REMEDIAL ALTERNATIVES TECHNICAL MEMORANDUM

STOUGHTON CITY LANDFILL

STOUGHTON, WISCONSIN

ENSR

SUBMITTED BY:

STOUGHTON CITY LANDFILL STEERING COMMITTEE

SEPTEMBER 6, 1990

PREPARED BY:

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ENSR DOCUMENT NO. 6885-002-300

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September 6, 1990

ENSR Project No: 6885-002-300

Mr. Michael A. Valentino
Remedial Project Manager
U.S. Environmental Protection Agency
Region V (Mail Code: 5HS-11)
230 South Dearborn Street
Chicago, IL 60604

SUBJECT: Transmittal of Remedial Alternatives Technical Memorandum for the Stoughton City Landfill

Dear Mr. Valentino:

At the direction of the Stoughton City Landfill Steering Committee, we are providing you with 10 copies of the Remedial Alternatives Technical Memorandum for the Stoughton City Landfill site.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Louis H. Meschede

Louis H. Meschede
Project Manager
Senior Project Hydrogeologist

LHM/lak

Reference No. 90-09-K160

cc: Ms. Robin Schmidt/WDNR (3 Copies)
Dr. Briand C. Wu (1 copy)
Mr. Robert P. Kardarsz (1 copy)
Mr. Michael Doran (1 copy)
Mr. Tim Wright, Esq. (w/o enclosure)

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1.0 INTRODUCTION

The purpose of the Remedial Alternatives Technical Memorandum is to present the detailed assessment and comparative analysis of remedial alternatives for the Stoughton City Landfill site. The development of remedial alternatives, described in the Final Alternatives Array Document (Final AAD) dated August 14, 1990 (Revision 1), was based on information and data presented in the Draft Remedial Investigation (RI) Report dated August 10, 1990 (Revision 2).

Based on the results of the baseline risk assessment (Chapter 6 of Draft RI Report) and the evaluation of applicable or relevant and appropriate requirements (ARARs) (Appendix A of Final AAD), two operable units were identified for the site: a solid waste or landfill operable unit and a groundwater operable unit. The solid waste operable unit includes the refuse and the soil underlying the refuse within the landfill boundary established in the RI. The groundwater operable unit is limited to the vicinity of monitoring well MW-3D, the only location where groundwater in the sand and gravel aquifer exceeded Wisconsin groundwater enforcement standards. The following remedial action objectives were established for the solid waste and groundwater operable units:

Solid Waste Operable Unit

- Prevent public from exposure to landfill refuse and potential hazardous substances contained therein; and,
- Control leaching of chemicals of concern from the landfill to groundwater to protect public health and the environment, including protection of aquatic life in the adjacent wetlands.

Groundwater Operable Unit

- Provide remedies that allow eventual achievement of groundwater standards that are applicable or relevant and appropriate for tetrahydrofuran at MW-3D.

These objectives formed the basis for the development of remedial alternatives that are analyzed in detail in this document.

The detailed analysis of alternatives was performed in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" [U.S. Environmental Protection

Agency (U.S. EPA), 1988] and Section 300.430(e)(9) of the National Contingency Plan (NCP). The purpose of the detailed analysis of alternatives is to provide decision-makers with sufficient information to adequately compare the alternatives and select an appropriate remedy for the site. The nine evaluation criteria for selection of a remedy that are outlined in Section 300.430(e)(9)(iii) of the NCP are categorized into three groups:

- **Threshold Criteria** - Address overall protection of human health and the environment and compliance with ARARs [unless a specific ARAR is waived in accordance with Section 300.430(f)(1)(ii)(c)].

- **Primary Balancing Criteria** - Address long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

- **Modifying Criteria** - Address state and community acceptance.

Any remedy selected must meet the threshold criteria and be cost-effective. Cost effectiveness is determined by examining whether the costs are proportional to the remedy's overall effectiveness, as determined by evaluating the following three of the five primary balancing criteria listed above: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. In addition, each remedial action selected must utilize permanent solutions to the maximum practicable extent.

The nine evaluation criteria outlined in the NCP serve as the basis for conducting the detailed analysis of alternatives and for subsequently selecting appropriate remedial action for the site. An overview of these evaluation criteria is presented in Section 2.0. In Section 3.0, each individual remedial alternative is described and then assessed in terms of the nine evaluation criteria. A comparative analysis of the remedial alternatives is presented in Section 4.0. The preferred alternative is discussed in Section 5.0.

2.0 OVERVIEW OF EVALUATION CRITERIA

The nine evaluation criteria to be used in the detailed analysis of alternatives are listed in Table 2-1. The following paragraphs briefly describe the factors addressed by each evaluation criterion.

2.1 Overall Protection of Human Health and the Environment

This criterion, which is a final assessment of whether the alternative adequately protects human health and the environment, encompasses assessments of other evaluation criteria, particularly long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The criterion also includes a description of how site risks are eliminated, reduced, or controlled, through treatment, engineering, or institutional controls. Potential cross-media impacts are also evaluated.

2.2 Compliance with ARARs

This criterion is used to determine whether all federal and state ARARs (as defined in the Final AAD) will be met. A summary of which requirements are applicable or relevant and appropriate to an alternative is provided, as well as a description of how the alternative will meet the requirements. For any ARARs that are not met, justification using one of the six allowable waivers is provided. The following are addressed for each alternative:

- Compliance with chemical-specific ARARs (such as maximum contaminant levels)
- Compliance with location-specific ARARs (such as impacts on regulated wetlands)
- Compliance with action-specific ARARs (such as Resource Conservation and Recovery Act [RCRA] minimum technology standards)

An evaluation of ARARs is presented in Appendix A of the Final AAD.

2.3 Long-Term Effectiveness and Permanence

This criterion considers the risk remaining at the site after remedial action objectives have been met. Two major factors are considered: magnitude of residual risk, and adequacy and reliability of controls. Magnitude of residual risk refers to risk remaining from untreated waste or treatment residuals. Adequacy and reliability of controls refers to the controls, if any, that are used to

TABLE 2-1

Summary of Detailed Evaluation Criteria

Criterion	Issues
Overall Protection of Human Health and the Environment	- Protection of human health and the environment.
Compliance with ARARs	- Compliance with chemical-specific ARARs, location-specific ARARS, action-specific ARARs, and other to-be-considered guidance and criteria.
Long-Term Effectiveness and Permanence	- Magnitude of residual risk - Adequacy and reliability of controls
Reduction of Toxicity, Mobility, and Volume Through Treatment	- Treatment process used and materials treated - Amount of hazardous materials destroyed or treated - Degree of expected reductions in toxicity, mobility, and volume - Degree to which treatment is irreversible - Type and quantity of residuals remaining after treatment
Short-Term Effectiveness	- Protection of community during remedial actions - Protection of workers during remedial actions - Environmental impacts - Time until remedial action objectives are achieved
Implementability	- Ability to construct and operate the technology - Reliability of the technology - Ease of undertaking additional remedial actions, if necessary - Ability to monitor effectiveness of remedy - Ability to obtain approval from other agencies - Coordination with other agencies - Availability of off-site treatment, storage, and disposal services and capacities - Availability of necessary equipment and specialists - Availability of prospective technologies

TABLE 2-1

Summary of Detailed Evaluation Criteria

Criterion	Issues
Cost	- Capital costs - Operating and maintenance costs - Present worth costs
State Acceptance*	- State acceptance of the preferred alternative
Community Acceptance*	- Community acceptance of the preferred alternative

* State and community acceptance criteria are addressed in the Record of Decision following public comment on the Feasibility Study.

manage the residual risk identified. Technical components and institutional controls are evaluated and the risk posed if a technical component needs replacement (e.g., cap or extraction well) is also considered.

2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The statutory preference for remedial alternatives that permanently and significantly reduce the toxicity, mobility, or volume of hazardous wastes is addressed by this criterion. Questions concerning to what extent the risk can be reduced through treatment and whether or not the principal threats at the site are addressed by the selected alternative are also considered.

2.5 Short-Term Effectiveness

This evaluation criterion, unlike the long-term effectiveness criterion, considers the risk associated with the alternative during the construction and implementation phase, up to the point when the remedial action objectives are met. Factors considered include protection from risks to the community, such as dust, air emissions, or transportation of hazardous materials; protection of workers on the site; potential environmental impacts; and time required for cleanup objectives to be met.

2.6 Implementability

The technical and administrative feasibility of implementing an alternative is addressed by this criterion. Technical feasibility factors include potential difficulties and uncertainties associated with construction and operation; reliability of the technology; feasibility of additional remedial action, if required; ability to monitor various pathways; and risks associated with insufficient monitoring. Administrative feasibility factors include coordination with other agencies; availability of treatment, storage, and disposal services and capabilities; availability of necessary equipment and specialists; and availability and level of development of required technologies.

2.7 Cost

The cost criterion includes capital costs and operating and maintenance (O&M) costs. Capital costs include direct costs, such as construction, equipment, and disposal costs; and indirect costs, such as engineering and design expenses, legal and permitting, mobilization and startup costs, and health and safety considerations and services during construction. Indirect costs also include scope and bid contingency costs. Scope contingencies cover changes that invariably occur during final design and implementation. The scope contingency is intended to adjust the estimate so it can be used for budgetary purposes. Bid contingencies may cover unknown costs associated with constructing a given project scope such as adverse weather conditions, geotechnical unknowns and unfavorable market conditions for a particular project scope. O&M costs, calculated on an annual basis, include costs for operating labor and materials, maintenance labor and parts, power requirements, sampling and analysis, administration, and periodic site reviews.

In order to allow costs to be compared, the net present value is also calculated. The net present value, or present worth, is calculated in order to evaluate expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. This single figure, the net present value or present worth of a project, represents the amount of money in today's dollars needed to cover all the expenditures associated with a remedial action alternative. Cost data including the net present value for each alternative are presented in Appendix A.

The feasibility study costs presented in the following sections have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs will vary from the estimates herein. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

2.8 State Acceptance

Technical and administrative issues and concerns of the state pertaining to the alternatives will be evaluated. This criterion will be addressed in the U.S. EPA's Record of Decision (ROD) once comments on the Feasibility Study (FS) report have been received from the state.

2.9 Community Acceptance

Technical and administrative issues and concerns of the community pertaining to the alternatives will be evaluated. As with state acceptance, this criterion will be addressed in the ROD once comments on the FS report have been received from the community.

Because they are not considered until comments are received from the state and community, the latter two evaluation criteria, state acceptance and community acceptance, are not assessed in the following section.

3.0 INDIVIDUAL ANALYSIS OF ALTERNATIVES

3.1 Alternative 1: No Action

3.1.1 Description

The No Action alternative includes no further activities at the site other than an increased level of groundwater monitoring and groundwater use deed restrictions. The preexisting monitoring wells at the site (SB-1 through SB-6) are currently monitored semiannually (March and September) for the parameters required for municipal solid waste facilities under NR 508.10(4) of the Wisconsin Administrative Code (WAC). The City of Stoughton would likely petition the Wisconsin Department Natural Resources (WDNR) to allow monitoring for these parameters using the monitoring wells installed as part of the RI, rather than the preexisting wells. In addition to the current parameters, the groundwater samples collected from these wells would be analyzed for Target Compound List (TCL) volatile and semivolatile organics, Target Analyte List (TAL) inorganics, tetrahydrofuran, dichlorodifluoromethane, and trichlorofluoromethane. A sampling plan would be prepared and submitted to WDNR for approval prior to initiation of groundwater monitoring. Groundwater use in the area, as restricted by WAC NR 112.07(2)(q), would be prevented by issuing deed restrictions. Groundwater monitoring and deed restrictions would also be implemented as part of the remaining seven alternatives.

3.1.2 Assessment

3.1.2.1 Overall Protection of Human Health and the Environment

Under the No Action alternative and other alternatives as well, future development of the landfill site is prohibited by WAC NR 504.07(8)(b). The use of the site may also be permanently restricted by municipal regulations. In addition, because most of the land adjacent to the west, north, and east property boundaries are wetlands, it is highly unlikely that development in these areas would be allowed or desired. Further, groundwater is not used as a source of drinking water downgradient of the site and future development of groundwater resources within 1,200 feet of the landfill boundary is restricted by WAC NR 112.07(2)(q). These facts, coupled with the results of the baseline risk assessment presented in the Draft RI Report, indicate the Stoughton City Landfill site is not a current threat to human health and the environment.

The only chemical that consistently exceeded federal or state groundwater standards was tetrahydrofuran. This chemical was measured in relatively low concentration (maximum of 660

μg/L) at monitoring well MW-3D located just west of the landfill. The concentration of tetrahydrofuran detected at this monitoring well exceeds Wisconsin groundwater enforcement standards; however, potential public health risk associated with the hypothetical consumption of groundwater containing even the maximum concentration of tetrahydrofuran was not identified. A concentration of tetrahydrofuran of 2,380 μg/L would be required to achieve a lifetime hazard index equal to or greater than 1, the value that represents a potential for noncarcinogenic health risk. Therefore, tetrahydrofuran in groundwater is not of public health concern at the concentrations measured during the RI.

As discussed in the RI, precipitation that falls on the landfill surface may infiltrate the established landfill cover and percolate downward through the refuse materials to the water table. Once at the water table, chemicals dissolved in the percolating water may be transported by groundwater flow. Groundwater flow paths established for the sand and gravel aquifer indicate that groundwater flows radially away from the central portion of the landfill (recharge area) to adjacent wetland and surface water bodies located to the west, north/northeast, and southeast of the landfill boundary. The recharge area is in the vicinity of the landfill shelter and is coincident with a relatively flat area that exists between two knolls that are the highest points on the landfill.

