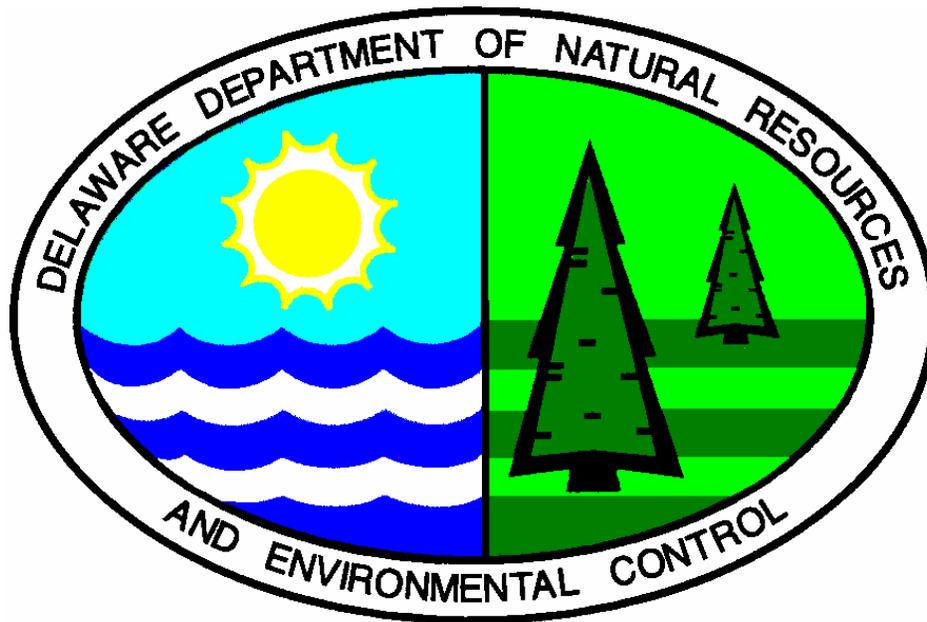


FINAL PLAN OF REMEDIAL ACTION

**Newark Landfill Site
University of Delaware Agricultural Farm
Newark, DE**

DE-039



November 2002

Delaware Department of Natural Resources and Environmental Control
Division of Air and Waste Management
Site Investigation & Restoration Branch
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TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	SITE DESCRIPTION AND HISTORY.....	1
2.1	SITE SETTING.....	1
2.2	SITE OPERATION.....	2
2.3	SITE INVESTIGATION HISTORY.....	2
2.4	SITE INVESTIGATION RESULTS.....	3
3.0	SITE RISK EVALUATION.....	3
3.1	CONTAMINANT OF POTENTIAL CONCERN.....	3
3.2	HUMAN HEALTH IMPACT.....	4
3.2.1	<i>Groundwater</i>	4
3.2.2	<i>Waste Material</i>	5
3.2.3	<i>Surface Water</i>	5
3.3	ECOLOGICAL IMPACT.....	5
4.0	INTERIM RESPONSE ACTION.....	5
5.0	REMEDIAL ACTION OBJECTIVES.....	6
6.0	FINAL PLAN OF REMEDIAL ACTION.....	7
7.0	PUBLIC PARTICIPATION.....	8
8.0	DECLARATION.....	9
9.0	REFERENCES.....	10

LIST OF FIGURES

FIGURE 1: LOCATION MAP.....	11
FIGURE 2: SITE MAP.....	12

1.0 INTRODUCTION

The Newark Landfill Site (site) is located at the University of Delaware Agricultural Farm, in Newark, Delaware (Figure 1). The site was operated as a municipal landfill by the City of Newark and the University of Delaware from 1968 to 1972 and is currently owned by the University. The University and the City entered the Delaware Department of Natural Resources and Environmental Control (DNREC or Department) Voluntary Cleanup Program (VCP) under the provisions of Delaware Hazardous Substance Cleanup Act, 7 Del. C. Chapter 91 (HSCA). Through a VCP Agreement, the University of Delaware and the City of Newark agreed to investigate the potential risks posed by the site to public health, welfare and the environment. The previous investigations, including a preliminary investigation by Delaware Geological Survey (DGS), a site inspection (SI) by a US EPA contractor and subsequent investigations completed by Tetra Tech, Inc. (Tetra Tech), are being accepted as equivalent to remedial investigation (RI) by DNREC.

