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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
JOHN F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-0001

May 31, 1995

Mark Evans, Remedial Project Manager
U.S. Department of the Navy
Naval Facilities Engineering Command
Northern Division
10 Industrial Highway
Code 1823, Mail Stop 82
Lester, PA 19113-2090

Re: Addendum to the Focused Feasibility Study for the Area A Landfill

Dear Mr. Evans:

Thank you for the opportunity to review the *Addendum to the Focused Feasibility Study for the Area A Landfill*. EPA coordinated its comments with Mr. Mark Lewis of the Connecticut Department of Environmental Protection who concurs with the reccommended text revisions indicated in the attached document.

I look forward to discussing these and other design issues at future meetings. Please do not hesitate to contact me at (617) 573-5777 should you have any questions.

Sincerely,

Kymberlee Keckler, Remedial Project Manager
Federal Facilities Superfund Section

Attachment

cc: Mark Lewis, CT DEP, Hartford, CT
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PRELIMINARY DRAFT

ADDENDUM TO THE

FOCUSED FEASIBILITY STUDY
AREA A LANDFILL

1.0 INTRODUCTION

This addendum to the Focused Feasibility Study (FFS) for the Area A Landfill was prepared in response to the U.S. Environmental Protection Agency's (EPA) comments dated April 19, 1995 and May 8, 1995 regarding certain design issues not addressed in the draft-final FFS for the Area A Landfill. Specifically, this addendum addresses ~~EPA's concern regarding two landfill design issues:~~ slope stability and leachate collection.

There is a potential for slope failure at the toe of the landfill slope along the wetland due to the accumulation of groundwater behind the impermeable cap at this location. The toe of slope can be stabilized either by draining the groundwater accumulating behind the cap (*i.e.*, by lowering the groundwater level) or ~~by providing sufficient weight to the cover in this area so that the pressure caused by the accumulation of groundwater does not cause the slope to fail~~ by providing lateral resistance (*e.g.*, sheet piles, slurry walls, retaining walls, or equivalent) to prevent the failure of the slope.

Although the proposed cap and associated run-on control measures are likely to lower the groundwater level in the landfill, the groundwater will still probably remain in contact with lower portions of the waste. ~~For this reason~~To prevent the migration of leachate from beneath the landfill into the adjacent wetlands, leachate collection is desirable to make the source containment remedy provided by the cap final and complete.

Both of these design issues can be addressed by installation of a system which lowers groundwater/leachate levels at the landfill. Groundwater/leachate levels can be lowered by preventing the inflow of groundwater into the landfill area by isolation methods, by collecting and treating groundwater/leachate, or by a combination of these two methods. These methods are described in Section 2.0.

The final method(s) to be used to lower groundwater levels at the Area A Landfill will be ~~selected after a predesign study is completed to determine the preferred method~~ described in the Record of Decision. Regarding the alternatives discussed in the FFS, the addition of such measures into the final remedy will not affect the comparative analysis of alternatives in the FFS, as the groundwater lowering method will be included as part of any alternative selected. Additionally, inclusion of a leachate collection system will not change the environmental requirements established in the Applicable or Relevant and Appropriate Requirements tables within the FFS.

2.0 GROUNDWATER ISOLATION, COLLECTION, AND TREATMENT

The following two subsections describe groundwater isolation and groundwater collection and treatment technologies potentially applicable to this site.

2.1 Leachate/Groundwater Isolation

Groundwater isolation technologies are implemented to either prevent or control groundwater flow into or through desired locations. Minimizing the volume of groundwater entering upgradient will reduce the amount of groundwater generated. Three technology options potentially applicable to the site are presented as follows. The first option entails the interception of groundwater flow using a slurry wall. The second option uses sheet piles rather than a slurry wall to intercept groundwater flow. The third option is a downgradient interceptor trench in which groundwater is collected and withdrawn from the aquifer. Slurry walls, sheet piles (or geomembrane walls), and interceptor trench technologies are described below.

