City of Sioux Falls Regional Solid Waste Master Plan

Prepared for:
Public Works Department
Sioux Falls, South Dakota

Prepared by:

EARTH TECH

R·W·BECK

October 2003

Project No. 63063

REGIONAL SOLID WASTE MASTER PLAN
SIOUX FALLS, SOUTH DAKOTA

October 2003

Prepared for:

City of Sioux Falls Public Works Department
Sioux Falls, South Dakota

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ACRONYMS AND ABBREVIATIONS

ARSD	Administrative Rules of South Dakota
C&D	Construction and Demolition Debris
CWA	Clean Water Act of 1977
FSA	Food Security Act
HDPE	High Density Polyethylene
HDR	HDR Engineering, Inc.
LBG	Leggette, Brashears, and Graham, Inc.
MSW	Municipal Solid Waste
MSWL	Municipal Solid Waste Landfill
NOI	Notice of Intent for Reauthorization
NMOC	Non-Methane Organic Compounds
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standards
PCS	Petroleum Contaminated Soils
SDDENR	South Dakota Department of Environment and Natural Resources
SDDENR-WMP	SDDENR Waste Management Program
SDDGFW	South Dakota Department of Game, Fish, and Wildlife
SDGS	South Dakota Geological Survey
SFRSL	Sioux Falls Regional Sanitary Landfill
SHPO	South Dakota State Historic Preservation Officer
SWANA	Solid Waste Association of North America
SWANCC	Solid Waste of Northern Cook County versus USACE (regarding isolated wetlands)
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

EXECUTIVE SUMMARY

INTRODUCTION

The team of Earth Tech, Inc. (Earth Tech), and R.W. Beck (Beck) was contracted by the City of Sioux Falls, South Dakota (City) to develop a Regional Solid Waste Master Plan. The general topics of the Master Plan are focused on landfill design, operations, environmental and land use issues. Waste diversion, recycling, tip fees, and financial aspects are likewise critical elements of the Master Plan.

The Sioux Falls Regional Sanitary Landfill (SFRSL) is owned and operated by the City of Sioux Falls. The Sioux Falls Public Works Department currently manages the operation of the facility. The facility is charged with the proper management of solid waste materials generated by a five county service area of approximately 200,000 citizens. The landfill currently accepts approximately 525 tons per day of municipal solid waste (MSW) and approximately 200 tons per day of construction and demolition (C&D) debris.

SFRSL has a total permitted area of approximately 469 acres. The City also owns approximately 160 acres of adjacent property that is not currently included in the facility permit. The current disposal areas of the landfill consist of a 160-acre active area (Active Area), and a 160-acre expansion area (Expansion Area). Surrounding properties owned by the City are devoted to facility operations, storm water management, and buffer. The 160-acre Active Area is currently being utilized for the disposal of MSW and C&D. The Active Area will soon reach it's permitted capacity for MSW and will therefore will be closed in phases over the next few years. Disposal of C&D in the Active Area will continue until final grades are achieved.

Future disposal of MSW is planned to occur within the 160 acre Expansion Area located to the west of the Active Area. The Expansion Area is estimated to have capacity for an operating life of approximately 34 years. Construction of the first cell in the Expansion Area was completed, with the exception of a leachate removal and management system, in 2002. Landfilling operations in Cell 1 has not yet begun.

The scope of this Master Plan is based on approximately 20 topics that were initially outlined by the City of Sioux Falls in their request for proposal and further defined during subsequent meetings. The topics of interest were categorized into the five major sections outlined in this report. The major subjects are addressed as follows:

- Regulatory and Environmental Assessments
- Operational Assessment and Issues
- Landfill Development and Long Term Management
- Financial Analysis
- Waste Diversion

REGULATORY AND ENVIRONMENTAL ASSESSMENTS

The City is committed to complying with all regulatory requirements for the design, construction, and operation of the SFRSL. In addition, it is recognized that regulatory requirements may not address all site-specific conditions and the City's local obligation to minimize risks to the public and the environment.

Physical Setting

Information regarding the physical setting of the site was reviewed to characterize and understand conditions that play a role in the development and operation of the facility. Based on the available information, the following specific recommendations are provided to improve site data and the understanding of site conditions and how the physical setting may affect the development and operation of the solid waste disposal facility:

- During site work in 2003, it was noted that a number of the monitoring wells were missing locks and some were in need of repair due to surface erosion. Existing monitoring wells should be repaired and maintained as needed for long-term use.

- Review of site documents encountered inconsistencies in the survey information for monitoring wells. All wells should be re-surveyed (location, and elevations of ground and top of inner casing) as necessary to provide reliable, accurate location and elevation information for site characterization and development purposes.

- The geologic conditions below the landfill and the Wisconsinan/pre-Illinoisan contact should be defined to evaluate likely ground water pathways in features unique to interglacial periods.

- Detailed soil boring logs, geotechnical data, and innovative technologies (e.g., surface geophysics, borehole geophysics) should be considered to define physical soil properties and depositional environment (i.e., subglacial, intraglacial, interglacial, resedimented, etc.).

- Geologic cross-sections should be updated to incorporate newer site data, regional information, and interpretations as well as proposed landfill base grades.

- Average linear flow velocities should be calculated in both the horizontal and vertical flow directions in order to define preferred ground water flow paths.

- The conceptual ground water model should be updated to reflect any new information obtained.

Permit Compliance Review

The SFRSL must obtain and comply with a number of federal, state, and local permits. The following permits and permitting issues were reviewed:

- County Solid Waste Permit

- State Solid Waste Permit

- NPDES Permit
- Wetlands and Waters of the State
- Air Permits and Requirements
- Local Zoning

County Solid Waste Permit: This permit was issued by Minnehaha County with an effective date of July 17, 2001. The term of the permit is five years and therefore expires July 17, 2006. The permit authorizes use of the Expansion Area and new scale-house area for the purpose of operating a MSW landfill. The Active Area does not require a County solid waste permit since this portion of the property was considered an existing landfill when Minnehaha County passed their solid waste ordinance in 1991.

There are a number of conditions included in the Minnehaha County Solid Waste Permit. The conditions are typically requests for submittal of documents to the County Office of Planning and Zoning. With the exception of a berming/landscaping plan (Condition #1), it appears that all of the other required documents have been submitted to the County. Certain conditions indicate that documents are to be "on file" with the County, implying that review and approval by County Staff is not required. Other conditions indicate that some documents area to be submitted for "staff approval." Although the County has acknowledged submittal, we are not aware if the County has "approved" any of the documents submitted. We recommend that the City clarify this issue with County staff.

State Solid Waste Permit: This permit was issued to the City by the South Dakota Department of Environment and Natural Resources (SDDENR) November 26, 2002. The permit carries a 5-year term and therefore expires November 26, 2007. Although many of the permit conditions are subject to interpretation, we are aware of no significant compliance issues with the permit. This is based on our review of the available documents as well as conversations and meetings with SDDENR staff during the preparation of this report.

NPDES Permit: The SFRSL is currently regulated under Surface Water Discharge Permit for Storm Water Discharges Associated with Industrial Activities, General Permit #SDR 000000. This permit became effective December 16, 1997, and expired December 15, 2002. On November 4, 2002, the SDDENR issued a letter stating that their renewal permit has not been completed. They stated that any facility that submitted an NOI by December 15, 2003, would be allowed coverage under an administrative extension of the existing permit. The City submitted a Notice of Intent for Reauthorization (NOI) and it was received by the SDDENR on December 13, 2002. We understand that recent conversations between City and SDDENR staff confirmed that the SFRSL is covered under the extended permit and the renewal permit will be issued shortly.

The Storm Water Pollution Prevention Plan for the facility was originally developed as a requirement of the NPDES permit in 1993. Significant changes have occurred to the landfill operations since the development of the 1993 plan. We recommend that this plan be updated to reflect current facility design, operations, as well as current permit requirements. This should be done after updating the closure plan.

Wetlands and Waters of the State: Earth Tech reviewed available documents provided by the City addressing waters of the U.S. (including wetland) issues at the SFRSL. Based on the available documentation, it appears that permitting efforts for recent construction at the site have been addressed.

One major exception is the mitigation project and permit certification for the Cell 1 construction. The nationwide permit authorization for this project expired April 3, 2003. Since the mitigation project will not be completed until later in 2003, the City should contact the USACE to verify the status of the permit and the steps necessary to return to compliance.

For future site development, we recommend that a meeting be held with pertinent agencies to review anticipated permitting feasibility and identify any potential issues. As part of the agency coordination, the likelihood of obtaining permits related to full expansion and required mitigation and design features should be identified.

It is our understanding that a wetland mitigation project was under consideration in the buffer area east of the Active Site. This project was put on hold pending the results of this site review. Although little detail is available about this project at the present time, we have no major concerns about this project from a conceptual standpoint. If the City chooses, this project could proceed. We recommend that this project be closely coordinated with current and potential future groundwater monitoring and remediation activities that may occur in response to ground water contamination identified in this vicinity.

In addition to, or instead of, the mitigation project east of the Active Site, we recommend that the City consider a mitigation project associated with the relocation of the Wall Lake drainage ditch in the Expansion Area. Permitting of the ditch relocation may be made more acceptable to agencies if it was combined with a mitigation project that includes meanders to elongate and stabilize the drainage in a favorable way. This mitigation project is contingent on the City purchasing adjacent property to the south and west of the Expansion Area.

Air Permits and Requirements: Earth Tech reviewed available documents addressing air quality compliance at the SFRSL. Initially, it was discovered that the facility did not have a required Title V permit. It is our understanding that the City recently (May 2003) applied for the Title V permit that includes both the Active Area and the Expansion Area. The rules also require that a Design Capacity Report be prepared for the Expansion Area (within 30 days after beginning construction). The City should verify with the SDDENR if the Design Capacity Report is needed.

Tier 2 landfill testing was performed at SFRSL by Earth Tech in July 2003. Although the July 2003 testing indicates that collection and control of landfill gas is not currently required under the NSPS, calculations indicate that the threshold for this may be reached in 2004. The landfill has three options to continue compliance with the air quality rules. Tier 2 testing can be performed again in 2004. If the testing results in lower non-methane organic compound (NMOC) concentration, the landfill may postpone having to install a gas collection system. However, if the results of the new testing are higher, Tier 3 of the NSPS will be triggered. Tier 3 testing is used to determine a gas generation rate from the landfilled waste. If the results still show greater than 50 MG/yr NMOC emissions, a collection system would be required. The third option is for the landfill to install a gas collection system at this time, and dispense with performing further gas sampling.

Zoning Review: The area surrounding SFRSL is primarily utilized for agricultural purposes. Several groupings of single-family homes are also present. The facility and the adjoining properties are zoned "A-1," Agricultural. Local zoning ordinances control property usage in Minnehaha County and landfills are subject to conditional use permitting in an A-1 district. Conditional use permits have been issued for the Active Area, the Expansion Area, and the parcel of land associated with the new scale-house facility.

Environmental Monitoring Evaluation

The SFRSL solid waste permit was reviewed along with State (ASRD 74:27) and federal (40 CFR, Part 258) regulations as part of the evaluation of environmental monitoring at the SFRSL. Based on our review, the following recommendations are made:

- Establish specific, permanent gas probes along property boundaries in order to monitor for potential methane migration.

- Improve the characterization of site geology and hydrogeology to establish likely ground water flow paths, particularly below the proposed base grades in the Expansion Area.

- Prepare a site-specific monitoring plan for ground water, surface water, leachate, and methane to outline all regulatory requirements pertaining to facility monitoring to be used by the City as well as those contracted to complete the work. To be of greater use to the facility and meet state of practice, the ground water monitoring plan should include additional information as follows:

    - Relevant point of compliance.
    - Monitoring network.
    - Monitoring frequency.
    - Monitoring parameters.
    - Statistical Methods.
    - Monitoring protocol.

Primary Containment Evaluation

Cell 1 in the Expansion Area was constructed in 2002 using an alternative liner system consisting of in-situ soils. Item 2.02 of the State Solid Waste Permit authorizes the use of in-situ clay soils as an alternative liner system with the following conditions:

- A qualified third-party Professional Geologist or equivalent, experienced in the hydrogeology of glacial till, is present on-site during cell excavation to ensure that the in-situ clay soils are of the characteristics stated in the permit application.

- Any discontinuities in the in-situ soil, or any soil material which is more permeable than 1×10^{-7} cm/sec are over-excavated as necessary and an engineered soil liner with a permeability of no more than 1×10^{-7} cm/sec be constructed in that area.

- The outside sidewalls of the cell(s) are lined with a synthetic liner no more permeable than 1×10^{-7} cm/sec.

During the construction of Cell 1, significant sand bodies were encountered at and below the base of the landfill. Although visible portions of this material were subcut 4 feet and replaced with clay, it was not possible to know if adequate liner materials existed beneath the other portions of the cell unless either the in-situ soils were removed and replaced with an engineered liner, or sufficient characterization through drilling and probing was performed. Direct push probes performed in May 2003 identified sand seams and layers within relatively close proximity to the bottom of the cell in areas that were not previously subcut and replaced with clay.

Cell 1 Development Recommendations: Considerable investment has been made by the City in the construction of Cell 1. This includes substantial effort taken during the construction to remove sand that was encountered at the base of the landfill and to replace it with up to 4 feet of compacted clay. The presence of sand seams in areas that were not subcut does present some risk to the integrity of the liner system. However, soil probes conducted in 2003 did not encounter sand seams at the most critical locations of the cell, which are along the leachate line trench and sump.

If the apparent uncertainty and potential risk associated with the construction are acceptable to the City, we recommend that the development and filling of Cell 1 proceed. To minimize potential risks, we recommend that Cell 1 not be used as a leachate collection point for upgradient cells. That is, the leachate collection system currently in Cell 1 will only service Cell 1. Future Cell 2 should be redesigned such that it has its own sump and leachate collection system that also services future upgradient Cell 3.

Future Cell Development Recommendations: The use of in-situ liner for future cell development is not recommended. Based on the current available information, there is no reason to believe that conditions similar to those encountered in the 2002 Cell 1 construction will not be encountered during the construction of one or more future cells. If the design remains unchanged, it is reasonable to assume that the liner for future cells will consist of a combination of in-situ soils and engineered clay liner (resulting from subcuts of unsuitable material). A uniform thickness of low permeable material cannot be assured under these conditions. The only way this can be assured is by requiring an engineered liner that completely covers the base grade and is integral to the sidewall liner.

Section 2.02 of the SDDENR Solid Waste Permit indicates that the operator "may" use in-situ clay soils as an alternative liner system. Presumably, the permit does not restrict more conservative liner systems (although a permit modification may be necessary in some cases). For future construction in the Expansion Area, we recommend that a more conservative liner system be implemented. The designs for a more conservative liner appropriate for this site will vary. Ultimately, the design that is chosen by the City will be based on cost versus the relative benefit in increased environmental protection.

What would be considered the "industry standard" liner system is described in the ARSD 74:27:12:17 (what the SDDENR requires if an alternative liner is not approved). This consists of a composite liner having a 60-mil geomembrane underlain by two feet of compacted clay with permeability of 1×10^{-7} cm/sec or less. It is our opinion that this type of liner is appropriate for this site.

If the City chooses to, other alternative liner systems, less conservative than the composite system described above, may be used. The sidewall liner, as constructed in Cell 1, appears to be well designed and provides reasonable environmental protection. For the base of the landfill, an alternative liner consisting of 4-foot thick compacted clay could be considered. The compacted clay should have permeability of 1×10^{-7} cm/sec or less. This liner would be more conservative than the in-situ liner and offer more assurance that a uniform thickness of low permeable material is present beneath the waste.

Closure/Post Closure Care Evaluation

The City's current Closure/Post-Closure Care Plan (Plan) for the landfill was reviewed. The Plan was prepared by HDR Engineering (HDR) and is dated August 2001. The Plan provides a description of activities, schedules, and features related to closure and post-closure care of the Active Area of the facility. The Expansion Area is not included in this Plan. For closure and post-closure of the Expansion Area, the Plan makes reference to the Permit Application (presumably the most recent application dated August 2001).

The requirements for the Closure/Post-Closure Care plan are contained in ARSD 74:27:15. Based on review of the available documents, it appears that for the Active Area, the Plan meets the requirements of the ARSD. However, for the Expansion Area, reference to other engineering documents, specified and unspecified, does not constitute a Closure/Post-Closure Plan in accordance with the ARSD.

We recommend that the Closure/Post-Closure Plan be updated to address the entire facility, including the Active Site and the Expansion Area. This updated Plan should be a comprehensive engineering document that is based on current site conditions. The drawings for the closure plan should be detailed enough so that they can be used by the operator for closure construction and staking of the final waste grades. For a complete design, the closure plan should include a complete analysis of storm water management features, including detailed location and design of all permanent surface water conveyance structures such as ditches, berms, letdown structures, culverts, and storm sewers.

Based on review of existing Closure/Post-Closure Plan and other documents associated with SFRSL, there are a number of design issues associated with closure that should be considered in future permitting efforts and Plan revisions. These are summarized as follows:

- Future Plan revisions should take into account current topographic conditions, location of existing waste units (as recently surveyed by the City), and placement of infrastructure (i.e., the proposed leachate loadout facility and flare).

- The permitted cover section for the Active Area is the minimum required under ARSD 74:27:12:21. Additional benefit in reduction of infiltration and resulting leachate generation could be realized by increasing the thickness of the cover. Considering the surplus of on-site clay soils, we recommend that the City consider this for future closure construction.

- The permitted final cover of the Expansion Area exceeds the final cover standards outlined in ARSD 74:27:12:21. We support the use of the more conservative permitted cover system in the Expansion Area. However, we recommend that for constructability, the permeability standard for the clay barrier layer of the cap be reduced from 1×10^{-7} cm/sec to 1×10^{-6} cm/sec. We then recommend that the thickness of the rooting layer of the cap be increased to provide a more substantial rooting zone for vegetation.

- The current designs for both the Active Area and the Expansion Areas include slopes at the top of the landfills of approximately 2 percent. In our experience, slopes this shallow are difficult to build and maintain. On a landfill, they are not sufficient to overcome the eventual subsidence of waste, resulting in ponded areas. To help ensure positive drainage off of the landfill cap, a minimum slope of five percent is recommended. To address this issue on the Active Area, we recommend that the City explore with the SDDENR the potential of a vertical expansion so that the top slopes can be increased. For reasons similar to those outlined above, we recommend that the design of the Expansion Area be modified to provide minimum slopes of 5 percent.

OPERATIONAL ASSESSMENT AND ISSUES

Representatives from Earth Tech and R.W. Beck performed an operational assessment of the City's landfill. The representatives met with City staff in January 2003 to observe landfill operations to obtain a better understanding of current operations and to make recommendations to the City to improve the operations. A comprehensive list of topics was discussed with City personnel including scale-house operations, traffic, C&D waste, the Active Area, equipment, composting, soil stockpiles, Expansion Area, operating procedures, and buffer land.

The overall assessment is that the landfill operations are well managed, the scale operations are state of practice, the record keeping on equipment is very good. Recommendations to further improve the landfill operations are as follows:

- Reconfigure the entrance road at the scale-house and upgrade the road from the scale-house to the working face to facilitate traffic flow.

- Develop an expanded public drop-off area near the scale-house to minimize the need for the public to haul their waste to the landfill disposal area.

- Modify the present standard operating procedures to minimize the quantities of non-construction and demolition materials (i.e., organics) being deposited in the unlined C&D disposal area.

- Upgrade the access road by widening the road for two-way semi-truck traffic for the gravel segment to Cell 1. This improvement is being implemented in 2003. Paving the perimeter access road is recommended for 2004.

- Move the compost area from its present location to an area east of the scale-house to allow more space for composting and to allow continued development of the C&D area. Consider using wood grindings from this operation for alternative daily cover. Outsource the processing (grinding) of wood that is too big to be processed by the City's existing tub grinder.

- Move forward with the design and implementation of a leachate collection system to ensure best management practices. In particular, a leachate storage and loadout facility will be constructed for Cell 1 in 2003 and 2004.

- Install landfill gas monitoring probes around the perimeter of the landfill and monitor them as part of the facility's monitoring program.

- Develop a comprehensive surface water management plan for the entire site in conjunction with an updated closure plan.

- Move forward with the purchase of an additional, larger compactor for the MSW area to increase waste density and maximize the landfill site life.

- Proceed with the proposed equipment items identified in the City's Capital Improvements Program and the Implementation Plan (Section 7.0 of the Master Plan) to maintain efficient operations.

- Continue to monitor the cost effectiveness of the present landfill equipment maintenance service agreement by benchmarking the per hour operating costs for the various types of heavy equipment over the next 12 to 24 months.

- Move forward with the design and building of a new maintenance building to ensure optimal space for the maintenance and storage of all the landfill equipment.

- Consider relocating the landfill manager's office to the existing maintenance/office building to provide closer access between the landfill manager and landfill superintendent.

- Continue to communicate with the U.S. Army Corps of Engineers to have the Corps use about 1 million cubic yards of surplus soil from the landfill stockpile for the flood control project in Sioux Falls.

- Continue with the adjacent property acquisition program to ensure an adequate buffer zone for future landfill expansion and landfill support facilities.

- Contract annual aerial surveys of the site and provide adequate survey control and closure plans to site personnel. Update surveys of monitoring wells to required accuracy standards.

LANDFILL DEVELOPMENT AND LONG-TERM MANAGEMENT

The unlined Active Area is approaching capacity for municipal solid waste (MSW) but will continue to fill with C&D material for many years before permitted final grades are reached. Areas of MSW that have reached final grades will be closed in 2004 and 2005.

The Expansion Area site life is estimated to be approximately 34 years with filling in Cell 1 expected to begin by January 2004. The Expansion Area will be developed as 15 cells and will be closed in 10 phases over its operating life.

Unless other arrangements are made, it is estimated that a surplus of 3.3 million cubic yards of soil stockpile may remain at the time of final site closure. Use of excess soil to improve final cover of the landfill or to create screening berms would be of benefit to the City and is recommended.

The City has acquired property adjacent to the landfill to maintain buffers. We recommend acquisition of additional properties that are important for the long-range development plans. In particular, properties should be purchased to the west and south of the Expansion Area to allow the rerouting of the Wall Lake drainage from the proposed fill area.

As required, leachate will be removed from the Expansion Area cells to maintain a liquid level of 12 inches or less on the liner. As a proactive measure, leachate will be extracted from the existing leachate mound in the Active Area. Initially, we recommend that the leachate extraction system consist of ten vertical leachate extraction wells. The wells would eventually be combined with a landfill gas extraction system in the future.