This document is DNREC's final plan of remedial action (final plan) for the site. It is based on the results of the previous investigations performed at the site. This final plan is issued under the provisions of the HSCA and the Regulations Governing Hazardous Substance Cleanup (Regulations). It presents DNREC's final remedial action based on an assessment of the potential health and environmental risks posed from chemicals present on the site.

As described in Section 12 of the Regulations, DNREC provided public notice and allowed the public an opportunity to comment on the proposed plan. At the conclusion of the public comment period, DNREC considered all of the comments received and then issued the final plan. The final plan designates the selected remedy for the site. All previous investigations of the site, the proposed plan, comments received from the public, DNREC's responses to those comments, and the final plan will constitute the remedial decision administrative record for the site.

Section 2.0 presents a description of the setting, operation, investigation history and investigation results of the site. Section 3.0 presents site risk evaluation. Section 4.0 describes the interim response actions taken at the site. Section 5.0 presents a discussion of the remedial action objectives. Section 6.0 presents the final plan of remedial action. Section 7.0 discusses public participation and DNREC's responses to comments. Section 8.0 is the Declaration and Signature portion of the final plan.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Setting

The site is located at the University of Delaware Agricultural Farm, in Newark, Delaware (Figure 1). It is a 10-acre, inactive municipal waste landfill that was in operation from 1968 to 1972. After closure, the landfill was covered with an impermeable asphalt barrier, re-graded and vegetated. Currently the largest portion of the landfill is within a fenced pasture area and is used for grazing livestock. The electric fence follows the south, west, and northern boundary of the main part of the landfill. A small drainage ditch, which forms the headwaters for Cool Run, a tributary of White Clay Creek, is situated along the eastern boundary of the landfill. A small portion of the landfill lies outside the western fence. Chicken cages and several gravel access

roads have been constructed over this portion of the landfill (Figure 2). The entire area is vegetated, with the exception of a few small depressions.

There are six functioning monitoring wells (MWs) at the site (MW-3, 5, 10, 11, 12 and 13). Another monitoring well, MW-7, which was sampled in 1996, could not be found during the August 2000 sampling, and was presumed, destroyed. MW-3, 5, and 7 were installed during the initial hydrogeologic evaluation of the site in 1971, and MW-10, 11, 12 and 13 were installed in 1989, as part of additional site monitoring activities. All of the wells are screened to a depth up to 39 feet below grade in the shallow Columbia Aquifer, with the exception of MW-10, which was screened from 125 to 135 feet below grade in the deeper Potomac Aquifer.

2.2 Site Operation

The site was operated as a municipal landfill by the City of Newark and the University of Delaware from 1968 to 1972, and was used for the disposal of domestic garbage. During the landfill's operation, waste disposal trenches were reportedly excavated from 15 to 18 feet below land surface. This waste disposal method may have resulted in wastes being disposed of below the water table, which ranges from 3 feet below grade along its eastern boundary to 25 feet along the southern boundary of the site. It is reported that approximately 200 cubic yards of material per day were deposited in cells that were approximately 15 feet deep (Woodruff, 1987). The landfill reportedly received household garbage and some construction material, although there was some indication that waste pigments from the Newark Assembly Plant of the Chrysler Corporation were also disposed at the landfill. However, there are no records available to verify the nature of the material disposed of over the entire life of the landfill. The landfill was closed in 1972, and was covered with an impermeable asphalt barrier, re-graded and vegetated. In November 1973, the effectiveness of the asphalt cover was evaluated by DGS. The findings indicated that leachate from the site has been reduced significantly and infiltration of rainwater has essentially ceased (Miller, 1973).

