.1.2 Back Yard Area

A total of four borings advanced during the Focused RI within this area (0.15 acres) encountered asbestos material. The asbestos waste is described as "tile". The tile is mixed with silt, gravel and rock fragments and extends between 0 to 8 feet below ground surface. The material is suitable for excavation and solidification. The total volume of ACM within this area has been estimated at 1,800 cy.

3.1.3 Standing Water Area

A total of seven borings, two from the 1992 predesign field investigation program and five from the Focused RI, advanced within this area (0.4 acres) encountered asbestos waste material. Of these, five encountered tile waste material, one a mixture of tile and slurry, and the other a mixture of tile and slurry to a depth of 2 feet and tile and green "foam" between 2 and 6 feet (no explanation can be given for the green foam). The depths of the asbestos waste ranged from the surface to a maximum of 8 feet below ground surface. Only two of seven borings in which asbestos was encountered had slurry. However this material was mixed with tile waste and the volumes were relatively small. In addition, the asbestos material was present with silt, organics, and peat. These materials appear suitable for excavation and solidification. The total volume of ACM within this area is estimated at 4,600 cy.

3.1.4 Brush and Debris Stockpile Area

A total of 23 borings, 10 from the 1992 predesign field investigation program and 13 from the Focused RI, advanced within this area (3 acres) encountered asbestos waste material. Of these, ten encountered tile waste material, two slurry, nine a mixture of tile and slurry, one tile and styrofoam, and the other is described in the boring logs as "ACM fill". The borings, that encountered only slurry, are 340 feet apart and the nine borings that encountered the tile and slurry waste are spread throughout the whole area. Due to the random nature of the borings encountering the slurry and tile/slurry mixtures, it is probable that the entire area consists of a mixture of tile and some slurry waste material. The waste material is also mixed with predominantly silt, with a trace of clay, fine sand, organics, gravel and asphalt chunks. The total volume of ACM within this area is estimated at 34,500 cy. Since the volume of waste in this area is considerable, it is not considered suitable for excavation. The waste material is however suitable for in-situ solidification.

3.1.5 Isolated Areas

Three small areas were found containing asbestos at the surface and will require scraping. Each area surrounds an isolated boring that was found to have asbestos contamination to a depth of 6 inches. It is probable that the asbestos was transported to these small areas via vehicle wheels, on the soles of shoes or by wind. The areas are estimated to account for a total ACM volume of 250 cy.

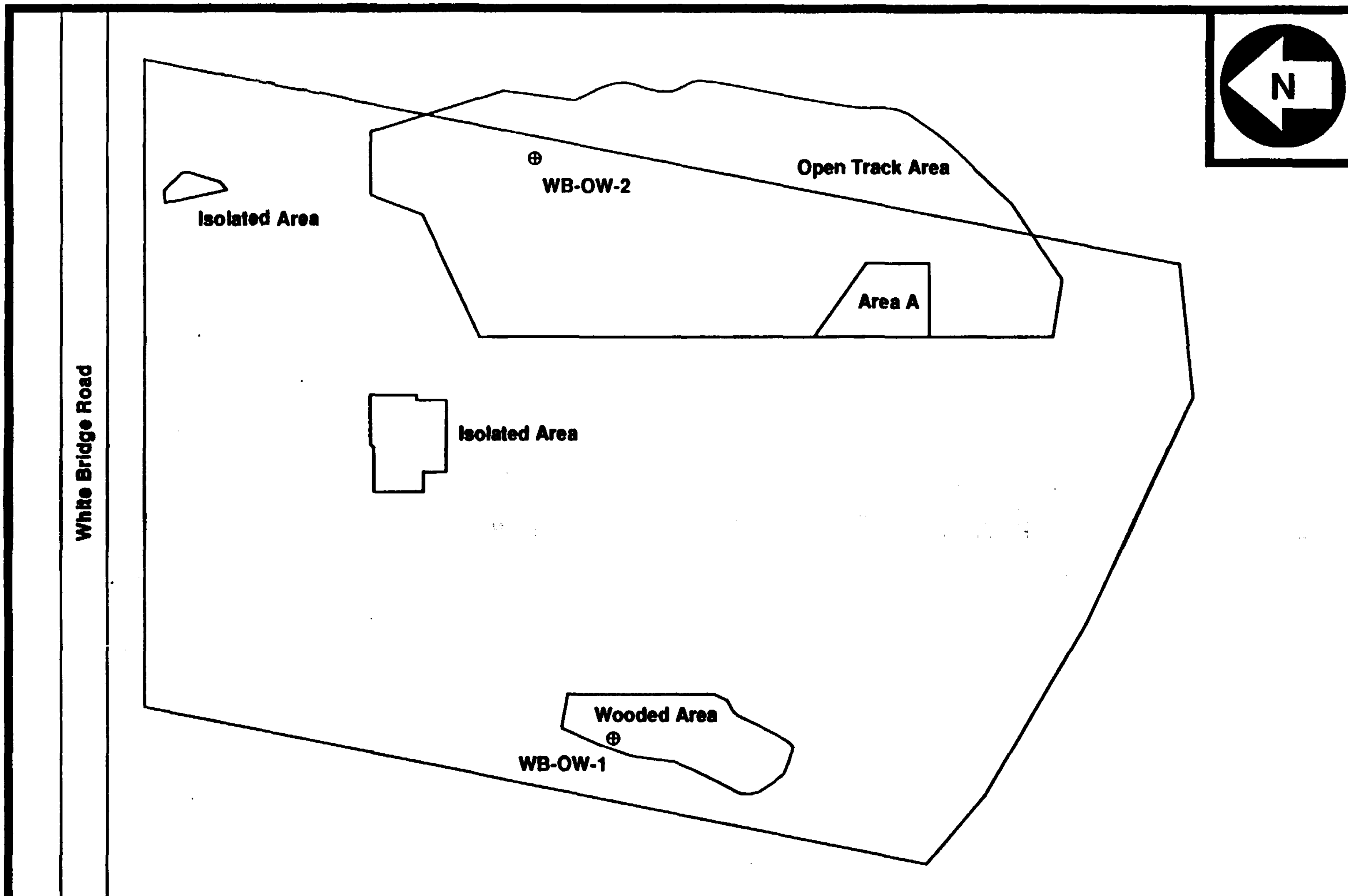
Asbestos contamination also exists on some of the roadways, beneath the asphaltic concrete and geotextile filter fabric. The asphaltic concrete will be removed and the surface of the roadways will be scraped to remove the asbestos and the pavement replaced. Areas where geotextile tabric covers roadways, and where the roadway is not within the "footprint" of solidification/stabilization, may be best remediated by being surficially scraped and consolidated with the bulk of the waste to be solidified/stabilized in-situ.

3.2 White Bridge Road

Two primary areas have been delineated at the White Bridge Road property which have been shown to be contaminated with asbestos. These areas are designated the "Open Track Area" and the "Wooded Area" (Figure 4). The area designated as Area "A" on the figure is to serve the same purpose as described previously for the New Vernon Road Site. The Open Track Area is adjacent to the wetlands and appears to have been filled in wetlands containing the majority of the contamination found on the site. Contamination in the Wooded Area has been found to a depth of 2.5 feet. There are a few additional areas on-site where borings were advanced and asbestos was found. These areas, however, appear to be isolated borings and surficial deposits. The following subsections describe the asbestos distribution and extent for each of the two main areas and the smaller isolated areas.

3.2.1 Open Track Area

A total of 26 borings, 6 from the 1992 predesign field investigation program and 20 from the Focused RI, advanced in the Open Track Area, encountered ACM. The depth of contamination ranged from surficial to 24 feet, with an average depth of 7 feet. Slurry was found in seven borings, usually in a homogeneous form, with tiles and soil also detected in the same boring. A deep well was installed in this area at approximately 32 to 37 feet below ground surface. Shelby Tube samples were collected at approximately the 18-20 and 28-30 foot depths,



SITE MAP

WHITE BRIDGE ROAD SITE
LONG HILL, NEW JERSEY

TRC

Figure 4.

A92-1701/A

with samples analyzed for grain size, permeability and Atterberg Limits. This area will be solidified/stabilized in-situ. The total volume of ACM within this area is estimated at 28,800 cy.

3.2.2 Wooded Area

Borings were advanced in the Wooded Area to a depth of 10 feet during the 1992 predesign field investigation program. A shallow well was installed at a depth of 15 feet, although the boring itself was advanced to a depth of 36 feet. Samples were collected using Shelby Tube samplers and analyzed for grain size, permeability and Atterberg Limits. The majority of the asbestos contamination was encountered within the first 2 feet of soil. Asbestos contamination consisted of tiles only.

No slurry was encountered. The total volume of ACM within this area is estimated at 1,400 cy.

3.2.3 Isolated Areas

There are primarily two additional isolated areas which contain asbestos contamination. One area is located directly north of the access road entering the site from White Bridge Road leading to the Open Track Area. Tile asbestos contamination was mostly surficially, although one boring encountered asbestos to a depth of 2 feet.

The other area is located in the pasture area east of the house. Asbestos contamination in the form of tiles was found to be mostly surficial, although one boring encountered asbestos to a depth of 4 feet. The surficial contamination, it appears, was mostly due to asbestos tile chips being carried on horses' hooves, while travelling between the riding track and the stables.

Also, the access road to the riding track covered with geotextile fabric may require surficial scraping and consolidation after removal of the fabric. These areas account for a total volume estimated at 1,000 cy of ACM.

3.3 Ground Water Contamination

During F.C. Hart's 1987 remedial investigation, three monitoring wells were installed at the New Vernon Road property and three at the White Bridge Road property. The monitoring wells were located, at both sites, along the perimeters and downgradient of the asbestos fill areas. In addition, ground water samples were obtained from private drinking water wells which are located in the vicinity of the two sites.

All ground water samples were analyzed for asbestos contamination. None was found to contain asbestos concentrations above the reported analytical detection limit of 100,000 fibers/liter. This is well below the Safe Drinking Water Act (40 CFR 141.50 - .51) maximum contaminant level of 7,200,000 fibers/liter. This indicates the asbestos is not particularly mobile through soils and ground water and therefore does not represent a threat to human health and the environment when in these media.

3.4 Surface Water Contamination

During F.C. Hart's 1987 RI, two surface water samples were collected from the New Vernon Road property and three were collected from the White Bridge Road property. Samples obtained at the New Vernon Road property were collected in drainage ditches (one upgradient and one downgradient of the property). One of the three samples obtained at the White Bridge Road property was sampled upstream of the property in Black Brook and the remaining two, downstream of the property in Black Brook.

Some of the surface water samples contained asbestos concentrations above method detection limits. Asbestos concentrations at the New Vernon Road property were below detection limits in the upgradient location and 3,200,000 fibers/liter in the downgradient location. Asbestos concentrations at the White Bridge Road property were 1,000,000 fibers/liter in the upgradient location and 2,000,000 and 300,000 fibers/liter at the downgradient locations. All water samples contained asbestos at levels well below the Safety Drinking Water Act (40 CFR 141-50-.51) maximum contaminant level of 7,200,000 fibers/liter. It is possible, however, that over time, erosion of the surface of the waste disposal areas may result in increased concentrations of asbestos fibers to the adjacent surface waters.

4.0 TREATABILITY STUDY

4.1 Introduction

TRC Environmental Corporation, under a separate contract, performed a Treatability Study in accordance with the requirements of the Record of Decision (ROD) to analyze the effectiveness of solidification/stabilization as a remediation/immobilization treatment for asbestos contaminated waste and to select an appropriate solidification reagent to achieve solidification/stabilization performance specifications. The actual specimen preparation and tests were conducted by Kiber Technologies, Atlanta, Georgia, with direction from the EPA and TRC personnel. Full details of this study are provided in a separate report. However, a summary of the procedures and results is presented below.

4.2 Methodology

The untreated asbestos contaminated waste material was tested in the forms of soil, slurry, tile and a composite material - a homogenized mixture consisting of equal-weight proportions of each of the three waste types. The composite was prepared to more accurately reflect the state of the asbestos contaminated material to be found at the two sites. There are however pockets of the individual waste types present at the sites which necessitated testing these individual states as well.

The Treatability Study was divided into four tasks. The aim of each task was as follows:

1. To conduct analytical characterization of the untreated waste material;

2. To conduct pre-screening of the solidification reagents using unconfined compressive strength (UCS) testing as the screening criterion;

3. To further evaluate the solidification reagents using more comprehensive testing methods; and

4. To perform a comprehensive analysis on the final two mixtures proposed for solidification/stabilization remediation.

Non-proprietary reagents - Type I Portland cement, cement kiln dust (CKD), and blast furnace slag (BFS) were selected to be tested as suitable solidification/stabilization reagents because they are readily available and relatively inexpensive. Concentrations of the various reagents, from 15% to 50%, by weight, were slurried with water and then mixed with the different forms of untreated waste. Mixtures were formed by placing aliquots of each untreated waste material into a blending chamber. A reagent and water were slurried, then added to the untreated wastes and blended at a rate of approximately 30 to 40 rotations per minute, until they appeared homogeneous. The blending process was necessary to activate the binding mechanism of the solidification reagents.

The resultant homogenized mixture was compacted into cylinders measuring approximately 2 inches in diameter by 4 inches in height. The mixtures were allowed to cure for a period of two days in an environment maintained at room temperature. A series of tasks was developed in which more detailed analytical and durability tests, according to various standard methods (American Society for Testing and Materials, ASTM, American Nuclear Society, ANS, etc.), were conducted on the solidified/stabilized cores, while progressively reducing the number of reagent concentrations tested.

After completion of the initial tasks, two reagent mixtures were identified for the final task. The mixtures selected for the soil, tile and composite materials were:

- 30% of a 50/50, by weight, mixture of cement and CKD; and
- 20% Blast Furnace Slag (BFS) with 8% CKD.

The concentrations selected and evaluated for the slurry material in the final task were:

- 50% of a 50/50, by weight, mixture of cement and CKD; and
- 20% BFS with 8% CKD.

The addition of cement kiln dust to the solidifying reagent appeared to be beneficial in that it filled in the voids within the specimen, resulting in an increased strength of the material.

4.3 Results

The solidified/stabilized cores were tested for various parameters - wet/dry and freeze/thaw durability, triaxial compressive strength, volumetric expansion, unconfined compressive strength (UCS), permeability, porosity, bulk density, and leachability. Each parameter is discussed in the sub-sections that follow:

Wet/Dry Durability (ASTM D-559)

The wet/dry durability testing was conducted to determine the durability of the material to resist moisture changes, material loss, and structural integrity when subjected to 12 cycles of wetting and drying. The specimens were placed in an oven at a temperature of 70°C for a minimum of 42 hours. Each specimen was then submerged in water for five hours. The action of drying/wetting constituted one cycle. After each cycle, the specimen was scraped with a wire brush to remove any loose debris. The results determined after 12 cycles of drying/wetting were as follows:

Waste Type	**Reagent type**	**Total Material Loss**
Soil	Cement/CKD	5.0%
Soil	BFS/CKD	5.0%
Slurry	Cement/CKD	16.8%
Slurry	BFS/CKD	21.5%
Composite	Cement/CKD	6.2%
Composite	BFS/CKD	13.0%

In the EPA document, (EPA/625/6-89/022) "Solidification/Stabilization of CERCLA and RCRA Wastes" it is stated "No standards are currently established for determining whether stabilized material has passed durability testing; however, Vick et al. (1987) suggest that up to 15 percent weight loss is an acceptable amount".

It can be seem from the above results that the soil and composite materials achieved the 15% maximum weight loss criterion while the slurry did not. In all cases, however, the cement/CKD mixtures achieved the better results.

Freeze/Thaw Durability (ASTM D-4842)

The freeze/thaw durability testing was conducted to determine the durability of the material to resist moisture changes, material loss, and structural integrity when subjected to 12 cycles of freezing and thawing. The freeze/thaw testing was conducted by placing each test specimen in a freezer at a temperature of less than minus 15°C for a minimum of 24 hours. The test specimens were then thawed in water for 24 hours. This 48 hour period constituted one freeze/thaw cycle. The results of the specimen degradation are presented in the following:

Waste Type	Reagent type	Total Material Loss
Soil	Cement/CKD	1.0%
Soil	BFS/CKD	1.7%
Slurry	Cement/CKD	3.7%
Slurry	BFS/CKD	1.2%
Composite	Cement/CKD	0.6%
Composite	BFS/CKD	0.7%

The durability criterion of a maximum of 15% weight loss was clearly achieved by all wastes types, for both reagent mixtures.

Triaxial Compressive Strength (ASTM D-2850)

Triaxial compressive strength testing was performed on specimens measuring 3 inches in diameter and 6 inches in height. The specimens were prepared by saturating each monolith in water for no less than 24 hours. Upon saturation, each specimen was placed in a plastic bag with a wet paper towel to maintain moisture. Each specimen was tested at a strain rate of approximately 0.3 percent per minute.

Triaxial compressive strength tests were performed on the soil, slurry, and composite test cores. The triaxial compressive strength at failure, at an effective confining stress of 10 pounds per square inch (psi), for the soil was in the range of 281 to 1300 psi; for the slurry in the range of 102 to 125 psi; and for the composite in the range of 178 to 634 psi. The results indicated that the BFS/CKD mixtures produced triaxial compressive strengths greater than the cement/CKD mixtures although both reagents provided adequate compressive strengths for each of the waste materials.

Volumetric Expansion

No ASTM test method was used for volumetric expansion. Volumetric expansion is a measurement of the percent change in volume between the before and after treatment volumes of the solidified monolith.

The following are the ranges of the volumetric changes for each of the developed mixtures:

Waste Type	Volumetric Expansion Cement/CKD	BFS/KD
Soil	26.0%	17.5%
Slurry	47.0%	37.5%
Composite	36.0%	20.0%

The volumetric expansion was between 9.5% to 16% greater for mixtures developed using the Cement/CKD than those using the BFS/CKD. There is no acceptance criterion for volumetric expansion. It is however, desirable from a construction standpoint to have as low a volumetric expansion as possible, to avoid local mounding of the waste material once it has been solidified.

Unconfined Compressive Strength (ASTM D-2166)

The unconfined compressive strength is generally used to evaluate the strength properties of solidified materials. This test was performed on the soil, slurry, composite, as well as on the tile mixtures. The tiles were reduced to three sub-specimens having a maximum particle size of 0.15 inches, 0.50 inches, and 1.0 inch respectively. Specimens tested were 6 inches in height and 3 inches in diameter.

Each specimen was tested at a strain rate of 0.06 inches per minute, an approximate equivalent of 1.0 percent per minute. Testing was terminated either when the load decreased with increasing strain or 15 percent axial strain was achieved.

The EPA considers a solidified/stabilized material with a strength of 50 psi to have a satisfactory Unconfined Compressive Strength (UCS) (EPA OSWER Directive No. 9437.00-2A). This minimum guideline of 50 psi has been suggested to provide a stable foundation for materials placed upon it, including construction equipment and cover material. The test cores produced with the final selected reagent concentrations all exceeded 50 psi during the UCS testing.

	UCS (psi)	
Waste Type	**Cement/CKD**	**BFS/CKD**
Soil	285.6	383.2
Slurry	78.3	163.4
Composite	155.0	530.0
Tile*		
0.15 inches	738	286
0.50 inches	888	717
1.00 inches	498	663

* Maximum size in one dimension

Permeability (EPA Method 9100/ASTM D-5084)

Permeability testing was performed to evaluate the ability of water to flow through the treated mixtures. Specimens measured 2.5 inches in height and 3.0 inches in diameter. Each specimen was back-pressure saturated at an effective confining stress of 0.7 psi, and consolidation was performed at an effective confining stress of 5.0 psi. Hydraulic conductivities of less than 10^{-5} cm/sec are generally acceptable according to EPA guidance document EPA/625/6-89/002. The values for the mixtures tested are summarized below. Both of the selected reagent mixtures produced favorable results.

Permeability (cm/sec)

Waste Type	Cement/CKD	BFS/CKD
Soil	3.1×10^{-7}	5.1×10^{-8}
Slurry	1.1×10^{-6}	3.0×10^{-7}
Composite	6.0×10^{-7}	2.3×10^{-7}

Porosity and Bulk Density (ASTM D-948)

Each specimen was submerged in water for no less than 24 hours. The specimen was then weighed in accordance with parameters specified in ASTM D-948. The submerged weight of each specimen was determined using a hydromassimeter developed by KIBER for treatability testing. Each specimen was resubmerged in the water for an additional 2 hours, after which each specimen was reweighed. The 2-hour soaking period continued until the mass increase for each specimen was less than 0.5% of the heavier mass. The specimens were then dried in an oven at a temperature of 105°C for a period of not less than 24 hours. The dried mass of each specimen was determined at intervals of 2 hours until a decrease of mass was less than 0.5% of the lowest mass. The information obtained from the testing enabled the saturated bulk density and the porosity of each specimen to be determined. The apparent porosity ranges achieved for the mixture types are summarized below:

Porosity

Soil	42.6 to 48.1%
Slurry	74.3 to 78.4%
Composite	58.8 to 59.6%

No conclusions can be drawn between the two reagent mixtures as the results were comparable. The saturated bulk densities ranges were as follows:

Bulk Densities (pcf)*

Soil	111 to 116 pcf
Slurry	79 to 83 pcf
Composite	97 to 99 pcf

*Pounds per cubic foot.

The two reagent mixtures both appear equally effective as the results were comparable.

Leachability (ANS 16.1)

This procedure, originally designed by the American Nuclear Society to measure for radioactive leachability, is often used to evaluate the leachability of inorganic constituents. The tests were performed on specimens measuring approximately 2 inches in diameter and 4 inches in height. The specimens were placed in a 3000 milliliter (ml) beaker and soaked in 2100 ml of water. The water "leachate" was replaced at the following intervals: 2, 7, 24, 48, 72 hours, 4, 5, 19, 47, and 90 days. The leachate samples were then submitted to a laboratory participating in the Contract Laboratory Program (CLP) program. ANS 16.1 leachability analytical analyses results are presented on Table 4-1. The results show that asbestos fibers are leaching from the solidified materials in amounts from 144 million to over 11 billion structures per liter. Although this is a substantial reduction from the trillions of structures per liter contained within the on-site asbestos tile, the leaching of fibers from the solidified materials is in excess of the Safe Drinking Water Act (40 CFR 141.50 - 51) maximum contaminant level of 7,200,000 fibers per liter asbestos contamination in ground water. The results did not show any significant difference in how the cement/CKD mixture performed compared to the BFS/CKD mixture.

TABLE 4-1. ANS16.1 LEACHABILITY TEST RESULTS UNITS (MILLION STRUCTURES PER LITER)

	Soil/ Cement	Soil/ Cement	Soil/BFS	Soil/BFS	Slurry/ Cement	Slurry/ Cement	Slurry/ BFS	Slurry/ BFS	Comp./ Cement	Comp./ Cement	Comp./ BFS	Comp./ BFS
2 hour	89.73	122.36	8.16	130.52	16.32	3242.66	3691.33	3385.42	2039.41	2753.20	3528.17	3161.08
7 hour	9.79	16.32	8.16	BDL	1019.70	220.26	840.24	407.88	709.71	1359.60	562.88	138.68
1 day	27.74	31.00	3.26	4.89	1111.48	513.93	791.29	978.92	2222.95	130.52	652.61	146.84
2 days	78.31	106.05	2447	32.63	358.94	840.24	1165.38		1903.45	734.19	987.98	1070.69
3 days	24.47	32.63	8.16	37.53	416.04	301.83	933.60	277.36	497.62	252.89	424.20	848.39
4 days	16.32	21.21	9.79	BDL	546.56	416.04	1664.16	1203.25	448.67	587.35	668.93	2528.86
5 days	57.10	8.16	57.10	17.95	293.67	296.39	1810.99	1359.60	350.78	424.20	530.25	693.40
19 days	65.26	BDL	24.47	1.63	203.94	158.26	644.45	301.83	334.46	269.20	57.10	1.63
47 days	24.47	0.00	BDL	BDL	244.73	326.31	34.26	220.26	203.94	179.47	16.32	114.24
90 days	9.78	1.63	0.48	BDL	61.94	65.20	40.96	143.44	44.16	19.56	9.12	52.16
Average	40.30	33.94	14.41	22.52	427.33	638.11	1161.67	827.80	875.52	671.02	743.76	875.60
Total Release of Fibers	402.97	339.36	144.05	225.15	4273.32	6381.12	11616.66	8277.96	8755.15	6710.18	7437.56	8755.97

*BFS (Blast Furnace Slag)

*Comp. (Composite of equal portions by weight of soil, tile, and slurry)

Note: Safe Drinking Water Act (40 CFR 141.50-.51) maximum contaminant level is 7,200,000 fibers/liter.

4.4 Conclusions and Applicability to Remedial Action

4.4.1 Conclusions

The following conclusions summarize the major results obtained from the Treatability Study:

- There are no target compound list (TCL) organic or target analyte list (TAL) inorganic contaminants in the untreated materials tested which will adversely affect the solidification/stabilization treatment process.

- Exothermic reactions, occurring as part of the solidification process are not expected to produce significant organic vapor emissions during remediation due to the non-detectable levels of volatile organic compounds (VOCs) found to be present in the untreated waste material tested.

- All mixtures had cured hydraulic conductivities adequate for effective solidification. The values obtained met the specifications typically accepted for land disposal of solidified materials, although this parameter is often project specific.

- The unconfined compressive strength properties meet the minimum guidelines established by EPA. The minimum guideline has been suggested to provide a stable base for overlying materials, such as construction equipment or an impermeable cover.

- The wet/dry durability test for the slurry ACM and the leachability test results for all ACM appear not to have achieved the specified requirements.

However, due to the methodology of the tests and the inert nature of asbestos, these results should be reviewed as follows:

Wet/Dry Durability: As reported in Section 4.3, the wet/dry durability testing achieved the 15% weight loss criterion for all waste types except the slurry mixtures. It is expected that the soil and composite materials are most representative of the ACM at the sites, however there are pockets of slurry, especially at the White Bridge Road site, which should be considered. The slurry material experienced a material loss of 16.8% for the final reagent concentration selected. However, the test method utilized to evaluate this criterion (as described in Section 4.3), was extremely rigorous and harsh and not representative of the situation to be found at the two Project Sites. The test method required complete saturation, followed by drying in an oven at 70°C and then scraping with a wire brush.

The solidified/stabilized asbestos contaminated material at the sites will be covered by a geomembrane and a 3 foot soil cap, effectively maintaining some moisture within the solidified mass at all times and preventing it from being completely dried out. The solidified mass, will therefore, be expected to experience minimal complete cycles of wet/dry. In addition to this, it is unlikely that ground temperatures of 70°C will ever be experienced at the Project Sites. The solidified monolith will also not experience any external, abrasive, degrading force similar to the wire brush applied to the test specimens. It is, therefore, expected that the slurry waste material will not degrade to the extent experienced during the Treatability Study.

Leachability testing: The results of the Treatability Study show that by addition of a cement-based grout to form a solidified mass, the asbestos fibers will still leach out in excess of the drinking water maximum contaminant level of 7,200,000 fibers/liter. Although this is an improvement over the number of fibers that were found to leach from the untreated waste material, solidification/stabilization of the ACM below the water table will clearly not prevent the asbestos from leaching into the ground water. A problem may arise also in that alkaline water may result which could raise local ground water and subsequently, surface water pH.

However, it is not expected that these fibers will travel rapidly through the soils. An EPA report "Movement of Selected Metals, Asbestos, and Cyanide in Soil," (EPA 600/2-77-020) compares the physical transport of asbestos with that of clay sized particles because of their comparable small size. The report states that "clay particles 0.1 to 2.0 micrometers (μm) in diameter are estimated to move at a rate of 1 to 10 centimeters per 3,000 to 40,000 years, depending on the soil texture." This report also states that migration of asbestos through soil is "not a problem of any significance" and that "asbestos does not offer a serious contamination prospect to the soil or underground water supplies and cannot be classed as a soil pollutant."

4.4.2 Applicability to Remedial Action

A review of the results of the Treatability Study has shown that solidification/ stabilization of the ACM below the water table will not prevent the asbestos fibers from leaching into the ground water at levels in excess of the maximum contaminant level. However, EPA Guidance does state that "asbestos migration through soil will not be a problem of any significance", and that "asbestos does not offer a serious contamination prospect to the soil or underground water supplies and cannot be classed as a soil pollutant". Since this guidance and the results of past ground water monitoring at the sites have not shown elevated levels of asbestos in ground water, solidification below the water table appears not to be warranted.

The testing conducted during the Treatability Study, that created conditions comparable to those the Solidified/Stabilized ACM may be subjected to, were: UCS, porosity, bulk density, permeability, and volumetric expansion. Based on the results obtained for these test methods, both final reagent mixtures achieved the required performance criteria. Although the BFS/CKD had lower volumetric expansions, these will be insignificant over the proposed approximately 4-foot depths of treatment.

Furthermore, blast furnace slag, varies considerably depending on the source. Considerable quantities of the reagent will be required to perform the solidification treatment (approximately 18,000 tons, in total) and it is therefore important to have a reliable reagent that will perform consistently over the course of the treatment to achieve the performance criteria. Whereas Type I - Portland Cement is widely available and has accepted, consistent standards. It was therefore recommended in the remedial design that the cement/CKD reagent mixture be used in preference to the BFS/CKD.

5.0 REMEDIAL DESIGN

The intent of the remedial design is to develop drawings and specifications which will allow compliance with the Record of Decision (ROD) (EPA/ROD/R02-91/163), as follows: implementation of the treatment of "asbestos-contaminated soils using in-situ solidification/stabilization".

The two Project Sites, New Vernon Road and White Bridge Road, have extensive asbestos contamination in the form of tiles, slurry and within the soil. The extent of contamination at both sites was previously described in Paragraph 3.0.

The primary risk associated with asbestos is that of inhalation. Asbestos fibers inhaled in sufficient quantities can be carcinogenic. The maximum contaminant level for asbestos in air is 0.2 fibers/cubic centimeter.

Although ingestion of asbestos through drinking water is also a potential health risk, this is not of primary concern when compared with the air risk. The maximum contaminant level of asbestos in drinking water is 7,200,000 fibers/liter. Asbestos is not particularly mobile through soils. As previously stated asbestos does not offer a serious contamination prospect to the soil or underground water supplies. In addition to this, all ground water and surface water sources sampled throughout the course of the EPA assessment of the sites, have shown that levels of asbestos in the water have been consistently below the maximum contaminant level. However, erosion of soils over time may result in elevating asbestos concentrations in surface water.

The Treatability Study results indicate that solidification/stabilization below the ground water table may be susceptible to degradation. With this in mind, the remedial design developed, has complied with the intent of the ROD, by addressing the primary risk (inhalation) and future risk to surface water through erosion and subsequently to human health and the environment, in a manner which provides a high degree of performance. Furthermore, the design developed is intended to minimize disruption of the wetland ecosystem, retain flood storage capacity, intercept and infiltrate post-development runoff and reduce project costs. Rationale for design development is provided in the following text with supporting calculations included in the Appendices.

The elements of the design include:

- excavation and consolidation of ACM;
- solidification/stabilization of the ACM above the ground water table;
- construction of a final protective geomembrane/soil cover;
- construction of a perimeter infiltration trench;
- final grading and revegetation;
- drainage; and
- erosion control.

5.1 Excavation and Consolidation

The ACM on both Project Sites has been determined to be primarily located in a main landfill area. There are satellite areas on each site where some ACM has been encountered. In the case of the New Vernon Road Site, the satellite areas contain substantial volumes of ACM. These areas have been discussed in Section 3.0 of this report and their locations are shown in Figures 3 and 4.

The proposed design requires the ACM from the satellite areas, at each site, to be excavated and then transported to a pit which has been excavated in clean material (Area A), adjacent to the main landfill area, and the ACM solidified/stabilized in conjunction with the main landfill area. This will increase the volume and area of the main landfill area. It is preferable to consolidate the ACM and only solidify/stabilize one area on each site rather than conduct in-situ solidification/stabilization at every location ACM has been encountered, for the following reasons:

- Although the asbestos contamination will have been remediated at each site, any future development of solidified/stabilized areas will be restricted with land deeds. It is, therefore, preferable to restrict the use of one area only, at each site, rather than several smaller areas. Both sites occupy considerable acreage and should the present owners wish to sell any parcel of the property, it would then be possible to sell a portion with no deed restrictions.

- ACM at the New Vernon Road property is currently located throughout the Front Lawn Area and Back Yard Area of the house. Solidification/stabilization of these areas would result in an estimated four foot increase in elevation as a result of volumetric expansion of the soil/reagent mixture and a three foot protective soil cover. This would result in the residence effectively being in a "basin", which would certainly be unacceptable to the property owners. Furthermore, New Vernon Road is currently at the same elevation as the surrounding land and is susceptible to flooding. Increasing the elevation of the surrounding areas, and altering the local ground water flow patterns will almost certainly expose the road and the residence to considerable flooding during storm events or heavy spring runoff.

- It is more cost-effective to solidify/stabilize one large area at each site, rather than several smaller areas. Each separate area to be solidified/stabilized would require separate stabilization, decontamination, and demobilization, each time incurring extra cost.

- Currently, it is recommended in the design that the New Vernon Road residents be relocated during the period of excavation of the Front Lawn and Back Yard (about a 4-week period). If it were decided to solidify/stabilize these two areas the time the residents would have to be relocated would increase to eight weeks. This additional time would incur additional cost and cause further inconvenience to the residents.

- At White Bridge Road, one of the satellite areas, the "Wooded Area", is located adjacent to Black Brook. The water table in this area is almost always at the surface. Solidification/stabilization of this area would result in flood storage volume loss and hydraulically impact Black Brook.

- Implementation of solidification/stabilization, close to Black Brook, would cause considerable damage to the trees and other vegetation, as well as causing the alkalinity of the reagent to leach into the ground water and Black Brook. This will cause an additional risk to the local flora and fauna.

- The depth at which some solidification/stabilization processes generally achieve proper mixing of reagents is a minimum of 4 feet. Some of the satellite areas have contamination to a depth of only 6 inches, which would mean the solidification/stabilization process would include, unnecessarily, a volume of uncontaminated soil to achieve proper mixing of reagents.

The areas and depths of excavation will include ACM as determined by previous field investigations. The main landfill areas, The Brush and Debris Stockpile Area at New Vernon Road, and the Open Track Area at White Bridge Road, will not be excavated, but solidified/stabilized in-situ. Adjacent to each of these two areas, "Area A" (Figures 3 and 4), will be excavated to sufficient size to accommodate the ACM excavated from the satellite areas. "Area A" will be solidified/stabilized along with the main landfill areas.

Excavation and transportation of ACM will be implemented by the Subcontractor using standard excavation equipment such as backhoes and enclosed trucks (to prevent escape of asbestos fibers). Due to the high water table in the areas to be excavated and the proximity of some areas to New Vernon Road and the residences, temporary shoring will be required to prevent structural damage or ground loss from occurring. Temporary shoring will enable dewatering activities to be implemented with the use of dewatering pumps. All excavation activities will be conducted in accordance with the requirements of a project Health and Safety Plan to be prepared by the Subcontractor and approved by the Contractor and EPA.

Following the completion of excavation, all areas will undergo confirmatory sampling and testing to ensure all asbestos contaminated material has been removed. Any additional ACM encountered will also be excavated and transported to Area A.

5.2 In-Situ Solidification/Stabilization

The areas to be solidified/stabilized in-situ [illegible] the [illegible]ash and Debris Stockpile Area at New Vernon Road and the Open [illegible] White Bridge Road. Both areas will have been expanded to include "Areas A", which contain the ACM transported from the satellite areas at each site. The design documents show that all ACM above the water table is to be solidified/stabilized in-situ. Estimating that, at the time of implementation, the water table at New Vernon Road and

White Bridge Road will be at a depth of 4 feet and 3 feet respectively, the total volume of ACM to be solidified/stabilized is estimated at 26,000 cubic yards (cy) and 11,000 cy respectively. The corresponding areas are approximately 4 and 2.3 acres, respectively.

To allow some flexibility in implementation, it is anticipated that the method of solidification/stabilization will be selected by the Subcontractor with the approval of the Contractor (EPA and/or designated representative). The Subcontractor will have to demonstrate considerable experience with the proposed technique to be utilized to perform a successful remediation. The method may include the use of backhoes to mix the reagent grout into the ACM or shallow mixing augers may be utilized. The auger method typically consists of an auger which has a hollow shaft through which the reagent grout is injected. As the auger penetrates the ACM, the reagent grout is injected. On the up-stroke, the grout is effectively mixed with the ACM. A pattern of overlapping columns is utilized to solidify/stabilize the ACM.

This operation has intentionally not been definitively specified to allow the Subcontractor (or expert in the field of solidification/stabilization) to prepare the most suitable technique for the site conditions. In this way the most cost effective technique will be proposed. Furthermore, prescribing a particular method could unintentionally limit the number of subcontractors who may be eligible to bid for the work.

In accordance with the results of the Treatability Study a suitable grout reagent has been selected for construction that will achieve the performance criteria. The final grout recommended is a 30% concentration of a 50:50, by weight, mixture of Type I Portland cement and cement kiln dust (CKD). Both are readily available at reasonable cost. Details of the Treatability Study performed are provided in Section 4.0 of this report.

Although the Treatability Study recommends the use of this grout concentration, the specifications require the Subcontractor to be responsible for producing a product that will achieve the designated performance criteria. In all likelihood it will be necessary to alter the grout mix to meet the changes in types and natural moisture content of the in-situ materials to ensure that the final product meets the specified parameters.

The Subcontractor will be required to sample the treated ACM, each day, or every 500 cy treated, whichever occurs more frequently. Molded samples of the treated ACM shall be allowed to set and then unconfined compressive strength (UCS) tests will be performed at 2, 5, 7, 14 and 28 day intervals. The performance criteria requires that 50 pounds per square inch (psi) UCS at 7 days and 100 psi at 28 days be obtained. After it has been shown that these criteria are regularly being achieved, the frequency of sampling may be reduced to one sample for every 1,000 cy treated. Durability testing in the form of freeze/thaw according to ASTM D-4842 and wet/dry according to ASTM D-4843 shall be conducted every 1,000 cubic yards. The performance criterion will be that a maximum weight loss of 15% will be permitted. Additional testing in the field for cement content and UCS, using a cone penetrometer, is specified.

The area to be solidified/stabilized at each site will be designated as the "Exclusion Zone" and only approved personnel shall be permitted to enter the area. The area will be clearly delineated using demarkation fencing. In addition, silt fencing, hay bales and operational berms will surround areas of activity to prevent migration of asbestos fibers due to surface runoff and erosion. All activities will be conducted strictly in accordance with the requirements of the Health and Safety Plan.

5.2.1 Steel Sheetpile Wall and Revetment on White Bridge Road

A steel sheetpile wall will be installed on White Bridge Road site between the mass to be solidified and the wetlands on the east side of the Open Track Area. The purposes of this wall are as follows:

1. To provide lateral support for heavy earthmoving equipment during the excavation of the contaminated material in the wetland;

2. To intercept any ground water containing asbestos which may have leached from the contaminated mass, from entering the wetlands after remediation;

3. To provide a "clean barrier" between the solidified mass and the wetlands; and

4. To minimize transport of alkaline leachate to the wetlands.

The contaminated material present in the wetlands extends to the treeline. If this material were to be solidified in place, the resulting solidified/stabilized mass, and equipment used to mix the materials, would sever the roots of the trees and most likely cause serious damage to the vegetation and sensitive habitats. Therefore, the wall is positioned to maintain a safe distance from the existing vegetation to protect the environment. The wall will allow excavation of ACM from the wetlands and the placement of clean backfill to provide a protective barrier between this solidified/stabilized ACM and the wetlands. The underlying weak soils are unable to support the loads imposed by the weights of the equipment and the resulting solidified mass and final soil cover. The wall will minimize the potential for a slope failure to occur into the wetlands.

The steel sheetpile wall is to be designed by the Subcontractor to meet all the objectives set forth by this document and the specifications, and to meet all acceptable engineering criteria. The Contractor will review and approve the final design, prior to its construction.

Existing soil borings from the area indicate slurry and peat to a depth of over 14 feet. This material does not provide adequate stability for the wall, and the effective pressures of the soil on the wall could create a loadings which would cause the wall to fail. The subcontractor may wish to advance some borings along the proposed location of the wall to better characterize the soils.

The steel sheetpile wall will be driven into the soil prior to excavation of the contaminated soil in the wetlands. Required excavation in the northern portion is to a depth of approximately two feet. The remaining wetlands area requires excavation up to a depth of 8 feet (including peat). The depth of excavation may seriously impact the integrity of the wall, therefore care will be exercised through construction sequencing in excavating and backfilling to prevent any wall failure. To minimize the potential for instability, the excavation in front of the wall will occur in limited sections so as to avoid exposing the whole wall at any given time. It is probable that where the excavation is only 2 feet, it may be performed in larger sections or no sections at all.

Because of the anticipated noise associated with the installation of the steel sheetpile wall, the Subcontractor will not be permitted to install the wall between April 1 and July 31. This is due to the potential noise disturbance to the Great Blue Heron whose rookeries are near the site.

A revetment will be constructed along the wall into the wetlands after excavation. The revetment will include backfilling with common fill to a grade of no less than 2:1, following the natural contour of the area. It is not necessary to completely backfill the area excavated, as long as the existing vegetation root system is not left exposed. A geotextile filter fabric, secured with pins, and stone will be placed over the common fill. The intent is to have no net loss of wetlands, and if possible, create some additional wetlands as a result of the excavation.

A 2-foot wide, 2-foot deep anchor trench will be constructed between the steel sheetpile wall and the beginning of the revetment. This "trench" will be lined with the geotextile filter fabric and crushed stone. At the bottom of the revetment, a 2-foot wide, 3-foot deep trench will also be constructed and lined with the geotexile and crushed stone. This will aid in the prevention of erosion of the revetment in the case of a severe storm which increases flows and velocities within the wetland and discourage animals burrowing into the revetment.

5.3 Grading; Final Protective Cover; and Revegetation

The solidified/stabilized mass is expected to expand approximately one foot as a result of the solidification/stabilization process. Therefore, the final grade of the mass will be higher than existing conditions. Overlying the solidified/stabilized mass a final 3-foot high soil cover will then be constructed, increasing the final elevation by a total of about four feet above existing grade. The final cover will be graded so the area will blend into the surrounding landscape. The grading on White Bridge Road will be carried out to allow for easy access for the horses.

The final surface of the solidified/stabilized mass is expected to be rough. A sand or common fill layer will be placed over the solidified/stabilized mass to even out the grade. A 60 mil high density polyethylene (HDPE) geomembrane exhibiting specific strength qualities will be placed on top of the leveled solidified mass to prevent infiltration of rain water from the top soil cover into the solidified mass, which could degrade the structural integrity of the solidified mass. Although the solidified/stabilized mass is required to meet wet/dry test performance specifications, the geomembrane will provide an additional measure of protection.

To protect the geomembrane from puncture by coarse aggregate (NJDOT #4), a geotextile filter fabric will be placed on top of the geomembrane. The cover will be graded to the intended slope shown on final grading plans. The final grade of the coarse aggregate will be approximately 2.5 feet lower than that shown on the drawings. The intent of the aggregate layer is to allow drainage of infiltration through the cap and to prevent burrowing animals from getting into the solidified/stabilized mass. A geotextile filter fabric will be placed on top of the coarse aggregate to prevent the fines of the overlying common fill from penetrating into the coarse aggregate.

Twenty four inches of compacted common fill will be placed on top of the geotextile filter fabric and be graded to within six inches of the final grading plan. The purpose of this layer will be to provide additional protection from frost and to serve as a protective erosional layer. Additional benefits are water retention and vegetative cover support.

The cover area will receive at least six inches of top soil and be seeded with commercially available mix and planted with representative vegetation of the pre-[illegible] conditions, where applicable. The area will be mulched to help prevent [illegible] create a stable environment in which the vegetation can become established.

The side slopes of the solidified mass will be no less that 3:1, and in some areas at White Bridge Road will be closer to 10:1 to provide maximum usage of the land by the horses and riders. The final grading will be constructed to blend in with the surrounding landscape and to direct surface runoff in approximately the same directions as pre-construction conditions.

5.4 Drainage

Solidification/stabilization of the ACM will substantially decrease or eliminate infiltration. This will create an increase in post-development runoff flow over pre-development runoff flow. Since this increase would potentially exacerbate flood hydrographs for Black Brook during storm events, the design has included an accommodation for the extra runoff flow. Because of the lack of available construction space on the sites, there is little room for construction of detention basins. The usable area is especially limited when considering a 100-year storm.

To comply with local regulations, a perimeter interceptor/infiltration trench around both solidified masses has been designed. The design concept is to employ the perimeter trenches in lieu of an infiltration/detention basin to allow collection and infiltration of runoff. The trenches will be an integral part of the final protective soil cover and drainage stone layer, and be positioned to allow collection and infiltration of surface runoff. The volume of storage for the trenches is intended to accommodate the difference between pre- and post-development flows for a 24-hour, 100-year storm.

Collected runoff/drainage in the trench will be allowed to infiltrate outside of the solidified mass into the ground water. Perforated drainage pipes will be placed inside the trench connected by several access manholes. An elevated spillway/outlet, will be included for each interceptor/infiltration drain to allow collected water to discharge to the wetlands in the event infiltration is impeded. The perforated pipe also will allow additional storage volume in the trench.

5.5 Erosion Control

5.5.1 General

The erosion control measures discussed are general in nature. Prior to construction, the Subcontractor will be required to submit a detailed Erosion Control Plan for review and approval by the Contractor and all interested agencies. This discussion addresses the concern for severe erosion potential at the sites and the need to provide for protection of ecologically sensitive areas.

During remedial site activities, the existing vegetative cover will be disturbed which will greatly increase the probability of soil erosion. Soil erosion and siltation of the adjacent wetlands potentially can destroy vegetation and habitats, impair aesthetic qualities, impede downgradient drainage and alter water conditions. Soil erosion can affect the integrity of the existing roads, create ruts posing a footing hazard for the horses boarded at the White Bridge Road property, and be a means of transporting contaminated material. To minimize erosion at the properties and siltation of the wetlands, surface water runoff is to be redirected away from areas of excavation and erosion control measures will be utilized during site operations. These erosion control measures will include at a minimum, siltation fencing, hay bales, operational berms, and covering exposed areas with stone and filter fabric.

During site activities, attempts will be made to limit areas of disturbance at any one time. Mulch or geotextile fabric will be placed over exposed areas until permanent vegetation is established. After site activities are complete, vegetation will be re-established and maintained in areas previously disturbed.

Where hay bales are used they will be placed parallel to the contours and embedded in the soil a minimum of about four inches. Two stakes set through the bales, 18 inches into the ground, will anchor the bales. The second stake will be angled toward the previously laid bale. The bales will be tightly placed end to end. The hay bales will be inspected periodically, after heavy rainfalls, and replaced when no longer effective.

Silt fences will be constructed of a semi-permeable material (geotextile fabric) approximately two feet high with the bottom four inches of material buried perpendicular to the fence. The silt fence creates a environment for coarse and fine grained materials to settle without penetrating the fence material.

Another method of controlling sedimentation transport is the utilization of operational berms. These soil berms will be between 2 and 3 feet high and constructed around the work area. Soil berms will be required around areas where chemical reagents are to be mixed with ACM for solidification/stabilization purposes. The berm will then minimize the potential for chemical reagent transport. The berms may also be used around other temporary facilities to be constructed by the Subcontractor.

Due to the poorly drained soil conditions at the two properties, movement of heavy equipment throughout both properties is expected to be difficult. Frequent traffic may erode the soils. Loss of vegetation, rutting, and the continued loosening of soil can be expected as a result of the vehicular traffic. Rutting poses an additional erosional problem because of the drainage diversion it creates. To alleviate these foreseeable problems, vehicular traffic will be restricted to temporary roadways which will be constructed to access the necessary work areas. The temporary roadways will be constructed using geotextile fabric, and crushed stone. The roadway accessing the "Wooded Area" on White Bridge Road will remain as a permanent roadway after the project is complete, at the request of the property owner. This roadway will be maintained throughout the project and upon completion of the work left in good condition.

In areas where the soil is fairly stable, geotextile fabric may be all that is required to prevent erosion. Where multiple pieces of fabric are required, proper procedures for joining fabric will be followed. The fabric will be inspected periodically and repaired, when necessary. After remediation is complete, the geotextile will be removed and any rutting resulting from traffic will be graded to reflect previous site conditions, and where necessary revegetated.

In areas where the soil is less stable, more effective methods will be used. The easiest of these methods is construction using crushed stone. Stone will be spread to a compacted thickness of at least 6", depending on site conditions. Additional stone will be kept on-site for routine maintenance and repair. Geotextile fabric may also be combined with crushed stone to create an effective stabilized area.

5.5.2 Erosion Control for White Bridge Road

Due to the proximity of Black Brook and the sensitivity of the wetlands, erosion control measures will be required on White Bridge Road, to prevent siltation, and erosion of the wetlands and Black Brook. Black Brook and the surrounding wetlands have experienced accelerated siltation in recent years due to excessive development in the Great Swamp watershed. Silt fences and hay bales will be installed along the perimeter of the wetlands and an operational berm will be installed at the limits of work prior to any earth moving activities at the limit of the area to be excavated.

Erosion control measures will be checked and maintained on a daily basis during excavation activities and until permanent vegetation becomes established. Disturbed areas will be graded, top soiled and seeded. A mulch will then be spread over the area to prevent erosion until vegetation is established. Once the area is deemed stable, the silt fences will be cleaned out and removed.

A steel sheetpile wall will be driven into the contaminated material prior to solidification/stabilization in the Open Track Area, for reasons discussed in Section 5.2.1. A silt fence and hay bale barrier will be constructed in the wetlands at the limits of excavation. The constructed revetment will help protect the wetland by providing a soil buffer, and allow for additional flood storage volume by limiting the amount of fill replaced at a steep slope.

The Subcontractor will utilize devices such as swamp mats to help distribute the weight over soft soils, where heavy equipment will be used. All staging areas and decontamination areas will be located away from the wetlands in a convenient location, where possible, with appropriate operational berms and silt fences.

5.5.3 Erosion Control for New Vernon Road

Placement of erosion control measures will be required to ensure protection of a small pond located to the south of a proposed area of excavation, the New Vernon Road ditch, the standing water ditch located east of the dwellings, the property owners' home, the unoccupied house, and the surrounding wetlands.

The Back Yard Area slopes towards the standing water ditch located behind the houses. Excavation of this area will come very close to the existing standing water ditch and the property owner's fenced-in patio. To prevent structural failure, slope failure and possible contamination of the water, temporary support of the excavation side slopes will be employed. An operational berm will not be utilized due to the lack of available space to construct one. Caution will be taken to limit the amount of runoff entering the pit during excavation and backfilling operations.

The area will be backfilled with uncontaminated, clean common borrow excavated from "Area A", topsoiled, seeded and mulched after the excavation is complete. The temporary support will be removed after backfilling is complete.

The Standing Water Area is located east of and adjacent to the standing water ditch. Temporary shoring will be installed along the boundary of the excavation and the standing water ditch. A silt fence will be installed along the entire limit of excavation.

After excavation is complete, the area will be backfilled with clean common fill excavated from "Area A", topsoiled and seeded with comparable vegetation. Mulch will be spread over the topsoil and seed to help stabilize the soils until vegetation is established.

The Brush and Debris Stockpile Area is surrounded on three sides by low lying, wetlands areas. These areas require protection from siltation or high runoff velocities which could erode the wetlands soils. Because of the use of chemical reagents to solidify/stabilize the ACM and extensive working of the soil, an operational berm will be constructed along the entire limit of work around the Brush and Debris Stockpile Area and "Area A". A silt fence will also be installed at the outer limit of the operational berm.

A sedimentation basin will be placed at the New Vernon Road site to trap sediment or excess debris that may collect along the temporary road ditches during site activities. The basin will help prevent unwanted deposition of sediment in the wetlands and surrounding sensitive environments. The basin configuration shall be such that the effective flow length is equal to at least two times the effective flow width. Design and construction of the sedimentation basins will be in accordance with "Standards for Soil Erosion and Sediment Control in New Jersey" to achieve 70% actual trap efficiency.

6.0 ENGINEERING ANALYSIS

The original design concept called for in-situ solidification/stabilization of all ACM encountered. This would have included processing to depths of up to 24 feet below ground surface at White Bridge Road. This design, if implemented, would have had potential, significant impacts on the adjacent ecosystem, wetlands and surface waters. Additionally, there would have been significant problems with volumetric expansion, differential settlement, loss of flood storage volume and increased drainage and erosion control measures.

Another primary factor which precipitated a review of the original design concept was the results of leachability tests of the Treatability Study. These indicated that solidification below the ground water table may not be technically nor cost-effective because of the inability of the cement reagent to prevent the development of leachate of asbestos fibers below maximum contaminant levels. Furthermore, EPA guidance states that asbestos fibers are not particularly mobile through the soil (1 to 10 centimeters per 3,000 to 40,000 years) and that asbestos cannot be classified as a soil pollutant. A concern, however, was that alkaline constituents released into ground water as a result of solidified mass degradation could migrate to a surface water discharge point.

The primary health risk associated with asbestos fibers is through the inhalation route (maximum contaminant level of 0.2 fibers/cubic centimeter). To address this major risk, it was decided to implement solidification/stabilization as a cap, thus preventing release of asbestos fibers to the atmosphere. The design, therefore, progressed on this basis. Solidification/stabilization of the ACM will be implemented from ground surface to the depth of the water table. A geomembrane and a 3 foot aggregate/soil cap will be constructed over the solidified/stabilized mass as further protection. This design will provide long term permanence by significantly reducing the surficial erosion and mobilization of fibers.

The engineering analysis performed during the remedial design is discussed in further detail in the following sub-sections.

6.1 Volumetric Expansion

The resultant total expanded volume of the treated waste material will be dependent on various factors. These include:

1. The volume of reagents and water that are added to the untreated waste material;

2. The percentage of each type of waste material present in the total volume to be treated (tile has the lowest resultant expansion); and

3. The confining effect of treating material in-situ.

This latter factor will tend to restrict the expansion of the treated waste material.

The results of the Treatability Study provide some indication of the volume expansion that can be expected. For the proposed reagent addition discussed in Section 4.0, the expansions of each of the waste material types were as follows:

soil	- 26%
tile	- 2%
composite	- 36%
slurry	- 47%

Because the majority of material to be treated is asbestos contaminated soil, an expansion of (26%) was assumed for design analysis purposes since it is most representative (other than the slurry areas). For areas containing 100% slurry, slurry expansion was assumed to be 47% for design analysis purposes.

New Vernon Road

The volume of ACM above the water table to be treated is approximately 26,000 cubic yards. A 26% expansion will result in a final volume of approximately 32,800 cubic yards. The area to be treated is approximately 4.0 acres (inclusive of the excavated receiving pit, Area A). The additional volume resulting from the solidification process is approximately 6,800 cubic yards. Assuming the expanded volume is confined to the vertical plane, the resultant increase in elevation of the existing ground surface would be approximately one foot. Actual thickness will depend upon site conditions encountered. It is expected that there may be some settlement of the solidified mass due to the additional weight of the final protective soil cover being applied to underlying compressible soils through placement . The final site grading plan is intended to allow for a one foot increase in base elevation for these areas under the final soil cover of three feet.

White Bridge Road

The original design envisioned solidification to an average depth of 10 feet with solidification up to 24 feet. Estimating volume expansion over 10 to 24 feet would result in a significant increase in final site elevation, even allowing for some settlement. However, because the solidification is to be only above the ground water table and no more than 4 feet below ground surface elevation, the amount of slurry expected to be encountered is minimal.

The volume of ACM above the water table is approximately 11,000 cubic yards. Of this, approximately half is composite, a mixture of soil, tile and slurry, with the other half being predominately ACM contaminated soil. Therefore, the anticipated expansion is estimated to be the average of the expansion rate of composite material and soil, which would be approximately 31%.

The total volume of the material to be treated will, therefore, expand from 11,000 cubic yards to approximately 14,400 cubic yards. The total area to be solidified will be approximately 2.3 acres and 3 to 4 feet in depth (above the ground water table). Assuming the expanded volume is confined to the vertical plane, the resultant increase in elevation of the existing ground surface would be approximately one foot. It is expected there may be some settlement of the solidified mass due to the additional weight from the final protective soil cover being applied to underlying compressible soils. The settlement will help to mitigate the increase in elevation that may occur. Detailed determination of grade increase due to volumetric expansion and settlement will be dependent upon site specific conditions. The final site grading plan assumes a total increase of one foot due to volumetric expansion, with a final soil cover of three feet.