Leachate generation estimates and evaluations of leachate management options are included in the Master Plan. Eight different options are presented for collecting, storing, treating, and disposing of an estimated average annual leachate volume of 1,600,000 gallons from both the Active and

Expansion Areas. Our recommendation is to proceed with the apparent most economical treatment option, which is to haul leachate to the POTW by landfill personnel in landfill-owned trucks. This system should be in place when waste placement is initiated in Cell 1 of the Expansion Area, which is expected in December 2003.

After about 5 years of leachate management, we recommend the City evaluate continued truck hauling of the leachate and compare it to the other promising alternatives such as leachate evaporation ponds or construction of a forcemain to the City sewer system. At that time the City will have a better understanding of operating costs for hauling leachate based on actual volumes, and a decision can be made as to the most cost-effective long term approach.

Results of the NSPS landfill gas Tier 2 testing performed in July 2003 suggest that SFRSL may exceed the 50.0-mg/yr threshold for NMOC in 2004. The NSPS requires gas collection and control for landfill emissions of 50.0 mg/yr or greater. If the threshold is exceeded, the anticipated schedule would be to prepare a design plan for submittal to SDDENR in 2005. Bidding would be expected to occur in 2006, and construction and startup would be completed in 2007. Initially, the MSW portion of the Active Area would have gas extraction and control. A dual leachate and gas extraction system is proposed in the Active Area to provide a cost effective means of extracting leachate. A blower and flare will be used for extraction and destruction of the landfill gas. In the future, options for beneficial use of landfill gas could be investigated and evaluated based on feasibility and cost.

FINANCIAL ANALYSIS

The financial analysis included two subtasks - financial assurance review and tipping fee analysis. The objective of the financial assurance review was to examine the City financial assurance calculation and determine the adequacy of the annual payments to meet regulatory and physical closure and post-closure requirements. The tipping fee analysis involved review of current landfill operational costs and planned facility and equipment upgrades in conjunction with the total landfill revenue. The objective was to identify a potential tip fee level needed to generate adequate revenue to meet future program needs through the next 5 years.

Financial Assurance

Two alternative calculations were performed that used the present values for closure and post-closure costs, total financial obligation, and projected monthly payment. The first scenario represented projected closure and post-closure obligations assuming these begin at the end of the projected life of the landfill in 2038. The second scenario represented projected closure and post-closure obligations assuming they begin when the largest segment of the Expansion Area to be open at any one time must be closed.

Per our review and discussions with the SDDENR staff, the annual set aside of approximately $109,000 per year identified in the first scenario may be adequate to meet the requirements. We recommend presenting this alternative calculation to the SDDENR for consideration. At minimum, we recommend the existing closure and post-closure per unit cost estimates be updated so financial assurance calculations can be more reliably updated during the future operating life of the SFRSL.

Tipping Fee Analysis

Based upon our analysis, we have calculated the MSW and C&D tip fees needed for the total nominal revenues to approximately equal the total nominal expenses for the 2003 – 2008 time frame. Assuming the present tip fees for the other materials remain constant (i.e., yard waste, asbestos, tires, etc.) and that the level of increase in the C&D rate mirrors the increase in the MSW rate, the tip fees would need to be $25.00 and $26.00, respectively. This level of tipping fee is within the reported range of tip fees for other landfills in the region. We recommend the City consider implementing an increase in the tip fees to generate adequate revenue to cover the projected operating expenses.

WASTE DIVERSION

In the development of the Regional Solid Waste Master Plan for the City, Beck analyzed the waste diversion activities within the Sioux Empire Region (Region). This Region is made up of five counties that use the SFRSL. As part of this analysis, Beck carried out the following tasks:

- Assessment of Regional Opportunities to Share Diversion Facilities and Equipment.
- Materials Recovery Processing and Reuse Evaluation.
- Evaluation of the Waste Reduction, Reuse, and Recycling Public Education and Information Program.

Through data provided by the City, as well as meetings with City staff, the Solid Waste Planning Board, the local haulers, and local recyclable materials processors, Beck characterized the current waste diversion programs. Recommendations were then made for improving waste diversion in Sioux Falls and the Region via policy and operational changes. Our recommendations for each of the tasks are as follows:

Regional Opportunities to Share Diversion Facilities and Equipment

- Add language to the Solid Waste Disposal Agreement that is signed each year by the municipalities that use the SFRSL, to ensure that landfill users are aware that a tub grinder and trommel screen are available for their use for a fee, as well as the use of the City's new Household Hazardous Materials (HHM) collection facility that is expected to be operational in 2004.

Materials Recovery Processing and Reuse Evaluation

- Consider standardizing the recycling program to ensure consistency between haulers regarding bin type, material type collected, and collection schedule.
- Enforce the landfill ban by conducting more frequent and consistent load inspections, and consider charging a fee above and beyond the current tip fee when a hauler violates the ban.
- To increase landfill diversion, consider mandating that commercially generated old corrugated cardboard be recycled.

- Consider an ordinance that requires the separation of C&D at construction sites and promote the reuse and recycling of C&D materials to increase waste diversion.

- To better monitor the effectiveness of the recycling program, the City should require that the haulers submit a monthly or quarterly recycling tonnage report.

- Require that the haulers itemize their collection services on their invoices to inform residents they are paying for recycling service.

- Strengthen efforts to increase recycling at multi-unit dwellings through a targeted education program, pilot collection program, and/or revisions to the applicable City ordinance.

- Consider partnering with the private sector to organize an annual or semi-annual electronics collection event.

- Consider partnering with the private sector to organize an annual or semi-annual electronics collection event.

- Consider a waste composition study to determine the quantities of additional recyclable materials (i.e., glass and mixed paper) in the waste stream.

- Consider adding glass to the recycling program via the current residential collection program or through a drop-off program because viable markets exist in the Region.

Recommendations for the City's yard waste program include:

- Require haulers to list the fee charged for yard waste collection on license applications.

- Require, via ordinance, all haulers to collect yard waste, and list collection fee on their bills as a separate line item.

- Include yard waste information on all public education pieces.

- Consider selling finished compost and obtain a license from the State to distribute finished compost.

Evaluation of the Waste Reduction, Reuse, and Recycling Public Education and Information Program

- Update the Comprehensive Solid Waste Source Reduction and Recycling Plan (Plan). The State requires local governments to update this Plan every 5 years. The Sioux Empire Regional Plan was last updated in December of 1998.

- Hire a staff person or redefine an existing City position to dedicate to recycling program management. If possible, research grant opportunities to pay for part or all of this person's salary.

- Enforce proper recycling setouts, to reduce contamination and amount of unacceptable materials. Work with the haulers to educate the residents by leaving reminder tags.

- When feasible, the City should identify disposal options for other materials such as tires, appliances, scrap metal, electronics, etc. in their printed materials. This information should also be added to the City's website.

- Update and re-publish the Business Recycling Guide that was developed in the mid-1990s as part of the Region's Comprehensive Solid Waste Source Reduction and Recycling Plan. Form a committee to oversee the design and content of the guide and develop a distribution plan.

- The City should increase the public education budget and expand its public education efforts to increase the visibility of the recycling and waste diversion programs. It is recommended that at least $1.00 per household per year be budgeted for public education.

IMPLEMENTATION PLAN

The Master Plan includes an implementation schedule that is a summary of the recommendations, capital improvements, and projects recommended over the next 10 years. Also included is a listing of new, recommended or replacement equipment over a five-year schedule. Each entry listed was rated in accordance with its priority for implementation. The estimated cost (if any) and year of implementation provides the basis for the tipping fee analysis included with the Master Plan.

In total, 81 separate items are listed on the Implementation Plan. These items are grouped into eight major categories. As would be expected, the majority of the recommendations are proposed for implementation, and associated costs incurred, within the next five years. The following table provides a summary of the estimated expenditures for the first five years of the plan by major category.

TABLE ES-1

IMPLEMENTATION COST SUMMARY

Category	Estimated Cost and Year of Implementation				
	2004	**2005**	**2006**	**2007**	**2008**
Environmental and Compliance	$81,000	$100,000	$50,000	$0	$0
Operational Improvements	$1,621,000	$10,000	$1,660,000	$10,000	$410,000
Landfill Development	$1,999,900	$2,974,850	$1,198,600	3,185,300	$140,000
Equipment	$970,444	$817,000	$362,000	$685,000	$627,000
HHW Facility	$1,500,000	$0	$0	$0	$0
Recycling	$525,000	$0	$0	$0	$0
Reuse	$10,000	$0	$0	$0	$0
Public Information/Education	$95,000	$40,000	$40,000	$40,000	$40,000
Total	**$6,802,344**	**$3,941,850**	**$3,310,600**	**$3,920,300**	**$1,217,700**

1.0 INTRODUCTION

The team of Earth Tech, Inc. (Earth Tech), and R.W. Beck (Beck) was contracted by the City of Sioux Falls (City) to develop a regional solid waste master plan. The general topics of the master plan are focused on landfill design, operations, environmental and land use issues. Waste diversion, recycling, tip fees, and financial aspects are likewise critical elements of the master plan.

1.1 BACKGROUND

The Sioux Falls Regional Sanitary Landfill (SFRSL) is owned and operated by the City of Sioux Falls, South Dakota. It is located approximately 7½ miles west of the City of Sioux Falls. The Sioux Falls Public Works Department currently manages the operation of the facility. SFRSL is charged with the proper management of solid waste materials generated by a five county service area of approximately 200,000 citizens. The landfill started operations in 1979 under different ownership, and was known at that time as the "Runge Landfill." The landfill currently accepts approximately 525 tons per day of municipal solid waste (MSW) and approximately 200 tons per day of construction and demolition (C&D) debris.

The most recent available aerial photograph of the facility, taken in April 2001, is included as Figure 1-1, which follows this Section. Included with the photo is an updated survey of site activities, features, and property boundaries. These features represent the current site features, as surveyed by the City in July 2003.

SFRSL has a total permitted area of approximately 469 acres. The City also owns approximately 160 acres of adjacent property that is not currently included in the facility permit. The disposal areas of the landfill consist of a 160-acre active area (Active Area), and a 160-acre expansion area (Expansion Area). Surrounding properties owned by the City are devoted to facility operations, storm water management, and buffer.

The 160-acre Active Area is currently being utilized for the disposal of MSW and C&D. Of this area, approximately 81 acres are designated for disposal of MSW with the remainder being devoted to disposal of C&D. The Active Area will soon reach it's permitted capacity for MSW and will therefore will be closed in phases over the next few years. Disposal of C&D in the Active Area will continue until final grades are achieved.

Future disposal of MSW is planned to occur within the 160 acre Expansion Area located to the west of the Active Area. The Expansion Area is estimated to have capacity for an operating life of approximately 34 years. Construction of the first cell in the Expansion Area was completed, with the exception of a leachate removal and management system, in 2002. Landfilling operations in Cell 1 has not yet begun.

1.2 SCOPE

The scope of this master plan is based on approximately 20 topics that were initially outlined by the City of Sioux Falls in their request for proposal and further defined during subsequent meetings. The topics of interest were categorized into the five major sections outlined in this report. The major subjects are addressed as follows.

Section 2.0 includes the regulatory and environmental assessment of the landfill. This section includes a detailed review of existing permits and evaluation of operations with respect to compliance with permit

conditions and other applicable regulations. Existing environmental monitoring systems are evaluated and recommendations for modifications are made. Based on review of the available hydrogeologic reports and other documentation reports, recommendations are made concerning the liner system currently permitted for use in the Expansion Area.

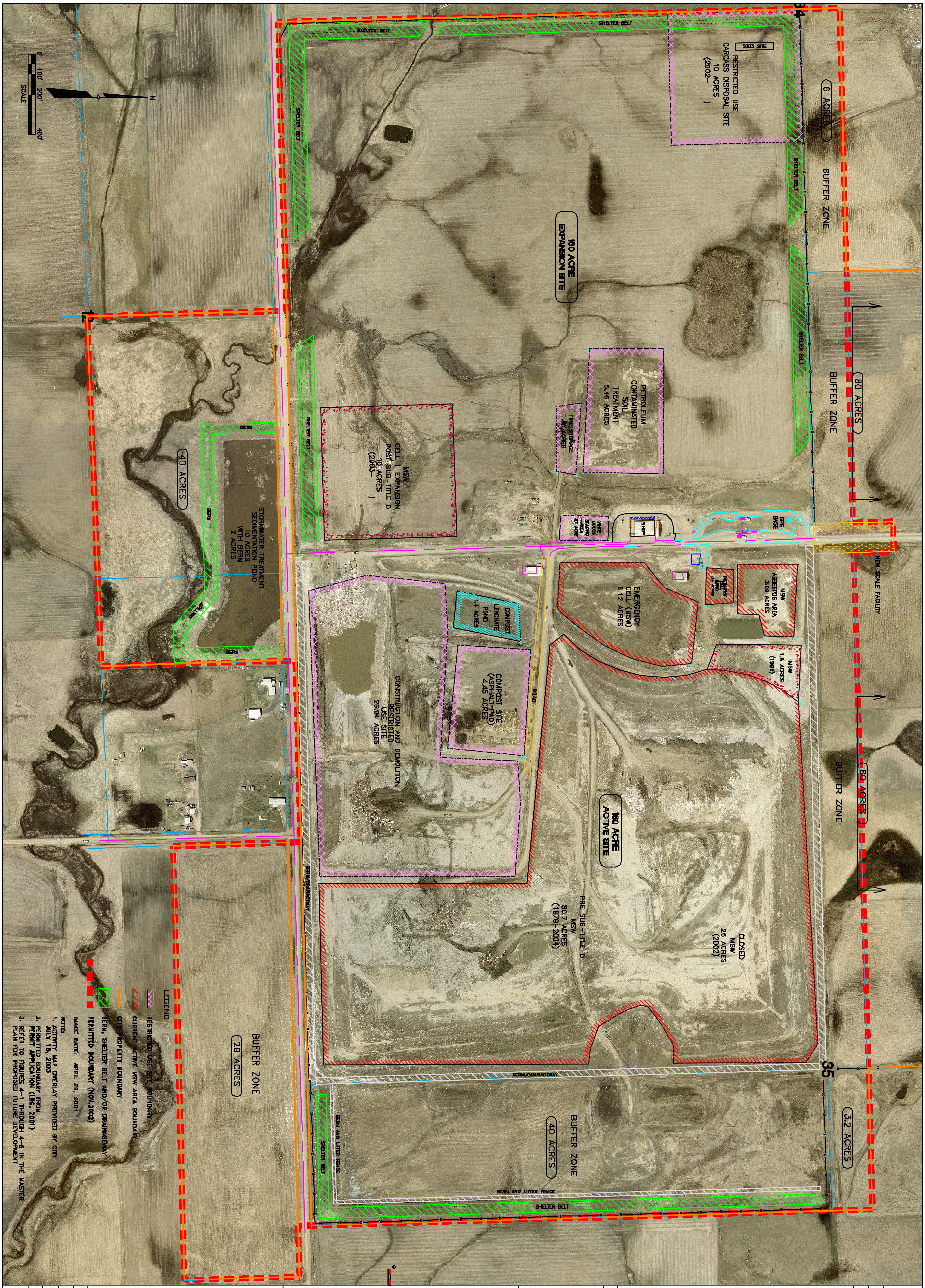
Section 3.0 describes an operational assessment of the landfill. Based on on-site observations, staff interviews, and data review, a variety of landfill operational issues were evaluated, with discussion of the issues and recommendations presented in this section.

Section 4.0 addresses landfill development and long-term management. This includes a series of drawings and descriptive narrative that address the present day through 20 years of development, at 5-year time intervals. Phased development of both the existing Active Area and the Expansion Area are shown, and phases are depicted in a sequential set of drawings showing construction, operation, and closure phases as appropriate.

Section 5.0 is a financial analysis of the landfill operation. This includes a user tip fee analysis that results in recommendations for a proposed landfill tipping fee schedule for the near term. This section also includes analysis of closure, post closure, and contingency action costs to evaluate financial assurance requirements for the facility.

Section 6.0 is an evaluation of issues pertaining to waste diversion and minimization. Included in this section is identification of opportunities for the City to share facilities and equipment with neighboring counties and municipalities. In addition, the City's recycling activities are characterized and recommendations are made to enhance recycling and reuse efforts. This section includes an evaluation of the City's public education program and informational efforts related to promoting waste reduction, reuse, and recycling. Based on this evaluation, an implementation plan is developed to provide a more effective program.

Section 7.0 includes a listing of capital improvements, projects, and recommendations made in this master plan that may be implemented over the next 10 years. Also included is a listing of new, recommended or replacement equipment over a five-year schedule. Included in this listing is the recommended priority and proposed year for implementation, and estimated cost.



DRAWING NO 1-1	SHEET NO	FILENAME COMPOSITE.DWG	PROJECT NO 83063
DATE OCTOBER 2003			

SOLID WASTE MASTER PLAN
SIOUX FALLS SANITARY LANDFILL
SIOUX FALLS, SOUTH DAKOTA

SITE AERIAL

EARTH TECH

EARTH TECH, MN
763-551-1001

DRN	CDD	08-27-03
DES		
CHK		
APP		

NO	REVISIONS	DRN	CHK	DATE

2.0 REGULATORY AND ENVIRONMENTAL ASSESSMENTS

The City of Sioux Falls is committed to complying with all regulatory requirements for the design, construction, and operation of the SFRSL. In addition, it is recognized that regulatory requirements may not address all site-specific conditions and the City's local obligation to minimize risks to the public and the environment. The following section summarizes available information obtained on the physical setting of the landfill site as it pertains to characterizing and understanding conditions that play a role in the development and operation of a solid waste disposal facility. The subsequent sections assess regulatory compliance of the SFRSL in regards to permitting, design, monitoring, and closure.

2.1 PHYSICAL SETTING

The SFRSL is located along the southern boundary of Minnehaha County, South Dakota. The physical setting of the site is typical of that found in eastern South Dakota with the surficial conditions characteristic of a mid-continental glacial region. The site's geological and hydrogeological conditions have been evaluated at the SFRSL through a series of investigations conducted by local consulting firms and the South Dakota Geological Survey. Documents reviewed as part of this assessment include: Davis et al. (1997); Iles (1989); Huntingdon (September 28, 1995); LBG (January 23, 1996); LBG (January 24, 1996); LBG (August 13, 1996); LBG (August 14, 2001); LBG (March 2002); LBG (March 2003), LBG (January 31, 2003); and Maxim (October 18, 1995). In addition, miscellaneous soil boring logs, well construction diagrams, and site maps prepared between 1989 and 2002 by Twin City Testing (TCT), Huntingdon, Maxim, and LBG were also reviewed. Supplemental hydrogeological information was collected during the installation of the Cell 1 ground water monitoring system during May and June of 2003 (Earth Tech, July 2003).

Information compiled and tabulated on the physical setting is provided following this section. Existing soil boring logs and geotechnical data available for review are summarized in Tables A-1 and A-2, respectively, included in Appendix A. Existing monitoring well and piezometer data is presented in Table A-3. The following sections summarize the climate, physiography and topography, surface water hydrology, geology, hydrogeologic conditions, and local water usage as documented in previous reports, publications, and as updated in 2003.

2.1.1 Climate

Sioux Falls is located in the Big Sioux River Valley in southeast South Dakota. The National Oceanic and Atmospheric Administration (NOAA) website describes the climate as a continental type. There are frequent weather changes from day to day or week to week as the locality is visited by differing air masses. Cold air masses arrive from the interior of Canada, cool, dry air from the northern Pacific, warm, moist air from the Gulf of Mexico, or hot, dry air from the southwest.

Temperatures fluctuate frequently as cold air masses move in very rapidly. The winter months of December through February have experienced cold spells with average temperatures under 8 degrees and more than 60 consecutive days below 32 degrees. Temperatures of 100 degrees and above occur about one in every three years, and will most likely happen in July. Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is October 1 and the average last occurrence in the spring is May 10.

The average annual precipitation at Sioux Falls from 1951 to 1980 was 24.12 inches. Rainfall is heavier during the spring and summer with nearly 64 percent of the normal yearly precipitation falling during the

growing season of April through August. One or two very heavy snows of 8 to 12 inches usually fall each winter. There is occasional flooding in the lower areas of Sioux Falls along the Big Sioux River and Skunk Creek. Runoff from the melting snow in the spring often causes substantial rises in the rivers.

Southerly winds prevail from late spring to early fall with northwest winds the remainder of the year. Strong winds of 70 mph with gusts to 90 mph have occurred.

2.1.2 Physiography and Topography

Minnehaha County lies on the southern flank of the Coteau des Prairies division of the Central Lowland Physiographic Province (Fenneman, 1931). The Coteau des Prairies consists of a highland or plateau of thick glacial deposits underlain by a small ridge of resistant shale and quartzite. Elevations in Minnehaha County range from 1,820 feet in the northwest to less than 1,270 feet in the southeast. The topography near the landfill is characterized by poorly drained uplands.

Based on the United States Geological Survey (USGS) topographic map (7.5 minute, Lennox quadrangle), the original slope of the landfill property varies from an elevation of 1,570 feet on the north-central edge of the property to less than 1,530 feet along the southern edge of the site. The site topographic map was updated in 2003 and incorporated past development. The undisturbed areas inside the landfill site are grass-covered and several rows of trees have been established to form shelterbelts at various locations. Excavations for landfill development extend to elevations as low as 1,480 feet.

2.1.3 Surface Water Hydrology

The Big Sioux River, which flows from north to south through central Minnehaha County, is the principal stream in eastern South Dakota. The Big Sioux River discharges to the Missouri River nearly 100 miles to the south. The nearest perennial stream to the landfill site is Skunk Creek, located more than 5 miles east of the site. The streams present in the vicinity of the landfill are intermittent and poorly defined with most stream flow derived from snowmelt and spring rains (Tomhave, 1992). An unnamed intermittent stream that carries drainage from Wall Lake (located about 2 miles northwest of the site) crosses the southwestern corner of the site and continues drainage toward the east along the southern boundary of the landfill.

The surface water features within a 1-mile radius of the landfill are primarily in the form of stock watering dams and natural wetland depressions. There are no natural lakes, ponds, or perennial streams within a 1-mile radius of the landfill. A sedimentation pond and several drainage ditches were constructed on-site as a part of surface water control features for the landfill.