2.3 Site Investigation History

The Site has a long history of investigation including several sampling events, starting with an initial Delaware Geological Survey study in 1971, through the most recent groundwater monitoring activities conducted in August 2000. The investigations include installation of monitoring wells and several rounds of groundwater sampling; a Preliminary Assessment (PA) by DNREC; a SI by a contractor for the U. S. EPA, and groundwater sampling of the municipal wells in the City of Newark North Well Field.

Tetra Tech, on behalf of the University of Delaware and the City of Newark, submitted a report entitled *Old City of Newark Landfill Environmental Data Summary* in January 1998. This report provides a summary of the previous investigations and the current status of the site. The University of Delaware and the City of Newark entered DNREC's (VCP) by signing a letter agreement with DNREC in April 1998, to review the environmental investigation reports and provide recommendations for remediation of the site. DNREC reviewed the report and requested additional sampling of groundwater from the onsite monitoring wells. The groundwater sampling was performed in August 2000. A report entitled *Supplemental Technical Information*

Update #2, Old City of Newark Landfill Site, was prepared by Tetra Tech and included the results of the August 2000 sampling. The report provided a comprehensive analysis of chemical data trends observed at the site. This report also evaluated the risk posed by the site and the potential remedial alternatives.

2.4 Site Investigation Results

Historically, contamination was detected primarily in the groundwater at the site. However, there have been no organic or inorganic analytes detected at the site that exceeded the Maximum Contaminant Level (MCL) or DNREC's Uniform Risk Based Standard (URS) values in groundwater since 1994. Prior to 1994, various volatile organic compounds (VOCs) had been detected at the site at concentrations in excess of the MCL or URS values. The Contaminants of Potential Concern (COPC) detected at the site prior to 1994, and their maximum concentrations, are as follows: benzene (36 micrograms per liter [ug/l]); methylene chloride (16 ug/l); 1,2 dichloroethene (10 ug/l); acetone (200 ug/l); 1,2 dichloropropane (82 ug/l); trichloroethene (27 ug/l); tetrachloroethane (7 ug/l); vinyl chloride (19 ug/l) and bis-2 ethylhexylphalate (58 ug/l). However, most of the COPC detected prior to 1994 are no longer present in the groundwater, or are present at relatively low concentrations, (generally less than 5 ug/l). Only chlorobenzene was detected at a concentration of 36 ug/l in MW-11 during the August 2000 monitoring event. This concentration is well below the 100 ug/l MCL of chlorobenzene. Previous sampling events indicated the presence of iron and manganese in groundwater at concentrations that exceeded the Secondary Maximum Contaminant Levels (SMCLs) that are aesthetic-based (taste and odor), not health based. The presence of iron and manganese in the groundwater at the site may be related to the landfill, but may also be related to the naturally high iron and manganese concentrations of the Columbia and Potomac aquifers in this area (Woodruff 1970).

In 1980, tetrachloroethene (PCE), chloroform and trichloroethene (TCE) were detected in the City of Newark North Well Field, Public Water Supply (PWS) wells PWS-5 and PWS-8.

In May 1985, NUS FIT III (an EPA contractor) collected soil, sediment, surface water, and groundwater samples at the site as a part of a SI. A sample from an off-site well (PW-8) located upgradient of the landfill indicated the presence of PCE (82ug/l). Surface water samples collected from the adjacent tributary detected iron at concentrations ranging from 5,180 to 6,550 ug/l and aluminum at 67 to 534 ug/l. A low level of ethylbenzene (24 ug/kg) was detected in a sediment sample collected from the standing water area in the tributary.

3.0 SITE RISK EVALUATION

The risks posed by the site were evaluated by considering the COPC at the site and their potential impact to human health, welfare and the environment.

3.1 Contaminant of Potential Concern

Historically, the site showed contamination primarily in groundwater. However, as stated earlier no analytes have been detected at the site that exceeded any MCLs or DNREC's URS values in the 1994, 1996 or 2000 groundwater monitoring events. The only contaminant detected was

chlorobenzene at 36 ug/l, which is well below the MCL of 100 ug/l. Chlorobenzene is retained as a COPC because its concentration has exhibited a gradual increase in groundwater over time.