6.2 Settlement Analysis

An assessment of potential settlement of the solidified/stabilized waste mass was performed employing data from the pre-design field investigation program. The analyses was performed in an attempt to predict a worse case scenario for each site. The data used was obtained from soil borings, split spoon sampling, soil classification and laboratory analyses of Shelby tube samples collected from both sites. The total depth of overburden for both sites was based upon a water well construction log for the New Vernon Road site. The soil descriptions below 40 feet were also taken from this log. For purposes of this analysis it was assumed, that since both sites are in close proximity to each other and lie in an area of a former glacial lake, the stratigraphy will be similar.

Laboratory analyses were conducted for Atterberg Limits, grain size distribution and laboratory permeability. In particular, values obtained for liquid limits and moisture content, in addition to soil classification were used to estimate various coefficients including consolidation index, coefficient of consolidation and coefficient of secondary consolidation. These coefficients were either derived numerically or from nomographs (NAVFAC 7.1). It should be noted that for the peat layer, laboratory data were not available. However, given the visual classification of peat observed in the field (fibrous), its saturated condition, and experience with similar materials, an estimated value of void ratio, density and natural water content were used to determine the coefficients of consolidation.

It should be emphasized that this analysis is for design evaluation purposes only. Due to the heterogeneity of the site soils and waste material, the probable variability of reagent addition in the in-situ mixing process, and the differing thickness of the various horizons in the soil profile throughout the site, actual settlement will vary. The purpose of this analysis was to evaluate the potential for a "catastrophic" settlement and to assess mitigation, through settlement, of the anticipated volume expansion in the solidification/stabilization process. Initially the calculations were performed assuming that all the ACM, to a depth of 24 feet, would be solidified/stabilized and that a two-foot soil cover would be installed on the solidified mass.

Calculations, data and nomographs for settlement analysis are provided in Appendix A. Densities for the various materials were obtained from the Treatability Study data and published average values. For the peat, an estimate of 50 percent natural water content and a void ratio of 1.0 was used for this initial assessment. It was assumed for the analysis that loading at both sites would be applied as an earthwork type surcharge load (infinite load) across the site. Also, soils and waste which undergo solidification/stabilization will increase in weight by approximately 24 pounds per cubic foot, due to addition of reagent. In all likelihood the actual reagent weight addition will vary.

New Vernon Road

The results for complete solidification/stabilization of the New Vernon Road site analysis indicated that primary consolidation would result in a settlement of 28 inches while secondary consolidation would result in a settlement of 2.2 inches. The time for primary consolidation was estimated at 28.7 years. This analysis assumed double drainage, from sand layers at the top and bottom of the clay soils. Secondary settlement was calculated for a period of 100 years. Due to the varying thicknesses of stabilized material and underlying compressible soils, the settlement will probably be differential in nature. This type of settlement would result in some cracking and breaking of the solidified/stabilized mass.

White Bridge Road

The results for complete solidification/stabilization of the White Bridge Road site analysis indicated that primary consolidation would result in a settlement of 35.2 inches while secondary consolidation would result in a settlement of less than 1 inch. The time for primary consolidation was estimated at 139 years. This time was longer than that for the New Vernon Road site since there is only one drainage layer (bottom). Since primary consolidation exceeded 100 years, secondary consolidation would not have occurred within the design life of the project. Secondary consolidation was, therefore, calculated for a period of 200 years.

The high settlement values of 28" and 35" for New Vernon Road and White Bridge Road respectively, were a further reason for reconsidering the initial design concept. A settlement of up to 3 feet could cause cracking of the solidified mass, and destruction of the final soil cover. This is clearly undesirable as asbestos would be exposed to the atmosphere via the extra surface area created by the cracks and the structural integrity of the mass would be greatly impaired.

The design analysis also considered settlement for the construction of a stabilized mass above the ground water table (approximately 4 feet deep) at both sites which would then be covered by a 3 foot earth cover. The reasons for this have been discussed in Section 5. Although this revised design will have higher settlement values on White Bridge Road there will be less potential for differential settlement due to a more uniform loading, thus preserving the integrity of the solidified mass. The expected values for settlement are as follows: at New Vernon Road (solidification to 4') primary settlement was estimated at 23 inches over a period of 28.7 years with an additional 2.3 inches occurring within 100 years, at White

Bridge Road (solidification to 3') primary settlement of 38 inches will occur within 142 years, secondary consolidation is negligible.

6.3 Flood Storage Volume Loss

A major problem encountered during the original design was the potential loss of flood storage volume due to solidification and the resulting volumetric expansion. Several acre-feet of flood storage volume would have been lost if solidification/stabilization was conducted on the two properties to an average depth of 10 feet. Given the critical location of the sites downstream in the wetlands, the past history of rising water elevations in the wetlands, and frequent flooding, this was considered a major issue and a major concern of several governmental agencies. Solidification/stabilization down to the ground water table only, will alleviate the potential for flood storage volume loss. A remedy has been designed so as not to affect the existing flood volume storage capacity. This will be ensured for the following reasons: the volume of the soil cap will effectively replace the volume of flood storage capacity above the water table that will be solidified; and, construction of an infiltration/retention trench around the perimeter of the mass will provide extra flood storage volume.

6.4 Drainage

The present surface drainage conditions will be affected by the construction of the solidified/stabilized mass. The mass will be impermeable, potentially increasing the runoff to the surrounding areas. New Jersey Storm Water Regulations require that volumes and rates of runoff be controlled so that there will be no increase in peak runoff from pre- to post-site development for a 2-year, 10-year, and 100-year, 24-hour storm, considered individually. Any increase in runoff must be accommodated by an appropriate drainage structure. The designed infiltration trench at both properties will maintain existing runoff conditions.

6.4.1 Pre- and Post-Development Flows

6.4.1.1 Methodology

As specified in the Storm Water Management Rules Subchapter 3, 7:8-3.4, an acceptable method for calculating pre- and post-development flows is using the Rational Method. The Rational Method for runoff can be calculated by multiplying the coefficient of runoff, the rainfall intensity for the individual storm, and the drainage area in question to obtain a total runoff amount (see Appendix C for details).

6.4.1.2 White Bridge Road

The coefficient of runoff for pre-development flow calculations for level pasture land ranges from 0.05 to 0.3 (see Table 6.4, Appendix XX). As the coefficient of runoff increases, the amount of runoff also increases. Due to the abundance of asbestos tiles in the soil and on the surface, and the lack of vegetation as a result of constant use (the grazing and riding of horses), a coefficient of runoff for level pasture land in poor condition was chosen for the analysis.

Rainfall intensity values were obtained from the U.S. Weather Bureau Rainfall Intensity Curves for Morris County, New Jersey. Values were extrapolated from the graph for the 2, 10 and 100 year, 24 hour duration storm. Rainfall intensity values have an error of approximately ± 0.01 in/hr.

The coefficient values selected to calculate post-development flow were based on a three foot soil cap with a geomembrane layer over the solidified mass. For the purposes of the technical analysis, it was assumed that the area will promote runoff, based on the grading plan and proposed vegetation. Rainfall intensities for the 2, 10 and 100 year storm and affected area remained constant for the post-development flow calculations. The results of the analysis indicated that a slight increase in flow would occur and be about 0.04 cfs.

6.4.1.3 New Vernon Road

Pre- and post-development flows were calculated for the area where the proposed solidification will take place. The other areas of excavation will be returned to their existing condition, therefore require no drainage analysis.

The coefficient of runoff used for calculating pre-construction flows for this area was for farmland in poor condition. The area had been previously used as a dumping ground by the tree service operating on-site. Various debris disposed in the area include tree limbs and stumps, mulch, stone, scrap metal, etc. The presence of debris impedes rainwater runoff and allows greater time for infiltration.

Rainfall intensity values were obtained from the U.S. Weather Bureau Rainfall Intensity Curves for Morris County. Rainfall intensity values remain constant for pre- and post-development flow calculations, but are different for each storm frequency.

Post-development conditions include a three foot soil cap with a vegetative layer. A geomembrane layer will be installed over the stabilized mass. Based on the grading plan, proposed vegetation and the absence of debris, the cap will promote drainage runoff. A coefficient of runoff was chosen to represent the proposed conditions. The drainage area analyzed remained unchanged. The results of the analysis indicates the runoff as a result of development will increase about 0.13 cubic feet per second for the 100 year storm.

6.4.2 Infiltration Trench Design

A perimeter infiltration trench and drainage pipe will be installed along the perimeter of the stabilized mass at both properties. The infiltration trench has been designed to be constructed at the limits of the solidified mass to collect the drainage runoff from the soil cover above the solidified mass. The proposed three foot soil cap will contain a coarse aggregate layer located above the geomembrane. The purpose of this layer is to allow efficient drainage for the soil cap, direct water away from the solidified mass and promote slope stability. Drainage from this layer will be directed to the perimeter infiltration trench. The trench will also restrict runoff into the wetlands during heavy rainfall, thereby minimizing detrimental impacts such as erosion of the wetlands.

The trench will be approximately 3 feet deep and 5 feet wide at White Bridge Road and 4 feet deep and 5 feet wide at New Vernon Road. Crushed stone and a 6-inch diameter perforated HDPE pipe will be placed in the trench. The trench will be lined with a filter fabric to prevent sediment penetration into the stone filled trench. Manholes will be installed at the junctions of all pipes to be used as clean-outs and for change of direction. The [illegible] of the trench is to retain the additional post-development runoff flows and infiltration flows originating from the drainage layer. The trench has been designed to have sufficient volume to effectively retain storm water runoff and allow infiltration into the ground, away from the stabilized mass. Therefore, the potential for flooding is minimized and the integrity of the stabilized structure will be maintained.

An elevated spillway is included in the trench system. Its purpose is to release retained water slowly to the wetlands should the infiltration ditch become saturated. The spillway will consist of a 6-inch diameter reinforced concrete pipe (RCP) that will exit from a manhole. The invert out of the RCP in the manhole will be higher than the invert in from the HDPE pipeline. Water will flow through the RCP to the wetland only during extended periods of intense rainfall when the trench has reached its maximum design capacity (100 year or greater storm). This spillway will prevent water from flooding above the trench and control the discharge to the wetlands. As required by the New Jersey Soil Erosion and Sediment Control Regulations a stone headwall and dispersion apron will be constructed at the outlet to reduce the discharge velocity.

Although not directly applicable, the Hydrologic Evaluation of Landfill Performance (HELP) computer model was thought to be valuable in the drainage assessment and was used to calculate expected runoff flows created by the proposed soil cap. Default data concerning soil types, thickness, and porosity, wilting point, field capacity, etc. was entered into the program. The model computed total amounts of runoff that could be expected during a 20 year, 24 hour storm. Data concerning a 100 year, 24 hour storm was not available for this model.

According to the HELP program output, approximately 4.3% of the total runoff produced by a 20 year, 24 hour storm would percolate through the soil cap and reach the drainage layer. This water would be directed to the trench. The amount of runoff produced during a 100 year, 24 hour storm over the solidified area was hand calculated using available hydrologic information. It was assumed that the same percentage of runoff calculated for the 20 year storm entering the drainage layer would also affect the 100 year storm. Therefore, the trench was designed based on 4.3% of the total runoff occurring during a 100 year storm.

Summing the flows caused by reduced permeability due to solidification/stabilization, and the flow in the drainage layer for a 100 year, 24 hour storm determined the volume of runoff entering the trench. Subtracting the amount of water that would be lost to infiltration, results in the total volume of water needing to be stored. The trench was then designed to accommodate the required storage volume.

6.5 Steel Sheetpile Wall and Temporary Support Systems

Support of excavations will be necessary when excavating and consolidating ACM. The selection and design for the temporary support system are to be performed by the Subcontractor with approval of the Contractor. The Subcontractor shall also design the required steel sheetpile wall at the White Bridge Road property.

Temporary earth support systems and steel sheetpiling shall be designed and constructed at the following project locations:

6.5.1 White Bridge Road - Steel Sheetpile Wall

- Wetlands Area (East of Open Track Area)
  - Steel sheetpile wall to provide temporary earth support during ACM excavation from the wetland, and provide permanent ground water cutoff between the re-established wetland and the stabilized mass,

6.5.2 New Vernon Road - Temporary Support Systems

- Front Lawn Area
  - To provide temporary earth support for New Vernon Road and the adjoining structures

- Back Yard Area
    - To provide a temporary cutoff between the excavation and adjacent surface water, and temporary earth support for adjacent structures.

- Standing Water Area
    - To provide a temporary cutoff between the excavation and adjacent surface water,

White Bridge Road

The wall to be constructed in the Wetlands Area will consist of interlocking steel sheetpiling. A preliminary design analysis was performed to determine the feasibility of constructing such a wall. The wall was preliminarily designed as a cantilevered wall. Design calculations are provided in Appendix D. The results of the analysis indicate that such a wall is feasible. It would have to be driven to a minimum depth of 24 feet below the existing ground surface, have an initial exposed wall height of 12 feet (before construction of revetment), and the steel sheetpile cross-section would have a minimum section modulus of 16 cubic inches per foot. As stated above, final design will be the responsibility of the Subcontractor, subject to approval of the Contractor.

The wall will be installed prior to excavation and solidification/stabilization activities and will remain as a permanent structure. Excavation of ACM within the wetlands will then take place. Only a small area at a time is to be excavated and this should be immediately backfilled and the revetment constructed prior to any further excavation. During excavation and backfilling, equipment and stockpiled materials will have to be kept back from the top of the wall to a safe distance to prevent failure of the wall.

New Vernon Road

Excavations in the Front Lawn, Back Yard and Standing Water areas will be provided with temporary support systems to be designed by the Subcontractor. The temporary support systems could include, wood bracing, shoring, sheeting or steel sheetpiling. Typical lateral earth pressure diagrams and other design criteria will be provided in the specifications, as minimum design standards.

Earth pressure calculations are included in Appendix E.

Additional criteria include:

1. Pre-stressing internal supports to limit earth movements;
2. Evaluation of building, traffic and equipment loads on a case by case basis; and
3. Design of all earth support structures by a qualified Professional Engineer registered in New Jersey.

6.6 Slope Stability of Final Soil Cover

A stability analysis of the cover side slopes was performed to determine the factor of safety of the proposed slope. The factor of safety is determined by dividing the forces [illegible] cause soil movement (i.e. weight of soil) by the forces resisting the soil movements (i.e. soil strength). Factors of safety selected for this type of design typically range from 1.15 to 2. This slope stability analysis utilized slope stability charts for slopes in uniform soils with friction angles greater than 0 degrees.

The preliminary analysis conservatively assumed low strength materials (common fill) for the slope construction and included a surcharge loading of 100 pounds per square foot. A minimum factor of safety of 1.25 was selected as acceptable. The factor of safety calculated from the charts was 1.40.

The final analysis utilized the actual higher strength materials utilized in the design and the worst case slope geometry shown on the drawings. A minimum factor of safety of 1.5 was selected for the final design. This higher minimum factor of safety was selected to minimize the possibility of slope failure exposing stabilized ACM. The calculated factor of safety for the design was 1.93. Design calculations are presented in Appendix F.

6.7 Hydraulic Conductivity Analysis

TRC conducted monitoring well in-situ hydraulic conductivity (slug) tests during October 1992 at the New Vernon Road and White Bridge Road sites. The objective was to determine the potential for contaminant migration at the sites and potential impacts to local hydraulic gradients as a result of solidification/stabilization. A total of seven tests were conducted on six wells.

6.7.1 Methods

TRC conducted the slug tests by displacing a volume of water in the well bore with a slug. The slug consisted of a 3-foot long, 3-inch outside diameter teflon bailer. The bailer was sealed on its lower end with latex and duct tape to limit leakage of water into or out of the bailer.

TRC recorded test data with an In-Situ Hermit model 1000C two-channel data logger connected to one or two pressure transducers (rated to 10 or 20 pounds per square inch (psi) via a polyethylene coated conductor cable. The pressure transducer was lowered to the bottom of the well or at least 10 feet below the water table, whichever depth was greater. The data logger was set to record logarithmically, with a maximum recording interval of one minute. One test was an exception, the maximum recording interval was set at 30 minutes, since the test ran for 14 hours. Recording started immediately before displacing water in the well.

TRC analyzed the data from all tests with the Bouwer and Rice (1976) method using the program BRISTA and the Hvorslev (1951) variable head method using the program HVORSLEV. Data from one well was also analyzed with the Cooper et al. (1967) method using the program AQTESOLV.

The Bouwer and Rice (1976) method is considered a more rigorous analysis of slug test data, because it takes into account aquifer thickness. However, since the saturated thickness of the aquifer had to be estimated, the Hvorslev (1951) variable head method was also used to analyze the data. This method does not take aquifer saturated thickness into account. The Cooper et al (1967) method was used for data from one well because one could argue that horizontal flow from the clay and silt could be considered primarily a confined form of flow. In addition, this method provided an estimate of the storativity of the clay/silt layer. An average of all results is provided in Table 6-1. Table 6-2 lists all geometry information and assumptions for factors such as aquifer thickness.

TABLE 6-1. SLUG TEST HYDRAULIC CONDUCTIVITY RESULTS SUMMARY							
	New Vernon Road			**White Bridge Road**			
Well #	NV-OW-01	MW-NVR2	MW-NVR1	WB-OW-01	WB-OW-01	MW-WBR3	WB-OW-02
TEST TYPE	RISING HEAD	RISING HEAD	RISING HEAD	FALLING HEAD	RISING HEAD	RISING HEAD	FALLIN G HEAD
SOIL TYPE	F.SAND & SILT	SANDY CLAY	SANDY PEAT	SANDY SILT	SANDY SILT	SILTY SAND	CLAYEY SILT
BOUWER & RICE (FT/MIN)	4.86E-04	1.04E-04	8.92E-04	1.64E-04	3.21E-05	3.00E-05	1.76E-06
HVORSLEV VARIABLE HEAD (FT/MIN)	3.97E-04	1.42E-04	1.07E-03	2.29E04	5.31E-05	3.85E-05	2.64E-06
COOPER ET AL. (FT/MIN)	NA	NA	NA	NA	NA	NA	8.64E-07
AVERAGE K (FT/MIN)	4.41E-04	1.23E-04	9.81E-04	1.97E-04	4.26E-05	3.42E-05	1.75E-06
AVERAGE K (FT/D)	6.36E-01	1.77-01	1.41E+00	2.83E-01	6.13E-02	4.93E-02	2.53E-03
AVERAGE K (CM/S)	2.24E-04	6.25E-05	4.99E-04	9.99E-05	2.17E-05	1.74E-05	8.92E-07

TABLE 6-2. SLUG TEST GEOMETRY SUMMARY							
	New Vernon Road					White Bridge Road	
Well #	NV-OW-01	MW-NVR2	MW-NVRI	WB-OW-01	WB-OW-01	MW-OW-WBR3	WB-OW-02
Test #	0	4	4	1	2	3	3
Input #	CH.1	CH.1	CH.2	CH.1	CH.1	CH.1	CH.2
SOIL TYPE	F.SAND & SILT	SANDY CLAY	SANDY PEAT	SANDY SILT	SANDY SILT	SILTY SAND	CLAYEY SILT
DEPTH TO WATER	7.48	4.36	3.59	4.05	4.05	6.05	7.62
TEST TYPE	RISING HEAD	RISING HEAD	RISING HEAD	FALLIN G HEAD	RISING HEAD	RISING HEAD	FALLIN G HEAD
MAXIMUM HEAD DISPLACE-MENT	1.53	1.65	1.657	-0.727	0.815	1.846	-1.445
DEPTH OF MAX. HEAD CHANGE	9.01	6.01	5.247	3.323	4.865	7.896	6.175
WELL LENGTH (FROM T.O.C.)	10	15.4	15.5	10	10	17.05	37
DEPTH TOP SCREEN (FROM T.O.C)	5.00	5.40	5.50	5.00	5.00	7.05	31.70
SCREEN LENGTH	5.00	10.00	10.00	5.00	5.00	10.00	5.00
PRE-TEST SAT. SCRN. LENGTH	2.52	10.00	10.00	5.00	5.00	10.00	5.00
TEST-START SAT. SCRN. LENGTH	0.99	9.39	10.00	5.00	5.00	9.15	5.00

TABLE 6-2. (CONTINUED)							
	New Vernon Road					White Bridge Road	
WELL DIAMETER	0.33	0.33	0.33	0.33	0.33	0.33	0.33
DRILLED DIA.	0.67	0.67	0.67	0.67	0.67	0.67	0.67
AQUIFER SAT. THICKNESS	2.52	11.05	29.38	11.68	11.91	9.95	9.95

6.7.2 Results

The main results are summarized below:

1. Hydraulic conductivity (K) estimated for the shallow overburden ranged from approximately $5x10^{-4}$ centimeters per second (cm/s) in the sandy peat (1.41 feet per day (ft/d)) to $1.74x10^{-5}$ cm/s ($4.93x10^{-2}$ ft/d) in silty sand.

2. The estimated horizontal K for the deeper clay and silt overburden was approximately $9x10^{-7}$ cm/s. This value is approximately 25 times higher than the vertical permeability of material from the Shelby tube recovered from the 28 to 30 foot interval in boring WB-OW-01 at the White Bridge Road Site. An initial estimate of the storativity of this material is $1x10^{-4}$. All results and data output sheets are presented in the following Appendices:

G	-	Bouwer and Rice Analysis
H	-	Hvorslev Analysis
I	-	Cooper et al. Analysis

6.7.3 Evaluation of Results

The following is a critical review of the data and analyses that could affect the results presented:

1. The results of the falling head test performed on well WB-OW-01 were an order of magnitude higher than the rising head test. A leak in the bailer used to displace water in the well may have skewed the results, thus the values derived from the rising head test, where the bailer was removed from the well, should be considered more accurate.

2. The Fred C. Hart monitoring well tested at White Bridge Road, MW-WBR3, was not developed prior to the start of the test. Any build up on the well screen or silt in the filter pack may have inhibited flow into the well.

3. A rising head test may have been more diagnostic of deep aquifer conditions in WB-OW-02, however, time limitations precluded inserting the slug in the well and waiting for well re-equilibration prior to the start of a rising head test. The decision to perform a falling head test is supported by the fact that the well recovered less than 50 percent in 14 hours.

4. Some wells did not recover to 90 percent of pre-test static water level after several hours. Tests where limited recovery occurred include the rising head tests on MW-OW-01 (76 percent recovery), MW-NVR2 (81 percent recovery) as well as the above mentioned WB-OW-02 (20 percent recovery). In the first two cases, review of the semi-logarithmic plots for those wells indicates that the rate of recovery was already drifting off of a straight line plot when the test ended. This drift indicates that the portion of the test where reliable aquifer response was occurring had ended.

   In the case of WB-OW-02, the aquifer response plotted on a straight line, with no deviations during the entire 14 hour test interval, indicating that the observed response represented actual aquifer response. The test may have continued in this manner for several days before significant drift occurred.

   In summary, the lack of full recovery was properly accounted for in the test analyses and the appropriate portion of the recovery curve was analyzed.

5. For analysis by the Bouwer and Rice (1976) method, assumptions had to be made concerning aquifer thickness, especially for the Fred C. Hart wells. For wells in the shallow overburden, aquifer thickness was considered the distance from the water table to the base of the well, if no data concerning the material below the bottom of the well were available. Where data were available, the base of the aquifer was considered the top of the clay/silt layer.

   For MW-OW-02, the saturated thickness of the aquifer was assumed to be the distance from the water table to the bottom of the well for the Bouwer and Rice (1976) analytical method. For the confined aquifer analysis using Cooper et al. (1967), the aquifer thickness was assumed to be the top of the clay layer to the bottom of the well, a distance of approximately 15 feet, because no data were available on the base of the clay layer.

6. In the test of NV-OW-01 the well screen crossed the water table. For the purposes of the Bouwer and Rice (1976) analysis, a filter pack porosity of 30 percent was assumed and the BRISTA program generated a larger effective well radius for its analysis, discussed in Bouwer (1989). In two other wells, MW-WBR3 and MW-NVR2, the initial water level fell below the top of the well screen. Although some filter pack drainage probably occurred, the filter pack and effective well radius was not recalculated for the analysis. However, in these two cases, the initial portion of the recovery curve was ignored, to compensate for any drainage from the filter pack.

6.7.4 Limitations

These analyses are subject to the following limitations and assumptions that restrict the accuracy of the results. Slug tests are capable of providing order of magnitude estimates of aquifer K only. Results are limited to the area in the immediate vicinity of the well bore. The results can be affected by:

- well completion methods;
- filter screen and sand pack size;
- the length of time since the well was developed prior to the start of the test;
- current well conditions such as screen corrosion or bacterial build up; and
- assumptions used in the data analysis methods.

7.0 IMPACTS OF DESIGN

7.1 Wetlands

Both properties are abutted by the Great Swamp National Wildlife Refuge. The low lying wetland areas on both sites interact with ground water and surface water which travels through and over the sites. Because of this, there is a high potential for remedial actions conducted at the sites to impact the wetlands. Several potential problems in addition to those discussed previously are discussed below.

Several methods of in-situ solidification/stabilization technology involve augers, backhoes and other heavy equipment. The use of this equipment in proximity to the wetlands and trees may sever roots and cause degradation of the Great Swamp. The same may be true for excavation, although excavation may allow for more careful control.

The solidification/stabilization process uses materials containing a higher alkalinity than that of the surrounding swamp. The pH of these materials, when mixed with water, is substantially different from that of the wetlands, which are naturally acidic. The final design minimizes the ground water contact with these alkaline materials. Elimination of solidification/stabilization to the full depth of ACM contamination will result in less alkalinity potentially being released to the wetlands. Also, construction of the steel sheetpile wall/revetment at White Bridge Road should minimize alkaline impacts to water.

Another possible problem with construction activities is that they may affect the migratory and breeding habits of local fauna. The Great Blue Heron is known to breed between the months of March and July in the vicinity of the White Bridge Road site. Significant construction activities at this site will have to be curtailed during this period. However, the expected construction time required for this site should be less than that for New Vernon Road, thereby allowing more flexibility during remedial action. Impacts from the implementation of the remedial design should be temporary, and it is expected that the fauna and flora should return to normal once the sites are remediated.

7.2 Local Hydrology

As a solidified mass with depth, the structure would have impacted the local hydrology. The Great Swamp, by adsorbing a portion of storm water, minimizes the impact of flooding to surrounding areas. The soils/waste mixture currently provides some water storage capacity. Solidification of the waste material and soils into the ground water table would have reduced their ability for storage capacity and thereby increased the likelihood of flooding, especially, locally.

In addition to causing problems locally, several streams in the area would have been subject to increased scouring and erosion as a result of having to carry larger volumes of water. This could have impacted the habitats of wildlife by varying stream eco-systems. Another possible impact would be the destruction of trees and other vegetation adjacent to and within shallower wetland areas as a result of an elevated water table. As a result of continuous submersion of their roots, from a raised water table, the trees and vegetation would be subject to an anaerobic environment which could have resulted in the eventual destruction of the trees.

Solidification into the ground water table would have caused changes in ground water flow patterns. Previous abandonment of constructed drainage systems within the swamp area has already appeared to have contributed to an elevated water table. An additional large mass would have displaced ground water storage, obstruct ground water flow and cause a redirecting of flow routes around the solidified mass and probably would have exacerbated the high water table.

The treatment of wastes would have also resulted in some increase in volume in site soils. This increase could have been as high as 20 to 30 percent. Surface water runoff patterns would have been altered because of the size increase and the impervious nature of the solidified mass. Drainage patterns to the swamp could have also been changed (ditches and trenches).

These impacts are anticipated to be minimized by the solidification/stabilization of ACM down to the water table only. Additionally, placement of a vegetated soil cover will replicate existing soil moisture storage. Lastly, impacts due to increased runoff should be minimized by construction of the perimeter detention/infiltration trench.

7.3 Excavation

Excavation and consolidation of ACM into one large mass prior to solidification will be required on-site. The time required to excavate will be minimal on White Bridge Road, minimizing the effects on the available space which is needed to carry on the horse boarding facility on-site. New Vernon Road requires a considerable amount of excavation including preparation for the excavation, which is time consuming.

Areas identified to be excavated and consolidated on-site are shown on the Final Design Drawings. These areas have been delineated using available knowledge of contamination from examination of descriptions and data on the boring logs. However, the actual limits of excavation may require the subcontractor to operate outside the areas shown on the drawings. The intent is to excavate all visible asbestos contaminated material from these areas and any further ACM encountered during the post-excavation confirmatory sampling. Due to the location of the excavation in the poorly drained soils, certain considerations will be made by the Subcontractor when determining what excavation equipment needs to be brought on-site. The depth of excavation will most likely be below the existing ground water table.

Due to the nature of on-site soils, there is a high probability for vehicles to become "bogged" down. Equipment brought on-site probably will have low-pressure tires and either wide tracks or very large wheels (all terrain vehicles). This will help distribute the weight of the equipment and prevent the equipment from sinking into the ground. The Subcontractor is also expected to provide temporary support devices such as swamp mats, geotextiles or geogrids, crushed stone, etc. where necessary, to continue operating on limited strength soils.

The excavation operations will impact the surrounding areas, residents, and environment only for the duration of the process. After excavation of ACM, the areas are to be backfilled with clean soil, compacted and vegetated. Once the areas are backfilled, topsoiled and seeded, the only permanent impact to be noticed will be mounding of the solidified mass with the soil cover.

The excavation process may generate asbestos contaminated dust. This dust has the potential to migrate and contaminate surrounding land, wetlands, and the resident homes and building structures located on each site. This, however, is not anticipated to pose a significant problem provided that specified, proper dust suppression measures are taken.

To reduce the amount of dust generated during excavation, the soils will be wetted down frequently, with water or a non-petroleum based product. Soil wetting will also occur during loading and dumping of the excavated material. Each bucket of soil will be wetted, if necessary, as it is loaded into the trucks. After loading is complete, the trucks will proceed to the receiving pit, Area A, and the ACM dumped. Dust would be kept to a minimum because of the already dampened soil. The pit will be continuously wetted to avoid dust generation, until it is covered with high density polyethylene (HDPE) sheeting. This cover will remain in place until the soil is ready for treatment. Furthermore, soils are expected to be predominantly wet, given the high water table, therefore wetting of the soils should only be necessary during excavation of the first few feet of soil or in dry, windy conditions.

It is assumed that during excavation ground water will be encountered. To limit the amount of water that comes in contact with the asbestos containing waste, the pit may be dewatered and/or temporary sheeting may be used to help minimize the flow of ground water into the pit.

Asbestos dust contains a high personal health risk to workers on-site. To reduce the hazards within the Work Area, personal protective equipment (PPE)(level C) will be worn by all personnel who enter the Work Area. Equipment and personnel will be required to follow decontamination procedures defined in the specifications before leaving the Work Area. All heavy machinery and equipment will also be decontaminated before leaving the Exclusion Zones.

During site activities, air monitoring for asbestos dust fibers will be performed. It is proposed that the residential homes and buildings will have windows sealed to prevent asbestos infiltration. Results of monitoring around the buildings will determine whether further measures should be taken to prevent infiltration of asbestos; these could include air locks at the entrances and filters on air intakes and exhausts. Before start of construction, to establish background levels, and at the end of the project, the resident homes will be tested for dust containing asbestos. Should, at the end of construction, asbestos dust be found within the resident's homes, the Subcontractor shall employ an asbestos control firm to fully decontaminate and clean the homes of asbestos.

7.3.1 White Bridge Road

The Wooded Area will be excavated and backfilled in a relatively short time. The existing post and rail fence surrounding a pasture will need to be relocated along the "No Work Zones" prior to constructing the access road to the Wooded Area. This will give the property owners access to their land and to provide turn out for their horses; although, depending on the recommendations of a horse specialist to be retained by the Subcontractor, the horses may have to be relocated during certain phases of construction. The horses will probably be able to be turned out once the area is backfilled and abandoned. Should the horse specialist recommend that the construction activities would not affect the well-being of the horses, they would not have to be relocated.

There is one other "isolated area" located adjacent to the existing post and rail fence which will also require consideration during the excavation. However, this area is very small and should not take more than a few days to excavate and backfill, thereby minimally disrupting the horse boarding facility minimally.

7.3.2 New Vernon Road

The New Vernon Road site requires extensive excavation.

The "Front Lawn Area" bounds New Vernon Road and the foundation of the property owners' home. The excavation of this area will require temporary support. This operation will impact the residents in the home, requiring them to be relocated for a period of time. It also impacts the property owner's business since the driveway accessing his garage will be temporarily removed. The driveway will be replaced after the excavation and backfilling operations have been completed. Construction sequencing has been established and an estimate has been made that access to the business will be disrupted for a period of about two weeks.

During the excavation, two underground oil tanks which are used to store fuel for the heating system of the residence, will be removed, cleaned, and removed from the site. New natural gas lines will be installed from the street main to the house. The property owner will replace the heating system for natural gas use.

The "Back Yard Area" excavation process will impact the residents' septic system and leach field. A licensed septic designer will be employed, by the Subcontractor, to design and construct a new septic system for the residents within the time frame in which they are relocated. This area abuts the standing water ditch and the residents' brick patio. Temporary support of the excavation walls is required to prevent slope failure into the standing water ditch and the collapse of the residents' patio.

The "Standing Water Area" presents potential stability problems for excavation and will require temporary support. The major problem is that this area abuts the standing water ditch. There is concern for slope failure which will need to be considered during excavation.

7.4 Chemical Effects

Initially, the injection of reagents used in the solidification/stabilization process will raise the temperature of the treated local soils due to heat of hydration produced by the cement-water reaction. As the curing process continues, the temperature of the surrounding wetland water may also increase. The increase in temperature, especially during the initial set could have the potential to temporarily affect the wetland environment.

A more potential problem is the increase in alkalinity due to the addition of large volumes of cement and cement kiln dust. The increased pH has the potential to significantly raise the wetland pH as a result of ground water discharge of surface water runoff, thereby altering the ambient acidic wetland ecosystem. The change in alkalinity may also result in precipitation of dissolved iron present in the swamp water which may cause discoloration. The solidification/stabilization to be carried out above the ground water table will minimize potential high pH ground water and still enhance the long term effectiveness of the remedy. Also, during remedial action, the areas undergoing solidification/stabilization will be enclosed with earthen berms to contain any high pH surface water runoff, which may be generated as a result of reagent addition and mixing.

8.0 REMEDIAL ACTION IMPLEMENTATION

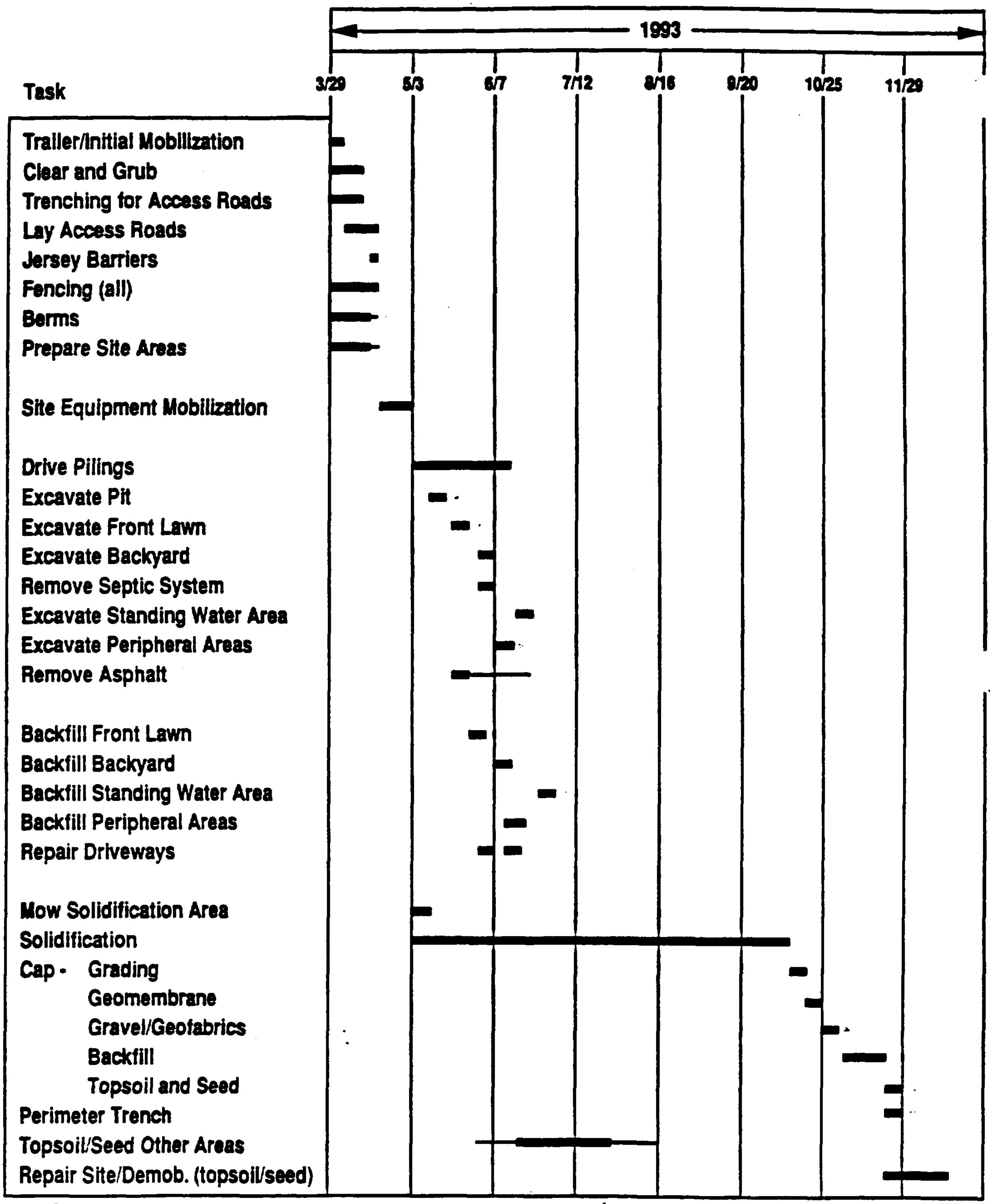
The Remedial Design, as described in Section 5.0 of this report is scheduled for implementation during 1993. The specifications have been written covering aspects and requirements for implementation of the proposed remedy, utilizing both design and performance criteria. Following approval of the design drawings and specifications by the EPA, prospective Subcontractors will be invited to submit proposals for completion of the work. After all bids have been received and evaluated, a subcontract will be awarded. It is anticipated that construction activities will commence by about the end of March 1993.

The following sub-sections discuss the proposed duration of the Remedial Action and anticipated cost thereof.

8.1 Scheduling

8.1.1 New Vernon Road

The duration to implement the remedy of the New Vernon Road Project Site is estimated to take 32 weeks. Assuming a construction start date of March 29, 1993, the Project should be completed by December 20, 1993. This is an ambitious schedule, which will require careful management to ensure timely completion. The major items of work are shown on Figure 5, "New Vernon Road Network Analysis". This figure indicates the expected duration of each of the activities listed and a float time, where appropriate. The results of the preliminary analysis indicates a period of 23 weeks. This was based on a treatment rate of 220 cubic yards (cy) per day, five days a week, assuming the sixth day is devoted to maintenance activities. The most time-consuming activity that affects the critical path is the solidification/stabilization process.



Note: This chart presents a summary of the major work items only.

Float Time — Expected Duration of Activity

Figure 5. New Vernon Road - Network Analysis

A final detailed schedule will be provided by the Subcontractor and will include each activity, its expected duration, late and early start dates, and late and early completion dates.

8.1.2 White Bridge Road

Although the White Bridge Road Project Site requires similar activities to complete remediation, it differs from the New Vernon Road site in four major areas:

- The volume of ACM to be excavated and transported to the clean pit adjacent to the Open Track Area is considerably less than the ACM to be excavated at New Vernon Road.

- The volume of ACM to be treated by solidification/stabilization is estimated to be only 11,000 cy as opposed to 26,000 cy at New Vernon Road (resulting in a substantial reduction in implementation cost and time).

- A permanent steel sheetpile wall (Section 5.2.1) is proposed.

- The Great Blue Heron uses the area within the Great Swamp National Wildlife Refuge, adjacent to the White Bridge Road site, as a nesting and breeding ground. The birds are considered a rare species. To avoid disturbing the birds and hence the loss of future generations, heavy construction activities will be restricted during the peak breeding season lasting from March to July. Preliminary site activities, which do not produce excessive noise such as site; preparation, laying of access roads and installing fencing, however, will be permitted.

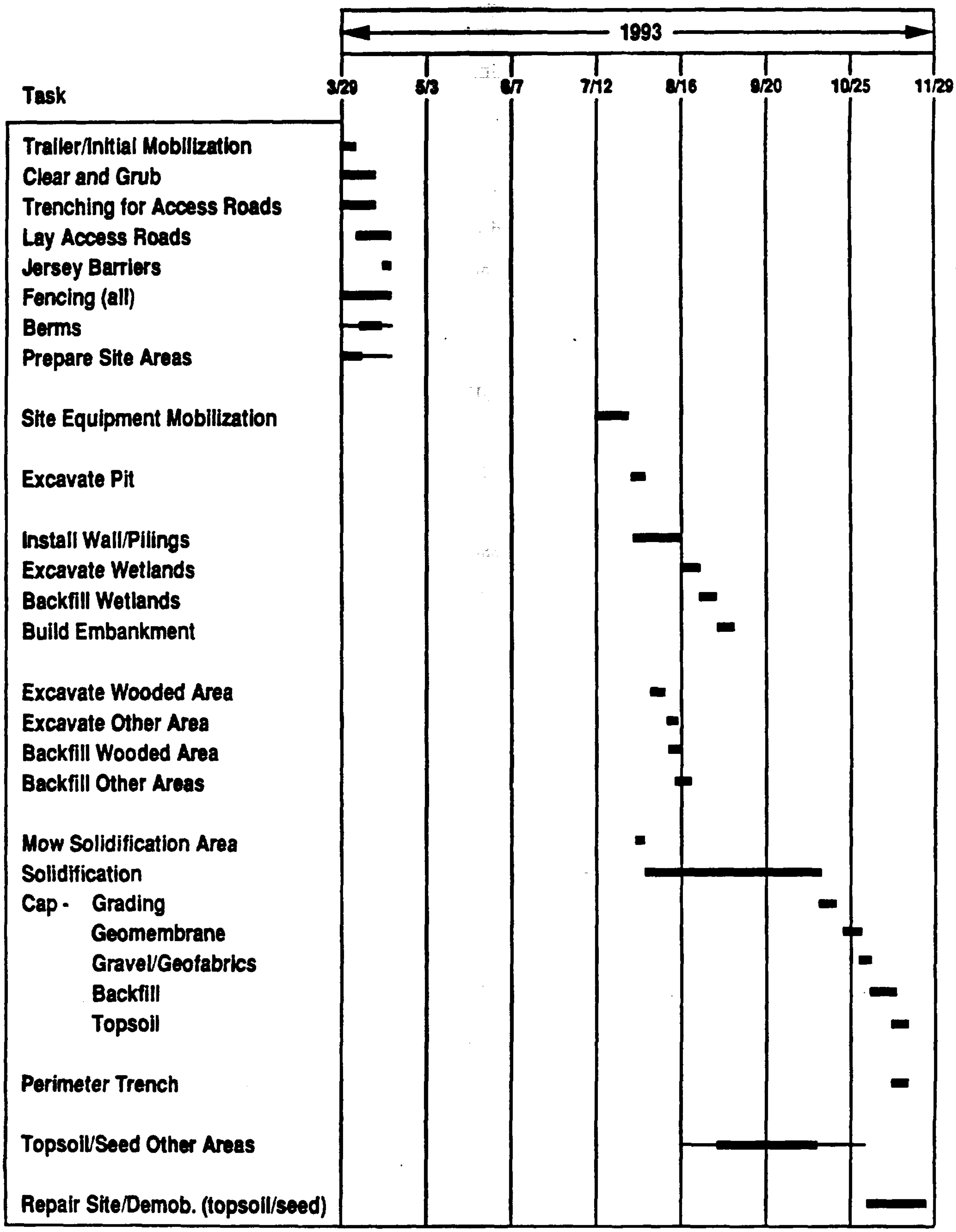
These four considerations have been included in the Summary Network Analysis, shown on Figure 6. The total duration of all site activities is expected to be 23 weeks, although the activities to be scheduled after July 12, 1993 are expected to take approximately 20 weeks. The expected project completion date is November 26, 1993. Despite the additional complications associated with the site, the schedule is not as aggressive as the New Vernon Road Site, because of the smaller volumes of ACM requiring excavation and solidification/stabilization. The duration of the solidification/stabilization activity is shown as 10 weeks, based on treating 220 cy of ACM per day for five days a week.

Should the construction start later than anticipated, it would require that the soil cover with the seeding to be placed late in the winter. This cannot be done because it is not prudent to place fill during freezing temperatures and seed will not germinate. It would, therefore, require this aspect of the work to be completed in the spring of the following year.

8.2 Cost Analysis

A cost estimate has been prepared based on the 95% Design Submittal. The unit costs reflect information obtained from the Means Site Work Cost Manuals and various vendors' printed literature and technical representatives. Past experience was then used to tailor individual costs to the project. Full details of the unit costs are provided in Appendix J.

This cost estimate was prepared to fall between +15% and -10% of the actual cost, as recommended by the "Superfund Remedial Design and Remedial Action Guidance, OSWER Directive 9355.0-4A, Section 2-7. This guidance also suggests that the following contingencies are utilized, when preparing cost estimates: 6%



Note: This chart presents a summary of the major work items only.

Float Time   Expected Duration of Activity

Figure 6. White Bridge Road - Network Analysis

for Supervision and Administration, 1% for Engineering and Design, and a Bid Contingency of 15%.

The estimated quantities for each site were calculated by identifying all the components involved for each bid item as described in the Measurement and Payment Specification, and then measuring the quantities from the 95% Design Plans.

The cost estimate has been separated for the two project sites. New Vernon Road cost estimate is shown in Table 8-1 and White Bridge Road cost estimate is shown in Table 8-2. The unit costs for some of the bid items differ between the sites due to the total length of time estimated for job completion or difference in design components. For example, it is estimated that temporary facilities will be needed on the White Bridge Road site for six months, but for nine months on New Vernon Road site.

The estimated cost, including contingencies, to complete all activities at the New Vernon Road site is $4.4 million and at the White Bridge Road site is $2.7 million. The total estimated cost for the project is, therefore, $7.1 million as shown in Table 8-3.

This exceeds the original cost of $5.7 million estimated during the Feasibility Study (FS) conducted in March 1991-a difference of $1.4 million. The FS estimated a total volume of ACM to be treated of 37,000 cy for both sites. During the 1992 predesign field investigation further sampling was conducted and considerably more asbestos was encountered. The total volume of ACM has been estimated at approximately 80,000 cy. Not all this material will be solidified/stabilized. Following excavation and consolidation of all the satellite areas at each site, only that material above the water table will be solidified/stabilized. This is estimated at 37,000 cy. The increased costs are, therefore, those associated with the excavation, backfilling, temporary shoring and final site restoration that had not been foreseen during the FS.

TABLE 8-1
NEW VERNON ROAD COST ESTIMATE
JANUARY 18, 1993

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
1	Mobilization/ Demobilization	LS	1	$200,000.00	$200,000
2	Health and Safety	LS	1	$150,000.00	$150,000
3	Temp. Erosion/ Sediment. Control	LS	1	$48,700.00	$48,700
4	Photographs/ Videographs	LS	1	$19,000.00	$19,000
5	Water Control	LS	1	$10,000.00	$10,000
6	Temp.Facilities	LS	1	$94,360.00	$94,360
7	Temp. Drum Staging	LS	1	$4,900.00	$4,900
8	Decontamination Pad	LS	1	$24,400.00	$24,400
9	Clearing/Grubbing	LS	1	$10,000.00	$10,000
10	Drum, PPE Disposal	EACH	90	$160.00	$14,400
11	Disposal, Subcontractor Waste (Drum)	EACH	20	$160.00	$3,200
12	Excavation	CY	29200	$8.79	$256,668
13	Common Fill, Imported	CY	42000	$10.00	$420,000
14	Common Fill, On-site	CY	15000	$7.50	$112,500
15	Coarse Aggregate	CY	4200	$16.00	$67,200
16	Stone Fill				
	a) Type A	CY	0	$10.00	$0
	b) Type B	CY	730	$10.00	$7,300
17	Soil-Cement Stab.	CY	26000	$55.00	$1,430,000
18	Geotextile				
	a) Type A	SY	24000	$2.00	$48,000
	b) Type B	SY	20500	$2.00	$41,000
19	Geomembrane	SY	19400	$5.00	$97,000
20	Plastic Sheeting	SY	500	$0.20	$100
21	Steel Sheet Piling	SF	N/A		$0
22	New Drives/Roadways	SY	220	$11.50	$2,530
23	Culverts	LF	180	$17.00	$3,060

TABLE 8-1
NEW VERNON ROAD COST ESTIMATE
JANUARY 18, 1993

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
24	Infiltr. Trench/Drain	LF	1900	$50.40	$95,760
25	Chain Link Fencing				
	a) Chain Link Fence	LF	N/A		$0
	b) Gates - 3 feet	EACH	N/A		$0
	c) Gates - 20 feet	EACH	N/A		$0
26	Post and Rail Fence (Relocation)	LF	N/A		$0
27	Topsoil and Seed	SY	20000	$4.00	$80,000
28	Landscaping	LS	1	$8,000.00	$8,000
29	Replace Septic System	ALLOWANCE	1	$10,000.00	$10,000
30	Site Gas Line	LS	1	$1,400.00	$1,400
31	UST Removal/Disposal	EACH	2	$1,400.00	$2,800
32	Monitoring Wells				
	a) new	LF	45	$100.00	$4,500
	b) abandon	EACH	3	$250.00	$750
	c) existing	EACH	1	$100.00	$100
33	Sampling/Analysis	LS	1	$94,500.00	$94,500
34	Confirm. Sampling				
	a) soil	EACH	226	$225.00	$50,850
	b) water	EACH	36	$200.00	$7,200
	c) air	EACH	100	$15.00	$1,500
					$3,421,678.00
	Administration/ Supervision**	0.06			$205,301
	Engineering and Design During Construction**	0.01			$34,217
	R. A. Contingency**	0.06			$205,301
	Subtotal				$3,866,497
	Bid Contingency**	0.15			$579,975

TOTAL COST NEW VERNON ROAD $4,446,472

* Unit Costs derived from: Means Costing Manual, Vendors, and TRC experience.
** Superfund Remedial Design and Remedial Action Guidance (OSWER Directive 9355.0-4A).

TABLE 8-2
WHITE BRIDGE ROAD COST ESTIMATE
JANUARY 18, 1993

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
1	Mobilization/ Demobilization	LS	1	$200,000.00	$200,000
2	Health and Safety	LS	1	$100,000.00	$100,000
3	Temp. Erosion/ Sediment. Control	LS	1	$15,700.00	$15,700
4	Photographs/ Videographs	LS	1	$19,000.00	$19,000
5	Water Control	LS	1	$7,000.00	$7,000
6	Temp.Facilities	LS	1	$81,770.00	$81,770
7	Temp. Drum Staging	LS	1	$4,900.00	$4,900
8	Decontamination Pad	LS	1	$24,400.00	$24,400
9	Clearing/Grubbing	LS	1	$7,500.00	$7,500
10	Drum, PPE Disposal	EACH	40	$160.00	$6,400
11	Disposal, Subcontractor Waste (Drum)	EACH	20	$160.00	$3,200
12	Excavation	CY	6500	$14.70	$95,550
13	Common Fill, Imported	CY	20000	$10.00	$200,000
14	Common Fill, On-site	CY	3000	$7.50	$22,500
15	Coarse Aggregate	CY	2720	$16.00	$43,520
16	Stone Fill				
	a) Type A	CY	1400	$10.00	$14,000
	b) Type B	CY	590	$10.00	$5,900
17	Soil-Cement Stab.	CY	11000	$55.00	$605,000
18	Geotextile				
	a) Type A	SY	19200	$2.00	$38,400
	b) Type B	SY	17100	$2.00	$34,200
19	Geomembrane	SY	12140	$5.00	$60,700
20	Plastic Sheeting	SY	500	$0.20	$100
21	Steel Sheet Filing	SF	12000	$18.40	$220,800
22	New Drives/Roadways	SY	100	$11.50	$1,150
23	Culverts	LF	100	$17.00	$1,700

TABLE 8-2
WHITE BRIDGE ROAD COST ESTIMATE
JANUARY 18, 1993

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
24	Infiltr. Trench/Drain	LF	1050	$48.20	$50,610
25	Chain Link Fencing				
	a) Chain Link Fence	LF	520	$14.50	$7,540
	b) Gates - 3 feet	EACH	1	$125.00	$125
	c) Gates - 20 feet	EACH	1	$735.00	$735
26	Post and Rail Fence (Relocation)	LF	2000	$8.00	$16,000
27	Topsoil and Seed	SY	15500	$4.00	$62,000
28	Landscaping	LS	1	$5,000.00	$5,000
29	Replace Septic System	LS	N/A		$0
30	Site Gas Line	LS	N/A		$0
31	UST Removal/Disposal	LS	N/A		$0
32	Monitoring Wells				
	a) new	LF	45	$100.00	$4,500
	b) abandon	EACH	5	$250.00	$1,250
	c) existing	EACH	0	$100.00	$0
33	Sampling/Analysis	LS	1	$67,650.00	$67,650
34	Confirm. Sampling				
	a) soil	EACH	190	$225.00	$42,750
	b) water	EACH	24	$200.00	$4,800
	c) air	EACH	93	$15.00	$1,395
					$2,077,745
	Administration/ Supervision**	0.06			$124,665
	Engineering and Design During Construction**	0.01			$20,777
	R. A. Contingency**	0.06			$124,665
	Subtotal				$2,347,852
	Bid Contingency**	0.15			$352,178

TOTAL COST WHITE BRIDGE ROAD $2,700,030

*Unit Costs derived from: Means Costing Manual, Vendors, and TRC experience.