2.1.4 Geology

2.1.4.1 Regional Geology

The Coteau des Prairies of the Central Lowland Physiographic Province developed because of the presence of resistant bedrock and subsequent glacial erosion and deposition. The resistant bedrock primarily consists of Sioux Quartzite that formed during Middle Proterozoic time and the Cretaceous-age Split Rock Creek Formation consisting of interbedded sands, siltstone, claystone, sandstone, bentonite, and lignite. The glacial deposits at the site overlie 30 to 50 feet of interbedded sedimentary rocks that make up the Split Rock Creek Formation (Tomhave, 1994). Underlying the Split Rock Creek Formation, the Sioux Quartzite Aquifer has an unknown thickness exceeding 1,000 feet and is a locally,

well-fractured and jointed crystalline rock. The eroded bedrock surface is overlain by zero to over 300 feet of Quaternary sediments associated with various types of glacial deposits (Tomhave, 1994). Glacial deposits primarily represent pre-Illinoisan, Illinoisan, and Late Wisconsinan glacial advances and recessions during the Pleistocene epoch.

Near the SFRSL, the Pleistocene-age deposits range in thickness from 151 to 200 feet (Tomhave, 1994). On-site water well SFSL-1 was constructed in the glacial deposits of the Wall Lake Aquifer confirming the depth to bedrock exceeds 183 feet (LBG, 2001). Tomhave (1994) illustrates the local stratigraphy in south central Minnehaha County to include both Wisconsinan and pre-Illinoisan-aged glacial deposits overlying bedrock. Based on the geological cross-section from Tomhave (1994), a copy of which is provided in Appendix A of this report, the approximate elevations of the top of each stratigraphic unit, from oldest to youngest, are as follows:

- Wisconsinan till → ground surface
- Outwash → 1,460 feet
- Pre-Illinoisan till → 1,450 feet
- Pre-Illinoisan outwash → 1,405 feet
- Cretaceous Split Rock Creek Formation → 1,395 feet
- Pre-Cambrian Sioux Quartzite → 1,350 feet

Illinoisan till is described by Tomhave (1994) as being present in the eastern portion of Minnehaha County, but not in the vicinity of the SFRLF. Three distinct pre-Illinoisan tills units have been identified within the county, but they have not been differentiated near the landfill site. Based on the approximate top elevation at 1,450 feet as shown in Tomhave's cross-section (Appendix A), the pre-Illinoisan till may occur 80 to 120 feet below ground surface at the landfill site. Conversely, Davis et al. (1997) state the Wisconsinan till as having a thickness of 100 to 125 feet at the landfill site.

The composition of both the Wisconsinan and Illinoisan-aged glacial till is very similar consisting of a very compact, clay-rich matrix, reflecting the predominance of shale in the local Cretaceous bedrock. Tomhave (1994) stresses that distinguishing till units is very difficult and are most often separated using palesols, oxidations zones, outwash and loess deposits, electric log signatures, and stratigraphic position. He further states that locally the pre-Illinoisan till is often mantled by loess (i.e., sediment primarily composed of silt-sized particles).

The physical properties of the pre-Illinoisan till have not been described in detail in the publications and consultants reports reviewed. On the Active Area, Davis et al. (1997) indicates the uppermost till as being Late-Wisconsinan in age and occurring in three distinct zones:

- A weathered, highly-fractured zone to a depth of about 22 feet consisting of oxidized, yellowish brown to reddish-brown, clay.

- An intermediate, transition zone from a depth of 22 to 40 feet that is characterized by decreasing fracture density with depth.

- An unfractured, unweathered zone below a depth of 40 feet consisting of gray, plastic, unoxidized till.

Although Steece (1958) describes the Wisconsinan depositional environment near the landfill as that of an end moraine, Tomhave (1994) specifically indicates the till as being characteristic of a stagnation moraine with the typical knob and kettle topography as well as numerous lakes, sloughs, and closed depressions. The glacial till consists of a heterogeneous mixture of boulders, sand, silt, and clay. Davis et al. (1997), also describe some shallow surficial deposits at the SFRSL as containing ice-contact, alluvial, and lacustrine deposits.

2.1.4.2 Site Geology

Over 150 soil borings have been completed at the landfill site to characterize site conditions on both the Active and Expansion areas. Twenty-two of those soil borings were conducted by Davis et al. (1997), over an approximate 1-acre study area on the active site. A comprehensive list of available soil boring logs is provided as Table A-1 in Appendix A of this report. Available information on the soil boring locations is also provided on figures in Appendix A. Although the number of soil borings appears extensive, the soil boring logs do not apply a consistent logging procedure or classification that assists accurate correlation from log to log. Soil descriptions from about 50 of the soil borings logs (36 logs from the expansion site) were completed in accordance with the Unified Soil Classification System (USCS) as described in ASTM D2488 [Recommended Practice for Description of Soils (Visual-Manual Method)]. The remaining boring logs did not apply any recognized standard. In addition, prior to permitting the expansion in 1996, only limited geotechnical data from interval sampling was available to confirm visual descriptions made in the field. A summary of available geotechnical data is included as Table A-2 in Appendix A of this report. With the available information, it is difficult to compare visual properties, as well as physical properties, from log to log.

Both the Active and Expansion Areas include waste placed below the pre-development ground surface. As indicated in logs for the installation of the fluid monitoring points, the bottom of waste elevation in the unlined Active Area varies from approximately 1,490 to 1,550 feet. The proposed design of the Expansion Area includes base grade elevations ranging from approximately 1,480 to 1,500 feet. Because the soil above the bottom of the landfill will be largely excavated for the Expansion Area, characterization of the soils at or near the bottom of the landfill are critical for evaluating potential long-term impacts. In particular, soils making up the most likely pathway for ground water flow should be identified in proximity to the landfill (lateral and underlying) including those soils with higher permeability caused by depositional environment (sand or gravel) or secondary features such as weathering and fracturing. Ground water pathways in glacial environments may be more prevalent in features unique to interglacial periods (e.g., the time between the Wisconsinan and pre-Illinoisan), which are often distinguished by the presence of paleosols, oxidations zones, outwash deposits, and loess described by Tomhave (1994).

Based on the 150 soil boring logs listed in Appendix A, 37 soil borings have been completed on the Expansion Area. However, only six soil borings on the 160-acre expansion site extended below an elevation of 1,480 feet, the base elevation of Cell 1 and only two sets of geotechnical tests were

performed from actual soil samples collected near the base grade for the expansion (Appendix A). Two soil borings (B-46 and B-47) were drilled to just below the 1,450-foot elevation on-site did not draw conclusions regarding depositional or secondary features that might contribute to ground water pathways. Soil boring log SB-46 describes six different lenses between 2- to 6-inches thick consisting of silt, silty sand, and sand, occurring at a depth between 74 to 84 feet (1,444 to 1,454 feet in elevation). Soil boring log SB-47 describes a similar sequence of sand and silty sand at 81 feet (1,451 feet in elevation). Based on the available publications and reports, the contact between the Wisconsinan and pre-Illinoisan tills (presumably below the base of the landfill) has not been defined on-site and the physical properties of the pre-Illinoisan till have not been described in publications.

All the till units described in previous on-site investigations primarily consisted of a clay matrix with silt, sand, and pebbles and occasional sand seams. Sand layers up to several feet thick have been encountered throughout the site, but most commonly in the upper or oxidized zone. However, four distinct sand bodies were encountered within the unoxidized till during the excavation of the 10-acres for Cell 1 (LBG, 2003a). Locations of the sand bodies are illustrated on a figure included in Appendix A. The bodies were sufficient in thickness to prompt the mobilization of a drill rig to investigate the thickness of the sand bodies. Although no soil boring logs or elevation data were provided, LBG indicates that one of the sand bodies had an approximate thickness of 40 feet; all sand bodies were over-excavated at the bottom the landfill by 4-feet to allow recompaction of clay. LBG described nearly vertical orientation of bedding planes at several locations within the sand bodies and concluded that they had been repositioned following their original fluvial deposition and were therefore discontinuous. Another explanation for the orientation of bedding planes includes collapse of fluvial deposits in association with glacial recession as adjacent ice blocks melted (Shaw, 1985).

Federal and state regulations require that the geology at all landfill sites be adequately defined to identify the most likely ground water flow pathways in the event there is a release of contaminants. At the SFRSL, geologic conditions below the proposed base of the Expansion Area are not sufficiently defined to identify preferential ground water flow paths. It is unknown whether the intervening outwash or pre-Illinoisan till illustrated by Tomhave (1994) was encountered in previous borings or whether the lenses and sand bodies encountered represent multiple advances within the Wisconsinan. It is also not certain as to the depositional environment and stratigraphic relationship of the sand bodies in Cell 1.

2.1.4.3 Cell 1 Supplemental Investigation

A supplemental investigation was conducted on the Expansion Site in May 2003 for the specific purpose of installing several piezometers for monitoring water levels and the placement of a ground water monitoring system for Cell 1. Specific results of the investigation will be presented as a separate Technical Memorandum (Earth Tech, in preparation). A summary of the supplemental investigation is included in this Section and in Section 2.1.5.4.

Soil samples were collected using a 5-foot long continuous sampler device. All samples were logged, classified, and geologically interpreted in the field by a geologist using the procedures described in ASTM D2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure). A soil laboratory testing program following ASTM standards was applied to characterize the site soils and assess the geotechnical and hydrogeologic properties of the soil. Soil boring data is summarized in Table A-1 in Appendix A. Geotechnical data is included in Table A-2 in Appendix A.

Preliminary observations confirmed the presence of the three distinct weathering zones described by Davis et al. (1997). Very few sand lenses or seams were encountered. In general, the oxidized till is

described as a yellowish-brown to very dark brown, lean clay with sand (CL). The unoxidized till is generally described as a gray to very dark gray, lean clay with sand (CL).

2.1.5 Hydrogeology

2.1.5.1 Regional Hydrogeology

The uppermost geologic units of hydrologic interest include over 180 feet of Wisconsinan and pre-Illinoisan glacial deposits as well as the Sioux Quartzite Aquifer. The stratigraphic units are saturated to within a few feet of the ground surface.

The Sioux Quartzite underlies all of Minnehaha County. It exists under artesian pressure and provides a maximum yield of about 150 gallons per minute depending on the extent of local fracturing (Lindgren and Niehus, 1992). Seasonal fluctuations in water levels indicate that recharge to the bedrock aquifer is primarily from infiltration of snowmelt and rainfall in areas where the Sioux Quartzite is at or near land surface. Ground water flow is generally toward the south and southwest. Discharge is generally to wells and intervening glacial aquifers present within bedrock valleys. The Cretaceous Split Rock Creek Formation, which directly overlies the Sioux Quartzite, consists predominantly of siltstone, shale, and sandy clay in this portion of Minnehaha County and is not designated an aquifer (Lindgren and Niehus, 1992).

The pre-Illinoisan outwash lying above bedrock occurs locally and is designated the Wall Lake Aquifer (Lindgren and Niehus, 1992). It is described as a fine to coarse-grained, well-sorted quartzose sand and fine pebble gravel; locally the sand and gravel is interbedded with 2- to 3-foot clay layers. The Wall Lake Aquifer is confined and generally under artesian conditions. Where in contact with the Sioux Quartzite, the aquifer is recharged by infiltration of precipitation through fractures of the underlying metamorphic rock. Ground water flow in the Wall Lake Aquifer is generally toward the south-southwest in the vicinity of the landfill. Hydraulic conditions of the Wall Lake Aquifer vary but can yield water to wells up to 500 gallons per minute.

Hydraulic conductivities of the overlying pre-Illinoisan till have not been defined. The outwash that may occur locally along the contact between the Wisconsinan and pre-Illinoisan tills has also not been defined, but may contain secondary permeabilities and normal anisotropies possibly providing preferential flow paths.

Ground water flow directions within the Wisconsinan till can vary widely since ground water contours at the water table are anticipated to mimic the undulating ground surface. Ground water flow directions and information on hydraulic conductivity obtain on the landfill site are presented in the following sections.

2.1.5.2 Local Water Usage

Water usage within a 1-mile radius of the facility is primarily for domestic and livestock use. The primary water source in the area is a rural water system operated by Minnehaha Community Water Corporation (LBG, 2001). The only documented water supply well within a 1-mile radius of the site was an on-site potable well (SFSL-1) screened within the Wall Lake Aquifer. However, the well was not used because of reportedly high hydrogen sulfide content and was proposed for abandonment in 2001. Information has not been obtained as to whether the well has been sealed in accordance with South Dakota requirements.

2.1.5.3 Site Hydrogeology

As part of previous investigations, over 70 wells or piezometers are currently present at the landfill site to evaluate and monitor ground water conditions. The 20 temporary wells installed by Davis et al. (1997) in their 1-acre study area on the active site were subsequently abandoned as the excavation area of the landfill expanded. A summary of existing well data is provided as Table A-3 in Appendix A. Well locations are also provided on figures in Appendix A. All wells are screened in Wisconsinan-age deposits. Some wells are screened across or near the water table, while others represent potentiometric conditions below the water table. Of the 70 wells/piezometers, 25 currently exist on the Expansion Area with about half of those monitoring water table conditions.

Ground Water Age Dating

Davis et al. (1997) conducted age dating on two ground water samples from each of four zones in the 1-acre study area on the active site. Ground water samples were not collected from any confirmed sand bodies. The results of age dating of ground water using both tritium and ^{14}C methods indicate a distribution of age as follows:

- Oxidized zone (15 to 20-foot depth) → Recent
- Transition zone (28-foot depth) → 9,300 to 12,100 years before present
- Unweathered zone (50 to 52-foot depth) → 17,900 to 19,100 years before present
- Unweathered zone (72 to 74-foot depth) → 10,900 to 21,800 years before present

It should be noted that the conditions present at the time of the investigation might no longer be characteristic of the site with the excavation of soils and exposure of the unweathered zone to the atmosphere, precipitation, and leachate at the bottom of the landfill.

Hydraulic Gradient

Previous investigations have contoured water level data reflective of both water table conditions and an undefined zone in the unoxidized till (Davis et al., 1997; Iles, 1989; LBG, 1996a; 1996b; 2002a; 2003b). In general, equipotential lines indicate a decrease in hydraulic head toward the south-southwest on both the Active Area and Expansion Area. Iles (1989) calculated a horizontal hydraulic gradient of the water table for the Active Area to range from 0.0124 to 0.0160 to the south-southwest. However, ground water interpretations presented by LBG (1996a; 1996b; 2002a; 2003b) do not present calculated horizontal hydraulic gradients (under the premise that any ground water movement is considered insignificant). LBG (January 23, 1996) states their ground water equipotential maps "… should not necessarily be construed as indicating lateral ground water flow is occurring…"

Vertical gradients were not evaluated by Iles (1989) or LBG (1996a; 1996b; 2002a; 2003b). Davis et al. (1997) calculated vertical gradients within the previously defined zones as follows:

- Weathered till → 0.041 upward to 0.042 downward
- Weathered-unweathered till boundary → 0.68 to 0.76 downward
- Unweathered till → 0.89 downward

Despite the presence of fractures and a subdued water level response to precipitation events, Davis et al. (1997) concludes that vertical movement in the transition zone between the weathered and unweathered tills is insignificant because of the ground water's age. Similarly, Davis et al. (1997) specifically maintains that ground water movement through the unweathered till is insignificant or nonexistent, but contends that additional research is needed to define horizontal ground water movement in the weathered till.

Hydraulic Conductivity

Hydraulic conductivity of the Wisconsinan-age deposits has been evaluated through in-situ rate-of-recovery (slug) and laboratory tests (LBG, 1996a; 1996b; Davis et al, 1997).

Based on 35 in-situ rate-of-recovery (slug) tests conducted on wells within the Wisconsinan-age deposits before 2003 [including 19 tests conducted on temporary wells by Davis et al. (1997)], hydraulic conductivities vary widely ranging from 6×10^{-3} cm/sec in imbedded sand units to 2×10^{-8} cm/sec in massive diamicton. Four temporary wells screened below an elevation of 1,500 feet on the active site were tested by Davis et al. (1997) with hydraulic conductivity estimates on the order of 1×10^{-8} cm/sec. One of the wells tested on the expansion site (MW-23un) was screened below an elevation of 1,500 feet with a hydraulic conductivity of 2.4×10^{-7} cm/sec. Such results are suspect given the low conductivity formations present at the site. For example, well development in low conductivity formations is difficult to complete, which can significantly impact slug test results (Butler, 1998). In addition, there is a greater potential for the slug test to be significantly affected by a well skin formed by the smearing of clay-sized particles on the walls of the borehole during drilling. Butler (1998) stresses that slug tests may only be a viable method to estimate hydraulic conductivity if the " . . . underlying mathematical models are appropriate representations of the governing physics," conditions difficult to overcome in low conductivity formations such as those at the SFRSL. Butler (1998) states that the hydraulic conductivity estimate obtained from a slug test should be viewed as a lower boundary. In other words, the hydraulic conductivity below the proposed base of the landfill in the Expansion Area should be viewed as somewhat greater than 2.4×10^{-7} cm/sec.

From previous studies, over 60 thin-walled (Shelby) tube samples or cores were collected and returned to the laboratory for analysis. Davis et al. (1997) recognized that it is difficult to collect, transport, and laboratory-test soil for hydraulic conductivity because of sample disturbance and inherent problems in the laboratory test methods. Results ranged from 3.2×10^{-4} to 2.5×10^{-9} cm/sec with the majority of results on the order of 1×10^{-8} to 1×10^{-9} cm/sec. Davis et al. (1997) concluded that the laboratory test results for hydraulic conductivity are one to two orders of magnitude lower than that determined by in-situ field methods, but did not offer an explanation. Clearly, comparison of the slug test results (horizontal hydraulic conductivity) and the laboratory tests (vertical hydraulic conductivity) indicates the glacial sediments were deposited horizontally creating an anisotropic condition for ground water flow. However,

with the number of spatial distribution of tests, it is not clear if the presence of sand bodies creates heterogeneous conditions providing preferential ground water flow.

Average Linear Flow Velocity

Previous investigations did not calculate average linear flow velocity at the site to evaluate the presence of preferential ground water flow paths.

2.1.5.4 Cell 1 Supplemental Investigation

A supplemental investigation was conducted on the expansion site in May 2003 for the specific purpose of installing several piezometers for monitoring water levels and the placement of a ground water monitoring system for Cell 1. Specific results of the investigation will be presented as a separate Technical Memorandum (Earth Tech, in preparation). A summary of the supplemental investigation is included in this Section and in Section 2.1.4.3.

Three shallow wells with 15-foot screens were installed to monitor water levels as the ground water adjusts to the operation of the nearby zone-of-saturation landfill (Cell 1). Three deeper wells were installed adjacent to each of the shallow wells to evaluate ground water conditions at the base of the landfill. Well construction information is included in Table A-3, included in Appendix A. Preliminary observations confirmed the presence of three distinct weathering zones described by Davis et al. (1997). Very few sand lenses or seams were encountered except in the shallow well (MW-50P) located south of Cell 1. Wells MW-50un and MW-50P yielded sufficient water for well development although the wells continued to result in high suspended solids. The remaining wells did not yield sufficient water for adequate well development. The water levels continue to be monitored until equilibrium conditions are reached.

During additional field activities during July 2003, a complete round of water levels was collected on the wells listed in Table A-3 (Appendix A). It was discovered that several of the wells and/or piezometers on this list no longer exist. In some areas, the locations were currently being used for the stockpiling of soil and, in other areas, the wells could not be located. Wells that were apparently abandoned include over 15 piezometers on the Active Area previously installed by the SDGS and 5 peizometers/wells on the Expansion Site (P-2S/P-2S, P-4, MW-26ox, and MW-27ox). We are not aware if the wells were sealed and documented in accordance with South Dakota regulations. It was also noted during the July 2003 site work that soil around several wells was severely eroded at the base resulting in a casing stick-up of more than 5 feet above ground surface. In addition, wells were not always located at the positions illustrated on site maps.

As a result of the 2003 observations, it is recommended that the affected wells be repaired and maintained to provide a stick-up no more than 3.5-feet above the ground surface, the protective casings, protective posts, and concrete collar repaired, and the wells painted, labeled, and locked. In addition, wells should be re-surveyed as necessary to provide accurate location and elevation information for site characterization and development purposes.

2.1.5.5 Conceptual Ground Water Model

Within permitting and compliance reporting documents, LBG explicitly concluded that ground water movement is insignificant to nonexistent within and between the three glacial till zones defined at the site. Because of this conclusion, a conceptual model of the ground water regime has not been developed for

the site. However, 40 CFR Part 258.51 stipulates that the number, spacing, and depths of the facility ground water monitoring system should be based on site characterization data including ground water flow rate, flow direction, and seasonal and temporal fluctuations in flow. Therefore, a conservative approach to meeting regulatory needs should apply a conceptual ground water flow model.

Applying basic hydrogeologic principles and available information, the conceptual shallow ground water flow system at the SFRSL site can be described as an unconfined, low permeability, unconsolidated flow system. The water table typically ranges from 5 to 10 feet below the ground surface. Given the thickness of the unconsolidated deposits and the poorly defined local stream patterns, no local hydraulic boundaries are present within the vicinity of the landfill site except for the shallowest ground water that may discharge to existing, intermittent drainageways.

The glacial deposits at the site overlie 30 to 50 feet of interbedded sedimentary rocks that make up the Split Rock Creek Formation (Tomhave, 1994). The Split Rock Creek Formation is predominantly, siltstone, shale, and sandy clay in this portion of Minnehaha County. Shale and marine clay typically have low hydraulic conductivities of 1×10^{-7} cm/sec or less (Freeze and Cherry, 1979); therefore, the Split Rock Creek Formation is not locally designated an aquifer (Lindgren and Niehus, 1992). Underlying the Split Rock Creek Formation, the Sioux Quartzite Aquifer has an unknown thickness exceeding 1,000 feet and is a locally, well-fractured and jointed crystalline rock. Freeze and Cherry (1979) estimate hydraulic conductivity of fractured metamorphic rock to range from 1×10^{-2} to 1×10^{-6} cm/sec. Where overlain by till, the bedrock units are generally under confined conditions.

The uppermost geologic units of hydrologic interest include over 180 feet of Wisconsinan and pre-Illinoisan glacial deposits. Based on illustrations by Tomhave (1994), the glacial deposits and their estimated thickness, from oldest to youngest, include: pre-Illinoisan outwash (10 feet), pre-Illinoisan till (45 feet), outwash (10 feet), and Wisconsinan Till (thickness varies by topography). The estimated top of pre-Illinoisan till elevation illustrated by Tomhave (1994) is 1,450 feet, approximately 80 to 120 feet below the ground surface at the landfill site.