Groundwater that transports dissolved chemicals (solutes) from the landfill toward MW-3D is expected to discharge to the Yahara River. Based on the hydraulic gradient measured in the vicinity of MW-3D and other data presented in the Draft RI Report, a horizontal groundwater velocity of 0.27 feet/day was calculated for groundwater migrating west of the landfill. The approximate distance from the central portion of the landfill to the Yahara River is 1,000 feet. Therefore, solutes migrating relatively unretarded in the groundwater (such as tetrahydrofuran) would discharge to the Yahara River in approximately 10 years. Given the operating period of the landfill, it can be assumed that groundwater affected by releases from the landfill has already discharged to the Yahara River.

Since disposal of large quantities of tetrahydrofuran likely ended in 1962 when the reported major industrial disposer of this chemical ceased sending waste to the landfill, it is likely that concentrations of tetrahydrofuran measured at MW-3D will decrease with time due to continued dissolution of the source of this chemical in the landfill under the No Action alternative.

In migrating away from the vicinity of MW-3D toward the Yahara River, the concentration of tetrahydrofuran in the sand and gravel aquifer would be reduced through dispersion and transformation/attenuation processes, including natural biodegradation. Also, because the Yahara River is a regional groundwater discharge area, groundwater affected by releases from the landfill that migrates toward the river would be diluted by unaffected groundwater discharging on a regional basis. Further, the potential exists for tetrahydrofuran to be adsorbed onto fine-grained sediments, potentially high in organic carbon content, that underlie the Yahara River. For all of these reasons, the concentration of tetrahydrofuran in the sand and gravel aquifer downgradient of the landfill is expected to be reduced over time under the No Action alternative. Potential impact on the Yahara River would be insignificant for the reasons cited above and the large dilution that would occur in the river.

Notwithstanding, Wisconsin groundwater enforcement standards for tetrahydrofuran would not be achieved in the short term under this alternative and gradual degradation of the existing landfill cover over time could increase the potential for human exposure through direct contact with solid waste material. Also, the existing landfill cover would continue to allow leaching of chemicals of concern from the landfill mass to the groundwater. Therefore, the No Action alternative is not likely to be protective of human health and the environment in the long term, primarily because of the potential for direct contact with waste material.

3.1.2.2 Compliance with ARARs

The No Action alternative does not meet the current Wisconsin requirements for final cover at solid waste disposal facilities (WAC NR 504.07) because the landfill was closed in accordance with an abandonment plan approved by WDNR in 1982. This abandonment plan is generally consistent with the closure requirements of WAC NR 506.08(3) that include 2 feet of compacted earth sloped adequately to allow surface water runoff, overlain by 6 inches of topsoil. The enforcement standard for tetrahydrofuran (WAC NR 140.10) would not be met in the short term and degradation of the landfill cover over time and leaching of constituents to the groundwater may lead to additional noncompliance with ARARs.

3.1.2.3 Long-Term Effectiveness and Permanence

The long-term effectiveness of this alternative is considered to be poor because risk would remain from potential exposure to waste. Dispersion and transformation/attenuation processes in the sand and gravel aquifer, including natural biodegradation, would provide some reduction of the mobility, toxicity, and volume of tetrahydrofuran in groundwater over time. The only control would be the existing landfill cover, which would likely degrade over time, and groundwater monitoring, which would only track, and not mitigate, any migration of constituents of concern.

3.1.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not include treatment. Therefore, there would be no significant reduction in the toxicity, mobility, or volume of the waste material. As noted above, some reduction of the mobility, toxicity, and volume of tetrahydrofuran in groundwater would occur over time.

3.1.2.5 Short-Term Effectiveness

There would be no construction under this alternative. Therefore, it is unlikely that remedial action objectives for the solid waste operable unit would ever be achieved. Natural processes would eventually achieve remedial action objectives for groundwater; however, this would occur over a long time period.

3.1.2.6 Implementability

The groundwater monitoring program and deed restrictions would be relatively easy to implement.

3.1.2.7 Cost

The only costs associated with this alternative are for preparation of a groundwater sampling plan and biannual groundwater sampling and analysis. Costs for these items are presented in Appendix A. Capital costs for preparation of the groundwater sampling plan are estimated at $5,000. Annual O&M costs to sample and analyze groundwater would be $67,300.

3.2 Alternative 2: Cap Repair and Fencing

3.2.1 Description

This alternative would combine repair or upgrading of the existing cap with fencing along the landfill (solid waste) boundary to restrict access.

The condition of the existing cap was not systematically investigated during the RI. In general, the condition of the existing landfill cover is sound; however, the thickness and nature of the material comprising the cap is unknown. Some waste was visible along the east landfill boundary as a result of incomplete capping or erosion of the cap. Animal holes were also observed in this area.

Prior to repair, the cap would be investigated to assess its overall condition. Soil borings, to determine the thickness and nature of materials comprising the cap, would be required as part of this investigation. Areas along the eastern boundary of the landfill, where erosion and exposed waste were observed, would also be documented, as would depressions, cracks, animal holes, and areas of extreme slope.

After assessment of its condition, affected areas of the cap would be repaired or upgraded to ensure that all areas where waste disposal occurred were covered with 2 feet of compacted clay and 6 inches of topsoil. The compacted clay would have a permeability of 1 x 10^{-7} cm/sec or less. The permeability and thickness of this layer would be equivalent to the hydraulic barrier layer required under current Wisconsin regulations for solid waste facilities. As such, the cap repair alternative may represent a significant upgrade of the existing cap, depending upon the outcome of the assessment of its condition. The east edge of the landfill extends to the property boundary. When repairing the cap in this area, it will necessary to extend the cap past the landfill property boundary. The potential need for a gas venting system following cap repair will also be considered. For cost preparation purposes, it is assumed that one half of the area within the landfill boundary and necessary adjacent areas will require cap repair. The total area of cap repair under this alternative is 8.8 acres. Regrading in some areas using imported fill will be required including the relatively flat area in the vicinity of the landfill shelter that has been identified as the groundwater recharge area. The repaired cap would also be revegetated.

Fencing would be installed around the entire landfill (solid waste) boundary to prevent access, further minimizing the potential for contact with solid waste. In addition, in order to fence around all areas where waste was disposed, it will be necessary to install fencing outside the east landfill property line. Cyclone fencing, with a locking gate at the landfill entrance, would be used.

Groundwater monitoring and deed restrictions would also be performed under this alternative.

3.2.2 Assessment

3.2.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment by preventing direct contact with waste materials, and by significantly reducing the generation of leachate.

Repair of the existing cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill area is covered with 2 feet of compacted clay, 6 inches of topsoil, and vegetation. Fencing the landfill area (approximately 18 acres) would help prevent deterioration of the cap due to recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier.

In addition to preventing direct contact with waste materials, the repaired or upgraded cap would significantly reduce infiltration of precipitation into the landfill since it will have a compacted permeability of 1×10^{-7} cm/sec or less. This would significantly reduce migration of constituents of concern from the landfill to the groundwater. It is anticipated that dispersion and transformation/attenuation processes, including natural biodegradation, would reduce the concentrations of the constituents of concern in the sand and gravel aquifer to acceptable levels over time. This is based on the low concentrations currently present in the monitoring wells and the removal of the release mechanism to groundwater of the constituents of concern through capping. Groundwater monitoring would be used to track the migration of constituents in the groundwater and the natural reduction in concentration of these constituents over time.

In the short term, there would be little risk to human health and the environment during cap repair and fence installation. No waste materials would be excavated. However, potential nuisances of increased traffic and dust resulting from delivery of capping materials and working of the soils on-site are likely.

Remedial action objectives related to preventing direct contact with waste materials and controlling leaching of constituents to the groundwater would be met. Groundwater standards for tetrahydrofuran would eventually be achieved by dispersion and natural attenuation, but not in the short term.

3.2.2.2 Compliance with ARARs

This alternative is consistent with WDNR requirements for landfill closure under WAC NR 506.08 (3) and includes a specified, low permeability soil for the 2-foot hydraulic barrier layer. In addition, the enforcement standard concentration for tetrahydrofuran in groundwater would be achieved over time.

3.2.2.3 Long-Term Effectiveness and Permanence

Preventing contact with solid waste and further reducing the leaching of constituents through improved capping would significantly reduce the risk of untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. However, the potential residual risk from constituents in groundwater may not be addressed. Groundwater would be monitored to track the constituents of concern and assess their potential risk. While this would not mitigate any risk, it would effectively track the constituents.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and ingestion of groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, as regular inspection of the cap would detect signs of deterioration, and repair could be completed as needed.

3.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative does not include any treatment processes, therefore no significant reduction of toxicity or volume of waste material in the landfill would be achieved. However, an effective cap would significantly reduce the leaching (mobility) of the constituents from the landfill. Dispersion and natural attenuation in the sand and gravel aquifer, including biodegradation, would reduce the toxicity and volume of groundwater affected by tetrahydrofuran over time.

3.2.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point at which remedial action objectives are achieved. For this alternative, construction and implementation include assessing the condition of and performing repairs on the landfill cap, and installing fencing.

Risks to the community would be minimal. The only potential effects would result from the transportation to the site of clay, topsoil, and other materials to repair the cap. Increased traffic through parts of the City of Stoughton would occur. Possible nuisance dust from working with the soils on-site could also result, in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of concern are anticipated.

Potential risks to workers involved in the implementation of the alternative would not likely be significant either. There is some potential for contact with waste materials while completing soil borings to assess the condition of the existing cap. All workers on-site will undergo health and safety training, and will comply with safety procedures included in the Site-Specific Health and Safety Plan. All health and safety activities will comply with Occupational Safety and Health Administration (OSHA) requirements for work at hazardous waste sites (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap repair and result in increased sediment loads to the adjacent wetlands. Such erosion would be controlled by physical barriers commonly used at construction sites. Due to the proximity of waste materials and the need to effectively cap them, it would be necessary to infringe on a small portion of the wetlands bordering the landfill to the east.

3.2.2.6 Implementability

In general, the repair of the landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread topsoil, and seed the surface. Investigation, design, and construction of the landfill cap is expected to take 1 year. O&M activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of both technical and administrative concern. Along portions of the east side of the landfill, the fill areas border both the property boundary and adjacent wetlands. In order to ensure that all waste materials are properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways would be necessary. Also, the issue of wetland protection by state and federal laws would have to be considered prior to this action. If it were necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required. The potential for the cap to be degraded by contact with surface water in the wetlands or by groundwater discharging directly through the refuse (and the installed cap) would also have to be investigated.

3.2.2.7 Cost

Capital costs associated with this alternative include an evaluation of the existing cap ($50,000) in order to determine the areas in need of repair or upgrading. This may include soil borings along a surveyed grid pattern to determine the thickness of the cap and geotechnical analysis of soil samples to determine its permeability and compaction. Capital costs also include the placement of a clay cap consisting of a 2-feet clay layer, a 6-inch topsoil layer, and a vegetative layer ($576,700 total). For the purposes of costing, it is assumed that one half of the landfill, or approximately 9 acres, would need to be repaired. This area is an assumed value and is not based on a detailed evaluation. Upon evaluation of the existing cap, the area in need of repair may be less. Also included in the capital cost is the cost for a fence installed around the landfill boundary ($32,000). Engineering design and permitting costs would be approximately $201,300. Annual O&M costs, which include long-term groundwater monitoring and cap maintenance, are estimated at $79,300. The total present worth of this alternative based upon a 30-year project life would be $1,762,000.

3.3 Alternative 3: Subtitle D Cap

3.3.1 Description

This alternative would include placing a new multi-layer clay cap over the entire landfill (solid waste) boundary. This cap would meet the current Wisconsin requirements (WAC NR 504.07) concerning final cover systems for solid waste disposal facilities. Regrading of certain parts of the landfill using imported fill would be required, including the area of shallow slope in the central portion of the landfill that has been identified as a groundwater recharge area.

After preparing the surface, a multi-layer clay cap would be installed. The areal extent of the cap would be the entire landfill boundary (17.6 acres). The cap to be installed would consist of a 0.5-foot grading layer, a 2-foot clay barrier layer, a 1.5-foot cover layer, and a vegetated 0.5-foot topsoil layer. However, the grading layer would be constructed from the existing cap. The clay barrier layer is required to have a compacted permeability of 1×10^{-7} cm/sec or less. The potential need for gas control would be assessed as part of this alternative.

The landfill boundary would be fenced to restrict access. The same fencing layout and specifications as described for Alternative 2 would be used. Groundwater monitoring and deed restrictions, as described for Alternative 1, would also be implemented as part of this alternative.

3.3.2 Assessment

3.3.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment by preventing direct contact with waste materials, and by reducing the leaching of constituents of concern to the groundwater.

Installation of the Subtitle D cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill boundary is covered with 2 feet of compacted clay, 1.5 feet of cover, 0.5 feet of topsoil, and vegetation. Fencing the capped landfill area would help prevent deterioration of the cap due to recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier.

In addition to preventing direct contact with waste materials, the cap would significantly reduce infiltration of precipitation into the landfill since the 2-foot clay layer will have a compacted permeability of 1×10^{-7} cm/sec or less. This would significantly reduce migration of constituents of concern from the landfill to the groundwater. It is anticipated that dispersion and transformation/attenuation processes, including natural biodegradation, would reduce the concentrations of the constituents of concern in the sand and gravel aquifer to acceptable levels over time. This is based on the low concentrations currently present in the monitoring wells and the removal of the release mechanism to groundwater of the constituents of concern through capping.