** Superfund Remedial Design and Remedial Action Guidance (OSWER Directive 9355.0-4A)

TABLE 8-3
NEW VERNON ROAD AND WHITE BRIDGE ROAD SITES - COMBINED COST ESTIMATE
JANUARY 18, 1992

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
1	Mobilization/ Demobilization	LS	1	$400,000.00	$400,000
2	Health and Safety	LS	1	$250,000.00	$250,000
3	Temp. Erosion/ Sediment. Control	LS	1	$64,400.00	$64,400
4	Photographs/ Videographs	LS	1	$38,000.00	$38,000
5	Water Control	LS	1	$17,000.00	$17,000
6	Temp.Facilities	LS	1	$176,200.00	$176,200
7	Temp. Drum Staging	LS	2	$4,900.00	$9,800
8	Decontamination Pad	LS	2	$24,400.00	$48,800
9	Clearing/Grubbing	LS	1	$17,500.00	$17,500
10	Drum, PPE Disposal	EACH	130	$160.00	$20,800
11	Disposal, Subcontractor Waste (Drum)	EACH	40	$160.00	$6,400
12	Excavation	CY	35700	$9.87	$352,359
13	Common Fill, Imported	CY	62000	$10.00	$620,000
14	Common Fill, On-site	CY	18000	$7.50	$135,000
15	Coarse Aggregate	CY	6920	$16.00	$110,720
16	Stone Fill				
	a) Type A	CY	1400	$10.00	$14,000
	b) Type B	CY	1320	$10.00	$13,200
17	Soil-Cement Stab.	CY	37000	$55.00	$2,035,000
18	Geotextile				
	a) Type A	SY	43200	$2.00	$86,400
	b) Type B	SY	37600	$2.00	$75,200
19	Geomembrane	SY	31540	$5.00	$157,700
20	Plastic Sheeting	SY	1000	$0.20	$200
21	Steel Sheet Piling	SF	12000	$18.40	$220,800
22	New Drives/Roadways	SY	320	$11.50	$3,680
23	Culverts	LF	280	$17.00	$4,760

TABLE 8-3
NEW VERNON ROAD AND WHITE BRIDGE ROAD SITES - COMBINED COST ESTIMATE
JANUARY 18, 1992

ITEM NO.	ITEM	UNIT	ESTIMATED QUANTITY	UNIT COST*	TOTAL COST
24	Infiltr. Trench/Drain	LF	2950	$49.62	$146,379
25	Chain Link Fencing				
	a) Chain Link Fence	LF	520	$14.50	$7,540
	b) Gates - 3 feet	EACH	1	$125.00	$125
	c) Gates - 20 feet	EACH	1	$735.00	$735
26	Post and Rail Fence (Relocation)	LF	2000	$8.00	$16,000
27	Topsoil and Seed	SY	35500	$4.00	$142,000
28	Landscaping	LS	1	$13,000.00	$13,000
29	Replace Septic System	ALLOWANCE	1	$10,000.00	$10,000
30	Site Gas Line	LS	1	$1,400.00	$1,400
31	UST Removal/Disposal	LS	2	$1,400.00	$2,800
32	Monitoring Wells				
	a) new	LF	90	$100.00	$9,000
	b) abandon	EACH	8	$250.00	$2,000
	c) existing	EACH	1	$100.00	$100
33	Sampling/Analysis	LS	1	$162,150.00	$162,150
34	Confirm. Sampling				
	a)Soil	EA	416	$225.00	$93,600
	b)Water	EA	60	$200.00	$12,000
	c)Air	EA	193	$15.00	$2,895
					$5,499,643.00
	Administration/ Supervision**	0.06			$329,979
	Engineering and Design During Construction**	0.01			$54,996
	R. A. Contingency**	0.06			$329,979
	Subtotal				6,214,597
	Bid Contingency**	0.15			$932,190

TOTAL COST NEW VERNON ROAD AND WHITE BRIDGE ROAD $7,146,787

*Unit Costs derived from: Means Costing Manual, Vendors, and TRC experience.
** Superfund Remedial Design and Remedial Action Guidance
(OSWER Directive 9355.0-4A)

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9.0 ADMINISTRATIVE REQUIREMENTS

Any remedial activity requires some administrative organization. The amount and cost of the administration is dependent on the extent of the activities and the area in which the activities are pursued. It should also be reiterated that the design proposed is a combination of detailed and performance based approaches, as such, by it's nature there are some areas which will require extensive coordination. Solidification/stabilization of the contaminated material at the White Bridge Road and New Vernon Road properties will require coordination between all the parties involved (EPA, Great Swamp National Wildlife Refuge, Corps of Engineers, Contractor, Subcontractor, residents, community and all other interested parties). Both properties are currently privately owned and the residents will have to be regularly and fully informed of all developments and progress. Approval to conduct activities within the Refuge boundary will be required before any activities can commence.

Any remediation of a contaminated site has inherent risks to human health and the environment during the process implementation, and all Federal and NJDEPE and other State requirements will need to be addressed. The following sections address the permit requirements and resident relocation in more detail.

9.1 Permit Requirements

Due to the location of the sites there are a number of permits that should be complied with prior to beginning remedial activities. There are permits on the Federal, State and local level that should be considered.

Because the properties are Superfund Sites, EPA requires that all relevant and appropriate permits need to be addressed, although the permits themselves do not need to be obtained. Detailed permit information is available on request from State and local offices. A list of the permits that should be complied with, or obtained, is presented in Table 9-1.

On the Federal level, the Army Corps of Engineers oversees permitting with regards to Section 404(b) of the Clean Water Act. The Corps also issues general Nationwide Permits. Cleanup of Hazardous and Toxic Waste is included in the Corps Nationwide Permit (NWP) program. A pre-discharge notification (PDN) should be submitted to the New York District Engineer at the Corps of Engineers.

On the State level, a Water Quality Certificate (WQC) or waiver should be obtained from the State in compliance with State Section 401. Because the sites are in 100-year flood plains, Stream Encroachment permit regulations will require compliance. Air permits may also be required, depending on the amount of asbestos that is released into the atmosphere. This should however not be necessary because dust control measures have been specified.

The local planning board will need to approve a variance if filling will take place in the 100-year flood plain. A permit from the Morris County Soil Conservation District in regards to Soil Erosion and Sediment Control Laws will have to be obtained (per court decision).

The Great Swamp Wildlife Refuge Manager will have to authorize a Special Use Permit for any activities that take place on lands located within the boundaries of the refuge.

TABLE 9-1. LIST OF PERMITS TO BE ADDRESSED

Permit Name	General Regulations
Township of Passaic, Country of Morris, **Application for Development**	•Applies to lands located in an area of special flood hazard. •Areas of special flood hazard are based on a report entitled the "Flood Insurance Study, Township of Passaic", October 1988, by the Federal Insurance Administration; also based on a map entitled "Special Flood Hazard Areas, Township of Passaic, NJ." prepared by C. Lindbloom, P.P., October 1981. •"No land may be subdivided, no structure may be erected, no equipment or goods stored, no landfill or excavation operation begun and no start of construction may be undertaken without the applicant first having received an approved development permit application from the Planning Board or Board of Adjustment and, whenever state law so requires, approval of the Department of Environmental Protection of the State of New Jersey." •Development permits are valid for one year from the date of approval.
Morris County Soil Conservation District (M.C.S.C.D.), **Soil Erosion and Sediment Control Plan Certification**	•Prior to any land disturbance of more than 5000 square feet in Morris County, this certification must be obtained. •M.C.S.C.D. must be notified 72 hours prior to any land disturbance activities.
New Jersey Department of Environmental Protection and Energy (NJDEPE), **Bureau of New Source Review**	•NJSA 26:2C-9.2 requires that no person shall construct, install, alter, or operate any equipment capable of causing the emission of air contaminants into the open air or control apparatus which prevents or controls the emissions of air contaminants until an application has been filed with and approved by the DEPE •The application consists of the following: VEM-003 Application for Permit to Construct, Install or Alter control Apparatus or Equipment and Certificate to Operate Control Apparatus or Equipment. VEM-004 Source Emissions and Source Data Form
NJDEPE, **Freshwater Wetlands Permits**	•Required if wetlands or transitional ares will be disturbed.
NJDEPE, **Stream Encroachment Permit**	•If the land being disturbed is in the 100-year flood plain, this permit is necessary.
Great Swamp National Wildlife Refuge, **Special Use Permit**	•Permit necessary for any activities that take place on lands located within the boundaries of the refuge. •There is no formal application; the specifications of the proposed work are reviewed and commented on by the Refuge Manager.

TABLE 9-1. (CONTINUED)

Permit Name	General Regulations
List of permits to be considered (as required)	
NJDEPE, **Water Quality Certificate**	•Required for nationwide permits (NWP) that may result in a discharge of dredged or fill material.
United States Army Corps of Engineers (COE), **ENG Form 4345** One of the following permits should be applicable: ENG Form 1721 LOP NWP	•Section 301 of Section 404 of the Clean Water Act (33 USC 1344) prohibits the discharge of dredged or fill material into waters of the United States without a permit from the Corps of Engineers. •"Waters of the United States" include all interstate water including interstate wetlands (33 CFR 328[a][2]). •ENG Form 4345 must be submitted to the COE to initiate the review process for a permit. The COE will review the application and determine the type of permit necessary (33 CFR §330.1[f]). The types of permits are as follows (COE, EP 1145-2-1, May 1985, Regulatory Program, Applicant Information): ENG Form 1721 is the standard individual permit, issued on a case-by-case basis; Letter of Permission (LOP) is issued if the work is minor or routine with minimum impacts and if objections are unlikely; General permits are issued on a regional or national basis by the COE, these include the "Nationwide Permits" (NWP). •It is determined that the work can be done under an NWP, a Pre-Discharge Notification (PDN) must be submitted to the COE as well as several NJ regulatory agencies. Prior to submitting a PDN, a Water Quality Certificate (see NJDEPE) from NJ must be obtained.

It is strongly recommended that a pre-application meeting be set up with the various agencies (eg: Corps of Engineers, New Jersey Department of Environmental Protection and Energy etc.). This should be at an early stage so that all relevant permits can be properly determined.

The following agencies should be contacted and a Pre-Discharge Notification submitted:

Field Supervisor
U.S. Fish & Wildlife Service
927 North Main Street (Bldg. D)
Pleasantville, NJ 08232

USEPA, Region II
Marine & Wetlands Protection Branch

Habitat and Protected Resources Division
National Marine Fisheries Service
Sandy Hook Laboratory
Highlands, NJ 07732

Administrator,
Land Use Regulation Element
New Jersey Department of Environmental
Protection and Energy
CN 401,
Trenton, NJ 08625-0401

New Jersey Department of Environmental
Protection and Energy
Natural and Historic Resources
Office of New Jersey Heritage
CN 404
Trenton, NJ 08625-0404

9.2 Resident Relocation Requirements

During remediation of the properties, large volumes of contaminated material will be excavated, transported on-site and treated. This may result in the release of air-borne asbestos. Due to the health risks associated with inhalation of friable asbestos, workers will be required to wear personnel protective clothing and equipment.

The Subcontractor conducting the remediation activities will be required to implement dust control measures, such as regularly wetting the ground, to control the generation of friable asbestos. In addition to this the Health and Safety Plan will require continual monitoring at the perimeter boundary of each site and at the location of the residences, horse stables (at White Bridge Road) and tree servicing business (at New Vernon Road). The primary cause of concern will be during excavation activities when the generation of dust and friable asbestos will be greater than during other construction activities.

At White Bridge Road, the excavation activities will be mostly conducted at the opposite end of the property from the residence. Because dust control measures are to be implemented and regular air monitoring required, it is considered acceptable for the residents to remain in the house during remediation. This should however be regularly reviewed in conjunction with construction activities, although the requirement in the specifications is to control asbestos release at all times. The horse stables, however, are located closer to the area of construction activities. The Subcontractor is required to employ a veterinarian, with a horse specialty, who will assess the affect construction activities will have on the horses. He will make a recommendation whether the horses can remain on-site during construction or whether they will have to be relocated.

Air monitoring will be used as a guide to control construction activities and ensure dust control methods are implemented, to maintain asbestos levels below the maximum air contaminant level of 0.2 fibers per cubic centimeter (fibers/cc).

At New Vernon Road, the areas to be excavated are adjacent to the houses - the Front Lawn, Back Yard and the Standing Water Area (close by). In addition the driveways and access roads to the tree servicing business will be demolished and the surfaces scraped for asbestos contamination.

During excavation, the septic system, located in the Back Yard will be destroyed and the two oil storage tanks in the Front Lawn will be removed. These factors will necessitate that the residents be relocated during the excavation activities and while the utilities are replaced or repaired. The estimated time period for these activities is about 4 weeks.

The tree-servicing business cannot be accessed until the northern end of the Front Lawn is backfilled and the access road replaced. It is expected that excavation and repair of this area will take at least two weeks.

The relocation process is regulated under Public Law 91-646, the Uniform Relocation and Benefits Act. The Law states that people who are relocated should be moved into safe, decent and sanitary quarters. The residents do, however, have the right to choose what type of accommodation they prefer. The EPA community relations office oversees the relocation process, but employs the U.S. Army Corps of Engineers to handle all the relocation activities.

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APPENDICES

Appendix A

Calculations, Data and Nomographs for Settlement

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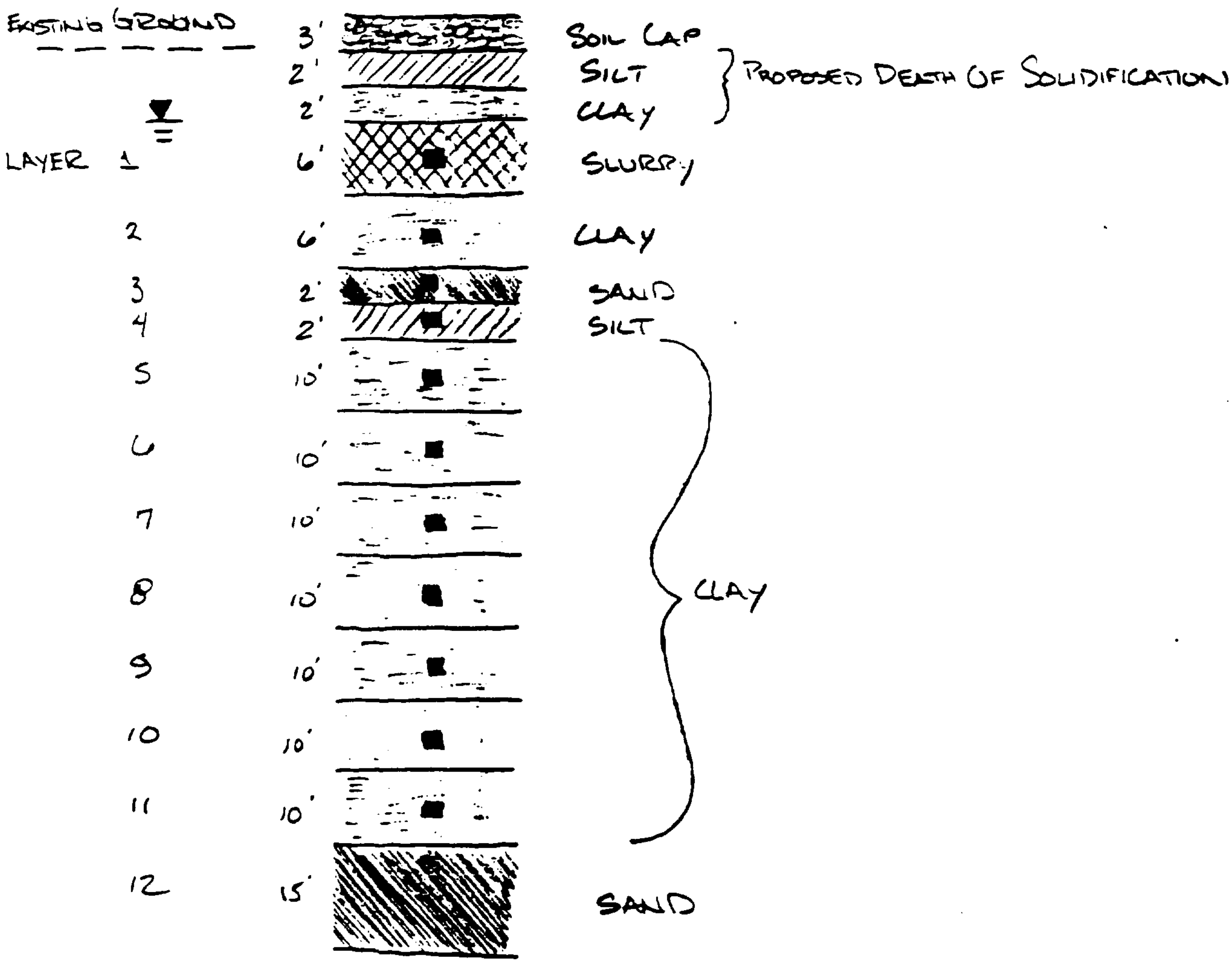
JOB NO. 1635 337 02P270
PROJECT PASSAIC
SUBJECT SETTLEMENT CALC'S

NEW VERNON ROAD

SETTLEMENT WAS CALCULATED IN THE AREA OF BORING #16 BECAUSE OF THE HIGH LIQUID LIMITS THAT EXIST. SOIL PROFILES WERE CONSTRUCTED FROM LOGS TAKEN DURING DRILLING ACTIVITIES AT B-16 AND FROM INSTALLATION OF A DRINKING WATER WELL INSTALLED AT THE SITE



APPROXIMATE SOIL PROFILE

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JOB NO. 11635 33702PZZO
PROJECT PASSAIC
SUBJECT SETTLEMENT

MATERIAL	TOTAL UNIT WEIGHT (PCF)	SOLIDIFIED WEIGHT (PCF)
CAP	120	—
SILT	120	140
CLAY	115	140
SAND	120	—
SLURRY	75	—
WATER	62.4	—

DUE TO METHODS USED TO STABILIZE, IT IS ASSUMED THAT AUGER MIXING OF SOIL WILL EFFECTIVELY COMBINE ALL LAYERS OF SOIL. THEREFORE, A SOLIDIFIED UNIT WEIGHT FOR SOIL WAS ASSUMED 140 PCF BECAUSE OF THE ADDED CONCRETE WEIGHT OF 24.5 $\#/FT^3$ (OBTAINED FROM TREATABILITY STUDY)

SOLIDIFICATION WILL PROCEED TO 4' DEPTH.

GROUNDWATER TABLE IS AT 4'

EXISTING WEIGHT OF SOIL ABOVE GWT = σ_{v_o} (TOTAL VERTICAL STRESS)

$\sigma_{v_{o_1}}$ = (DEPTH OF SOIL × UNIT WEIGHT)

= (2' × 120 PCF) + (2' × 115 PCF) = 470 PSF

EXISTING STRESS OF SOIL BELOW GWT TO MIDDLE OF SLURRY (EFFECTIVE VERTICAL STRESS)

SLURRY

75 PCF − 62.4 PCF = 12.6 PSF

$\sigma_{v_{o_2}}$ = 3' × 12.6 PCF = 38 PSF

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TOTAL EFFECTIVE STRESS ON SLURRY LAYER (MID-DEPTH)

$\sigma_{v_0} = \sigma_{v_{0_1}} + \sigma_{v_{0_2}}$

$= 470 \text{ PSF} + 38 \text{ PSF}$

$\sigma_{v_0} = 508 \text{ PSF}$

ADDITIONAL STRESS DUE TO STABILIZATION/SOLIDIFICATION

$\Delta\sigma_v = (3 \text{FT CAP}) + (2' \text{SOLIDIFIED SILT}) + (2' \text{SOLIDIFIED CLAY})$

$= (3' \times 120) + (2' \times 24.5 \text{PCF}) + (2' \times 24.5 \text{PCF})$

$\Delta\sigma_v = 458 \text{ PSF}$

THE INCREASED STRESS IS ASSUMED TO REMAIN CONSTANT THROUGHOUT THE FULL DEPTH OF NATIVE SOIL, (MCCARTHY, ESSENTIALS OF SOIL MECHANICS & FOUNDATIONS, PRENTICE HALL, 1988).

COMPUTING THE EXISTING STRESS (σ_{v_0}) FOR EACH LAYER (MID-DEPTH)

LAYER 2

115 PCF - 62.4 PCF = 52.6 PCF

σ_{v_0} = 508 PSF + (3' x 126 PCF) + (3' x 52.6 PCF) =
= 704 PSF @ MIDDLE OF LAYER

LAYER 3

120 PCF - 62.4 PCF = 57.6 PCF

σ_{v_0} = 704 PSF + (3' x 52.6) + (1' x 57.6)
= 920 PSF

LAYER 4

120 PCF - 62.4 PCF = 57.6 PCF

σ_{v_0} = 920 PSF + (1' x 57.6) + (1' x 57.6)
= 1035 PSF

LAYER 5

σ_{v_0} = 1035 PSF + (1' x 57.6) + (5' x 52.6)
= 1356 PSF

LAYER 6

σ_{v_0} = 1356 PSF + (5' x 52.6) + (5' x 52.6)
= 1882 PSF

LAYER 7

σ_{v_0} = 1882 PSF + (5' x 52.6) + (5' x 52.6)

= 2408 PSF

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LAYER 8

$$\sigma_{v_o} = 2408\text{ PSF} + (5' \times 52.6) + (5' \times 52.6)$$
$$= 2934\text{ PSF}$$

LAYER 9

$$\sigma_{v_o} = 2934\text{ PSF} + (5' \times 52.6) + (5' \times 52.6)$$
$$= 3460\text{ PSF}$$

LAYER 10

$$\sigma_{v_o} = 3460\text{ PSF} + (5' \times 52.6) + (5' \times 52.6)$$
$$= 3986\text{ PSF}$$

LAYER 11

$$\sigma_{v_o} = 3986\text{ PSF} + (5' \times 52.6) + (5' \times 52.6)$$
$$= 4512\text{ PSF}$$

LAYER 12

$$\sigma_{v_o} = 4512\text{ PSF} + (5' \times 52.6) + (7.5' \times 57.6)$$
$$= 5207\text{ PSF}$$

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SETTLEMENT

$$\Delta H = \frac{H_0}{1+e_0} C_c \left(\log \bar{\sigma}_{v_f} - \log \sigma_{v_0} \right)$$

ΔH = SETTLEMENT FOR LAYER

H_0 = HEIGHT OF LAYER

e_0 = VOID RATIO

C_c - COMPRESSION INDEX

$\bar{\sigma}_{v_f}$ - SUM OF OVERBURDEN PRESSURE AND PRESSURE CAUSED BY SOLIDIFICATION

σ_{v_0} = OVERBURDEN SOIL PRESSURE

H_0 = BECAUSE OF DEPTH OF COMPRESSIBLE LAYERS, SETTLEMENT WILL BE CALCULATED FOR EACH LAYER

e_0 - FOR MEDIUM CLAY (CONSERVATIVE) = 0.8 -

e_0 - FOR SAND = 0.7

e_0 - FOR SILT = 0.6

e_0 - FOR SLURRY, DUE TO LACK OF INFORMATION, SLURRY WILL BE ASSUMED SIMILIAR TO ORGANIC PEAT WITH A MOISTURE CONTENT OF 50%. e_0 IS ASSUMED TO BE 1.0.

FOR CLAY

$$C_c = .009(LL-10)^*$$

LL OBTAINED FROM ATTERBERG LIMITS FOR BORING B-16, 18-20' (SEE APPENDIX)

LL = 54

$$C_c = .009(54-10)$$

$$= .4$$

FOR SILT

$$C_c = 0.3(e_o - 0.27)^*$$

$$= 0.3(0.6 - 0.27)$$

$$= 0.1$$

FOR SLURRY (ASSUMED SIMILIAR TO PEAT W/ 50% MOISTURE CONTENT)

$$C_c = 1.15 \times 10^{-2} w_n \; ^*$$

$$= 1.15 \times 10^{-2}(50)$$

$$= .6$$

FOR THE PURPOSES OF THIS TECHNICAL ANALYSIS, SAND WILL BE ASSUMED INCOMPRESSIBLE.

* INTRO. TO GEOTECHNICAL ENG., HOLTZ, PRENTICE HALL, 1981

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$$\Delta H_1 = \frac{6}{1+1.0}(0.6)(\log 966 - \log 508) = 0.5' = 6.0''$$

$$\Delta H_2 = \frac{6}{1+0.8}(0.4)(\log 1162 - \log 704) = \cancel{0.3}\ 0.29' = \cancel{3.6}\ 3.5''$$

$$\Delta H_4 = \frac{2}{1+0.6}(0.1)(\log 1493 - \log 1035) = 0.02' = 0.2''$$

$$\Delta H_5 = \frac{10}{1+0.8}(0.4)(\log 1814 - \log 1356) = \cancel{0.3}\ 0.28' = \cancel{3.6}\ 3.4''$$

$$\Delta H_6 = \frac{10}{1+0.8}(0.4)(\log 2340 - \log 1882) = 0.2' = 2.4''$$

$$\Delta H_7 = \frac{10}{1+0.8}(0.4)(\log 2866 - \log 2408) = 0.2' = 2.4''$$

$$\Delta H_8 = \frac{10}{1+0.8}(0.4)(\log 3401 - \log 2934) = 0.1' = 1.2''$$

$$\Delta H_9 = \frac{10}{1+0.8}(0.4)(\log 3918 - \log 3460) = 0.1' = 1.2''$$

$$\Delta H_{10} = \frac{10}{1+0.8}(0.4)(\log 4444 - \log 3986) = 0.1' = 1.2''$$

$$\Delta H_{11} = \frac{10}{1+0.8}(0.4)(\log 4970 - \log 4512) = 0.09' = 1.1''$$

TOTAL PRIMARY SETTLEMENT = 22.5''

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RATE OF PRIMARY SETTLEMENT WAS ALSO CALCULATED IN THE AREA OF B-16. TIME PERIODS FOR VARIOUS PERCENTAGES OF TOTAL SETTLEMENT ARE CALCULATED BELOW.

$$t = \frac{T_v H^2}{C_v}$$

t = TIME PERIOD

T_v = TIME FACTOR FOR CONSOLIDATION DUE TO VERTICAL DRAINAGE

H = DRAINAGE DISTANCE FOR PORE WATER

C_v = COEFFICIENT OF CONSOLIDATION

A[illegible] INDICATED IN THE SOIL PROFILE, TWO SAND LAYERS EXI[illegible] APPROX. 72' APART. ONCE CONSOLIDATION BEGINS, PORE WA[illegible] WILL MOVE UPWARD OR DOWNWARD TO ESCAPE THROUGH EITHER SAND LAYER (REFERRED TO AS "DOUBLE DRAINAGE). THE VALUE OF T_v IS RELATED TO THE RATE OF CONSOLIDATION AS DETERMINED BY THE RATE OF ESCAPING WATER. T_v WAS DETERMINED FROM FIGURE @ END OF CAL[illegible]S.

C_v WAS OBTAINED FROM A GRAPH OF THE COEFF. OF CONSOLIDATION vs. THE LIQUID LIMIT.

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% OF CONSOLIDATION	TIME FACTOR
10%	0.02
25%	0.06
50%	0.19
75%	0.45
90%	0.9
95%	1.2

MOST SETTLEMENT OCCURS IN THE 70' THICK CLAY LAYER. 50% OF PORE WATER WILL ESCAPE THROUGH THE TOP SAND LAYER AND 50% THROUGH THE BOTTOM.

∴ $H = 70/2 = 35'$ DRAINAGE DISTANCE

C_v = USING LL FROM ATTERBERG LIMITS OF LL = 54 FOR B-16 @ 18-20' AND C_v FOR UNDISTURBED SAMPLES IN RANGE OF VIRGIN COMPRESSION

$C_v = .14\ FT^2/DAY$

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$$t_{10\%} = \frac{(0.02)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 175 \text{ DAYS} = 0.5 \text{ YEAR}$$

$$t_{25\%} = \frac{(0.06)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 525 \text{ DAYS} = 1.4 \text{ YEARS}$$

$$t_{50\%} = \frac{(0.19)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 1660 \text{ DAYS} = 4.5 \text{ YEARS}$$

$$t_{75\%} = \frac{(0.45)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 3950 \text{ DAYS} = 10.8 \text{ YEARS}$$

$$t_{90\%} = \frac{(0.9)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 7875 \text{ DAYS} = 21.5 \text{ YEARS}$$

$$t_{95\%} = \frac{(1.2)(35\text{FT})^2}{.14\ \text{FT}^2/\text{DAY}} = 10500 \text{ DAYS} = 28.7 \text{ YEARS.}$$

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SECONDARY COMPRESSION:

$$\Delta H_{SEC} = C_\alpha (H_t) \log \frac{t_{SEC}}{t_P}$$

C_α = COEFF. OF SECONDARY COMPESSION DETERMINED FROM GRAPH OF NATURAL WATER CONTENT vs COEFF. OF SECONDARY COMPRESSION.

WATER CONTENT OBTAINED FROM PERMEABILITY TESTS

FOR UNDISTURBED SAMPLES = .003 - .008

USE • .005

H_t = THICKNESS OF LAYER = 70'

t_{SEC} = USEFUL LIFE = 100 YEARS

t_P = TIME OF COMPLETION OF PRIMARY CONSOLIDATION = 28.7 YEARS

$$\Delta H_{SEC} = (.005)(70')\left(\log \frac{100}{28.7}\right)$$

$$\Delta H_{SEC} = .189' = 2.3 \text{ IN.}$$

MASS WILL SETTLE AN ADDITIONAL 2.3" AFTER PRIMARY CONSOLIDATION IS COMPLETE

HOWEVER, SURROUNDING AREA WILL BE SUBJECTED TO SOME SECONDARY COMPRESSION, ∴ DIFFERTIAL 2NDRY SETTLEMENTS WILL BE LESS.

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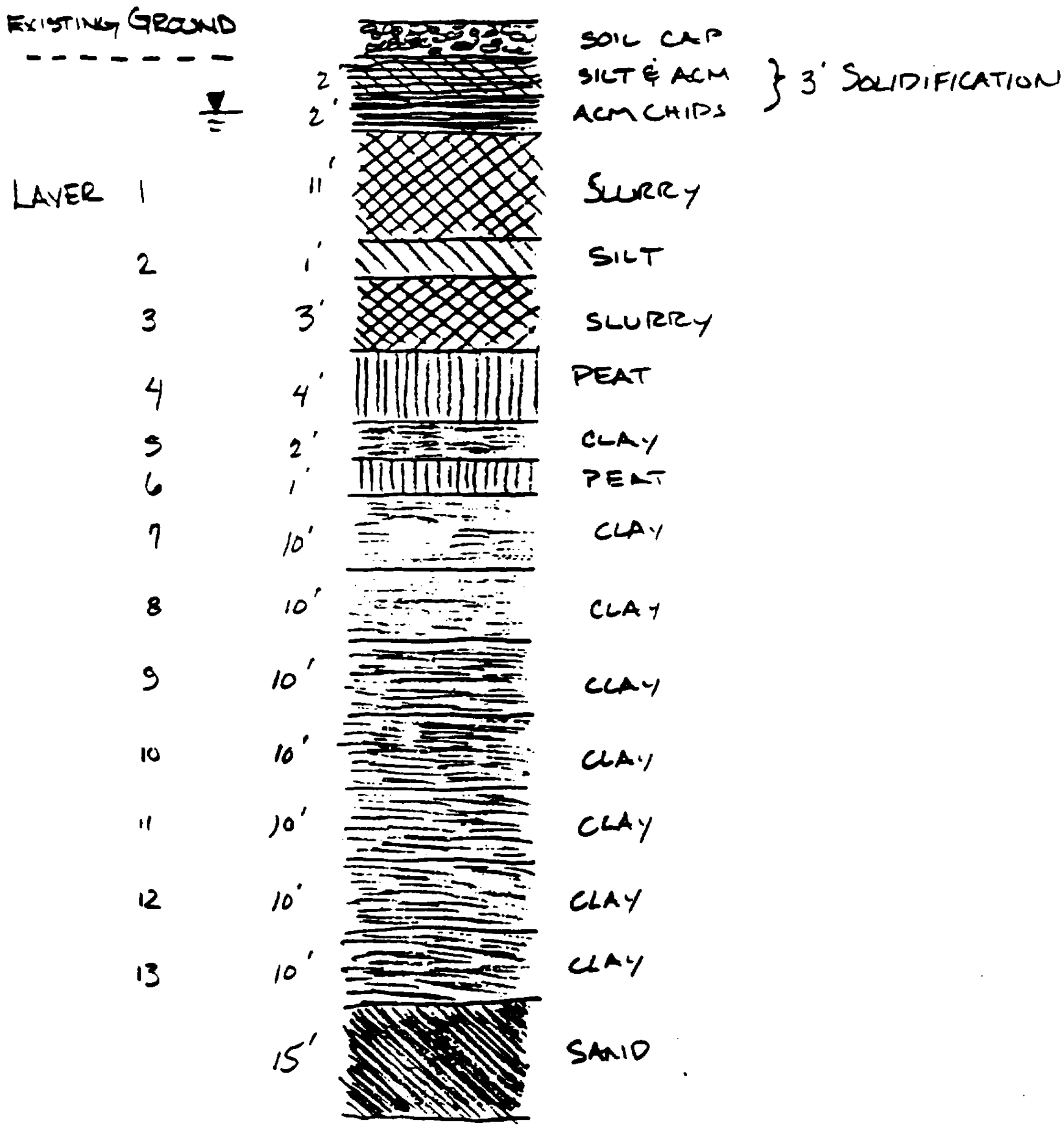
WHITE BRIDGE ROAD

SETTLEMENT WAS CALCULATED IN THE AREA OF BORING N1060 E650 BECAUSE OF THE PRESENCE OF SEVERAL PEAT LAYERS.



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MATERIAL	UNIT WEIGHT	SOLIDIFIED UNIT WEIGHT
CAP	120 PCF	—
SILT	120	140
ACM CHIPS	83	100
SLURRY	75	—
PEAT	70	—
CLAY	115	—
SAND	120	—
WATER	62.4	—

VALUES FOR UNIT WIEGHTS WERE OBTAINED FROM TREATABILITY STUDY RESULTS.

SOLIDIFICATION WILL PROCEED TO 3' DEPTH

GROUNDWATER TABLE IS @ 3.5'

EXISTING STRESS OF SOIL BELOW GWT TO MIDDLE OF 1ST SLURRY LAYER.

SLURRY

75 PCF − 62.4 = 12.6 PSF ✓

ACM CHIPS

83 PCF − 62.4 = 20.6 PSF

$\sigma_{v_{o2}} = (.5' \times 20.6) + (5.5 \times 12.6) = 76$ PSF ✓

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EXISTING EFFECTIVE STRESS OF SOIL ABOVE WATER TABLE

$$\sigma_{v_{o_1}} = (.1' \times 120) + (1' \times 83) + (1 \times 83)$$

$$\sigma_{v_{o_1}} = 286 \text{ PSF}$$

EXISTING STRESS ON MIDDLE OF SLURRY LAYER

$$\sigma_{v_o} = \sigma_{v_{o_1}} + \sigma_{v_{o_2}}$$

$$\sigma_{v_o} = 286 + 76 = 362 \text{ PSF}$$

ADDITIONAL WEIGHT DUE TO SOLIDIFICATION

$= (3 \text{ FT CAP}) + (2 \text{ FT SILT}) + (1 \text{ ACM CHIPS})$

$= (3 \times 120) + (2 \times 24.5) + (1 \times 24.5)$

$= 458 \text{ PSF}$

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COMPUTING EXISTING STRESS FOR EA. LAYER

LAYER 2

SILT - 120 - 62.4 = 57.6 PSF
SLURRY - 75 - 62.4 = 12.6 PSF

$\sigma_{v_o} = 362 + (5.5 \times 12.6) + (.5 \times 57.6)$
$= 460$ PSF

LAYER 3

$\sigma_{v_o} = 460 \text{ PSF} + (.5 \times 57.6) + (1.5 \times 12.6)$
$= 510$ PSF

LAYER 4

PEAT - 70 - 62.4 = 7.6 PSF

$\sigma_{v_o} = 510 \text{ PSF} + (1.5 \times 12.6) + (2' \times 7.6)$
$= 544$ PSF

LAYER 5

CLAY 115 - 62.4 = 52.6 PSF

$\sigma_{v_o} = 544 + (2' \times 7.6) + (1' \times 52.6)$
$= 610$ PSF

LAYER 6

$\sigma_{v_o} = 610 + (1' \times 52.6) + (.5' \times 7.6)$
$= 666$ PSF

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LAYER 7

σ_{v_0} = 666 PSF + (.5' × 7.6) + (5 + 52.6)

= 933 PSF

LAYER 8

σ_{v_0} = 933 + (5 × 52.6) + (5 × 52.6)

= 1459 PSF

LAYER 9

σ_{v_0} = 1459 PSF + (5 × 52.6) + (5 × 52.6)

σ_{v_0} = 1985 PSF

LAYER 10

σ_{v_0} = 1985 PSF + (5 × 52.6) + (5 × 52.6)

= 2511. PSF

LAYER 11

σ_{v_0} = 2511 , + (5 × 52.6) + (5 × 52.6)

= 3037 PSF

LAYER 12

σ_{v_0} = 3037 PSF + (5 × 52.6) + (5 × 52.6)

= 3563 PSF

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LAYER 13

$$\sigma_{v_o} = 3563 \text{ PSF} + (5 \times 52.6) + (5 \times 52.6)$$

$$= 4089 \text{ PSF}$$

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$$\Delta H = \frac{H_o}{1-e_o} C_c \left(\log \bar{\sigma}_{v_f} - \log \sigma_{v_o} \right)$$

e_o - FOR PEAT VALUES RANGE FROM 0.55 TO 3.0. ASSUMING PEAT HAS A WATER CONTENT OF 50% e_o IS ASSUMED TO BE 1.0. (ASSUMED FOR SLURRY ALSO)

e_o - FOR CLAY = 0.8

e_o - FOR SAND = 0.7

e_o - FOR SILT = 0.6

CLAY: $C_{c_{cl}} = .009(LL-10)$

LL OBTAINED FROM ATTERBERG LIMITS TEST
LL = 45 (BORING WB-OW-2D, -28-30')

$C_{c_{cl}} = .3$

PEAT: $C_{c_p} = 1.15 \times 10^{-2} W_N$

W_N IS WATER CONTENT OF PEAT (ASSUMED 50%)

$C_{c_p} = .6$ (WILL ALSO BE USED FOR SLURRY)

SILT: $C_c = 0.3(e_o - 0.27)$
$C_c = 0.1$

FOR THIS TECHNICAL ANALYSIS SAND WILL BE ASSUMED INCOMPRESSIBLE.

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$\Delta H_1 = \frac{11}{1+1.0}(0.6)(\log 820 - \log 362) = 1.17' = 14''$ SLURRY

$\Delta H_2 = \frac{1}{1+0.6}(0.1)(\log 918 - \log 460) = 0.02' = 0.22''$ SILT

$\Delta H_3 = \frac{3}{1+1.0}(0.6)(\log 968 - \log 510) = 0.25' = 3.0''$ 2ND SLURRY

$\Delta H_4 = \frac{4}{1+1.0}(0.6)(\log 1002 - \log 544) = 0.32' = 3.82''$ 1ST PEAT

$\Delta H_5 = \frac{2}{1+0.8}(0.3)(\log 1068 - \log 610) = 0.08' = 0.97''$ 1ST CLAY

$\Delta H_6 = \frac{1}{1+1.0}(0.6)(\log 1124 - \log 666) = 0.07' = 0.82''$ 2ND PEAT

$\Delta H_7 = \frac{10}{1+0.8}(0.4)(\log 1391 - \log 933) = 0.39' = 4.62''$ 2ND CLAY

$\Delta H_8 = \frac{10}{1+0.8}(0.4)(\log 1917 - \log 1459) = 0.26' = 3.16''$ 3RD CLAY

$\Delta H_9 = \frac{10}{1+0.8}(0.4)(\log 2443 - \log 1985) = 0.20' = 2.40''$ 4TH CLAY

$\Delta H_{10} = \frac{10}{1+0.8}(0.4)(\log 2969 - \log 2511) = 0.16' = 1.94''$ 5TH CLAY

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$$\Delta H_{11} = \frac{10}{1+0.8}(0.4)(\log 3495 - \log 3037) = 0.14' = 1.63'' \quad \text{6TH CLAY}$$

$$\Delta H_{12} = \frac{10}{1+0.8}(0.4)(\log 4021 - \log 3563) = 0.12' = 1.44'' \quad \text{7TH CLAY}$$

$$\Delta H_{13} = \frac{10}{1+0.8}(0.4)(\log 4547 - \log 4089) = 0.10' = 1.22'' \quad \text{8TH CLAY}$$

TOTAL PRIMARY SETTLEMENT = 39.2"

RATE OF PRIMARY SETTLEMENT

$$t = \frac{T_v H^2}{C_v}$$

% OF CONSOLIDATION	TIME FACTOR (T_v)
10%	0.02
25%	0.06
50%	0.19
75%	0.45
90%	0.9
~~100~~ 95%	1.2

SEE FIGURE 9-16

H = DRAINAGE DISTANCE TO SAND LAYER = 93'

C_v = SEE FIGURE 4

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$$t_{10\%} = \frac{(0.02)(93\ FT)^2}{.2\ FT^2/DAY} = 865\ DAYS = 2.4\ YEARS$$

$$t_{25\%} = \frac{(0.06)(93FT)^2}{.2\ FT^2/DAY} = 2595\ DAYS = 7.1\ YRS$$

$$t_{50\%} = \frac{(0.19)(93FT)^2}{.2\ FT^2/DAY} = 8220\ DAYS = 22.5\ YRS$$

$$t_{75\%} = \frac{(.45)(93FT)^2}{.2\ FT^2/DAY} = 19460\ DAYS = 53.0\ YRS$$

$$t_{90\%} = \frac{(.9)(93\ FT)^2}{.2\ FT^2/DAY} = 38920\ DAYS = 106\ YRS$$

$$t_{\cancel{100\%}\ 95} = \frac{(1.2)(93FT)^2}{.2\ FT^2/DAY} = 51900\ DAYS = 142\ YRS$$

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SECONDARY COMPRESSION FOLLOWING PRIMARY CONSOLIDATION:

$$\Delta H_{SEC} = C_\alpha (H_t) \log \frac{t_{SEC}}{t_p}$$

C_α = 0.02 FOR PEAT & SLURRY

= 0.005 FOR CLAY

H_t = 5' FOR PEAT

= 72' FOR CLAY

= 14' FOR SLURRY

t_{SEC} = 150 yrs (ASSUMED, 100 yrs IS ACTUAL LIFE EXPECTENCY)

t_p = 142 yrs

PEAT: $\Delta H_{SEC} = (0.02)(5\text{FT})(\log \frac{150}{142}) = .002' = 0.03''$

CLAY: $\Delta H_{SEC} = (0.005)(72\text{FT})(\log \frac{150}{142}) = .009' = 0.11''$

SLURRY: $\Delta H_{SEC} = (0.02)(14\text{FT})(\log \frac{150}{142}) = .007' = 0.08''$

TOTAL = 0.22"

STABILIZED MASS WILL SETTLE AN ADDITIONAL 0.2" AFTER PRIMARY CONSOLIDATION IS COMPLETE.

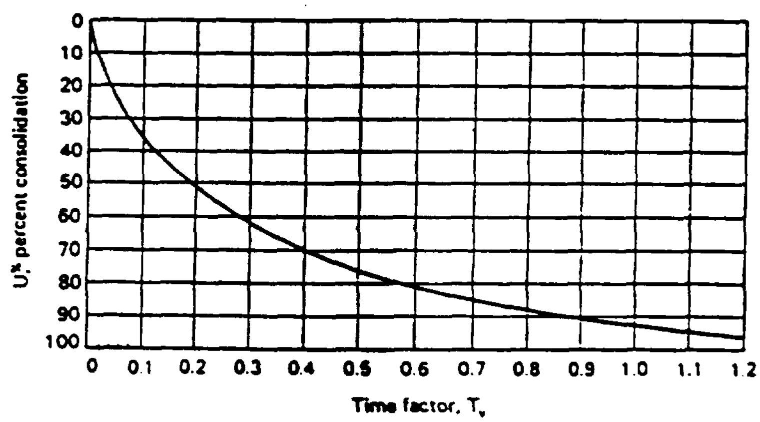

Figure 9-16 Variation of time factor T_v with percentage of consolidation U.

Consolidation

David McCarthy, Essentials of Soil Mechanics And Foundations, Prentice Hall, 1988.

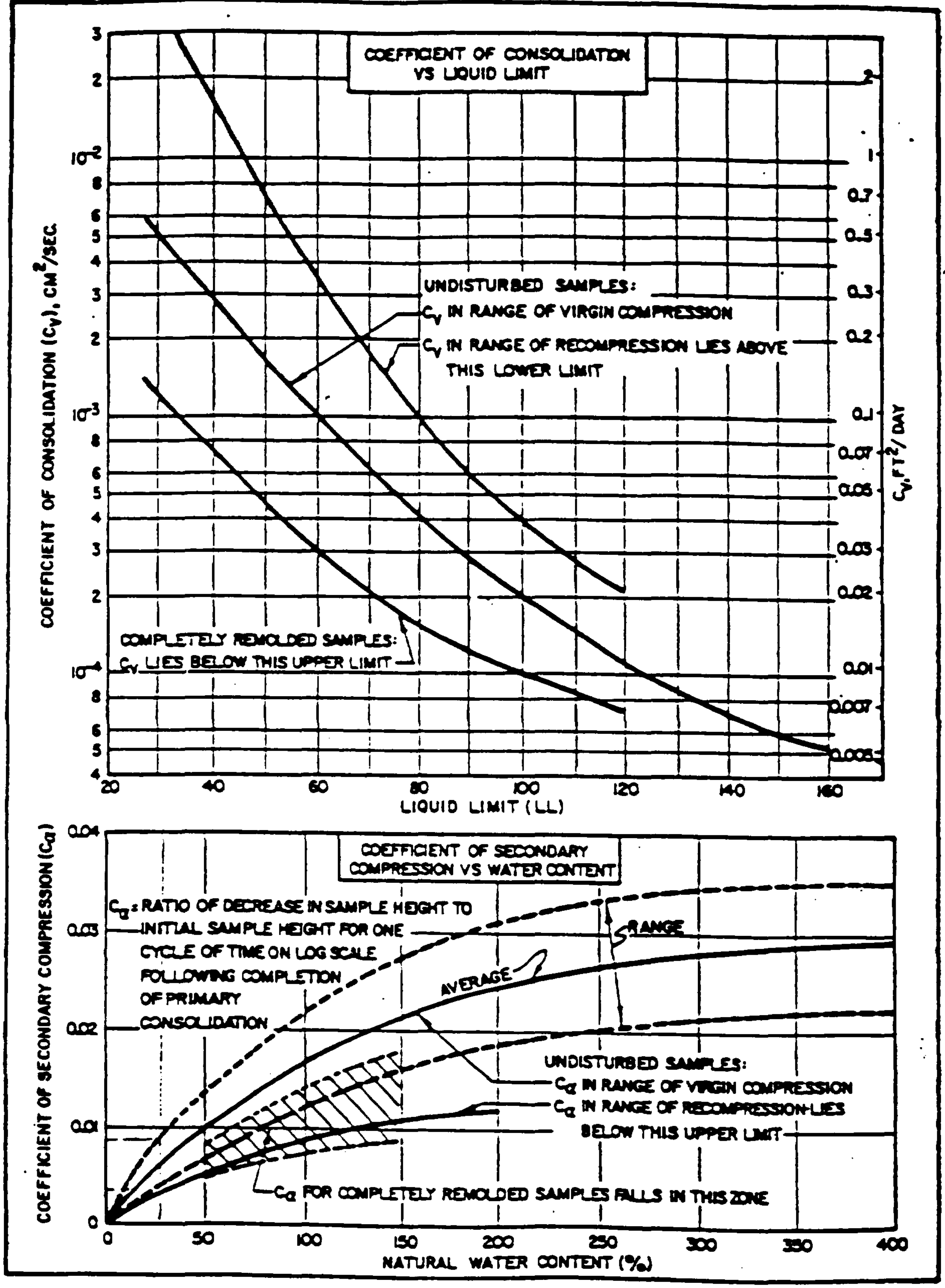

FIGURE 4
Approximate Correlations for Consolidation Characteristics of Silts and Clays

Department of the Navy,
Soil Mechanics, Design Manual 7.1,
NAVFAC DM-7.1,
May 1982.

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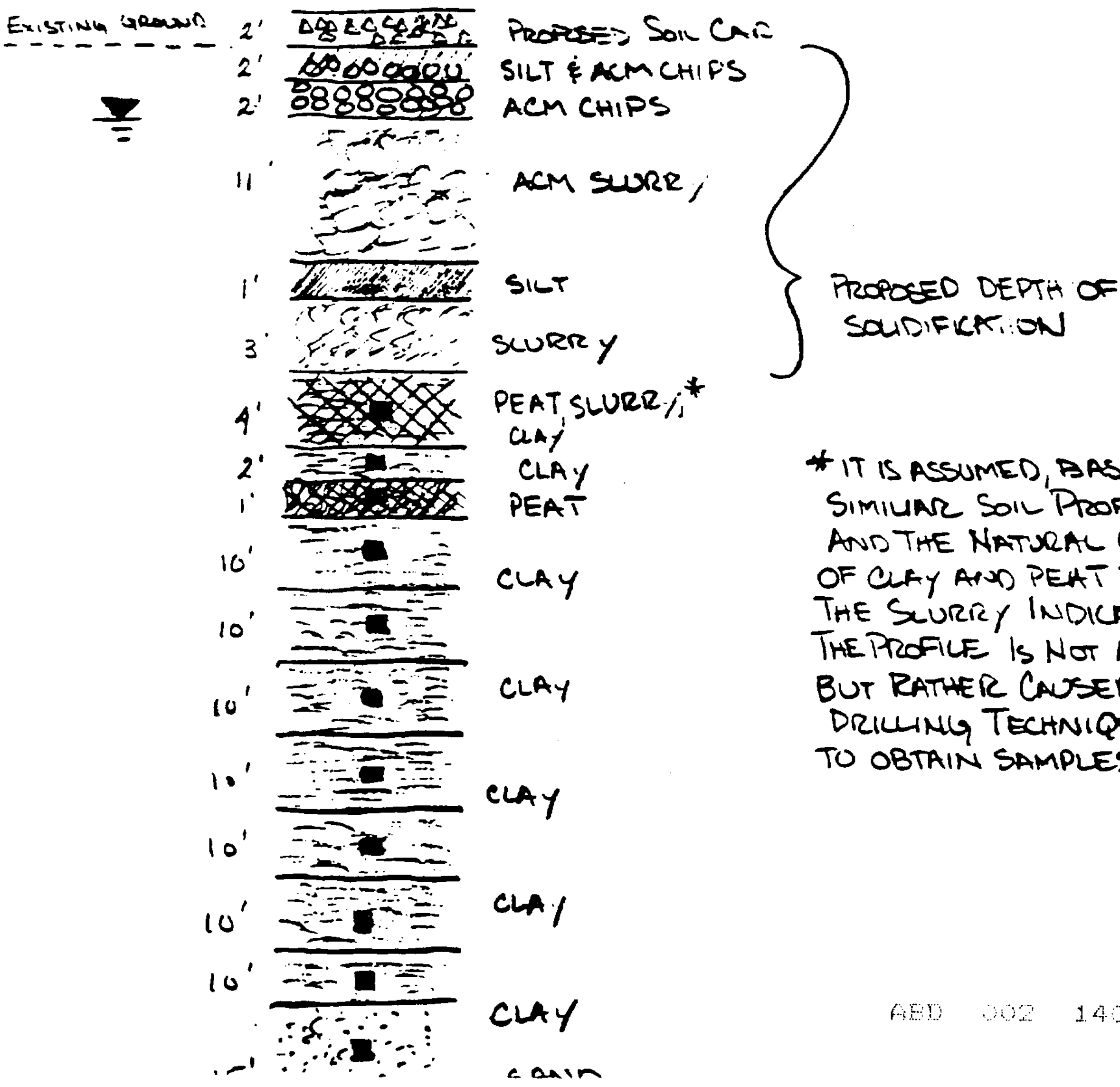
SUBJECT SETTLEMENT CALCULATIONS
WHITE BRIDGE ROAD

SOLIDIFICATION / STABILIZATION TO 23'

SETTLEMENT WAS CALCULATED IN THE AREA OF BORING N1060 E650 BECAUSE OF THE 23 FOOT DEPTH OF SOLIDIFICATION AND THE PRESENCE OF SEVERAL PEAT LAYERS. THE SOIL PROFILE BELOW WAS CONSTRUCTED FROM LOGS TAKEN DURING DRILLING ACTIVITES AT N1060E650 AND FROM THE INSTALLATION OF A DRINKING WATER WELL INSTALLED AT THE NEW VERNON ROAD SITE. DUE TO THE SIMILARITES BETWEEN THE TWO SITES AND THE CLOSE PROXIMITY BETWEEN THEM, IT IS ASSUMED THAT THE SOIL PROFILE IS THE SAME AT BOTH SITES BELOW 40'.



* IT IS ASSUMED, BASED ON SIMILIAR SOIL PROFILES, AND THE NATURAL OCCURRANCE OF CLAY AND PEAT THAT THE SLURRY INDICATED IN THE PROFILE IS NOT ACTUAL, BUT RATHER CAUSED BY DRILLING TECHNIQUES USED TO OBTAIN SAMPLES.

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MATERIAL	UNIT WEIGHT (PCF)	SOLIDIFIED UNIT WEIGHT (PCF)
CAP	120	—
SILT	120	140
ACM CHIPS	83	100
ACM SLURRY	75	95
PEAT	70	—
CLAY	115	—
SAND	120	—
WATER	62.4	—

VALUES FOR UNITWEIGHTS (BULK) WERE OBTAINED FROM TREATABILITY STUDY LAB TEST RESULTS FOR ACM CHIPS AND ACM TILE, ALL OTHERS WERE OBTAINED FROM TEXTBOOKS AND VARIOUS ENGINEERING SOURCES FOR TYPICAL VALUES OF GENERAL CLASSES OF SOIL.

SOLIDIFICATION UNIT WEIGHTS WERE OBTAINED FROM TREATABILITY STUDY TEST RESULTS. VALUES WERE INCREASED SLIGHTLY TO PROVIDE A FACTOR OF SAFTEY.

SOLIDIFICATION IS EXPECTED TO PROCEED TO APPROXIMATELY 20 FT BELOW GROUND SURFACE.

GROUND WATER TABLE IS AT 4'.