3.2 *Human Health Impact*

3.2.1 Groundwater

Groundwater is the primary medium of concern. Known water supply wells located near the site include the City of Newark North Well Field, City of Newark South Well Field and the University of Delaware water supply well.

The City of Newark North Well Field (the wellheads of which are located immediately north and west of the site) is not currently in use, and hasn't been used since early 1980's. Three production wells were developed in this well field (PWS-5, 8 and 9). The casing in PWS-9 collapsed in the 1970s and was abandoned. PCE was detected in PW-5 and PWS-8, and the wells were taken out of use in the early 1980s. At present, only PWS-8 still contains an operable pump, which is capable of producing 150 gallons per minute (gpm). The only known use of this well since the early 1980s was during the drought conditions of the summer of 1999, when water was pumped briefly for non-potable irrigation purpose. The City of Newark is not considering the use of this well field in the near future. Based on the pumping test performed at the North Well Field and the water level data, it was concluded that the landfill was within the zone of influence of the well field when it was operating at its peak capacity of 720 gpm. However, water level data indicate that the landfill site was not within the zone of influence of the well field during the normal pumping conditions, as represented by 1974 pumping condition, which is estimated to be 150 gpm.

Although the site is within the potential zone of influence for the North Well Field under peak operating conditions, the concentration of chlorobenzene detected during August 2000 sampling in the groundwater at the site does not pose a concern for the well field, as the concentration is well below the MCL for this analyte. Iron and manganese are present in groundwater at maximum concentrations of 62.2 mg/l and 20.1 mg/l, respectively. While these concentrations exceeded the SMCLs, they do not present a direct human health risk, but could present a taste, appearance and staining problem.

The University of Delaware well was installed on March 2000, at a location approximately 2,500 feet north of the landfill site. This is a non-potable production well and provides 75 gpm of water for use in the campus heating plant boiler and air conditioning system. A pump test performed by Duffield Associates as a part of the well evaluation concluded that the site is outside the zone of influence of the well.

The Newark South Well Field is located more than one mile south and east of the landfill site. The March 1996 Aquifer Management Plan for the City of Newark South Well Field demonstrated, through groundwater modeling, that the landfill site was not within the zone of influence of the well field. A formal risk assessment was not performed with respect to future groundwater users. However, groundwater data for the landfill indicated that contaminants have not been detected above MCLs or URS values during the 1994, 1995, and 2000 groundwater sampling events.

3.2.2 Waste Material

The waste material at the landfill was covered with impervious asphalt and 18 inches of soil. The surface is vegetated. As long as the cover is maintained properly and any intrusive work is prevented, the risk of exposure is eliminated. Leachate from the landfill along the embankment of the tributary adjacent to the site declined after the landfill cover was installed.

3.2.3 Surface Water

A small drainage ditch, which forms the headwater of Cool Run, is located adjacent to the site and is the primary surface water body in the vicinity of the landfill. Runoff from the landfill should not affect the surface water because of the existing landfill cover. The groundwater discharge from the shallow aquifer to the tributary is low. The specific quantity of groundwater discharge to the drainage ditch is unknown. It is probably seasonal and variable, with discharge occurring during periods of high water table conditions, with no discharge occurring during regular or low water table conditions. The total stream flow through the drainage ditch has never been measured, but given the size of the ditch (2-3 feet wide, 6 inches to a foot in depth), the flow through the ditch is estimated to be on the order of magnitude of 0.05 to 0.1 cubic feet per second (cfs). Assuming that groundwater discharge accounts for 50% of this flow at any given time, the rate of discharge is estimated to be 20 to 50 gallons per minute (gpm) along the entire stretch of the drainage ditch. The two monitoring wells (MW-3 and MW-5) located closest to the tributary did not contain any COPC in groundwater. Even if chlorobenzene at its current concentration (36 ug/l) discharges undiluted to the tributary, it is well below the ecological URS for chlorobenzene of 64 ug/l. Dilution from other surface water will further reduce this concentration. Iron and manganese were detected in groundwater exceeding the respective SMCLs at the site and may discharge into the tributary from the site. However, dilution from the surface water is expected to reduce iron and manganese below URS for surface water.