In the short term, there would be little risk to human health and the environment during cap and fence installation. No waste materials would be excavated. The existing cap would be used as the grading layer. However, potential nuisances of increased traffic and dust resulting from delivery of capping materials to the site are likely.

Remedial action objectives related to preventing direct contact with waste materials and controlling leachate generation would be met; however, the groundwater cleanup objective may not be achieved in the short term.

3.3.2.2 Compliance with ARARs

Current Wisconsin final cover requirements for solid waste disposal facilities would be achieved by this alternative. Wisconsin groundwater enforcement standards for tetrahydrofuran in groundwater would not be met in the short term, as no groundwater treatment is included. However, it is anticipated that the enforcement standards for tetrahydrofuran would be met in the long term.

3.3.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. As was discussed previously, remedial action objectives for the solid waste would be met. Those for groundwater would eventually be met.

Preventing contact with solid waste and significantly reducing the leaching of constituents through capping would reduce the risk of the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. Any residual risk from constituents in groundwater would additionally be reduced over time to acceptable levels. Groundwater would be monitored to track the constituents of concern and assess the rate of natural attenuation.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and the ingestion of groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration, and repair could be completed as needed.

3.3.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not include any treatment processes, therefore no significant reduction of toxicity, or volume of waste material in the landfill would be achieved. However, an effective cap on the landfill would significantly reduce the mobility of the constituents by reducing infiltration of precipitation. Dispersion and transformation/attenuation processes, including natural biodegradation, would effectively reduce the toxicity and volume of the constituents of concern in the sand and gravel aquifer over time.

3.3.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, construction and implementation includes installing the landfill cap and fencing.

Risks to the community would be minimal. The only potential effects would result from the transportation to the site of clay, topsoil, and other materials to install the cap. Increased traffic through parts of the City of Stoughton would occur. Possible nuisance dust from working with the soils on-site could also result, in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest are anticipated.

Potential risks to workers involved in the implementation of the alternative would likely not be significant either. All workers on-site will undergo health and safety training, and will comply with safety procedures included in the Site-Specific Health and Safety Plan. All health and safety activities will comply with OSHA requirements for work at hazardous waste sites (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. Due to the proximity of waste materials and the need to effectively cap these materials, it would be necessary to infringe on a small portion of the wetlands bordering the landfill to the east.

3.3.2.6 Implementability

In general, the installation of the Subtitle D landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread cover and topsoil, and seed the surface. Investigation, design, and construction of the landfill cap is expected to take 1 year. O&M activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of both technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways will be necessary. Not only would permission from the property owner be required, but the issue of wetland protection by state and federal laws would have to be considered. If it were necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit will be required.

3.3.2.7 Cost

Capital costs associated with this alternative would include the installation of a subtitle D cap over the entire landfill area ($1,733,350); a site fence ($32,000); and engineering, design, and permitting costs ($549,750). Total capital costs for this alternative would be approximately $3,167,600. Annual O&M costs, which include long-term groundwater monitoring and cap maintenance, would be approximately $79,300. The total present worth of this alternative based upon a 30-year project life is estimated at $4,151,600.

3.4 Alternative 4: Subtitle C Cap

3.4.1 Description

This alternative consists of placing a new multi-layer clay and geomembrane cap over the entire landfill (solid waste) boundary. This cap would meet the requirements of WAC NR 181 for cover systems for hazardous waste disposal sites. Regrading of sections of the landfill surface using imported fill would be required to meet the slope requirements.

After preparing the surface, a multi-layer clay and geomembrane cap would be installed. The areal extent of the cap would be the same as for the Subtitle D cap described for Alternative 3. The cap would consist of a 2-foot clay liner, a geomembrane barrier with 0.5 feet of sand bedding above and below, a 1-foot gravel drainage layer, a geotextile filter, 6 feet of cover, and

0.5 feet of topsoil. The top cover would be vegetated with persistent species, and have a minimum slope of 3% to 5% and a maximum slope of 25%. The geomembrane barrier must be at least 1 foot below the maximum recorded depth of frost penetration, which is reportedly 7 feet in this area. This cap would be designed to be impermeable to water. The potential need for gas control would be assessed as part of this alternative.

The landfill boundary would be fenced to restrict access. The same fencing layout and specifications as described for Alternative 2 would be used. Groundwater monitoring and deed restrictions, as described for Alternative 1, would also be implemented as part of this alternative.

3.4.2 Assessment

3.4.2.1 Overall Protection of Human Health and the Environment

This alternative would be protective of human health and the environment by preventing direct contact with waste materials, and by essentially prohibiting the leaching of constituents of concern to the groundwater.

Installation of the Subtitle C cap would prevent direct contact with solid waste material in the landfill. Fencing the capped landfill area would help prevent deterioration of the cap due to recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier.

In addition to preventing direct contact with waste materials, the cap would prohibit infiltration of precipitation into the landfill. This would prevent leaching of constituents of concern from the landfill to the groundwater.

3.4.2.2 Compliance with ARARs

Placement of a Subtitle Cap would exceed the final cover requirements of solid waste disposal facilities. The Wisconsin groundwater enforcement standard for tetrahydrofuran in groundwater in the vicinity of MW-3D would eventually be met due to the elimination of leachate generation and the reduction of concentration of this constituent in the sand and gravel aquifer through natural subsurface processes over time.

3.4.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. As was discussed previously, remedial action objectives for the solid waste would be met, as well as those for groundwater (eventually).

Preventing contact with solid waste and prohibiting the leaching of constituents through capping would prevent the risk of the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. Any residual risk from constituents in groundwater would additionally be reduced over time to acceptable levels. Groundwater would be monitored to track the constituents of interest and assess the rate of reduction in concentration over time.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and ingestion of groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration, and repair could be completed as needed.

3.4.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not include any treatment processes, therefore no significant reduction of toxicity, or volume of waste material would be achieved. However, a Subtitle C cap on the landfill would essentially preclude the leaching of constituents from the landfill by eliminating the infiltration of precipitation. Dispersion and natural attenuation processes in the sand and gravel aquifer would reduce the toxicity and volume of the constituents of concern in groundwater following cap installation.

3.4.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, construction and implementation includes installing the landfill cap and fencing.

Risks to the community would be minimal. The only potential effects would result from the trucking in of clay, topsoil, and other materials to install the cap. Increased traffic through parts of the City of Stoughton would occur. Possible nuisance dust from working with the soils on-site could also result, in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest are anticipated.

Potential risks to workers involved in the implementation of the alternative would likely not be significant either. All workers on-site will undergo health and safety training, and will comply with safety procedures included in the Site-Specific Health and Safety Plan. All health and safety activities will comply with OSHA requirements for work at hazardous waste sites (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. Due to the proximity of waste materials and the need to effectively cap these materials, it would be necessary to infringe on a small portion of the wetlands bordering the landfill to the east.

3.4.2.6 Implementability

Generally, the installation of the Subtitle C landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread topsoil, and seed the surface. Installation of the geomembrane barrier would be the most difficult step. Such membranes have been installed at numerous sites across the country so implementation should not be a significant problem. Investigation, design, and construction of the landfill cap is expected to take 1.5 years. O&M activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and the adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways would be necessary. Not only will permission from the property owner be required, but the issue of wetland protection by state and federal laws would have to be considered. If it were necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required.

3.4.2.7 Cost

Capital costs associated with this alternative would include the installation of a Subtitle C cap ($4,997,750); a fence installed around the landfill boundary ($32,000); and engineering, design and permitting costs ($1,607,600). Total capital costs for this alternative are approximately $9,262,850. Annual O&M costs, which include long-term groundwater monitoring and cap maintenance, are estimated $79,300 a year. The total present worth of this alternative based upon a 30-year project life would be $10,246,860.

3.5 Alternative 5: Subtitle D Cap with Groundwater Collection and Treatment

3.5.1 Description

This alternative consists of placing a multi-layer clay cap over the landfill (solid waste) boundary, pumping groundwater in the vicinity of MW-3D to the surface using recovery wells, treatment of the groundwater by carbon adsorption, and discharge of the treated water to the Yahara River. Fencing to restrict access, groundwater monitoring and deed restrictions would also be included.

The cap would meet the requirements of WAC NR 504 for final cover systems for solid waste disposal facilities. The details of construction and related issues would be the same as those discussed for Alternative 3. The potential need for gas control would be assessed as part of this alternative.

The exact number of wells, and their locations, depths, and pumping rates, would be determined based on treatability studies. However, for cost estimation purposes, it was assumed that two groundwater recovery wells would be installed west of the landfill in the vicinity of MW-3D, the only area where tetrahydrofuran was detected in groundwater above Wisconsin groundwater enforcement standards. The wells would collectively pump groundwater to collection piping at a rate of approximately 75 gpm, which would carry the water to the on-site treatment facility. Calculations pertaining to the assumption of two groundwater recovery wells and the discharge rate are contained in Appendix B. Appropriate permits for well construction and pump installation would be obtained as outlined in WAC NR 112, as well as discharge permits under the Wisconsin Pollutant Discharge Elimination System (WPDES).

The groundwater treatment facility would likely be located adjacent to the southwest portion of the landfill, in the lowest area that would still allow easy access for setup, O&M and removal.

Carbon adsorption would be used to remove tetrahydrofuran from the groundwater. Carbon adsorption is a physical process in which compounds are transferred from the liquid to the surface of the carbon. The compounds accumulate on the carbon until the carbon is loaded, and then they are removed or destroyed. Carbon adsorption is typically carried out in fixed beds of carbon. Water enters the top of the unit, flows through the carbon, and exits. The carbon loaded with tetrahydrofuran and other compounds would require regeneration, with treatment of the removed compounds. Because tetrahydrofuran is miscible in water, it is not removed efficiently by carbon. The carbon will have to be replaced or regenerated regularly, which substantially adds to the operating costs. The treated water exiting the carbon system would be discharged via piping to the Yahara River.

3.5.2 Assessment

3.5.2.1 Overall Protection of Human Health and the Environment

This alternative would be very protective of human health and the environment by preventing direct contact with the solid waste, and by achieving groundwater standards for tetrahydrofuran within a shorter time frame.

Installation of the Subtitle D cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill area is covered with 2 feet of compacted clay, 1.5 feet of cover, 0.5 feet of topsoil, and vegetation. Fencing the capped landfill area would help prevent deterioration of the cap due to recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier. In addition to preventing direct contact with waste materials, the cap would significantly reduce infiltration of precipitation into the landfill. This would significantly reduce migration of constituents of concern from the landfill to the groundwater.

The groundwater collection and treatment system would actively remove and treat affected groundwater and prevent further migration, thereby eliminating any potential risk. Monitoring would be used to track constituents of concern in the groundwater.

The surface treatment system, consisting of carbon adsorption, would remove the tetrahydrofuran. Treated water would be discharged to the Yahara River, and monitored to ensure there was no risk to surface water. Treatment residuals, including the loaded carbon, would be disposed of or treated off-site.

In the short-term, there would be little risk to human health and the environment during cap and fence installation. No waste materials would be excavated. The existing cap would be used as the grading layer. However, potential nuisances of increased traffic and dust resulting from delivery of capping materials to the site would be likely.

Short-term risk associated with the groundwater recovery and treatment system include risks to workers during the installation of wells, and normal operational hazards.

Remedial action objectives related to preventing direct contact with waste materials would be met. In addition, the groundwater recovery and treatment system would be designed to achieve the groundwater cleanup objective within approximately 5 years of cap placement (Appendix B).

3.5.2.2 Compliance with ARARs

The cap would meet current Wisconsin regulations for final cover at solid waste disposal facilities. The treatment system would be designed to remove tetrahydrofuran from the groundwater to a concentration below the enforcement standard. Discharge of the treated water to the Yahara River would be done in full compliance with the WPDES permit requirements. By proper design of the treatment system, levels of compounds in the discharged water would meet applicable criteria. Design of the groundwater collection system, and construction of the treatment system and the landfill cap, would be completed in a manner that minimized effects on the floodplain areas and wetlands.

3.5.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. Preventing contact with solid waste and significantly reducing the leaching of constituents through capping would prevent the risk of the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. In addition, constituents of concern would be removed from groundwater to levels below the Wisconsin enforcement standards. Groundwater would be monitored to ensure that remedial action levels were not exceeded.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and ingestion of groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration and repair could be completed as needed.

3.5.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No treatment of solid waste is included in this alternative, therefore no significant reduction of toxicity, or volume of waste material would be achieved. The cap on the landfill would significantly reduce mobility of the constituents of concern in the landfill by reducing infiltration of precipitation, which causes leaching of the constituents to groundwater. The groundwater recovery system would remove tetrahydrofuran from the subsurface in the vicinity of MW-3D and prevent its further migration, thereby reducing its mobility. The groundwater treatment system would reduce the concentration of tetrahydrofuran in groundwater to below enforcement standard levels. This would result in reduction in the toxicity and volume of tetrahydrofuran. Treatment residuals produced, including loaded carbon, would be treated or disposed of off-site, according to applicable regulations.

3.5.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, construction and implementation includes installing the landfill cap and fencing installing the groundwater collection and treatment system and treating the groundwater until Wisconsin enforcement standard levels are achieved.