The pre-Illinoisan outwash lying above bedrock occurs locally and is designated the Wall Lake Aquifer (Lindgren and Niehus, 1992). Hydraulic conditions of the Wall Lake Aquifer vary but can yield water to wells up to 500 gallons per minute. Hydraulic conductivities of the overlying pre-Illinoisan till have not been defined; however, the confining conditions provided to the Wall Lake Aquifer suggest that the hydraulic conductivity is on the low range for glacial till at less than 1×10^{-6} cm/sec (Freeze and Cherry, 1979). The outwash that may occur locally along the contact between the Wisconsinan and pre-Illinoisan tills has also not been defined. The contact between the Wisconsinan and pre-Illinoisan tills may contain secondary permeabilities and normal anisotropies, which may provide a preferential flow path. Based on in-situ rate-of-recovery tests conducted on wells within the Wisconsinan-age deposits, hydraulic conductivities vary widely ranging from 6×10^{-3} in imbedded sand units to 2×10^{-8} cm/sec in massive diamicton.

The stratigraphic units, including the Wisconsinan-age deposits, are saturated to within a few feet of the ground surface. Seasonal fluctuations in water levels indicate that recharge to the bedrock aquifers in Minnehaha County is from infiltration of snowmelt and rainfall in areas where the Sioux Quartzite is at or near land surface. The Wall Lake Aquifer is generally under artesian and confining conditions and, where in contact with the Sioux Quartzite, it is recharged by infiltration of precipitation through fractures of the underlying metamorphic rock. The low permeability of the glacial tills presents confining conditions for the Sioux Quartzite and Wall Lake Aquifers, locally protecting them from near surface contamination.

Precipitation is believed to be the major recharge for the shallow ground water flow system as evidenced by seasonal fluctuations at the water table; however, only a small portion of the total rainfall is anticipated to actually recharge the ground water on-site. However, the vertical and horizontal average linear flow velocities of the ground water at the SFRSL have not been quantified for evaluating predominant flow directions and flow rates. It is assumed that the flow at the water table would be predominantly horizontal given the horizontal gradients toward the intermittent stream located along the southern boundary of the landfill site. Some recharge would move laterally near the water table and discharge in a relatively short time within very localized flow systems near drainage ways. The intermittent streams located on and near the site indicate that discharge is primarily in the form of evapotranspiration. The low permeability of the upper units causes numerous small, local, and very shallow flow systems to develop, which are influenced by topography (such as wetlands, drainage ways, and landfill development), inhomogeneities (such as sand lenses), and the seasonal weather conditions. Movement in the shallow, local flow systems can be quite variable. Although the permeability is low, ground water movement does occur, with the majority of ground water flowing through fractures, inhomogeneities, and normal anisotropies, where present.

Throughout the year, a portion of the recharge continues to move downward. Within inhomogeneities or along the Wisconsinan/pre-Illinoisan till interface, the suspected higher permeability may provide for a preferential lateral pathway for ground water movement with horizontal flow toward the south, similar to that of the water table and the underlying Wall Lake Aquifer. As ground water flows horizontally through this zone, some water continues its downward movement into the pre-Illinoisan till and Wall Lake Aquifer below. The artesian pressure exhibited in the uppermost aquifer (Wall Lake Aquifer) indicates that shallow ground water will likely not enter the uppermost aquifer.

In summary, a portion of the water entering the site in the form of precipitation or by lateral ground water movement may be discharged at the water table through evapotranspiration during dry seasons. Some water continues downward to move laterally along preferred horizontal pathways or continues a downward movement to ultimately reach deeper aquifer units. During wet seasons, less water is lost to evapotranspiration and more water recharges the ground water flow system.

2.1.6 Conclusions and Recommendations

Based on the available information, the physical setting can be summarized as follows:

- The vicinity of the SFRSL is described as having a continental type climate with frequent weather changes. The average annual precipitation exceeds 24 inches. There is occasional flooding in the lower areas.

- Lying on the southern flank of the Coteau des Prairies, the poorly drained uplands consist of thick glacial deposits underlain by a small ridge of resistant shale and quartzite. The original slope of the landfill property varies from an elevation of 1,570 feet on the north-central edge of the property to less than 1,530 feet along the southern edge of the site. Excavations for landfill development extend to elevations as low as 1,480 feet.

- The streams present in the vicinity of the landfill are intermittent and poorly defined. An unnamed intermittent stream carrying drainage from Wall Lake crosses the southwestern corner of the site. The nearest perennial stream to the landfill site is Skunk Creek, located more than five miles east of the site.

- Depth to bedrock ranges from 150 to 200 feet in the area. The uppermost bedrock consists of 30 to 50 feet of the Split Rock Creek Formation comprised of interbedded sands, siltstone, claystone, sandstone, bentonite, and lignite. Underlying the Split Rock Creek Formation, the Sioux Quartzite has an unknown thickness exceeding 1,000 feet and is a locally, well-fractured and jointed crystalline rock.

- In the vicinity of the landfill, the bedrock is overlain by 150 to 200 feet of glacial deposits primarily representing pre-Illinoisan underlying the younger, Late Wisconsinan glacial deposits. The composition of both the Wisconsinan and pre-Illinoisan-aged glacial till is very similar consisting of a very compact, clay-rich matrix. It is difficult to distinguish till units, which are most often separated using palesols, oxidations zones, outwash and loess deposits, electric log signatures, and stratigraphic position.

- The Wisconsinan till forms a typical knob and kettle topography with numerous lakes, sloughs, and closed depressions. The glacial till consists of a heterogeneous mixture of boulders, sand, silt, and clay with some shallow surficial deposits containing ice-contact, alluvial and lacustrine deposits. At the SFRSL, the Late-Wisconsinan age deposits occurring three distinct zones: A weathered, highly fractured zone, an intermediate, transition zone, and an unfractured, unweathered zone.

- Published information suggests that the contact of the Wisconsinan/pre-Illinoisan till is at an approximate elevation of 1,460 feet, about 20 feet below the proposed base of the landfill.

- The geologic conditions below the landfill and the Wisconsinan/pre-Illinoisan contact should be better defined because ground water pathways in glacial environments may be more prevalent in features unique to interglacial periods. Only six soil borings and two sets of geotechnical tests from the 160-acre expansion site extend below an elevation of 1,480 feet, the base elevation of Cell 1.

- Four distinct sand bodies were encountered within the unoxidized till during the excavation of the Cell 1 expansion with one body up to 40 feet thick. It is unknown whether the sand bodies encountered or whether silt and sand seams encountered in other deeper borings represent the Wisconsinan/pre-Illinoisan contact or multiple advances within the Wisconsinan.

- The primary local water source in the area is a rural water system. Information has not been obtained as to whether a landfill well to the Wall Lake Aquifer was sealed in accordance with South Dakota requirements to prevent potential cross-contamination from near surface sources.

- The Sioux Quartzite Aquifer exists under artesian pressure and is recharged from infiltration of snowmelt and rainfall in areas where the Sioux Quartzite is at or near land surface. Discharge is generally to wells and intervening glacial aquifers present within bedrock valleys. The Cretaceous Split Rock Creek Formation is not designated an aquifer.

- The pre-Illinoisan outwash lying above bedrock occurs locally and is designated the Wall Lake Aquifer and is described as a sand and gravel. It is confined, under artesian conditions and recharged by infiltration from the Sioux Quartzite Aquifer. Hydraulic conditions of the overlying pre-Illinoisan till have not been defined.

- The outwash that may occur locally along the contact between the Wisconsinan and pre-Illinoisan tills has also not been defined, but may contain secondary permeabilities and normal anisotropies possibly providing preferential flow paths.

- Age dating of ground water resulted in a distribution of age as recent in the weathered till and 9,300 years old or greater in the transition zone and below.

- Ground water flow directions within the Wisconsinan till can vary widely since ground water contours at the water table are anticipated to mimic the undulating ground surface. Ground water contour lines indicate a decrease in hydraulic head toward the south-southwest on both the Active Area and Expansion Area. Horizontal hydraulic gradients of the water table on the Active Area range from 0.0124 to 0.0160 to the south-southwest. Recent site work does not present calculated horizontal hydraulic gradients under the premise that any ground water movement is considered insignificant.

- Vertical gradients on the active site were calculated to be low within the weathered till and varying from upward to downward. Gradients from the weathered till to the unweathered till and below were an order of magnitude greater ranging from 0.68 to 0.89 downward.

- Although hydraulic conductivities from slug tests conducted within the Wisconsinan deposits vary widely ranging from 6×10^{-3} cm/sec in imbedded sand units to 2×10^{-8} cm/sec in massive diamicton, the hydraulic conductivity estimate obtained should be viewed as a lower boundary.

- Based on laboratory permeability results, the glacial sediments were clearly deposited horizontally creating an anisotropic condition for ground water flow. However, it is not clear if the presence of sand bodies creates heterogeneous conditions that provide preferential flow paths.

- Previous investigations did not calculate average linear flow velocity at the site to evaluate the presence of preferential ground water flow paths.

- Problems exist with some existing wells. A number of well/piezometers used in previous investigations no longer exist. It is unknown whether the wells were sealed and documented in accordance with South Dakota regulations in order to prevent vertical conduits for potential near-surface contamination. Erosion has undermined the wellhead at some locations and some wells were not located on the positions illustrated on site maps.

Based on the above observations, the following specific recommendations are provided to improve the understanding of site conditions and how the physical setting may affect the development and operation of a solid waste disposal facility:

1. Existing wells should be repaired and maintained to provide adequate access (stick-up at approximately 3.5-feet above the ground surface), protective casings, protective posts, and concrete collars, and the wells should be painted, labeled, and locked.

2. All wells should be re-surveyed (location and ground and top of inner casing elevation) as necessary to provide accurate location and elevation information for site characterization and development purposes.

3. The geologic conditions below the landfill and the Wisconsinan/pre-Illinoisan contact should be defined to evaluate likely ground water pathways in features unique to interglacial periods.

4. Detailed soil boring logs, geotechnical data, and innovative technologies (e.g., surface geophysics, borehole geophysics) should be considered to define physical soil properties and depositional environment (i.e., subglacial, intraglacial, interglacial, resedimented, etc.).

5. Geologic cross-sections should be updated to incorporate newer site data, regional information, and interpretations as well as proposed landfill base grades.

6. Average linear flow velocities should be calculated in both the horizontal and vertical flow directions in order to define preferred ground water flow paths.

7. The conceptual ground water model should be updated to reflect any new information obtained.

In addition to the above recommendations, additional recommendations associated with site characterization issues are provided in Section 2.3 in regards to regulatory compliance and environmental monitoring.

2.2 PERMIT AND COMPLIANCE REVIEW

The SFRSL must obtain and comply with a number of federal, state, and local permits. The following sections present a review of the primary permits required for this facility. Included are the following:

- County Solid Waste Permit.
- State Solid Waste Permit.
- NPDES Permit.
- Wetlands and Waters of the State.
- Air Permits and Requirements.
- Local Zoning.

2.2.1 County Solid Waste Permit

The SFRSL has a Solid Waste Permit issued by Minnehaha County. The effective date of the permit is July 17, 2001. The term of the permit is five years and therefore expires July 17, 2006.

The permit authorizes use of the Expansion Area and new scale-house area for the purpose of operating a MSW landfill. The Active Area does not require a County solid waste permit since this portion of the property was considered an existing landfill when Minnehaha County passed their solid waste ordinance in 1991.

2.2.1.1 County Permit Review and Conditions

The permit has six specific conditions that are applied. A listing of these conditions, along with our current understanding of compliance is as follows:

Condition 1: A berming and landscaping plan shall be submitted to the Minnehaha Planning Department for staff approval.

We understand from the City that there is no record that the plan was ever completed or submitted to the County. Based on the activity map provided to us by the City as well as our observations of site conditions, there appears to be a well established plan at the site for landscaping including berms and shelterbelts. Documentation of the current conditions and submittal to the County may satisfy this permit condition.

Condition 2: A financial surety shall be required, however, said surety may be the same as that required by the state provided that Minnehaha County is notified of any intent to release the surety and concurs with the release.

The City has established a financial assurance fund for the facility. It is our understanding that the City submitted updated financial information to the County on June 13, 2003.

Condition 3: A copy of the design information, including the means employed to minimize potential impacts to surface or ground water shall be submitted to the Minnehaha County Planning Department for staff approval.

The City submitted a number of engineering reports to the County on October 2, 2001. The documents include the following:

- Sioux Falls Regional Sanitary Landfill Expansion Cell 1 Construction – Construction Documents Specifications, January 15, 2001.
- Sioux Falls Regional Sanitary Landfill Solid Waste Permit Renewal Application, August 14, 2001.
- Sioux Falls Regional Sanitary Landfill Closure/Post Closure Plan for Active Site, August 21, 2001.
- Sioux Falls Regional Sanitary Landfill Leachate Management Evaluation Report, August 2001.

The County Office of Planning and Zoning acknowledged receipt of these documents in a letter to the City dated June 13, 2003. The letter only indicates that the documents are "on file" and does not indicate whether they are approved or not.

Condition 4: A copy of the site closure and post-closure plan(s) shall be filed with the Minnehaha County Planning Department.

As indicated above, the Closure/Post Closure plan for the Active Area is on file with the County. We recommend that updated closure and post-closure plans, which include the Expansion Area, be developed and submitted.

Condition 5: A copy of the storm water management plan shall be filed with the Minnehaha County Planning Department.

The City indicated that a Storm Water Pollution Prevention Plan (HDR, 1993) was submitted and is on file with the County. This plan is in the process of being updated and will be resubmitted when it is completed. A storm water management plan is included with the closure plan of the Active Area (HDR, 2001b), however, the plan does not include the Expansion Area. At a minimum, a comprehensive storm water management plan should be prepared for the site, including the Expansion Area. This plan should then be submitted to the County.

Condition 6: This permit may not be transferred to any other party.

The SFRSL is in compliance with this condition.

2.2.1.2 Conclusions and Recommendations

There are a number of conditions included in the Minnehaha Solid Waste Permit. The conditions are typically requests for submittal of documents to the County Office of Planning and Zoning. With the exception of the berming/landscaping plan (Condition #1), it appears that all of the other required documents have been submitted to the County. The conditions indicate that some of the documents are to be "on file" with the County, implying that review and approval by County Staff is not required. Conditions #1 and #3 indicate that the berming/landscaping plan and the design information are to be submitted for "staff approval." We are not aware if the County has "approved" any of the documents submitted. We recommend that the City clarify this issue with County staff.

2.2.2 State Solid Waste Permit

The current Permit to Operate a Solid Waste Facility (Permit No. 02-26) was issued to the City of Sioux Falls by the South Dakota Department of Environment and Natural Resources (SDDENR) November 26, 2002. The permit carries a five-year term and therefore has an expiration date of November 26, 2007. In accordance with the Administrative Rules of South Dakota (ARSD) 74:27:08:11, an application for renewal of this permit must be submitted at least 90 days before the expiration date.

2.2.2.1 State Solid Waste Permit Review

The State Solid Waste Permit is the principal permit for the operation of this facility and is referred to throughout this Solid Waste Master Plan. The permit is broken down into five sections that are summarized in the following paragraphs.

General Requirements

The General Requirements (Section 1.0) of the state solid waste permit, among other things, incorporates by reference the permit application and supplemental documents. Specific documents are not referenced although presumably, this includes the permit renewal application prepared and submitted by the City's consultant in 2001 (LBG, 2001). The General Requirements describe the City's responsibilities for following the applicable laws and rules and potential penalties for not doing so. This section also outlines requirements for amending the permit resulting from significant deviation in the design of the facility and the SDDENR's right to incorporate administrative changes at any time. Reference is made to the approval of five variances included as attachments of the permit. The variances pertain to the following issues:

- Alternative Daily Cover.
- Floodplains.
- Distance to Residences, Other Buildings, Roads, and Parks.
- Wetlands.
- Liner Systems.

Further discussions of the approved variances are presented in other sections of this Solid Waste Master Plan.

Design and Construction Requirements

This section of the state solid waste permit (Section 2.0) references that portion of the ARSD pertaining to facility design and construction. It also authorizes the use of in-situ clay soils and the associated conditions for implementation of the alternative liner system in the Expansion Area. The permit outlines the requirements for review and approval of plans and specifications by the SDDENR before construction of landfill expansions or ancillary structures. Design issues associated with the in-situ liner are presented in this Solid Waste Master Plan in Section 2.4, Primary Containment Evaluation.

Operational Requirements

Section 3.0 of the state solid waste permit outlines the operational requirements. The permit references ARSD 74:27:13 pertaining to facility operation as well as the facility operation section of the solid waste permit renewal application (presumably LBG's 2001 document). Operational and related compliance issues that are covered under the permit are addressed in this Solid Waste Master Plan in Section 3.0, Operational Assessment and Issues.

Record Keeping and Reporting Requirements

Section 4.0 of the state solid waste permit also references ARSD 74:27:13:22, with regard to record keeping and reporting requirements. In summary, this lists the nature of the facility records that must be kept and made available to the SDDENR upon request. An annual report for ground water monitoring is required to be submitted by April 1 of the following year. A detailed discussion of the facility's annual report is included in Section 2.3 of this Solid Waste Master Plan.

Monitoring Requirements

The monitoring requirements in Section 5.0 of the state solid waste permit reference ARSD 74:27:12, ARSD 74:27:13, and ARSD 74:27:15. The permit establishes the schedule for ground water sampling and measurement of water levels. The approved chemical parameter list for ground water monitoring is also included. A detailed discussion of environmental monitoring and associated compliance issues is included in Section 2.3 of this Solid Waste Master Plan.

Financial Assurance Requirements

This portion of the state solid waste permit requires that the operator develop and maintain a financial assurance account. A discussion of financial assurance for the facility is included in Section 5.0 of this Solid Waste Master Plan.

2.2.2.2 Conclusions and Recommendations

The State Solid Waste Permit is the principal permit for the SFRSL and guides the operation of the facility. Although many of the permit conditions are subject to interpretation, we are aware of no significant compliance issues with the permit. This is based on our review of the available documents as well as conversations and meetings with SDDENR staff during the preparation of this report.

2.2.3 NPDES Permit

Earth Tech reviewed available documents provided by the City addressing NPDES permitting issues at the SFRSL. The following discussion provides a summary of the documents, our understanding of the status of compliance, and our recommendations.

2.2.3.1 NPDES Permit Review

The facility (under the name of Runge Sanitary Landfill) was issued coverage under a NPDES general storm water permit by the U.S. Environmental Protection Agency (USEPA) February 8, 1993. As a requirement of that permit, the facility developed a Storm Water Pollution Prevention Plan (HDR, 1993). In a letter dated January 12 1994, the USEPA indicates to the permittee that the SDDENR was given authority to administer the NPDES program (which includes storm water).

The SFRSL is currently regulated under Surface Water Discharge Permit for Storm Water Discharges Associated with Industrial Activities, General Permit #SDR 000000. This permit became effective December 16, 1997, and expired December 15, 2002. On November 4, 2002, the SDDENR issued a letter stating that their renewal permit has not been completed. They stated that any facility that submitted an Notice of Intent for Reauthorization (NOI) by December 15, 2003, would be allowed coverage under an administrative extension of the existing permit.

The City submitted a NOI and it was received by the SDDENR on December 13, 2002. We understand that recent conversations between City and SDDENR staff confirmed that the SFRSL is covered under the extended permit and the renewal permit will be issued shortly.

2.2.3.2 Conclusions and Recommendations

Based on our review of the available information pertaining to NPDES, we recommend the following:

- The SFRSL appears to be covered under the General Storm Water Discharge Permit #SDR 000000. If the City has not received written confirmation of this by December 2003, we recommend that the City contact the SDDENR for a status report of the permit schedule.

- Significant changes have occurred to the landfill operations since the development of the 1993 Storm Water Pollution Prevention Plan (HDR, 1993). This plan is typically a condition of the NPDES permit and should be updated to reflect current facility design, operations, as well as current permit requirements.

2.2.4 Wetlands and Waters of the State

Earth Tech has reviewed available documents provided by the City of Sioux Falls addressing Waters of the U.S. (including wetland) issues at the SFRSL. The following discussion provides a summary of the documents and our understanding of the status of permitting and mitigation along with our recommendations.

2.2.4.1 Wetland Permitting Framework

Section 404 of the Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established the Section 404 Regulatory Program. At the federal level under Section 404 of the Clean Water Act (CWA) of 1977, the U.S. Army Corps of Engineers (USACE) oversees the permit program for the discharge of dredge or fill material into wetlands. The USACE administers the day-to-day program, including individual permit decisions and jurisdictional determinations, develops policy and guidance, and enforces Section 404 provisions.

Under Section 404, it is unlawful to discharge dredged or fill material into Waters of the U.S. without first receiving authorization (usually a permit) from the USACE, unless the discharge is covered under an exemption. The term "Waters of the U.S." defines the extent of geographic jurisdiction of the Section 404 program. The term includes such waters as rivers, lakes, streams, tidal waters, and many wetlands. A discharge of dredged or fill material involves the physical placement of soil, sand, gravel, dredged material, or other such materials into the Waters of the U.S.

The U.S. Environmental Protection Agency (USEPA) develops and interprets environmental criteria used in evaluating Section 404 permit applications, determines scope of geographic jurisdiction, approves and oversees state assumption, identifies activities that are exempt, reviews/comments on individual permit applications, has authority to veto the Corps' permit decisions (Section 404[c]), can elevate specific cases (Section 404[q]), and enforces Section 404 provisions.

The Section 404 permitting process requires review/authorization from a number of other state and federal agencies. In South Dakota, this includes the SDDENR, responsible for Section 401 Water Quality Certification, United States Fish and Wildlife Service (USFWS), the South Dakota Department of Game, Fish, and Wildlife (SDDGFW), and the South Dakota State Historic Preservation Officer (SHPO).

South Dakota Solid Waste Rules

According to the Administrative Rules of South Dakota ARSD 74:27:11:07, no municipal solid waste landfill facility shall be located in wetlands. A variance was received from the South Dakota Department of Environment and Natural Resources-Waste Management Program (SDDENR-WMP) for the construction of Phase 1 (in the Expansion Area) based on the following conditions: It was determined that wetlands existed within the permitted area of the landfill. Federal and state regulations and rules allow disturbance of wetlands, provided that the disturbance is minimal and/or the impact is mitigated by the construction of new wetlands or renovation of existing wetlands of equivalent value and use. The operator cannot disturb, drain, or otherwise destroy or impact any wetland in the permitted area until a wetland mitigation plan has been approved by appropriate governmental agencies and the plan implemented.