3.3 Ecological Impact

There is a very limited potential for any ecological receptors to be exposed to the groundwater originating from the landfill. The only potentially complete pathway is related to discharge from shallow Columbia Aquifer to the small tributary of Cool Run, located adjacent to the landfill. The COPC, chlorobenzene present in the groundwater is below the ecological URS for surface water. Iron and manganese present in groundwater when discharged to the surface water may exceed the ecological URS. However, the cap on the landfill has significantly reduced the amount of groundwater discharge to the tributary. It should be noted that iron and manganese concentrations in the shallow Columbia Aquifer are naturally high in this area. (Woodruff, 1970; Spoljarie and Woodruff, 1970)

4.0 INTERIM RESPONSE ACTION

During late 1972, and early 1973, the University of Delaware reportedly re-graded the landfill surface after the landfill operation ceased on March 1972. On March 1973, a subsurface impermeable asphalt moisture barrier was placed over the landfill by George and Lynch (Woodruff, 1986). Approximately 18 inches of soil fill was placed on the asphalt cover and grass was planted to restore the site (Miller, 1973).

In November 1973, the effectiveness of the asphaltic surface cover was evaluated by the Delaware Geological Survey (DGS). The findings indicated that the movement of the leachate had been retarded, infiltration of rainwater through the landfill surface had more or less ceased, and mounding within the landfill had been reduced significantly (Miller, 1973). Concurrently, the City of Newark reduced pumping at the North Well Field to reduce the potential for leachate migration. The North Well field has not been in operation for potable water supply since the early 1980s.

In February 1974, contingency plans were developed to address leachate movement from the landfill, if necessary. Operations and maintenance plans related directly to the landfill included: liming of an existing seep to reduce odor (this operation was implemented on March 18, 1974); re-grading of the landfill surface to eliminate any standing water; and reseeded of the landfill surface with permanent water-consuming grasses (Jordon, 1974).

During 1990, Jacobi Contractors, under contract with the University, re-graded the landfill surface to address pockets of standing water. All trees and underbrush were removed prior to grading activities, and the area was rough graded and low-lying areas were filled with soil from the site. The area was then compacted with a roller before fine grading and seedbed preparation. The University assumed responsibility for liming, fertilizing, and seeding of the area (Bowman, 1992).

Several monitoring wells were installed at the site and numerous groundwater-sampling events were conducted. Tetra Tech conducted annual ground water sampling of the on-site wells starting in July 1990, through May 1996. All existing wells were sampled as recently as August 2000.

5.0 REMEDIAL ACTION OBJECTIVES

DNREC considers the data and information generated in the previous investigations of the site to meet the criteria of a remedial investigation (RI), and hereby adopts the previous investigations as the RI. According to Section 8.4 (1) of the Regulations, site-specific remedial action objectives must be established for all plans of remedial action.

The remedial action will be evaluated for contaminants of potential concern, utilizing the qualitative and quantitative objectives and the following considerations:

- The anticipated future land use of the site by the University of Delaware, the current owner, to be the same as the current land use as pasture; and
- The risk posed by the site to human health and the environment.

Qualitative Remedial Objectives:

Based on the above considerations, the following qualitative objectives were developed for the site:

- Prevent human contact (dermal and ingestion) with the waste material by maintaining the integrity and effectiveness of the landfill cover;

- Control run-on and run-off of storm water from eroding or otherwise damaging the landfill cover;
- Prevent infiltration of water into the landfill due to ponding in depressions on the landfill;
- Restrict exposure and discharge of potential hazardous substances from site waste material along the tributary embankment; and
- Prevent human exposure to groundwater.