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WHITE BRIDGE ROAD

EXISTING WEIGHT OF SOIL ABOVE GWT = $\sigma_{v_{0_1}}$

$\sigma_{v_{0_1}}$ = (DEPTH OF SOIL × UNIT WEIGHT)

$\sigma_{v_{0_1}}$ = (1FT × 120PCF) + (1FT × 83 PCF) + (2FT × 83 PCF)

= 369 PSF

EXISTING WEIGHT OF SOIL BELOW WATER TABLE TO MIDDLE OF 1ST PEAT LAYER

ACM SLURRY

75 PCF − 62.4 PCF = 12.6 PCF

SILT

120 PCF − 62.4 PCF = 57.6 PCF

PEAT

70 PCF − 62.4 PCF = 7.6 PCF

$\sigma_{v_{0_2}}$ = (11FT × 12.6PCF) + (1FT × 57.6 PCF) + (3FT × 12.6PCF) + (2FT × 7.6 PCF)

= 249.2 PSF

TOTAL EXISTING STRESS ON MIDDLE OF PEAT LAYER

$\sigma_{v_0} = \sigma_{v_{0_1}} + \sigma_{v_{0_2}}$

= 369 PSF + 249.2 PSF

σ_{v_0} = 618 PSF

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WEIGHT OF SOLIDIFICATION

= (2FT CAP) + (1FT SILT) + (3FT ACM CHIPS) + (6FT SLURRY) + (1FT SILT) + (3FT SLURRY)

= (2FT × 120PCF) + (1FT × 140PCF) + (3FT × 100PCF) + (6FT × 95PCF) + (1FT × 140PCF) + (3FT × 95PCF)

= 1675 PSF

ACTUAL STRESS INCREASE ON MIDDLE OF CLAY LAYER

$$\Delta\sigma_v = 1675\text{ PSF} - 618\text{ PSF}$$

$$\Delta\sigma_v = 1057\text{ PSF}$$

THE INCREASED STRESS IS ASSUMED TO REMAIN CONSTANT THROUGHOUT THE FULL DEPTH OF NATIVE SOIL (McCARTHY, ESSENTIALS OF SOIL MECHANICS & FOUNDATIONS, PRENTICE HALL, 1988)

COMPUTING THE EXISTING STRESS (σ_{v_0}) FOR EACH SOIL LAYER

CLAY LAYER

115PCF − 62.4PCF = 52.6PCF

$$\sigma_{v_0} = 618\text{ PSF} + (2\text{FT} \times 7.6\text{PCF}) + (1 \times 52.6\text{PCF})$$

$$= 685.8\text{ PSF}$$

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PEAT LAYER

70 PCF − 62.4 PCF = 7.6 PCF

σ_{v_0} = 685.8 + (1 FT × 52.6 PCF) + (.5 FT × 7.6 PCF)

σ_{v_0} = 742.2 PSF

1ST CLAY LAYER

σ_{v_0} = 742.2 PSF + (.5 FT × 7.6 PCF) + (5 FT × 52.6 PCF)

σ_{v_0} = 1009 PSF

2ND CLAY LAYER

σ_{v_0} = 1009 PSF + (5 FT × 52.6 PCF) + (5 FT × 52.6 PCF)

σ_{v_0} = 1535 PSF

3RD CLAY LAYER

σ_{v_0} = 1535 PSF + (5 FT × 52.6 PCF) + (5 FT × 52.6 PCF)

σ_{v_0} = 2061 PSF

4TH CLAY LAYER

σ_{v_0} = 2061 PSF + (5 FT × 52.6 PCF) + (5 FT + 52.6 PCF)

σ_{v_0} = 2587 PSF

5TH CLAY LAYER

σ_{v_0} = 2587 PSF + (5 FT × 52.6 PCF) + (5 FT × 52.6 PCF)

σ_{v_0} = 3113 PSF

6TH CLAY LAYER

σ_{v_0} = 3113 + (5 FT × 52.6 PCF) + (5 FT × 52.6 PCF)

σ_{v_0} = 3639 PSF

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7TH CLAY LAYER

$$\sigma_{v_0} = 3639 + (5FT \times 52.6PCF) + (5FT \times 52.6) = 4165 \text{ PSF}$$

SAND LAYER (MIDDLE)

$$120 - 62.4 = 57.6 \text{ PCF}$$

$$\bar{\sigma}_{v_0} = 4165 + (5FT \times 52.6) + (7.5 \times 57.6) = 4860 \text{ PSF}$$

SETTLEMENT

$$\Delta H = \frac{H_0}{1-e_0} C_c \left(\log \bar{\sigma}_{v_f} - \log \sigma_{v_0}\right)$$

ΔH = SETTLEMENT FOR LAYER
H_0 = HEIGHT OF COMPRESSIBLE LAYER
e_0 = VOID RATIO
C_c = COMPRESSION INDEX
$\bar{\sigma}_{v_f}$ = SUM OF OVERBURDEN PRESSURE AND PRESSURE CAUSED BY SOLIDIFICATION/STABILIZATION
σ_{v_0} = OVERBURDEN PRESSURE

e_0 FOR PEAT, VALUES RANGE FROM 0.55 to 3.0, (DEPT. OF NAVY, SOIL MECHANICS, DESIGN MANUAL 7.1), ASSUMING PEAT HAS WATER CONTENT OF 50%, e_0 IS ASSUMED TO BE:
$e_0 = 1.0$

e_0 FOR CLAY, VALUES RANGE FROM 0.7 to 0.8, 0.8 WILL BE USED

$e_{0_c} = 0.8$ FOR CLAY

$C_c = .009(LL - 10)$ FOR NORMALLY CONSOLIDATED CLAYS

LL = LIQUID LIMIT OBTAINED FROM ATTERBERG LIMITS FOR SAMPLES TAKEN NEAR N1060E650.
LL = 45 (BORING WB-OW-2D, 28-30' INTERVAL)

$C_c = .315$

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$C_{c_p} = 1.15 \times 10^{-2} W_N$ W_N IS WATER CONTENT OF PEAT, ASSUME
$= 1.15 \times 10^{-2} (50\%)$ PEAT CONTAINS 50% WATER

$C_p = .575$

e_o FOR SAND, COMMON VALUES ARE 0.4 TO 1.0,

$e_{o_s} = 1.0$

C_{c_s} FOR SAND WILL BE ASSUMED EQUAL TO THAT OF CLAY

$C_{c_s} = .315$

	PEAT	CLAY	SAND
e_o	1.0	0.8	1.0
C_c	.575	.315	.315

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SETTLEMENT:

$\Delta H_1 = \frac{4'}{1+1.0}(.575)(\log 1675 - \log 618) = .49' = 5.88''$

$\Delta H_2 = \frac{2'}{1+.8}(.315)(\log 1692 - \log 685.8) = .13' = 1.64''$

$\Delta H_3 = \frac{1'}{1+1.0}(.575)(\log 1749 - \log 742) = .10' = 1.28''$ (.00575)

$\Delta H_4 = \frac{10'}{1+.8}(.315)(\log 2016 - \log 1009) = .52' = 6.31''$

$\Delta H_5 = \frac{10'}{1+.8}(.315)(\log 2542 - \log 1545) = .37' = 4.54''$

$\Delta H_6 = \frac{10'}{1+.8}(.315)(\log 3068 - \log 2061) = .30' = 3.62''$

$\Delta H_7 = \frac{10'}{1+.8}(.315)(\log 3594 - \log 2587) = .24' = 2.99''$

$\Delta H_8 = \frac{10'}{1+.8}(.315)(\log 4120 - \log 3113) = .21' = 2.55''$

$\Delta H_9 = \frac{10}{1+.8}(.315)(\log 4646 - \log 3639) = .18' = 2.22''$

$\Delta H_{10} = \frac{10}{1+.8}(.315)(\log 5172 - \log 4165) = .16' = 1.9''$

$\Delta H_{11} = \frac{15}{1+1.0}(.315)(\log 5867 - \log 4860) = .19 = 2.31''$

TOTAL 35.2"

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RATE OF PRIMARY SETTLEMENT WAS ALSO CALCULATED IN THE AREA OF N1060 E650. TIME PERIODS FOR VARIOUS PERCENTAGES OF TOTAL SETTLEMENT ARE CALCULATED BELOW.

$$t = \frac{T_v H^2}{C_v}$$

t = TIME PERIOD

T_v = TIME FACTOR FOR CONSOLIDATION DUE TO VERTICAL DRAINAGE

H = DRAINAGE DISTANCE FOR ESCAPING PORE WATER (TO SAND LAYER)

C_v = COEFFICIENT OF CONSOLIDATION

THE VALUE OF T_v IS A TIME FACTOR THAT IS CONSTANT FOR A GIVEN PERCENTAGE OF CONSOLIDATION. THE VALUES OF T_v CAN BE DETERMINED FROM A CURVE OF T_v vs U% (PERCENT OF CONSOLIDATION), SEE FIGURE AT END OF CALCULATIONS.

THE VALUE C_v WAS OBTAINED FROM A GRAPH OF COEFFICIENT OF CONSOLIDATION vs THE LIQUID LIMIT. SEE FIGURE AT END OF CALCULATIONS.

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$t_{10\%} = \frac{(.02)(92FT)^2}{.2\ FT/DAY} = 2.3$ YEARS FOR 3.52" SETTLEMENT

$t_{25\%} = \frac{(.06)(92FT)^2}{.2\ FT^2/DAY} = 6.95$ YEARS FOR 8.8" SETTLEMENT

$t_{50\%} = \frac{(.19)(92FT)^2}{.2\ FT^2/DAY} = 22$ YEARS FOR 17.6" SETTLEMENT

$t_{75\%} = \frac{(.45)(92FT)^2}{.2\ FT^2/DAY} = 52.2$ YEARS FOR 26.4" SETTLEMENT

$t_{90\%} = \frac{(.9)(92FT)^2}{.2\ FT^2/DAY} = 104$ YEARS FOR 31.7" SETTLEMENT

$t_{100\%} = \frac{(1.2)(92\ FT)^2}{.2FT^2/DAY} = 139$ YEARS FOR 35.2" SETTLEMENT

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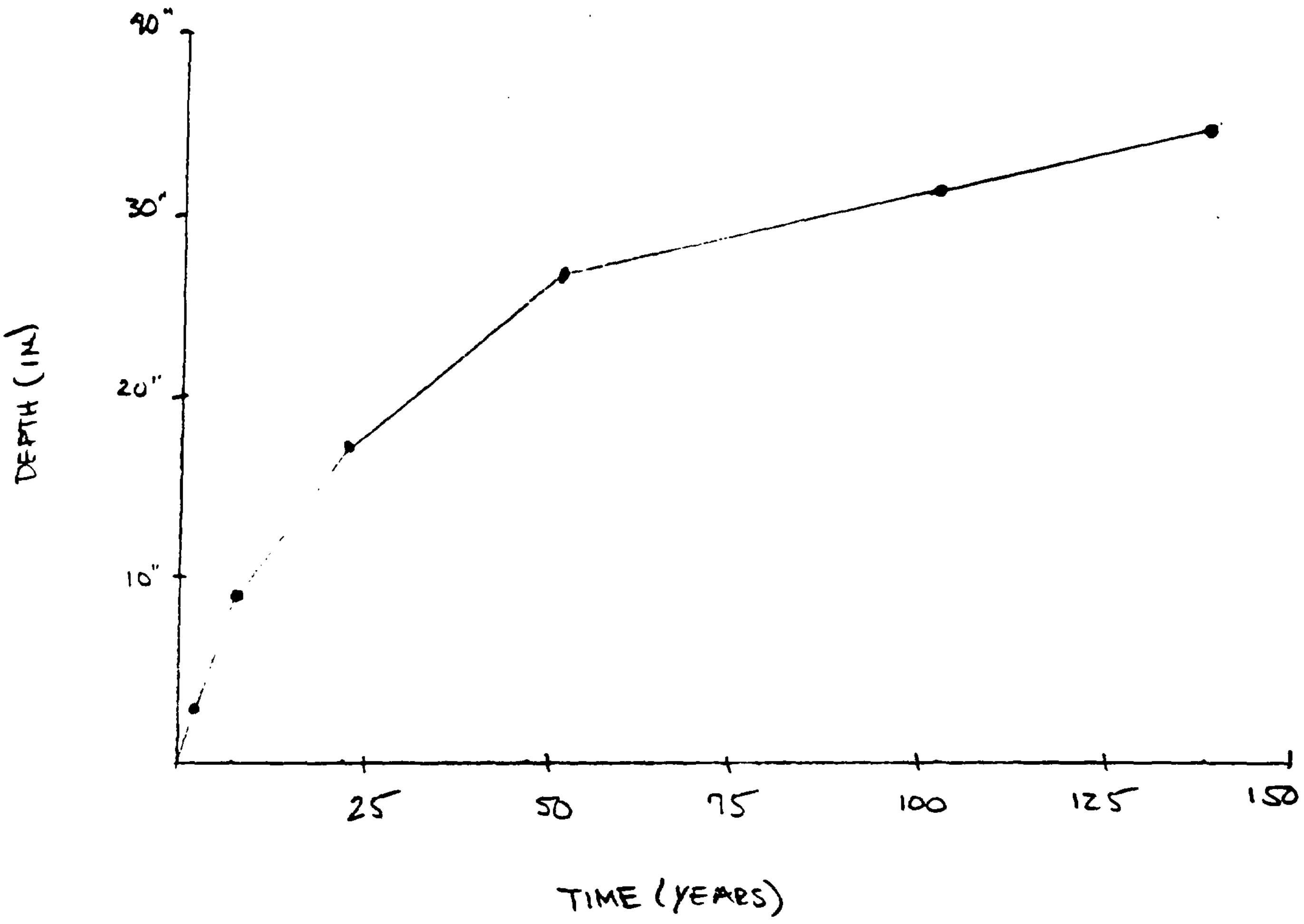

SETTLEMENT DEPTH vs TIME FOR WHITE BRIDGE ROAD SITE.

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SUBJECT SETTLEMENT CALCS
WBR
B'K CH'K BY SL

SECONDARY COMPRESSION FOLLOWING PRIMARY CONSOLIDATION:

$$\Delta H_{SEC} = C_\alpha (H_t) \log \frac{t_{SEC}}{t_p}$$

ΔH_{SEC} = SETTLEMENT FROM SECONDARY COMPRESSION

C_α = COEFFICIENT OF SECONDARY COMPRESSION,
= 0.02 FOR PEAT, 0.005 CLAY

H_t = THICKNESS OF COMPRESSIBLE LAYER

H_t = 5' FOR PEAT
= 72' FOR CLAY

t_{SEC} = USEFUL LIFE OF STRUCTURE, 200 YEARS

t_p = TIME OF COMPLETION OF PRIMARY CONSOLIDATION
= 139 YEARS

PEAT $\quad \Delta H_{SEC} = (0.02)(5\,FT)\left(\log \frac{200\,YRS}{139\,YRS}\right) = .015\,FT = .2''$

CLAY $\quad \Delta H_{SEC} = (.005)(72')\left(\log \frac{200}{139}\right) = .056\,FT = .68''$

TOTAL = 0.88"

SOLIDIFIED MASS WILL SETTLE AN ADDITIONAL 0.88" AFTER PRIMARY CONSOLIDATION IS COMPLETE.

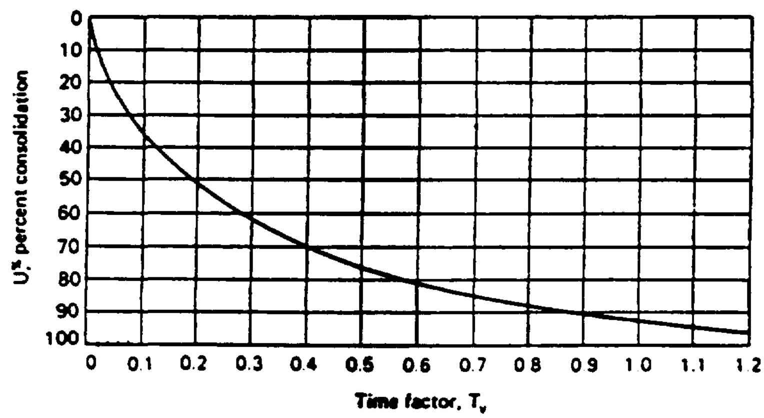

Figure 9-16 Variation of time factor T_v with percentage of consolidation U.

Consolidation

David McCarthy, Essentials of Soil Mechanics And Foundations,
Prentice Hall, 1988.

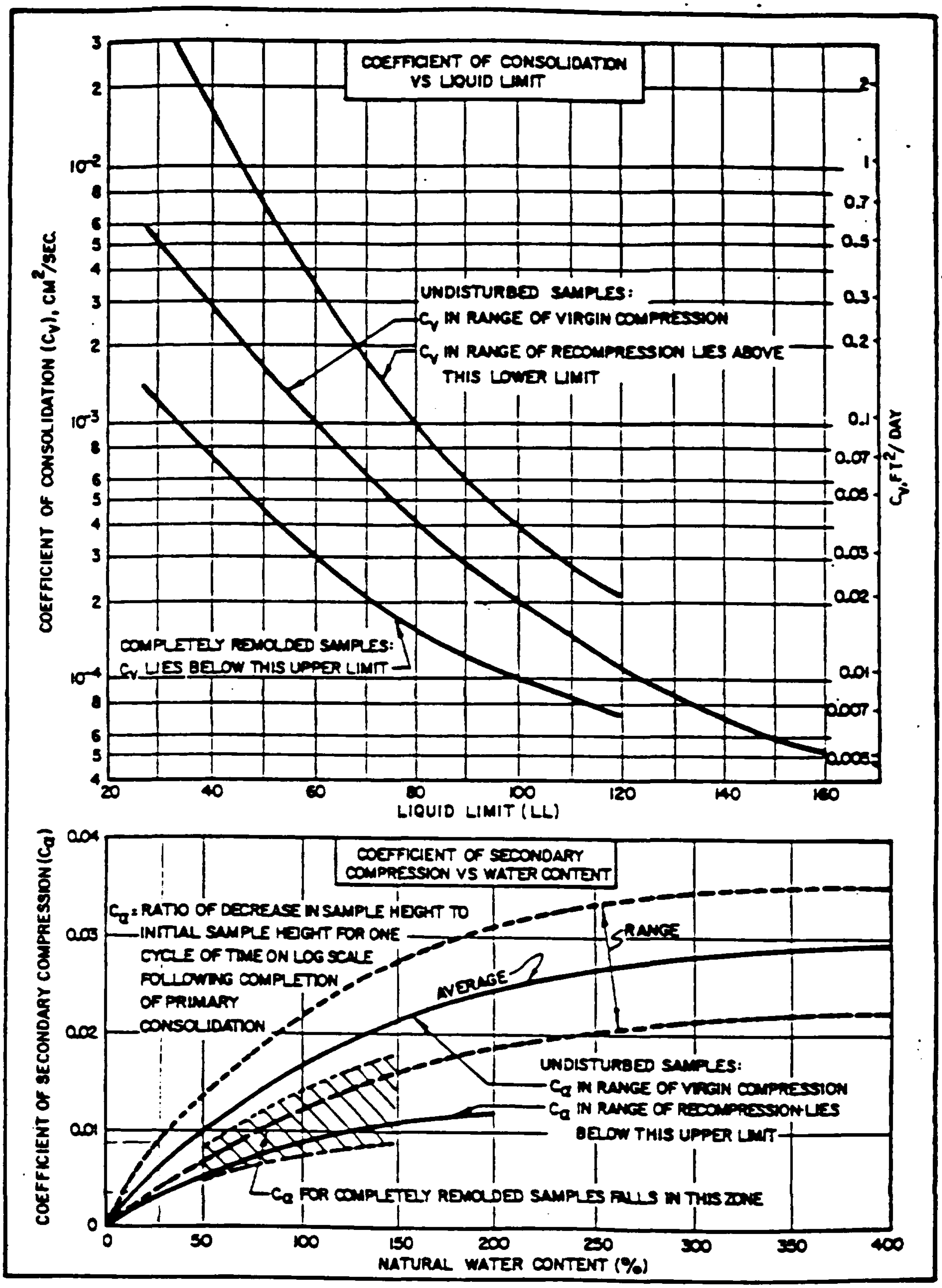

FIGURE 4
Approximate Correlations for Consolidation Characteristics of Silts and Clays

Department of the Navy,
Soil Mechanics, Design Manual 7.1,
NAVFAC DM-7.1,
May 1982.

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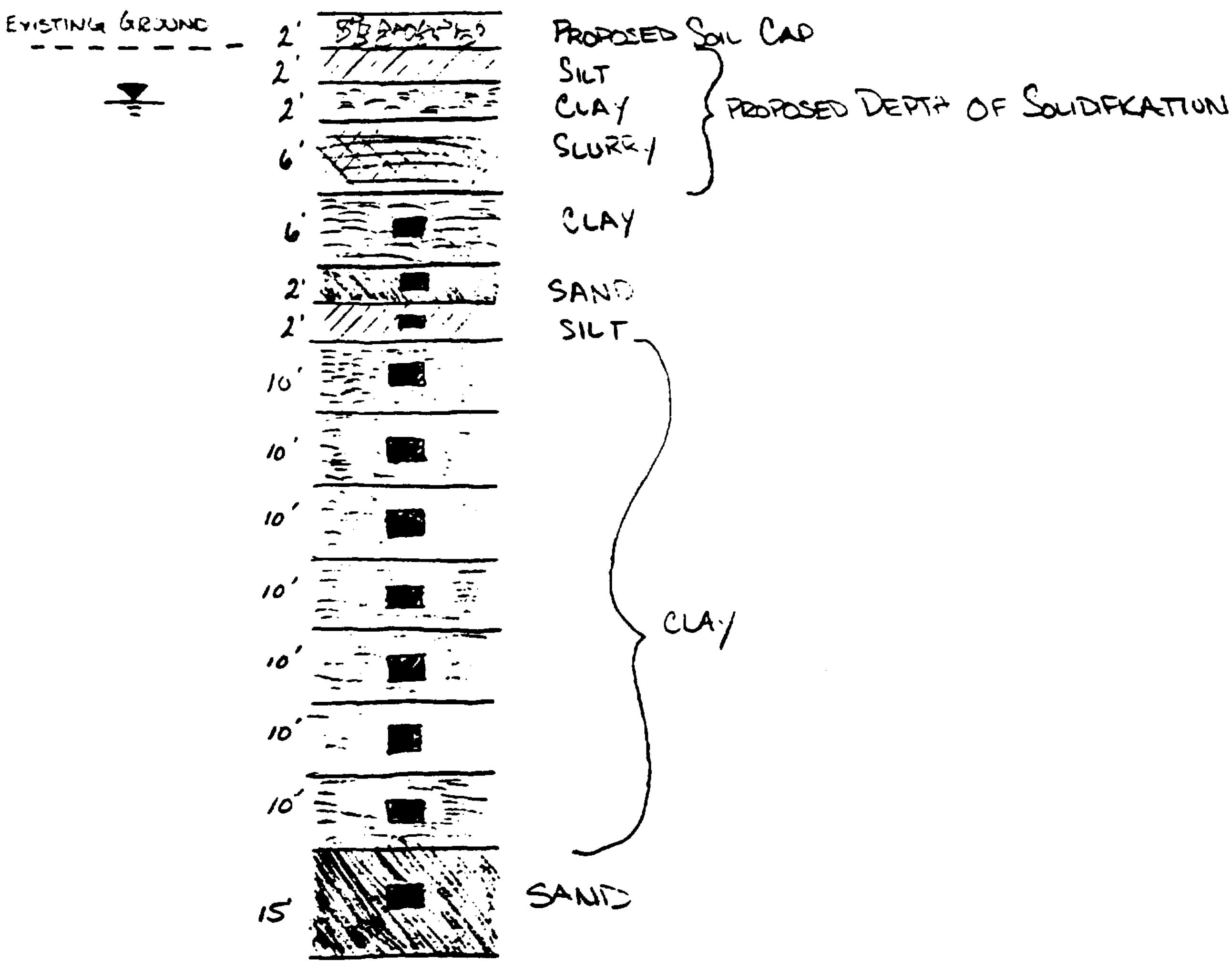
DATE CH'K 10/16/92
B'K CH'K BY JL

JOB NO. 1-635-337-0-2PZZ-0
PROJECT PASSAIC REMEDIAL DESIGN
SUBJECT SETTLEMENT CALCULATIONS
NEW VERNON ROAD

SOLIDIFICATION / STABILIZATION TO 10'

SETTLEMENT WAS CALCULATED IN THE AREA OF BORING #16 BECAUSE OF THE HIGH LIQUID LIMITS THAT EXIST. LIQUID LIMITS WERE DETERMINED FROM SHELBY TUBE SAMPLES COLLECTED FROM TWO BORINGS. THE HIGHEST LIMIT WAS IN B-16 AT THE 18-20' INTERVAL. THE SOIL PROFILE BELOW WAS CONSTRUCTED FROM LOGS TAKEN DURING DRILLING ACTIVITIES AT B-16 AND FROM THE INSTALLATION OF A DRINK WATER WELL INSTALLED AT THE NEW VERNON ROAD SITE.



APPROXIMATE SOIL PROFILE

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MATERIAL	UNIT WEIGHT (PCF)	SOLIDIFIED UNIT WEIGHT (PCF)
CAP	120	—
SILT	120	140
CLAY	115	140
SAND	120	140
SLURRY	75	95
WATER	62.4	—

DUE TO METHODS USED TO STABILIZE, IT IS ASSUMED THAT AUGER MIXING OF SOIL WILL EFFECTIVELY COMBINE ALL LAYERS OF SOIL. THEREFORE, A SOLIDIFIED UNIT WEIGHT FOR SOIL WAS ASSUMED 140 PCF BECAUSE OF THE ADDED CONCRETE DENSITY OF 24.5 #/FT³.

SOLIDIFICATION IS EXPECTED TO ADVANCE TO 10' BELOW GROUND SURFACE.

GROUND WATER TABLE IS AT 3'.

EXISTING WEIGHT OF SOIL ABOVE GWT = $\sigma_{V_{o_1}}$

$$\sigma_{V_{o_1}} = (\text{DEPTH OF SOIL} \times \text{UNIT WEIGHT})$$

$$= (2' \times 120\,PCF) + (1' \times 115\,PCF) = 355\,PSF$$

EXISTING WEIGHT OF SOIL BELOW GWT TO MIDDLE OF CLAY LAYER.

CLAY

$$115\,PCF - 62.4\,PCF = 52.6\,PCF$$

SLURRY

$$75\,PCF - 62.4\,PCF = 12.6\,PCF$$

$$\sigma_{V_{o_2}} = (1' \times 52.6\,PCF) + (6' \times 12.6\,PCF) + (3' \times 52.6\,PCF) = 286\,PSF$$

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TOTAL EXISTING STRESS ON MIDDLE OF CLAY LAYER

$$\sigma_{v_0} = \sigma_{v_{0_1}} + \sigma_{v_{0_2}}$$

$$= 355 \text{ PSF} + 286 \text{ PSF}$$

$$\sigma_{v_0} = 641 \text{ PSF}$$

WEIGHT OF SOLIDIFICATION:

= (2 FT CAP) + (2' SOLIDIFIED SILT) + (2' SOLIDIFIED CLAY) + (6' SOLIDIFIED SLURRY)

= (2' × 120 PCF) + (2' × 140 PCF) + (2' × 140 PCF) + (6' × 95 PCF)

= 1370 PSF

ACTUAL STRESS INCREASE ON MIDDLE OF CLAY LAYER:

$$\Delta\sigma_v = 1370 - 641 = 729 \text{ PSF}$$

THE INCREASED STRESS IS ASSUMED TO REMAIN CONSTANT THROUGHOUT THE FULL DEPTH OF NATIVE SOIL, (McCARTHY, ESSENTIALS OF SOIL MECHANICS & FOUNDATIONS, PRENTICE HALL, 1988).

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COMPUTING THE EXISTING STRESS (σ_{v_o}) FOR EACH LAYER

SAND LAYER

120 PCF − 62.4 PCF = 57.6 PCF

σ_{v_o} = 641 PSF + (3' × 52.6) + (1' × 57.6)
= 856 PSF @ MIDDLE OF LAYER

SILT LAYER

120 PCF − 62.4 PCF = 57.6 PCF

σ_{v_o} = 856 PSF + (1' × 57.6 PCF) + (1' × 57.6 PCF)
= 971 PSF

1ST CLAY LAYER

115 PCF − 62.4 PCF = 52.6

σ_{v_o} = 971 PSF + (1' × 57.6) + (5' × 52.6)
= 1292 PSF

2ND CLAY LAYER

σ_{v_o} = 1292 + (5 × 52.6) + (5 × 52.6)
= 1818 PSF

3RD CLAY LAYER

σ_{v_o} = 1818 + (5 × 52.6) + (5 × 52.6)
= 2344 PSF

4TH CLAY LAYER

σ_{v_o} = 2871 PSF

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5TH CLAY LAYER

$\sigma_{v_o} = 3397$ PSF

6TH CLAY LAYER

$\sigma_{v_o} = 3923$ PSF

7TH CLAY LAYER

$\sigma_{v_o} = 4449$ PSF

SAND LAYER (MIDDLE)

$\sigma_{v_o} = 4450 + (7.5' \times 57.6 \text{ PCF})$

$\sigma_{v_o} = 4882$ PSF

SETTLEMENT

$$\Delta H = \frac{H_o}{1-e_o} C_c \left(\log \bar{\sigma}_{v_f} - \log \sigma_{v_o} \right)$$

ΔH = SETTLEMENT FOR LAYER
H_o = HEIGHT OF COMPRESSIBLE LAYER
e_o = VOID RATIO
C_c = COMPRESSION INDEX FOR NORMALLY CONSOLIDATED SILTS & CLAYS
$\bar{\sigma}_{v_f}$ = SUM OF OVERBURDEN PRESSURE AND PRESSURE CAUSED BY SOLIDIFICATION / STABILIZATION

σ_{v_o} = OVERBURDEN SOIL PRESSURE

H_o = BECAUSE OF THE GREAT DEPTH OF COMPRESSIBLE LAYERS, SETTLEMENT WILL BE CALCULATED FOR EACH LAYER

e_o = COMMON VALUES FOR VOID RATIO ARE 0.7 OR 0.8 FOR CLAYS, 0.8 WILL BE USED.

$C_c = .009(LL-10)$ FOR NORMALLY CONSOLIDATED CLAYS
LL WAS OBTAINED FROM ATTERBERG LIMITS
FOR B-16, 18-20'
$LL = 54$

$C_c = .009(54-10)$

$C_c = .396$

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$$\Delta H_1 = \frac{6}{1+.8}(.396)(\log 1370 - \log 691) = .90' \; (.43) = 4.9''$$

$$\Delta H_2 = \frac{2}{1+.8}(.396)(\log 1535 - \log 856) = .11' \quad 1.3''$$

$$\Delta H_3 = \frac{2}{1+.8}(.396)(\log 1650 - \log 971) = .1' = 1.2''$$

$$\Delta H_4 = \frac{10}{1+.8}(.396)(\log 1971 - \log 1292) = .4' = 4.8''$$

$$\Delta H_5 = \frac{10}{1+.8}(.396)(\log 2497 - \log 1818) = .3' = 3.6''$$

$$\Delta H_6 = \frac{10}{1+.8}(.396)(\log 3024 - \log 2345) = .24' = 2.9''$$

$$\Delta H_7 = \frac{10}{1+.8}(.396)(\log 3550 - \log 2871) = .2' = 2.4''$$

$$\Delta H_8 = \frac{10}{1+.8}(.396)(\log 4076 - \log 3397) = .17' = 2.0''$$

$$\Delta H_9 = \frac{10}{1+.8}(.396)(\log 4602 - \log 3923) = .15' = 1.8''$$

$$\Delta H_{10} = \frac{10}{1+.8}(.396)(\log 5129 - \log 4450) = .13' = 1.6''$$

$$\Delta H_{11} = \frac{15}{1+.8}(.396)(\log 5561 - \log 4882) = .18' \; (0.19) = 2.2''$$

TOTAL = 28.7"

RATE OF PRIMARY SETTLEMENT WAS ALSO CALCULATED IN THE AREA OF B-16. TIME PERIODS FOR VARIOUS PERCENTAGES OF TOTAL SETTLEMENT ARE CALCULATED BELOW.

$$t = \frac{T_v H^2}{C_v}$$

t = TIME PERIOD

T_v = TIME FACTOR FOR CONSOLIDATION DUE TO VERTICAL DRAINAGE.

H = DRAINAGE DISTANCE FOR ESCAPING PORE WATER

C_v = COEFFICIENT OF CONSOLIDATION

THE VALUE T_v IS A TIME FACTOR THAT IS A CONSTANT FOR A GIVEN PERCENTAGE OF CONSOLIDATION. FOR THE CONDITIONS INDICATED BY THE SOIL PROFILE, REFERRED TO AS "DOUBLE DRAINAGE" BECAUSE PORE WATER CAN MOVE UPWARD OR DOWNWARD TO EITHER SAND LAYER TO ESCAPE, THE VALUES OF T_v CAN BE DETERMINED FROM A CURVE OF T_v vs U% (PERCENT OF CONSOLIDATION), SEE FIGURE AT END OF CALCULATIONS.

THE VALUE C_v WAS OBTAINED FROM A GRAPH OF COEFFICIENT OF CONSOLIDATION vs THE LIQUID LIMIT. THIS GRAPH REPRESENTS GENERAL VALUES FOR C_v, SEE FIGURE AT END OF CALCULATIONS.

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PERCENTAGE OF CONSOLIDATION	TIME FACTOR
10%	.02
25%	.06
50%	.19
75%	.45
90%	.9
100%	1.2

H = MOST SETTLEMENT OCCURS IN THE 70' THICK CLAY LAYER. ASSUME 50% OF ALL PORE WATER WILL ESCAPE THROUGH THE TOP SAND LAYER AND THE REMAINING PORE WATER (50%) WILL ESCAPE THROUGH THE BOTTOM SAND LAYER.

H = 70'/2 = 35' AINAGE DISTANCE

C_v = USING LIQUID LIMIT OBTAINED FROM ATTERBERG LIMITS OF LL = 54, FOR B-16 @ 18-20' INTERVAL, AND C_v FOR UNDISTURBED SAMPLES IN RANGE OF VIRGIN COMPRESSION (TO ASSUME A WORST CASE SCENARIO);

C_v = .14 FT²/DAY

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$$t_{10\%} = \frac{(.02)(35\,FT)^2}{.14\,FT^2/DAY} = 175\ DAYS$$

$$t_{25\%} = \frac{(.06)(35\,FT)^2}{.14\,FT^2/DAY} = 525\ DAYS$$

$$t_{50\%} = \frac{.19(35\,FT)^2}{.14\,FT^2/DAY} = 1662\ DAYS$$

$$t_{75\%} = \frac{.45(35\,FT)^2}{.14\,FT^2/DAY} = 3937\ DAYS$$

$$t_{90\%} = \frac{.9(35\,FT)^2}{.14\,FT^2/DAY} = 7875\ DAYS$$

$$t_{100\%} = \frac{1.2(35\,FT)^2}{.14\,FT^2/DAY} = 10{,}500\ DAYS$$

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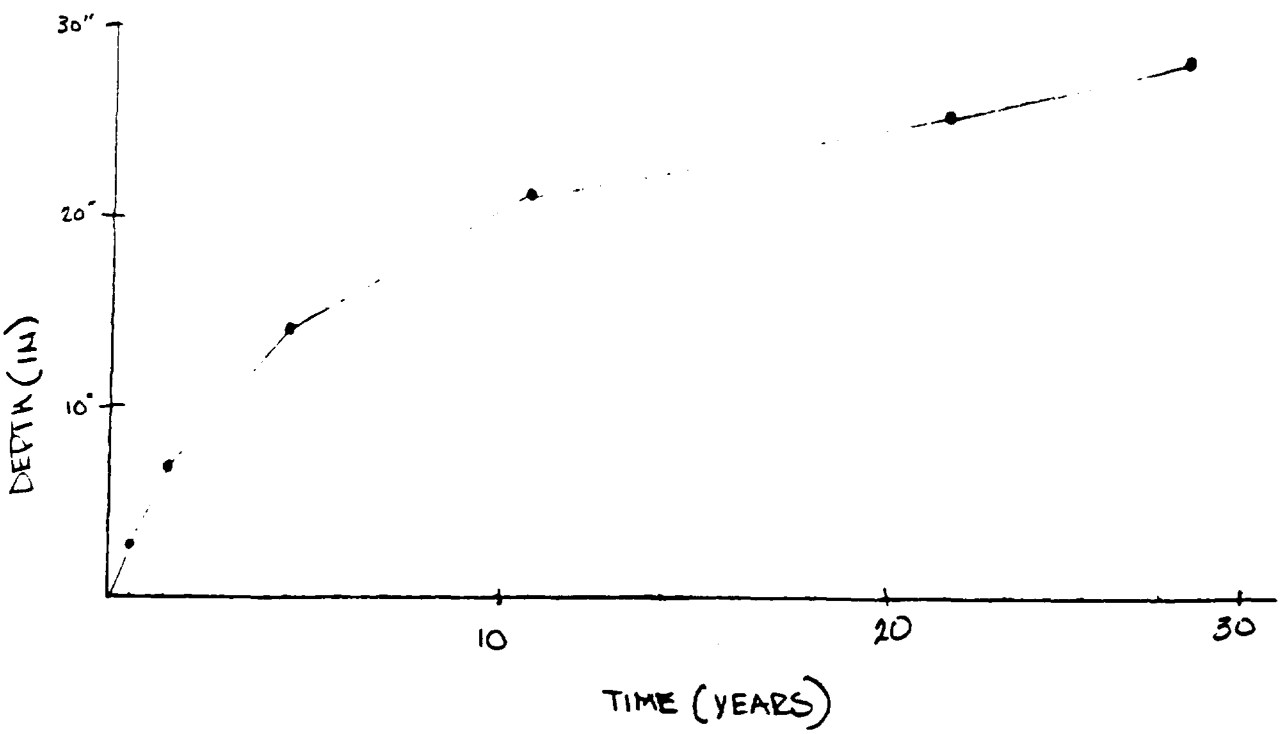
SUBJECT SETTLEMENT CALCS NVR

DATE CH'K. 10/16/92

B'K. CH'K. BY SL

1) SOLIDIFIED MASS WILL SETTLE 2.8" IN 175 DAYS
2) MASS WILL SETTLE 7.0" IN 1.4 YEARS
3) MASS WILL SETTLE 14.0" IN 4.5 YEARS
4) MASS WILL SETTLE 21.0" IN 10.7 YEARS
5) MASS WILL SETTLE 25.2" IN 21.5 YEARS
6) MASS WILL SETTLE 28.0" IN 28.7 YEARS



SETTLEMENT DEPTH VS TIME FOR NEW VERNON ROAD SITE.

SECONDARY COMPRESSION SETTLEMENT FOLLOWING PRIMARY CONSOLIDATION IS COMPUTED AS FOLLOWS:

$$\Delta H_{SEC} = C_\alpha (H_t) \log \frac{t_{SEC}}{t_p}$$

ΔH_{SEC} = SETTLEMENT FROM SECONDARY COMPRESSION

C_α = COEFFICIENT OF SECONDARY COMPRESSION DETERMINED FROM A GRAPH OF NATURAL WATER CONTENT (%) VS COEFFICIENT OF SECONDARY COMPRESSION. SEE FIGURE AT END OF CALCULATIONS. WATER CONTENT OBTAINED FROM PERMEABILITY TESTS.

C_α = FOR UNDISTURBED SAMPLES IN RANGE OF VIRGIN COMPRESSION = .003 TO .008

C_α = USE .005

H_t = THICKNESS OF COMPRESSIBLE LAYER

H_t = 70'

t_{SEC} = USEFUL LIFE OF STRUCTURE = 100 YEARS

t_p = TIME OF COMPLETION OF PRIMARY CONSOLIDATION (FOUND PREVIOUSLY) = 28.7 YEARS

$$\Delta H_{SEC} = (.005)(70 \text{ FT}) \log \frac{100 \text{ YRS}}{28.7 \text{ YRS}}$$

$$\Delta H_{SEC} = .189 \text{FT} = 2.27 \text{IN}$$

SOLIDIFIED MASS WILL SETTLE AN ADDITIONAL 2.27 IN AFTER PRIMARY CONSOLIDATION IS COMPLETE.

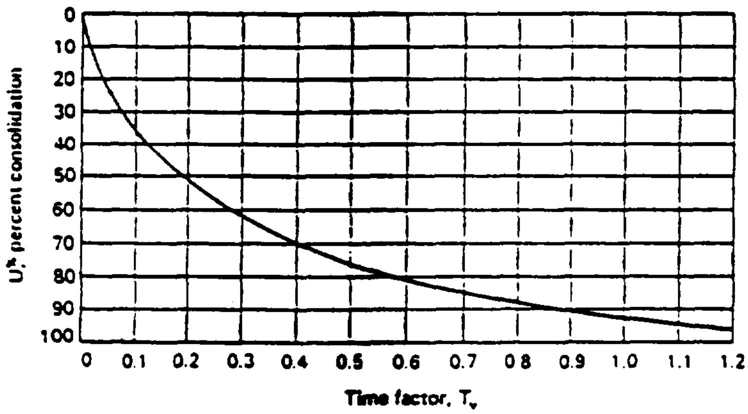


Figure 9-16 Variation of time factor T_v with percentage of consolidation U.

Consolidation

David McCarthy, Essentials of Soil Mechanics And Foundations, Prentice Hall, 1988.

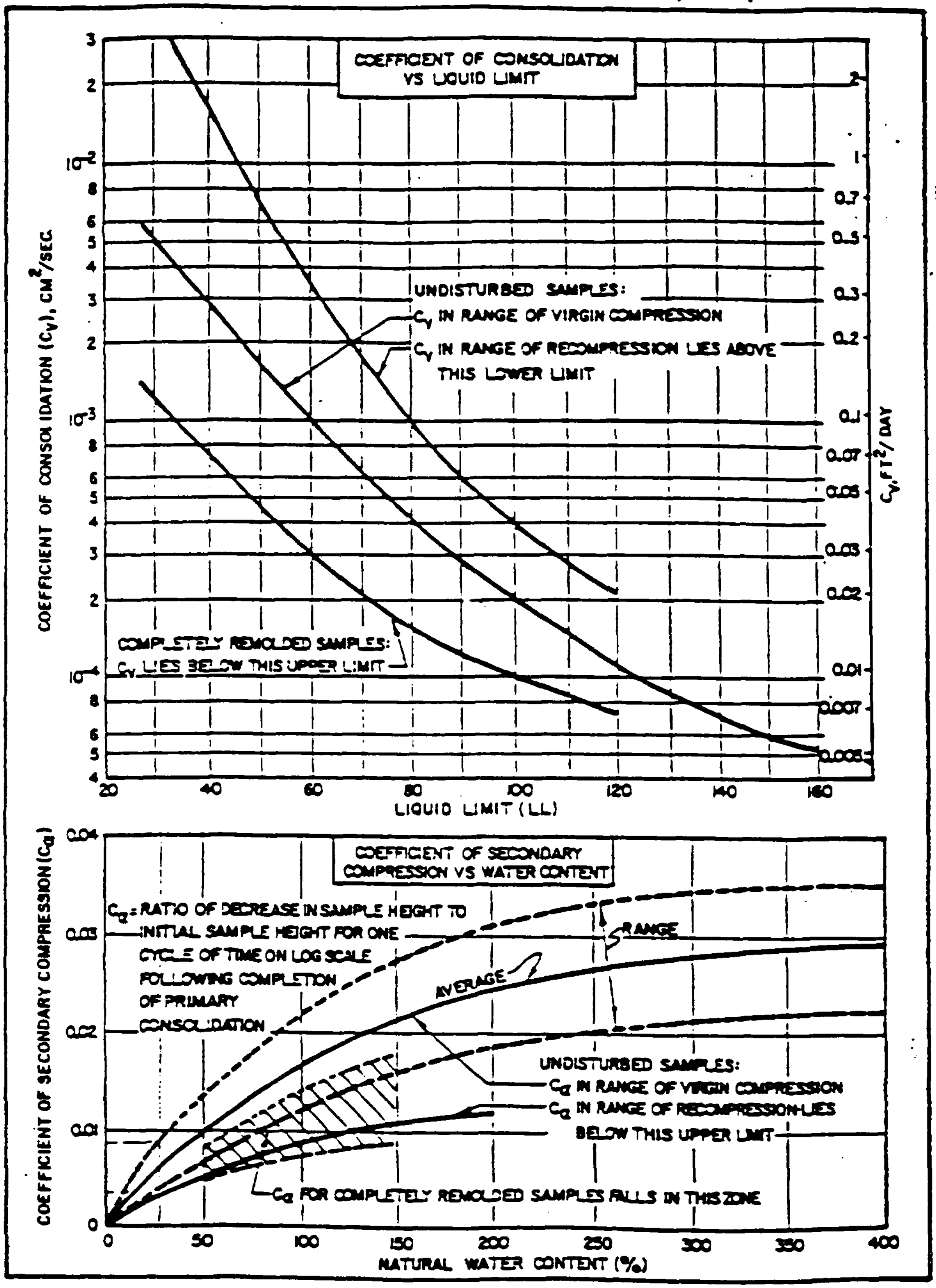


FIGURE 4
Approximate Correlations for Consolidation Characteristics
of Silts and Clays

Department of the Navy,
Soil Mechanics, Design Manual 7.1,
NAVFAC DM-7.1,
May 1982.

Appendix B

Pre- and Post-Development Flow Calculations

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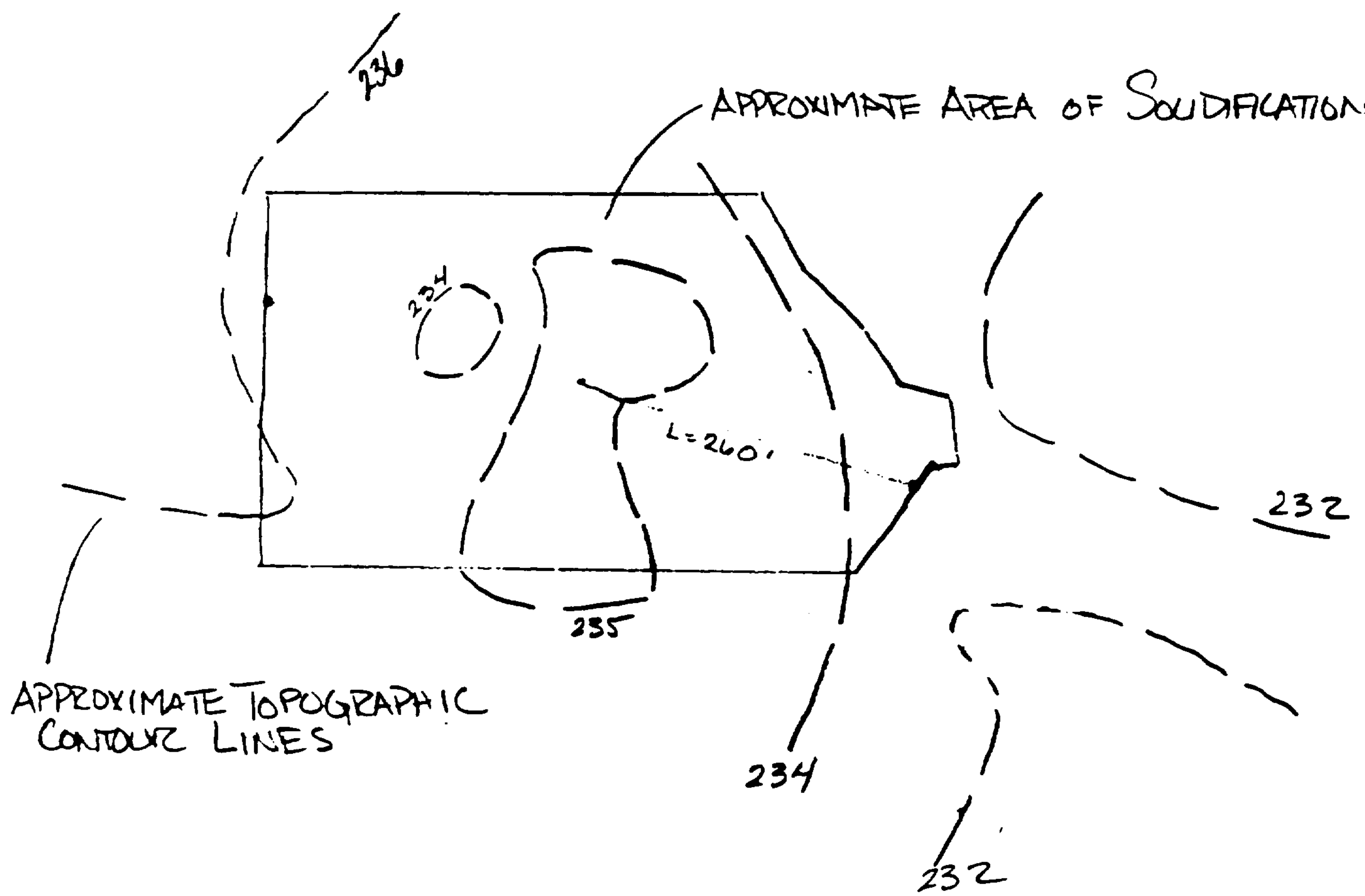
NEW VERNON ROAD

TO COMPUTE TIME OF CONCENTRATION, THE DISTANCE AND VELOCITY MUST BE KNOWN, USING THE UPLAND METHOD.

PRE CONSTRUCTION



AREA OF PROPOSED SOLIDIFICATION IS CURRENTLY STREWN WITH DEBRIS, ASSUME THAT RUNOFF VELOCITY WOULD CORRESPOND TO TRASH FALLOW ON FIGURE 15-2.

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BASED ON TOPOGRAPHIC MAP (KELLER & KIRKPATRICK) A DRAINAGE PATHWAY FROM CENTER OF SOLIDIFICATION TO EDGE OF SOLIDIFICATION WAS DETERMINED TO BE 260'

$$SLOPE = \frac{1.5'}{260'} \times 100 = 0.6\% = 1\%$$

FROM FIGURE 15.2

VELOCITY = 0.5 FT/SEC

$$T_t = \frac{l}{3600V}$$

T_t = TRAVEL TIME IN HOURS

l = HYDRAULIC LENGTH IN FEET

V = VELOCITY IN FEET PER SECOND

$$T_t = \frac{260'}{3600(0.5)} = 0.14 \text{ HR} = 8.6 \text{ MINS} = 9 \text{ MINS}$$

$T_c \leq T_t = 9.0$ MINS.

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MORRIS COUNTY SOIL CONSERVATION DISTRICT REQUESTED RUNOFF FLOWS FOR 2, 10, AND 25 YEAR STORM EVENTS

FROM RAINFALL INTENSITY vs DURATION OF STORM (FIGURE 7-3), T_C = 20 MINS

i_2 = RAINFALL INTENSITY FOR 2 YEAR STORM = 4.0 IN/HR

i_{10} = RAINFALL INTENSITY FOR 10 YEAR STORM = 5.5 IN/HR

i_{25} = RAINFALL INTENSITY FOR 25 YEAR STORM = 6.3 IN/HR

RATIONAL METHOD FOR COMPUTING RUNOFF

$$Q = CiA$$

Q = RUNOFF (CFS)

C = COEFFICIENT OF RUNOFF (UNITLESS)

i = RAINFALL INTENSITY (SEE ABOVE)

A = AREA (ACRES)

AREA TO BE SOLIDIFIED = 4.0 AC

C = FROM TABLE 6.4, VALUES RANGE FROM 0.05 - 0.3 FOR FARMLAND. ASSUME DUE TO DEBRIS FARMLAND IS IN POOR CONDITION = 0.05

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$Q_2 = 0.05 \times 4.0 \times 4.0 = 0.80$ CFS

$Q_{10} = 0.05 \times 5.5 \times 4.0 = 1.10$ CFS

$Q_{25} = 0.05 \times 6.3 \times 4.0 = 1.26$ CFS

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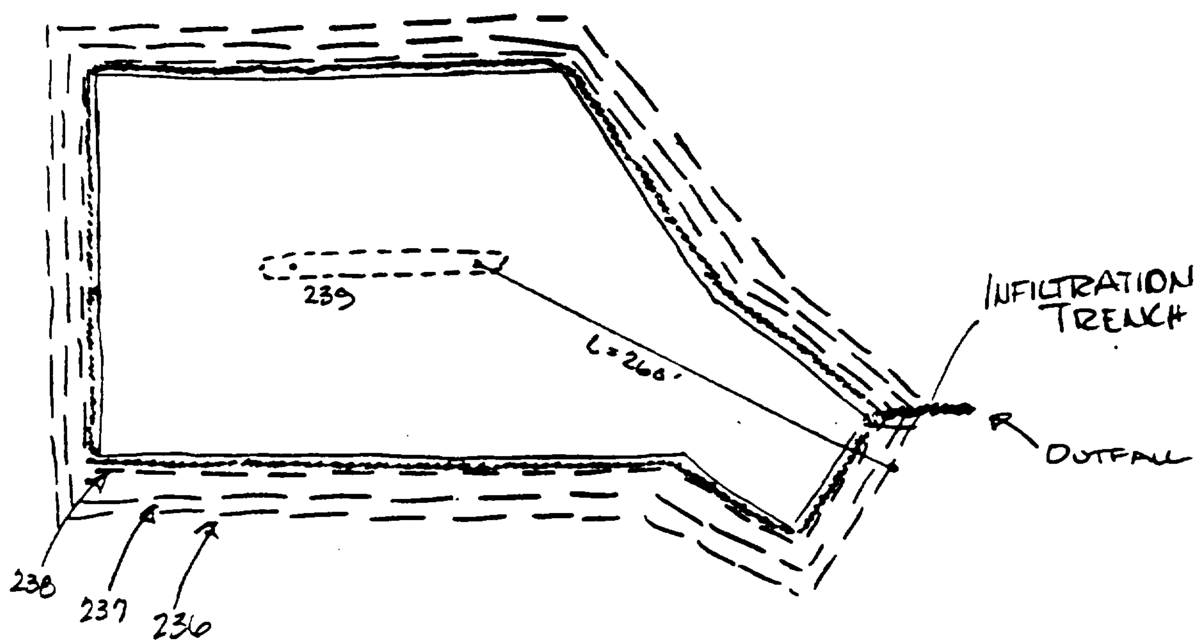
POST CONSTRUCTION

GRADING PLAN



FARTHEST OVERLAND DISTANCE RUNOFF WILL TRAVEL - FROM CENTER OF STABILIZED MASS TO EDGE OF MASS = 260'

AREA WILL BE CLASSIFIED AS A SHORT GRASS PASTURE @ 1% SLOPE

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FROM FIGURE 15-2

	VELOCITY
SHORT GRASS PASTURE @ 1% -	0.7 FT/SEC

$$T_t \text{ (PASTURE)} = \frac{260}{3600(0.7)} = 0.10 \text{ HR}$$

$$T_C = \Sigma T_t = 0.10 \text{ HR} = 6.2 \text{ MINS} = 6 \text{ MINS}$$

FROM FIG. 7-3, FOR T_C = 60 MINS

i_2 = 4.1 IN/HR

i_{10} = 6.0 IN/HR

i_{25} 7.5 IN/HR

C = ASSUME THAT NEW SOIL CAP PROMOTES DRAINAGE THROUGH GRADING AND VEGETATION, C = 0.15

Q_2 = 0.15 × 4.1 × 4.0 = 2.46 CFS

Q_{10} = 0.15 × 6.0 × 4.0 = 3.60 CFS

Q_{25} = 0.15 × 6.5 × 4.0 = 3.90 CFS

ADDITIONAL FLOW CAUSED BY REMEDIATION

2YR FLOW = 2.46 − 0.80 = 1.66 CFS

10YR FLOW = 3.60 − 1.10 = 2.50 CFS

25YR FLOW = 3.90 − 1.26 = 2.64 CFS

DESIGN STORM (REQUIRED BY SCS) DURATION IS ONE HOUR

25 YR 1 HOUR STORM = 2.64 CFS × 3600 $\frac{SEC}{HOUR}$ = 9500 CF/HOUR

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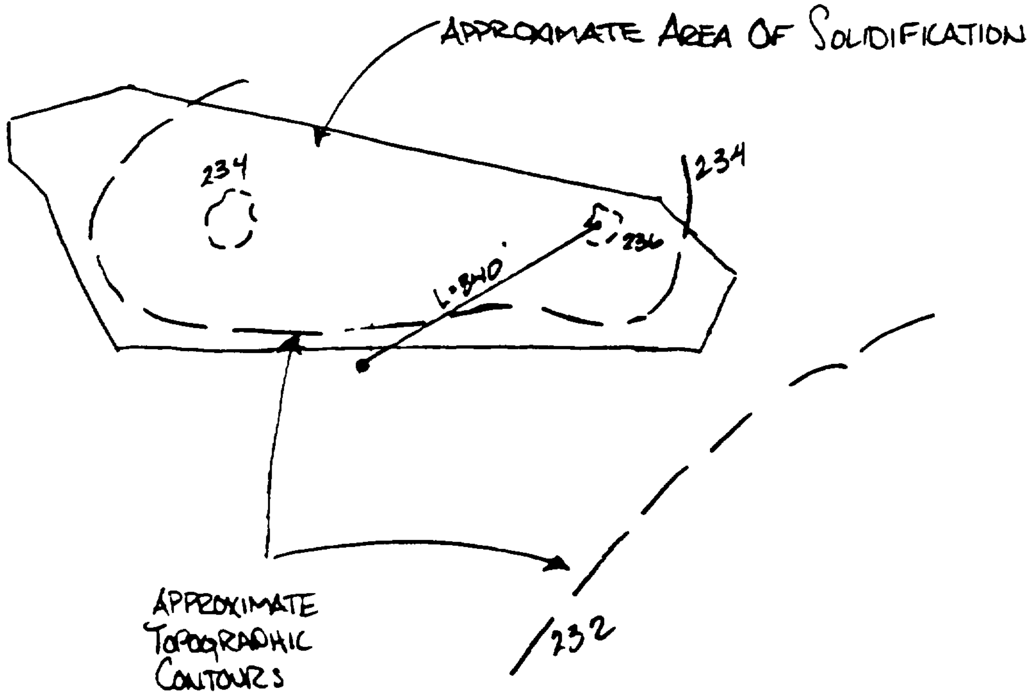
SUBJECT SCS DRAIN (PRE & POST)

WHITE BRIDGE ROAD

PRE CONSTRUCTION



AREA OF PROPOSED SOLIDIFICATION IS CURRENTLY A PASTURE, ASSUME DUE TO PRESENCE OF ASBESTOS TILES AND BARE GROUND THAT PASTURE IS IN POOR CONDITION. RUNOFF VELOCITY WOULD CORRESPOND TO SHORT GRASS PASTURE.