2.2.4.2 Wetland Permit Review

Expansion Area - Wetland Permit Review

In December of 2000, the City and HDR Engineering, Inc. (HDR), completed a wetland delineation report for the proposed 160-acre Expansion Area. The delineation was performed in accordance with the USACE Manual for Delineating Wetlands (Environmental Laboratory 1987) and the Food Security Act (FSA) of 1985 methodology. The fieldwork was conducted on August 21 and 22, and November 6 and 7, 2000. Through the implementation of the FSA methodology, 26 areas containing mapping conventions of wetland signatures were identified. Upon field investigation, 16 areas were determined to have hydric soils and to be farmed wetlands. Additionally, four areas met wetland definitions based on the USACE 1987 Manual. The remaining six areas were determined not to meet the necessary criteria for either FSA or USACE 1987 Manual wetland delineations. In total, the delineation of the Expansion Area identified approximately 6.1 acres of jurisdictional wetlands. In addition to the wetlands, two other Waters of the U.S. were noted. Of the total 6.1 acres, it was determined that approximately 0.4 acres of wetlands would be impacted within the area of the proposed Phase I construction. We should note that the documents referred to "Phase I" and "Cell 1" interchangeably. The term "Phase I" includes the entire construction area of Cell 1 including sideslopes and roads that reside in portions of the adjacent cell areas.

To mitigate for the 0.4 acres of wetland lost as part of the Phase I construction, the City proposed to combine this with a mitigation project associated with an unrelated city street project. The City proposed to construct just over 2 acres of wetland mitigation in the South Western Avenue detention pond in the area located approximately 1 mile south of the junction of 267th Street and 464th Street. According to City documents, the South Western Avenue project impacted approximately 1 acre of wetlands. The remaining 1-plus acres of the mitigation would be reserved for either the wetland bank program or a future mitigation site. The USACE permitted the widening of the road, which involved the placement of fill into approximately 1 acre of wetland and the compensatory mitigation plan of the expansion of an existing wetland by excavation of upland approximately 1.5 acres in size.

A Section 404 permit application and mitigation plan regarding the 0.4-acre wetland impact was submitted to the USACE on January 22, 2001. A Nationwide Permit was granted by the USACE in a letter dated May 11, 2001. The Nationwide Permit number for the Cell 1 Expansion Site is 200130071 and was issued April 3, 2001.

In the May 11, 2001, letter to the City, the USACE indicates that the permit is valid until April 3, 2003. The Compliance Certification form should have been signed and returned to the USACE upon completion of the authorized work. It is our understanding that the mitigation work was not completed in the timeframe of the permit. We understand that the City plans to complete the mitigation in 2003.

Scale-House Construction - Wetland Permit Review

On June 12, 2001, HDR completed wetland delineations for the construction of a new scale facility north of the existing landfill. Construction of the scale facility required the expansion of road rights-of-way by 25 feet on both the east and west sides of the existing road. One wetland was impacted by the new scale facility. The total wetland area was 0.25 acres, but only 0.09 acres was impacted by the scale facility construction.

A Section 404 permit application was submitted to the USACE on June 29, 2001. On August 8, 2001, the USACE responded saying no Section 404 permit was required due to the SWANCC ruling (Solid Waste of Northern Cook County versus USACE) regarding isolated wetlands.

Entrance Road Construction - Wetland Permit Review

On January 9, 2002, HDR completed a wetland delineation report for the entrance road reconstruction north of the landfill. Wetland delineation was conducted on December 13, 2001, along the landfill access road located on the section line between Sections 34 and 35. According to the planned layout for the reconstruction of the access road, 4,187 square feet (0.096 acres) of wetlands would be impacted. Five wetlands were delineated and four were impacted by the road construction.

In January 2002 a Section 404 permit application was submitted to the USACE. On February 20, 2002, the USACE replied saying they don't have authority over the work area and that a Section 404 permit was not required due to the SWANCC ruling regarding isolated wetlands.

Buffer Area North and East of Active Area - Wetland Permit Review

On July 22, 2002, HDR completed a wetland delineation report for an 80 acre buffer area (Area 1) located north of the Active Area and a 40 acre buffer area (Area 2) located east of the Active Area. The wetland delineations were conducted on June 12 and 13, 2002. A portion of Area 1 along the road corridor had been previously delineated and the wetlands were determined to be non-jurisdictional isolated wetlands. Six wetlands were identified and delineated in Area 1. The documents indicated that all wetlands in Area 1 would be impacted, which included a total of 27,747 square feet (0.637 acres) of wetlands. The proposed project in Area 2 would impact approximately 12,675 square feet (0.291 acres) of existing wetland.

A Section 404 permit application was submitted to the USACE. On August 21, 2002, the USACE replied saying a Section 404 Permit was not required for grading with associated placement of fill into isolated wetlands in Areas 1 and 2 per the SWANCC ruling.

Farmed Wetlands

Several of the wetlands delineated by HDR were identified as FSA wetlands and were mapped by HDR using FSA methodology. Under the FSA Swampbuster program, wetlands that are identified as farmed wetlands are regulated by the Natural Resource Conservation Service (NRCS) as long as the wetlands occur on land in agricultural use. A NRCS map of farmed wetlands is included in the HDR report. The NRCS is responsible for the delineation of wetlands on agricultural land and the USEPA and USACE accept their delineations. However, on non-agricultural land the USACE is the lead federal agency responsible for delineations.

The CWA exempts from the Section 404 program discharges associated with normal farming, ranching, and forestry activities such as plowing, cultivating, minor drainage, and harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices (Section 404(f)(1)(A)). To be exempt, these activities must be part of an established, ongoing operation. For example, if a farmer has been plowing, planting, and harvesting in wetlands, he can continue to do so without the need for a Section 404 permit, so long as he does not convert the wetlands to dry land.

Grading activities (such as landfill development) that would change any area of Waters of the U.S., including wetlands, into dry land are typically not exempt. Minor drainage that is exempt under Section 404(f) is limited to discharges associated with the continuation of established wetland crop production (e.g., building rice levees) or the connection of upland crop drainage facilities to Waters of the U.S.

Section 404(f)(2) provides that discharges related to activities that change the use of the Waters of the U.S., including wetlands, and reduce the reach, or impair the flow or circulation of Waters of the U.S. are not exempted. This "recapture" provision involves a two-part test that results in an activity being considered not exempt when both parts are met: 1) does the activity represent a "new use" of the wetland, and 2) would the activity result in a "reduction in reach/impairment of flow or circulation" of Waters of the U.S.? Consequently, any discharge of dredged or fill material that results in the destruction of the wetlands character of an area (e.g., conversion to uplands due to new or expanded drainage) is considered a change in the Waters of the U.S., and by definition, a reduction of their reach and is not exempt under Section 404(f).

It should be emphasized that the use of Section 404(f) exemptions does not affect Section 404 jurisdiction. For example, the fact that an activity in wetlands is exempted as normal farming practices does not authorize the filling of the wetland for other uses without a review by the USACE to assess the need for Section 404 permit.

As a result, to ensure that all wetland permitting requirements are met, farmed wetlands that meet the wetland criteria should be identified in Section 404-related correspondence and applications. For example, Wetland 15b (0.14 acres) and wetland 12 (0.02 acres) met wetland criteria as described in the HDR Report, but were not included in the list of wetlands that would be filled by Phase 1 development. They may have been left off because they were considered farmed wetlands. However, filling a farmed wetland to create an upland for other use typically requires a 404 permit unless it is exempt under the SWANCC ruling as an isolated wetland or other criteria. This should be considered as part of future wetland impact assessment and permitting.

2.2.4.3 Waters of the United States

The HDR delineation report identified the channelized drainage ditch in the southwestern portion of the Expansion Area and the stock pond adjacent to it as Waters of the U.S. Based on conversations with Steve Naylor, USACE, the ditch running from Wetland 13 southward, including areas 15 a, b, c, and d would also likely be considered a Water of the U.S. for permitting purposes. A ditch can make previously isolated natural or manmade otherwise isolated wetlands Waters of the U.S. A distinct ditch (as opposed to a plow furrow) conveying water to a creek is a surface water connection and may be considered a Water of the U.S. This should be considered and discussed with the USACE as part of future permitting.

Relocation of Channelized Drainage (Southeast ¼ Section 34)

A drainageway crosses the southwest portion of the proposed Expansion Area. This includes a delineated 100-year floodplain that carries drainage from Wall Lake. The drainageway was channeled prior to the City taking ownership of the land. To fully develop this area for disposal, the drainageway would have to be rerouted.

Attachment C of the City of Sioux Falls Solid Waste Permit, dated November 26, 2002, is a copy of a floodplain variance for construction of the Expansion Area. The document stated that the operator does not plan to disturb or operate in this floodplain during the term of the permit. The variance also stated that, "federal and state regulations and rules allow lateral expansion of an existing municipal solid waste landfill (MSWL) within a floodplain. The operator must demonstrate that the MSWL will not restrict the flow of the 100-year floodplain, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste to pose a hazard to human health and the environment. The operator must place the demonstration in the operating record and notify the SDDENR-Water Management Program that it has been placed in the operating record. The operator will need to complete the demonstration prior to any landfill activities within the floodplain. Furthermore, the operational and design requirements of this permit are specifically designed to ensure that the operation of the landfill will not pose a hazard to human health or degrade the environment. The operator shall comply with the conditions of this permit."

According to Steve Naylor, USACE, and based on past experience, as a general rule the relocation of a channel is not viewed positively. However, there are specific case-by-case evaluations as to whether the relocation would be in the public's interest. In this case, the drainage has already been channelized and it is likely that the USACE would consider relocation, if meanders were incorporated to elongate and stabilize the drainage, more favorably. The conceptual design of future relocation should be discussed with the USACE and other agencies that would be involved in the Section 404 process such as the USFWS, SDDENR, and SDDGFP. The SHPO has already suggested a records search and survey of future expansion areas.

Stock Pond

Section 404 permitting procedures related to stock ponds can be complex. The construction of ponds for watering stock is exempt. Therefore, in some cases when they are eliminated it has been interpreted by the USACE that if the construction is exempt, the decommissioning is exempt. However, if the pond was built of previously existing wetlands or streams, the USACE may still have jurisdiction over the pond and require a 404 permit to fill it. In regard to ponds adjacent to waterways that are excavated rather than dammed, the USACE may require that a 404 permit be obtained if the area is not returned to original contours.

2.2.4.4 Conclusions and Recommendations

Based on the available documentation, it appears that permitting efforts for recent construction have been addressed. One major exception is the mitigation project and permit certification for the Cell 1 construction. The nationwide permit authorization for this project expired April 3, 2003. Since the mitigation project will not be completed until later in 2003, the City should contact the USACE to verify the status of the permit and the steps necessary to return to compliance.

For future site development, we recommend that a meeting be held with pertinent agencies to review anticipated permitting feasibility and identify any potential issues. As part of the agency coordination, the likelihood of obtaining permits related to full expansion and required mitigation and design features should be identified. The meeting could include an agency site review. Issues warranting discussion include:

- Wetland Mitigation: Determine current status of wetland mitigation and potential future needs. Assess the potential for on-site mitigation for future wetland impacts and wetland banking, possibly in association with the relocation of the drainage area identified as Area 19, or other site development.

- Floodplains: Discuss with agencies potential floodplain impacts and related permitting requirements related to development of the area identified as Area 19.

- Waters of the U.S.: Through coordination with the USACE, determine which ditches and drainages on site are Waters of the U.S. Wetlands identified as 15 a-d and 12, part of a ditch system that would likely be regulated as Waters of the U.S. regardless of whether they met wetland criteria. Discuss the feasibility and requirements related to the relocation of the channel identified as Area 19, as well as design criteria, such as meanders, that would increase the likelihood of permittability. Determine if the stock pond located in the Expansion Area would be exempt or require a permit.

- Farmed Wetlands: Discuss with agencies the permitting requirements related to development in areas identified as farmed wetlands. Farmed wetlands that meet the wetland criteria should be identified in Section 404-related correspondence and applications.

It is our understanding that a wetland mitigation project was under consideration in the buffer area east of the Active Site. This project was put on hold pending the results of this site review. Although little detail is available about this project at the present time, we have no major concerns about this project from a conceptual standpoint. If the City chooses, this project could proceed. We recommend that this project be closely coordinated with current and potential future groundwater monitoring and remediation activities that may occur in response to ground water contamination identified in this vicinity.

In addition to, or instead of, the mitigation project east of the Active Site, we recommend that the City consider a mitigation project associated with the relocation of the Wall Lake drainage ditch in the Expansion Area. Permitting of the ditch relocation may be made more acceptable to agencies if it was combined with a mitigation project that includes meanders to elongate and stabilize the drainage in a favorable way. This mitigation project is contingent on the City purchasing adjacent property to the south and west of the Expansion Area.

2.2.5 Air Permits and Requirements

Earth Tech has reviewed available documents addressing air quality compliance at the SFRSL. These documents include a Tier II NMOC Emission Rate Report (HDR, 1998) and a letter including updated NMOC calculations (HDR, 2000). The following discussion provides a summary of applicable regulations, our understanding of the status of compliance of the landfill, and our conclusions.

2.2.5.1 Regulatory Overview

Specific federal air quality regulations pursuant to 40 CFR 60 Subpart WWW (Landfill New Source Performance Standards, or NSPS) apply to landfills having a waste capacity of 2.5 million megagrams (Mg) or 2.5 million cubic meters (3.25 million cubic yards). These regulations apply to landfills constructed or modified after May 30, 1991. It is our assumption that the SFRSL is subject to these regulations.

Since the capacity of SFRSL exceeds the threshold of 3.25 million cubic yards, the site is subject to air permitting requirements regardless of the air emissions estimated for the site. Therefore the following air permitting requirements are applicable:

- Submittal of a Title V air permit application (in South Dakota, initial Title V permit applications were due April 21, 1996. The landfill's application would have been due 12 months after the site became subject to the NSPS).
- NSPS NMOC emission rate reports (annual or 5 year reports).
- Submittal of annual emission inventories.
- Annual compliance certifications (once a Title V Permit is issued).
- Semi-annual deviation reports (once a Title V Permit is issued).

The MSW Landfill NSPS requires landfills with annual air emissions of non-methane organic compounds (NMOC) greater than 50 Mg/yr (approximately 55 tons/yr) to collect and control landfill gas emissions. Landfills meeting this control criteria are also subject to National Emissions Standards for Hazardous Air Pollutants (NESHAP) for MSW Landfills. The NESHAP regulations were recently promulgated in January 2003 and address primarily administrative and reporting requirements.

To determine emissions and the applicability of installing a collection and control system pursuant to the NSPS, landfills subject to the NSPS have the option of calculating NMOC emissions using standard default values (Tier 1) or by site specific testing (Tier 2). The NSPS defaults used in the Tier 1 analysis are considered conservative. In the event that Tier 1 calculations predict NMOC emissions greater than 50 Mg/yr, within 180 days of the initial Tier I calculation a facility may determine its NMOC concentration in the landfill gas and recalculate NMOC emissions using the Tier 2 NMOC concentration.

There are currently no air quality permit requirements or control requirements for methane emissions. Methane is a greenhouse gas however and could be regulated in the future.

2.2.5.2 Regulatory Compliance Status

The SFRSL has a current waste capacity of 2.9275 million megagrams (Mg), not including the Expansion Area (HDR, 2000). Therefore, SFRSL is subject to the NSPS and therefore should have applied for a facility Title V application within 12 months of becoming subject to the NSPS.

South Dakota rules require Title V facilities to obtain either a preconstruction permit or Title V permit before beginning construction and to authorize operation of expansions. It is our understanding from the City that an air quality permit for the landfill has not been issued. The City made an application to the SDDENR in May 2003.

In addition to the air quality permit, the NSPS requires landfills to submit a Design Capacity Report by the earliest of either 30 days after beginning construction on an expansion, 90 days after receiving an air quality construction permit, or 30 days after waste is placed in an expansion. It is our understanding that a Design Capacity Report has not been submitted. Construction of Cell 1 in the Expansion Area was completed in 2002.

It is our understanding from the City that the SDDENR performed Tier 1 calculations for the facility in July 1997. The initial Tier 1 calculations "start the clock" on subsequent NSPS compliance activities and deadlines. In 1998, the City proceeded with Tier 2 testing (site-specific testing) for NMOCs to identify the site's average NMOC concentration in its landfill gas. Under the NSPS regulations, Sioux Falls is required to conduct verification of NMOC sampling programs (Tier 2) every 5 years. As required, Tier 2 testing was most recently performed in July 2003. Both of the 1998 and 2003 sampling events resulted in calculated NMOC emissions for the landfill below the 50 Mg/yr threshold where the NSPS requires gas collection and control. However, based on the calculations, the facility is expected to reach the 50 Mg/yr threshold in the year 2004.

2.2.5.3 Tier 2 Testing Results

1998 Testing Results

The 1998 testing resulted in an average NMOC concentration of 130 ppmv, as hexane (HDR, 2000). Those results suggested that if future annual waste acceptance rates remained fairly constant over the landfill's life and the site's NMOC concentration remains constant, the NSPS gas collection and control requirements would not apply. However, as evidenced by the 2003 test results, the measured NMOC concentrations can vary widely at a site and can vary over time.

2003 Testing Results

The 2003 testing resulted in an average NMOC concentration of 501 ppmv, as hexane. This results in an NMOC emission rate of 49.6 Mg for the year 2003. Based on the waste acceptance for 2002 (the landfill gas generation calculations assume there is a 1-year pause before waste starts to decompose and emit gas), the facility will exceed the 50 Mg/yr threshold in 2004.

The difference in the 1998 results and the 2003 results is not surprising. Samples from the 1998 Tier 2 testing were collected around the perimeter of the main Active Area, apparently because the upper 40 feet of waste in the central portion of this area was placed relatively recently, within two years of the testing (1996 and 1997). The methodology actually requires that 2 samples per hectare be obtained from all areas of waste that are two years old or older. The 2003 sampling event included areas of the landfill not sampled previously. This included areas in the central portion of the landfill.

2.2.5.4 Conclusions and Recommendations

It is our understanding that the City recently (May 2003) applied for a Title V permit for the landfill that includes both the Active Area and the Expansion Area. The City should also verify with the SDDENR if a Design Capacity Report is needed for the Expansion Area. The rules require this report within 30 days after beginning construction on an expansion.

Although the July 2003 Tier 2 testing indicates that collection and control of landfill gas is not currently required under the NSPS, calculations indicate that the threshold for this may be reached in 2004. The landfill has three options to continue compliance with the air quality rules. Tier 2 testing can be performed again in 2004. If the testing results in a lower NMOC concentration, the landfill may avoid having to install a gas collection system. Comparatively, further Tier 2 testing is much less expensive than the other options. However, if the results of the new Teir 2 testing are the same or higher, Tier 3 of the NSPS will be triggered. Tier 3 testing is used to determine a gas generation rate from the landfilled waste. This testing involves drilling and installing several wells into the landfill. Tier 3 testing would cost more than Tier 2 testing would, but would be less than installing a gas collection system. Once the gas generation rate is determined, the NMOC emissions are recalculated. If the results still show greater than 50 Mg/yr emission, a collection system would be required. The third option is for the landfill to install a gas collection system at this time, and dispense with performing further gas sampling.

In addition to the NSPS compliance issues, we believe there are other tangible and intangible benefits that a landfill gas collection system could facilitate for the City. Potential benefits could include the following:

- Collection of landfill gas may present opportunities for beneficial use such as generation of electricity or heat.

- Collection and control of landfill gas may complement efforts to remove leachate from the Active Area. That is, gas wells could also be used for leachate removal and the accompanying header system could be used for conveyance of leachate to storage tanks or ponds.

- Regardless of NMOC concentrations, methane is also a powerful greenhouse gas. Although methane emissions are currently unregulated, collection and control of landfill gas will reduce a significant source of these emissions, particularly if the gas is beneficially used and results in offset of fossil fuels.

- Landfill gas extraction systems assist in removing and destroying volatile organic compounds from the waste mass and reduces the potential for these compounds to migrate in gaseous form and to leach into groundwater. Landfill gas extraction systems are known to reduce the risk of groundwater contamination.

- Collection and control of landfill gas will mitigate potential problems with odors.

- Collection and control of landfill gas will mitigate potential problems of gas migration off-site or to adjacent structures.

- Collection and control of landfill gas will reduce the risk of gas seeps through the landfill cover that could result in stressed vegetation and increased cover maintenance.

Further discussion of the above issues and implementation of a landfill gas collection and control system are addressed in Section 4.0 of this report.

2.2.6 Zoning Review

Zoning issues for the landfill and surrounding properties are presented in the 2001 Permit Renewal Application (LBG, 2001). Information contained in the document outlines the specific zoning ordinances applicable to the facility. The following is a summary of the information presented.

The area surrounding the facility is primarily utilized for agricultural purposes. Several groupings of single-family homes are also present. The facility and the adjoining properties are zoned "A-1," Agricultural. Within a 1 mile radius of the site, there is a small area zoned "RR," Rural Residential.

Local zoning ordinances control property usage in Minnehaha County. Landfills are subject to conditional use permitting in an A-1 district. The following is the status of the conditional use permits for the facility. The information was taken or paraphrased from a letter to the Sioux Falls Health Department from the Minnehaha County dated June 26, 2001.

Active Area (SW¼ Section 35-T101N-R15W)

This is the original portion of the landfill that was begun in the 1970s. The area was approved by conditional use permit #78-1 on March 13, 1978. That conditional use permit carries with the land and continues as long as the use of the property for a landfill continues. This portion of the property was considered an existing landfill when Minnehaha County passed their solid waste ordinance in 1991 and does not require a County solid waste permit.

Expansion Area (SE¼ Section 34-T101N-R51W)

The Expansion Area received zoning approval from Minnehaha County under conditional use permit #95-22 and was approved by the Minnehaha Planning Commission on June 26, 1995. That permit continues in effect as long as the City continues to meet the permit conditions and continues the use of the property for a landfill use. The solid waste permit #95-1 for the Expansion Area was also approved by the Minnehaha County Commission July 26, 2001. The renewal permit will be effective for 5 years from its effective date of July 17, 2001.