Risks to the community would be minimal. The only potential effects associated with capping would result from the trucking in of clay, topsoil, and other materials to install the cap. Increased traffic through parts of the City of Stoughton would occur. Possible nuisance dust from working with the soils on-site could also result, in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest are anticipated. No water supply wells are expected to be affected by groundwater pumping on-site.

Potential risks to remedial workers would be associated with subsurface work in installing groundwater wells and fenceposts. Potential risks to operating workers during remedial activities would be associated with normal process-type operations. These risks would likely include hazards associated with electrical and mechanical maintenance, and the potential exposure to various constituents. These risks will be addressed and minimized through good operating procedures specified in the Operation and Maintenance Plan. All workers at the site will be subject to OSHA health and safety requirements (29 CFR 1910.120).

Minimal impacts to the environment would be expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. Due to the proximity of waste materials and the need to effectively cap these materials, it would necessary to infringe on a small portion of the wetlands bordering the landfill to the east.

Investigation, design, and construction of the landfill cap is expected to take 1 year. Groundwater collection and treatment is estimated to require 5 years.

3.5.2.6 Implementability

Generally, the installation of the Subtitle D landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread cover and topsoil, and seed the surface. O&M activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of both technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and the adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways would be necessary. Permission from the property owner would be required, and the issue of wetland protection by state and federal laws would have to be considered. If it were necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required.

No major difficulties are anticipated with the construction and operation of the groundwater recovery and treatment system. However, because tetrahydrofuran is not removed efficiently by carbon, the carbon units will have to be replaced or regenerated regularly. A permit will be required from WDNR to remove more than 70 gpm of groundwater in accordance with WAC NR 112.26. Additional studies may be required to determine optimum pumping rates and recovery well arrangement. Treatability studies would also need to be conducted to determine treatment system design and operating parameters. Carbon adsorption systems are available in pre-packaged units from vendors. If additional remedial action was necessary, it would not be difficult to implement, and could be done in conjunction with the system to be installed.

Coordination with other agencies would be necessary. It would be necessary to obtain a U.S. Army Corps of Engineers permit for encroaching onto the wetland. Also, a WPDES permit from WDNR would be required for the discharge of treated water to the Yahara River.

Availability of off-site treatment, storage capacity, and disposal services would not be a problem, because only small amounts of treatment residuals would have to be dealt with off-site. The necessary equipment and specialists are also available. The technology involved in installing the Subtitle D cap and the groundwater recovery and treatment system is readily available as well.

3.5.2.7 Cost

Capital costs associated with this alternative would include the installation of a Subtitle D Cap over the entire landfill area ($1,733,350), a fence around the landfill boundary ($32,000), the installation of a groundwater collection and treatment system including the installation of two recovery wells, and two carbon units ($478,800). Engineering, design, and permitting costs for this alternative would be approximately $645,000. Annual O&M costs include long-term groundwater monitoring, cap maintenance, carbon replacement, replacement of spent parts of the water treatment system, and an on-site operator. Annual O&M costs for this alternative are estimated at $927,400 for the first 5 years of operation when groundwater is being treated. After groundwater treatment is complete the annual O&M costs would be $79,300.

The total present worth for this alternative based upon a project life of 30 years would be $8,178,100.

3.6 Alternative 6: Subtitle C Cap with Groundwater Collection and Treatment

3.6.1 Description

This alternative would include placement of a multi-layer clay and geomembrane cap over the entire landfill (solid waste) boundary, pumping groundwater from the vicinity of MW-3D to the surface using recovery wells treating the groundwater with carbon adsorption, and discharging the treated water to the Yahara River. Fencing to restrict access, groundwater monitoring, and deed restrictions would also be included.

The cap would meet the requirements for cover systems for hazardous waste disposal sites and comply with federal regulations under 40 CFR Subtitle C, and Wisconsin State regulations under NR 181. The details of the cap construction and related issues would be the same as those discussed for Alternative 4. The potential need for gas control would be assessed as part of this alternative.

Two groundwater recovery wells would be installed west of the landfill in the vicinity of MW-3D, as described for Alternative 5. An on-site treatment system consisting of carbon adsorption to remove tetrahydrofuran would be installed. Treated water would be discharged to the Yahara

River. Details of the groundwater collection and treatment system would be the same as for Alternative 5.

3.6.2 Assessment

3.6.2.1 Overall Protection of Human Health and the Environment

This alternative would be very protective of human health and the environment by preventing direct contact with the solid waste, and by achieving groundwater enforcement standards for tetrahydrofuran.

Installation of the Subtitle C cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill area was covered with 2 feet of compacted clay, a geomembrane barrier with sand bedding above and below, 1 foot of gravel, a geotextile filter, 6 feet of cover, 0.5 feet of topsoil, and vegetation. Fencing the capped landfill area would help prevent deterioration of the cap due to recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier.

In addition to preventing direct contact with waste materials, the cap would prohibit infiltration of precipitation into the landfill, which would in term prevent the leaching of constituents of concern from the landfill to the groundwater.

The groundwater collection and treatment system would lower the concentration of tetrahydrofuran to levels below Wisconsin enforcement standards. Two recovery wells located in the vicinity of MW-3D would remove the affected groundwater and prevent further migration, thereby eliminating any potential risk. Groundwater monitoring would be used to track constituents of concern in the groundwater.

The surface treatment system, consisting of carbon adsorption, would remove the tetrahydrofuran. Treated water would be discharged to the Yahara River, and monitored to ensure there was no risk to surface water. Treatment residuals, including the loaded carbon, would be disposed of or treated off-site.

In the short-term, there would be little risk to human health and the environment during cap and fence installation. No waste materials would be excavated; the existing cap would be used as the grading layer. Potential nuisances, including increased traffic and dust resulting from delivery of capping materials to the site, are likely, however.

Short-term risk associated with the groundwater recovery and treatment system include risks to workers during the installation of wells, and normal operational hazards.

Remedial action objectives related to preventing direct contact with waste materials would be met. In addition, the groundwater recovery and treatment system would be designed to achieve Wisconsin enforcement standards within 5 years.

3.6.2.2 Compliance with ARARs

Placement of a Subtitle C cap would exceed the final cover requirements of solid waste disposal facilities. The treatment system would be designed to remove tetrahydrofuran from the groundwater to a concentration below the enforcement standard. Discharge of the treated water to the Yahara River would be conducted in full compliance with WPDES permit requirements. By proper design of the treatment system, levels of compounds in the discharged water would meet applicable criteria. Construction of the treatment system and the landfill cap would be completed in a manner that minimized effects on the floodplain areas and wetlands.

3.6.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. Preventing contact with solid waste and significantly reducing migration of constituents through capping would prevent the risk of contact with the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. In addition, tetrahydrofuran would be removed from groundwater to levels below enforcement standards. Groundwater would be monitored to ensure that remedial action levels were not exceeded.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and with constituents in groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration, and repairs could be completed as needed.

3.6.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No treatment of solid waste is included in this alternative; therefore no significant reduction of toxicity; or of volume of solid waste material would be achieved. The cap on the landfill would significantly reduce mobility of the constituents of concern in the landfill by reducing infiltration of precipitation, which causes leaching of the constituents to groundwater.

The groundwater recovery system would remove tetrahydrofuran from the subsurface in the vicinity of MW-3D and prevent its further migration, thereby reducing its mobility. The groundwater treatment system would reduce tetrahydrofuran in the groundwater to below enforcement standards. This would result in reduction in the toxicity and volume of this constituent. The treatment process is irreversible. Treatment residuals, including loaded carbon, would be treated and disposed of or treated off-site, in accordance with applicable regulations.

3.6.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, construction and implementation involves installing the landfill cap and fencing, installing the groundwater collection and treatment system, and treating the groundwater until remedial action goals are achieved.

Risks to the community would be minimal. The only potential effects associated with capping would result from the trucking of clay, topsoil, and other materials to the site to install the cap. Potential nuisances, such as increased traffic through parts of the City of Stoughton and dust from working with the soils on-site could result in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest is anticipated. No water supply wells are expected to be affected by groundwater pumping on-site.

Potential risks to remedial workers include those associated with subsurface work in installing groundwater wells and fenceposts. Potential risks to operating workers during remedial activities are likely to include those associated with normal process-type operations; hazards associated with electrical and mechanical maintenance, and potential exposure to various constituents. These risks will be addressed and minimized through good operating procedures specified in the Operation and Maintenance Plan. All workers at the site will be subject to OSHA health and safety requirements (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. It would be necessary to infringe on a small portion of the wetlands bordering the landfill to the east, because of the proximity of waste materials and the need to effectively cap these materials.

Investigation, design, and construction of the landfill cap is expected to require 1 1/2 years. Groundwater treatment is estimated to be required for 5 years.

3.6.2.6 Implementability

Generally, the installation of the Subtitle C landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread cover and topsoil, and seed the surface. Installation of the geomembrane barrier would be the most difficult step; but such membranes have been installed at numerous sites across the country. Therefore, implementation would not be a significant problem. Operation and maintenance activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and the adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Small sections of the property would have to be purchased or right-of-ways obtained. Not only would permission from the property owner be required, but the issue of wetland protection by state and federal laws would have to be considered. If it is necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required.

No major difficulties are anticipated with the construction and operation of the groundwater recovery and treatment system. However, because tetrahydrofuran is not efficiently removed by carbon, carbon units will have to be replaced or regenerated regularly. Additional studies may be required to determine optimum pumping rates and recovery well arrangement. Treatability studies would also need to be conducted to determine treatment system design and operating parameters. Carbon adsorption systems are available in pre-packaged units from vendors. If additional remedial action were necessary, it would not be difficult to implement, and could be performed in conjunction with the system to be installed.

Coordination with other agencies would be necessary. First, as discussed previously, it would necessary to obtain a U.S. Army Corps of Engineers permit for encroaching onto the wetland. Also, a WPDES permit from the WDNR would be required for the discharge of treated water to the Yahara River.

Availability of off-site treatment, storage, and disposal services would not be a problem, because only small amounts of treatment residuals would have to be managed off-site. The necessary equipment and specialists are also available. The technology involved in installing the Subtitle C cap and the groundwater recovery and treatment system is readily available as well.

3.6.2.7 Cost

Capital costs associated with this alternative would include costs for installation of a Subtitle C cap over the entire landfill area ($4,997,750), construction of a fence around the landfill boundary ($32,000); and installation of a groundwater collection and treatment system, including two recovery wells and two carbon units ($478,800). Engineering, design, and permitting costs for this alternative would be approximately $1,708,150. Annual O&M expenses would include costs for long-term groundwater monitoring, cap maintenance, carbon replacement, replacement of spent parts of the water treatment system, and an on-site operator. Annual O&M costs for this alternative would be approximately $927,400 for the first 5 years of operation when groundwater is being treated. After this period, the annual O&M would be $79,300.

The total present worth for this alternative, based upon a project life of 30 years, is $14,303,600.

3.7 Alternative 7: Subtitle D Cap with In-Situ Treatment of Groundwater

3.7.1 Description

This alternative would include placement of a multi-layer clay cap (Subtitle D) over the landfill (solid waste) boundary and in-situ treatment of groundwater using bioremediation. Fencing to restrict access, groundwater monitoring, and deed restrictions would also be included. The cap would meet the requirements of Wisconsin NR 504 regulations for final cover for solid waste disposal facilities. The details of construction and related issues would be the same as those discussed for Alternative 3. The potential need for gas control would also be assessed as part of this alternative.

The in-situ bioremediation system would consist of a series of PVC wells for the aeration or oxygenation of the subsurface water. The system would include fine bubble diffusers in the wells to provide a source of oxygen to water flowing through the wells. The oxygenated water is expected to flow into the aquifer, creating a zone of bioactivity whereby naturally occurring microorganisms would be stimulated through the increased concentrations of oxygen. The necessity of injecting nutrients into the subsurface would be assessed in treatability studies.

3.7.2 Assessment

3.7.2.1 Overall Protection of Human Health and the Environment

This alternative would be very protective of human health and the environment by preventing direct contact with the solid waste at the landfill, and by achieving groundwater enforcement standards for tetrahydrofuran in the vicinity of MW-3D.

Installation of the Subtitle D cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill area was covered with 2 feet of compacted clay, 1.5 feet of cover, 0.5 feet of topsoil, and vegetation. Fencing the capped landfill area would help prevent wear on the cap from recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier. In addition to preventing direct contact with waste materials, the repaired cap would significantly reduce infiltration of precipitation into the landfill, which would reduce the leaching of constituents of concern from the landfill to groundwater.

The in-situ groundwater bioremediation system would reduce the concentration of tetrahydrofuran in groundwater to levels below enforcement standard concentrations following cap placement. By injecting oxygen into the subsurface to optimize conditions for biodegradation, the tetrahydrofuran would be destroyed in place, thereby eliminating any potential risk. Monitoring would be used to track tetrahydrofuran in the groundwater.

In the short-term, there would be little risk to human health and the environment during cap and fence installation. No waste materials would be excavated; the existing cap would be used as the grading layer. Potential nuisances of increased traffic and dust resulting from delivery of capping materials to the site are likely, however. Short-term risk associated with the in-situ groundwater bioremediation system include risks to workers during the installation of wells, and normal operational hazards.

Remedial action objectives related to preventing direct contact with waste materials would be met. In addition, the groundwater treatment system would be designed to achieve the groundwater cleanup objective in the vicinity of MW-3D in approximately 10 years following cap installation (Appendix B).