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CH'K. BY SL
PROJECT PASSAIC
DATE CH'K. 1/18/93
SUBJECT SCS DRAIN (PRE & POST)
B'K. CH'K. BY

LENGTH OF RUNOFF = 340'

$$\text{SLOPE} = \frac{3'}{340'} \times 100 = 0.88\,\% = 1\%$$

FIGURE 5-2

VELOCITY (SHORT GRASS @ 1%) = 0.7 FT/SEC - SINCE PASTURE IS IN POOR CONDITION ASSUME V = 0.6 FT/SEC

$$T_t = \frac{340}{3600\,(0.6)} = 0.16 \text{ HOURS} = 9.6 \text{ MINS} = 10 \text{ MINS}$$

$T_c = T_t = 10$ MINS

FROM FIGURE 7-3, AT $T_c = 10$ MINS

$i_2 = 3.9$ IN/HR

$i_{10} = 5.5$ IN/HR

$i_{25} = 6.3$ IN/HR

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PROJECT Passaic

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Q = CIA

C = TABLE 6.4, ASSUME PASTURE IS IN POOR CONDITION = 0.1

A = 2.3 AC

$Q_2 = 0.1 \times 3.9 \times 2.3 = 0.90$ CFS

$Q_{10} = 0.1 \times 5.5 \times 2.3 = 1.27$ CFS

$Q_{25} = 0.1 \times 6.3 \times 2.3 = 1.45$ CFS

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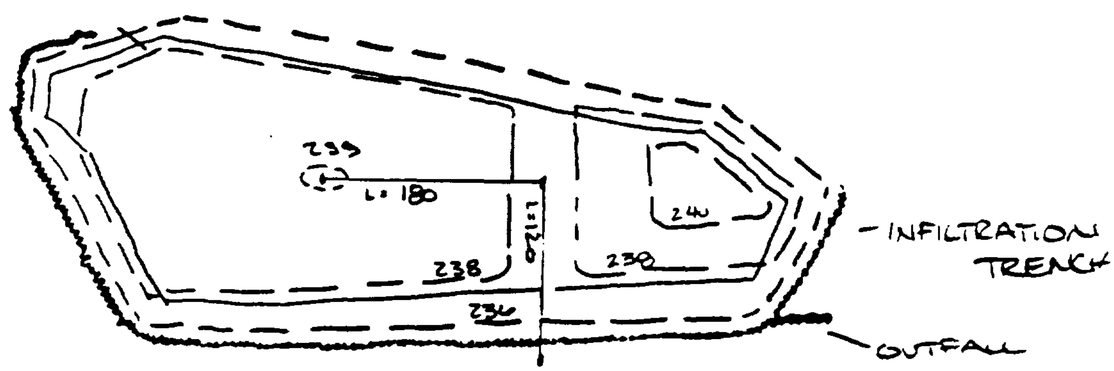
B'K. CH'K. BY

POST CONSTRUCTION

GRADING PLAN



AREA WILL BE CLASSIFIED AS A SHORT GRASS PASTURE @ 1% SLOPE

FARTHEST OVERLAND DISTANCE = 300'

FROM FIG 15-2

VELOCITY

SHORT GRASS @ 1% = 0.7 FT/SEC

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SUBJECT

DATE CH'K. 1/18/93

SCS DRAIN (PRE & POST)

B'K. CH'K. BY

$$T_t \text{ (PASTURE)} = \frac{300'}{3600(0.7)} = 0.12 \text{ HR} = 7.2 \text{ MIN}$$

$$T_c = \Sigma T_t = 7.2 \text{ MINS} = 7.0 \text{ MIN}$$

FROM FIGURE 7-3

$i_2 = 4.0$ IN/HR

$i_{10} = 5.7$ IN/HR

$i_{25} = 6.5$ IN/HR

$Q = CIA$

C = ASSUME SOIL CAP PROMOTES DRAINAGE = 0.15

$Q_2 = 0.15 \times 4.0 \times 2.3 = 1.38$ CFS

$Q_{10} = 0.15 \times 5.7 \times 2.3 = 1.97$ CFS

$Q_{25} = 0.15 \times 6.5 \times 2.3 = 2.24$ CFS

ADDITIONAL FLOWS CAUSED BY SOLIDIFICATION

2YR FLOW 1.38 × 0.90 = 0.48 CFS

10YR FLOW 1.97 × 1.27 = 0.70 CFS

25YR FLOW 2.24 × 1.45 = 0.79 CFS

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PROJECT Passaic
SUBJECT SCS DRAINAGE (PRE & POST)

BY TT
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DATE CH'K. 1/18/93
B'K. CH'K. BY

DESIGN STORM (REQUIRED BY SOIL CONSERVATION SERVICE)
DURATION IS ONE HOUR

25 YR 1 HOUR STORM $\quad 0.79\ \text{CFS} \times 3600\ \frac{\text{SEC}}{\text{HOUR}} = 2850\ \text{CF/HOUR}$

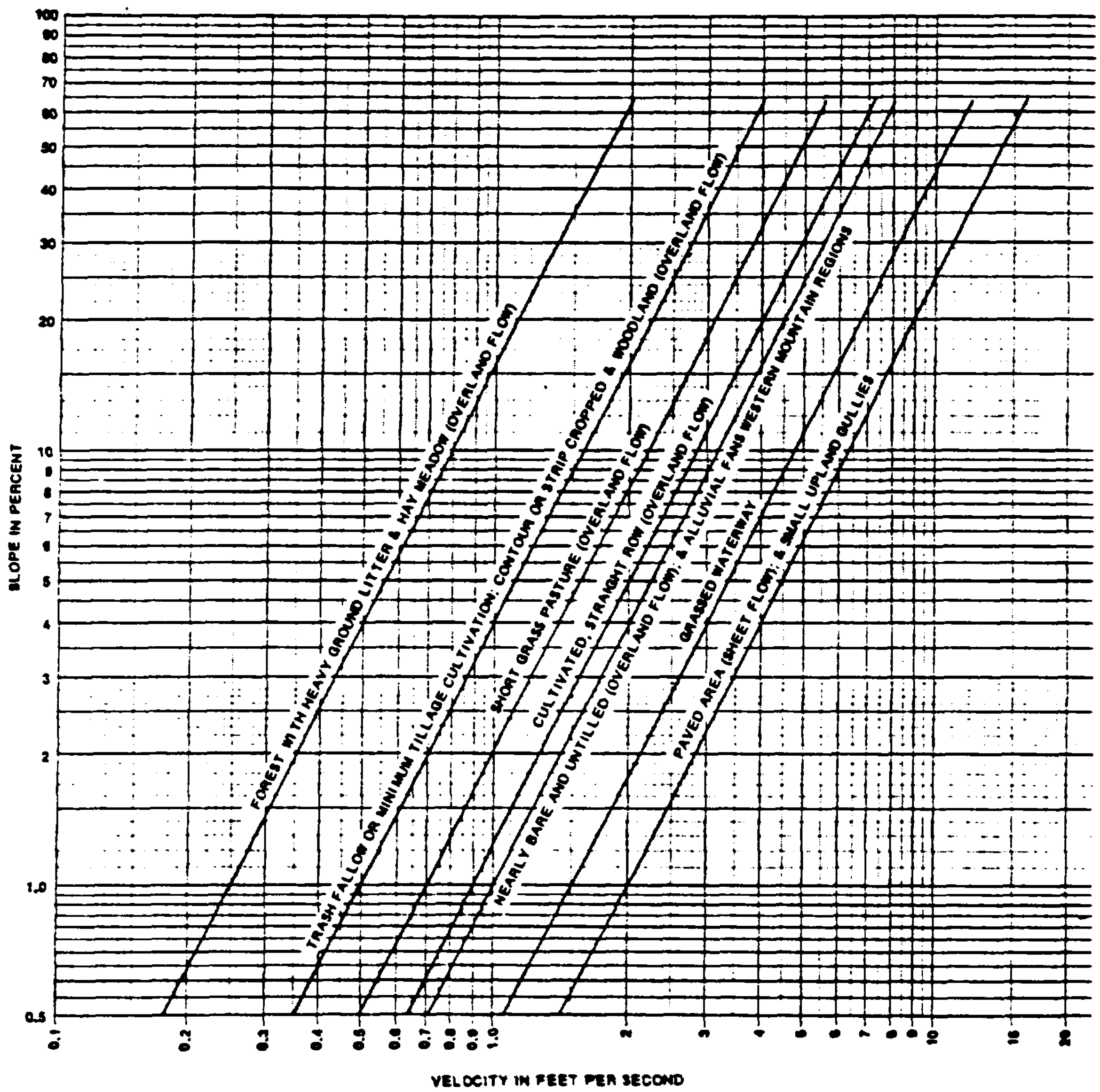

Figure 15.2.—Velocities for upland method of estimating T_c

Table 6.4

Rational Method Runoff Coefficients

Categorized by Surface	
Forested	.05 - .2
Asphalt	.7 - .95
Brick	.7 - .85
Concrete	.8 - .95
Shingle roof	.75 - .95
Lawns, well drained (sandy soil)	
Up to 2% slope	.05 - .1
2% to 7% slope	.10 - .15
Over 7% slope	.15 - .2
Lawns, poor drainage (clay soil)	
Up to 2% slope	.13 - .17
2% to 7% slope	.18 - .22
Over 7% slope	.25 - .35
Driveways, walkways	.75 - .85
Categorized by Use	
Farmland	.05 - .3
Pasture	.05 - .3
Unimproved	.1 - .3
Parks	.1 - .25
Cemetaries	.1 - .25
Railroad yard	.2 - .40
Playgrounds (except asphalt or concrete)	.2 - .35
Business districts	
neighborhood	.5 - .7
city (downtown)	.7 - .95
Residential	
single family	.3 - .5
multi-plexes, detached	.4 - .6
multi-plexes, attached	.6 - .75
suburban	.25 - .4
apartments, condominiums	.5 - .7
Industrial	
light	.5 - .8
heavy	.6 - .9

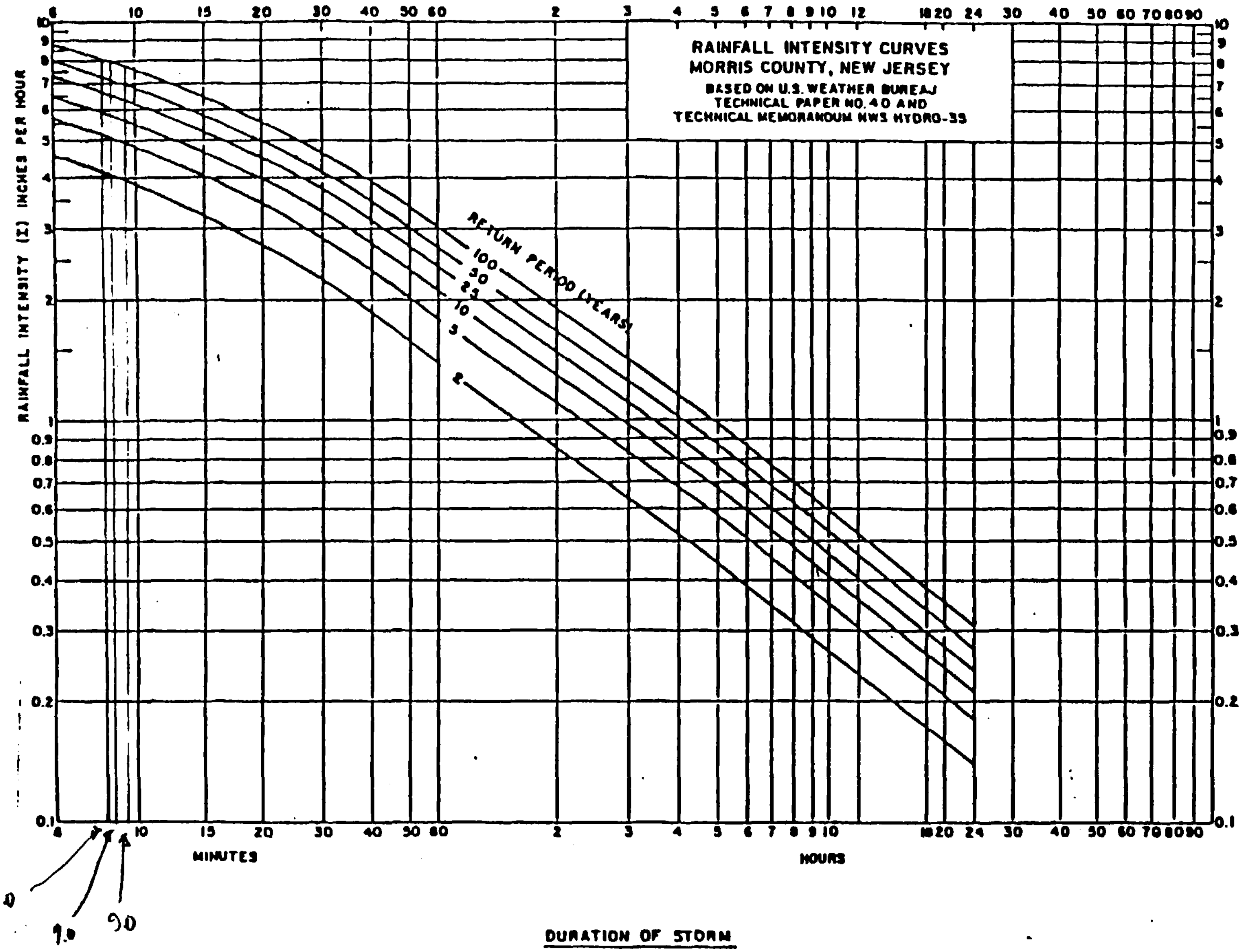

Figure 7-3 Rainfall Intensity Curves for Morris County

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JOB NO. 1635.337 0 2PZZ 0
PROJECT PASSAIC
SUBJECT PRE & POST DEVELOPMENT FLOWS

NEW JERSEY STORM WATER LAWS REQUIRE A 2YR, 10YR, AND 100YR 24 HOUR DESIGN STORM FOR RUNOFF CALCULATIONS.

PRE-DEVELOPMENT WHITE BRIDGE ROAD

RATIONAL METHOD $Q = CiA$

Q = RUNOFF (CFS)

C = COEFFICIENT OF RUNOFF, USUALLY OBTAINED FROM REFERENCE MATERIAL (UNITLESS)

i = RAINFALL INTENSITY, OBTAINED FROM RAINFALL INTENSITY CURVE FOR MORRIS COUNTY, SEE FIGURE 7-3 (IN/HR)

A = AREA (AC)

A = 2.3 AC (AREA TO BE SOLIDIFIED, SEE DRAWINGS IN REPORT)

C = FROM TABLE 6.4, VALUES RANGE FROM 0.05 - .3 FOR LEVEL PASTURE. ASSUME, DUE TO PRESENCE OF ASBESTOS TILES AND BARE GROUND, THAT PASTURE IS IN POOR CONDITION = 0.1

i = FROM F[illegible] -3

i_2 = .15 [illegible]/HR

i_{10} = .22 IN/HR

i_{100} = .31 IN/HR

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CH'K BY MGL

SUBJECT

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PRE & POST FLOWS

B'K CH'K BY DDB

$Q_{2_{PR}} = .1 \times .15 \times 2.3 = .03$ CFS

$Q_{10_{PR}} = .1 \times .22 \times 2.3 = .05$ CFS

$Q_{100_{PR}} = .1 \times .31 \times 2.3 = .07$ CFS

POST DEVELOPMENT WHITE BRIDGE ROAD

A = 2.3 AC

C = VEGATATED SOIL CAP WILL BE PLACED OVER SOLIDIFIED AREA. DUE TO THE PRESENCE OF RIDING TRACK AND GRADING, ASSUME COEFFICIENT OF RUNOFF OF 0.15

i = SEE PREVIOUS PAGE

$Q_{2_{PO}} = .15 \times .15 \times 2.3 = .05$ CFS

$Q_{10_{PO}} = .15 \times .22 \times 2.3 = .08$ CFS

$Q_{100_{PO}} = .15 \times .31 \times 2.3 = .11$ CFS

ADDITIONAL RUNOFF CAUSED BY REMDIATION

$Q_{100_{PO}} - Q_{100_{PR}} = .11 - .07 = .04$ CFS

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CH'K. BY MFC

PROJECT PASSAIC

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SUBJECT PRE & POST FLOWS

B'K. CH'K. BY DAB

PRE-DEVELOPMENT NEW VERNON ROAD

A = 4.0 AC (AREA TO BE SOLIDIFIED, SEE DRAWINGS IN REPORT)

C = ASSUMED FARMLAND IS IN POOR CONDITION. AREA HAS DEBRIS (TREES, STONES, MULCH, ETC...) = .05

i_2 = .15 IN/HR
i_{10} = .22 IN/HR
i_{100} = .31 IN/HR

$Q_{2_{PR}}$ = .05 × .15 × 4.0 = .03 CFS

$Q_{10_{PR}}$ = .05 × .22 × 4.0 = .04 CFS

$Q_{100_{PR}}$ = .05 × .31 × 4.0 = .06 CFS

POST-DEVELOPMENT NEW VERNON ROAD

A = 4.0 AC

C = ASSUME THAT NEW SOIL CAP PROMOTES DRAINAGE THROUGH GRADING AND VEGATATION, ASSUME C = .15

i = REMAINS CONSTANT

$Q_{2_{PO}}$ = .15 × .15 × 4.0 = .09 CFS

$Q_{10_{PO}}$ = .15 × .22 × 4.0 = .13 CFS

$Q_{100_{PO}}$ = .15 × .31 × 4.0 = .19 CFS

ABD 002 1450

ADDITIONAL RUNOFF CAUSED BY REMEDIATION

$Q_{100_{PO}} - Q_{100_{PR}}$ = .19 - .06 = $\boxed{.13 \text{ CFS}}$

Table 6.4

Rational Method Runoff Coefficients

Categorized by Surface

Forested	.05 - .2
Asphalt	.7 - .95
Brick	.7 - .85
Concrete	.8 - .95
Shingle roof	.75 - .95
Lawns, well drained (sandy soil)	
Up to 2% slope	.05 - .1
2% to 7% slope	.10 - .15
Over 7% slope	.15 - .2
Lawns, poor drainage (clay soil)	
Up to 2% slope	.13 - .17
2% to 7% slope	.18 - .22
Over 7% slope	.25 - .35
Driveways, walkways	.75 - .85

Categorized by Use

Farmland	.05 - .3
Pasture	.05 - .3
Unimproved	.1 - .3
Parks	.1 - .25
Cemetaries	.1 - .25
Railroad yard	.2 - .40
Playgrounds (except asphalt or concrete)	.2 - .35
Business districts	
neighborhood	.5 - .7
city (downtown)	.7 - .95
Residential	
single family	.3 - .5
multi-plexes, detached	.4 - .6
multi-plexes, attached	.6 - .75
suburban	.25 - .4
apartments, condominiums	.5 - .7
Industrial	
light	.5 - .8
heavy	.6 - .9

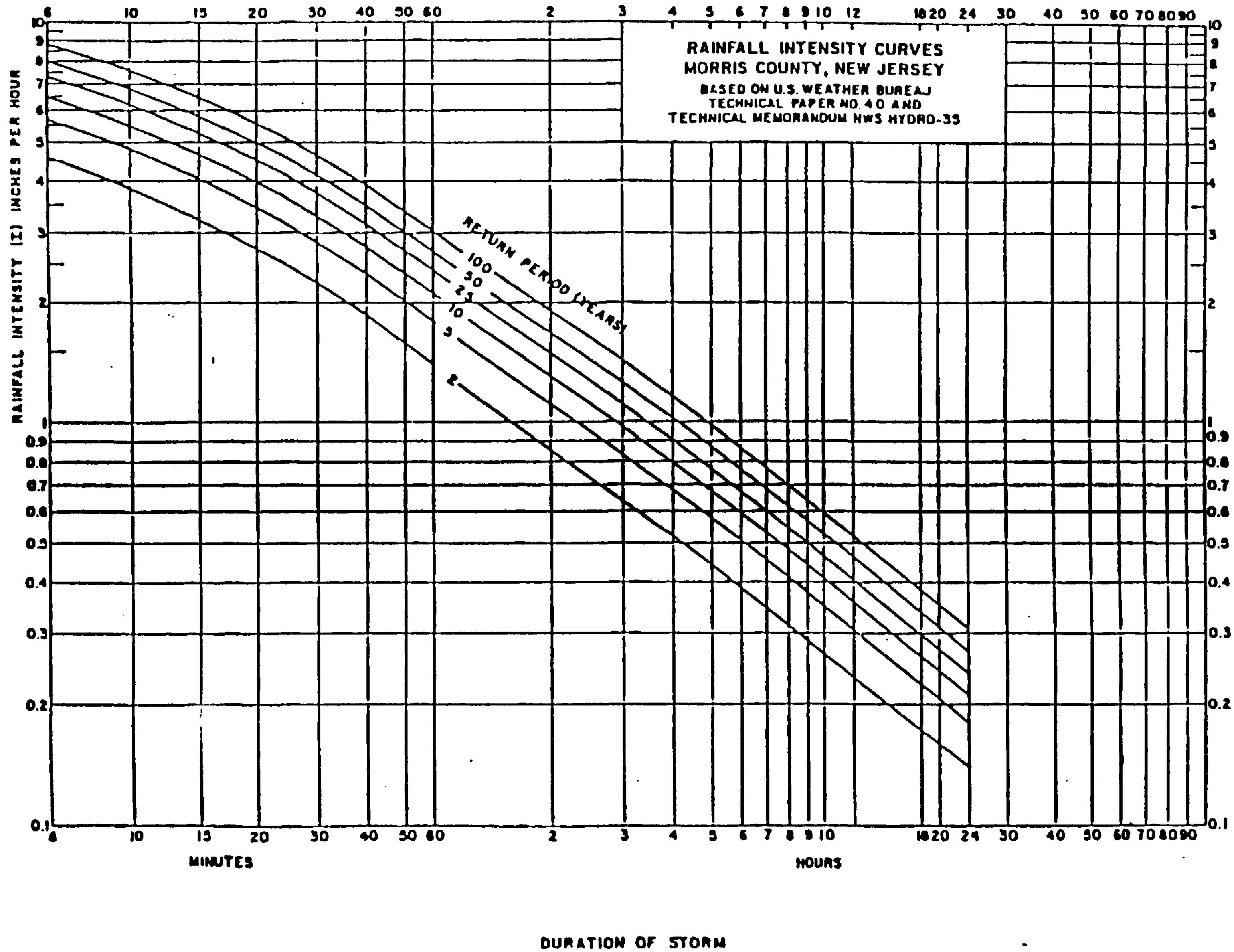

Figure 7-3 Rainfall Intensity Curves for Morris County

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Appendix C

Perimeter Infiltration Trench Calculations

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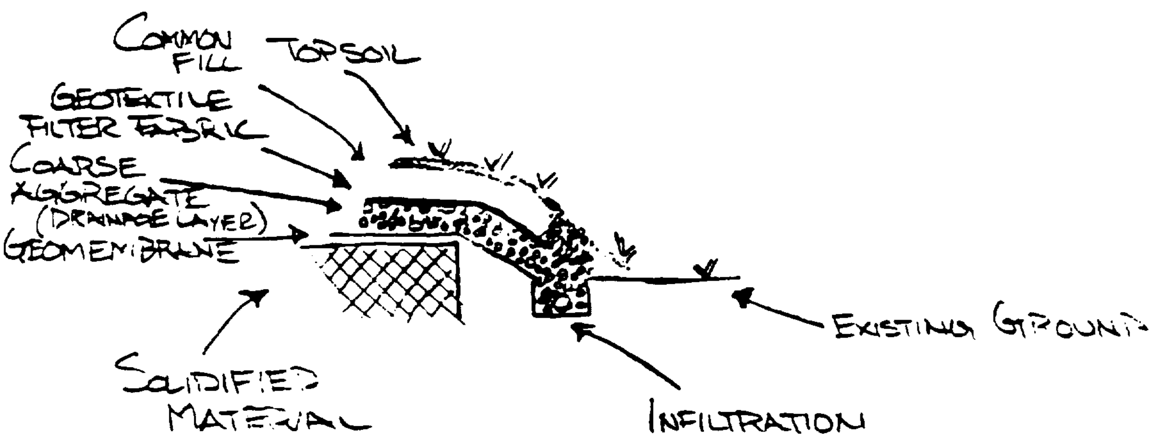
PROJECT Passaic
SUBJECT
Trench Sizing

THE PROPOSED CAP OVER THE SOLIDIFIED MATERIAL WILL CONTAIN A LATERAL DRAINAGE LAYER. WATER REACHING THIS LAYER WILL BE TRANSFERED BY GRAVITY TO AN INFILTRATION TRENCH LOCATED ALONG SEVERAL SIDES OF THE SOLIDIFIED MASS.



APPROX. TRENCH DETAIL

TO ACCURATELY SIZE THE TRENCH, THE HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP) MODEL WAS USED TO ACCOUNT FOR CAP DRAINAGE IN CONJUNCTION WITH PRE & POST DEVELOPMENT FLOW DIFFERENCES.

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JOB NO. 1635 337 0 2PZZ0
PROJECT PASSAIC
SUBJECT TRENCH SIZING

WHITE BRIDGE ROAD

FROM PRE & POST CALC'S, AN ADDITIONAL 0.04 CFS (3450 FT³/DAY) OF POST DEVELOPMENT FLOW MUST BE ACCOMODATED.

THE HELP MODEL SYNTHETICALLY GENERATES RAINFALL DATA OVER A 20 YR PERIOD (20 YRS IS THE MAXIMUM INPUT FOR THE PROGRAM).

AVE. PEAK DAILY RAINFALL FOR A 20 YEAR ~~STORM~~ PERIOD HAS APPROXIMATELY 31981 FT³ OF TOTAL RAINFALL.

1369 FT³ OF TOTAL RAINFALL WILL EXIST AS "LATERAL DRAINAGE FROM LAYER 3" (SEE PEAK DAILY VALUES FOR YEARS 1 THROUGH 20)

$$\frac{1369 \text{ FT}^3}{31981 \text{ FT}^3} \times 100 = 4.3\%$$

≅ 4.3% OF RAINFALL WILL DRAIN THROUGH THE DRAINAGE LAYER INTO TRENCH. THE REMAINING 96% WILL RESULT AS RUNOFF, EVAPOTRANSPIRATION, OR WILL BE STORED BY SOIL.

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PROJECT PASSAIC
SUBJECT TRENCH SIZING

FROM PRE & POST CALC'S FIGURE 7-3, RAINFALL INTENSITY FOR A 100 YR, 24 HOUR DURATION STORM IS:

$$i = .31\frac{IN}{HR} \times \frac{1HR}{3600SEC} \times \frac{1FT}{12IN} = 7.2\times10^{-6}\frac{FT}{SEC}$$

AREA TO BE SOLIDIFIED = 2.3 AC (SEE REPORT)

$$2.3AC \times 43560\frac{FT^2}{AC} = 100200\ FT^2$$

VOLUME OF RAINFALL FALLING ON AREA OVER TIME

$$q_t = iA = (7.2\times10^{-6})(100200\ FT^2) = 0.7\ CFS$$

$$0.7\ CFS \times 4.3\% = 0.03\ CFS$$

AMOUNT OF WATER ENTERING TRENCH IN 24 HOURS

$$0.03\frac{FT^3}{SEC} \times \frac{86400\ SEC}{DAY} = 2600\ \frac{FT^3}{DAY}$$

TO DETERMINE THE AMOUNT OF WATER EXITING TRENCH THROUGH INFILTRATION

$$Q = KiA$$

K = INFILTRATION RATE (0.06 FT/DAY, TABLE 1, WB-OW-01)

i = HYDRAULIC GRADIENT

$$= \frac{HEAD(FT) + THK.\ BARRIER\ LAYER\ (FT)}{THK.\ BARRIER\ LAYER\ (FT)} = \frac{3+0.5}{0.5} = 7\frac{FT}{FT}$$

BARRIER LAYER = UNSATURATED ZONE BETWEEN BOTTOM OF TRENCH AND WATER TABLE. = 0.5'

HEAD = MAXIMUM HEIGHT OF WATER ACHIEVED IN TRENCH
= 3.0' (WHEN TRENCH IS FULL, WORST CASE)

A = AREA WHERE INFILTRATION WILL TAKE PLACE (BOTTOM OF TRENCH) = 4200 FT^2

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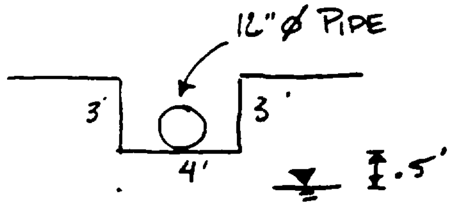
PROJECT PASSAIC

SUBJECT TRENCH SIZING

ASSUME TRENCH IS 1050' x 4' x 3'



AREA: 4' x 1050' = 4200 FT^2

ASSUMING A FULL TRENCH (WORST CASE), A ~~10500~~ 4200 FT^2 AREA EXISTS WHERE INFILTRATION WILL TAKE PLACE.

WATER LOST TO INFILTRATION = $Q = kiA = (0.06)(7)(4200) = 1765\ FT^3/DAY$

ADDITIONAL FLOW CAUSED BY DEVELOPMENT:

100 YR 24 HOUR STORM = 0.04 CFS x 86400 SEC/DAY = 3450 FT^3/DAY

25 YR 1 HOUR STORM = 0.79 CFS x 3600 SEC/HOUR = 2850 FT^3/HOUR

3450 FT^3 > 2850 FT^3 ∴ USE 3450 FT^3

VOLUME WATER NEEDING STORAGE:

PRE & POST CALC'S	3450 FT^3/DAY
DRAINAGE LAYER	2600 FT^3/DAY
INFILTRATION LOSS	− 1765 FT^3/DAY
	4285 FT^3

TRENCH VOLUME = 1050 FT x 4 FT x 3 FT = 12600 FT^3

VOLUME OF PIPE = $\frac{\pi (1)^2}{4}(1050) = 825\ FT^3$

VOLUME OF STONE IN TRENCH = 12600 FT^3 − 825 FT^3 = 11800 FT^3

ASSUME POROSITY OF STONE IS 33% (TABLE 4-2)

.33 x 11800 = 3900 FT^3

TRENCH'S TOTAL CAPACITY = 3900 FT^3 + 825 FT^3 = 4725 FT^3

4725 FT^3 > 4285 FT^3 OK

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JOB NO. 1 635 357 0 2P270
PROJECT Passaic
SUBJECT Trench Sizing

NEW VERNON ROAD

USING SIMILIAR PROCEDURE FOR NEW VERNON ROAD:

FROM HELP MODEL

PEAK DAILY VALUES

PRECIPITATION - 59241 FT^3

DRAINAGE FROM LAYER 3 - 2587 FT^3

$$\frac{2587 \text{ FT}^3}{59241 \text{ FT}^3} \times 100 = 4.3\%$$

$\cong$ 4.3% OF RAINFALL WILL DRAIN THROUGH DRAINAGE LAYER INTO TRENCH. THE REMAINING ~~93~~ 96% WILL WILL RESULT IN RUNOFF, EVAPOTRANSPIRATION, OR HELD BY THE SOIL.

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DATE CH'K. 1/5/97

SUBJECT TRENCH SIZING

B'K. CH'K. BY

FROM PRE & POST CALC'S FIGURE 7-3, RAINFALL INTENSITY FOR A 100 YR, 24 HOUR STORM IS:

$$i = .31 \frac{IN}{HR} \times \frac{1FT}{12IN} = .03\ FT/HR$$

AREA TO BE SOLIDIFIED = 4.0 AC (SEE REPORT)

$$4.0AC \times 43560 \frac{FT^2}{AC} = 174,240\ FT^2$$

VOLUME OF RAINFALL FALLING ON AREA OVER TIME

$$Q/t = iA = \left(.03 \frac{FT}{HR}\right)\left(174.240\ FT^2\right) = 5250 \frac{FT^3}{HR}$$

$$5250 \frac{FT^3}{HR} \times 4.3\% = 225 \frac{FT^3}{HR}$$

AMOUNT OF WATER ENTERING TRENCH IN 24 HOURS

$$225 \frac{FT^3}{HR} \times \frac{24\ HR}{DAY} = 5420 \frac{FT^3}{DAY}$$

TO DETERMINE AMOUNT OF WATER EXITING TRENCH THROUGH INFILTRATION

$Q = K i A$

K - INFILTRATION RATE ($0.18 \frac{FT}{DAY}$, TABLE 1, MW-NR2)

i = HYDRAULIC GRADIENT

$$= \frac{HEAD + THICK.\ BAR.\ LAYER}{THICK.\ BAR.\ LAYER} = \frac{3+1.0}{1.0} = 4$$

A = AREA OF BOTTOM OF TRENCH

= 9500 FT² (SEE NXT PG)

ASSUME TRENCH IS 1900' × 5' × 3'

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SUBJECT

DATE CH'K. 1/5/93

TRENCH SIZING

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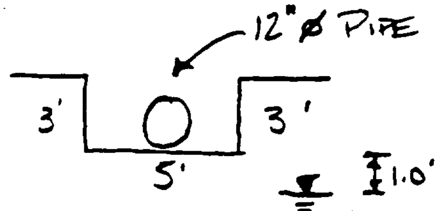

AREA OF TRENCH: 5' × 1900' = 9500'

ASSUMING A FULL TRENCH (WORST CASE), A 20 900 FT^2 AREA EXISTS WHERE INFILTRATION WILL TAKE PLACE

WATER LOST TO INFILTRATION = $Q = kiA = (0.18)(4)(9500) = 6850$ FT^3/DAY

ADDITIONAL FLOW CAUSED BY DEVELOPMENT:

100 YR 24 HOUR STORM = 0.13 CFS × 86400 SEC/DAY = 11,250 CF/DAY

25 YR 1 HOUR STORM = 2.64 CFS × 3600 SEC/HR = 9504 CF/HOUR

11 250 CF >> 9504 CF ∴ USE 11,250 CF FOR POST-DEV. FLOW.

VOLUME OF WATER NEEDING STORAGE:

PRE & POST CALC'S	11 250 FT^3/DAY
DRAINAGE LAYER	5420 FT^3/DAY
INFILTRATION LOSS	−6850 FT^3/DAY
	9820 FT^3/DAY

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SUBJECT
DATE CH'K. 1/93
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B'K. CH'K. BY

TRENCH VOLUME = 1900 FT × 5 FT × 3 FT = 28500 FT^3

VOLUME OF PIPE = $\frac{\pi (1)^2}{4}$ (1900) = 1500 FT^2

VOLUME OF STONE IN TRENCH = 28500 − 1500 = 27000 FT^3

ASSUME POROSITY OF STONE FILL IS 33% (TABLE 4-2)

.33 × 27000 = 8910 FT^3

8910 FT^3 + 1500 FT^3 = 10410

10410 FT^3 > 9820 FT^3 OK

TABLE 1:	PASSAIC NEW JERSEY ASBESTOS DUMP SITES SLUG TEST HYDRAULIC CONDUCTIVITY RESULTS SUMMARY						
Well # TEST TYPE	NV-OW-01 RISING HEAD	WB-OW-01 FALLING HD.	WB-OW-01 RISING HEAD	MW-WBR3 RISING HEAD	WB-OW-02 FALLING HD.	MW-NVR2 RISING HEAD	MW-NVR1 RISING HEAD
SOIL TYPE	F. SAND & SILT	SANDY SILT	SANDY SILT	SILTY SAND	CLAYEY SILT	SANDY CLAY	SANDY PEAT
BOUWER & RICE (FT/MIN)	4.86E-04	1.64E-04	3.21E-05	3.00E-05	1.76E-06	1.04E-04	8.92E-04
HVORSLEV VARIABLE HEAD (FT/MIN)	[illegible].97E-04	2.29E-04	5.31E-05	3.85E-05	2.64E-06	1.42E-04	1.07E-03
COOPER ET. AL. (FT/MIN)	NA	NA	NA	NA	8.64E-07	NA	NA
AVERAGE K (FT/MIN)	4.41E-04	1.97E-04	4.26E-05	3.42E-05	1.75E-06	1.23E-04	9.81E-04
AVERAGE K (FT/D)	6.36E-01	2.83E-01	6.13E-02	4.93E-02	2.53E-03	1.77E-01	1.41E+00
AVERAGE K (CM/S)	2.24E-04	9.99E-05	2.17E-05	1.74E-05	8.92E-07	6.25E-05	4.99E-04

9 of 16

OCTOBER 7, 1992 MEMORANDUM TO C. LESZKIEWCZ FROM A. KOENIGSBERG

NEW JERSEY ASBESTOS SITES

HYDRAULIC CONDUCTIVITY ANALYSIS

TABLE 4.2 Typical Index Properties for Granular Soils*

	Particle Size and Gradation				Voids			
	Approx. Size		Approx.	Approx. Range	Void Ratio		Porosity (%)	
	Range (mm) D_{max}	(mm) D_{min}	D_{10} (mm)	C_u	e_{max} (loose)	e_{min} (dense)	n_{max} (loose)	n_{min} (dense)
1. Uniform materials:								
(a) Equal spheres		...	—	1.0	0.92	0.35	48	26
(b) Standard Ottawa sand	0.84	0.59	0.67	1.1	0.80	0.50	44	33
(c) Clean, uniform sand (fine or medium)	—	-	—	1.2 to 2.0	1.0	0.40	50	29
(d) Uniform, inorganic silt	0.05	0.005	0.012	1.2 to 2.0	1.1	0.40	52	29
2. Well graded materials:								
(a) Silty sand	2.0	0.005	0.02	5 to 10	0.90	0.30	47	23
(b) Clean, fine to coarse sand	2.0	0.05	0.09	4 to 6	0.95	0.20	49	17
(c) Micaceous sand	...	.	...	—	1.2	0.40	55	29
(d) Silty sand and gravel	100	0.005	0.02	15 to 300	0.85	0.14	46	12

*Modified after B. K. Hough (1969), *Basic Soils Engineering*, © 1969 by the Ronald Press, Co. Reprinted by permission of John Wiley & Sons, Inc.

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WHITE BRIDGE ROAD
PASSAIC REMEDIAL DESIGN
DECEMBER 29,1992

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.4000 VOL/VOL
FIELD CAPACITY = 0.2837 VOL/VOL
WILTING POINT = 0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.2837 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000570000033 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS = 24.00 INCHES
POROSITY = 0.3500 VOL/VOL
FIELD CAPACITY = 0.1924 VOL/VOL
WILTING POINT = 0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1924 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000411243353 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.7500 VOL/VOL
FIELD CAPACITY = 0.0454 VOL/VOL
WILTING POINT = 0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.156000003219 CM/SEC
SLOPE = 1.00 PERCENT
DRAINAGE LENGTH = 200.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 0.06 INCHES
POROSITY = 0.4000 VOL/VOL
FIELD CAPACITY = 0.3560 VOL/VOL
WILTING POINT = 0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000010000 CM/SEC
LINER LEAKAGE FRACTION = 0.00010000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 81.48
TOTAL AREA OF COVER = 100200. SQ FT
EVAPORATIVE ZONE DEPTH = 20.00 INCHES
UPPER LIMIT VEG. STORAGE = 7.3000 INCHES
INITIAL VEG. STORAGE = 4.0286 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 6.6162 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

EVAPOTRANSPIRATION

TOTALS 1.016 1.500 2.858 3.412 3.460 2.890
3.325 3.569 2.859 2.105 1.474 1.032

STD. DEVIATIONS 0.239 0.236 0.242 0.915 1.124 1.346
1.562 1.765 1.156 0.682 0.187 0.138

LATERAL DRAINAGE FROM LAYER 3

TOTALS 1.6349 1.3136 1.4721 1.2770 0.8945 0.4833
0.2528 0.1230 0.1625 0.4224 0.6750 1.1596

STD. DEVIATIONS 0.7859 0.7405 0.7979 0.7337 0.4473 0.2295
0.1427 0.1019 0.2730 0.4348 0.4834 0.8244

PERCOLATION FROM LAYER 4

TOTALS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

STD. DEVIATIONS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.79 (5.385)	332238.	100.00
RUNOFF	0.460 (0.334)	3844.	1.16
EVAPOTRANSPIRATION	29.501 (3.741)	246331.	74.14
LATERAL DRAINAGE FROM LAYER 3	9.8708 (2.7831)	82421.	24.81
PERCOLATION FROM LAYER 4	0.0003 (0.0001)	2.	0.00
CHANGE IN WATER STORAGE	-0.043 (2.034)	-360.	-0.11

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR NEWARK NEW JERSEY

MAXIMUM LEAF AREA INDEX = 3.30
START OF GROWING SEASON (JULIAN DATE) = 123
END OF GROWING SEASON (JULIAN DATE) = 290

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.23	2.50	4.16	3.81	3.13	2.84
	3.40	4.04	3.75	3.38	2.90	3.64
STD. DEVIATIONS	1.24	1.20	1.93	1.72	1.41	1.37
	1.77	2.61	2.02	1.37	1.31	1.32
RUNOFF						
TOTALS	0.009	0.003	0.069	0.027	0.021	0.022
	0.037	0.065	0.075	0.068	0.017	0.049
STD. DEVIATIONS	0.025	0.009	0.135	0.076	0.061	0.085
	0.074	0.131	0.127	0.215	0.034	0.063

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.83	31980.5
RUNOFF	0.960	8013.8
LATERAL DRAINAGE FROM LAYER 3	0.1640	1369.6
PERCOLATION FROM LAYER 4	0.0000	0.1
HEAD ON LAYER 4	11.0	
SNOW WATER	2.28	19015.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3048

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1132

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.18	0.1959
2	5.43	0.2264
3	2.71	0.4523
4	0.02	0.4000

SNOW WATER 0.00

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NEW VERN0N ROAD
PASSAIC REMEDIAL DESIGN
DECEMBER 29, 1992

****
****

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.2837 VOL/VOL
WILTING POINT	=	0.1353 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2837 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000570000033 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.3500 VOL/VOL
FIELD CAPACITY	=	0.1924 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1924 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000411243353 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS = 6.00 INCHES
POROSITY = 0.7500 VOL/VOL
FIELD CAPACITY = 0.0454 VOL/VOL
WILTING POINT = 0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.156000003219 CM/SEC
SLOPE = 1.00 PERCENT
DRAINAGE LENGTH = 200.0 FEET

LAYER 4

BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS = 0.06 INCHES
POROSITY = 0.4000 VOL/VOL
FIELD CAPACITY = 0.3560 VOL/VOL
WILTING POINT = 0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000010000 CM/SEC
LINER LEAKAGE FRACTION = 0.00010000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 81.48
TOTAL AREA OF COVER = 174240. SQ FT
EVAPORATIVE ZONE DEPTH = 20.00 INCHES
UPPER LIMIT VEG. STORAGE = 7.3000 INCHES
INITIAL VEG. STORAGE = 4.5727 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 6.6162 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

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NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.85	2.38	3.98	3.56	3.45	2.51
	3.91	4.02	3.12	3.37	3.10	3.60
STD. DEVIATIONS	1.22	1.07	1.08	1.54	1.42	1.01
	2.09	2.10	1.57	1.67	1.24	1.81
RUNOFF						
TOTALS	0.031	0.013	0.032	0.021	0.050	0.006
	0.082	0.080	0.068	0.078	0.035	0.042
STD. DEVIATIONS	0.069	0.029	0.052	0.043	0.137	0.015
	0.292	0.136	0.095	0.151	0.062	0.069

EVAPOTRANSPIRATION

TOTALS	0.961	1.529	2.846	3.465	3.699	2.751
	3.542	3.519	2.885	1.864	1.442	1.053
STD. DEVIATIONS	0.230	0.229	0.339	0.985	1.219	0.946
	1.572	1.871	1.256	0.663	0.269	0.152

LATERAL DRAINAGE FROM LAYER 3

TOTALS	1.5678	1.6565	1.4960	1.1604	0.8262	0.4428
	0.2262	0.1337	0.1692	0.2333	0.6077	1.2434
STD. DEVIATIONS	1.0148	0.8955	0.6244	0.4960	0.4216	0.2758
	0.2277	0.2517	0.2877	0.2558	0.6134	0.9614

PERCOLATION FROM LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.84 (4.723)	578411.	100.00
RUNOFF	0.537 (0.456)	7800.	1.35
EVAPOTRANSPIRATION	29.557 (3.388)	429167.	74.20
LATERAL DRAINAGE FROM LAYER 3	9.7633 (2.3377)	141764.	24.51
PERCOLATION FROM LAYER 4	0.0003 (0.0001)	4.	0.00
CHANGE IN WATER STORAGE	-0.022 (2.744)	-323.	-0.06

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	4.08	59241.6
RUNOFF	1.054	15302.0
LATERAL DRAINAGE FROM LAYER 3	0.1782	2587.4
PERCOLATION FROM LAYER 4	0.0000	0.1
HEAD ON LAYER 4	13.2	
SNOW WATER	2.24	32475.0

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2991

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1131

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.06	0.1773
2	5.42	0.2257
3	1.45	0.2412
4	0.02	0.4000

SNOW WATER 0.00

Appendix D

Steel Sheetpile Wall

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

BY

JOB NO.

DATE

PROJECT PASSAIC REMEDIAL DESIGN

CH'K. BY

SUBJECT SHEET PILE RETAINING / CUT OFF WALL

DATE CH'K.

BK. CH'K. BY

ASSUMPTIONS:

1. WALL OBJECTIVE IS TO SUPPORT LIMITED SHALLOW EXCAVATION OF ACM AND CUT OFF FLOW OF ACM LEACHATE TO AN ABUTTING WETLAND.
2. DATA AVAILABLE FOR WALL DESIGN IS VERY LIMITED; THEREFORE ONLY SIMPLIFIED ANALYSIS IS PERFORMED ACCORDING TO PROCEDURES OUTLINED IN NAVFAC 7.2.
3. SIGNIFICANT DEWATERING WILL NOT OCCUR DUE TO PROXIMITY TO WETLANDS.
4. EXCAVATION AND REVETMENT BACKFILL WILL BE ACCOMPLISHED IN 20-30 FOOT SECTIONS.
5. FULL IMPLEMENTATION OF DESIGN WILL REQUIRE SEVERAL GEOTECHNICAL SOIL BORINGS ALONG THE PROPOSED WALL ALIGNMENT.
6. THE PEAT LAYER DOES NOT EXIST ACROSS THE TOTAL WALL ALIGNMENT AND APPEARS TO VARY FROM APPROXIMATELY 2→6 FEET.
7. SOME STANDARD DATA FOR MATERIALS DOES NOT EXIST (FRICTION ANGLE FOR ACM) SO A CONSERVATIVE ESTIMATED VALUE WAS USED.
8. FOR A CANTILEVER WALL, MAXIMUM DEPTH OF EXCAVATION ALLOWABLE = 15 FEET.

TRC
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Fax: (508) 452-1995

BY

JOB NO.

DATE

PROJECT: PASSAIC REMEDIAL DESIGN

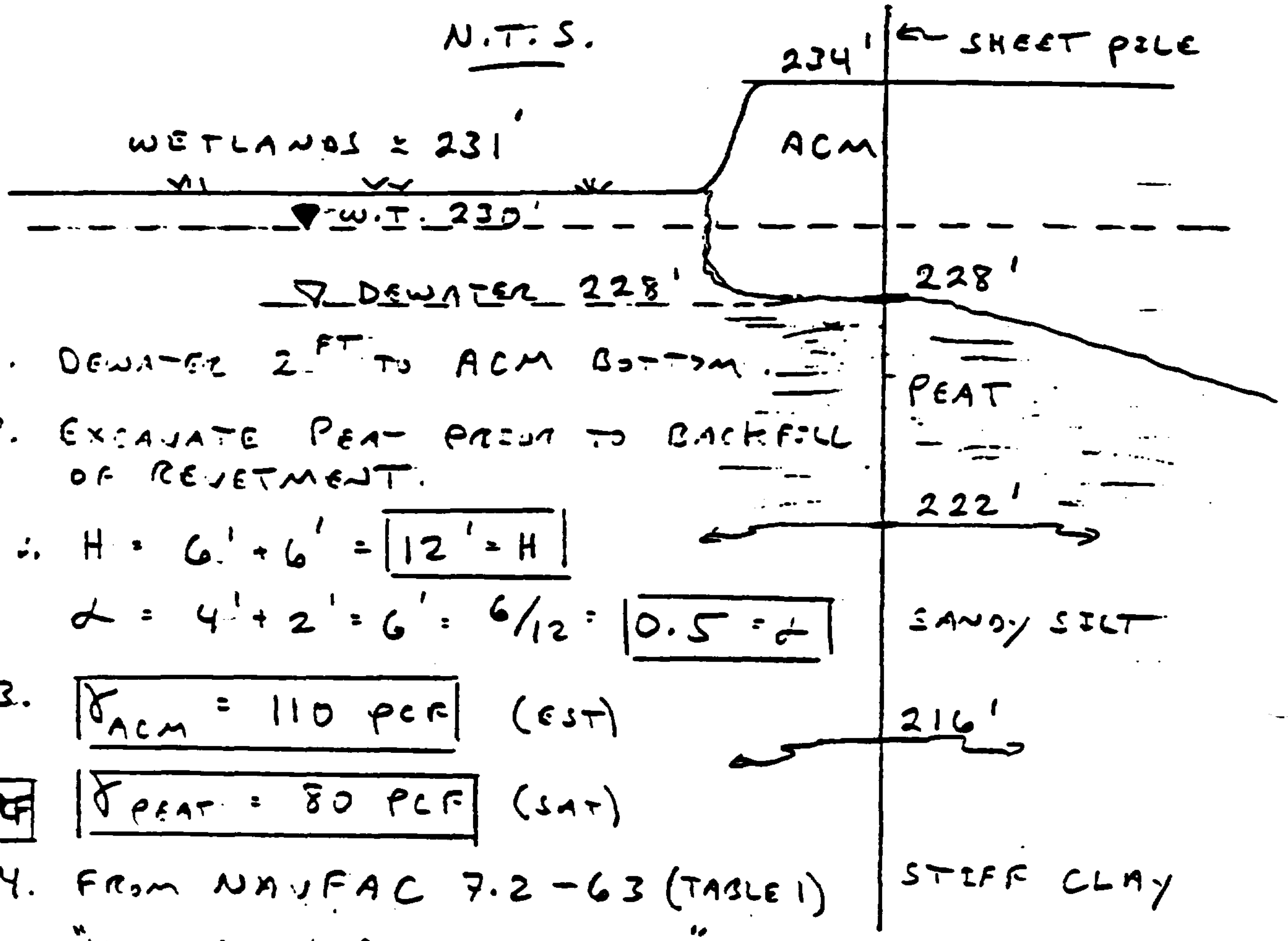
CH'K. BY

SUBJECT: SHEET PILE RETAINING / CUT-OFF WALL

DATE CH'K.

B'K. CH'K. BY

N.T.S.



1. DEWATER 2 FT TO ACM BOTTOM.
2. EXCAVATE PEAT PRIOR TO BACKFILL OF REVETMENT.

$\therefore H = 6' + 6' = \boxed{12' = H}$

$\alpha = 4' + 2' = 6' : 6/12 : \boxed{0.5 = \alpha}$

3. $\boxed{\gamma_{ACM} = 110 \text{ pcf}}$ (EST)

$\boxed{\gamma_{H_2O} = 62.4 \text{ PCF}}$ $\boxed{\gamma_{PEAT} = 80 \text{ PCF}}$ (SAT)

4. FROM NAVFAC 7.2-63 (TABLE 1)

"VERY SOFT COHESIVE SOIL" C_a = 0 - 250 PSF
"SOFT COHESIVE SOIL" C_a = 250 - 500 PSF
"MEDIUM STIFF COHESIVE SOIL" C_a = 500 - 750 PSF

$\boxed{C_a = 375 \text{ PSF}}$ (CONSERVATIVE)

5. FROM NAVFAC 7.2-63 (TABLE 1); STEEL SHEET ON:

"SILTY SAND, GRAVEL OR SAND MIXED WITH SILT OR CLAY" $\tan\delta = 0.25$ $(\delta = 14°)$

"FINE SANDY SILT, NONPLASTIC SILT"

$\tan\delta = 0.20$ $(\delta = 11°)$

$\boxed{\text{USE FRICTION FACTOR} = 0.20}$ (CONSERVATIVE)

TABLE 1
Ultimate Friction Factors and Adhesion for Dissimilar Materials

Interface Materials	Friction factor, $\tan \delta$	Friction angle, δ degrees
Mass concrete on the following foundation materials:		
Clean sound rock	0.70	35
Clean gravel, gravel-sand mixtures, coarse sand	0.55 to 0.60	29 to 31
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	0.45 to 0.55	24 to 29
Clean fine sand, silty or clayey fine to medium sand	0.35 to 0.45	19 to 24
Fine sandy silt, nonplastic silt	0.30 to 0.35	17 to 19
Very stiff and hard residual or preconsolidated clay	0.40 to 0.50	22 to 26
Medium stiff and stiff clay and silty clay	0.30 to 0.35	17 to 19
(Masonry on foundation materials has same friction factors.)		
Steel sheet piles against the following soils:		
Clean gravel, gravel-sand mixtures, well-graded rock fill with spalls	0.40	22
Clean sand, silty sand-gravel mixture, single size hard rock fill	0.30	17
Silty sand, gravel or sand mixed with silt or clay	0.25	14
Fine sandy silt, nonplastic silt	0.20	11
Formed concrete or concrete sheet piling against the following soils:		
Clean gravel, gravel-sand mixture, well-graded rock fill with spalls	0.40 to 0.50	22 to 26
Clean sand, silty sand-gravel mixture, single size hard rock fill	0.30 to 0.40	17 to 22
Silty sand, gravel or sand mixed with silt or clay	0.30	17
* Fine sandy silt, nonplastic silt	0.25	14
Various structural materials:		
Masonry on masonry, igneous and metamorphic rocks:		
Dressed soft rock on dressed soft rock	0.70	35
Dressed hard rock on dressed soft rock	0.65	33
Dressed hard rock on dressed hard rock	0.55	29
Masonry on wood (cross grain)	0.50	26
Steel on steel at sheet pile interlocks	0.30	17

Interface Materials (Cohesion)	Adhesion C_a (psf)
Very soft cohesive soil (0 - 250 psf)	0 - 250
* Soft cohesive soil (250 - 500 psf)	250 - 500
Medium stiff cohesive soil (500 - 1000 psf)	500 - 750
Stiff cohesive soil (1000 - 2000 psf)	750 - 950
Very stiff cohesive soil (2000 - 4000 psf)	950 - 1,300

TRC
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BY ____ DATE ____

JOB NO. ____

PROJECT: PASSAIC REMEDIAL DESIGN CH'K. BY ____

SUBJECT: SHEET PILE RETAINING / CUT OFF WALL DATE CH'K. ____

B'K. CH'K. BY ____

6. ANGLE OF INTERNAL FRICTION FOR ACM IS CONSERVATIVELY ESTIMATED AT 14° SINCE ACM INCLUDES CHIPS, SOIL, ETC. $\boxed{\phi = 14°}$

PEAT IS BELOW GROUNDWATER TABLE.