Scale-House Area
(S400' E75' N¼ Section 34-T101N-R51W and S400' W75' NW¼ Section 35-T101N-R51W)

This area that includes the new scale-house was approved by the Minnehaha County Planning Commission on June 25, 2001, as conditional use permit #01-58, which amended conditional use permit #95-22. That conditional use permit will continue in effect provided that the City continues to meet the permit requirements. This area was also added to the County Solid Waste Permit under permit #01-03 approved by the County Commission on June 26, 2001.

2.3 ENVIRONMENTAL MONITORING EVALUATION

Environmental monitoring is conducted at a waste disposal facility to evaluate the potential impacts and their risk to surrounding water resources including ground water and surface water. In addition, to ensure safety, landfill gas is monitored to prevent accumulation of methane in nearby structures and possible off-site migration. The following regulatory documents were reviewed as part of the evaluation of environmental monitoring at the SFRSL:

- Permit to Operate a Solid Waste Facility, Solid Waste Permit Number 02-26 issued to the City of Sioux Falls, November 26, 2002.
- Administrative Rules of South Dakota (ARSD) 74:27.
- 40 Code of Federal Regulations (CFR) Part 258 (Resource Conservation and Recovery Act-RCRA, Subtitle D).
- U.S. EPA, November 1993, Solid Waste Disposal Facility Criteria Technical Manual (for achieving compliance with 40 CFR Part 258), EPA530-R-93-017.

The results of the evaluation are discussed in the following sections in reference to regulatory compliance.

2.3.1 Solid Waste Permit Number 02-26 (SDDENR-WMP)

The requirements provided in Section 5.0 of the facility solid waste permit are listed below. Each requirement is followed by a discussion concerning the status of compliance.

5.01 The operator shall monitor leachate, ground water, surface water, methane gas, and perform any other testing and/or monitoring required by ARSD 74:27:12, ARSD 74:27:13, and ARSD 74:27:15.

The 2001 and 2002 annual reports (LBG, March 2002; LBG, March 2003) provided a discussion on the monitoring results for ground water and methane gas. The annual reports did not provide information on leachate or surface water monitoring. Based on correspondence with the City, Storm Water Discharge Monitoring Reports have been submitted to the SDDENR during 7 of the last 10 years. The requirement for monitoring of leachate refers to leachate collected from a lined Subtitled D cell. Leachate monitoring is being provided as part of a proactive process to address leachate head levels in the Active Area (pre-Subtitle D area). The state supports the City's efforts in this regard and has not placed mandates or reporting requirements at this time. The reports were not reviewed by Earth Tech. Specific discussion on ARSD requirements is provided in the following section.

5.02 The operator shall monitor ground water quality and ground water levels throughout the active closure, post-closure phases of the facility. This shall be in accordance with the ARSD 74:27:19 and the SDDENR-WMP approved ground water monitoring plan. This includes:

- *Semi-annual measurement of ground water levels in all designated wells.*
- *Semi-annual sampling and analysis of all designated wells for the parameters listed in Attachment A of this permit.*

The results of the required measurements, sampling and analysis shall be maintained in the facility's operating record and included in the annual ground water monitoring report.

The SDDENR approved a ground water monitoring plan in a letter dated June 10, 2002. A proposed change and a summary of the ground water monitoring plan was submitted to the SDDENR in a letter from LBG dated November 25, 2002 (LBG, 2002b). Although we have not reviewed all correspondence pertaining to the ground water monitoring plan, we understand from the City that the amended plan was approved by the SDDENR as submitted.

In general, the current monitoring program appears to meet the minimum monitoring requirements of the facility permit. The 2001 and 2002 annual reports (LBG, March 2002; LBG; March 2003) indicate that water levels have been measured in most wells on a quarterly basis over the past 10 years; no explanation was provided as to why water levels are occasionally not available in some wells. Compliance with ARSD 74:27:19 is discussed in a following section.

5.03 The ground water monitoring system and monitoring program are considered adjustable and subject to revision as construction and operation of the facility progresses, as site conditions change, or as test results from the ground water monitoring dictate. The operator shall submit to and receive written approval from SDDENR-WMP, for any proposed changes in the monitoring system prior to implementation. SDDENR-WMP reserves the right to require changes in the monitoring systems and programs as needed without public notice.

In the November 25, 2002, letter to the SDDENR from LBG (LBG, 2002b), modifications to the monitoring system were proposed in accordance with the facility permit. Although we have not reviewed all written correspondence, we understand from the City that the amended plan was approved by the SDDENR as submitted. Presumably, the approval does not include the proposed changes for filtered metals as requested in the 2001 annual report (LBG, March 2002).

5.04 The operator shall measure methane gas concentrations quarterly in all buildings and at the property boundaries, and in accordance with ARSD 74:27:13:26.

The 2001 and 2002 annual reports (LBG, March 2002; LBG, March 2003) presents the results from quarterly methane monitoring from monitoring wells, along property lines, and in on-site buildings. No detectable concentrations of methane were reported.

5.05 All monitoring and sampling data, results, and measurements referenced in this section are subject to the record keeping requirements of Section 4.0 of this permit.

Section 4 of the permit outlines steps and requirements for operations including contingency action and an annual report submittal to the SDDENR-WMP by April 1 of the following year. Based on the documents provided, it appears that this requirement is met each year by the annual monitoring reports prepared by LBG.

2.3.2 Administrative Rules of South Dakota

Specific monitoring requirements described in the ARSD are summarized as follows by comments as to the facility's status of compliance:

ARSD 74:27:12:19 Ground water monitoring systems: Stipulates the incorporation of a ground water monitoring system that meets applicable provisions of Chapter 74:27:19 and follows a ground water monitoring plan describing the monitoring system, monitoring parameters, and monitoring frequencies.

The SDDENR approved a ground water monitoring plan in a letter dated June 10, 2002. A proposed change and a summary of the ground water monitoring plan was submitted to the SDDENR in a letter from LBG dated November 25, 2002 (LBG, 2002b). Although we have not reviewed all written correspondence, we understand from the City that the amended plan was approved by the SDDENR as submitted. Compliance with ARSD 74:27:19 is discussed in a subsequent section below.

ARSD 74:27:13:16 Monitoring: Requires all monitoring systems be operated and maintained throughout the active life and post-closure period.

This requirement is not applicable at this time.

ARSD 74:27:13:26 Methane gas monitoring: Requires measurement of methane gas concentrations quarterly in all buildings and in soils or air at the property boundaries.

As stated in the previous section, the 2001 and 2002 annual reports (LBG, 2002a; LBG, 2003) presents the results from quarterly methane monitoring from monitoring wells, along property lines, and in on-site buildings. No detectable concentrations of methane were reported.

ARSD 74:27:15:09 Post-Closure Plan: Stipulates a written post-closure plan be prepared that includes a description of monitoring activities during the post-closure period.

The Closure/Post-Closure Plan (HDR, 2001b) outlines post-closure activities at the facility including maintaining the facility monitoring activities.

ARSD 74:27:19 Ground water monitoring: Outlines the ground water monitoring requirements at facility including detection monitoring systems, parameters, frequency, and procedures. Detection monitoring systems must be located to determine ambient ground water quality and to detect migration of leachate constituents from a facility. At least three wells must be located immediately downgradient of the waste disposal areas and installed by a well driller licensed in South Dakota. Monitoring parameters shall ensure an accurate representation of ground water quality with, at a minimum, analysis conducted for the parameters listed 40 CFR Part 258. Frequency of monitoring should occur semi-annually with four independent samples collected during the first semi-annual sampling period for new wells. Sampling procedures must comply with ARSD 74:54:01:06 except that field filtering (dissolved) is not allowed for metals analysis. A qualified ground water scientist or engineer licensed in South Dakota must certify that the ground water monitoring system meets the requirements of 40 CFR Part 258.

As stated above, the SDDENR approved a ground water monitoring plan in a letter dated June 10, 2002. A proposed change and a summary of the ground water monitoring plan was submitted to the SDDENR in a letter from LBG (LBG, 2002b). The letter prepared by LBG lists the following tasks as the ground water monitoring plan:

- Obtaining ground water elevation data from 30 monitoring wells on a semi-annual basis.

- Obtaining ground water samples from background wells MW-11, MW-17, MW-21ox, MW-23ox, MW-25ox, and MW-39ox and compliance wells MW-5, MW-7R, MW-13R, MW-18, MW-20, MW-22ox, MW-42ox, MW-44ox, MW-45ox, MW-47ox, and MW-48ox on a semi-annual basis.

- Analyzing the samples for the presence and concentration of RCRA Subtitle D Appendix I constituents, dissolved metals (filtered samples) from Table 1 of ARSD 74:54:01:04 and chlorides.

In general, the current monitoring program appears to meet the minimum monitoring requirements of the facility permit. The 2001 and 2002 annual reports (LBG, 2002a; LBG, 2003b) indicate that water levels have been measured in most wells on a quarterly basis over the past 10 years; no explanation was provided as to why water levels are occasionally not available in some wells. There does appear to be ambient water quality data from several upgradient wells and the number of downgradient wells available at the facility would meet the three-well minimum requirement. The parameter list does meet requirements. However, 40 CFR Part 258 (Subtitle D) and ARSD 74:27:19:06 do not allow ground water samples for metals analysis to be filtered. It is not known if the SDDENR has approved the monitoring for filtered metals for the SFRSL.

The annual reports do not reference certification by a qualified ground water scientist or engineer. Sampling procedures are summarized in the annual report, but well-specific information is limited.

ARSD 74:27:20 Assessment monitoring: Required at facilities that have detected a statistically significant increase in concentration of one or more parameters.

The 2001 and 2002 annual reports (LBG 2002a; 2003b) presents that several wells indicate ground water contamination, but the report does not refer to the need or the status of assessment monitoring. We understand from the City that the SDDENR has not determined or notified the SFRSL that assessment monitoring is required at this facility.

2.3.3 40 CFR Part 258

Specific monitoring requirements described in 40 CFR Part 258 are summarized below followed by comments as to the facility's status of compliance:

40 CFR Part 258.23 Explosive gases control: Describes monitoring requirements for facilities such as the type and frequency of monitoring that must be determined based on soil conditions, hydrogeologic conditions, hydraulic conditions, and the location of structures and the property boundary.

The monitoring described in the 2001 and 2002 annual reports (LBG, 2002a; 2003b) meets the frequency criteria and indicates structures are monitored. However, it is unclear whether the type and frequency of monitoring in wells and along property boundaries are based on soil, hydrogeologic, or hydraulic conditions. Monitoring wells may or may not provide adequate monitoring points for methane based upon the screened interval and the static water level in the well. Above ground monitoring at the property boundary does not take into consideration the soil, hydrogeologic, or hydraulic conditions.

40 CFR Part 258.50 Applicability: Allows federal requirements to be suspended by the State of South Dakota based on site-specific measurements and contaminant fate and transport predictions.

Although the State of South Dakota can suspend portions of the rules, the ARSD 74:27:19:03 specifically states that the ground water monitoring system must meet the requirements of 40 CFR Part 258.

40 CFR Part 258.51 Ground water monitoring systems: Monitoring systems should be placed in the operating record and certified by a qualified ground water scientist. Ground water monitoring systems must consist of a sufficient number of wells to yield ground water samples from the uppermost aquifer. When physical obstacles preclude monitoring the relevant point of compliance, the monitoring system may be installed at the closest practicable distance hydraulically downgradient ensuring detection of ground water contamination in the uppermost aquifer. Well construction should meet industry standards. Wells should provide representative background (or upgradient) data and represent the quality of ground water passing the relevant point of compliance as specified by the State of South Dakota (a maximum of 150 meters from waste). Monitoring systems should be based on orientation of landfill units, hydrogeologic setting, site history, engineering design, and type of waste. The number, spacing, and depths of monitoring systems should be based on site characterization data including: aquifer thickness, ground water flow rate, flow direction, and seasonal and temporal fluctuations in flow. Characterization should include definition of the geologic units in reference to thickness, stratigraphy, lithology, hydraulic conductivities, porosities, and effective porosities.

As stated in the preceding sections, the SDDENR approved a ground water monitoring plan in a letter dated June 10, 2002. A proposed change and a summary of the ground water monitoring plan was submitted to the SDDENR in a letter from LBG dated November 25, 2002 (LBG, 2002b). We understand from the City that the amended plan was approved as submitted. The ground water monitoring plan presumably meets the requirement of the operating record. However, the ground water monitoring plan in the November 25, 2002, letter does not provide certification or confirmation that the SDDENR has accepted the Wall Lake aquifer as the relevant point of compliance for the facility. It appears that all wells constructed between 1989 and 2002 meet minimum well construction requirements of the current South Dakota SDDENR Water Well Code.

Because the Wall Lake aquifer is greater than 150 feet below ground surface, monitoring the Wall Lake aquifer would not meet other technical considerations. The U.S. EPA's Technical Manual for Solid Waste Disposal Facility Criteria for 40 CFR Part 258 (U.S. EPA, November 1993) states:

- The objective of a ground water monitoring system is to intercept ground water that has been contaminated by leachate.

- Early contaminant detection is important to allow sufficient time for corrective measures to be developed and implemented before sensitive receptors are significantly affected.

Therefore, the closest practicable distance hydraulically downgradient is the weathered till hydrostratigraphic unit bounded by underlying low permeability clays. Monitoring and corrective action within the water table hydrostratigraphic unit would ensure protection of the uppermost aquifer.

Based on the November 25, 2002, ground water monitoring plan (LBG, 2002b), six wells were proposed for monitoring that would meet the criteria of upgradient wells. Typically, one well from each geologic unit would be sufficient for defining upgradient water quality. Therefore, the proposed background monitoring is exceeding regulatory requirements.

The available information (LBG, 1996a; 1996b; 1996c) indicates that the bottom of the waste (or proposed bottom of waste) in both the existing Active Area and the Expansion Area is approximately 30 to 60 feet below the water table. Downgradient wells at this site should be positioned to monitor a landfill below the water table (landfill orientation and engineering design criteria) and along preferred ground water flow paths within the low permeability glacial tills (hydrogeologic setting criteria). In disposal areas where leachate has been allowed to build-up within the landfill, there is a risk of leachate migration into both shallow ground water (lateral migration) and deeper ground water (downward migration at the landfill base) and therefore, the monitoring of both water table and deeper wells would be appropriate. Up to six-nested wells meet these criteria in the existing waste disposal areas. In the Expansion Area where leachate will be managed 12-inches or less above the bottom liner, the greatest risk of leachate migration is through the base of the landfill and monitoring deeper wells near the base of the landfill would be appropriate. Prior to the Cell 1 supplemental investigation in May 2003, only two wells met this criterion in the Expansion Area and these wells were not located downgradient of the first 10-acre cell (Cell 1).

The basis for the number, depth, and spacing of downgradient monitoring wells is not clear as presented in the amended ground water monitoring plan dated November 25, 2002 (LBG, 2002b). Although several wells were installed to define oxidized versus unoxidized ground water conditions, the available reports (Iles, 1989; Maxim, 1995; LBG, 1996a; 1996b) do not adequately characterize the site in reference to ground water flow rate and flow direction. Instead, the hydrogeologic assessment report for the Expansion Area (LBG, 1996b) states that the prepared ground water contour maps "should not be construed as indicating lateral ground water flow is occurring." Furthermore, Maxim (1995) concludes that based on the age of the ground water, there is very little ground water flow occurring in the vertical direction. Although the hydraulic conductivity of the oxidized and unoxidized tills does not appear to be conducive to yield significant quantities of ground water, contaminants are present in both units (probably from diffusion). Monitoring results from wells MW-19 and MW-19I in the central and northeast corner of the site verifies that ground water movement occurs and contaminants are able to migrate in the absence of significant sands.

Sufficient information appears to be available to adequately define hydrogeologic parameters at the water table such as ground water flow rate, flow direction, and seasonal and temporal fluctuations in flow. However, the limitations on the available data are related to interpretation and the following additional information:

- Well locations screened below the proposed base of the landfill expansion, and/or at the contact between the Wisconsinan and pre-Illinoisan-aged tills.

- In-situ hydraulic conductivity data for the over 350 acres (only 16 of the 70 wells were tested).

- Documentation of lithology in terms of grain-size distribution and Atterberg limits (the results from only four samples were available at the time of facility permitting).

- Use of the lithology to estimate porosity and effective porosity.

Although ground water maps are routinely generated (LBG, 1996a; 1996b; 2002a; 2003b), they do not consistently and accurately interpolate between data points. Location-specific flow rates and directions are not defined under the premise that any ground water movement is considered insignificant. Groundwater contours and water levels are not used to quantify horizontal and vertical gradients and the hydraulic conductivities are not used in conjunction with gradients to estimate the specific discharge and average linear flow velocities. This information is critical for the evaluation of contaminant fate and transport within the ground water system to allow appropriate corrective action measures to be designed.

40 CFR Part 258.53 Ground water sampling and analysis requirements: States that the monitoring system placed in the operating record should include consistent sampling and analysis procedures including techniques and procedures for sample collection, preservation and shipment, Chain-of-Custody control, analytical procedures, and quality assurance/quality control (QA/QC). The monitoring program should include methods that accurately measure hazardous constituents and be protective of human health and the environment. Monitoring must determine the rate and direction of ground water flow for each sampling event. Sampling should include background or upgradient data. The operating record should specify the proposed statistical method and evaluate data to determine if a statistically significant increase has occurred.

The ground water monitoring plan proposed in the November 25, 2002, letter (LBG, 2002b) does not outline procedures for sample collection, preservation and shipment, Chain-of-Custody control, analytical procedures, and QA/QC. Based on the information provided in the 2002 annual report (LBG, 2003b), sampling procedures are summarized and well-specific information limited. Modifications to field and the Chain-of-Custody forms were not completed per U.S. EPA guidance and the state of practice with edits blacked out and unreadable. However, the 2001 and 2002 annual reports (LBG, 2002a; 2003b) suggest that analytical methods are inconsistent and inadequate. The method detection limits vary over time and are often higher than the baseline causing a nondetect to be reported as a statistically significant increase.

In reference to QA/QC, field blank samples were analyzed to assure contaminants are not introduced from field equipment. Similarly, laboratory blanks and matrix spikes were used by the laboratory to evaluate quality control in the laboratory. However, trip blanks and duplicate samples were applied inconsistently to assure contaminants are not introduced during transport and to assure repeatability of the laboratory results. In addition, the applied analytical methods do not appear to be adequate for evaluating human health criteria because the detection limits for at least three parameters (antimony, beryllium, and thallium) appear to routinely exceed drinking water standards. Although the application of statistical methods appears thorough, it does not sufficiently distinguish natural occurring metals.

40 CFR Part 258.54 Detection monitoring program: Outlines the need for semi-annual detection monitoring for parameters in Appendix I. Alternative parameters and frequencies may be proposed based on waste constituents, pre-development water chemistry, lithology, hydraulic conductivity, ground water flow rates, distance to wells, and resource value of aquifer.

As stated above, the SDDENR approved a ground water monitoring plan in a letter dated June 10, 2002, and LBG proposed modifications to the plan in 2002 (LBG, 2002b). In general, the current monitoring program in reference to frequency of monitoring and the list of analytical parameters appear to meet the minimum monitoring requirements of the facility permit. Other than the addition of chloride to the analytical list, very little information is provided in the amended

ground water monitoring plan (LBG, 2002b) letter regarding the rational to the list of parameters or the frequency of monitoring.

40 CFR Part 258.54 Assessment monitoring program: Outlines the procedures and timelines to follow should statistically significant increase over background has occurred.

The 2001 and 2002 annual reports (LBG, 2002a; 2003b) presents that several wells indicate ground water contamination, but the report does not refer to the need or the status of assessment monitoring. Based on correspondence with the City, the SDDENR has not determined or notified the SFRSL that assessment monitoring is required at this facility.

2.3.4 Conclusions and Recommendations

Based on our review of available documents and our understanding of state and federal regulations, the following regulated issues appear to be consistent with the minimum regulatory requirements:

- Methane monitoring frequency.
- Ground water analytical parameters.
- Annual reporting.
- Monitoring portions of the Closure/Post-Closure Plan.
- Number of ground water samples for ambient water quality.
- Well construction.
- Laboratory QA/QC procedures.

However, information that is absent in the documents reviewed include:

- Methane monitoring in soil.
- Trip blank analytical results.
- Duplicate sample analytical results.
- Chain-of-custody documentation per U.S. EPA guidance.
- Facility compliance in reference to assessment monitoring.

In conclusion, the following observations were made concerning environmental monitoring at the SFRSL:

- Although the State of South Dakota can suspend portions of the rules, the ARSD 74:27:19:03 specifically states that the ground water monitoring system must meet the requirements of 40 CFR Part 258.

- Monitoring wells may or may not provide adequate monitoring points for methane based upon the screened interval and the static water level in the well. Above ground monitoring at the property boundary does not take into consideration the soil, hydrogeologic, or hydraulic conditions.

- The Wall Lake aquifer represents the uppermost aquifer and therefore, meets the designation of the relevant point of compliance. However, due to site-specific technical considerations and physical obstacles to monitoring this deep aquifer, the closest practicable distance for monitoring hydraulically downgradient of the disposal areas and still ensure protection of the uppermost aquifer is the water table hydrostratigraphic unit.

- The permitting documents do not adequately characterize the site in reference to ground water flow rate and flow direction. Although the hydraulic conductivity of the oxidized and unoxidized tills does not appear to be conducive to yield significant quantities of ground water, the presence of contaminants in ground water in several wells in the central and northeast corner of the site verifies that ground water movement occurs and contaminants are able to migrate in the absence of significant sands.

- Sufficient information appears to be available to adequately define hydrogeologic parameters such as ground water flow rate, flow direction, and seasonal and temporal fluctuations in flow. The limitations on the available data appear to be related to interpretation; however, adequacy of the monitoring systems could be substantiated with additional information on wells screened below the landfill expansion (including the contact between the Wisconsinan and pre-llinoisan-ged till), in-situ hydraulic conductivity data, lithology, and effective porosity.

- Not all available water level data is interpolated to define location-specific flow rates and directions. In addition, the contours and water levels are not used to quantify horizontal and vertical gradients and the hydraulic conductivities are not used in conjunction with gradients to estimate the specific discharge and average linear flow velocities.

- The basis for the number, depth, and spacing of downgradient monitoring wells is not clear.