3.7.2.2 Compliance with ARARs

The cap would meet current Wisconsin regulations for final cover at solid waste disposal facilities. The in-situ groundwater treatment system would reduce the concentration of tetrahydrofuran to below the enforcement standard in the vicinity of MW-3D. Injection of oxygen into the subsurface would be conducted according to WDNR requirements. Construction of the treatment system and the landfill cap would be completed in a manner that minimized effects on the floodplain areas and wetlands.

3.7.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. Preventing contact with solid waste and significantly reducing migration of constituents through capping would prevent the risk of the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. In addition, tetrahydrofuran would be destroyed in groundwater to levels below Wisconsin enforcement standards. Groundwater would be monitored to ensure that these levels were not exceeded.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site, and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and constituents in groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration, and repairs could be completed as needed.

If, after remedial action objectives are achieved, groundwater monitoring determined that constituents of concern remained in the groundwater, wells already in place could be used for groundwater treatment.

3.7.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No treatment of solid waste is included in this alternative, therefore no significant reduction of toxicity or volume of waste material would be achieved. The cap on the landfill would significantly reduce leaching of the waste constituents of concern from the landfill by reducing infiltration of precipitation.

The in-situ groundwater bioremediation system would destroy tetrahydrofuran in the subsurface and prevent its further migration, thereby reducing its mobility. The in-situ groundwater bioremediation system would reduce the level of tetrahydrofuran in groundwater in the vicinity of MW-3D to below enforcement standard levels following cap placement. This would result in reduction in the toxicity and volume of tetrahydrofuran. The treatment process is irreversible.

3.7.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, construction and implementation involves installing the landfill cap and fencing, installing the in-situ groundwater bioremediation system, and treating the groundwater until enforcement standard levels are achieved.

Risks to the community would be minimal. The only potential effects associated with capping would result from the trucking of clay, topsoil, and other materials to the site to install the cap. Potential nuisances, such as increased traffic through parts of the City of Stoughton and dust from working with the soils on-site could result in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest is anticipated.

Potential risks to remedial workers include those associated with subsurface work in installing injection wells. Potential risks to operating workers during remedial activities are likely to include those associated with normal process-type operations, such as hazards associated with electrical and mechanical maintenance. These risks will be addressed and minimized through good operating procedures specified in the Operation and Maintenance Plan. All workers at the site will be subject to OSHA health and safety requirements (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. It would also be necessary to infringe on a small portion of the wetlands bordering the landfill to the east, because of the proximity of waste materials and the need to effectively cap these materials.

Investigation, design, and construction of the landfill cap is expected to require 1 year. Groundwater treatment is estimated to be required for 10 years.

3.7.2.6 Implementability

Generally, the installation of the Subtitle D landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread cover and topsoil, and seed the surface. Operation and maintenance activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues that are of technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and the adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways would be necessary. Not only will permission from the property owner be required, but the issue of wetland protection by state and federal laws would have to be considered. If it is necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required.

No major difficulties are anticipated with the construction and operation of the in-situ groundwater bioremediation system. Treatability studies would be required to determine optimum conditions for biodegradation and injection well arrangement. While not as common as other treatment systems, such as carbon adsorption, the technology is available. If additional remedial action was necessary, it would not be difficult to implement, and could be performed in conjunction with the system to be installed.

Coordination with other agencies would be necessary. As discussed previously, it would be necessary to obtain a U.S. Army Corps of Engineers permit for encroaching onto the wetland. Also, a permit from the WDNR would be required for the injection of oxygen (and nutrients, if utilized) into the subsurface.

Availability of off-site treatment, storage, and disposal services would not be a problem, because no treatment residuals would have to be managed off-site. The necessary equipment and specialists are also available. The technology involved in installing the Subtitle D cap and the in-situ groundwater bioremediation system is readily available as well.

3.7.2.7 Cost

Capital costs associated with this alternative would include costs for installation of a Subtitle D cap over the entire landfill area ($2,580,850); construction of a fence around the landfill boundary ($32,000); and installation of an in-situ groundwater bioremediation system that includes 8 injection wells, 30 air diffuser wells, 2 monitoring wells, various pipes, pumps, and compressors, and a building to house the system ($240,000). Also included in the capital costs would be engineering, design, and permitting costs ($599,119). The total capital cost for this alternative would be approximately $3,559,100.

Annual O&M costs for this alternative would include long-term groundwater monitoring, cap maintenance, materials, reagents for the in-situ remediation system, system maintenance and replacement parts, and an operator. The annual O&M costs would be approximately $201,800 during the first 10 years of operation, during which groundwater treatment is taking place. After treatment is complete, the annual O&M cost will be approximately $79,300. The total present value for this alternative based upon a project life of 30 years is $5,403,500.

3.8 Alternative 8: Subtitle C Cap with In-Situ Groundwater Bioremediation

3.8.1 Description

This alternative includes placement of a multi-layer clay and geomembrane cap over the landfill (solid waste) boundary and treatment of groundwater with in-situ bioremediation. Fencing to restrict access, groundwater monitoring, and deed restrictions would also be included.

The cap would meet the requirements for final cover systems for hazardous waste disposal sites and comply with federal regulations, under 40 CFR Subtitle C, and Wisconsin State regulations under NR 181. The details of the cap construction and related issues would be the same as those discussed for Alternative 4. Details for the in-situ bioremediation of groundwater would be the same as discussed for Alternative 7.

3.8.2 Assessment

3.8.2.1 Overall Protection of Human Health and the Environment

This alternative would be very protective of human health and the environment by preventing direct contact with the solid waste, and by achieving groundwater enforcement standards for tetrahydrofuran in the vicinity of MW-3D in approximately 10 years following cap installation.

Installation of the Subtitle C cap would prevent direct contact with solid waste material in the landfill by ensuring that the entire landfill area is covered with 2 feet of compacted clay, a geomembrane barrier with sand bedding above and below, 1 foot of gravel, a geotextile filter, 6 feet of cover, 0.5 feet of topsoil, and vegetation. Fencing the capped landfill area would help prevent wear on the cap from recreational use. Regular inspection and maintenance would ensure that the cap remained an effective barrier.

In addition to preventing direct contact with waste materials, the repaired cap would prohibit infiltration of precipitation into the landfill, which would prevent the leaching of constituents of concern from the landfill into the groundwater.

The in-situ groundwater bioremediation system would reduce the concentration of tetrahydrofuran in the vicinity of MW-3D to concentrations below enforcement standard levels.

By injecting oxygen into the subsurface to optimize conditions for biodegradation, the tetrahydrofuran would be destroyed in place. Monitoring would be used to track constituents of concern in the groundwater.

In the short-term, there would be little risk to human health and the environment during cap and fence installation. No waste materials would be excavated; the existing cap would be used as the grading layer. Potential nuisances of increased traffic and dust resulting from delivery of capping materials to the site are likely, however.

Short-term risk associated with the in-situ groundwater bioremediation system include risks to workers during the installation of wells, and normal operational hazards.

Remedial action objectives related to preventing direct contact with waste materials would be met. In addition, the groundwater treatment system would be designed to achieve the groundwater cleanup objective.

3.8.2.2 Compliance with ARARs

Placement of the Subtitle C cap would exceed final cover requirements for solid waste disposal facilities. The treatment system would be designed to remove tetrahydrofuran from the groundwater to a concentration below the enforcement standard in the vicinity of MW-3D following cap placement. Injection of oxygen into the subsurface would be conducted according to WDNR requirements. Construction of the treatment system and the landfill cap would be completed in a manner that minimized effects on the floodplain areas and wetlands.

3.8.2.3 Long-Term Effectiveness and Permanence

This criterion assesses the risk remaining at the site after remedial action objectives are achieved. Preventing contact with solid waste and significantly reducing migration of constituents through capping would prevent the risk of the untreated waste in the landfill. Access restriction and regular maintenance would further prevent direct contact. In addition, the concentration of tetrahydrofuran would be reduced in groundwater to levels below enforcement standards in the vicinity of MW-3D. Groundwater would be monitored to ensure that this level was not exceeded.

Controls would also include administrative controls, including deed restrictions to prevent future development of the site and controls on groundwater use in the area near the landfill. These would be effective in preventing direct contact with the waste materials and constituents of concern in groundwater.

The risk resulting from the need to replace or repair the cap would be minimal, because regular inspection of the cap would detect signs of deterioration, and repairs could be completed as needed.

If, after remedial action objectives are achieved, groundwater monitoring determined that constituents of interest remained in the groundwater, wells already in place could be used for the groundwater treatment.

3.8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

No treatment of solid waste is included in this alternative, therefore no significant reduction of toxicity or volume of waste material would be achieved. The cap on the landfill would significantly reduce the mobility of constituents of concern in the landfill by reducing infiltration of precipitation.

The in-situ groundwater bioremediation system would destroy tetrahydrofuran in the subsurface and prevent its further migration, thereby reducing its mobility. The in-situ groundwater bioremediation system would reduce the concentration of tetrahydrofuran in groundwater to below enforcement standard levels in the vicinity of MW-3D. This would result in reduction of the toxicity and volume of tetrahydrofuran. The treatment process is irreversible.

3.8.2.5 Short-Term Effectiveness

This evaluation criterion assesses the risk associated with construction and implementation of the alternative up to the point when remedial action objectives are achieved. For this alternative, this includes installing the landfill cap and fencing; installing the in-situ groundwater bioremediation system; and treating the groundwater until levels below enforcement standards are achieved.

Risks to the community would be minimal. The only potential effects associated with capping would result from the trucking of clay, topsoil, and other materials to the site to install the cap. Potential nuisances, such as increased traffic through parts of the City of Stoughton and dust from working with the soils on-site could result in areas closest to the landfill. No waste materials would be excavated, however, so no airborne exposure to constituents of interest is anticipated.

Potential risks to remedial workers are those associated with subsurface work in installing injection wells. Potential risks to operating workers during remedial activities would include those associated with normal process-type operations, such as hazards associated with electrical and mechanical maintenance. These risks will be addressed and minimized through good operating procedures specified in the Operation and Maintenance Plan. All workers at the site will be subject to OSHA health and safety requirements (29 CFR 1910.120).

Minimal impacts to the environment are expected during the implementation of this alternative. Soil erosion could occur during cap installation and result in increased sediment loads to the adjacent wetlands. Such erosion and runoff would be controlled by physical barriers commonly used at construction sites. It would be necessary to infringe on a small portion of the wetlands bordering the landfill to the east, because of the proximity of waste materials, and the need to effectively cap these materials.

Investigation, design, and construction of the landfill cap is expected to require 1 1/2 years. Groundwater treatment is estimated to be required for 10 years following cap installation.

3.8.2.6 Implementability

Generally, the installation of the Subtitle C landfill cap would not involve any major technical feasibility constraints. Standard construction techniques would be used to grade the site, spread and compact clay, spread cover and topsoil, and seed the surface. Installation of the geomembrane barrier would be the most difficult step; but such membranes have been installed at numerous sites across the country. Therefore, implementation would not be a significant problem. Operation and maintenance activities, including inspection of the cap on a regular basis and repair when necessary, would also be relatively simple.

There are issues of technical and administrative concern. Along the east side of the landfill, the fill areas border both the property boundary and the adjacent wetlands. In order to ensure that all waste materials were properly capped, it would be necessary to extend the cap onto adjacent property owned by Vennevol, Inc. Purchase of small sections of the property or obtaining right-of-ways would be necessary. Not only would permission from the property owner be required, but the issue of wetland protection by state and federal laws would have to be considered. If it were necessary to place some fill in the wetland area, a U.S. Army Corps of Engineers permit would be required.

No major difficulties are anticipated with the construction and operation of the in-situ groundwater bioremediation system. Treatability studies would be required to determine optimum conditions for biodegradation and injection well arrangement. While not as common as other treatment systems, such as carbon adsorption, the technology is available.

If additional remedial action became necessary, it would not be difficult to implement, and could be done in conjunction with the system to be installed.

Coordination with other agencies would be necessary: a U.S. Army Corps of Engineers permit for encroaching onto the wetland and a permit from the WDNR for the injection of oxygen (and nutrients if utilized) into the subsurface would be required.

Availability of off-site treatment, storage, and disposal services would not be a problem, because no treatment residuals would have to be managed off-site. The necessary equipment and specialists are also available. The technology involved in installing the Subtitle D cap and the in-situ groundwater bioremediation system is readily available as well.

3.8.2.7 Cost

Capital costs associated with this alternative would include installation of a Subtitle C cap over the entire landfill area ($7,623,250); construction of a fence around the landfill boundary ($32,000); and installation of an in-situ groundwater bioremediation system that would include 30 air diffuser wells, two monitoring wells, various pipes, pumps, and compressors, and a building to house the system ($240,000). Also included in the capital costs would be engineering, design, and permitting costs ($1,658,024). The total capital cost for this alternative would be approximately $9,553,400. Annual O&M costs for this alternative include long-term groundwater monitoring, cap maintenance, reagents for the in-situ bioremediation system, system maintenance and replacement parts, and an operator. The annual O&M costs for this system would be approximately $201,800 during the first 10 years and $79,300 after groundwater treatment is complete.

The total present value for this alternative, based upon a project life of 30 years, is $11,397,800.

4.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

In the following sections, all the alternatives are compared to evaluate the performance of each alternative in relation to each specific evaluation criterion.