7. FROM NAVFAC 7.2-66 FIGURE 5.

ASSUME $\delta/\phi = 1$, $\theta = 0$

AT 14°, COEFFICIENT OF ACTIVE PRESSURE

$$\boxed{K_A = 0.55}$$

8. EFFECTIVE PRESSURE = $\gamma_E H$

$$\gamma_E H = (110\ PCF)(6\ FT) + (80\ PCF - 62.4\ PCF)(6\ FT)$$
$$= 765.6\ PSF \approx \boxed{766\ PSF}$$

$$\gamma' = \frac{(660\ PSF) + (105.6\ PSF)}{12} = \boxed{63.8\ PCF}$$

$$q_u = 2C_u = 2(375\ PSF) = \boxed{750\ PSF}$$

9. CALCULATE DEPTH RATIO

$$\frac{2q_u - \gamma_E H}{\gamma' K_A H} = \frac{2(750\ PSF) - 766\ PSF}{(63.8\ PSF)(0.55)(12\ FT)} = \frac{743\ PS}{421\ PS} = \boxed{1.74}$$

FROM NAVFAC 7.2-97, FIGURE 25

1.77 AT $\alpha = 0.5$ ∴ $\boxed{D.R. = 1.5}$

ABD 002 1478

5 of 7

REDUCTION FACTOR (R) OF Kp FOR VARIOUS RATIOS OF $-\delta/\phi$

ϕ \ δ/ϕ	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	0.0
10	.978	.962	.946	.929	.912	.898	.881	.864
15	.961	.934	.907	.881	.854	.830	.803	.775
20	.939	.901	.862	.824	.787	.752	.716	.678
25	.912	.860	.808	.759	.711	.666	.620	.574
30	.878	.811	.746	.686	.627	.574	.520	.467
35	.836	.752	.674	.603	.536	.475	.417	.362
40	.783	.682	.592	.512	.439	.375	.316	.262
45	.718	.600	.500	.414	.339	.276	.221	.174

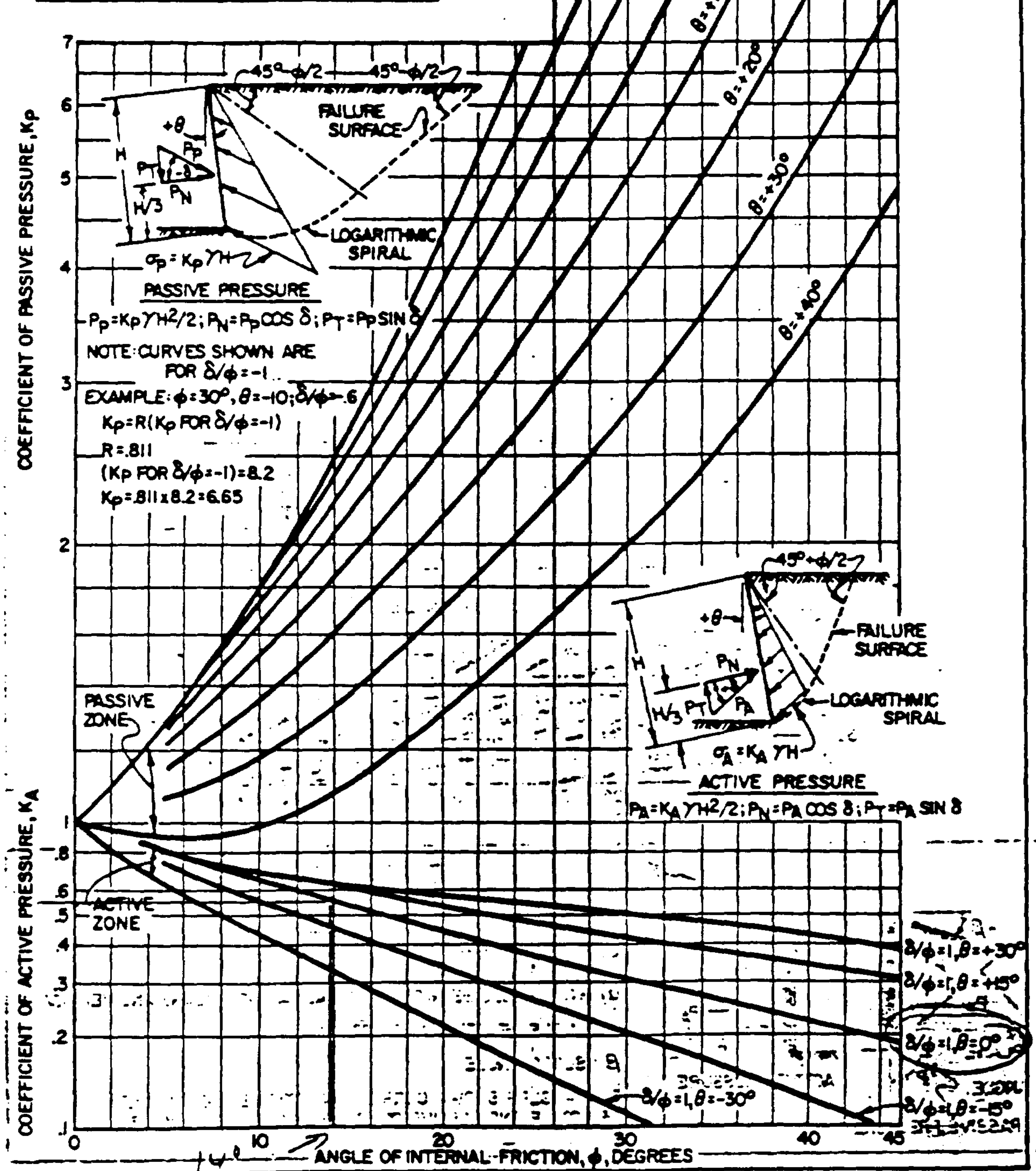

FIGURE 5
Active and Passive Coefficients with Wall Friction
(Sloping Wall)

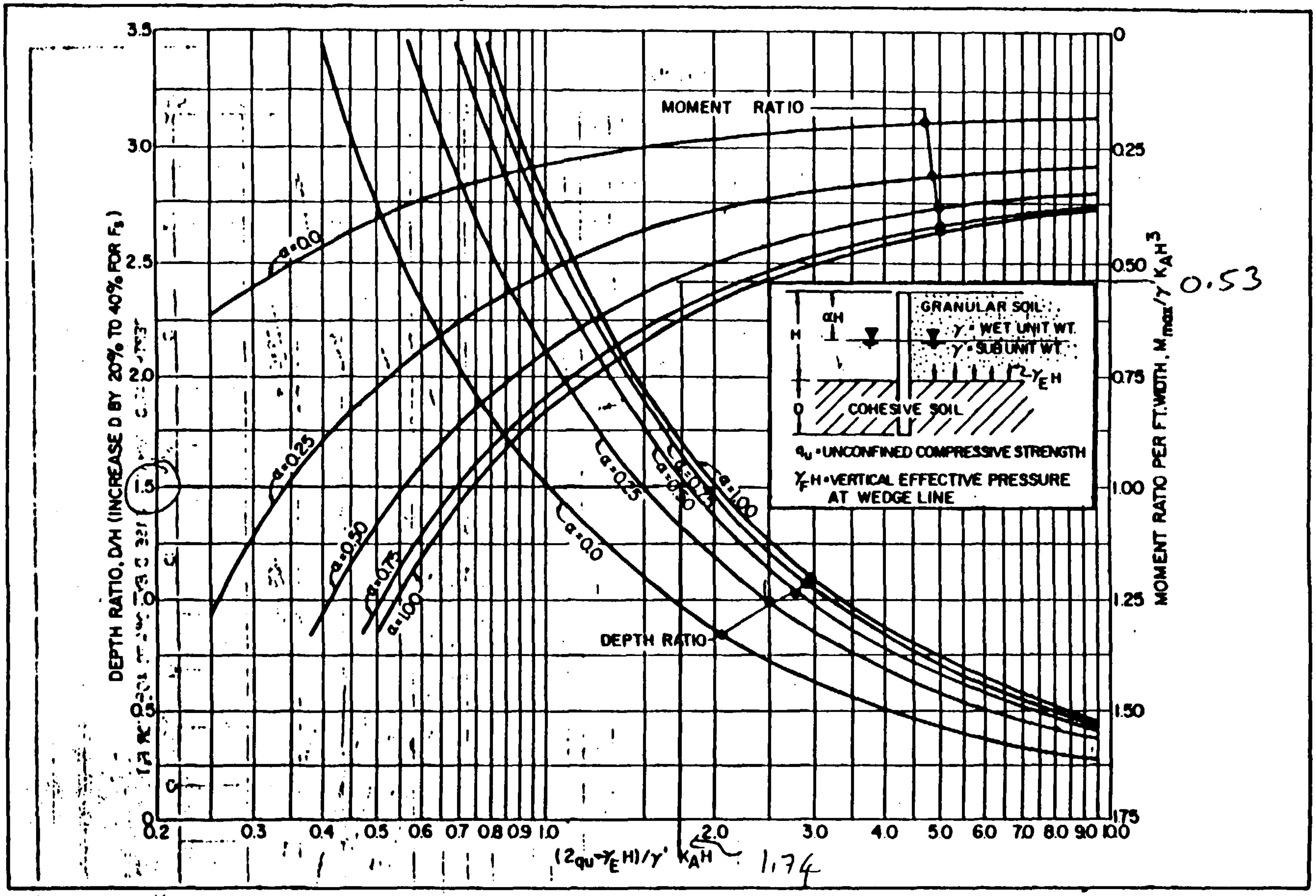

FIGURE 25
Cantilever Steel Sheet Pile Wall in Cohesive Soil with Granular Backfill

6 of 7

TRC
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BY

DATE

JOB NO.

PROJECT PASSAIC REMEDIAL DESIGN

SUBJECT SHEET PILE RETAINING / CUT OFF WALL

CH'K. BY

DATE CH'K.

B'K. CH'K. BY

10. CALCULATE SHEET PILE DEPTH FROM SURFACE.

$D/H = 1.5 \quad \therefore \quad (1.5)(12\ FT) = \boxed{18.0\ FT}$

FACTOR OF SAFETY = 1.3 $\therefore$ $(1.3)(18.0\ FT) = \boxed{23.4\ FT}$

$\boxed{\text{DEPTH = 24 FEET.}}$

11. $\boxed{\text{MOMENT RATIO: 0.53}}$

FROM NAVFAC 7.2-97 AT 1.77 AND $\alpha = 0.5$.

12. CALCULATE MAXIMUM MOMENT.

$$M_{MAX} = (M_R)(\gamma')(K_A)(H)^3$$

$$= (0.53)(63.8\ PSF)(0.55)(12\ FT)^3$$

$$= \boxed{32{,}137\ FT\text{-}lb / FT\ WALL}$$

13. CALCULATE SECTION MODULUS

$$S_x = \frac{M_{MAX}}{F_b}$$

FOR REGULAR CARBON GRADE STEEL

$F_b = 25{,}000\ lb/IN^2$

$$\therefore \frac{32{,}137\ FT\text{-}lb}{25{,}000\ lb/IN^2}(12\ IN/FT) =$$

$$\boxed{S_x = 15.43\ IN^3}$$

Appendix E

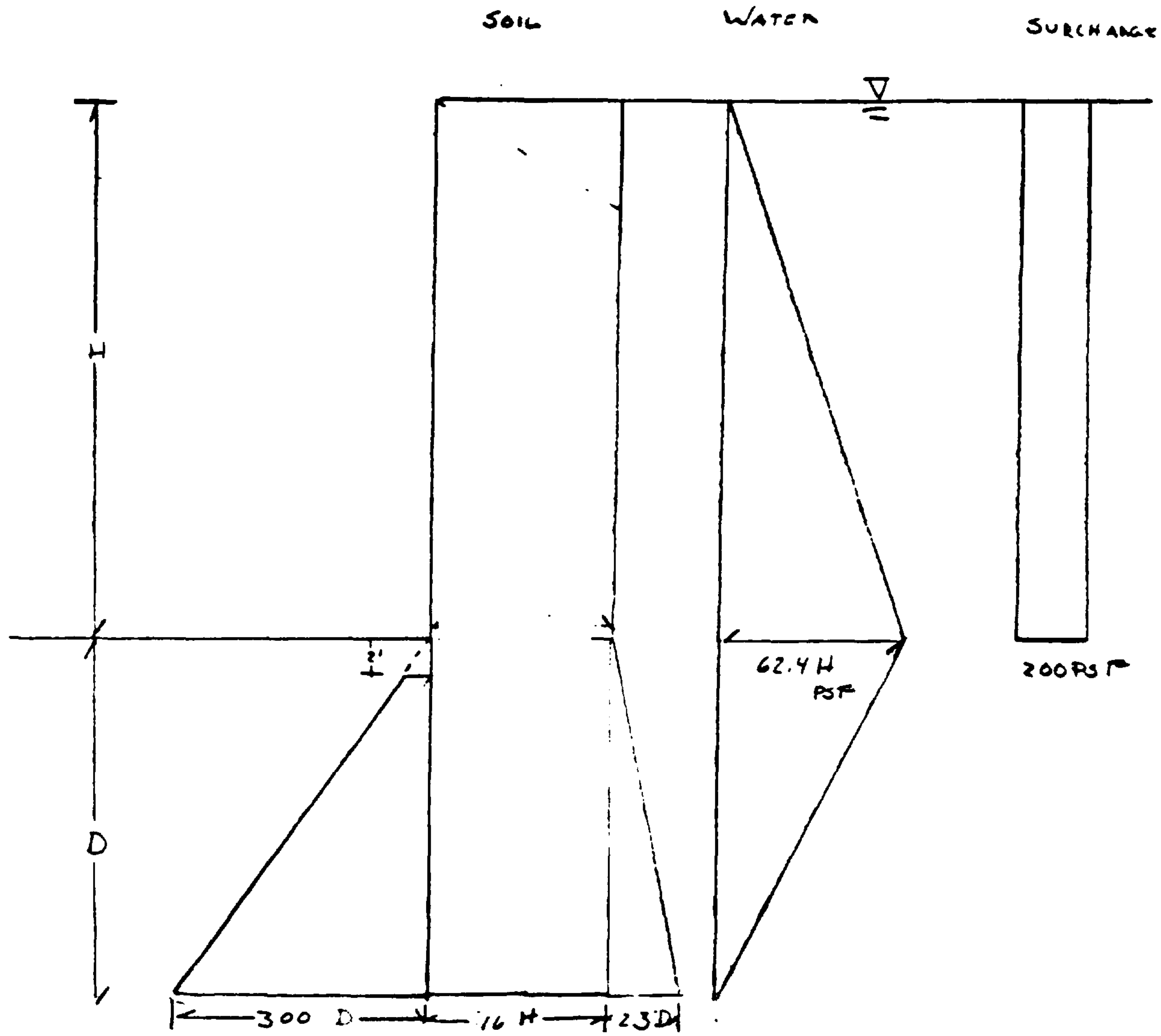
Earth Pressure Calculations

TRC
TRC Environmental Corporation

Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET 1 OF 2
BY MFC
DATE 1/5/92
CH'K. BY DPB
DATE CH'K. 1/13/93
B'K. CH'K. BY

JOB NO. 1-635-337-0-2P22-0
PROJECT Passaic
SUBJECT Earth Pressure Diagrams (LATERAL)
New Vernon Road



Assumptions

$\phi = 25^{\circ}$, $\gamma_T = 120$ PSF, $K_A = 0.40$, $\gamma_S = 60$ PSF

$16H = 0.65 \, K_A \, \gamma_S H$

$23D = K_A \, \gamma_S \, D$

$145D = K_p \, \gamma \, D$

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

BY MFC
DATE 1/5/92
CH'K. BY
DATE CH'K.
B'K. CH'K. BY

JOB NO. 1-635-337-02P22-0
PROJECT PASSAIC
SUBJECT EARTH PRESSURES DIAGRAM
NEW VERNON ROAD

NOTES

1. FOR CANTILIVER SHEETING WALLS, THE PENETRATION "D" SHALL BE INCREASED BY 20%.
2. VALUES OF "H" AND "D" ARE IN FEET.
3. ALL EARTH PRESSURE UNITS ARE IN POUNDS PER SQUARE FOOT.
4. LATERAL SURCHARGE PRESSURES ARE BASED ON AN ASSUMED TRAFFIC SURCHARGE OF 400 PSF, ACTING OVER A LIMITED AREA. MORE SEVERE EQUIPMENT LOADING SHALL BE EVALUATED ON A CASE BY CASE BASIS.
5. BUILDING LOADS SHALL BE EVALUATED ON A CASE BY CASE BASE. FOUNDATION CONTACT PRESSURES SHALL INCLUDE LIVE AND DEAD LOADS.
6. Excavation beneath BRACING LEVELS SHALL BE LIMITED TO TWO FEET BELOW BRACING PRIOR TO INSTALLATION OF BRACING.
7. STRUTS, RAKERS AND TIEBACKS, IF REQUIRED SHALL BE PRESTRESSED, IN THE PRESENCE OF THE ENGINEER, TO 50% OF THE MAXIMUM DESIGN LOAD.

Appendix F

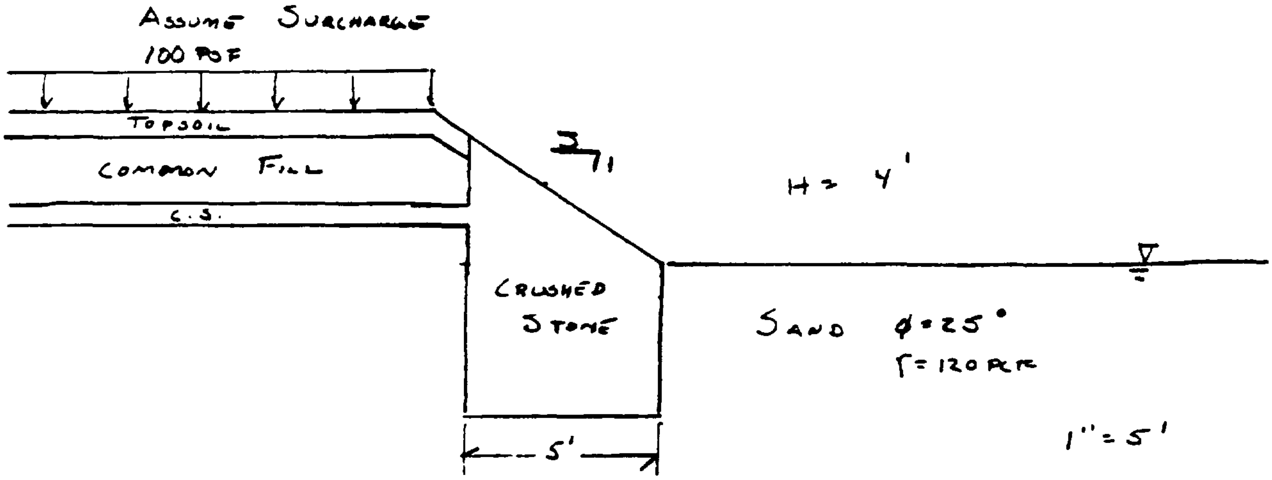
Cover Slope Stability-Final Cover

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

BY MFC
DATE 1/5/93
CH'K. BY BPB
DATE CH'K. 1/12/93
B'K. CH'K. BY

JOB NO. 1-635-337-0-2P2C-0
PROJECT Asbestos Dump Site - ODU #7
SUBJECT Cover Slope Stability
Final Cover

Worst Case



Max. Slope from Drawings 3:1

Max Height 4'

Crushed Stone Assume $\phi = 40°$

$\gamma = 135$ PCF

Slope Angle $\beta = 18.3°$

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

BY MFC

DATE 1-5-93

JOB NO. 1-635-337-0-2P22-0

CH'K BY DAB

PROJECT Asbestos Dump Site - ODU

DATE CH'K. 1/12/93

SUBJECT Cover Slope Stability

Final

B'K CH'K BY

Ref: Duncan & Buchignani, "An Engineering Manual for Slope Stability Analysis".

Uniform Soils w $\phi > 0$. $F_{min} = 1.25$

Use $\phi = 25°$ (Conservative) (Very Conservative Assumptions).

1. $$P_d = \frac{\gamma H + q - \gamma_w H_w}{\mu_q \mu_w \mu_t}$$

$\gamma = 135$ PCF $\mu_q =$

$H = 4'$

$q = 100$ PSF

$H_w = 0$

$\mu_q = 0.97$ (Fig 7) $\beta = 25°$

Toe

$$\frac{q}{\gamma H} = \frac{100}{4(135)} = .19$$

$\mu_w = 1$

$\mu_t = 1$

$$P_d = \frac{120(4) + 100}{.97} = 598 \approx 600 \text{ PSF}$$

2. $P_d = P_c$

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

BY MFC
DATE 1-5-93
JOB NO. 1-635-337-0-2PEL-0
PROJECT Asbestos Dump Site
CH'K BY PAB
SUBJECT Cover Slope Stability
DATE CH'K. 1/12/93
B'K. CH'K. BY

3. $\lambda_{c\phi} = \infty \quad \therefore \quad c = \phi$

4. $F = \frac{P_e}{P_d} b \tan\phi$ Factor of Safety

$= \frac{600}{600} \frac{1}{\tan 18.3^\circ} \tan 25^\circ$

$= 1.40 > 1.25$ OK

5. Using Weighted $\phi = \frac{40^\circ + 25^\circ}{2} = 32.5^\circ$

$F = 1.93 \gg 1.25$ OK

Appendix G

Bouwer and Rice Analysis

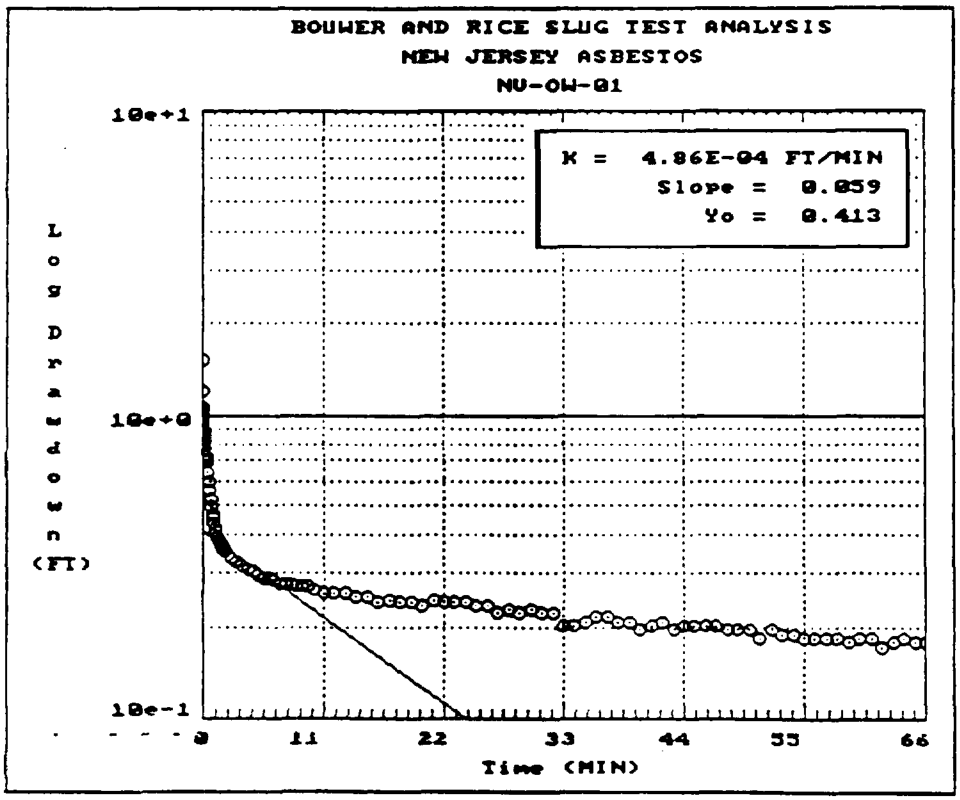
NEW JERSEY ASBESTOS
NV-OW-01
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	4.86E-04 FT/MIN
Well Screen Ratio (Le/rw):	15.0
C Value:	1.50
Dimensionless Ratio ln(Re/rw):	1.55

Well/Aquifer Paramaters

Depth of well:	2.52	FT
Length of well screen:	5.00	FT
Saturated thickness:	2.52	FT
Diameter of the well casing:	0.459	FT
Diameter of the well filter:	0.667	FT
Porosity of filter pack:	0.30	



NEW JERSEY ASBESTOS
NV-OW-01
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0010	1.530	2	0.0033	1.207	3	0.0066	1.068
4	0.0100	1.043	5	0.0133	0.973	6	0.0166	1.018
7	0.0200	0.992	8	0.0233	0.999	9	0.0266	0.986
10	0.0300	0.986	11	0.0333	0.986	12	0.0500	0.954
13	0.0666	0.929	14	0.0833	0.910	15	0.1000	0.891
16	0.1166	0.879	17	0.1333	0.860	18	0.1500	0.841
19	0.1666	0.828	20	0.1833	0.809	21	0.2000	0.796
22	0.2166	0.784	23	0.2333	0.765	24	0.2500	0.758
25	0.2666	0.739	26	0.2833	0.727	27	0.3000	0.720
28	0.3166	0.701	29	0.3333	0.695	30	0.4166	0.638
31	0.5000	0.594	32	0.5833	0.556	33	0.6666	0.524
34	0.7500	0.493	35	0.8333	0.468	36	0.9166	0.455
37	1.0000	0.436	38	1.0833	0.423	39	1.1666	0.411
40	1.2500	0.398	41	1.3333	0.392	42	1.4166	0.385
43	1.5000	0.379	44	1.5833	0.373	45	1.6666	0.366
46	1.7500	0.366	47	1.8333	0.360	48	1.9166	0.354
49	2.0000	0.354	50	2.5000	0.335	51	3.0000	0.328
52	3.5000	0.316	53	4.0000	0.309	54	4.5000	0.303
55	5.0000	0.297	56	5.5000	0.290	57	6.0000	0.290
58	6.5000	0.284	59	7.0000	0.278	60	7.5000	0.278
61	8.0000	0.278	62	8.5000	0.271	63	9.0000	0.271
64	9.5000	0.271	65	10.0000	0.265	66	11.0000	0.259
67	12.0000	0.259	68	13.0000	0.259	69	14.0000	0.252
70	15.0000	0.252	71	16.0000	0.240	72	17.0000	0.246
73	18.0000	0.240	74	19.0000	0.240	75	20.0000	0.233
76	21.0000	0.246	77	22.0000	0.240	78	23.0000	0.240
79	24.0000	0.240	80	25.0000	0.233	81	26.0000	0.233
82	27.0000	0.221	83	28.0000	0.227	84	29.0000	0.221
85	30.0000	0.227	86	31.0000	0.221	87	32.0000	0.221
88	33.0000	0.202	89	34.0000	0.202	90	35.0000	0.208
91	36.0000	0.215	92	37.0000	0.215	93	38.0000	0.208
94	39.0000	0.208	95	40.0000	0.196	96	41.0000	0.202
97	42.0000	0.208	98	43.0000	0.196	99	44.0000	0.202
100	45.0000	0.202	101	46.0000	0.202	102	47.0000	0.202
103	48.0000	0.196	104	49.0000	0.196	105	50.0000	0.196
106	51.0000	0.183	107	52.0000	0.196	108	53.0000	0.189
109	54.0000	0.189	110	55.0000	0.183	111	56.0000	0.183
112	57.0000	0.183	113	58.0000	0.183	114	59.0000	0.177
115	60.0000	0.183	116	61.0000	0.183	117	62.0000	0.170
118	63.0000	0.177	119	64.0000	0.183	120	65.0000	0.177
121	66.0000	0.177						

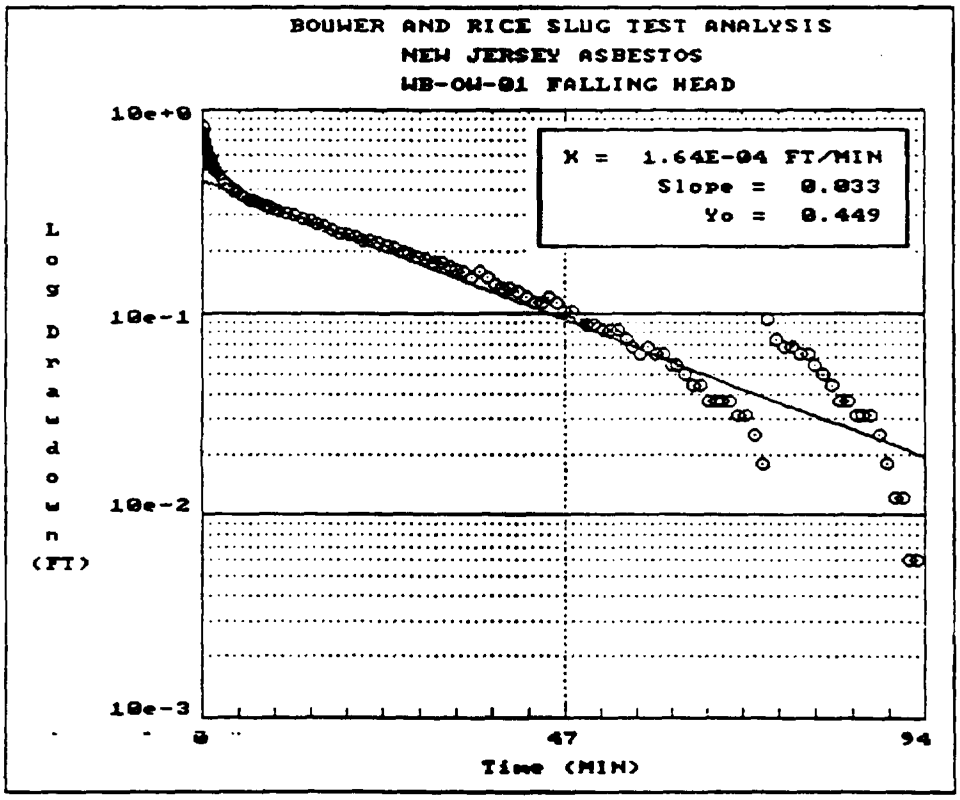
NEW JERSEY ASBESTOS
WB-OW-01 FALLING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	1.64E-04 FT/MIN
Well Screen Ratio (Le/rw):	15.0
A Value:	2.00
B Value:	0.31
Dimensionless Ratio ln(Re/rw):	1.77

Well/Aquifer Paramaters

Depth of well:	5.95	FT
Length of well screen:	5.00	FT
Saturated thickness:	9.95	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



NEW JERSEY ASBESTOS
WB-OW-01 FALLING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	0.543	2	0.0033	0.695	3	0.0066	0.834
4	0.0100	0.720	5	0.0133	0.645	6	0.0166	0.758
7	0.0200	0.758	8	0.0233	0.746	9	0.0266	0.727
10	0.0300	0.708	11	0.0333	0.720	12	0.0500	0.727
13	0.0666	0.701	14	0.0833	0.720	15	0.1000	0.727
16	0.1166	0.708	17	0.1333	0.695	18	0.1500	0.695
19	0.1666	0.689	20	0.1833	0.689	21	0.2000	0.682
22	0.2166	0.676	23	0.2333	0.670	24	0.2500	0.670
25	0.2666	0.670	26	0.2833	0.664	27	0.3000	0.657
28	0.3166	0.657	29	0.3333	0.651	30	0.4166	0.638
31	0.5000	0.626	32	0.5833	0.613	33	0.6666	0.600
34	0.7500	0.588	35	0.8333	0.575	36	0.9166	0.569
37	1.0000	0.562	38	1.0833	0.550	39	1.1666	0.543
40	1.2500	0.531	41	1.3333	0.524	42	1.4166	0.518
43	1.5000	0.505	44	1.5833	0.505	45	1.6666	0.499
46	1.7500	0.486	47	1.8333	0.486	48	1.9166	0.486
49	2.0000	0.480	50	2.5000	0.449	51	3.0000	0.430
52	3.5000	0.417	53	4.0000	0.398	54	4.5000	0.392
55	5.0000	0.379	56	5.5000	0.373	57	6.0000	0.360
58	6.5000	0.354	59	7.0000	0.347	60	7.5000	0.341
61	8.0000	0.335	62	8.5000	0.335	63	9.0000	0.328
64	9.5000	0.322	65	10.0000	0.316	66	11.0000	0.309
67	12.0000	0.303	68	13.0000	0.290	69	14.0000	0.284
70	15.0000	0.271	71	16.0000	0.265	72	17.0000	0.259
73	18.0000	0.246	74	19.0000	0.240	75	20.0000	0.234
76	21.0000	0.227	77	22.0000	0.227	78	23.0000	0.221
79	24.0000	0.215	80	25.0000	0.208	81	26.0000	0.202
82	27.0000	0.196	83	28.0000	0.189	84	29.0000	0.183
85	30.0000	0.177	86	31.0000	0.177	87	32.0000	0.170
88	33.0000	0.164	89	34.0000	0.158	90	35.0000	0.151
91	36.0000	0.158	92	37.0000	0.151	93	38.0000	0.139
94	39.0000	0.132	95	40.0000	0.132	96	41.0000	0.126
97	42.0000	0.120	98	43.0000	0.113	99	44.0000	0.113
100	45.0000	0.120	101	46.0000	0.113	102	47.0000	0.101
103	48.0000	0.101	104	49.0000	0.094	105	50.0000	0.088
106	51.0000	0.088	107	52.0000	0.082	108	53.0000	0.082
109	54.0000	0.082	110	55.0000	0.075	111	56.0000	0.069
112	57.0000	0.063	113	58.0000	0.069	114	59.0000	0.063
115	60.0000	0.063	116	61.0000	0.056	117	62.0000	0.056
118	63.0000	0.050	119	64.0000	0.044	120	65.0000	0.044
121	66.0000	0.037	122	67.0000	0.037	123	68.0000	0.037
124	69.0000	0.037	125	70.0000	0.031	126	71.0000	0.031
127	72.0000	0.025	128	73.0000	0.018	129	74.0000	0.094
130	75.0000	0.075	131	76.0000	0.069	132	77.0000	0.069
133	78.0000	0.063	134	79.0000	0.063	135	80.0000	0.056
136	81.0000	0.050	137	82.0000	0.044	138	83.0000	0.037
139	84.0000	0.037	140	85.0000	0.031	141	86.0000	0.031
142	87.0000	0.031	143	88.0000	0.025	144	89.0000	0.018
145	90.0000	0.012	146	91.0000	0.012	147	92.0000	0.006
148	93.0000	0.006						

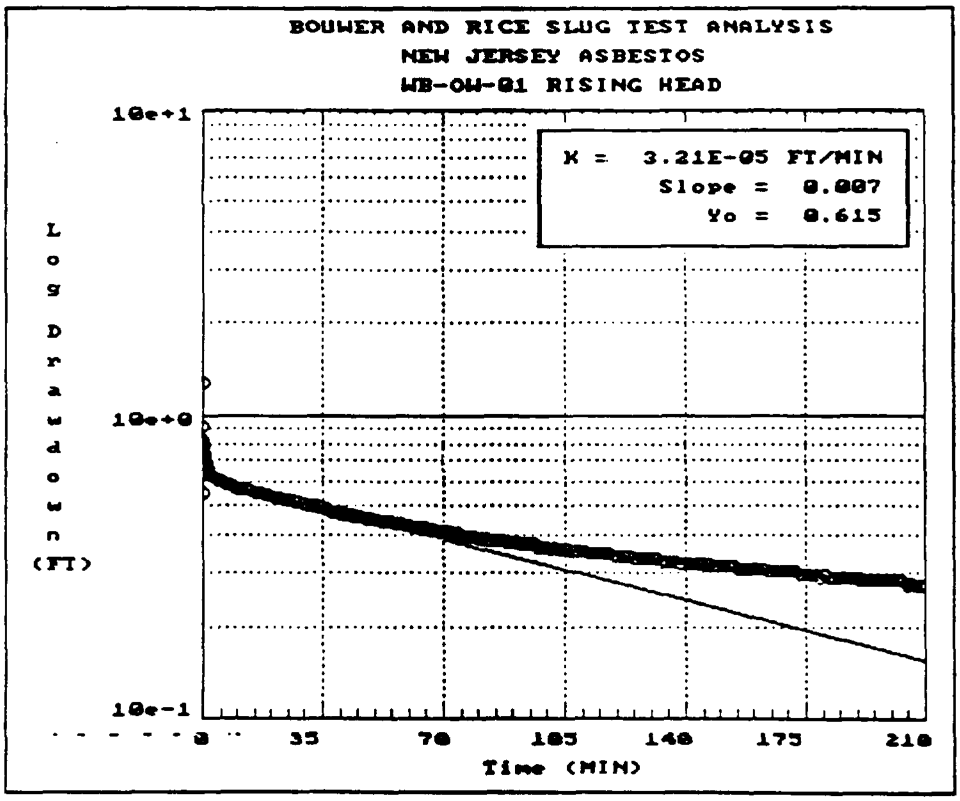
NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	3.21E-05 FT/MIN
Well Screen Ratio (Le/rw):	15.0
A Value:	2.00
B Value:	0.31
Dimensionless Ratio ln(Re/rw):	1.77

Well/Aquifer Paramaters

Depth of well:	5.95	FT
Length of well screen:	5.00	FT
Saturated thickness:	9.95	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	0.910	2	0.0033	0.550	3	0.0066	1.277
4	0.0100	0.758	5	0.0133	0.815	6	0.0166	0.815
7	0.0200	0.803	8	0.0233	0.803	9	0.0266	0.803
10	0.0300	0.803	11	0.0333	0.803	12	0.0500	0.790
13	0.0666	0.784	14	0.0833	0.784	15	0.1000	0.777
16	0.1166	0.771	17	0.1333	0.765	18	0.1500	0.765
19	0.1666	0.758	20	0.1833	0.758	21	0.2000	0.752
22	0.2166	0.752	23	0.2333	0.746	24	0.2500	0.739
25	0.2666	0.739	26	0.2833	0.733	27	0.3000	0.733
28	0.3166	0.727	29	0.3333	0.727	30	0.4166	0.714
31	0.5000	0.708	32	0.5833	0.701	33	0.6666	0.695
34	0.7500	0.689	35	0.8333	0.682	36	0.9166	0.682
37	1.0000	0.676	38	1.0833	0.670	39	1.1666	0.670
40	1.2500	0.664	41	1.3333	0.664	42	1.4166	0.657
43	1.5000	0.657	44	1.5833	0.651	45	1.6666	0.651
46	1.7500	0.651	47	1.8333	0.645	48	1.9166	0.645
49	2.0000	0.645	50	2.5000	0.626	51	3.0000	0.619
52	3.5000	0.613	53	4.0000	0.607	54	4.5000	0.607
55	5.0000	0.600	56	5.5000	0.600	57	6.0000	0.594
58	6.5000	0.588	59	7.0000	0.588	60	7.5000	0.588
61	8.0000	0.581	62	8.5000	0.581	63	9.0000	0.575
64	9.5000	0.575	65	10.0000	0.569	66	11.0000	0.569
67	12.0000	0.569	68	13.0000	0.562	69	14.0000	0.556
70	15.0000	0.550	71	16.0000	0.550	72	17.0000	0.550
73	18.0000	0.543	74	19.0000	0.543	75	20.0000	0.537
76	21.0000	0.531	77	22.0000	0.531	78	23.0000	0.531
79	24.0000	0.524	80	25.0000	0.518	81	26.0000	0.518
82	27.0000	0.512	83	28.0000	0.512	84	29.0000	0.505
85	30.0000	0.505	86	31.0000	0.499	87	32.0000	0.499
88	33.0000	0.499	89	34.0000	0.493	90	35.0000	0.493
91	36.0000	0.486	92	37.0000	0.480	93	38.0000	0.474
94	39.0000	0.474	95	40.0000	0.467	96	41.0000	0.474
97	42.0000	0.467	98	43.0000	0.467	99	44.0000	0.461
100	45.0000	0.461	101	46.0000	0.461	102	47.0000	0.455
103	48.0000	0.448	104	49.0000	0.455	105	50.0000	0.448
106	51.0000	0.448	107	52.0000	0.442	108	53.0000	0.442
109	54.0000	0.442	110	55.0000	0.442	111	56.0000	0.436
112	57.0000	0.436	113	58.0000	0.436	114	59.0000	0.430
115	60.0000	0.430	116	61.0000	0.423	117	62.0000	0.423
118	63.0000	0.423	119	64.0000	0.423	120	65.0000	0.423
121	66.0000	0.417	122	67.0000	0.417	123	68.0000	0.411
124	69.0000	0.411	125	70.0000	0.411	126	71.0000	0.411
127	72.0000	0.404	128	73.0000	0.404	129	74.0000	0.404
130	75.0000	0.398	131	76.0000	0.398	132	77.0000	0.398
133	78.0000	0.398	134	79.0000	0.398	135	80.0000	0.392
136	81.0000	0.392	137	82.0000	0.392	138	83.0000	0.385
139	84.0000	0.385	140	85.0000	0.385	141	86.0000	0.385
142	87.0000	0.385	143	88.0000	0.379	144	89.0000	0.379
145	90.0000	0.379	146	91.0000	0.379	147	92.0000	0.373
148	93.0000	0.373	149	94.0000	0.373	150	95.0000	0.373
151	96.0000	0.373	152	97.0000	0.366	153	98.0000	0.366

NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
154	99.0000	0.366	155	100.0000	0.366	156	101.0000	0.360
157	102.0000	0.366	158	103.0000	0.360	159	104.0000	0.360
160	105.0000	0.360	161	106.0000	0.360	162	107.0000	0.354
163	108.0000	0.354	164	109.0000	0.354	165	110.0000	0.354
166	111.0000	0.354	167	112.0000	0.347	168	113.0000	0.347
169	114.0000	0.347	170	115.0000	0.347	171	116.0000	0.347
172	117.0000	0.347	173	118.0000	0.347	174	119.0000	0.341
175	120.0000	0.341	176	121.0000	0.341	177	122.0000	0.341
178	123.0000	0.341	179	124.0000	0.341	180	125.0000	0.335
181	126.0000	0.335	182	127.0000	0.335	183	128.0000	0.335
184	129.0000	0.335	185	130.0000	0.335	186	131.0000	0.335
187	132.0000	0.335	188	133.0000	0.328	189	134.0000	0.328
190	135.0000	0.328	191	136.0000	0.328	192	137.0000	0.328
193	138.0000	0.322	194	139.0000	0.322	195	140.0000	0.322
196	141.0000	0.322	197	142.0000	0.322	198	143.0000	0.322
199	144.0000	0.322	200	145.0000	0.322	201	146.0000	0.316
202	147.0000	0.322	203	148.0000	0.316	204	149.0000	0.316
205	150.0000	0.316	206	151.0000	0.316	207	152.0000	0.316
208	153.0000	0.316	209	154.0000	0.316	210	155.0000	0.309
211	156.0000	0.309	212	157.0000	0.309	213	158.0000	0.309
214	159.0000	0.309	215	160.0000	0.309	216	161.0000	0.309
217	162.0000	0.309	218	163.0000	0.309	219	164.0000	0.303
220	165.0000	0.303	221	166.0000	0.303	222	167.0000	0.303
223	168.0000	0.303	224	169.0000	0.303	225	170.0000	0.303
226	171.0000	0.303	227	172.0000	0.303	228	173.0000	0.297
229	174.0000	0.297	230	175.0000	0.297	231	176.0000	0.297
232	177.0000	0.297	233	178.0000	0.297	234	179.0000	0.290
235	180.0000	0.297	236	181.0000	0.297	237	182.0000	0.290
238	183.0000	0.290	239	184.0000	0.290	240	185.0000	0.290
241	186.0000	0.290	242	187.0000	0.290	243	188.0000	0.290
244	189.0000	0.290	245	190.0000	0.284	246	191.0000	0.290
247	192.0000	0.284	248	193.0000	0.284	249	194.0000	0.284
250	195.0000	0.284	251	196.0000	0.284	252	197.0000	0.284
253	198.0000	0.284	254	199.0000	0.284	255	200.0000	0.284
256	201.0000	0.284	257	202.0000	0.284	258	203.0000	0.284
259	204.0000	0.278	260	205.0000	0.271	261	206.0000	0.278
262	207.0000	0.271	263	208.0000	0.271	264	209.0000	0.271
265	210.0000	0.271						

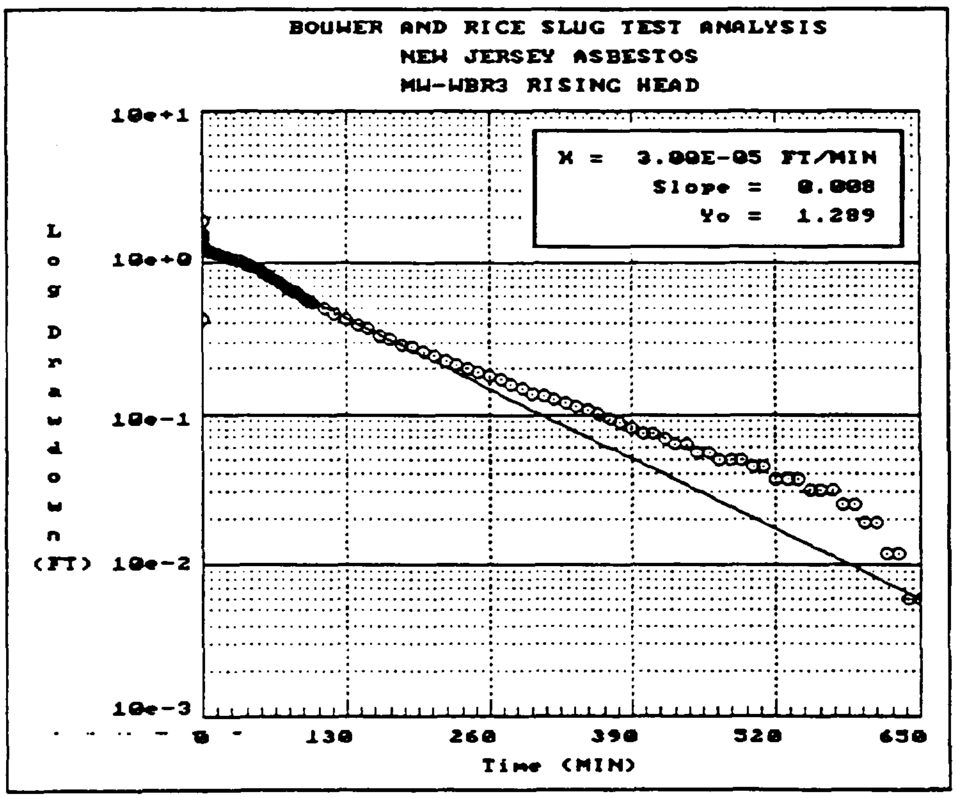
NEW JERSEY ASBESTOS
MW-WBR3 RISING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	3.00E-05 FT/MIN
Well Screen Ratio (Le/rw):	30.0
A Value:	2.00
B Value:	0.31
Dimensionless Ratio ln(Re/rw):	2.61

Well/Aquifer Paramaters

Depth of well:	11.05	FT
Length of well screen:	10.00	FT
Saturated thickness:	11.00	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



NEW JERSEY ASBESTOS
MW-WBR3 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	1.378	2	0.0033	1.378	3	0.0066	0.429
4	0.0100	1.529	5	0.0133	1.846	6	0.0166	1.542
7	0.0200	1.435	8	0.0233	1.447	9	0.0266	1.454
10	0.0300	1.454	11	0.0333	1.473	12	0.0500	1.428
13	0.0666	1.390	14	0.0833	1.365	15	0.1000	1.340
16	0.1166	1.327	17	0.1333	1.315	18	0.1500	1.308
19	0.1666	1.302	20	0.1833	1.289	21	0.2000	1.289
22	0.2166	1.283	23	0.2333	1.277	24	0.2500	1.277
25	0.2666	1.270	26	0.2833	1.270	27	0.3000	1.264
28	0.3166	1.264	29	0.3333	1.264	30	0.4166	1.251
31	0.5000	1.245	32	0.5833	1.239	33	0.6666	1.239
34	0.7500	1.232	35	0.8333	1.232	36	0.9166	1.232
37	1.0000	1.226	38	1.0833	1.226	39	1.1666	1.226
40	1.2500	1.220	41	1.3333	1.220	42	1.4166	1.220
43	1.5000	1.220	44	1.5833	1.220	45	1.6666	1.220
46	1.7500	1.220	47	1.8333	1.213	48	1.9166	1.213
49	2.0000	1.213	50	2.5000	1.207	51	3.0000	1.201
52	3.5000	1.201	53	4.0000	1.194	54	4.5000	1.194
55	5.0000	1.188	56	5.5000	1.188	57	6.0000	1.182
58	6.5000	1.175	59	7.0000	1.175	60	7.5000	1.169
61	8.0000	1.163	62	8.5000	1.163	63	9.0000	1.163
64	9.5000	1.156	65	10.0000	1.150	66	12.0000	1.144
67	14.0000	1.131	68	16.0000	1.119	69	18.0000	1.106
70	20.0000	1.087	71	22.0000	1.081	72	24.0000	1.068
73	26.0000	1.055	74	28.0000	1.043	75	30.0000	1.030
76	32.0000	1.024	77	34.0000	1.011	78	36.0000	0.998
79	38.0000	0.992	80	40.0000	0.979	81	42.0000	0.967
82	44.0000	0.948	83	46.0000	0.935	84	48.0000	0.916
85	50.0000	0.897	86	52.0000	0.878	87	54.0000	0.859
88	56.0000	0.840	89	58.0000	0.821	90	60.0000	0.809
91	62.0000	0.790	92	64.0000	0.771	93	66.0000	0.758
94	68.0000	0.739	95	70.0000	0.727	96	72.0000	0.714
97	74.0000	0.701	98	76.0000	0.682	99	78.0000	0.670
100	80.0000	0.657	101	82.0000	0.644	102	84.0000	0.632
103	86.0000	0.619	104	88.0000	0.606	105	90.0000	0.594
106	92.0000	0.581	107	94.0000	0.569	108	96.0000	0.562
109	98.0000	0.550	110	100.0000	0.537	111	110.0000	0.499
112	120.0000	0.461	113	130.0000	0.423	114	140.0000	0.391
115	150.0000	0.366	116	160.0000	0.335	117	170.0000	0.316
118	180.0000	0.290	119	190.0000	0.278	120	200.0000	0.259
121	210.0000	0.246	122	220.0000	0.227	123	230.0000	0.215
124	240.0000	0.202	125	250.0000	0.189	126	260.0000	0.183
127	270.0000	0.170	128	280.0000	0.158	129	290.0000	0.151
130	300.0000	0.139	131	310.0000	0.132	132	320.0000	0.126
133	330.0000	0.120	134	340.0000	0.113	135	350.0000	0.107
136	360.0000	0.101	137	370.0000	0.094	138	380.0000	0.088
139	390.0000	0.082	140	400.0000	0.075	141	410.0000	0.075
142	420.0000	0.069	143	430.0000	0.063	144	440.0000	0.063
145	450.0000	0.056	146	460.0000	0.056	147	470.0000	0.050
148	480.0000	0.050	149	490.0000	0.050	150	500.0000	0.044
151	510.0000	0.044	152	520.0000	0.037	153	530.0000	0.037

NEW JERSEY ASBESTOS
MW-WBR3 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
154	540.0000	0.037	155	550.0000	0.031	156	560.0000	0.031
157	570.0000	0.031	158	580.0000	0.025	159	590.0000	0.025
160	600.0000	0.019	161	610.0000	0.019	162	620.0000	0.012
163	630.0000	0.012	164	640.0000	0.006	165	650.0000	0.006

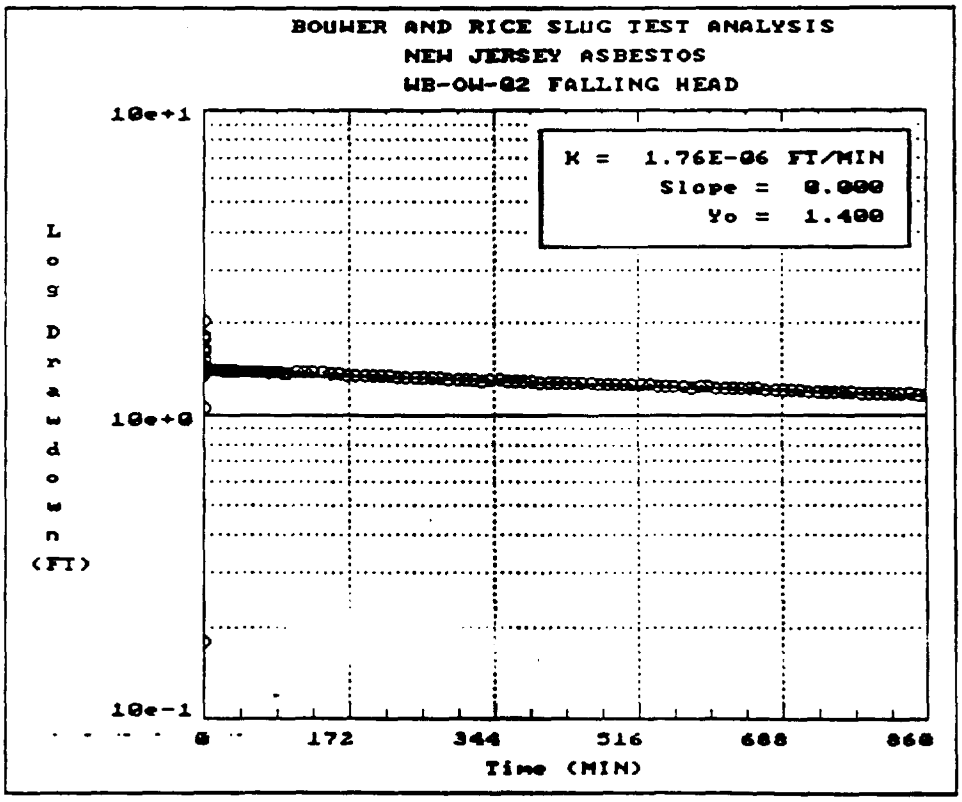
NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	1.76E-06 FT/MIN
Well Screen Ratio (Le/rw):	15.0
C Value:	1.50
Dimensionless Ratio ln(Re/rw):	2.89

Well/Aquifer Paramaters

Depth of well:	29.38	FT
Length of well screen:	5.00	FT
Saturated thickness:	29.38	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 10-05-1992

NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	1.448	2	0.0033	1.512	3	0.0066	1.794
4	0.0100	1.769	5	0.0133	1.810	6	0.0166	1.645
7	0.0200	0.177	8	0.0233	1.048	9	0.0266	1.607
10	0.0300	2.020	11	0.0333	1.353	12	0.0500	1.369
13	0.0666	1.442	14	0.0833	1.445	15	0.1000	1.442
16	0.1166	1.445	17	0.1333	1.442	18	0.1500	1.442
19	0.1666	1.442	20	0.1833	1.442	21	0.2000	1.442
22	0.2166	1.442	23	0.2333	1.442	24	0.2500	1.442
25	0.2666	1.442	26	0.2833	1.442	27	0.3000	1.439
28	0.3166	1.442	29	0.3333	1.439	30	0.4166	1.439
31	0.5000	1.439	32	0.5833	1.439	33	0.6666	1.435
34	0.7500	1.435	35	0.8333	1.432	36	0.9166	1.432
37	1.0000	1.432	38	1.0833	1.429	39	1.1666	1.432
40	1.2500	1.429	41	1.3333	1.429	42	1.4166	1.429
43	1.5000	1.426	44	1.5833	1.426	45	1.6666	1.423
46	1.7500	1.423	47	1.8333	1.423	48	1.9166	1.423
49	2.0000	1.419	50	2.5000	1.419	51	3.0000	1.416
52	3.5000	1.416	53	4.0000	1.413	54	4.5000	1.410
55	5.0000	1.410	56	5.5000	1.410	57	6.0000	1.407
58	6.5000	1.404	59	7.0000	1.404	60	7.5000	1.400
61	8.0000	1.400	62	8.5000	1.397	63	9.0000	1.397
64	9.5000	1.394	65	10.0000	1.394	66	12.0000	1.394
67	14.0000	1.394	68	16.0000	1.394	69	18.0000	1.394
70	20.0000	1.391	71	22.0000	1.391	72	24.0000	1.388
73	26.0000	1.391	74	28.0000	1.394	75	30.0000	1.391
76	32.0000	1.388	77	34.0000	1.391	78	36.0000	1.381
79	38.0000	1.391	80	40.0000	1.388	81	42.0000	1.385
82	44.0000	1.381	83	46.0000	1.385	84	48.0000	1.381
85	50.0000	1.385	86	52.0000	1.381	87	54.0000	1.381
88	56.0000	1.385	89	58.0000	1.378	90	60.0000	1.381
91	62.0000	1.378	92	64.0000	1.381	93	66.0000	1.378
94	68.0000	1.375	95	70.0000	1.375	96	72.0000	1.375
97	74.0000	1.378	98	76.0000	1.369	99	78.0000	1.372
100	80.0000	1.375	101	82.0000	1.372	102	84.0000	1.372
103	86.0000	1.372	104	88.0000	1.372	105	90.0000	1.372
106	92.0000	1.369	107	94.0000	1.365	108	96.0000	1.369
109	98.0000	1.369	110	100.0000	1.365	111	110.0000	1.372
112	120.0000	1.372	113	130.0000	1.378	114	140.0000	1.372
115	150.0000	1.365	116	160.0000	1.359	117	170.0000	1.350
118	180.0000	1.350	119	190.0000	1.343	120	200.0000	1.343
121	210.0000	1.340	122	220.0000	1.337	123	230.0000	1.331
124	240.0000	1.331	125	250.0000	1.324	126	260.0000	1.321
127	270.0000	1.324	128	280.0000	1.318	129	290.0000	1.311
130	300.0000	1.302	131	310.0000	1.305	132	320.0000	1.305
133	330.0000	1.296	134	340.0000	1.299	135	350.0000	1.299
136	360.0000	1.289	137	370.0000	1.286	138	380.0000	1.289
139	390.0000	1.283	140	400.0000	1.273	141	410.0000	1.280
142	420.0000	1.270	143	430.0000	1.270	144	440.0000	1.270
145	450.0000	1.264	146	460.0000	1.267	147	470.0000	1.261
148	480.0000	1.261	149	490.0000	1.257	150	500.0000	1.251

NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
151	510.0000	1.248	152	520.0000	1.248	153	530.0000	1.251
154	540.0000	1.242	155	550.0000	1.242	156	560.0000	1.242
157	570.0000	1.235	158	580.0000	1.229	159	590.0000	1.235
160	600.0000	1.232	161	610.0000	1.229	162	620.0000	1.226
163	630.0000	1.222	164	640.0000	1.219	165	650.0000	1.216
166	660.0000	1.213	167	670.0000	1.210	168	680.0000	1.210
169	690.0000	1.207	170	700.0000	1.200	171	710.0000	1.200
172	720.0000	1.194	173	730.0000	1.194	174	740.0000	1.188
175	750.0000	1.191	176	760.0000	1.181	177	770.0000	1.181
178	780.0000	1.178	179	790.0000	1.178	180	800.0000	1.175
181	810.0000	1.175	182	820.0000	1.172	183	830.0000	1.168
184	840.0000	1.165	185	850.0000	1.156	186	860.0000	1.162