- In disposal areas where leachate has been allowed to build-up within the landfill, there is a risk of leachate migration into both shallow ground water (lateral migration) and deeper ground water (downward migration at the landfill base) and therefore, the monitoring of both water table and deeper wells would be appropriate.

- In the expansion disposal area where leachate is or will be managed 12-inches or less above the bottom liner, the greatest risk of leachate migration is through the base of the landfill and monitoring deeper wells near the base of the landfill would be appropriate.

- The six nested wells in the Expansion Area that meet site-specific monitoring criteria are not adequate for monitoring the along potential preferential flow paths below the base of the landfill. Wells in May 2003 address this issue for Cell 1.

- Analytical methods are inconsistent and inadequate and cause failure in the application of statistical methods.

- Analytical methods do not appear to be adequate for evaluating human health criteria because the detection limits for at least three parameters (antimony, beryllium, and thallium) appear to routinely exceed drinking water standards.

- Although the application of statistical methods appears thorough, it does not sufficiently distinguish natural occurring metals.

Based on the above observations and conclusions, the following recommendations are made concerning environmental monitoring at the SFRSL:

1. Establish specific, permanent gas probes along property boundaries to evaluate methane migration.

2. Improve the characterization of site geology and hydrogeology to establish likely ground water flow paths, particularly below the proposed base grades in the Expansion Area. (See Section 2.1.6)

3. Prepare a site-specific monitoring plan ground water, surface water, leachate, and methane to outline all regulatory requirements pertaining to facility monitoring to be used by the City as well as those contracted to complete the work. To be of greater use to the facility and meet state of practice, the ground water monitoring plan should include additional information as follows:

    - Relevant point of compliance.

    - Monitoring network.

    - Monitoring frequency.

    - Monitoring parameters.

    - Statistical Methods.

    - Monitoring procedures including:

        - Sample collection.
        - Sample preservation and shipment.
        - Chain-of-Custody control.
        - Analytical methods.
        - QA/QC.
        - Certification of monitoring plan.

2.4 PRIMARY CONTAINMENT EVALUATION

The SFRSL was re-issued their permit to operate a solid waste facility by the SDDENR on November 26, 2002. Of the information outlined in the permit, one permit condition authorizes the use of an alternative liner system in lieu of a standard Subtitle D composite liner (40 CFR Part 258).

2.4.1 Design and Construction Requirements

The Administrative Rules of South Dakota (ARSD) 74:27:12:17 provides that the alternative liner system demonstrate compliance with 74:27:12:02. This rule states "facilities must be designed and constructed to protect human health and prevent degradation of the environment, including ambient groundwater quality, surface water quality, and air quality." Item 2.02 of the facility Solid Waste Permit authorizes the use of in-situ clay soils as an alternative liner system with the following conditions:

- A qualified third-party Professional Geologist or equivalent, experienced in the hydrogeology of glacial till, is present on-site during cell excavation to ensure that the in-situ clay soils are of the characteristics stated in the permit application.

- Any discontinuities in the in-situ soil, or any soil material which is more permeable than 1×10^{-7} cm/sec are over-excavated as necessary and an engineered soil liner with a permeability of no more than 1×10^{-7} cm/sec be constructed in that area.

- The outside sidewalls of the cell(s) are lined with a synthetic liner no more permeable than 1×10^{-7} cm/sec.

2.4.2 Liner Soil Characterization

The SFRSL lies within the Central Lowland Physiographic Province near the border between what is termed the James River Lowland and Coteau des Prairies. This area is characterized by the low plateau of thick glacial deposits underlain by a small ridge of resistant Cretaceous shale. The unoxidized till of the Wisconsinan-aged deposits is the in-situ soil thought to meet the criteria for the facility's in-situ liner.

Soils used for engineered liners must exhibit geotechnical properties conducive to achieving the required permeability and the liner must be constructed using procedures that attempt to assure uniform and continuous physical properties across the facility. Similarly, the uniformity, continuity, and the geotechnical properties of the in-situ unoxidized till should also be demonstrated if it is to be used in place of an engineered liner.

The glacial deposits that make up the soils at the SFRSL have been defined by about 150 soil boring locations over an approximate 350-acre area. Given that the expansion design includes base grades that range in elevation from approximately 1,480 to 1,500 feet, about six of those soil borings were extended to a depth below an elevation of 1,480 feet in the proximity of the 160-acre Expansion Area. Although geotechnical tests demonstrate a grain-size distribution and permeability similar to an engineered liner, only two sets of geotechnical tests were performed from actual soil samples collected at or below the proposed base grade. Similarly, standard penetration test data is only available below the proposed base grades at four locations on the Expansion Area. Furthermore, only one well screened below the proposed base grade was subjected to in-situ hydraulic conductivity testing with a result of 2.4×10^{-7} cm/sec,

slightly higher than the 1×10^{-7} cm/sec criteria. The available geotechnical data and permeability data does not appear to adequately characterize the geotechnical properties over a 160-acre area.

Although glacial till units can be uniform when laid down within certain depositional environments (Kemmis et al., 1979), the available data is not sufficient to confirm its uniformity and continuity at this site. The soil boring logs completed over the years are not detailed enough and do not apply a consistent logging procedure or classification from log to log such as the Unified Soil Classification System (USCS) or that described in ASTM D2488; therefore, it is difficult to even compare visual properties from log to log. Without supporting geotechnical data, the variability of the glacial till unit on the site produces doubt concerning its uniformity and continuity.

2.4.3 Ground Water Inflow

Although the lateral infiltration of ground water into the landfill through the sidewalls will be restricted by a geosynthetic clay liner (GCL), the permeability of a clay base may allow measurable infiltration to occur. During excavation of trenches on the Active Area, Davis et al, (1997) observed "significant accumulations of sand" in isolated pockets above the elevation of 1,500 feet that were saturated and were ultimately pumped for hours or several days after they were encountered by heavy equipment. Similarly, the sand bodies encountered at the base of the Cell 1 excavation (below 1,480 to 1,485 feet) were pumped for several weeks after they were encountered (LBG, 2003a). Because the expansion design includes base grades that range approximately 35 to 55 feet below the water table, the water removed from below the liner during construction is anticipated to eventually recharge. Excavation for each landfill cell below the water table and maintenance of 12-inches or less of head on the liner by the leachate collection system will ultimately induce an inward gradient. The induced gradient will promote inward flow to be intercepted by the leachate collection system.

It has been our experience at Brown County Sanitary Landfill (Aberdeen, South Dakota) under similar landfill conditions over the past 10 years that the potentiometric surface below the landfill has decreased because of the landfill construction and operation. The decrease in the potentiometric surface is probably due to a significant decrease in pressure head on the underlying soils as the saturated soils are removed and replaced with unsaturated waste. Reasonably, it would appear that a hydraulic head or gradient would be less than that currently measured between the liner elevation and the potentiometric surface.

Although the contribution of inflow at the Sioux Falls landfill to the overall leachate stream is difficult to predict, it should be noted that inflow could have some impact on the site, both operationally and financially.

2.4.4 Cell 1 Construction Documentation

Construction of Cell 1 was started in May 2001 and was completed in June 2002. A construction quality assurance plan (CQAP) was prepared and implemented for the project by HDR Engineering, Inc. (HDR, 2001a). LBG acted as a geologic consultant to HDR during the construction.

According to HDR's documentation report (HDR, 2003), the excavation of the cell was performed primarily by use of scrapers. When the excavation work neared the elevation of the in-situ liner, a representative of LBG performed observations to verify that the soil conditions complied with the construction documents and the permit. The documentation report states that soils identified as unsuitable were subcut 4 feet below the liner grade and replaced with recompacted clay.

During the construction, LBG identified four separate "sand bodies" at the base elevation of the cell. The conditions are documented in LBG's observation report (LBG, 2003a), which is included as an appendix to HDR's Construction Quality Assurance Report (HDR, 2003). A sketch provided in the observation report (also included in Appendix A of this report) indicates that the granular soils were present over more than one acre of cell bottom. The report indicates that soil borings performed at the time of construction encountered sand in one or more of the identified areas to a depth of approximately 15 feet below the base grade of the landfill. Boring logs were not included in the report.

2.4.4.1 Subcut Depth Criteria

The CQAP (HDR, 2001a) states, "unsuitable materials at the base of the landfill will be removed to a depth recommended by the Geologist (LBG) and replaced with compacted clay soils." The CQAP does not state if all unsuitable soil should be removed nor does it specify a minimum subcut depth. The 1996 solid waste permit application (LBG, 1996c) makes reference to the 4-foot subcut in the Construction Quality Plan, however the 2001 application (LBG, 2001) does not. It is our understanding that Cell 1 was constructed under the 1996 permit conditions.

2.4.4.2 Permeability Documentation of Clay Backfill

The documentation report (HDR, 2003) indicates that areas of the base of the landfill that were unsuitable were subcut and replaced with a 4-foot thick recompacted clay liner. Consistent with the CQAP (HDR, 2001a), the clay liner was indirectly tested for permeability using the "Daniel Method." The Daniel Method is a method of determining whether acceptable permeability is obtained based on water content and dry unit weight measurements. The recommended approach (Daniel, 1990) is based on defining water content-density requirements for a broad, but representative, range of compactive energy, and relating those requirements to hydraulic conductivity. The recommended procedure involves compaction and permeation of five to six soil samples at each of three different compactive efforts, or a total of 15 to 18 compaction/permeability tests for each type of soil to be investigated. Based on this data, an "acceptable zone" for moisture/density field measurements is established. The primary advantage of this method is to establish set criteria before construction begins, provide an easy way to verify compliance, and to allow greater flexibility in compaction and moisture conditions during placement of the material.

It is our opinion that the documentation report (HDR, 2003) is not conclusive in demonstrating that the specified permeability (1×10^{-7} cm/sec) was achieved in the recompacted areas of the liner. As stated in the report, the "acceptable zone" was initially established using only two hydraulic conductivity tests as opposed to the 15 to 18 tests recommended by the Daniel method. Initially, six of the nine moisture/density tests taken of the recompacted liner fell outside of the previously defined "acceptable zone." Several months after the construction was complete, three additional permeability tests were performed on samples to be used to "further define the acceptable zone." It is unclear how this data was applied to the Daniel method, but the documentation report uses it to interpret a "potential acceptable zone." The report states that using the "potential acceptable zone as a reasonable indication of acceptance, all but one of the nine (moisture/density) tests (taken of the compacted liner) passed." As mentioned in the documentation report, none of the three permeability tests conducted after the construction was completed met the requirement of 1×10^{-7} cm/sec or less.

2.4.4.3 Granular Drainage Layer

The granular drainage layer at the bottom of the landfill is intended to collect and convey leachate to a perforated leachate collection pipe and sump. The granular material must be sufficiently permeable to prevent buildup of head on the liner greater than 12-inches. The documentation report (HDR, 2003) and contract documents (HDR, 2000) indicated that the drainage layer material above the liner was to have permeability no less than 1×10^{-2} cm/sec. The CQAP (HDR, 2001a) indicates that the minimum testing frequency of the granular material for particle size (including p200) is one test per 1,500 cubic yards of material placed. One hydraulic conductivity test was required per borrow source.

Test reports for the granular drainage layer were not provided in the documentation report. The only reference to test results for the material was included in the field representative's daily notes taken on July 10, 2001. The representative indicated that the supplier (Mryl & Roys) reported that the permeability test for the granular layer was 1.3×10^{-3} cm/sec. This result is nearly an order of magnitude slower than what was specified. Without the actual test reports, it is unclear if the field representative's notes accurately report the permeability of the material that was placed. If it is accurate, the result may affect the calculated performance of the liner system that was presented in previous landfill permit applications (and amendments) and engineering studies regarding leachate management.

2.4.5 Cell 1 Supplemental Investigation

Earth Tech conducted further investigations of the Cell 1 in-situ liner and ground water monitoring system in May 2003. The analysis of this work is not yet complete and will be reported under separate cover. In addition to installing a more conservative ground water monitoring system for the cell, the investigation included sampling of soils at the bottom of Cell 1 to confirm that no significant sand bodies are present in areas that were not previously subcut and replaced with compacted clay during the initial construction. Direct push sampling was conducted at 12 locations to a minimum depth of 4 feet below the clay surface (5 feet below the surface of the granular drainage layer). The locations of the direct push borings are shown on a figure included in Appendix A.

The direct push sampling encountered fairly homogeneous dark gray lean clay at 7 of the 12 locations. Lenses or layers of sand were encountered within the clay at five locations, generally located on the eastern and western boundaries of the cell. Of the five test holes where sand was encountered, the sand was described as thin (1 mm) lenses at two locations (probes #1 and #5). Two other test holes had one- to two-inch lenses of sand present (probes #8 and #11). A 12-inch layer of sand was encountered 2 feet below the surface of the clay at one location (probe #10).

2.4.6 Conclusions and Recommendations

During the construction of Cell 1, significant sand bodies were encountered at and below the base of the landfill. Although visible portions of this material were subcut 4 feet and replaced with clay, it was not possible to know if adequate liner materials existed beneath the other portions of the cell unless either the in-situ soils were removed and replaced with an engineered liner, or sufficient characterization through drilling and probing was performed. The direct push probes performed in May 2003 identified sand seams and layers within relatively close proximity to the bottom of the cell in areas that were not previously subcut and replaced with clay.

The facility permit requires that any discontinuities in the in-situ soil, or any soil material that is more permeable than 1×10^{-7} cm/sec be over-excavated as necessary and an engineered soil liner with a permeability of no more than 1×10^{-7} cm/sec be constructed in that area. The permit language is not specific in how the presence of discontinuities and permeable soils should be addressed when they are present within close proximity below the liner surface but are not visible at the design base grade. Based on discussions with SDDENR staff at a meeting with the City on June 20, 2003, it is their opinion that the construction for Cell 1 met permit requirements for the in-situ liner.

2.4.6.1 Cell 1 Development Recommendations

Considerable investment has been made by the City in the construction of Cell 1. This includes substantial effort taken during the construction to remove sand that was encountered at the base of the landfill and to replace it with up to 4 feet of compacted clay. The presence of sand seams in areas that were not subcut does present some risk to the integrity of the liner system. However, we should note that investigations did not encounter sand seams at the most critical locations of the cell, which are along the leachate line trench and sump.

If the apparent uncertainty and potential risk associated with the construction are acceptable to the City, we recommend that the development and filling of Cell 1 proceed. To minimize potential risks, we recommend that Cell 1 not be used as a leachate collection point for upgradient cells. That is, the leachate collection system currently in Cell 1 will only service Cell 1. In comparison to the other cells, Cell 1 is considered to be relatively small in terms of waste capacity. The size has a direct bearing on the amount of leachate that can be generated, thus minimizing potential environmental and compliance risks associated with development of this cell. Future Cell 2 should be redesigned such that it has its own sump and leachate collection system that also services future upgradient Cell 3.

2.4.6.2 Future Cell Development Recommendations

The use of in-situ liner for future cell development is not recommended. Based on the current available information, there is no reason to believe that conditions similar to those encountered in the Cell 1 construction will not be encountered during the construction of one or more future cells. If the design remains unchanged, it is reasonable to assume that the liner for future cells will consist of a combination of in-situ soils and engineered clay liner (resulting from subcuts of unsuitable material). A uniform thickness of low permeable material cannot be assured under these conditions. The only way this can be assured is by requiring an engineered liner that completely covers the base grade and is integral to the sidewall liner.

Section 2.02 of the SDDENR Solid Waste Permit indicates that the operator "may" use in-situ clay soils as an alternative liner system. Presumably, the permit does not restrict more conservative liner systems (although a permit modification may be necessary in some cases). For future construction in the Expansion Area, we recommend that a more conservative liner system be implemented. The designs for a more conservative liner appropriate for this site will vary. Ultimately, the design that is chosen by the City will be based on cost versus the relative benefit in increased environmental protection.

What would be considered the "industry standard" liner system is described in the ARSD 74:27:12:17 (what the SDDENR requires if an alternative liner is not approved). This consists of a composite liner having a 60 mil geomembrane underlain by two feet of compacted clay with permeability of 1×10^{-7} cm/sec or less. It is our opinion that this type of liner is appropriate for this site.

If the City chooses to, other alternative liner systems, less conservative than the composite system described above, may be used. The sidewall liner, as constructed in Cell 1, appears to be well designed and provides reasonable environmental protection. For the base of the landfill, an alternative liner consisting of 4-foot thick compacted clay could be considered. This liner would be more conservative than the in-situ liner and offer more assurance that a uniform thickness of low permeable material is present beneath the waste. In lieu of subcutting the full 4 foot depth, the design could include in-place scarification and compaction of the bottom one foot, assuming that predominately clay soils are encountered. As required by the facility permit, the compacted clay liner should be designed for a permeability of no greater than 1×10^{-7} cm/sec. To meet this criterion throughout the liner, we recommend the following:

- Place liner soils in no greater than 8-inch thick loose lifts.

- Material distribution throughout should be free of lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from surrounding material.

- Use a sheepsfoot compacter that fully penetrates the depth of the loose lift. The sheepsfoot is intended to break up and homogenize the clods to minimize the formation of flow paths along clod boundaries. Use of scrapers or other heavy equipment that are not designed for compaction provides inconsistent compactive energy and unpredictable results.

- The "Daniels Method" was used in previous site construction to verify permeability results. If this method is used in future construction, we recommend that the method be followed to assure that compliance is met. If the method is not followed, we would recommend a more traditional approach that involves specifying a moisture range and minimum dry density along with permeability conformance testing. Alternatively, a properly documented test pad could be used to document field permeability.

- Clay should be compacted wet of the optimum moisture content in order to achieve the lowest permeability. However, if the clay is too wet, then it may be difficult to place and may rut excessively. If necessary, moisture conditioning may be required to reach the proper moisture content. Conditioning may be performed by disking the clay lift to allow drying or by adding water to increase moisture.

- Uniformly distribute moisture and disc each lift of clay material prior to compaction.

- Once the clay is placed, care must be taken so that the integrity of the liner is not compromised by either vehicular traffic or adverse weather. The overlying drainage layer (or in the case of a composite liner, the geomembrane) needs to be placed as soon as practical to prevent drying and desiccation cracking.

2.5 CLOSURE/POST-CLOSURE CARE PLAN EVALUATION

The City's current Closure/Post-Closure Care Plan for the landfill was reviewed. The plan was prepared by HDR Engineering (HDR) and is dated August 2001. The intent of the evaluation was to:

- Identify inconsistencies with applicable rules and regulations.
- Determine consistency of the plan with current processes and operations.
- Identify potential deficiencies in the plans.

2.5.1 Summary of Plan

The Closure/Post-Closure Care Plan (Plan) prepared by HDR provides a description of activities, schedules, and features related to closure and post-closure care of the Active Area of the facility. The Expansion Area is not included in this Plan. For closure and post-closure of the Expansion Area, the Plan makes reference to the Permit Application (presumably the most recent application dated August 2001).

In summary, the Plan for the Active Area presents the following items:

- Description of waste types, quantities, and closure schedule.
- Administrative procedures for closure and post closure activities.
- A description of engineering features included in closure of the facility such as capping system, surface water management, leachate management, gas management, etc.
- Post-closure monitoring and maintenance requirements.
- Cost estimates for closure and post-closure activities.

The Plan indicates that the MSW portion of the Active Area is nearly at capacity and will be closed in phases over a several year period, concluding in 2006. Disposal of C&D on the Active Area would continue in restricted use areas and over side slopes of the MSW disposal boundary until the final closure grades are achieved. The Plan indicates that the majority of the C&D area will be closed by 2018. Based on current acceptance rates, the Plan indicates that the Asbestos area could remain open through 2070.

As mentioned previously, the Plan does not specifically address the Expansion Area but rather, makes a single reference to other engineering reports and permitting documents. These include the landfill permit application (LBG, 2001), a leachate management evaluation report (HDR, 2001c), and "other documents prepared as part of the design, construction, operation and repermitting."

2.5.2 Compliance of Plan with Rules

The requirements for the Closure/Post-Closure Care plan are contained in ARSD 74:27:15. Based on review of the available documents, it appears that for the Active Area, the Plan meets the requirements of the ARSD. However, for the Expansion Area, reference to other engineering documents, specified and unspecified, does not constitute a Closure/Post-Closure Plan in accordance with the ARSD.

The Closure/Post-Closure plan is a required element of a solid waste disposal permit application (ARSD 74:27:09:03:5) as well as a Minnehaha County permit condition. A comprehensive Plan should be developed that includes both the Active Areas and the Expansion Area.

2.5.3 Consistency of Plan with Current Operations

The Plan (HDR, 2001b) outlines a closure schedule of the pre-Subtitle D MSW areas in the Active Area that started in 2002 and concludes in 2005. Final cover was applied to 25 acres in Phase 1 in 2002. It appears that closure of Phases II and III (approximately 32 acres and 14 acres, respectively) are consistent with the Plan and will likely be at final capacity and ready for closure in 2004 and 2005. An updated survey of the area would be required to more accurately determine the remaining capacity and time of closure.

The Plan indicates a closure date of 2006 for the area including the emergency cell. Since the emergency cell is separate from other MSW areas, it cannot achieve final contours of the facility without placement of C&D around and on top of the area. Technically, final closure of the emergency cells as well as intermediate slopes of the primary pre-Subtitle D MSW landfill will not occur until the areas are filled to final contours with C&D material. Based on discussions with SDDENR staff, it is acceptable to apply one foot of intermediate cover to these areas as an interim measure while developing the area with C&D material.

Another inconsistency with the closure schedule is that the Plan indicates that the last receipt of MSW in the Active Area is anticipated to occur around year 2003. Upon closing a landfill unit, ARSD 74:27:15:03 requires that the owner or operator complete closure activities within 180 days of the last receipt of waste. To comply with the ARSD, the Plan schedule should have initiated closure in year 2003 or 2004 for Phases II, III, and V. At this time, sufficient survey information is not available to accurately determine the remaining capacity of the MSW area, however it is expected that capacity is available beyond year 2003. The majority of the waste flow of MSW to the Active Area will likely shift to the Expansion Area as soon as it is operational. We assume that there will be a transition period when some MSW will continue to be directed to the Active Area in order to achieve the permitted grades for final closure.

The Plan indicates that Phase IV (the large C&D area located in the southwest quadrant) may close between year 2012 and 2018. Phase VI (the asbestos area) would close between year 2060 and 2070, presumably based on the amount of asbestos waste accepted (not C&D). The Plan does not include details on how these closure dates were calculated. Based on available 2001 survey data, we conservatively estimated that the combined volume of all restricted use areas in the Active Site are sufficient to provide C&D capacity (at least 45 years) well past the remaining operational life of the MSW disposal areas in the Active and Expansion Areas. A current site survey, accurate delineation of the disposal areas, and updated Closure Plan is necessary to more accurately estimate remaining capacity.