4.1 Overall Protection of Human Health and the Environment

The No Action Alternative is least protective of human health and the environment. The Cap Repair Alternative (Alternative 2), and Alternatives 3 and 4, consisting primarily of installation of a Subtitle D Cap and Subtitle C Cap, respectively, are essentially equally protective. The Subtitle C cap would prevent, as opposed to reduce (under Alternatives 2 and 3), the leaching of constituents to the groundwater. For this reason, the Subtitle C cap may achieve cleanup objectives for tetrahydrofuran in a somewhat shorter time frame; however, the caps under Alternatives 2 and 3 would also be expected to achieve these objectives eventually and the time difference would not likely be significant.

There is not a complete exposure route for the ingestion of groundwater at the site and future use is restricted by state regulations. The use of the site may also be restricted by municipal regulations. Therefore, the difference between these types of caps would be minimal. Alternatives 5 and 6, which consist of groundwater collection and treatment in addition to the Subtitle D and C caps; and alternatives 7 and 8, which consist of in-situ treatment of groundwater through bioremediation in addition to the Subtitle D and C caps; would not provide any more protection to human health for the reason just stated. However, there would be a slight increase in protection of the environment under alternatives 5 through 8 because tetrahydrofuran present in groundwater on the west side of the landfill would be prevented from migrating farther, toward the Yahara River and adjacent wetlands. As discussed in the Draft RI Report, tetrahydrofuran may be removed prior to discharge due to adsorption onto clay sediments that underlie the Yahara River and adjacent wetlands. Therefore, for this and other reasons cited in Section 3.1.2.1, impacts on the Yahara River are likely insignificant.

Because permanent access restrictions by the municipality are included under each alternative, each would be protective from a standpoint of direct contact with waste materials in the landfill. Alternatives 2 and 3 would reduce the chance for degradation of the cap. Installation of a Subtitle C cap (Alternative 4) would reduce this possibility even further.

In the short term, the potential impacts to the community, workers on-site, and the environment from cap repair or cap installation would be essentially the same for Alternatives 2 through 8.

Groundwater removal and treatment, under Alternatives 5 and 6, would result in additional risks to workers on-site, and the community, because tetrahydrofuran is removed from the subsurface, adsorbed onto carbon, and shipped off-site for treatment. Under Alternatives 7 and 8, tetrahydrofuran is treated in the subsurface, resulting in no additional potential for exposure.

4.2 Compliance with ARARs

Alternative 1 is generally consistent with closure requirements under WAC NR 506.08(3) and enforcement standard levels for tetrahydrofuran in groundwater would eventually be achieved, but not in the short term. Alternative 2 would achieve the final cover requirements under WAC NR 506.08(3), and includes a 2-foot layer of low permeability soil to function as the hydraulic barrier. This alternative will also eventually achieve enforcement standard levels for tetrahydrofuran over time. Alternatives 3, 5, and 7 would meet current Wisconsin requirements for final cover, while Alternatives 4, 6, and 8 would exceed them. Alternatives 2 through 8 would achieve enforcement standard levels for tetrahydrofuran. However, the time period would be shorter for Alternatives 5 through 8, which utilize treatment, than for Alternatives 1, 2, 3, and 4, which rely on natural processes to reduce the concentration of tetrahydrofuran. The estimated time frame for achievement of groundwater cleanup objectives for tetrahydrofuran is on the order of 5 years for Alternatives 5 and 6, and 10 years for Alternatives 7 and 8, following the installation of the caps associated with each of these alternatives.

4.3 Long-Term Effectiveness and Permanence

There is residual risk associated with all eight alternatives due to untreated waste, because none of the alternatives include treatment of the waste material. There is considerable difference, however, in the adequacy and reliability of controls used to manage this residual risk. All of the alternatives include access restriction to prevent direct contact with the waste materials in the landfill area. Alternative 2 includes upgrading the existing cap by placing clay and soil to control leachate generation. Alternatives 3, 5, and 7 include the installation of a Subtitle D cap, consisting of clay and other natural materials. Alternatives 4, 6, and 8 include the installation of a Subtitle C cap, which consists of geomembranes and geotextiles in addition to the clay and soil layers. The geomembrane would prevent infiltration of precipitation, whereas the clay and soil caps would allow some infiltration. All of the caps would be more than adequate to prevent direct contact. It is believed that the clay and soil caps (Alternatives 2, 3, 5, and 7) would be adequate in controlling infiltration. Therefore, the leaching of constituents of concern to the groundwater would also be controlled. These alternatives would be more protective than the existing cap. However, it must be noted that, with the exception of tetrahydrofuran in the vicinity of MW-3D, leaching of constituents from the landfill has not resulted in significant releases to groundwater. Dispersion and natural attenuation would be sufficient to prevent an even smaller amount of leached constituents from affecting the environment. Not only would the clay and soil cap (Alternatives 2, 3, 5, and 7) be adequate, but it is also simpler to install and easier to repair, if necessary. If it became necessary in the future to replace the cap, replacing a clay and soil cap would present fewer problems than replacing a multi-layer geomembrane cap (Alternatives 4, 6, and 8). Groundwater monitoring would be continued, and would be sufficient to detect any increase in the types or concentrations of constituents of concern leaching from the landfill.

4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

None of the alternatives include treatment of the solid waste; therefore, no significant reduction of toxicity; or volume of waste material would be achieved. The mobility of the constituents would be reduced, however, through cap repair or installation of a new cap, which would reduce or prevent infiltration of precipitation that may allow constituents of concern to leach the groundwater. Repairing the cap (Alternative 2) and the Subtitle D cap would provide more protection than the No Action Alternative. The Subtitle C cap would be most protective, because it would prohibit infiltration, compared to the Subtitle D cap and cap repair, for which a small amount of infiltration would still occur. Therefore, Alternatives 4, 6, and 8 would reduce the mobility the most, followed by Alternatives 2, 3, 5, and 7.

The toxicity, mobility, or volume of tetrahydrofuran in groundwater would not be immediately reduced under Alternatives 1 through 4, which do not include groundwater treatment. However, natural processes of dispersion and attenuation would reduce the concentration of tetrahydrofuran in the sand and gravel aquifer over time.

Alternatives 5 and 6 include groundwater pumping, treatment with activated carbon, and destruction of the constituents off-site during carbon regeneration. The constituents would be concentrated through adsorption onto carbon and destroyed off-site. This would result in significant reduction of toxicity, mobility, and volume of tetrahydrofuran.

Alternatives 7 and 8 include in-situ bioremediation, through which constituents are biodegraded in the subsurface. This method of groundwater treatment would also result in a significant reduction of toxicity, mobility, and volume of tetrahydrofuran. The reduction would be more immediate than using carbon adsorption, however, because tetrahydrofuran would be destroyed in place.

4.5 Short-Term Effectiveness

Risks to the community during the construction and implementation phase would obviously be least for the No Action Alternative. Some risk is associated with cap repair and capping to be conducted under the remaining alternatives. Trucking of clay, topsoil, and other materials would result in increased traffic through the City of Stoughton. Dust from working with the soil on-site would also result in areas closest to the landfill. Because no waste would be excavated, no potential exposure to these constituents is expected. These traffic and dust effects would be greatest for the Subtitle C cap (which requires the most materials), followed by the Subtitle D cap, and finally, the cap repair.

Of the two groundwater treatment systems, in-situ bioremediation would pose the least risk to the community, because tetrahydrofuran would be treated in place. The use of carbon adsorption would create the need to transport tetrahydrofuran, adsorbed onto carbon, off-site for destruction.

Risks to workers on-site would be greatest for Alternatives 5 and 6, which include groundwater recovery and treatment, because there is some potential for exposure to constituents of concern. These would be followed by Alternatives 7 and 8, which include in-site bioremediation. Although normal operational-type hazards would still exist, tetrahydrofuran would be treated in the subsurface, reducing the potential for exposure. Alternatives 2, 3, and 4, which include cap repair, Subtitle D cap, and Subtitle C cap, respectively, would all pose similar risks with earth-moving equipment and general construction-type risks.

Minimal impacts to the environment are expected from the implementation of the alternatives. Except for the No Action alternative, all of the alternatives include cap repair or capping, which may result in soil erosion and increased sediment loads to adjacent wetlands. This could be controlled by physical barriers commonly used at construction sites. Also, a small portion of the wetlands area east of the landfill could be affected by cap repair or capping. No significant adverse effects on the environment are expected from the groundwater treatment systems.

4.6 Implementability

The No Action Alternative would obviously be the least difficult to implement. Alternative 2 (Cap Repair) would be the next easiest, followed by Alternative 3 (Subtitle D cap) and Alternative 4 (Subtitle C cap). Both types of groundwater treatment; pump and treat by carbon adsorption (Alternatives 5 and 6), and in-situ bioremediation (Alternatives 7 and 8), would result in additional implementability concerns. Carbon adsorption is a more common and proven technology than in-situ bioremediation; however, because the removal of tetrahydrofuran using carbon is inefficient, carbon units will have to be replaced or regenerated regularly. For in-situ bioremediation, it may be difficult to obtain permission from the State of Wisconsin to inject the necessary treatment solutions into the subsurface. Both types of groundwater treatment could be monitored effectively.

Administrative feasibility issues would be similar for all alternatives (except No Action), because the cap would need to extend onto land not owned by the City of Stoughton, and could impact the wetlands. Coordination with neighboring property owners and the U.S. Corps of Engineers would be required.

The technology, equipment, and specialists required to implement each of the technologies are readily available.

4.7 Cost

The costs for each alternative are listed in Table 4-1. Capital, annual O&M, and net present values are included. Alternative 1 (No Action) is the least expensive alternative for obvious reasons. Alternative 2, the limited action alternative, which primarily consists of repairing or upgrading an assumed area of the existing cap, is the next least expensive alternative followed by the installation of a Subtitle D cap over the entire landfill (Alternative 3). Of the alternatives that contain groundwater treatment as a principal element, in-situ biotreatment along with the installation of a Subtitle D cap (Alternative 7) is the least expensive, followed by groundwater extraction and treatment with carbon along with the installation of a Subtitle D cap (Alternative 5). The most expensive alternative includes groundwater extraction and treatment with carbon and the installation of a Subtitle C cap. Alternatives that involve the installation of a Subtitle C cap (Alternatives 4, 6, and 8) have the highest capital cost due to complexity of design of this cap and the amount of materials required. Alternatives with the highest annual O&M costs involve the use carbon as a form of treatment (Alternatives 5 and 6). This is due to the cost and frequency of carbon replacement.

TABLE 4-1

Comparative Costs of Remedial Alternatives

Remedial Alternative	Total Capital Cost	Annual O&M Cost	Net Present Value Over Life of Project (30 yrs at 7% discount rate)
Alternative 1 No Action	$ 5,000	$ 67,300	$ 840,130
Alternative 2 Cap Repair	1,160,200	79,300	1,762,000
Alternative 3 Solid Waste Cap	3,167,600	79,300	4,151,640
Alternative 4 Hazardous Waste Cap	9,262,000	79,300	10,246,860
Alternative 5 Solid Waste Cap with Groundwater Treatment	3,716,700	927,400 (first 5 yrs) 79,300	8,178,100
Alternative 6 Hazardous Waste Cap with Groundwater Treatment	9,842,200	927,400 (first 5 yrs) 79,300	14,303,600
Alternative 7 Solid Waste Cap with In-Situ Biotreatment	3,559,100	201,800 (first 10 yrs) 79,300	5,403,500
Alternative 8 Hazardous Waste Cap with In-Situ Biotreatment	9,553,400	201,800 (first 10 yrs) 79,300	11,397,800

5.0 DISCUSSION OF THE PREFERRED ALTERATIVE

In this section, the results of the individual analysis of the alternatives (Section 3.0) and the comparative analysis of the alternatives (Section 4.0) are evaluated in order to determine the most viable alternative based upon the characteristics of the site and the seven evaluation criteria discussed in Sections 3.0 and 4.0.

In order to attain threshold criteria and the remedial action objectives for the Stoughton City Landfill site in the most cost-effective manner, Alternative 2, cap repair with natural attenuation of groundwater, is recommended. This alternative consists of evaluating the existing cap and repairing or upgrading the cap in areas of deficiency based upon the evaluation. The deficient areas will be covered with 2 feet of compacted clay, a 6-inch topsoil layer, and vegetation to prevent erosion. Because the repaired cap will significantly reduce infiltration, leachate generation would also be significantly reduced thereby eliminating the release mechanism of tetrahydrofuran to the groundwater. Once the release of tetrahydrofuran is eliminated, the concentration of tetrahydrofuran already present in the aquifer would be reduced over time by dispersion and natural attenuation in the sand and gravel aquifer, including natural biodegradation. These processes would reduce the toxicity and volume of groundwater affected by tetrahydrofuran and the remedial objectives would be achieved over time. Conclusions in support of this alternative include the following:

- The cap specified under this alternative is consistent with the closure requirements of WAC NR 506.08(3). Further, the repaired or upgraded cap will provide a hydraulic barrier equal to that required under current Wisconsin regulations for solid waste facilities.

- Tetrahydrofuran poses no threat to any known users of groundwater and the maximum concentration detected (660 μg/L) is well below the concentration (2,380 μg/L as presented in Section 2.2 of the Final AAD) that would pose a potential noncarcinogenic risk to public health. Further, the installation of water supply wells within 1,200 feet of a landfill is precluded by WAC NR 112.07(q). Therefore, natural attenuation can be allowed to take place without endangering public health.

- The potential impact of the discharge of groundwater containing tetrahydrofuran on the Yahara River would be insignificant.

- Alternative 2 can attain the threshold criteria and remedial action objectives at a much lower cost than the other alternatives with the exception of the No Action Alternative.