2.1.1 Slurry Walls

Slurry walls are typically used as low permeability barriers and may be used as load bearing foundations. This technology is widely accepted as an effective low-permeability barrier for diversion of groundwater around impacted areas or containment of impacted water in shallow conditions (<100 feet deep). These walls are installed using typical trench excavation techniques, and the trench is filled during excavation with a bentonite-based slurry that holds the excavation open and hardens into a low-permeability vertical zone.

Soil-bentonite slurry walls can only be installed in relatively flat areas since the slurry will flow under stress (gravity). Cement-bentonite slurry walls are set semi-rigid and provide a stronger barrier than soil-bentonite walls. The cement-bentonite slurry walls average higher in cost (30%), have a somewhat lower resistance to chemical degradation, and may require disposal of excavated soils. However, they require less installation area than soil-bentonite walls.

Subsurface drains can be placed upgradient of a slurry wall to prevent overtopping of the wall and to minimize potentially impacted water contact with the wall (the latter in case of downgradient walls). The groundwater could be discharged to the surface water or reintroduced into an underlying formation. Drains can consist of both perforated piping or gravel drains. Selection of the drain material is dependent on the characteristics of the groundwater and formation.

Slurry walls may be keyed-into low-permeability confining layers. Walls that are not keyed-into confining layers are generally used in cases where gases or substances are found at or near the water table surface. Where the integrity of a confining layer (*i.e.*, fractured bedrock) is in doubt, drains or dewatering wells may be required within the barrier walls or grouting may be used to cut off subsurface flow. Grouting is a process during which a cementitious fluid is injected into a rock or soil mass for the purposes of reducing permeability and increasing strength. Grouting is best used for sealing fractures in rock. Grouting can be performed in formations below the water table. However, owing to possible interaction with leachate, grouting may not be effective if used within the barrier where leachate is present.

2.1.2 Sheet Pile Walls

Sheet piles are also installed to provide low-permeability barriers. The installation of sheet piling involves physically driving interlocking steel sheets into the soil to form a thin, low-permeability barrier. The sections are driven individually into the ground by a pile driver or vibratory hammer. The piles are traditionally made of steel; however, synthetic materials (*e.g.*, geomembrane walls) are also available for specific applications. Pile driving requires a relatively uniform, loose, boulder-free soil for ease of construction. Drains and dewatering would be used in the same manner as for slurry walls described in the previous subsection to improve the effectiveness of the sheet pile barrier.

2.1.3 Interceptor Trenches

Interceptor trenches act as buried conduits to convey and collect groundwater as it flows into the trench. Trenches function as an infinite line of extraction wells and therefore may be used to collect impacted water or lower the groundwater table, in lieu of wells. Trenches and drains are more effective than pumping wells in strata with low or variable hydraulic conductivity.

Several technology options exist for interceptor trenches. A standard arrangement for subsurface drains consists of perforated pipe that is surrounded by a permeable aggregate wrapped in a geotextile fabric to prevent the migration of fine grained soils to the system. Biopolymer slurry may be used during trench excavation to reduce excavation volumes in areas where there is inadequate room to perform traditionally cutback excavation. The biopolymer slurry maintains the integrity of the trench while the gravel layer is installed. The trench is then backfilled as the slurry naturally biodegrades and seeps into the groundwater. Generally, collection sumps are installed at low points in the trenches to permit pumping of the collected water and transport. Collected groundwater would be treated and or disposed in the same manner as groundwater collected by wells as described below in subsection 2.2.2.

2.2 Landfill Leachate Collection and Treatment

Landfill leachate collection and treatment technologies consist of both collection and treatment technologies. Most collection technologies are compatible with most treatment technologies and vice versa. Therefore, this section describes each component technology separately.

2.2.1 Leachate Collection

Leachate collection technologies are designed to prevent the landfill leachate from impacting groundwater. Potential applicable technologies for the site include leachate collection using interceptor trenches as described in subsection 2.1.3 and leachate collection through a network of wellpoints.

A network of shallow wells may be installed at strategic locations and connected to form a collection system for leachate extraction. A well point system requires a shallow groundwater table or the ability to locate pockets or preferential pathways of leachate inside or beneath the landfill to effectively collect leachate. A collection sump could be constructed to contain collected leachate.