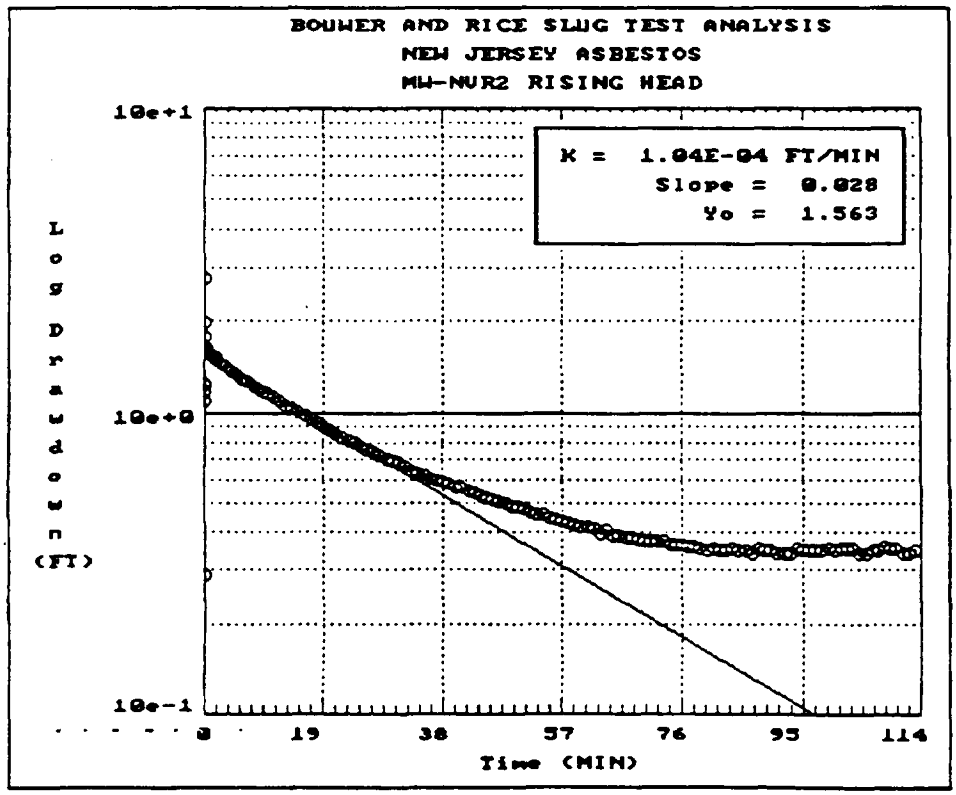
NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	1.04E-04 FT/MIN
Well Screen Ratio (Le/rw):	30.0
C Value:	2.05
Dimensionless Ratio ln(Re/rw):	2.65

Well/Aquifer Paramaters

Depth of well:	11.68	FT
Length of well screen:	10.00	FT
Saturated thickness:	11.68	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	0.290	2	0.0033	2.756	3	0.0066	1.232
4	0.0100	1.100	5	0.0133	1.169	6	0.0166	1.656
7	0.0200	1.985	8	0.0233	1.770	9	0.0266	1.599
10	0.0300	1.593	11	0.0333	1.618	12	0.0500	1.637
13	0.0666	1.605	14	0.0833	1.650	15	0.1000	1.631
16	0.1166	1.631	17	0.1333	1.624	18	0.1500	1.624
19	0.1666	1.624	20	0.1833	1.624	21	0.2000	1.618
22	0.2166	1.618	23	0.2333	1.618	24	0.2500	1.618
25	0.2666	1.618	26	0.2833	1.618	27	0.3000	1.618
28	0.3166	1.612	29	0.3333	1.612	30	0.4166	1.599
31	0.5000	1.593	32	0.5833	1.586	33	0.6666	1.580
34	0.7500	1.574	35	0.8333	1.567	36	0.9166	1.561
37	1.0000	1.555	38	1.0833	1.549	39	1.1666	1.542
40	1.2500	1.542	41	1.3333	1.536	42	1.4166	1.530
43	1.5000	1.523	44	1.5833	1.523	45	1.6666	1.517
46	1.7500	1.517	47	1.8333	1.511	48	1.9166	1.485
49	2.0000	1.498	50	2.5000	1.466	51	3.0000	1.441
52	3.5000	1.416	53	4.0000	1.390	54	4.5000	1.365
55	5.0000	1.340	56	5.5000	1.321	57	6.0000	1.296
58	6.5000	1.277	59	7.0000	1.264	60	7.5000	1.245
61	8.0000	1.226	62	8.5000	1.207	63	9.0000	1.188
64	9.5000	1.176	65	10.0000	1.157	66	11.0000	1.125
67	12.0000	1.087	68	13.0000	1.055	69	14.0000	1.030
70	15.0000	1.005	71	16.0000	0.973	72	17.0000	0.954
73	18.0000	0.923	74	19.0000	0.897	75	20.0000	0.878
76	21.0000	0.859	77	22.0000	0.834	78	23.0000	0.809
79	24.0000	0.796	80	25.0000	0.777	81	26.0000	0.758
82	27.0000	0.746	83	28.0000	0.727	84	29.0000	0.708
85	30.0000	0.695	86	31.0000	0.682	87	32.0000	0.663
88	33.0000	0.644	89	34.0000	0.632	90	35.0000	0.625
91	36.0000	0.606	92	37.0000	0.600	93	38.0000	0.588
94	39.0000	0.581	95	40.0000	0.569	96	41.0000	0.562
97	42.0000	0.550	98	43.0000	0.543	99	44.0000	0.531
100	45.0000	0.524	101	46.0000	0.512	102	47.0000	0.505
103	48.0000	0.499	104	49.0000	0.486	105	50.0000	0.486
106	51.0000	0.480	107	52.0000	0.467	108	53.0000	0.461
109	54.0000	0.461	110	55.0000	0.448	111	56.0000	0.442
112	57.0000	0.436	113	58.0000	0.429	114	59.0000	0.423
115	60.0000	0.417	116	61.0000	0.417	117	62.0000	0.410
118	63.0000	0.398	119	64.0000	0.404	120	65.0000	0.391
121	66.0000	0.391	122	67.0000	0.385	123	68.0000	0.385
124	69.0000	0.379	125	70.0000	0.373	126	71.0000	0.373
127	72.0000	0.373	128	73.0000	0.373	129	74.0000	0.366
130	75.0000	0.366	131	76.0000	0.366	132	77.0000	0.360
133	78.0000	0.360	134	79.0000	0.354	135	80.0000	0.347
136	81.0000	0.354	137	82.0000	0.347	138	83.0000	0.347
139	84.0000	0.354	140	85.0000	0.347	141	86.0000	0.347
142	87.0000	0.341	143	88.0000	0.354	144	89.0000	0.347
145	90.0000	0.347	146	91.0000	0.341	147	92.0000	0.341
148	93.0000	0.341	149	94.0000	0.354	150	95.0000	0.347

NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
151	96.0000	0.347	152	97.0000	0.347	153	98.0000	0.347
154	99.0000	0.354	155	100.0000	0.347	156	101.0000	0.354
157	102.0000	0.354	158	103.0000	0.354	159	104.0000	0.341
160	105.0000	0.341	161	106.0000	0.347	162	107.0000	0.347
163	108.0000	0.360	164	109.0000	0.354	165	110.0000	0.354
166	111.0000	0.341	167	112.0000	0.341	168	113.0000	0.347

BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 10-05-1992

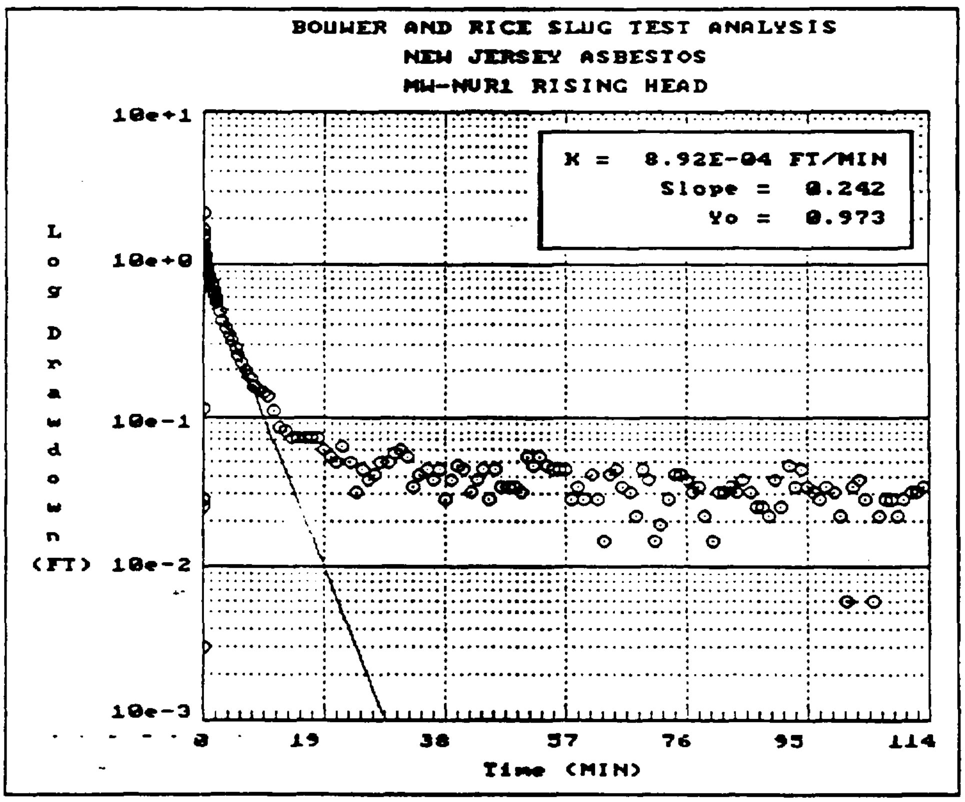
NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC

Results

Hydraulic Conductivity:	8.92E-04 FT/MIN
Well Screen Ratio (Le/rw):	30.0
C Value:	2.05
Dimensionless Ratio ln(Re/rw):	2.66

Well/Aquifer Paramaters

Depth of well:	11.91	FT
Length of well screen:	10.00	FT
Saturated thickness:	11.91	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT



NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
1	0.0000	0.003	2	0.0033	0.028	3	0.0066	0.025
4	0.0100	0.114	5	0.0133	1.016	6	0.0166	2.153
7	0.0200	1.562	8	0.0233	0.724	9	0.0266	1.457
10	0.0300	1.657	11	0.0333	1.241	12	0.0500	1.292
13	0.0666	1.254	14	0.0833	1.209	15	0.1000	1.190
16	0.1166	1.171	17	0.1333	1.155	18	0.1500	1.143
19	0.1666	1.130	20	0.1833	1.121	21	0.2000	1.111
22	0.2166	1.102	23	0.2333	1.092	24	0.2500	1.079
25	0.2666	1.070	26	0.2833	1.060	27	0.3000	1.057
28	0.3166	1.048	29	0.3333	1.038	30	0.4166	1.000
31	0.5000	0.962	32	0.5833	0.927	33	0.6666	0.895
34	0.7500	0.866	35	0.8333	0.838	36	0.9166	0.809
37	1.0000	0.787	38	1.0833	0.765	39	1.1666	0.746
40	1.2500	0.724	41	1.3333	0.705	42	1.4166	0.685
43	1.5000	0.666	44	1.5833	0.647	45	1.6666	0.628
46	1.7500	0.612	47	1.8333	0.597	48	1.9166	0.581
49	2.0000	0.565	50	2.5000	0.485	51	3.0000	0.428
52	3.5000	0.381	53	4.0000	0.342	54	4.5000	0.314
55	5.0000	0.282	56	5.5000	0.250	57	6.0000	0.225
58	6.5000	0.203	59	7.0000	0.184	60	7.5000	0.174
61	8.0000	0.158	62	8.5000	0.155	63	9.0000	0.149
64	9.5000	0.146	65	10.0000	0.136	66	11.0000	0.111
67	12.0000	0.085	68	13.0000	0.082	69	14.0000	0.073
70	15.0000	0.073	71	16.0000	0.073	72	17.0000	0.073
73	18.0000	0.073	74	19.0000	0.060	75	20.0000	0.054
76	21.0000	0.050	77	22.0000	0.063	78	23.0000	0.050
79	24.0000	0.031	80	25.0000	0.044	81	26.0000	0.038
82	27.0000	0.041	83	28.0000	0.050	84	29.0000	0.050
85	30.0000	0.057	86	31.0000	0.060	87	32.0000	0.054
88	33.0000	0.034	89	34.0000	0.041	90	35.0000	0.044
91	36.0000	0.038	92	37.0000	0.044	93	38.0000	0.028
94	39.0000	0.038	95	40.0000	0.047	96	41.0000	0.044
97	42.0000	0.031	98	43.0000	0.038	99	44.0000	0.044
100	45.0000	0.028	101	46.0000	0.044	102	47.0000	0.034
103	48.0000	0.034	104	49.0000	0.034	105	50.0000	0.031
106	51.0000	0.054	107	52.0000	0.047	108	53.0000	0.054
109	54.0000	0.047	110	55.0000	0.044	111	56.0000	0.044
112	57.0000	0.044	113	58.0000	0.028	114	59.0000	0.034
115	60.0000	0.028	116	61.0000	0.041	117	62.0000	0.028
118	63.0000	0.015	119	64.0000	0.041	120	65.0000	0.044
121	66.0000	0.034	122	67.0000	0.031	123	68.0000	0.022
124	69.0000	0.044	125	70.0000	0.038	126	71.0000	0.015
127	72.0000	0.019	128	73.0000	0.028	129	74.0000	0.041
130	75.0000	0.041	131	76.0000	0.038	132	77.0000	0.031
133	78.0000	0.034	134	79.0000	0.022	135	80.0000	0.015
136	81.0000	0.031	137	82.0000	0.031	138	83.0000	0.034
139	84.0000	0.031	140	85.0000	0.038	141	86.0000	0.031
142	87.0000	0.025	143	88.0000	0.025	144	89.0000	0.022
145	90.0000	0.038	146	91.0000	0.025	147	92.0000	0.047
148	93.0000	0.034	149	94.0000	0.044	150	95.0000	0.034

BOUWER AND RICE INTERACTIVE SLUG TEST ANALYSIS 10-05-1992

NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC

Time vs Drawdown Data

No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)	No.	Time (MIN)	Drawdown (FT)
151	96.0000	0.031	152	97.0000	0.028	153	98.0000	0.034
154	99.0000	0.031	155	100.0000	0.022	156	101.0000	0.006
157	102.0000	0.034	158	103.0000	0.038	159	104.0000	0.028
160	105.0000	0.006	161	106.0000	0.022	162	107.0000	0.028
163	108.0000	0.028	164	109.0000	0.022	165	110.0000	0.028
166	111.0000	0.031	167	112.0000	0.031	168	113.0000	0.034

Appendix H

Hvorslev Analysis

HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 10-06-1992

NEW JERSEY ASBESTOS
NV-OW-01
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

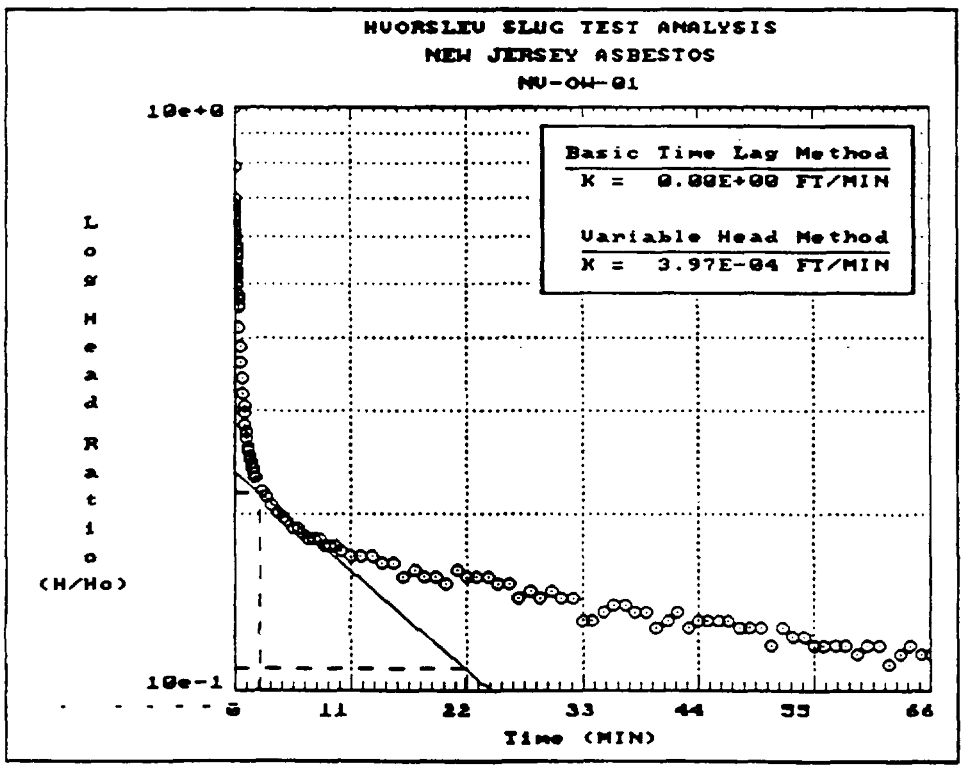
Hydraulic Conductivity:	0.00E+00 FT/MIN
Basic Time Lag:	0.00 MIN
Equalization Ratio:	0.00 MIN

Variable Head

Hydraulic Conductivity:	3.97E-04 FT/MIN
Time Coordinate T1:	2.4 MIN
Time Coordinate T2:	21.9 MIN
Head Ratio Coordinate H1:	21.70E-02
Head Ratio Coordinate H2:	10.90E-02

Well/Aquifer Parameters

Length of well screen:	2.52	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT
Kh/Kv ratio:	1.0	



NEW JERSEY ASBESTOS
NV-OW-01
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0010	1.000	2	0.0033	0.789	3	0.0066	0.698
4	0.0100	0.682	5	0.0133	0.636	6	0.0166	0.665
7	0.0200	0.648	8	0.0233	0.653	9	0.0266	0.644
10	0.0300	0.644	11	0.0333	0.644	12	0.0500	0.624
13	0.0666	0.607	14	0.0833	0.595	15	0.1000	0.582
16	0.1166	0.575	17	0.1333	0.562	18	0.1500	0.550
19	0.1666	0.541	20	0.1833	0.529	21	0.2000	0.520
22	0.2166	0.512	23	0.2333	0.500	24	0.2500	0.495
25	0.2666	0.483	26	0.2833	0.475	27	0.3000	0.471
28	0.3166	0.458	29	0.3333	0.454	30	0.4166	0.417
31	0.5000	0.388	32	0.5833	0.363	33	0.6666	0.342
34	0.7500	0.322	35	0.8333	0.306	36	0.9166	0.297
37	1.0000	0.285	38	1.0833	0.276	39	1.1666	0.269
40	1.2500	0.260	41	1.3333	0.256	42	1.4166	0.252
43	1.5000	0.248	44	1.5833	0.244	45	1.6666	0.239
46	1.7500	0.239	47	1.8333	0.235	48	1.9166	0.231
49	2.0000	0.231	50	2.5000	0.219	51	3.0000	0.214
52	3.5000	0.207	53	4.0000	0.202	54	4.5000	0.198
55	5.0000	0.194	56	5.5000	0.190	57	6.0000	0.190
58	6.5000	0.186	59	7.0000	0.182	60	7.5000	0.182
61	8.0000	0.182	62	8.5000	0.177	63	9.0000	0.177
64	9.5000	0.177	65	10.0000	0.173	66	11.0000	0.169
67	12.0000	0.169	68	13.0000	0.169	69	14.0000	0.165
70	15.0000	0.165	71	16.0000	0.157	72	17.0000	0.161
73	18.0000	0.157	74	19.0000	0.157	75	20.0000	0.152
76	21.0000	0.161	77	22.0000	0.157	78	23.0000	0.157
79	24.0000	0.157	80	25.0000	0.152	81	26.0000	0.152
82	27.0000	0.144	83	28.0000	0.148	84	29.0000	0.144
85	30.0000	0.148	86	31.0000	0.144	87	32.0000	0.144
88	33.0000	0.132	89	34.0000	0.132	90	35.0000	0.136
91	36.0000	0.141	92	37.0000	0.141	93	38.0000	0.136
94	39.0000	0.136	95	40.0000	0.128	96	41.0000	0.132
97	42.0000	0.136	98	43.0000	0.128	99	44.0000	0.132
100	45.0000	0.132	101	46.0000	0.132	102	47.0000	0.132
103	48.0000	0.128	104	49.0000	0.128	105	50.0000	0.128
106	51.0000	0.120	107	52.0000	0.128	108	53.0000	0.124
109	54.0000	0.124	110	55.0000	0.120	111	56.0000	0.120
112	57.0000	0.120	113	58.0000	0.120	114	59.0000	0.116
115	60.0000	0.120	116	61.0000	0.120	117	62.0000	0.111
118	63.0000	0.116	119	64.0000	0.120	120	65.0000	0.116
121	66.0000	0.116						

HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 10-06-1992

NEW JERSEY ASBESTOS
WB-OW-01 FALLING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

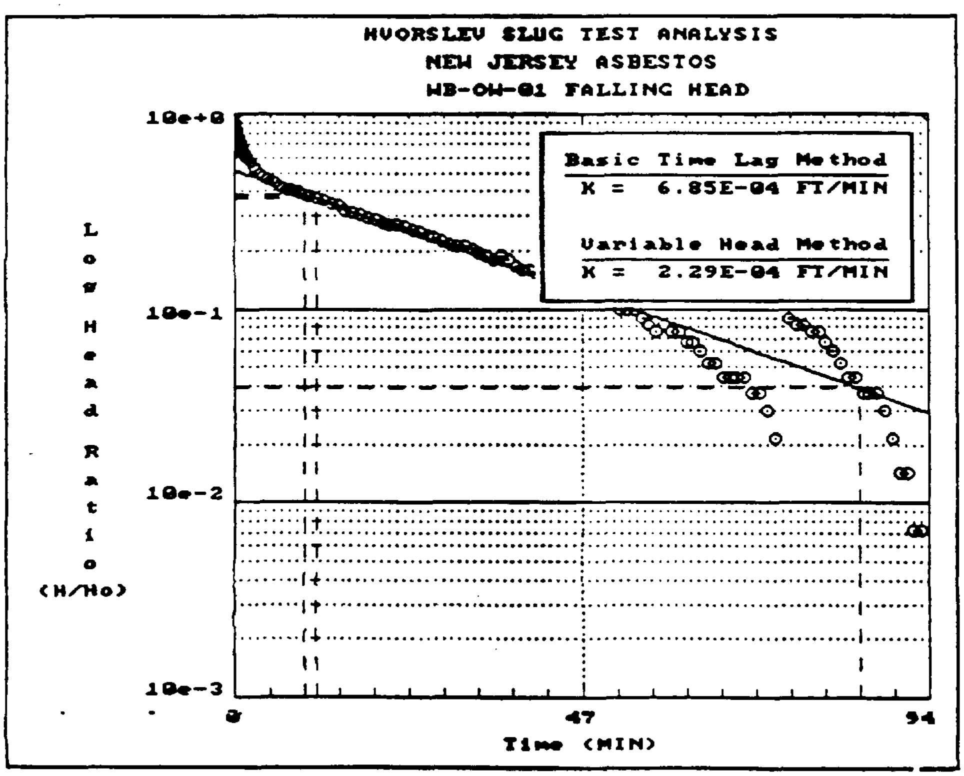
Hydraulic Conductivity:	6.85E-04 FT/MIN
Basic Time Lag:	10.95 MIN
Equalization Ratio:	25.19 MIN

Variable Head

Hydraulic Conductivity:	2.29E-04 FT/MIN
Time Coordinate T1:	9.4 MIN
Time Coordinate T2:	84.6 MIN
Head Ratio Coordinate H1:	38.79E-02
Head Ratio Coordinate H2:	39.06E-03

Well/Aquifer Parameters

Length of well screen:	5.00 FT
Diameter of the well casing:	0.333 FT
Diameter of the well filter:	0.667 FT
Kh/Kv ratio:	1.0



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HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 10-06-1992

NEW JERSEY ASBESTOS
WB-OW-01 FALLING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.651	2	0.0033	0.833	3	0.0066	1.000
4	0.0100	0.863	5	0.0133	0.773	6	0.0166	0.909
7	0.0200	0.909	8	0.0233	0.894	9	0.0266	0.872
10	0.0300	0.849	11	0.0333	0.863	12	0.0500	0.872
13	0.0666	0.841	14	0.0833	0.863	15	0.1000	0.872
16	0.1166	0.849	17	0.1333	0.833	18	0.1500	0.833
19	0.1666	0.826	20	0.1833	0.826	21	0.2000	0.818
22	0.2166	0.811	23	0.2333	0.803	24	0.2500	0.803
25	0.2666	0.803	26	0.2833	0.796	27	0.3000	0.788
28	0.3166	0.788	29	0.3333	0.781	30	0.4166	0.765
31	0.5000	0.751	32	0.5833	0.735	33	0.6666	0.719
34	0.7500	0.705	35	0.8333	0.689	36	0.9166	0.682
37	1.0000	0.674	38	1.0833	0.659	39	1.1666	0.651
40	1.2500	0.637	41	1.3333	0.628	42	1.4166	0.621
43	1.5000	0.606	44	1.5833	0.606	45	1.6666	0.598
46	1.7500	0.583	47	1.8333	0.583	48	1.9166	0.583
49	2.0000	0.576	50	2.5000	0.538	51	3.0000	0.516
52	3.5000	0.500	53	4.0000	0.477	54	4.5000	0.470
55	5.0000	0.454	56	5.5000	0.447	57	6.0000	0.432
58	6.5000	0.424	59	7.0000	0.416	60	7.5000	0.409
61	8.0000	0.402	62	8.5000	0.402	63	9.0000	0.393
64	9.5000	0.386	65	10.0000	0.379	66	11.0000	0.371
67	12.0000	0.363	68	13.0000	0.348	69	14.0000	0.341
70	15.0000	0.325	71	16.0000	0.318	72	17.0000	0.311
73	18.0000	0.295	74	19.0000	0.288	75	20.0000	0.281
76	21.0000	0.272	77	22.0000	0.272	78	23.0000	0.265
79	24.0000	0.258	80	25.0000	0.249	81	26.0000	0.242
82	27.0000	0.235	83	28.0000	0.227	84	29.0000	0.219
85	30.0000	0.212	86	31.0000	0.212	87	32.0000	0.204
88	33.0000	0.197	89	34.0000	0.189	90	35.0000	0.181
91	36.0000	0.189	92	37.0000	0.181	93	38.0000	0.167
94	39.0000	0.158	95	40.0000	0.158	96	41.0000	0.151
97	42.0000	0.144	98	43.0000	0.135	99	44.0000	0.135
100	45.0000	0.144	101	46.0000	0.135	102	47.0000	0.121
103	48.0000	0.121	104	49.0000	0.113	105	50.0000	0.106
106	51.0000	0.106	107	52.0000	0.098	108	53.0000	0.098
109	54.0000	0.098	110	55.0000	0.090	111	56.0000	0.083
112	57.0000	0.076	113	58.0000	0.083	114	59.0000	0.076
115	60.0000	0.076	116	61.0000	0.067	117	62.0000	0.067
118	63.0000	0.060	119	64.0000	0.053	120	65.0000	0.053
121	66.0000	0.044	122	67.0000	0.044	123	68.0000	0.044
124	69.0000	0.044	125	70.0000	0.037	126	71.0000	0.037
127	72.0000	0.030	128	73.0000	0.022	129	74.0000	0.113
130	75.0000	0.090	131	76.0000	0.083	132	77.0000	0.083
133	78.0000	0.076	134	79.0000	0.076	135	80.0000	0.067
136	81.0000	0.060	137	82.0000	0.053	138	83.0000	0.044
139	84.0000	0.044	140	85.0000	0.037	141	86.0000	0.037
142	87.0000	0.037	143	88.0000	0.030	144	89.0000	0.022
145	90.0000	0.014	146	91.0000	0.014	147	92.0000	0.007
148	93.0000	0.007	149	94.0000	1.000	150	0.0000	1.000

NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

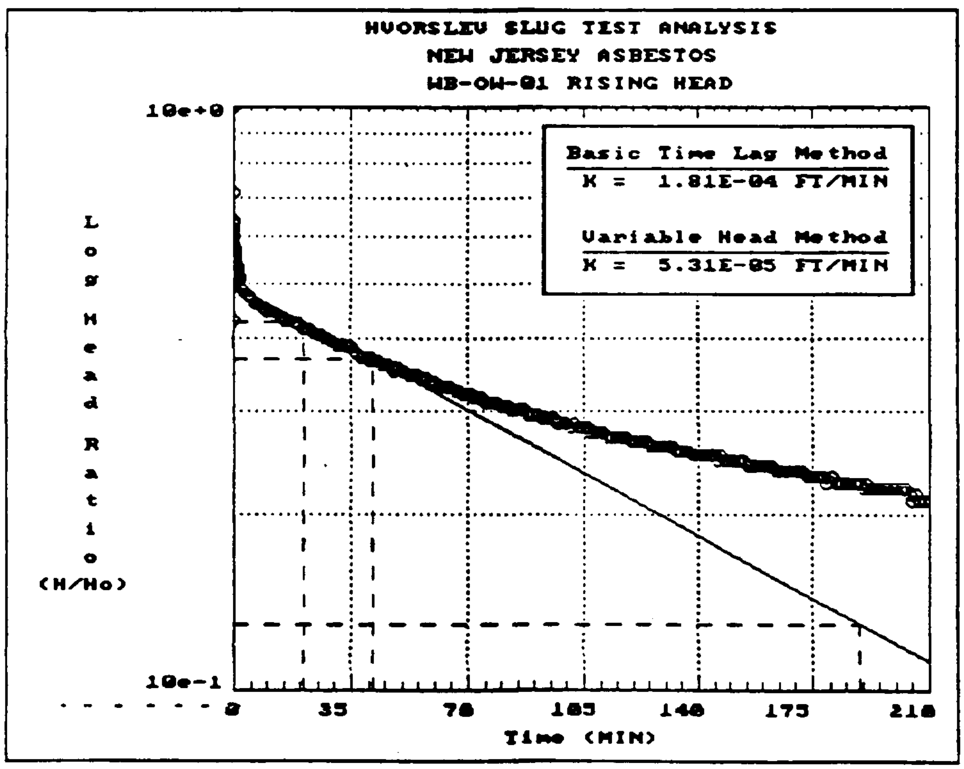
Hydraulic Conductivity:	1.81E-04 FT/MIN
Basic Time Lag:	41.38 MIN
Equalization Ratio:	95.17 MIN

Variable Head

Hydraulic Conductivity:	5.31E-05 FT/MIN
Time Coordinate T1:	21.0 MIN
Time Coordinate T2:	189.0 MIN
Head Ratio Coordinate H1:	42.74E-02
Head Ratio Coordinate H2:	13.02E-02

Well/Aquifer Parameters

Length of well screen:	5.00	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT
Kh/Kv ratio:	1.0	



NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.713	2	0.0033	0.431	3	0.0066	1.000
4	0.0100	0.594	5	0.0133	0.638	6	0.0166	0.638
7	0.0200	0.629	8	0.0233	0.629	9	0.0266	0.629
10	0.0300	0.629	11	0.0333	0.629	12	0.0500	0.619
13	0.0666	0.614	14	0.0833	0.614	15	0.1000	0.608
16	0.1166	0.604	17	0.1333	0.599	18	0.1500	0.599
19	0.1666	0.594	20	0.1833	0.594	21	0.2000	0.589
22	0.2166	0.589	23	0.2333	0.584	24	0.2500	0.579
25	0.2666	0.579	26	0.2833	0.574	27	0.3000	0.574
28	0.3166	0.569	29	0.3333	0.569	30	0.4166	0.559
31	0.5000	0.554	32	0.5833	0.549	33	0.6666	0.544
34	0.7500	0.540	35	0.8333	0.534	36	0.9166	0.534
37	1.0000	0.529	38	1.0833	0.525	39	1.1666	0.525
40	1.2500	0.520	41	1.3333	0.520	42	1.4166	0.514
43	1.5000	0.514	44	1.5833	0.510	45	1.6666	0.510
46	1.7500	0.510	47	1.8333	0.505	48	1.9166	0.505
49	2.0000	0.505	50	2.5000	0.490	51	3.0000	0.485
52	3.5000	0.480	53	4.0000	0.475	54	4.5000	0.475
55	5.0000	0.470	56	5.5000	0.470	57	6.0000	0.465
58	6.5000	0.460	59	7.0000	0.460	60	7.5000	0.460
61	8.0000	0.455	62	8.5000	0.455	63	9.0000	0.450
64	9.5000	0.450	65	10.0000	0.446	66	11.0000	0.446
67	12.0000	0.446	68	13.0000	0.440	69	14.0000	0.435
70	15.0000	0.431	71	16.0000	0.431	72	17.0000	0.431
73	18.0000	0.425	74	19.0000	0.425	75	20.0000	0.421
76	21.0000	0.416	77	22.0000	0.416	78	23.0000	0.416
79	24.0000	0.410	80	25.0000	0.406	81	26.0000	0.406
82	27.0000	0.401	83	28.0000	0.401	84	29.0000	0.395
85	30.0000	0.395	86	31.0000	0.391	87	32.0000	0.391
88	33.0000	0.391	89	34.0000	0.386	90	35.0000	0.386
91	36.0000	0.381	92	37.0000	0.376	93	38.0000	0.371
94	39.0000	0.371	95	40.0000	0.366	96	41.0000	0.371
97	42.0000	0.366	98	43.0000	0.366	99	44.0000	0.361
100	45.0000	0.361	101	46.0000	0.361	102	47.0000	0.356
103	48.0000	0.351	104	49.0000	0.356	105	50.0000	0.351
106	51.0000	0.351	107	52.0000	0.346	108	53.0000	0.346
109	54.0000	0.346	110	55.0000	0.346	111	56.0000	0.341
112	57.0000	0.341	113	58.0000	0.341	114	59.0000	0.337
115	60.0000	0.337	116	61.0000	0.331	117	62.0000	0.331
118	63.0000	0.331	119	64.0000	0.331	120	65.0000	0.331
121	66.0000	0.327	122	67.0000	0.327	123	68.0000	0.322
124	69.0000	0.322	125	70.0000	0.322	126	71.0000	0.322
127	72.0000	0.316	128	73.0000	0.316	129	74.0000	0.316
130	75.0000	0.312	131	76.0000	0.312	132	77.0000	0.312
133	78.0000	0.312	134	79.0000	0.312	135	80.0000	0.307
136	81.0000	0.307	137	82.0000	0.307	138	83.0000	0.301
139	84.0000	0.301	140	85.0000	0.301	141	86.0000	0.301
142	87.0000	0.301	143	88.0000	0.297	144	89.0000	0.297
145	90.0000	0.297	146	91.0000	0.297	147	92.0000	0.292
148	93.0000	0.292	149	94.0000	0.292	150	95.0000	0.292
151	96.0000	0.292	152	97.0000	0.287	153	98.0000	0.287

NEW JERSEY ASBESTOS
WB-OW-01 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
154	99.0000	0.287	155	100.0000	0.287	156	101.0000	0.282
157	102.0000	0.287	158	103.0000	0.282	159	104.0000	0.282
160	105.0000	0.282	161	106.0000	0.282	162	107.0000	0.277
163	108.0000	0.277	164	109.0000	0.277	165	110.0000	0.277
166	111.0000	0.277	167	112.0000	0.272	168	113.0000	0.272
169	114.0000	0.272	170	115.0000	0.272	171	116.0000	0.272
172	117.0000	0.272	173	118.0000	0.272	174	119.0000	0.267
175	120.0000	0.267	176	121.0000	0.267	177	122.0000	0.267
178	123.0000	0.267	179	124.0000	0.267	180	125.0000	0.262
181	126.0000	0.262	182	127.0000	0.262	183	128.0000	0.262
184	129.0000	0.262	185	130.0000	0.262	186	131.0000	0.262
187	132.0000	0.262	188	133.0000	0.257	189	134.0000	0.257
190	135.0000	0.257	191	136.0000	0.257	192	137.0000	0.257
193	138.0000	0.252	194	139.0000	0.252	195	140.0000	0.252
196	141.0000	0.252	197	142.0000	0.252	198	143.0000	0.252
199	144.0000	0.252	200	145.0000	0.252	201	146.0000	0.247
202	147.0000	0.252	203	148.0000	0.247	204	149.0000	0.247
205	150.0000	0.247	206	151.0000	0.247	207	152.0000	0.247
208	153.0000	0.247	209	154.0000	0.247	210	155.0000	0.242
211	156.0000	0.242	212	157.0000	0.242	213	158.0000	0.242
214	159.0000	0.242	215	160.0000	0.242	216	161.0000	0.242
217	162.0000	0.242	218	163.0000	0.242	219	164.0000	0.237
220	165.0000	0.237	221	166.0000	0.237	222	167.0000	0.237
223	168.0000	0.237	224	169.0000	0.237	225	170.0000	0.237
226	171.0000	0.237	227	172.0000	0.237	228	173.0000	0.233
229	174.0000	0.233	230	175.0000	0.233	231	176.0000	0.233
232	177.0000	0.233	233	178.0000	0.233	234	179.0000	0.227
235	180.0000	0.233	236	181.0000	0.233	237	182.0000	0.227
238	183.0000	0.227	239	184.0000	0.227	240	185.0000	0.227
241	186.0000	0.227	242	187.0000	0.227	243	188.0000	0.227
244	189.0000	0.227	245	190.0000	0.222	246	191.0000	0.227
247	192.0000	0.222	248	193.0000	0.222	249	194.0000	0.222
250	195.0000	0.222	251	196.0000	0.222	252	197.0000	0.222
253	198.0000	0.222	254	199.0000	0.222	255	200.0000	0.222
256	201.0000	0.222	257	202.0000	0.222	258	203.0000	0.222
259	204.0000	0.218	260	205.0000	0.212	261	206.0000	0.218
262	207.0000	0.212	263	208.0000	0.212	264	209.0000	0.212
265	210.0000	0.212						

NEW JERSEY ASBESTOS
MW-WB3 RISING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

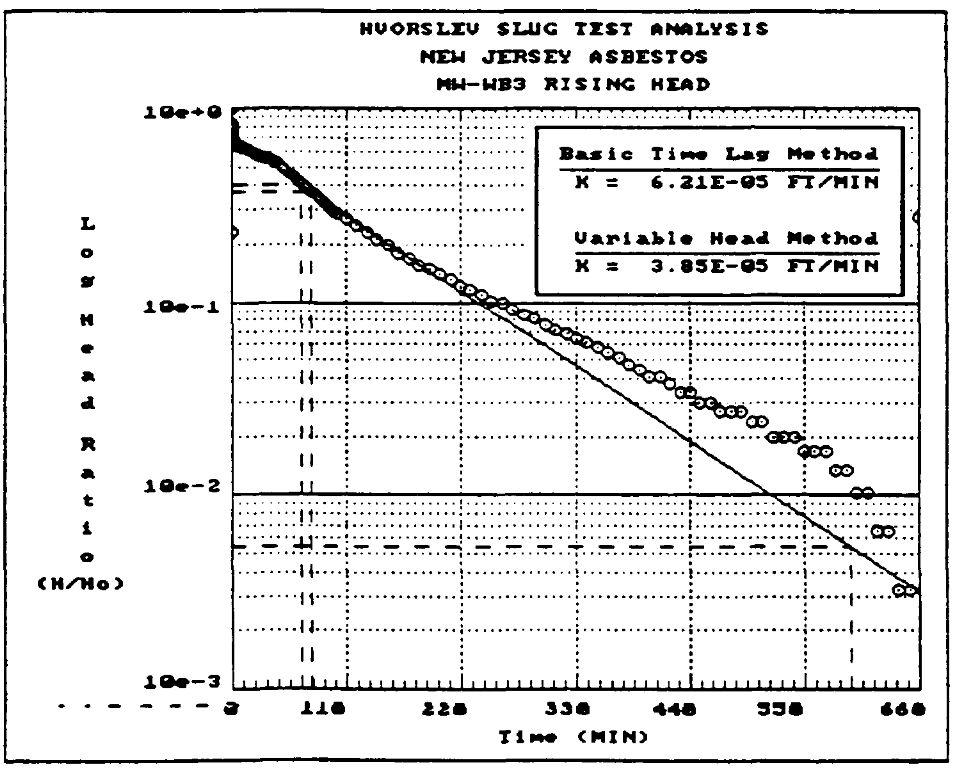
Hydraulic Conductivity:	6.21E-05 FT/MIN
Basic Time Lag:	75.85 MIN
Equalization Ratio:	174.45 MIN

Variable Head

Hydraulic Conductivity:	3.85E-05 FT/MIN
Time Coordinate T1:	66.0 MIN
Time Coordinate T2:	594.0 MIN
Head Ratio Coordinate H1:	40.10E-02
Head Ratio Coordinate H2:	53.95E-04

Well/Aquifer Parameters

Length of well screen:	10.00	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT
Kh/Kv ratio:	1.0	



HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 10-06-1992

NEW JERSEY ASBESTOS
MW-WB3 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.746	2	0.0033	0.746	3	0.0066	0.232
4	0.0100	0.828	5	0.0133	1.000	6	0.0166	0.835
7	0.0200	0.777	8	0.0233	0.784	9	0.0266	0.788
10	0.0300	0.788	11	0.0333	0.798	12	0.0500	0.774
13	0.0666	0.753	14	0.0833	0.739	15	0.1000	0.726
16	0.1166	0.719	17	0.1333	0.712	18	0.1500	0.709
19	0.1666	0.705	20	0.1833	0.698	21	0.2000	0.698
22	0.2166	0.695	23	0.2333	0.692	24	0.2500	0.692
25	0.2666	0.688	26	0.2833	0.688	27	0.3000	0.685
28	0.3166	0.685	29	0.3333	0.685	30	0.4166	0.678
31	0.5000	0.674	32	0.5833	0.671	33	0.6666	0.671
34	0.7500	0.667	35	0.8333	0.667	36	0.9166	0.667
37	1.0000	0.664	38	1.0833	0.664	39	1.1666	0.664
40	1.2500	0.661	41	1.3333	0.661	42	1.4166	0.661
43	1.5000	0.661	44	1.5833	0.661	45	1.6666	0.661
46	1.7500	0.661	47	1.8333	0.657	48	1.9166	0.657
49	2.0000	0.657	50	2.5000	0.654	51	3.0000	0.651
52	3.5000	0.651	53	4.0000	0.647	54	4.5000	0.647
55	5.0000	0.644	56	5.5000	0.644	57	6.0000	0.640
58	6.5000	0.637	59	7.0000	0.637	60	7.5000	0.633
61	8.0000	0.630	62	8.5000	0.630	63	9.0000	0.630
64	9.5000	0.626	65	10.0000	0.623	66	12.0000	0.620
67	14.0000	0.613	68	16.0000	0.606	69	18.0000	0.599
70	20.0000	0.589	71	22.0000	0.586	72	24.0000	0.579
73	26.0000	0.572	74	28.0000	0.565	75	30.0000	0.558
76	32.0000	0.555	77	34.0000	0.548	78	36.0000	0.541
79	38.0000	0.537	80	40.0000	0.530	81	42.0000	0.524
82	44.0000	0.514	83	46.0000	0.507	84	48.0000	0.496
85	50.0000	0.486	86	52.0000	0.476	87	54.0000	0.465
88	56.0000	0.455	89	58.0000	0.445	90	60.0000	0.438
91	62.0000	0.428	92	64.0000	0.418	93	66.0000	0.411
94	68.0000	0.400	95	70.0000	0.394	96	72.0000	0.387
97	74.0000	0.380	98	76.0000	0.369	99	78.0000	0.363
100	80.0000	0.356	101	82.0000	0.349	102	84.0000	0.342
103	86.0000	0.335	104	88.0000	0.328	105	90.0000	0.322
106	92.0000	0.315	107	94.0000	0.308	108	96.0000	0.304
109	98.0000	0.298	110	100.0000	0.291	111	110.0000	0.270
112	120.0000	0.250	113	130.0000	0.229	114	140.0000	0.212
115	150.0000	0.198	116	160.0000	0.181	117	170.0000	0.171
118	180.0000	0.157	119	190.0000	0.151	120	200.0000	0.140
121	210.0000	0.133	122	220.0000	0.123	123	230.0000	0.116
124	240.0000	0.109	125	250.0000	0.102	126	260.0000	0.099
127	270.0000	0.092	128	280.0000	0.086	129	290.0000	0.082
130	300.0000	0.075	131	310.0000	0.072	132	320.0000	0.068
133	330.0000	0.065	134	340.0000	0.061	135	350.0000	0.058
136	360.0000	0.055	137	370.0000	0.051	138	380.0000	0.048
139	390.0000	0.044	140	400.0000	0.041	141	410.0000	0.041
142	420.0000	0.037	143	430.0000	0.034	144	440.0000	0.034
145	450.0000	0.030	146	460.0000	0.030	147	470.0000	0.027
148	480.0000	0.027	149	490.0000	0.027	150	500.0000	0.024
151	510.0000	0.024	152	520.0000	0.020	153	530.0000	0.020

NEW JERSEY ASBESTOS
MW-WB3 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
154	540.0000	0.020	155	550.0000	0.017	156	560.0000	0.017
157	570.0000	0.017	158	580.0000	0.014	159	590.0000	0.014
160	600.0000	0.010	161	610.0000	0.010	162	620.0000	0.007
163	630.0000	0.007	164	640.0000	0.003	165	650.0000	0.003
166	660.0000	0.277						

NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

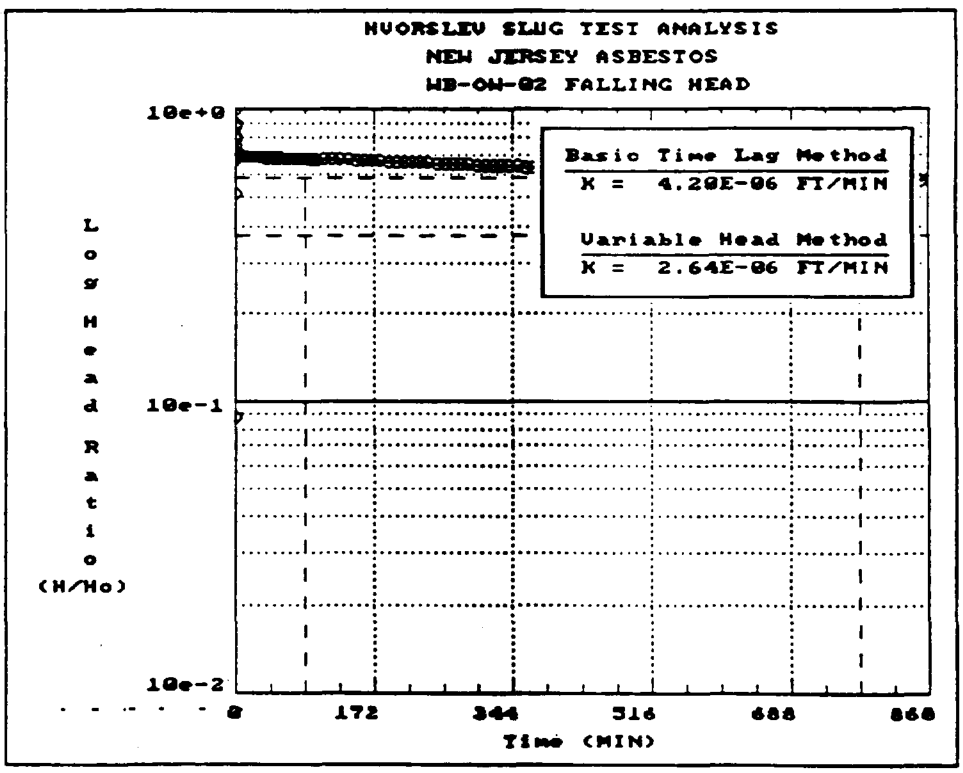
Hydraulic Conductivity:	4.20E-06 FT/MIN
Basic Time Lag:	2852.23 MIN
Equalization Ratio:	6560.13 MIN

Variable Head

Hydraulic Conductivity:	2.64E-06 FT/MIN
Time Coordinate T1:	86.0 MIN
Time Coordinate T2:	774.0 MIN
Head Ratio Coordinate H1:	68.05E-02
Head Ratio Coordinate H2:	58.48E-02

Well/Aquifer Parameters

Length of well screen:	5.00 FT
Diameter of the well casing:	0.333 FT
Diameter of the well filter:	0.667 FT
Kh/Kv ratio:	25.0



NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.717	2	0.0033	0.749	3	0.0066	0.888
4	0.0100	0.876	5	0.0133	0.896	6	0.0166	0.814
7	0.0200	0.088	8	0.0233	0.519	9	0.0266	0.796
10	0.0300	1.000	11	0.0333	0.670	12	0.0500	0.678
13	0.0666	0.714	14	0.0833	0.715	15	0.1000	0.714
16	0.1166	0.715	17	0.1333	0.714	18	0.1500	0.714
19	0.1666	0.714	20	0.1833	0.714	21	0.2000	0.714
22	0.2166	0.714	23	0.2333	0.714	24	0.2500	0.714
25	0.2666	0.714	26	0.2833	0.714	27	0.3000	0.712
28	0.3166	0.714	29	0.3333	0.712	30	0.4166	0.712
31	0.5000	0.712	32	0.5833	0.712	33	0.6666	0.710
34	0.7500	0.710	35	0.8333	0.709	36	0.9166	0.709
37	1.0000	0.709	38	1.0833	0.707	39	1.1666	0.709
40	1.2500	0.707	41	1.3333	0.707	42	1.4166	0.707
43	1.5000	0.706	44	1.5833	0.706	45	1.6666	0.704
46	1.7500	0.704	47	1.8333	0.704	48	1.9166	0.704
49	2.0000	0.702	50	2.5000	0.702	51	3.0000	0.701
52	3.5000	0.701	53	4.0000	0.700	54	4.5000	0.698
55	5.0000	0.698	56	5.5000	0.698	57	6.0000	0.697
58	6.5000	0.695	59	7.0000	0.695	60	7.5000	0.693
61	8.0000	0.693	62	8.5000	0.692	63	9.0000	0.692
64	9.5000	0.690	65	10.0000	0.690	66	12.0000	0.690
67	14.0000	0.690	68	16.0000	0.690	69	18.0000	0.690
70	20.0000	0.689	71	22.0000	0.689	72	24.0000	0.687
73	26.0000	0.689	74	28.0000	0.690	75	30.0000	0.689
76	32.0000	0.687	77	34.0000	0.689	78	36.0000	0.684
79	38.0000	0.689	80	40.0000	0.687	81	42.0000	0.686
82	44.0000	0.684	83	46.0000	0.686	84	48.0000	0.684
85	50.0000	0.686	86	52.0000	0.684	87	54.0000	0.684
88	56.0000	0.686	89	58.0000	0.682	90	60.0000	0.684
91	62.0000	0.682	92	64.0000	0.684	93	66.0000	0.682
94	68.0000	0.681	95	70.0000	0.681	96	72.0000	0.681
97	74.0000	0.682	98	76.0000	0.678	99	78.0000	0.679
100	80.0000	0.681	101	82.0000	0.679	102	84.0000	0.679
103	86.0000	0.679	104	88.0000	0.679	105	90.0000	0.679
106	92.0000	0.678	107	94.0000	0.676	108	96.0000	0.678
109	98.0000	0.678	110	100.0000	0.676	111	110.0000	0.679
112	120.0000	0.679	113	130.0000	0.682	114	140.0000	0.679
115	150.0000	0.676	116	160.0000	0.673	117	170.0000	0.668
118	180.0000	0.668	119	190.0000	0.665	120	200.0000	0.665
121	210.0000	0.663	122	220.0000	0.662	123	230.0000	0.659
124	240.0000	0.659	125	250.0000	0.655	126	260.0000	0.654
127	270.0000	0.655	128	280.0000	0.652	129	290.0000	0.649
130	300.0000	0.645	131	310.0000	0.646	132	320.0000	0.646
133	330.0000	0.642	134	340.0000	0.643	135	350.0000	0.643
136	360.0000	0.638	137	370.0000	0.637	138	380.0000	0.638
139	390.0000	0.635	140	400.0000	0.630	141	410.0000	0.634
142	420.0000	0.629	143	430.0000	0.629	144	440.0000	0.629
145	450.0000	0.626	146	460.0000	0.627	147	470.0000	0.624
148	480.0000	0.624	149	490.0000	0.622	150	500.0000	0.619
151	510.0000	0.618	152	520.0000	0.618	153	530.0000	0.619

NEW JERSEY ASBESTOS
WB-OW-02 FALLING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
154	540.0000	0.615	155	550.0000	0.615	156	560.0000	0.615
157	570.0000	0.611	158	580.0000	0.608	159	590.0000	0.611
160	600.0000	0.610	161	610.0000	0.608	162	620.0000	0.607
163	630.0000	0.605	164	640.0000	0.603	165	650.0000	0.602
166	660.0000	0.600	167	670.0000	0.599	168	680.0000	0.599
169	690.0000	0.598	170	700.0000	0.594	171	710.0000	0.594
172	720.0000	0.591	173	730.0000	0.591	174	740.0000	0.588
175	750.0000	0.590	176	760.0000	0.585	177	770.0000	0.585
178	780.0000	0.583	179	790.0000	0.583	180	800.0000	0.582
181	810.0000	0.582	182	820.0000	0.580	183	830.0000	0.578
184	840.0000	0.577	185	850.0000	0.572	186	860.0000	0.575

HVORSLEV INTERACTIVE SLUG TEST ANALYSIS 10-06-1992

NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag

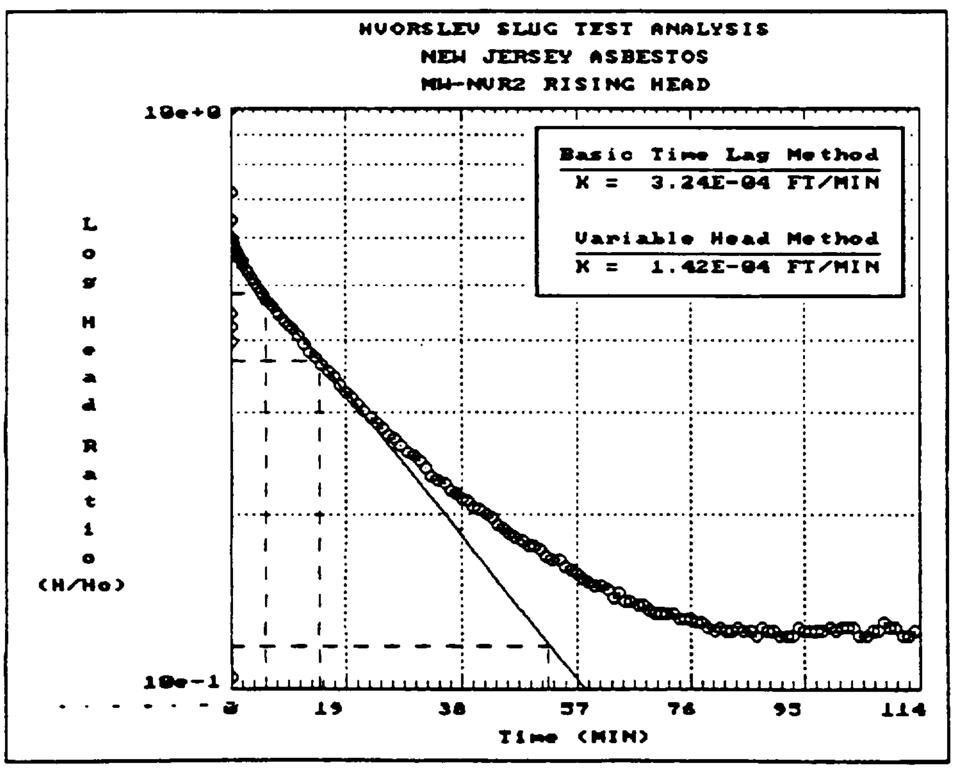
Hydraulic Conductivity:	3.24E-04 FT/MIN
Basic Time Lag:	14.55 MIN
Equalization Ratio:	33.47 MIN

Variable Head

Hydraulic Conductivity:	1.42E-04 FT/MIN
Time Coordinate T1:	5.8 MIN
Time Coordinate T2:	52.3 MIN
Head Ratio Coordinate H1:	48.11E-02
Head Ratio Coordinate H2:	11.91E-02

Well/Aquifer Parameters

Length of well screen:	10.00	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT
Kh/Kv ratio:	1.0	



NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.105	2	0.0033	1.000	3	0.0066	0.447
4	0.0100	0.399	5	0.0133	0.424	6	0.0166	0.601
7	0.0200	0.720	8	0.0233	0.642	9	0.0266	0.580
10	0.0300	0.578	11	0.0333	0.587	12	0.0500	0.594
13	0.0666	0.582	14	0.0833	0.599	15	0.1000	0.592
16	0.1166	0.592	17	0.1333	0.589	18	0.1500	0.589
19	0.1666	0.589	20	0.1833	0.589	21	0.2000	0.587
22	0.2166	0.587	23	0.2333	0.587	24	0.2500	0.587
25	0.2666	0.587	26	0.2833	0.587	27	0.3000	0.587
28	0.3166	0.585	29	0.3333	0.585	30	0.4166	0.580
31	0.5000	0.578	32	0.5833	0.575	33	0.6666	0.573
34	0.7500	0.571	35	0.8333	0.569	36	0.9166	0.566
37	1.0000	0.564	38	1.0833	0.562	39	1.1666	0.560
40	1.2500	0.560	41	1.3333	0.557	42	1.4166	0.555
43	1.5000	0.553	44	1.5833	0.553	45	1.6666	0.550
46	1.7500	0.550	47	1.8333	0.548	48	1.9166	0.539
49	2.0000	0.544	50	2.5000	0.532	51	3.0000	0.523
52	3.5000	0.514	53	4.0000	0.504	54	4.5000	0.495
55	5.0000	0.486	56	5.5000	0.479	57	6.0000	0.470
58	6.5000	0.463	59	7.0000	0.459	60	7.5000	0.452
61	8.0000	0.445	62	8.5000	0.438	63	9.0000	0.431
64	9.5000	0.427	65	10.0000	0.420	66	11.0000	0.408
67	12.0000	0.394	68	13.0000	0.383	69	14.0000	0.374
70	15.0000	0.365	71	16.0000	0.353	72	17.0000	0.346
73	18.0000	0.335	74	19.0000	0.325	75	20.0000	0.319
76	21.0000	0.312	77	22.0000	0.303	78	23.0000	0.294
79	24.0000	0.289	80	25.0000	0.282	81	26.0000	0.275
82	27.0000	0.271	83	28.0000	0.264	84	29.0000	0.257
85	30.0000	0.252	86	31.0000	0.247	87	32.0000	0.241
88	33.0000	0.234	89	34.0000	0.229	90	35.0000	0.227
91	36.0000	0.220	92	37.0000	0.218	93	38.0000	0.213
94	39.0000	0.211	95	40.0000	0.206	96	41.0000	0.204
97	42.0000	0.200	98	43.0000	0.197	99	44.0000	0.193
100	45.0000	0.190	101	46.0000	0.186	102	47.0000	0.183
103	48.0000	0.181	104	49.0000	0.176	105	50.0000	0.176
106	51.0000	0.174	107	52.0000	0.169	108	53.0000	0.167
109	54.0000	0.167	110	55.0000	0.163	111	56.0000	0.160
112	57.0000	0.158	113	58.0000	0.156	114	59.0000	0.153
115	60.0000	0.151	116	61.0000	0.151	117	62.0000	0.149
118	63.0000	0.144	119	64.0000	0.147	120	65.0000	0.142
121	66.0000	0.142	122	67.0000	0.140	123	68.0000	0.140
124	69.0000	0.138	125	70.0000	0.135	126	71.0000	0.135
127	72.0000	0.135	128	73.0000	0.135	129	74.0000	0.133
130	75.0000	0.133	131	76.0000	0.133	132	77.0000	0.131
133	78.0000	0.131	134	79.0000	0.128	135	80.0000	0.126
136	81.0000	0.128	137	82.0000	0.126	138	83.0000	0.126
139	84.0000	0.128	140	85.0000	0.126	141	86.0000	0.126
142	87.0000	0.124	143	88.0000	0.128	144	89.0000	0.126
145	90.0000	0.126	146	91.0000	0.124	147	92.0000	0.124
148	93.0000	0.124	149	94.0000	0.128	150	95.0000	0.126
151	96.0000	0.126	152	97.0000	0.126	153	98.0000	0.126

NEW JERSEY ASBESTOS
MW-NVR2 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
154	99.0000	0.128	155	100.0000	0.126	156	101.0000	0.128
157	102.0000	0.128	158	103.0000	0.128	159	104.0000	0.124
160	105.0000	0.124	161	106.0000	0.126	162	107.0000	0.126
163	108.0000	0.131	164	109.0000	0.128	165	110.0000	0.128
166	111.0000	0.124	167	112.0000	0.124	168	113.0000	0.126

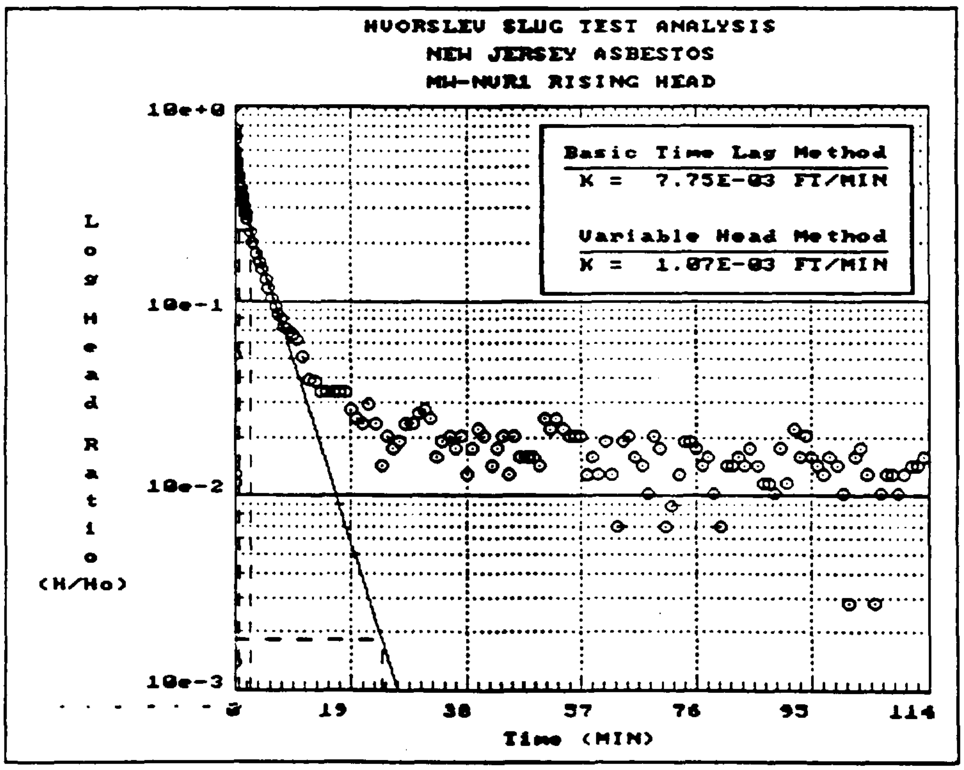
NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC.