APPENDIX A

COST DATA

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 1 No Action					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Sampling Plan	1	ls	5,000	5,000				0				0	5,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				5,000				0				0	5,000

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 1 NO ACTION
PRESENT WORTH OF 30 - YR O&M

Operations, Maintanance, and Replace
Cost Estimate

Description	Quantity	Unit	Unit Price	Cost	n	7%
PRESENT WORTH	1	LS	67300	67300	30	835128.471
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
				0		0
Subtotal				67300		

Note: Columns Quantity, Unit, Unit Price, Cost are under "Unit Cost Method"; columns n and 7% are under "Present Worth of Cost over Project Life".

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 2 Repair Cap					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
2' clay cap	28500	cy	15	427,500				0				0	427,500
6" topsoil	7500	cy	18	135,000				0				0	135,000
vegetation	40500	sy	0	14,175				0				0	14,175
fence	4000	lf	8	32,000				0				0	32,000
25% scope cont.	1	ls	152,170	152,170				0				0	152,170
5% mobe & demobe	1	ls	30,430	30,430				0				0	30,430
3% H&S cont.	1	ls	18,260	18,260				0				0	18,260
15% bid cont.	1	ls	91,300	91,300				0				0	91,300
				0				0				0	0
GW Deed	1	ls	3,000	3,000				0				0	3,000
Sampling Plan	1	ls	5,000	5,000				0				0	5,000
Cap Evaluation	1	ls	50,000	50,000				0				0	50,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				958,835				0				0	958,835

ALTERNATIVE 2

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method: Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	76,700	76,700				0				0	76,700
LEGAL, PRMTNG 5%	1	LS	47,940	47,940				0				0	47,940
CONSTN SERVS 8%	1	LS	76,700	76,700				0				0	76,700
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				201,340				0				0	201,340

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 2 - CAP REPAIR AND GROUNDWATER MONITORING
O&M 30-YR PRESENT WORTH

Operations, Maintanance, and Replace
Cost Estimate

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost		
PRESENT WORTH	1	LS	79300	79300	n	7%
OF 30-YEAR O&M				0	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 3 Subtitle D Cap					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
6" grading layer	15000	cy	$10.00	$150,000				$0				$0	$150,000
2' clay cap	57000	cy	$15.00	$855,000				$0				$0	$855,000
1.5' cover layer	43000	cy	$10.00	$430,000				$0				$0	$430,000
6" topsoil	15000	cy	$18.00	$270,000				$0				$0	$270,000
vegetation	81000	sy	$0.35	$28,350				$0				$0	$28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	$32,000
3% H&S	1	ls	$53,000.00	$53,000				$0				$0	$53,000
5% mobe/dem	1	ls	$88,300.00	$88,300				$0				$0	$88,300
25% scope cont	1	ls	$441,400.00	$441,400				$0				$0	$441,400
15% bid cont	1	ls	$264,800.00	$264,800				$0				$0	$264,800
				$0				$0				$0	$0
Sampling Plan	1	ls	$5,000.00	$5,000				$0				$0	$5,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$2,617,850				$0				$0	$2,617,850

ALTERNATIVE 3

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	209,428	209,428				0				0	209,428
LEGAL, PRMTNG 5%	1	LS	130,893	130,893				0				0	130,893
CONSTN SERVS 8%	1	LS	209,428	209,428				0				0	209,428
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				549,749				0				0	549,749

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 3 SUBTITLE D CAP
PRESENT WORTH OF 30-YR O&M

Operations, Maintanance, and Replace
Cost Estimate

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost		
PRESENT WORTH	1	LS	79300	79300	n	7%
				0	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 4 Subtitle C Cap					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
2′ clay cap	57000	cy	$15.00	$855,000				$0				$0	$855,000
1′ sand layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
1′ gravel layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
6′ cover layer	171000	cy	$10.00	$1,710,000				$0				$0	$1,710,000
6" topsoil	15000	cy	$14.00	$210,000				$0				$0	$210,000
geo liner	724000	sf	$0.40	$289,600				$0				$0	$289,600
geotex filter	724000	sf	$0.20	$144,800				$0				$0	$144,800
vegetation	81000	sy	$0.35	$28,350				$0				$0	$28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	$32,000
3% H&S	1	ls	$164,100.00	$164,100				$0				$0	$164,100
5% mobe/dem	1	ls	$273,500.00	$273,500				$0				$0	$273,500
25% scope cont	1	ls	************	$1,367,400				$0				$0	$1,367,400
15% bid cont	1	ls	$820,500.00	$820,500				$0				$0	$820,500
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$7,655,250				$0				$0	$7,655,250

ALTERNATIVE 4

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	612,420	612,420				0				0	612,420
LEGAL, PRMTNG 5%	1	LS	382,763	382,763				0				0	382,763
CONSTN SERVS 8%	1	LS	612,420	612,420				0				0	612,420
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				1,607,603				0				0	1,607,603

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 4 SUBTITLE C CAP WITH GROUNDWATER MONITORING
PRESENT WORTH 30-YR O&M Operations, Maintanance, and Replace Cost Estimate

Description	Unit Cost Method				Material	
	Quantity	Unit	Unit Price	Cost	Present Worth of Cost over Project Life	
PRESENT WORTH	1	LS	79300	79300	n	7%
				0	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 5 D-Cap Carbon Adsorb					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
6" grading layer	15000	cy	$10.00	$150,000				$0				$0	$150,000
2' clay cap	57000	cy	$15.00	$855,000				$0				$0	$855,000
1.5' cover layer	43000	cy	$10.00	$430,000				$0				$0	$430,000
6" topsoil	15000	cy	$18.00	$270,000				$0				$0	$270,000
vegetation	81000	sy	$0.35	$28,350				$0				$0	$28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	$32,000
3% H&S	1	ls	$53,000.00	$53,000				$0				$0	$53,000
5% mobe/dem	1	ls	$88,300.00	$88,300				$0				$0	$88,300
25% scope cont	1	ls	$441,400.00	$441,400				$0				$0	$441,400
15% bid cont	1	ls	$264,800.00	$264,800				$0				$0	$264,800
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$2,612,850				$0				$0	$2,612,850

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Treatment					Material				Labor				
Carbon Adsorb.	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Ext. Wells & Pum	2	ea	30,000	60,000				0				0	60,000
Extraction Pipe	400	lf	5	2,000				0				0	2,000
Controls	1	ls	15,000	15,000				0				0	15,000
Feed/eff tanks	2	ea	6,000	12,000				0				0	12,000
Feed Pumps	2	ea	1,500	3,000				0				0	3,000
2 Carbon Adsorb.	2	ea	80,000	160,000				0				0	160,000
Discharge Pumps	2	ea	1,500	3,000				0				0	3,000
Discharge Piping	600	lf	5	3,000				0				0	3,000
Electrical	1	ls	20,000	20,000				0				0	20,000
Heat Trace	1000	lf	4	4,000				0				0	4,000
Insulate	1000	lf	8	8,000				0				0	8,000
Treatment Bldg.	400	sf	100	40,000				0				0	40,000
3% H&S	1	ls	9,300	9,300				0				0	9,300
5% mobe/dem	1	ls	15,500	15,500				0				0	15,500
40% scp/bid cont	1	ls	124,000	124,000				0				0	124,000
Subtotal				478,800				0				0	478,800

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
Annual O&M GW Treatment Carbon Adsorb					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
electric				0	12	mo	700	8,400				0	8,400
maintenanace				0	1	ls	5,000	5,000	190	hr	40	7,600	12,600
carbon exc/reg				0	1	ls	770,000	770,000	32	hr	50	1,600	771,600
operator				0				0	1,250	hr	30	37,500	37,500
monitoring				0	1	ls	18,000	18,000				0	18,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				801,400				46,700	848,100

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 5

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	245,732	245,732				0				0	245,732
LEGAL, PRMTNG 5%	1	LS	153,583	153,583				0				0	153,583
CONSTN SERVS 8%	1	LS	245,732	245,732				0				0	245,732
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				645,047				0				0	645,047

ALTERNATIVE 5 SUBTITLE D CAP,GROUNDWATER TREATMENT WITH CARBON
PRESENT WORTH O&M,GROUNDWATER TREATMENT FOR 5 YEARS
PRESENT WORTH O&M,LANDFILL MAINT. AND GW MONITORING FOR 30 YEARS

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost	n	7%
TREATMENT 5-YRS	1	LS	848100	848100	5	3477377.44
MONITOR 30-YRS	1	LS	79300	79300	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 6 C-Cap Carbon Adsorb					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
2′ clay cap	57000	cy	$15.00	$855,000				$0				$0	$855,000
1′ sand layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
1′ gravel layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
6′ cover layer	171000	cy	$10.00	$1,710,000				$0				$0	$1,710,000
6" topsoil	15000	cy	$14.00	$210,000				$0				$0	$210,000
geo liner	724000	sf	$0.40	$289,600				$0				$0	$289,600
geotex filter	724000	sf	$0.20	$144,800				$0				$0	$144,800
vegetation	81000	sy	$0.35	$28,350				$0				$0	$28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	$32,000
3% H&S	1	ls	$164,100.00	$164,100				$0				$0	$164,100
5% mobe/dem	1	ls	$273,500.00	$273,500				$0				$0	$273,500
25% scope cont	1	ls	************	$1,367,400				$0				$0	$1,367,400
15% bid cont	1	ls	$820,500.00	$820,500				$0				$0	$820,500
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$7,655,250				$0				$0	$7,655,250

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Insp. tion	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Treatment Carbon Adsorb.					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
Ext. Wells & Pum	2	ea	30,000	60,000				0				0	60,000
Extraction Pipe	400	lf	5	2,000				0				0	2,000
Controls	1	ls	15,000	15,000				0				0	15,000
Feed/eff tanks	2	ea	6,000	12,000				0				0	12,000
Feed Pumps	2	ea	1,500	3,000				0				0	3,000
2 Carbon Adsorb.	2	ea	80,000	160,000				0				0	160,000
Discharge Pumps	2	ea	1,500	3,000				0				0	3,000
Discharge Piping	600	lf	5	3,000				0				0	3,000
Electrical	1	ls	20,000	20,000				0				0	20,000
Heat Trace	1000	lf	4	4,000				0				0	4,000
Insulate	1000	lf	8	8,000				0				0	8,000
Treatment Bldg.	400	sf	100	40,000				0				0	40,000
3% H&S	1	ls	9,300	9,300				0				0	9,300
5% mobe/dem	1	ls	15,500	15,500				0				0	15,500
40% scp/bid cont	1	ls	124,000	124,000				0				0	124,000
Subtotal				478,800				0				0	478,800

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
Annual O&M Bioremediation					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
electricity / yr				0	1	yr	79,000	79,000				0	79,000
				0				0				0	0
operator				0				0	830	hr	30	24,900	24,900
maintenance				0	1	ls	4,000	4,000	190	hr	40	7,600	11,600
monitoring				0	1	ls	7,000	7,000				0	7,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				90,000				32,500	122,500

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 6

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	650,724	650,724				0				0	650,724
LEGAL, PRMTNG 5%	1	LS	406,703	406,703				0				0	406,703
CONSTN SERVS 8%	1	LS	650,724	650,724				0				0	650,724
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				1,708,151				0				0	1,708,151

ALTERNATIVE 6 SUBTITLE C CAP WITH GROUNDWATER TREATMENT
PRESENT WORTH O&M FOR 5-YRS GW TREATMENT
PRESENT WORTH O&M FOR 30-YRS LANDFILL MAINT.AND GW MONIT

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost	n	7%
TREATMENT 5-YRS	1	LS	848100	848100	10	860388.738
MONITORING 30-YR	1	LS	79300	79300	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 7 D-Cap Bio					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
6" grading layer	15000	cy	$10.00	$150,000				$0				$0	150,000
2' clay cap	57000	cy	$15.00	$855,000				$0				$0	855,000
1.5' cover layer	43000	cy	$10.00	$430,000				$0				$0	430,000
6" topsoil	15000	cy	$18.00	$270,000				$0				$0	270,000
vegetation	81000	sy	$0.35	$28,350				$0				$0	28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	32,000
3% H&S	1	ls	$53,000.00	$53,000				$0				$0	53,000
5% mobe/dem cont	1	ls	$88,300.00	$88,300				$0				$0	88,300
25% scope cont	1	ls	$441,400.00	$441,400				$0				$0	441,400
15% bid cont	1	ls	$264,800.00	$264,800				$0				$0	264,800
				$0				$0				$0	0
				$0				$0				$0	0
				$0				$0				$0	0
				$0				$0				$0	0
				$0				$0				$0	0
Subtotal				$2,612,850				$0				$0	2,612,850

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
In-Situ Bioremediation					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Air Diffuse Well	30	ea	4,400	132,000				0				0	132,000
Air Compressor	3	ea	2,000	6,000				0				0	6,000
Air Piping	1200	lf	3	3,000				0				0	3,000
Monitoring Wells	3	ea	5,000	15,000				0				0	15,000
Elec/water Hk-up	1	ls	30,000	30,000				0				0	30,000
Treatment Bldg.	200	sf	100	20,000				0				0	20,000
Heat Trace/Insul	1200	lf	12	14,400				0				0	14,400
Controls	1	ls	5,000	5,000				0				0	5,000
3% H&S	1	ls	6,760	4,900				0				0	4,900
5% mobe/dem	1	ls	11,270	8,100				0				0	8,100
40% scp/bid cont	1	ls	90,160	90,160				0				0	90,160
Subtotal				328,560				0				0	328,560

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
Annual O&M Bioremediation					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
electricity / yr				0	1	yr	79,000	79,000				0	79,000
				0				0				0	0
operator				0				0	830	hr	30	24,900	24,900
maintenance				0	1	ls	4,000	4,000	190	hr	40	7,600	11,600
monitoring				0	1	ls	7,000	7,000				0	7,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				90,000				32,500	122,500

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 7

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	235,300	235,300				0				0	235,300
LEGAL, PRMTNG 5%	1	LS	147,100	147,100				0				0	147,100
CONSTN SERVS 8%	1	LS	235,300	235,300				0				0	235,300
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				617,700				0				0	617,700

ALTERNATIVE 7 SUBTITLE D CAP WITH IN-SITU BIOTREATMENT
PRESENT WORTH O&M FOR 10 YRS GW TREATMENT
PRESENT WORTH O&M FOR 30 YRS LANDFILL CAP MAINT.