2.2.2 Leachate Treatment

Leachate treatment technologies are designed to treat collected leachate to meet discharge requirements. Discharge requirements are determined by the off-site treatment facility or surface water discharge requirements. Leachate treatment options consist of on-site or off-site technologies. On-site pretreatment technologies include chemical treatment processes and physical treatment processes. Off-site treatment technologies consist of the use of the local POTW or an industrial treatment facility.

2.2.2.1 Off-Site Treatment

Transportation options consist of over-the-road transportation, railroad, or pipeline. Over-the-road transportation uses tanker trucks to periodically transport collected leachate. Railroad transportation involves staging several tanker cars and subsequent delivery to the facility. Pipeline transportation consists of constructing an underground or aboveground steel or plastic pipe to the nearest treatment facility connection. A description of industrial treatment facility and POTW facilities is provided in the following subsections.

Industrial Wastewater Treatment Facility. Facility treatment requirements for various physical and chemical parameters determine the off-site treatment options. Industrial facilities are commercial facilities that accept and treat wastewater (leachate) and generally have less stringent acceptance requirements than POTWs; therefore, they usually do not require pretreatment. Industrial wastewater treatment facilities have the ability to handle a variety of contaminants at high concentrations.

POTW. POTWs generally have more stringent requirements than industrial treatment facilities. The ability to discharge water to the local POTW is contingent upon pretreatment standards, the composition of the leachate/groundwater, and the volume to be treated relative to the capacity of the POTW and the approval of the local water pollution authority. Depending on the POTW requirements, on-site pretreatment may be required. Applicable pretreatment processes are presented in subsection 2.2.2.2 as on-site treatment options. It remains to be determined if the local POTW can effectively treat the leachate or if it is willing to accept this discharge.

2.2.2.2 On-Site Pretreatment

Chemical, physical, and biological processes may be used to remove contaminants from the leachate/groundwater. These processes may be employed separately or combined, where appropriate, to form a process treatment train that will treat the leachate/groundwater to the required levels. The pretreatment technology selection is based on the discharge or off-site treatment facility requirements.

Understanding the general nature of leachate production in a landfill serves to reinforce the analytical characterization of the leachate formed during the investigations and offers insight - into treatment processes that may be appropriate.

Leachate produced in a municipal landfill can vary in composition according to many factors (refuse, precipitation, compaction, *etc.*). One factor studied extensively is the change in the composition of the leachate as the landfill ages. Landfills in the acetic phase (less than 5 years old) create leachate that contains many shortchained organic compounds (volatile fatty acids) that are very biodegradable. The Biological Oxygen Demand ("BOD") concentrations can be as high as 40,000 mg/l. Older landfills in the methanogenic phase (greater than 10 years old) produce leachate that contains more longchained (refractory) volatile compounds (BOD less than 50 mg/l), as seen in the Area A Landfill. The longer-chained volatiles are not broken down as easily in aerobic conditions. High concentrations of chemically-reduced inorganic substances, such as ammonia, iron, and zinc, are produced in the landfill as a result of anaerobic activities.

Owing to the age of the Area A Landfill and the leachate's low BOD range (<5 mg/l), it seems appropriate that only chemical and physical treatment options will be considered.

Chemical Treatment Processes. *Neutralization* is the mixing of an acid or a base into an aqueous stream to achieve a desired pH. This can be a batch or a continuous process.

Coagulation/flocculation is the process by which colloidal material agglomerates, with help from chemical additives, to form a small floc (coagulation) which then combines (flocculates) to produce larger particles that separate from the liquid. Adding lime raises the pH of the solution and lowers the solubility of heavy metals. Lime is a preferred coagulant for the precipitation of heavy metals. Polymers are another common coagulant.

Oxidation involves the use of a strong oxidation agent to break down complex organic compounds. Typical materials include chlorine, potassium permanganate, ozone, and hydrogen peroxide. Highly efficient destruction of toxic and hazardous materials has been achieved when chemical oxidation is combined with ultraviolet (UV) irradiation.