Quantitative Remedial Objectives:

Based on the above qualitative Remedial Action Objectives, the following quantitative Remedial Action Objective was developed:

- Prevent human contact with contaminant concentrations that exceed 1×10^{-5} cumulative cancer risk and a hazard index of 1 for non-carcinogenic compounds. The primary containment of potential concern is chlorobenzene in groundwater. The current concentration is 36 ug/l and the MCL is 100 ug/l.
- Prevent use of groundwater from the site.

6.0 FINAL PLAN OF REMEDIAL ACTION

Based on the success in the reduction of contaminants at the site below the MCLs and/or the URS values, DNREC determines that the following remedial measures should be taken at the site to ensure that the waste material does not impact human or ecological receptors.

1. The current soil and vegetation cover will be maintained to eliminate potential pathways for exposure of the waste materials to human or ecological receptors.
2. All depressions in the landfill area that are prone to ponding will be filled and the area re-graded and vegetated to improve the surface water runoff from this area and to restrict the potential movement of surface water through the cover.
3. An Operation and Maintenance (O&M) Plan will be established and implemented, detailing the procedures and practices to minimize the potential for disturbing the vegetation and soil cover and to promote the long-term integrity of the cover. The O&M Plan must include, but not be limited to, the following:
 - a. Semi-annual site inspection will be performed for the following purpose:
 - i. To ensure that the existing landfill cover is adequately protecting the waste materials.
 - ii. To visually inspect the drainage ditch, located immediately adjacent to the eastern boundary of the landfill, for possible bank erosion and sign of leachate production.

- b. A contingent groundwater-monitoring plan will be implemented if the City of Newark resumes operation of the North Well Field thereby affecting the groundwater flow regime in the area.
 - c. A deed restriction will be placed on the site prohibiting any land-disturbing activities at the site without the prior written approval of DNREC.
 - d. The deed for the property will be amended to indicate that any modifications that change the current use of the land (agriculture) will require an engineering assessment to ensure that the landfill is not being adversely affected by the change. The deed will also be amended to incorporate this O&M Plan.
 - e. A groundwater management zone (GMZ) will be established that will prohibit groundwater withdrawals at this site. A deed restriction will be placed on the deed for the property prohibiting groundwater use without DNREC written approval.
4. The City of Newark shall notify in writing DNREC's Site Investigation and Restoration Branch concerning any intention to resume or initiate groundwater extraction within a one-mile radius of the site.

7.0 PUBLIC PARTICIPATION

DNREC actively solicited public comments or suggestions on the proposed plan. The public comment period began on September 23, 2002, and ended on October 14, 2002.

A comment letter dated October 10, 2002 from the University of Delaware and the City of Newark, the potential responsible parties for the site, was received by DNREC. The comment letter indicated that they are in agreement with majority of the remedial actions and made the following comment for consideration:

“Operation and Maintenance (O&M) Plan: The proposed plan indicates that a component of the O&M plan will be the establishment of a ground water monitoring plan to address possible impact to future public water supply wells in the area.

Comment: Given that 1) the most recent rounds of groundwater sampling have indicated that there are no compounds present in excess of the MCL, and 2) there are no current plans to reactivate the Newark North Well field, there is currently no benefit for continued groundwater monitoring at the site.

However, it is acknowledged that should the North well field be used for water supply at some point in the future, monitoring of the landfill wells would be appropriate and prudent as part of the operation of that well field. Therefore, it is requested that a ground-water monitoring plan, as an element of the O&M Plan, would only be required in the future if the North Well field is returned to operation.”

DNREC's Response: The Department agrees with the comment since the intent of the groundwater monitoring plan is to address possible impact to future public water supply wells in

the area, which include return to operation of the City of Newark's North Well Field. The final plan has been modified to explain this requirement.

8.0 DECLARATION

This final plan of remedial action for the Newark Landfill site is protective of human health, welfare and the environment and is consistent with the requirements of the Delaware Hazardous Substance Cleanup Act.

John Blevins
Director, Air and Waste Management

Date

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9.0 REFERENCES

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Figure 1: Location Map

Figure 2: Site Map