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost	n	7%
TREATMENT 10-YRS	1	LS	122500	122500	10	860388.738
MONITORING 30-YR	1	LS	79300	79300	30	984036.965

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Alternative 8 C-Cap Bio					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
2' clay cap	57000	cy	$15.00	$855,000				$0				$0	$855,000
1' sand layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
1' gravel layer	44000	tn	$20.00	$880,000				$0				$0	$880,000
6' cover layer	171000	cy	$10.00	$1,710,000				$0				$0	$1,710,000
6" topsoil	15000	cy	$14.00	$210,000				$0				$0	$210,000
geo liner	724000	sf	$0.40	$289,600				$0				$0	$289,600
geotex filter	724000	sf	$0.20	$144,800				$0				$0	$144,800
vegetation	81000	sy	$0.35	$28,350				$0				$0	$28,350
fencing	4000	lf	$8.00	$32,000				$0				$0	$32,000
3% H&S	1	ls	$164,100.00	$164,100				$0				$0	$164,100
5% mobe/dem	1	ls	$273,500.00	$273,500				$0				$0	$273,500
25% scope cont	1	ls	************	$1,367,400				$0				$0	$1,367,400
15% bid cont	1	ls	$820,500.00	$820,500				$0				$0	$820,500
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$7,655,250				$0				$0	$7,655,250

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
O&M Landfill Cap					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Mowing	7	mo	$1,000.00	$7,000				$0				$0	$7,000
Cover Maintenanc	1	ls	$4,000.00	$4,000				$0				$0	$4,000
Inspection	1	ls	$1,000.00	$1,000				$0				$0	$1,000
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
				$0				$0				$0	$0
Subtotal				$12,000				$0				$0	$12,000

Capital Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
In-Situ Bioremediation					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Air Diffuse Well	30	ea	4,400	132,000				0				0	132,000
Air Compressor	3	ea	2,000	6,000				0				0	6,000
Air Piping	1200	lf	3	3,000				0				0	3,000
Monitoring Wells	3	ea	5,000	15,000				0				0	15,000
Elec/water Hk-up	1	ls	30,000	30,000				0				0	30,000
Treatment Bldg.	200	sf	100	20,000				0				0	20,000
Heat Trace/Insul	1200	lf	12	14,400				0				0	14,400
Controls	1	ls	5,000	5,000				0				0	5,000
3% H&S	1	ls	6,760	4,900				0				0	4,900
5% mobe/dem	1	ls	11,270	8,100				0				0	8,100
40% scp/bid cont	1	ls	90,160	90,160				0				0	90,160
Subtotal				328,560				0				0	328,560

Operating and Maintenance Costs

Description	Unit Cost Method				Material and Labor Method								
Annual O&M Bioremediation					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
electricity / yr				0	1	yr	79,000	79,000				0	79,000
				0				0				0	0
operator				0				0	830	hr	30	24,900	24,900
maintenance				0	1	ls	4,000	4,000	190	hr	40	7,600	11,600
monitoring				0	1	ls	7,000	7,000				0	7,000
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				90,000				32,500	122,500

O & M Costs Estimate

Description	Unit Cost Method				Material and Labor Method								
Groundwater Monitoring					Material				Labor				
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Costs
Laboratory				0	1	ls	33,800	33,800				0	33,800
Sampling				0	1	ls	9,100	9,100	1	ls	17,000	17,000	26,100
Reports				0				0	1	ls	7,400	7,400	7,400
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				0				42,900				24,400	67,300

ALTERNATIVE 8

Engineering and Permitting Costs

Description	Unit Cost Method				Material and Labor Method								
					Material				Labor				Capital Costs
	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	Quantity	Unit	Unit Price	Cost	
ENG.&DESGN 8%	1	LS	638,700	638,700				0				0	638,700
LEGAL, PRMTNG 5%	1	LS	399,200	399,200				0				0	399,200
CONSTN SERVS 8%	1	LS	638,700	638,700				0				0	638,700
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
				0				0				0	0
Subtotal				1,676,600				0				0	1,676,600

ALTERNATIVE 8 SUBTITLEC CAP WITH IN-SITU BIOTREATMENT
PRESENT WORTH 10 YRS O&M GW TREATMEN
PRESENT WORTH 30 YRS O&M FOR LANDFILL CAP MAIN

Description	Unit Cost Method				Present Worth of Cost over Project Life	
	Quantity	Unit	Unit Price	Cost	n	7%
TREATMENT 10-YRS	1	LS	122500	122500	10	860388.738
MONITORING 30-YR	1	LS	79300	79300	30	984036.965

APPENDIX B

GROUNDWATER COLLECTION AND REMEDIATION TIME ESTIMATES

The data presented in this appendix were used to estimate the quantity of groundwater that could be collected for treatment during the implementation of Alternatives 5 and 6. In addition, remediation time period estimates for these alternatives and also for Alternatives 7 and 8 are presented herein. These estimates are based on standard analytical solutions using data and information obtained from the RI and other data from the literature, as noted.

Tetrahydrofuran was the only chemical measured at concentrations above Wisconsin groundwater enforcement standards during the RI. This chemical was measured during all three sampling rounds in the concentration range of 330 to 660 μg/L in MW-3D. The source of tetrahydrofuran is apparently a discrete location within the west-central portion of the landfill. Based on groundwater migration pathways defined in the Draft RI report, groundwater in the sand and gravel aquifer in the vicinity of MW-3D migrates to the west/southwest and presumably discharges to the Yahara River. Based on data presented in the Draft RI Report, a horizontal groundwater velocity of 0.27 feet day was calculated in the vicinity of MW-3D. The approximate distance from the west-central portion of the landfill to the Yahara River is 1,000 feet. Therefore, the approximate time for solutes that migrate relatively unretarded in the groundwater (such as tetrahydrofuran) to reach the Yahara River is 10 years. Therefore, groundwater that has been affected by releases from the landfill has already discharged to the Yahara River and a narrow plume of groundwater containing tetrahydrofuran may extend from the landfill to the Yahara River. However, potential effects on the Yahara River are likely insignificant for the reasons cited in Section 3.1.2.1 of this document.

Based on a review of aerial photographs and field observation, wetlands are located adjacent to the Yahara River approximately 300 feet west of the landfill property boundary in the vicinity of MW-3D. The installation of groundwater recovery wells in the wetlands is impractical and would require filling in of the wetlands to construct drilling pads for recovery well installation (which would in turn require a permit from the U.S. Army Corps of Engineers). Further, the concentrations of tetrahydrofuran downgradient of the landfill are likely significantly less than at MW-3D because of dispersion and natural attenuation processes. Therefore, the downgradient limit of groundwater recovery is restricted to the area west of the wetlands that border the Yahara River in the vicinity of MW-3D. The assumed maximum width of the plume at this location is 500 feet. It is also assumed that the plume extends toward the east (beneath the landfill) a distance of 500 feet from the wetland edge. The shape of the plume approximates that of a right triangle.

A total volume of affected groundwater, approximately 10.7 million gallons, was calculated using the following equation.

$$V = (A)(z)(s_y)(7.48\, gal./ft.^3) \tag{1}$$

Where:

V	=	Volume of affected groundwater (gal.)
A	=	Area of affected aquifer
	=	500 ft. x 500 ft. ÷ 2 = 125,000 ft.^{2}
z	=	Thickness of affected aquifer
	=	38 ft. (one-half of saturated thickness penetrated by MW-3D)
s_y	=	specific yield
	=	0.30 (Davis and DeWiest, 1966)[1]
V	=	(125,000 ft.^{2})(38 ft.)(0.3)(7.48 gal./ft.^{3})
	=	10,659,000

Assuming that 10 pore volumes of groundwater would have to be extracted to lower the concentration of tetrahydrofuran to acceptable levels (Jackson and Patterson, 1989)[2], the total volume of groundwater requiring collection approximates 106.7 million gallons.

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1 Davis, S.N., and R.J.M. DeWiest, Hydrogeology, John Wiley & Sons, 1966.

2 Jackson, R.E., and R.J. Patterson, A Remedial Investigation of an Organically Polluted outwash Aquifer, Groundwater Monitoring Review, Vol. IX, No. 3, Summer 1989.

The average horizontal hydraulic conductivity (K) measured during the RI was 15.58 ft./day or 116.5 gal/day/ft.[2] Assuming that the aquifer is 165 ft. thick (b) at this location (difference between the elevation of the water table and bedrock surface penetrated at an upgradient residential well), the transmissivity (T=Kb) is approximately 19,200 gal./day/ft. The water table elevation west of the wetlands in the vicinity of MW-3D is approximately 847.5 ft. above the National Geodetic Vertical Datum (NGVD). The elevation of surface water in the Yahara River and adjacent wetlands is approximately 843 ft. above the NGVD. Therefore, a maximum available drawdown of 4 feet was used in estimating groundwater recovery rates in order to minimize the effects on these features. The Theis equation (Davis and DeWiest, 1966) may be used to estimate the groundwater pumping rate from unconfined aquifers where drawdown is small compared to saturated thickness. The estimated groundwater pumping rate from a single well is approximately 37 gpm, as calculated below:

$$Q = \frac{sT}{114.6\,W(u)} \qquad (2)$$

Where:

Q	=	Pumping rate (gpm)
s	=	Drawdown = 4 ft.
T	=	Transmissivity = 19,200 gpd/ft.
W(u)	=	Well function of u

$$u = \frac{1.87 r^2 s_y}{Tt} \qquad (3)$$

Where:

r	=	Distance from center of pumped well to point where drawdown is measured = 0.5 feet
s_y	=	0.30 (as defined for Equation 1)
t	=	Time since pumping started = 1,000 days

Substituting in Equation 3,

$$u = \frac{(1.87)(0.5)^2(0.3)}{(19{,}200)(1{,}000)} = 7.0 \times 10^{-9}$$

Therefore, W(u) = 18.2001

Substituting in Equation 2,

$$Q = \frac{(4)(19{,}200)}{(114.6)(18{,}201)} = 36.8\ gpm$$

The width of the capture zone from a single well pumping at this rate was calculated as follows (Todd, 1980)[3]:

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[3] Todd, D.K., Groundwater Hydrology, 1980.

$$W = \frac{Q}{2Kbi}$$

Where:

W	=	Width of envelope contributing flow to well (ft.)
Q	=	Pumping rate = 37 gpm = 7,123 ft.^{3}/day
K	=	Hydraulic conductivity = 15.58 ft./day
b	=	Aquifer thickness = 165 ft.
i	=	Hydraulic gradient = 0.006 (unitless)

Substituting,

$$W = \frac{7{,}123}{2(15.58)(165)(0.006)} = 230.9\ ft.$$

The downgradient boundary of the area contributing flow to this well (stagnation point - x_s) was calculated as follows (Todd, 1980):

$$X_s = \frac{Q}{2\pi Kbi}$$

Using terms described above, this distance is approximately 73 feet downgradient of the pumping well.

Two pumping wells would be required to recover groundwater from the affected area. As previously noted, the total volume requiring recovery is approximately 106.7 million gallons. Collectively, the two groundwater wells would recover 74 gpm or 106,560 gal./day. Therefore, approximately 1,000 days, or 2.7 years, would be required to recover and treat the affected groundwater. Under non-pumping conditions, the travel time from the west-central portion of the landfill to the groundwater recovery wells (500 feet) would be approximately 5 years. This travel time would be increased due to pumping. However, in order to account for some limited retardation of tetrahydrofuran while migrating through the aquifer and for the migration of residual water in the landfill to the water table following capping, a total time of 5 years is assumed to remediate groundwater under Alternatives 5 and 6, following the completion of capping and the reduction of leachate generation.

Under Alternatives 7 and 8, oxygen would be injected through wells to facilitate in-situ biotreatment of affected groundwater. These injection wells would also be located just east of the wetlands adjacent to the Yahara River. As previously noted, the calculated travel time under non-pumping conditions to this location would be about 5 years. Following the completion of capping and the reduction of leachate generation, the concentration of tetrahydrofuran in the sand and gravel aquifer would decrease. Solutes released to the water table would migrate under the natural hydraulic gradient toward the injection wells, where the tetrahydrofuran would be destroyed. Theoretically, the time period for one pore volume of groundwater containing tetrahydrofuran to pass the bioactive zone created by the injection wells would be about 5 years. However, for the reasons cited above for the groundwater collection and treatment alternatives, the remediation time may be longer. Therefore, a remediation period of 10 years was assumed for Alternatives 7 and 8 following the completion of capping activities.