Physical Treatment Processes. *Physical separation* includes precipitation, specific gravity separation, filtration, and dissolved air flotation ("DAF") processes, and is used to remove soluble and insoluble matter from aqueous streams. Precipitation is a physical process that transforms soluble matter into a solid phase that can be removed by settling. Sedimentation is a purely physical process that uses gravity and inertia to settle suspended particles from solution. Specific

gravity separation refers to the separation of fluids based on the specific gravity of its components. Filtration removes suspended solids from a liquid via disposable or backwashable filter media. DAF is a process which uses the release of dissolved air or other gas to carry suspended particles to the top of a tank where they may be removed by skimming.

Air Stripping involves the transfer of volatile compounds from the aqueous phase or the gaseous phase. Air pollution control equipment may be required to contain the volatiles in the gaseous phase.

Adsorption is the process by which material is transferred from a gas or liquid to the surface of a material (sorbent) because of either physical or chemical surface forces. Activated carbon is the most widely accepted sorbent for volatile compounds and can remove metals at low quantity levels. Carbon can be used in both powder and granular form.

~~3.0 ARARs~~

~~The leachate isolation, collection and treatment and/or disposal system will have to be designed, constructed, and operated in compliance with all applicable or relevant and appropriate requirements (ARARs). The most significant requirements are listed below. Further information on these ARARs is contained in the Area A Landfill FFS.~~

~~State~~

- ~~Water Quality Standards (CGS § 22a-426~~
- ~~Water Pollution Control (RCSA §§ 22a-430-1 to 8)~~
- ~~Water Pollution Control (CGS § 22a-430)~~
- ~~Connecticut Water Diversion Policy Act (CGS §§ 22a-365 to 378)~~

~~Federal~~

- ~~National Pollution Discharge Elimination system (NPDES) (40 CFR Parts 122-125~~

3.0 COST

The estimated costs are shown in Tables 3-1 and 3-2. These costs are ~~very~~ preliminary and are presented ~~primarily useful~~ to give a range of potential costs. Costs were estimated for two sets of alternatives. One set of alternatives does not include any vertical barriers and contains four alternatives as follows:

Alternative 1: $442,000. This alternative utilizes interceptor trenches to collect groundwater, and the groundwater collected is discharged directly to the POTW.

Alternative 2: $1,492,000. This alternative also utilizes interceptor trenches to collect groundwater; however, the collected groundwater is treated and discharged on site.

Alternative 3: $187,000. This alternative uses dewatering wells to collect groundwater, and the groundwater collected is discharged directly to the POTW.

Alternative 4: $1,237,000. This alternative also uses dewatering wells to collect groundwater; however, the collected groundwater is treated and discharged onsite.

The other set of alternatives are the same as the first set except they all include ~~the addition of~~ vertical barriers. It was assumed that the average depth of the barriers was ten feet and that the amount of groundwater to be collected and treated under this scenario would be reduced 90% by installation of the vertical barriers. Total costs are as follows:

Alternative 1a: $1,965,000.

Alternative 2a: $2,058,000.

Alternative 3a: $1,777,000.

Alternative 4a: $1,870,000.

Based on the assumptions made in the cost estimates, the first set of alternatives which do not use a vertical barrier are cheaper ~~more cost effective~~. Among this first set, the most cost-effective alternative utilizes dewatering wells to collect groundwater and directly discharge this groundwater to the POTW. Further hydrogeologic characterization and analysis would be required to confirm the assumptions made. With better hydrogeologic data and more detailed cost estimates, the cost of these alternatives may vary.

Comments on Tables 3-1 and 3-2

1. The text should explain how the estimates were developed. It is unclear whether the long-term benefits of a leachate collection system (stabler slope; reduced volume of contaminated groundwater) were considered when generating the estimates.

2. Note that the unit cost for shallow slurry walls or geomembrane walls is about $5.00 to $10.00 per square foot. Therefore, the use of slurry walls or geomembrane walls instead of sheet piles ($25.00 per square foot) will save more than $750,000.