Results

Basic Time Lag	
Hydraulic Conductivity:	7.75E-03 FT/MIN
Basic Time Lag:	0.61 MIN
Equalization Ratio:	1.40 MIN
Variable Head	
Hydraulic Conductivity:	1.07E-03 FT/MIN
Time Coordinate T1:	2.7 MIN
Time Coordinate T2:	24.1 MIN
Head Ratio Coordinate H1:	23.18E-02
Head Ratio Coordinate H2:	18.31E-04

Well/Aquifer Parameters

Length of well screen:	10.00	FT
Diameter of the well casing:	0.333	FT
Diameter of the well filter:	0.667	FT
Kh/Kv ratio:	1.0	



NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
1	0.0000	0.001	2	0.0033	0.013	3	0.0066	0.012
4	0.0100	0.053	5	0.0133	0.472	6	0.0166	1.000
7	0.0200	0.725	8	0.0233	0.336	9	0.0266	0.677
10	0.0300	0.770	11	0.0333	0.576	12	0.0500	0.600
13	0.0666	0.582	14	0.0833	0.562	15	0.1000	0.553
16	0.1166	0.544	17	0.1333	0.536	18	0.1500	0.531
19	0.1666	0.525	20	0.1833	0.521	21	0.2000	0.516
22	0.2166	0.512	23	0.2333	0.507	24	0.2500	0.501
25	0.2666	0.497	26	0.2833	0.492	27	0.3000	0.491
28	0.3166	0.487	29	0.3333	0.482	30	0.4166	0.464
31	0.5000	0.447	32	0.5833	0.431	33	0.6666	0.416
34	0.7500	0.402	35	0.8333	0.389	36	0.9166	0.376
37	1.0000	0.366	38	1.0833	0.355	39	1.1666	0.346
40	1.2500	0.336	41	1.3333	0.327	42	1.4166	0.318
43	1.5000	0.309	44	1.5833	0.301	45	1.6666	0.292
46	1.7500	0.284	47	1.8333	0.277	48	1.9166	0.270
49	2.0000	0.262	50	2.5000	0.225	51	3.0000	0.199
52	3.5000	0.177	53	4.0000	0.159	54	4.5000	0.146
55	5.0000	0.131	56	5.5000	0.116	57	6.0000	0.105
58	6.5000	0.094	59	7.0000	0.085	60	7.5000	0.081
61	8.0000	0.073	62	8.5000	0.072	63	9.0000	0.069
64	9.5000	0.068	65	10.0000	0.063	66	11.0000	0.052
67	12.0000	0.039	68	13.0000	0.038	69	14.0000	0.034
70	15.0000	0.034	71	16.0000	0.034	72	17.0000	0.034
73	18.0000	0.034	74	19.0000	0.028	75	20.0000	0.025
76	21.0000	0.023	77	22.0000	0.029	78	23.0000	0.023
79	24.0000	0.014	80	25.0000	0.020	81	26.0000	0.018
82	27.0000	0.019	83	28.0000	0.023	84	29.0000	0.023
85	30.0000	0.026	86	31.0000	0.028	87	32.0000	0.025
88	33.0000	0.016	89	34.0000	0.019	90	35.0000	0.020
91	36.0000	0.018	92	37.0000	0.020	93	38.0000	0.013
94	39.0000	0.018	95	40.0000	0.022	96	41.0000	0.020
97	42.0000	0.014	98	43.0000	0.018	99	44.0000	0.020
100	45.0000	0.013	101	46.0000	0.020	102	47.0000	0.016
103	48.0000	0.016	104	49.0000	0.016	105	50.0000	0.014
106	51.0000	0.025	107	52.0000	0.022	108	53.0000	0.025
109	54.0000	0.022	110	55.0000	0.020	111	56.0000	0.020
112	57.0000	0.020	113	58.0000	0.013	114	59.0000	0.016
115	60.0000	0.013	116	61.0000	0.019	117	62.0000	0.013
118	63.0000	0.007	119	64.0000	0.019	120	65.0000	0.020
121	66.0000	0.016	122	67.0000	0.014	123	68.0000	0.010
124	69.0000	0.020	125	70.0000	0.018	126	71.0000	0.007
127	72.0000	0.009	128	73.0000	0.013	129	74.0000	0.019
130	75.0000	0.019	131	76.0000	0.018	132	77.0000	0.014
133	78.0000	0.016	134	79.0000	0.010	135	80.0000	0.007
136	81.0000	0.014	137	82.0000	0.014	138	83.0000	0.016
139	84.0000	0.014	140	85.0000	0.018	141	86.0000	0.014
142	87.0000	0.012	143	88.0000	0.012	144	89.0000	0.010
145	90.0000	0.018	146	91.0000	0.012	147	92.0000	0.022
148	93.0000	0.016	149	94.0000	0.020	150	95.0000	0.016
151	96.0000	0.014	152	97.0000	0.013	153	98.0000	0.016

NEW JERSEY ASBESTOS
MW-NVR1 RISING HEAD
TRC ENVIRONMENTAL, INC.

Time vs Head Ratio Data

No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)	No.	Time (MIN)	H/Hmax (FT)
154	99.0000	0.014	155	100.0000	0.010	156	101.0000	0.003
157	102.0000	0.016	158	103.0000	0.018	159	104.0000	0.013
160	105.0000	0.003	161	106.0000	0.010	162	107.0000	0.013
163	108.0000	0.013	164	109.0000	0.010	165	110.0000	0.013
166	111.0000	0.014	167	112.0000	0.014	168	113.0000	0.016

Appendix I

Cooper et al. Analysis

TEST DESCRIPTION

Data set........... OW2.DAT
Data set title..... NJ ASBESTOS WELL WB-OW-02D
Company............ TRC ENVIRONMENTAL, INC.
Project............ 1-635-337-0-2PZZ-0
Client............. USEPA
Location........... WHITE BRIDGE ROAD, PASSAIC, NJ
Test date.......... 10-2-92
Test well.......... WB-OW-02

Knowns and Constants:
No. of data points.................. 156
Pumping rate........................ 1
Radius (distance) to obs. well...... 0.1667

ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

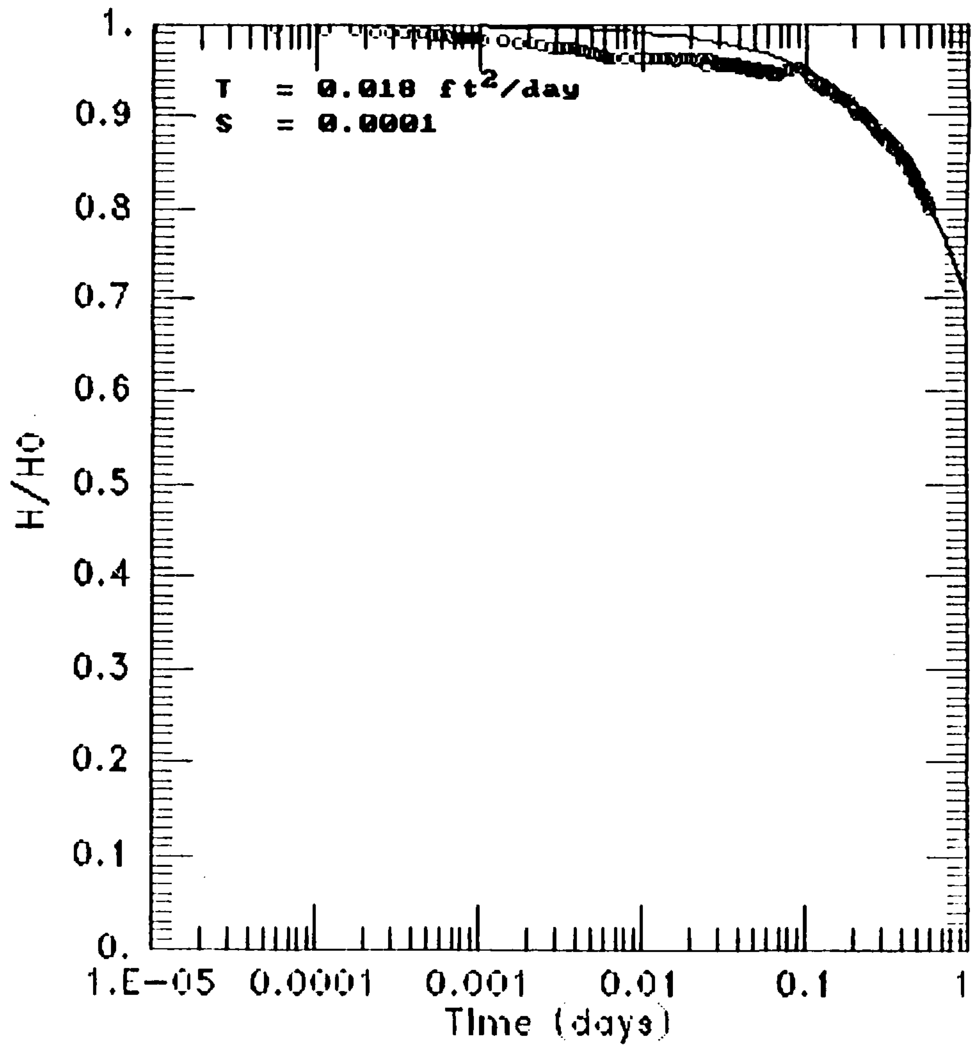
	Estimate
T =	1.8000E-002
S =	1.0000E-004

TYPE CURVE DATA

T = 1.79999E-002
S = 1.00000E-004

Time	Drawdown	Time	Drawdown	Time	Drawdown
1.000E-005	1.445E+000	1.122E-005	1.445E+000	1.259E-005	1.445E+000
1.413E-005	1.445E+000	1.585E-005	1.445E+000	1.778E-005	1.445E+000
1.995E-005	1.445E+000	2.239E-005	1.445E+000	2.512E-005	1.445E+000
2.818E-005	1.445E+000	3.162E-005	1.445E+000	3.548E-005	1.445E+000
3.981E-005	1.445E+000	4.467E-005	1.445E+000	5.012E-005	1.445E+000
5.623E-005	1.445E+000	6.310E-005	1.445E+000	7.079E-005	1.444E+000
7.943E-005	1.444E+000	8.913E-005	1.444E+000	1.000E-004	1.444E+000
1.122E-004	1.444E+000	1.259E-004	1.444E+000	1.413E-004	1.444E+000
1.585E-004	1.444E+000	1.778E-004	1.444E+000	1.995E-004	1.444E+000
2.239E-004	1.444E+000	2.512E-004	1.444E+000	2.818E-004	1.444E+000
3.162E-004	1.444E+000	3.548E-004	1.444E+000	3.981E-004	1.444E+000
4.467E-004	1.444E+000	5.012E-004	1.443E+000	5.623E-004	1.443E+000
6.310E-004	1.443E+000	7.079E-004	1.443E+000	7.943E-004	1.443E+000
8.913E-004	1.443E+000	1.000E-003	1.443E+000	1.122E-003	1.442E+000
1.259E-003	1.442E+000	1.413E-003	1.442E+000	1.585E-003	1.442E+000
1.778E-003	1.441E+000	1.995E-003	1.441E+000	2.239E-003	1.441E+000
2.512E-003	1.440E+000	2.818E-003	1.440E+000	3.162E-003	1.440E+000
3.548E-003	1.439E+000	3.981E-003	1.439E+000	4.467E-003	1.438E+000
5.012E-003	1.438E+000	5.623E-003	1.437E+000	6.310E-003	1.436E+000
7.079E-003	1.436E+000	7.943E-003	1.435E+000	8.913E-003	1.434E+000
1.000E-002	1.433E+000	1.122E-002	1.432E+000	1.259E-002	1.431E+000
1.413E-002	1.429E+000	1.585E-002	1.428E+000	1.778E-002	1.426E+000
1.995E-002	1.425E+000	2.239E-002	1.423E+000	2.512E-002	1.421E+000
2.818E-002	1.419E+000	3.162E-002	1.416E+000	3.548E-002	1.413E+000
3.981E-002	1.410E+000	4.467E-002	1.407E+000	5.012E-002	1.404E+000
5.623E-002	1.400E+000	6.310E-002	1.395E+000	7.079E-002	1.391E+000
7.943E-002	1.386E+000	8.913E-002	1.380E+000	1.000E-001	1.374E+000
1.122E-001	1.367E+000	1.259E-001	1.359E+000	1.413E-001	1.351E+000
1.585E-001	1.342E+000	1.778E-001	1.332E+000	1.995E-001	1.322E+000
2.239E-001	1.310E+000	2.512E-001	1.297E+000	2.818E-001	1.283E+000
3.162E-001	1.268E+000	3.548E-001	1.251E+000	3.981E-001	1.233E+000
4.467E-001	1.213E+000	5.012E-001	1.192E+000	5.623E-001	1.169E+000
6.310E-001	1.144E+000	7.079E-001	1.117E+000	7.943E-001	1.088E+000
8.913E-001	1.057E+000	1.000E+000	1.023E+000		

NJ ASBESTOS WELL WB-OW-02D



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Appendix J-1

Details of Costing Analysis of White Bridge Road

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone (508) 970-5600
Fax (508) 452-1995

SHEET ____ OF ____
BY SZ
DATE 1-6-93
JOB NO. ____
PROJECT WBR
CH'K. BY AM
SUBJECT
DATE CH'K. 1-8-93
BID ITEM 1 - Mob/demob
B'K. CH'K. BY ____

MOB/DEMOB SOLIDIFYING EQ	= $60,000
MISC	= 140,000
	$200,000

SOURCE: VENDOR REPRESENTATIVES
TRC EXPERIENCE

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY SZ
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT
DATE CH'K. 1-6-93
BID ITEM 2 - HEALTH & SAFETY
B'K. CH'K. BY ____

HEALTH & SAFETY = ≈ 5% total

= $100,000

SOURCE: TRC EXPERIENCE

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO.
DATE
PROJECT WBR
CH'K. BY SZ
SUBJECT TEMP EROSION
ITEM # 3
DATE CH'K. 1-6-93
B'K. CH'K. BY

	AMOUNT	TOTAL
SILT FENCING	950LF	$2.92
TREE FENCING	1215LF	$2.15
BERM	731CY	$9.08
DRAINAGE DITCH	146 CY	$19
DUST CONTROL	9MO	$96

TOTAL $15,700

SOURCE: MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT PHOTOS / VIDEOTAPE
ITEM #4
DATE CH'K. 1-9-9_
B'K. CH'K. BY ____

PHOTOS

BEFORE CONST.	=	100
DURING	=	130
ADDED FAC.	=	100
		330

2 EACH = 660 PHOTOS @ $27/each = 17820
660 slides $1 = 660
VIDEO $500 = 500

$19,000

SOURCE - MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT BID ITEM 5
WATER CONTROL
DATE CH'K. 1-12-93
B'K. CH'K. BY ____

DEWATERING FOR 6 MONTHS

- TANK / SITE
- WASH WATER
- TOILETS

ETC.

$7,000

SOURCE: MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone (508) 970-5600
Fax: (508) 452-1995

SHEET ___ OF ___
BY ꟷ
JOB NO. ___
DATE ___
PROJECT WBR
CH'K BY SZ
SUBJECT
ITEM #6
DATE CH'K. 1-6-93
B'K CH'K. BY ___

BUILDINGS	AMOUNT			TOTAL (INCL O&P)
3 TRAILERS	6 MON	$1850	=	11 100
3 ~~6~~ PORT. TOILETS	"	75		1350 ~~2700~~ ~~450~~
3 DIESEL GENERATORS	"	260		4680 ~~1560~~
2 UTILITY POLES	"	1040		6240
WIRING (3 TRAIL.)	"	20		120
2 SHOWERS	"	1020		6120
WASHING MACHINE	"	819		4920
CLOTHES DRYER	"	681		4086
				~~34 556~~ ~~29 966~~ 38616

BASE (PARKING)

6" SUBBASE	2600	SY	$5 10	-	13260
12" BASE	2600	SY	$10	=	26000
					~~79 226~~ ~~73856~~

$\boxed{\$73500}$
~~74300~~
77876

FOR PC, PHONES, ETC

77876
~~73500~~ × 1.05 = ~~77548~~
~~83265~~
81770

$\boxed{\$ \cancel{77600}}$
~~83700~~

SOURCE - MEANS

ABD 002 1541

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone (508) 970-5600
Fax (508) 452-1995

SHEET ____ OF ____
BY TT
DATE ____
CH'K. BY SZ
DATE CH'K. 1-12-93
B'K. CH'K. BY ____

JOB NO. ____
PROJECT WBR
SUBJECT BID ITEM 7
TEMP DRUM STAGING

GEOMEMBRANE	500 SF	~~$6~~ $5	=	$2500
10 MIL SHEETING	~~5000~~ 500 SF	0.18	=	~~900~~ 90
WOOD	24 LF	0.50	=	12
GEOTEXTILE FILTER FABRIC	500 SF	$2.0		1000
WOOD (12" X 12")	90 LF	$1.00		90
SAND	3 CY	$10		30
GRAVEL	3 CY	$16		48
1" PLYWOOD*	500 SF			340
1 DRUM	1	$50		50
				~~4970~~ 4880

* $20/SHEET at 4'x8' => at 17 sheets = $340

TOTAL = $ ~~4970~~ 4880

SOURCE: MEANS

ARD 002 1542

1508452603З PAGE.002

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT BID ITEM 8
DECON PAD
DATE CH'K. 1-12-93
B'K. CH'K. BY ____

	AMOUNT	COST		TOTAL
REINF. SLAB	55 CY	207	=	11400
HDPE	600 SF	0.20	=	120
SUBBASE	600 SF	10.0	=	6000
STEM WASHER	9 MOS*	405	=	3645
HEPA VAC	9 MOS	300	=	2700
PUMP		500	=	500
				$24,400

* ACT. CONSTRUCTION SHOULD BE 6 MOS. – ASSUME A CONSERVATIVE APPROACH –

SOURCE – MEANS

ABD 002 1513

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY JJ
JOB NO. ____
DATE ____
PROJECT WBR
CH'K BY SZ
SUBJECT
DATE CH'K. 1-12-93
ITEM 9 - CLEARING / GRUBBING
B'K. CH'K. BY ____

PAST TRC EXPERIENCE - $7,500

INCLUDES: MOWING
MOVING MANURE PILE
CUT FEW TREES (SMALL)
CLEARING "GRUB"

APD 002 1544

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT BID ITEM 10 - PPE DISPOSAL
DATE CH'K. 1-12-93
B'K. CH'K. BY ____

DRUM REMOVAL ~

ASSUME 40 DRUMS at $160

SOURCE: MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY TT
JOB NO ____
DATE ____
PROJECT ı VBR
CH'K. BY SZ
SUBJECT ITEM 11 - DISPOSAL CONTR. WASTE
DATE CH'K. 1-12-93
B'K. CH'K. BY ____

10 - DRUMS PRESENT
10 - DRUMS GENERATED

20 DRUMS AT $160—

SOURCE: MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY SMZ
DATE 1/6/93
CH'K. BY ____
DATE CH'K. ____
B'K. CH'K. BY ____

JOB NO. ____
PROJECT ____
SUBJECT WHITE BRIDGE ROAD
ITEM 12 - EXCAVATION

6500 cy 4.55/cy (MEANS)

INCLUDE TEMP. SHORING
at 8000 SF @ $8.25/SF = $66,000

6500 x 4.55 = $29575
+ 66,000
$95,575

95,575 ÷ 6500 cy = $14.70 /cy

SOURCE - MEANS

TRC
TRC Environmental Corporation
Boott Mills South
Foot of John Street
Lowell, Massachusetts 01852
Telephone: (508) 970-5600
Fax: (508) 452-1995

SHEET ____ OF ____
BY SZ
JOB NO. ____
DATE ____
PROJECT NBR
CH'K BY SZ/AM
SUBJECT BID ITEM 13 - COMMON FILL IMPORTED
DATE CH'K. ____
B'K. CH'K. BY ____

- ROADS = $(1100 \text{ LF}^{*} \times 20' \text{ WIDE} \times 1' \text{ DEEP})\frac{1}{27}$ = 815 cy

- GRADING OVER SOLIDIFIED MASS (TO "EVEN UP" GRADE ON TOP OF CONCRETE)

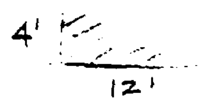
  $((3.2 \text{ ACRES}) \times 1')^{1}/27$ = 5,162 cy (CONSERVATIVE)

- CAP OVER MASS

  $(3.2 \text{ AC.} \times 2')^{1}/27$ = 10,325

- PERIMETER TRENCH AND BLENDING INTO NATURAL GRADE

  ASSUME $\left[1100 \text{ LF} \times (4' \times 12' \times 1/2)^{1}/27\right]\frac{1}{2}$ = 489 cy
  (ASSUME ½ IS CONSTRUCTED USING CLEAN FILL FROM AREA A)



TOTALS = 815
5162
10325
489
Σ = 16,791

TOTAL = $16{,}791 \times 1.2^{*}$ = 20,150 cy

* COMPACTION FACTOR

NOTE: CLEAN FILL FROM AREA A WILL BE USED TO BACKFILL EXCAVATED AREAS AND PART OF BLENDING IN OF FINAL GRADING

SOURCE: MEANS

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Foot of John Street
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Fax: (508) 452-1995

SHEET ____ OF ____
BY 12-18-92
DATE TT
JOB NO. ____
CH'K BY SS
PROJECT WBR
DATE CH'K. 1/6-93
SUBJECT BID ITEM 14
COMMON FILL, ON-SITE
B'K. CH'K. BY ____

AREA A EXCAVATED: 3,200 CY

ASSUME ONLY 3,000 usable:

1. Fill in excavated areas:

WOODED AREA	=	1400
ISOLATED	=	1000
		2,400

2. 600 CY USED ON SITE (as FILL) DEPENDING ON QUALITY OF MATERIAL

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SHEET ___ OF ___
BY SMZ
DATE 12-18-92
CH'K BY SMZ/CL
DATE CH'K. 1-6-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT WBR
SUBJECT BID ITEM NO. 15
COARSE AGGREGATE

QUANTITY

1.	ACCESS ROAD (1100 LF 1' DEEP 20' WIDE)	820 CY
2.	CAP (12140 SY, 6" DEEP)	1900 CY
		2720 CY

COST: $16⁻/CY

FROM MEANS + PAST EXPERIENCE

QUANTITY = 2720 CY
COST = $16⁻

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SHEET ___ OF ___
BY SMZ
DATE 1-6-93
JOB NO. ___
CH'K. BY SZ/AM
PROJECT WBR
DATE CH'K. 1-12-93
SUBJECT BID ITEM 16
STONE FILL
B'K. CH'K. BY ___

A: REVETMENT

1' DEEP
10' LONG
TRENCH (TOP) = 4 SF
(BOTTOM) = 6 SF

LENGTH OF WALL = 380'

$(380' \times (4\,SF + 6\,SF) \times 10' \times 1') \div 27 = 1400$ cy

QUANTITY = 1400 cy
COST = 10-

B: ROAD TRENCH

$[1100\,LF \times 2\,SIDES \times 4'\,WIDE \times 1'\,DEEP] / 27 = 325$ cy

OPERATIONAL BERM

$1450\,LF \times 4\,SF = 5800\,CF \div 27 = 215$ cy

CULVERTS

50 cy

TOTAL QUANTITY = 590 cy

SOURCE: MEANS/ TRC EXPERIENCE

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SHEET ____ OF ____
BY SMZ
DATE 1-6-93
CH'K. BY SZ
DATE CH'K. ____
B'K. CH'K. BY ____

JOB NO. ____
PROJECT INBR
SUBJECT BID ITEM 17
SOIL STAB/SOLID

QUANTITY = 11,000 CY
COST = $ 55 /cy

SOURCE GEOCON VENDOR
(ESTIMATE FROM TECHNICAL REPRESENTATIVES)

includes all Q/A TESTING

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SHEET ____ OF ____
BY SMZ
DATE 1-6-93
JOB NO. ____
PROJECT WBR
CH'K. BY ____
SUBJECT BID ITEM NO. 18
GEOTEXTILE FILTER FABRIC
DATE CH'K. ____
B'K. CH'K. BY ____

TYPE

A:

ACCESS ROAD 1100LF X 30 = 33000 SF

CAP 140,000 SF

TOTAL = 19,200 SY
COST = $2-

B:

CAP: 140,000SF

REVETMENT. 380' X 20' = 7600 SF ≅ 850 SY

TOTAL = 16,400 SY

AROUND BERM. 1450LF X 4' = 5800SF = 644 SY

TOTAL = 17,100 SY
COST = $2-

SOURCE: MEANS / TRC EXPERIENCE

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
CH'K BY SZ
DATE CH'K. ____
B'K CH'K. BY ____

JOB NO. ____
PROJECT WBR
SUBJECT BID ITEM # 19
GEOMEMBRANE

QUANT		UNIT COST
12,140	SY	$5.00

(CAP OVER 3.2 AC.)

SOURCE: TRC EXPERIENCE

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT WBR
CH'K. BY SZ
SUBJECT BID ITEM 20 - PLASTIC SHEETING
DATE CH'K. 1-6-93
B'K. CH'K. BY ____

ASSUME 500 sy
@ \$0.20/sy

SOURCE : MEANS

ABD 002 1555

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SHEET ____ OF ____
BY SZ
DATE 12/18/92
CH'K BY SZ/JLY
DATE CH'K 1/12/93
B'K CH'K BY ____

JOB NO. ____
PROJECT NBR
SUBJECT BID ITEM 21 - STEEL SHEET PILING

*PER PHONE CONV. RE: ITEM ONLY PERMANENT SHEET PILING

400 LF x 30' DEEP = 12,000 SF

$18.40 / SF SOURCE: MEANS

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SHEET ___ OF ___
BY SZ
DATE 1-12-93
JOB NO. ___
PROJECT WBR
CH'K BY ___
SUBJECT
BID ITEM 22 - NEW DRIVES
DATE CH'K. ___
B'K. CH'K. BY ___

ASSUME 100 sy will NEED REPLACEMENT
@ $11.50/sy

SOURCE: MEANS

ABD 002 1557

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SHEET ____ OF ____
BY SE
DATE 12-18-92
JOB NO. ____
PROJECT WBR
CH'K. BY ____
SUBJECT
BID ITEM 23 - CULVERT
DATE CH'K. ____
B'K. CH'K. BY ____

ASSUME 100 LF OF RCP
TO BE USED ON SITE UNDER
ACCESS ROAD

COST = $17 / LF

SOURCE - MEANS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
JOB NO. ____
PROJECT WBR
CH'K. BY ____
SUBJECT ITEM NO. 24
DATE CH'K. ____
INFILTRATION DRAIN PIPING + TRENCH
B'K. CH'K. BY ____

COST / LF

	QUANT		COST
* TRENCH CUTTING	1050 LF 780cy	($6/cy)	
PIPE BEDDING	590 CY		32.85 / cy
6" Φ PERF. HDPE	1050		17.80 / LF
MANHOLE	3		1345 / MH
GEOFABRIC	1900 SF		2 / SY

* 1050 LF × 3 Ft × 5 Ft = 15750 ÷ 27 = 590 cy

Backfill, labor = $25 / cy
Mat $7.85 / cy
32.85

MH COVERS + FRAMES = 460
MH = 885
1,345

TOTAL COST = $ 50586.5 ÷ 1050 LF
= 48.18 / LF

SOURCE - MEANS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
JOB NO.
CH'K. BY
PROJECT WBR
DATE CH'K.
SUBJECT BID ITEM NO. 25
CHAIN LINK FENCING
B'K CH'K. BY

	QUANT	COST
FENCE	510	$ 11.15
CORNER POSTS	17	82
BRACES	6	29

$ 7300

	LF	COST/LF
Fence	510	14.30

a) gate 3'

b) gate 20' $735

THE 20' GATE IS INCLUDED IF, DURING CONSTRUCTION, THE RESIDENTS/EPA/WILDLIFE PEOPLE WANT TO ADD IT IN. IT IS CURRENTLY NOT IN THE DESIGN.

SOURCE: MEANS

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SHEET ____ OF ____
BY SZ
DATE 1/6/93
JOB NO. ____
PROJECT WBR
CH'K. BY ____
SUBJECT
BID ITEM 26 - FENCE
DATE CH'K. ____
B'K. CH'K. BY ____

APPROX 2000 LF WILL BE
"RELOCATED"

$8-/LF

SOURCE: MEANS

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SHEET ____ OF ____
BY SZ
DATE 12-18-92
JOB NO. ____
PROJECT WBR
CH'K BY ____
SUBJECT BID ITEM 27
TOPSOIL + SEED
DATE CH'K. ____
B'K. CH'K. BY ____

3.2 ACRES = 15,500 sy -

$4/sy -SOURCE = MEANS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
CH'K BY SZ/MC
DATE CH'K. 1-6-93
B'K. CH'K. BY ____

JOB NO. ____
PROJECT WBR
SUBJECT BID ITEM NO. 28
LANDSCAPING

LUMP SUM

NEED MINIMAL AMT FOR REPLANTINGS

$5000-

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
JOB NO. ____
PROJECT WBR
CH'K BY ____
SUBJECT BID ITEM NO. 32
MONITORING WELLS
DATE CH'K ____
B'K. CH'K. BY ____

	QUANT.	COST
a) NEW WELLS (incl installation + devel) ASSUME 15'	2	$100/LF
b) Abandon WELLS	5	$250/Each

c) Developing existing WELLS – ALL WELLS WILL NEED TO BE TAKEN OUT, ∴ NO WELLS WILL BE LEFT.

SOURCE: MEANS / TRC EXPERIENCE

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SHEET ___ OF ___
BY SZ
DATE 1-6-93
JOB NO. ___
CH'K. BY ___
PROJECT WBR
DATE CH'K. ___
SUBJECT BID ITEM 33 - SAMPLING/ANALYSIS
B'K. CH'K. BY ___

ASSUME ≈ 4% OF TOTAL COST OF PROJ.

= $67,650

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SHEET ____ OF ____
BY SJ
DATE 1-6-93
JOB NO. ____
PROJECT WBR
CH'K. BY ____
SUBJECT BID ITEM 34 - CONFIRMATIONAL SAMP.
DATE CH'K. ____
B'K. CH'K. BY ____

		samples	cost
SOIL	=	190	$225
WATER	=	24	200
AIR	=	93	15

SOURCE: TRC EXP | LAB

Appendix J-2

Details of Costing Analysis of New Vernon Road

TRC
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SHEET ___ OF ___
BY SZ
DATE 1-6-93
CH'K. BY AM
DATE CH'K. 1-8-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT NVR
SUBJECT ITEM #1 MOB/DEMOB

Mob/demob solidifying eq. = 60,000

misc. = 140,000

$200,000

SOURCE: VENDOR Representatives
TRC EXPERIENCE

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SHEET ____ OF ____
BY TT
JOB NO ____
DATE ____
PROJECT NVR
CH'K BY SZ
SUBJECT
DATE CH'K 1/6/93
ITEM #2
B'K CH'K BY ____

HEALTH & SAFTEY ASSUMED

ASSUME ≈ 5%

= 150,000

SOURCE TRC EXPERIENCE

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT NVR
CH'K. BY SZ
SUBJECT
DATE CH'K. 1-6-93
ITEM #3
B'K. CH'K. BY ____

		AMOUNT	TOTAL (INCL O&P)		
1.	SILT FENCE	3820 LF	$2.92	p39	
2.	TREE FENCING	1740 LF	$2.15	p85	(SNOW FENCING)
3.	OPERATIONAL BERMS	1660 CY	$9.08	p27	COMPACTED 12" WALK BEHIND ROLLER
4.	JERSEY BARRIERS	500LF	$27	p86	MEDIAN 3'6" SINGLE FACE
5.	12" HDPE	25LF	$54	p77	HIGH STRENGTH NOT INCL. EX. & BKFIL
6.	DRAINAGE DITCH	20CY	$19	p35	GRAVEL FILL COMPACTED 6" DEEP
7.	SED. BASIN	15CY	$19	p35	"
8.	DUST CONTROL	9MO	$96	p14	PORTABLE WATER TANK

TOTAL #3 = $\boxed{\$46350}$

Multiply by 1.05 to include extras such as plans —

46,350 X 1.05 = 48,700

SOURCE - MEANS

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT NYR
CH'K BY SMZ
SUBJECT ITEM 4 PHOTOGRAPHS / VIDEOTAPES
DATE CH'K. 1-6-93
B'K. CH'K. BY ____

ASSUME 630 PHOTOS @ $27/each = 17,010
(MEANS)
630 slides @ $1/each = 630
VIDEO = 500

18,140

include: copies, rentals etc 960

$19,000

SOURCE: MEANS

ABD 002 1571

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SHEET ____ OF ____
BY TT
JOB NO.
DATE
PROJECT NVR
CH'K. BY SZ
SUBJECT ITEM #5
DATE CH'K. 1-6-93
B'K. CH'K. BY

CONTROL OF WATER

DEWATERING . FOR 9 MONTHS

. Include: - 1 tank/site (5000 gal)
wash water - $7000 (incl. tank)
- toilets - $ 3000
≈ $10,000 /site

SOURCE: MEANS

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT NVR
CH'K BY SZ
SUBJECT ITEM #6
DATE CH'K. 1-6-93
B'K. CH'K. BY ____

BUILDINGS	AMOUNT	TOTAL (INCL O&P)	
3 TRAILERS (W/WATER)	9 MO	$1850	= 16650
3 ~~6~~ PORT. TOILETS	9 MO	$75	= 2025 ~~4050~~ ~~675~~
3 DIESEL GENERATORS	9 MO	$260	= 7020
UTILITY POLES (2)		$1040	= 2080
WIRING (3 TRAILERS)		$20	= 60
SHOWERS (2)	9 MO	$1020	= 9180
WASHING MACHINE	9 MO	$810	= 7380
CLOTHES DRYER	9 MO	$681	= 6130
			$ ~~49495~~ ~~52250~~ 50525

BASE (PARKING)			
6" SUBBASE	2605 SY	$5.10	= $13286
12" BASE	2605 SY	$10	$26050
			39336

SOURCE: MEANS

TOTAL ITEM #6 $ 89861 ~~8884~~ ~~91884~~

multiply by 1.05 to include
PC
furnishings
phones

94360
~~96480~~
$ ~~93,250~~

AED 002 1573

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SHEET ___ OF ___
BY TT
DATE ___
CH'K. BY SZ
DATE CH'K. 1-12-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT WBR
SUBJECT BID ITEM 7
TEMP DRUM STAGING

GEOMEMBRANE	500 SF	$5	=	2500
10 MIL SHEETING	500 SF	0.18	=	90
WOOD	24 LF	0.50	=	12
GEOTEXTILE FILTER FABRIC	500 SF	$2.0		1000
WOOD (12"X12")	90 LF	$1.00		90
SAND	3 CY	$10		30
GRAVEL	3 CY	$16		48
1" PLYWOOD*	500 SF			340
1 DRUM	1	$50		50
				~~4470~~ 4880

$20/SHEET at 4'x8' => at 17 sheets = $340

TOTAL = $ ~~4470~~ 4880

SOURCE: MEANS

ABD 002 1574

JAN 21 '93 8:41 15084526033 PAGE.002

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT NVR
CH'K. BY SMZ
SUBJECT DECON PAD
DATE CH'K. 1-7-93
ITEM # 8
B'K. CH'K. BY ____

	AMOUNT	(TOTAL)		
REIN. SLAB	55 CY	$207	= $11400	P37 FLATS
HDPE MEMBRANE	600 SF	$0.20	= $120	INSC
SUBBASE (12")	600SF	$10	= $6000	P37
STEAM WASHER	9MO	$405	= 3645	p14
HEPA VAC.	9MO	$300	= $2700	p14
PUMP	1	$500	= 500	P18 1/4 HP

TOTAL ITEM #8 $24364

SOURCE - MEANS

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SHEET ____ OF ____
BY TT
JOB NO. ____
DATE ____
PROJECT NVR
CH'K BY SZ
SUBJECT CLEARING & GRUBBING
ITEM #5
DATE CH'K 1-6-93
B'K CH'K BY ____

		AMOUNT	TOTAL	
P23	TREE REMOVAL (24")	3	$ 460	= $ 1380
P22	STUMP REMOVAL	3	$ 30	= $ 90
P21	~~REMOVAL~~/DISPOSAL GEOFABRIC	30 DRUMS	$ 158	= 4740

SEE COST ESTIMATE

TOTAL ABOVE = $\boxed{6210}$

also include
- mowing,
- clearing, all areas
- to be disturbed

includes the woodchip pile on NVR
+ manure pile on WBR

Mowing = $44 / MSF AREA = $150

Moving woodchip pile = $1000 ~~[illegible]~~ 1000

Moving Manure pile = $100

TOTAL = 7360

FROM PAST EXPERIENCE USE $10,000

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SHEET ____ OF ____
BY TT
DATE ____
CH'K. BY SZ
DATE CH'K. 1-7-93
B'K. CH'K. BY ____

JOB NO. ____
PROJECT NVR
SUBJECT ITEM 10 DISPOSAL -PPE

DRUM + REMOVAL 90 DRUMS
@ $160 / DRUM

SOURCE: MEANS

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TRC Environmental Corporation

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SHEET ______ OF ______
BY TT
JOB NO. ______
DATE ______
PROJECT NVR
CH'K. BY SZ
SUBJECT ITEM 11 - DISPOSAL CONTR WASTE
DATE CH'K. 1-7-93
B'K. CH'K. BY ______

10 DRUMS PRESENT

10 DRUMS GENERATED BY CONTR.

20 DRUMS AT $160 (MEANS)

ABD 002 1578

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SHEET ___ OF ___
BY SMZ
DATE 1-6-93
CH'K BY SZ/AM
DATE CH'K 1-8-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT ___
SUBJECT NEW VERNON ROAD
ITEM 12 - EXCAVATION

29,200 cy @ \$4.55/cy = \$132,860

INCLUDES:
STEEL (OR CONTRACTORS CHOICE) SHORING
15,000 SF x \$8.25/SF = \$123,750

\$256,610

\$256,610 ÷ 29,200 cy = \$8.79/cy

29,200 cy:

	AMT (cy)
ISOLATED AREAS	315
STANDING WATER	4600
FRONT LAWN	6900
BACK YARD	1800
AREA A	15022
TREE STUMP AREA	524
	29161 cy

ASSUME NO SWELLING OF SOILS DURING EXCAVATION

SOURCE: MEANS

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SHEET ____ OF ____
BY SZ
DATE 1-6-93

JOB NO. ____
PROJECT NVR
CH'K. BY ____
SUBJECT COMMON FILL - IMPORTED
ITEM 13
DATE CH'K. ____
B'K. CH'K. BY ____

- SOIL EXCAVATED (ITEM 12) = 29200 (INCLUDES "A")

AREAS REQUIRING FILL:

ISOLATED	=	315 cy
STAND WATER	=	4600
FRONT LAWN	=	6900
BACK YARD	=	1800
TREE STUMP	=	524
		Σ = 14,139 cy

*[ASSUME 1/2 OF THIS VOLUME IS BACKFILLED WITH EXISTING ON-SITE SOILS] AMT NEEDED = 7070 cy

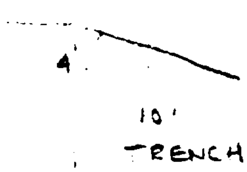
- ROADS = (1300 LF × 20' WIDE × 1' DEEP) 1/27 = 963 cy

- GRADING + CAP COVER
  1) IMPORTED COMMON FILL WILL BE USED OVER SOLIDIFIED MASS AS A PROTECTION + GRADING FOR GEOMEMBRANE AND 2' FOR CAP: ASSUME 3' TOTAL

$$(4 \times 43560 \times 3')\ 1/27 = 19,360 \text{ cy}$$

  2) OVER PERIMETER TRENCH:

1990 LF × (4' high × 10' length × 0.5)



= 1500 cy + 500 cy FOR "SMOOTHING" + "blending" into natural grade

  3) FOR GRADING AREAS TO BE USED BY CONTRACTOR ASSUME 3 ACRES @ 1' DEEP = 4840 cy

* CONSERVATIVE: SOILS IN AREA A MAY NOT BE ALL SUITABLE AS BACKFILL. VOL OF AREA A = 15,022 cy

(cont)

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SHEET ____ OF ____
BY ____
JOB NO. ____
DATE ____
PROJECT ____
CH'K BY ____
SUBJECT NVR
DATE CH'K. ____
ITEM 13 (CONT)
B'K. CH'K. BY ____

TOTAL =

7070
963
19360
2000
4840

$\Sigma = 34233 \times 1.2^{*} = 41{,}080$ cy

ROUND TO 42,000 cy

* COMPACTION FACTOR

SOURCE = MEANS

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SHEET ____ OF ____
BY TT
DATE ____
JOB NO. ____
PROJECT NVR
CH'K BY SZ
DATE CH'K. 1/6/93
SUBJECT ITEM 14 - COMMON FILL - ON-SITE
B'K. CH'K. BY ____

- SOIL IN AREA A TO BE EXCAVATED: 15022 CY

COST = \$750

(MEANS / PAST EXPERIENCE)

ASSUME 1/2 OF THE MATERIAL IS USED TO BACKFILL EXCAVATED AREAS

THIS COST INCLUDES THE TRANSPORTATION AND COMPACTION OF COMMON FILL ON-SITE.

ASSUME REMAINING MATERIAL IN AREA A USED SOMEWHERE ON SITE.

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SHEET ____ OF ____
BY SMZ
DATE 1-6-93
CH'K BY AM
DATE CH'K. 1-8-93
B'K. CH'K. BY ____

JOB NO. ____
PROJECT NVR
SUBJECT BID NO. 15
COARSE AGGREGATE

		QUANTITY
1.	ACCESS ROAD (1300 LF, 20' WIDE 1' DEEP)	970 cy
2.	CAP (19354 SY 6" DEEP)	3230 cy
		4200 cy

COST: $16

BY MEANS AND EXPERIENCE

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SHEET ___ OF ___
BY SMZ
DATE 1-6-93
CH'K. BY AM
DATE CH'K. 1-8-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT NVR
SUBJECT BID ITEM 16
STONE FILL

A: REVETMENT ∴ 0

B: ROAD TRENCH
OPERATIONAL BERM TRENCH
CULVERT / HEADWALL / ENERGY DISPERSION

ROAD = 1300 LF × 2 SIDES × 4' WIDE × 1' DEEP
≈ 385 cy

HEADWALLS ≈ 2 × 20' LONG × 10' WIDE × 1' DEEP
≈ 15 cy

OPERATIONAL BERM = 1900 LF × 4' WIDE × 1' DEEP
(ONE SIDE ONLY)
≈ 282 cy

TOTAL QUANTITY = 682 cy

ASSUME 48 ADDITIONAL cy FOR
OTHER DITCHES, CULVERTS, INTERCEPTOR
TRENCHS.

TOTAL = 730 cy

COST (MEANS) = $ 10/cy

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SHEET ____ OF ____
BY SMZ
DATE 1-6-93
JOB NO. ____
PROJECT NVR
CH'K BY AM
SUBJECT BID ITEM 17
SOIL STABILIZATION / SOLIDIFICATION
DATE CH'K. 1-8-93
B'K. CH'K. BY ____

QUANTITY = 26,000 cy

COST = $55/cy

(COST FROM GEOCON VENDOR)

- GUESSTIMATE DEPENDING ON METHOD USED AND REAGENT GROUT CONCENTRATION.

INCLUDES QA/QC SAMPLING

26,000 × 55 = $1,430,000

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BY SMZ
DATE 1-6-93
CH'K BY AM
DATE CH'K 1-8-93
B'K CH'K BY ____

JOB NO. ____
PROJECT NVR
SUBJECT BID ITEM NO. 18
GEOTEXTILE FILTER FABRIC

TYPE	QUANT	UNIT COST

A

ACCESS RD 1300LF x 30 = 39,000 SF
CAP 174200 SF
TOTAL = 24,000 SY

B CAP 174200 SF. = 19,300 SY
DITCH AROUND BERM = 2500 LF x 4' = 10,000 SF
= 1200 SY

TOTAL = 20,500 SY

SOURCE - MEANS

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SHEET ___ OF ___
BY SZ
DATE 12-18-92
CH'K. BY AM
DATE CH'K. 1-6-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT NVR
SUBJECT BID ITEM 19 - GEOMEMBRANE

4 acres = 172240 SF
= 19360 SY

UNIT COST = \$5

MEANS / TRC EXPERIENCE

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SHEET ___ OF ___
BY TT
DATE
JOB NO.
PROJECT NVR
CH'K. BY SZ
SUBJECT BID ITEM 20 - PLASTIC SHEETING
DATE CH'K. 1-12-93
B'K. CH'K. BY

ASSUME 500 SY

$0.20/SY

SOURCE MEANS

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SHEET ___ OF ___
BY SZ
DATE 12-18-92
JOB NO. ___
PROJECT NVR
CH'K BY ___
SUBJECT BID ITEM 22
DATE CH'K ___
NEW DRIVES + ROADWAYS
B'K CH'K BY ___

ASSUME 15 WIDE, 130 LF OF DRIVEWAY

= 1950 SF

= 220 SY

COST:	ASPHALT	:	10.80 / SY
	AGG. FINISH	:	0.45
	SUBGRADE	:	0.11
			\$11.50 / SY

SOURCE: MEANS

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SHEET ___ OF ___
BY SMZ
DATE 12-18-92
CH'K BY AM
DATE CH'K. 1-6-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT NVR
SUBJECT BID ITEM NO 23
CULVERTS

		QUANT.	UNIT COST
ASSUME:	18" RCP	L=180'	17.05

SOURCE: MEANS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
JOB NO. ____
PROJECT NVR
CH'K BY ____
SUBJECT ITEM NO. 24
INFILTRATION DRAIN PIPE + TRENCH
DATE CH'K ____
B'K CH'K BY ____

	QUANT.	COST PER
TRENCH CUTTING -	1900 LF / 1400 cy	6/cy
PIPE BEDDING -	1400 cy	32.85/cy
12" 6" ϕ PERF. PIPE -	1900 LF	17.80/LF
MANHOLE -	5	1345/MH
GEOFABRIC -	380 SF	2.00/SY

assume mat. + labor

Total cost = 95695

\$95695 ÷ 1900 LF = \$50.37/LF

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SHEET ___ OF ___
BY SZ
DATE 12-18-92
JOB NO. ___
PROJECT NVR
CH'K. BY AM
SUBJECT BID ITEM 27
TOPSOIL AND SEED
DATE CH'K. 1-6-93
B'K. CH'K. BY ___

THIS ITEM ONLY FOR TOPSOIL/SEED OF CAP AREA

4 ACRES = 20,000 SY

$4/SY

SOURCE = MEANS / TRC EXPERIENCE

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SHEET ___ OF ___
BY SMZ
DATE 12-18-92
CH'K BY AM
DATE CH'K. 1-8-93
B'K CH'K. BY ___

JOB NO. ___
PROJECT NVR
SUBJECT BID ITEM NO. 28
LANDSCAPING

LUMP SUM

NEED TO INCLUDE PLANTINGS

ITEM	QUANT	COST
TREE REMOVAL	100 ea	11.80
REPLACEMENT OF PLANTINGS		5,000
		6,180

Allow $ 2,000 for landscape architect fees, pre-construction survey etc.

Total: $ 8,000

SOURCE: MEANS / TRC EXP.

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BY SMZ
DATE 12-18-92
CH'K BY AM
DATE CH'K. 1-8-93
B'K CH'K. BY ____

JOB NO. ____
PROJECT NVR
SUBJECT BID ITEM NO 29
SEPTIC SYSTEM

COST PER SYSTEM:

1 system $5000

HOWEVER, THE COST ESTIMATE WILL PROVIDE AN ALLOWANCE OF $10,000. (TAMS)

SOURCE: TAMS CONSULTANTS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
CH'K BY AM
DATE CH'K 1-8-93
B'K CH'K BY ____

JOB NO. ____
PROJECT NVR
SUBJECT BID ITEM NO 30.
SITE GAS LINES

Lumpsum

$ 1378

SOURCE: TAMS CONSULTANTS

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BY SMZ
DATE 12-18-92
CH'K BY AM
DATE CH'K. 1-6-93
B'K CH'K. BY ____

JOB NO. ____
PROJECT NVR
SUBJECT BID ITEM NO. 31
UG OIL TANK REMOVAL

	QUANT	COST
TANK	2	1325 each

(incl removal,
decon
+ replacement)

SOURCE: TAMS

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SHEET ____ OF ____
BY SMZ
DATE 12-18-92
JOB NO. ____
PROJECT NVR
CH'K. BY AM
SUBJECT BID ITEM NO. 32 MONITORING WELLS
DATE CH'K. 1-8-93
B'K. CH'K. BY ____

	QUANT.	COST	
1. a) New Wells (incl installing + devel.) depth = 15' (ASSUME)	2	100 /ft	= 3000
c) EXISTING WELLS (redevelopment)	1	100	100
b) ABONDON EXISTING WELLS	3	250	750
			$ 3,850

SOURCE: MEANS/TRC EXP.

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SHEET ___ OF ___
BY SZ
DATE 12-18-92
CH'K BY SZ/AM/JL
DATE CH'K. 1/6-93
B'K. CH'K. BY ___

JOB NO. ___
PROJECT ___
SUBJECT NVR
BID ITEM 34 - CONFIRMATIONAL SAMPLING

SOIL (TEM)	=	226	@	225
WATER	=	36	@	200
AIR	=	100	@	15

SOURCE: TRC EXP. /LABS