2.5.4 Closure Schedule

Proposed Schedule for Active Area Closure

The proposed closure phases for the Active Area are shown on Figure 2-1, included at the end of this section. The areas of the phases are approximations. Closure of Phases I, II, and III generally reflect HDR's Plan. For the remaining portion of the Active Area, we recommend that sequencing of closure and the areas of the closure be modified from the Plan as indicated on Figure 2-1. Phase IV includes the C&D area that is currently under development. As outlined in Section 3.0, Operational Assessment and Issues, we recommend that the compost site be moved from this area. This will allow continuous development of the existing C&D pit, which will maximize disposal capacity. During development of Phase IV, the Phase V area would have intermediate cover and could still be used for other site needs such as petroleum contaminated soils treatment, temporary storage of materials or stockpiles, continued use for asbestos disposal, and temporary placement of landfill gas collection infrastructure (it is expected that active gas extraction will also occur in the Emergency Cell).

Proposed Schedule for Expansion Area Closure

Although the Plan did not address closure of Expansion Area, a proposed schedule was included in the Leachate Management Plan (HDR, 2001c). That document proposed 12 closure phases over the 34-year landfill life. Based on our review of the development plans, we propose that the number of Phases be reduced from 12 to 10. This is intended to improve efficiency and control cost by enlarging some of the phases so that construction would occur in more reasonably sized areas. The proposed closure phases for the Expansion Area are shown on Figure 2-2, included at the end of this section. Note that construction of the first closure phase will not occur until the time that Cell 5 is active. From that time forward, with one exception (Phase 4), a closure phase is planned to occur at the time of development of each successive Cell.

2.5.5 Closure Design Issues

Based on review of HDR's Plan and other documents associated with SFRSL, there are a number of design issues associated with closure that should be considered in future permitting efforts and Plan revisions.

2.5.5.1 Active Area Waste Boundaries

During the process of developing this report, the City surveyed actual boundaries of waste within the Active Area. This survey is documented on an "activity map" that the City prepared July 18, 2003. The closure contours that were developed for the Plan (HDR, 2001b) were prepared without the benefit of this information.

The proposed waste boundary used in the Plan on the west side of the Active Area is highly irregular. This was presumably done during preparation of the existing Plan to avoid existing site structures and to maximize landfill capacity. In practice, construction of final slopes with sharp jogs is not recommended due to construction difficulty and the potential problems with long-term maintenance caused by channeling and erosion.

Future Plan revisions should take into account current topographic conditions, location of existing waste units, and placement of infrastructure (i.e., the proposed leachate loadout facility).

2.5.5.2 Cover Design

Active Area Cover Design

The permitted cover section for the Active Area is 18 inches of soil with permeability of 1×10^{-5} cm/sec or less covered with six inches of topsoil. Additional reduction in infiltration and resulting leachate generation could be realized by increasing the thickness of the cover. Considering the surplus of on-site clay soils, we recommend that the City consider increasing the cover thickness for future closure construction. Increasing the thickness by just six inches in the remaining areas to be closed (Phases II through V) will use approximately 100,000 cubic yards of additional soil.

Expansion Area Cover Design

The permitted final cover of the Expansion Area consists of 2 feet of clay soil placed in 1-foot lifts to permeability of 1×10^{-7} cm/sec or less. The compacted clay soil will be covered by a 1-foot granular drainage layer and 1 foot of topsoil or other material suitable to support vegetative growth. This permitted cover design exceeds the final cover standards outlined in ARSD 74:27:12:21. It is our opinion that the minimum requirements of ARSD are not adequate for this site and we support the use of the more conservative permitted cover system in the Expansion Area. However, obtaining permeability of 1×10^{-7} cm/sec or less on a cover can be difficult. The documentation report for construction of Cell 1 in the Expansion Area (HDR, 2003) suggested difficulty in achieving this standard (and that construction presumably occurred on a stable subgrade). Although low permeability is the goal, for future compliance reasons, the City should consider proposing to raise the permeability requirement (such as to 1×10^{-6} cm/sec) as part of future repermitting efforts. Construction dollars may be better spent providing a thicker layer of soil on top of the drainage layer that would result in a better rooting zone for vegetation.

2.5.5.3 Slopes

Vertical Expansion of Active Area

Regardless of the obvious benefit of gaining disposal capacity, it is our opinion that vertical expansion of the Active Area for the expressed purpose of increasing final slopes at the top of the landfill would be extremely beneficial. The current Plan provides for a final top slope of 2 percent with a slope length of 900 feet. In our experience, slopes this shallow are difficult to build and maintain. On a landfill, they are not sufficient to overcome the eventual subsidence of waste, resulting in ponded areas. On landfills with similar slopes, it is not uncommon to see wetlands forming on subsided areas. To help ensure positive drainage off of the landfill cap, a minimum slope of 5 percent is recommended.

It is our understanding the City and SDDENR agreed in principle that future waste filling would be done in the Expansion Area and no additional vertical expansion would be considered for the Active Area. We recommend that the City consider revisiting this issue with the SDDENR prior to closure of Phases II and III.

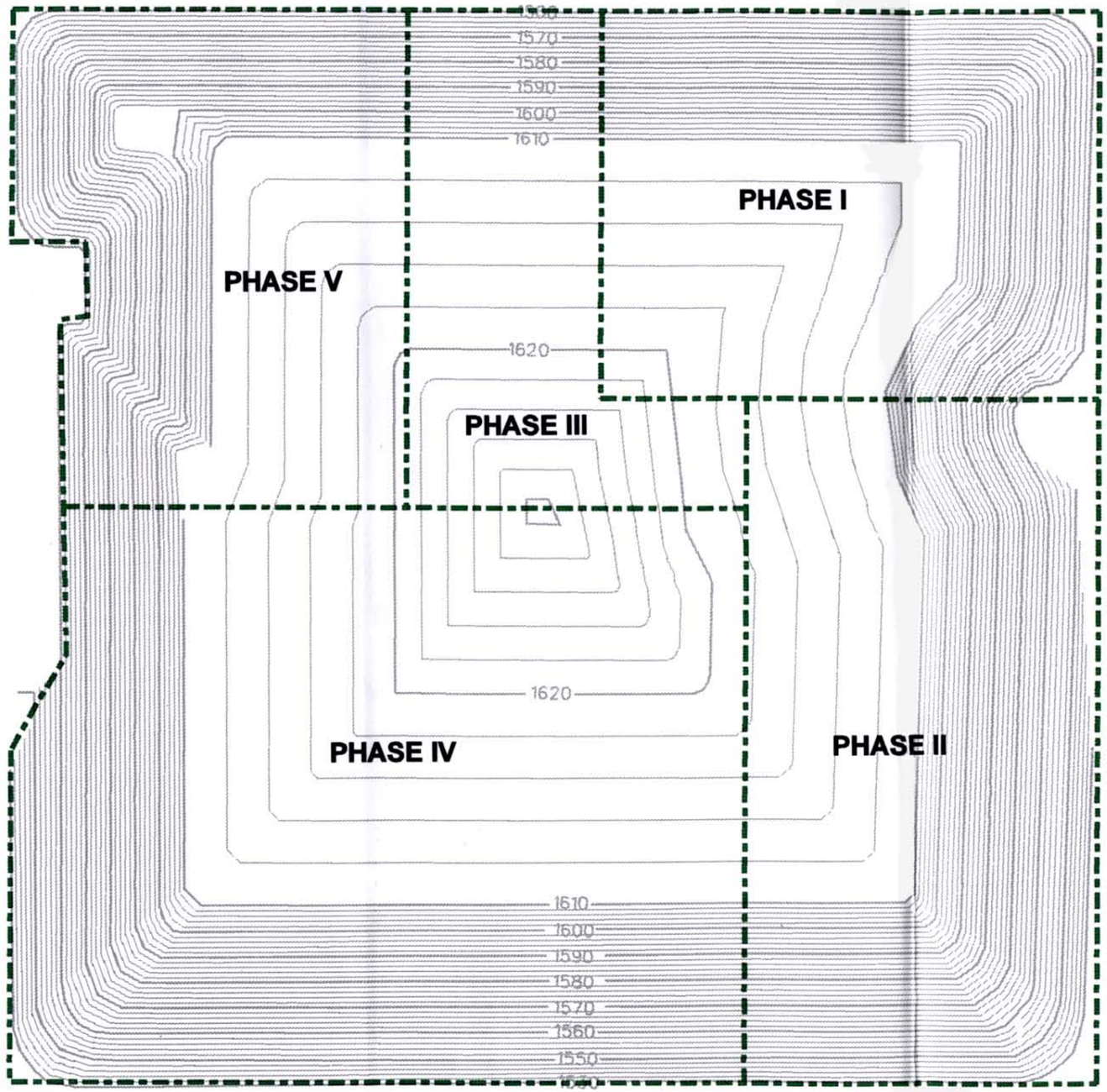
Redesign of Slopes in Expansion Area

Similar to the Active Area, the top slope on the Expansion Area is minimal. The development plan included in the 2001 permit application provides for a final top slope of 2.6 percent with a slope length of 1,080 feet. Also, a 300 foot portion of the top slope is only 1.3 percent. For reasons similar to those outlined above for the Active Area, we recommend that the design of the Expansion Area be modified to provide minimum slopes of 5 percent.

2.5.6 Conclusions and Recommendations

We recommend that the Closure/Postclosure Plan be updated to address the entire facility, including the Active Site and the Expansion Area. This updated Plan should be a comprehensive engineering document that is based on current surveyed site conditions. The drawings for the closure plan should be detailed enough so that they can be used by the operator for closure construction and staking of the final waste grades. For a complete design, the closure plan should include a complete analysis of storm water management features, including detailed location and design of all permanent surface water conveyance structures including; ditches, berms, letdown structures, culverts, and storm sewers. As approved by the City, the updated Plan could address the design issues discussed in Section 2.5.5 including:

- Revising waste boundaries in the Active Area.
- Modifying the cover section design in both the Active and Expansion Areas.
- Modifying top slopes in both the Active and Expansion Areas.



LEGEND

1570 — PROPOSED GRADES

PHASE CLOSURE BOUNDARY

CLOSURE PHASE	YEAR	AREA CLOSED
I	2002	24 ACRES
II	2004	32 ACRES
III	2005	14 ACRES
IV	2030	54 ACRES
V	2048	23 ACRES

NOTES:

1. CLOSURE PLAN BASE MAP IS FROM "CLOSURE/POST-CLOSURE PLAN FOR ACTIVE SITE" (HDR, 2001). THE AREAS AND PROGRESSION OF THE PHASED CLOSURE HAVE BEEN MODIFIED PER RECOMMENDATIONS OF THE MASTER PLAN. THE ESTIMATED YEAR OF CLOSURE IS BASED ON SITE LIFE ESTIMATES CONTAINED IN THE HDR REPORT AND APPROXIMATION BY EARTH TECH.

2. THE FINAL CLOSURE CONTOURS SHOWN ON THIS PLAN SHOULD BE CONSIDERED APPROXIMATE. MINOR MODIFICATIONS OF THE WASTE BOUNDARIES (PARTICULARLY ON THE WEST SIDE) WILL BE REQUIRED DUE TO CURRENT SURVEYED WASTE BOUNDARIES AND FUTURE PLANNED USES (I.E., LEACHATE STORAGE AND LOADOUT AREA, FLARE STATION ETC.).

3. AREAS OF PHASE CLOSURE ARE APPROXIMATE. A CURRENT SITE TOPOGRAPHICAL SURVEY, ALONG WITH CORRESPONDING DETAILED AND UPDATED CLOSURE PLAN WILL BE REQUIRED TO ACCURATELLY DEPICT CLOSURE PHASES.

N

APPROXIMATE SCALE: 1" = 300'

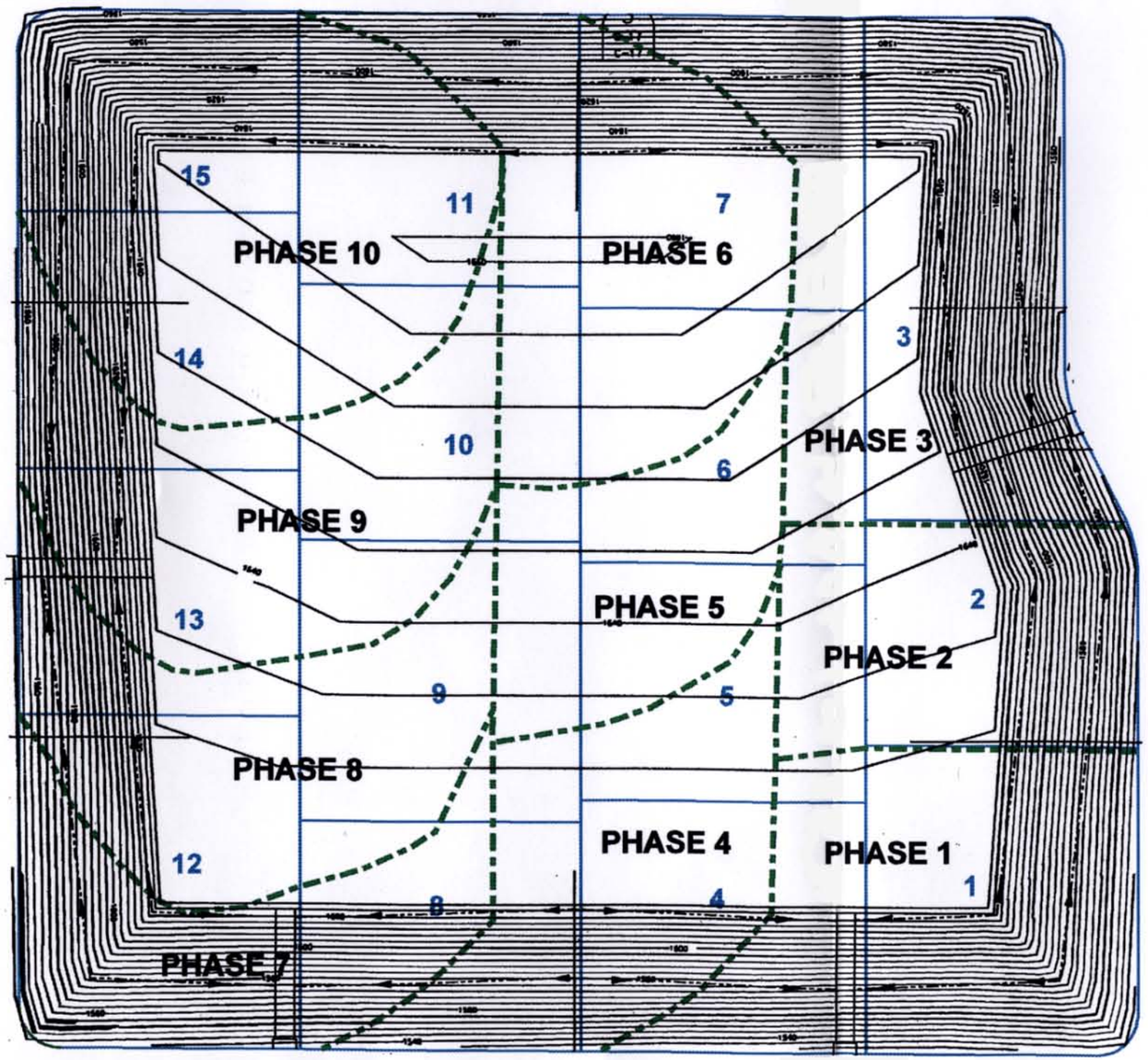
EARTH TECH

FIGURE 2-1
CLOSURE PHASING FOR ACTIVE AREA

SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS, SOUTH DAKOTA
OCTOBER 2003 SIOUX FALLS REGIONAL LANDFILL 63063

DATE = Mon Oct 20 11:36:24 2003

DGN: s:\work\sioux_falls\63063\cadd\sheb-ab\030811\fig2-1.dgn



LEGEND

PHASE CLOSURE BOUNDARY

CELL BOUNDARY

CLOSURE PHASE	CONDITION	YEAR	AREA CLOSED
1	CELL 5 ACTIVE	2014	12.9 ACRES
2	CELL 6 ACTIVE	2017	9.0 ACRES
3	CELL 7 ACTIVE	2020	17.3 ACRES
4	CELL 9 ACTIVE	2025	11.2 ACRES
5	CELL 10 ACTIVE	2027	7.6 ACRES
6	CELL 11 ACTIVE	2030	13.3 ACRES
7	CELL 12 ACTIVE	2032	9.0 ACRES
8	CELL 13 ACTIVE	2034	12.1 ACRES
9	CELL 14 ACTIVE	2036	12.2 ACRES
10	FINAL CLOSURE	2038	17.1 ACRES

NOTE:

1. CLOSURE PLAN BASE MAP IS FROM "SIOUX FALLS REGIONAL LANDFILL LATERAL EXPANSION DISPOSAL AREA FILLING PLAN" (HDR, 2001). AREAS AND PROGRESSION OF PHASED CLOSURE HAVE BEEN MODIFIED PER RECOMMENDATIONS OF THE MASTER PLAN. THE ESTIMATED YEAR OF CLOSURE IS BASED ON SITE LIFE ESTIMATES CONTAINED IN THE HDR FILLING PLAN.

N

APPROXIMATE SCALE: 1" = 300'

EARTH TECH

FIGURE 2-2
CLOSURE PHASING
FOR EXPANSION AREA
SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS, SOUTH DAKOTA
OCTOBER 2003 SIOUX FALLS REGIONAL LANDFILL 63063

DATE = Mon Oct 20 11:37:23 2003

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3.0 OPERATIONAL ASSESSMENT AND ISSUES

3.1 INTRODUCTION

On January 28 through 30, 2003, representatives from Earth Tech and Beck met with City personnel and observed operations at the SFRSL to obtain a better understanding of current operations and to make recommendations to the City to improve the operations. An Implementation Plan, which includes many of the recommendations contained in this section, along with estimated costs and the recommended year of implementation, is presented in Section 7.0.

3.2 LANDFILL OPERATIONS OVERVIEW

The following topics are discussed regarding landfill operations and related landfill features:

- Scale-House and Traffic
- Public Drop Off Area
- Existing Landfill (Active Area)
- New Cell Development
- Daily Cover
- Miscellaneous Waste/Recyclable Storage and Treatment Areas
- Leachate Management
- Landfill Gas Management
- Surface Water Management
- Litter Control
- Landfill Equipment
- Maintenance and Office Buildings
- Hours of Operation, Staffing, and Training
- Soil Stockpiles
- Buffer Land
- Surveying

3.2.1 Scale-House and Traffic

The new scale-house and three new scales were placed in operation in January 2003. The scale-house utilizes two personnel for customer service. The Landfill Manager's office is also located at the scale-house. Two incoming scales allow for the public to use one scale and pre-tared commercial haulers to use the other, thereby expediting the weighing process and improving traffic flow. Commercial customers have a bar code for each vehicle that is preprogrammed for tare weight in the City's software program to provide efficient processing of the commercial customers. The commercial operator punches in the type of waste being hauled from a menu on a display board mounted adjacent to the commercial scale. The City verifies the commercial truck's tare weight on a periodic basis.

Based on daily scale records, approximately 700 to 1,500 vehicles use the landfill during the busiest days of summer. The fee is $10 per pickup load and $5 per carload if the gross weight of the vehicle plus the materials is less than 7,500 lbs. Otherwise, the rate charged is $13.75 per ton. The public is offered one free opportunity per year to dispose of waste during the summer months. The free disposal opportunity is part of the City's proactive cleanup program. This program is estimated to cost the City approximately $120,000 in lost revenue based on the City's projections.

The following photograph depicts the scale and road.

The scale-house is at the north entrance just inside the gate. At the gate, the two-lane entrance road flares into the various inbound and outbound lanes. During the site visit (January 2003), a long queue was not observed. However, this area could become very congested during summer peak periods and on Saturdays.

This traffic pattern to the scale is restricted by the landfill entrance road layout and traffic lanes. The general public traffic may become congested with the present system requiring checking in at the scale both coming in and out of the facility and thereby restricting access to the commercial scale. Too many vehicles may result in blocking off the entrance gate. The City has purchased an 80-acre parcel adjacent to the landfill entrance road. With the purchase of this additional parcel, we recommend that the entrance road layout be altered to improve entering and queuing at the scale-house. The entrance road should be

widened to provide an additional traffic lane before the scale-house area. Widening of the road will allow vehicles better access to the incoming scales and will facilitate traffic flow during high traffic periods. This modification will consist of an additional traffic lane on the west side of the entrance road from the scale-house to the north for approximately 300 feet. The existing gate and fence will have to be relocated from its present location to north of the proposed traffic lane.

Vehicle speed can become a safety issue between the scale-house and landfill. The City has posted speed limit signs to attempt to limit vehicle speed. If these signs do not result in reducing vehicle speeds to reasonable levels, SFRSL may want to consider installation of speed bumps. However, these speed bumps can become an inconvenience to City staff and customers and a nuisance during snow removal.

The City staff stated that they plan to blacktop the segment of access road to the new cell (Cell 1) in the Expansion Area. Moreover, the access road into the new cell needs to be widened to allow for two-way traffic around the tight curves. The road improvements within Cell 1 are planned for construction in the fall of 2003. The paving will occur in 2004.

Dumpsters near the scale-house offer the public the opportunity to dispose of small quantities of materials at this location and thereby reduce some of the traffic to the working facility. This convenience is appreciated by the general public because it is efficient, safer, and a simple operation. The City should consider developing an opportunity for public drop-off customers to bypass the scale-house without going through the two-window system during high traffic time periods. One approach the City could consider would be for the scale attendants to have a pad of receipts for these transactions, this data could then be entered into the system later in the day as time allows.

3.2.2 Public Drop-Off Area

The traffic within the active landfill area is considerable. For efficient operations to occur, the amount of traffic from the public that the equipment operators and commercial haulers are subjected to should be minimized to the extent possible. We recommend an expanded public drop-off area be developed near the scale-house to minimize the need for the general public to haul their waste to the active disposal areas. This approach will be safer for the public, more convenient, and will reduce traffic within the landfill area.

One way of implementing the public drop-off is to stage a series of roll-off containers at the designated location east of the scale-house. Roll-offs should be provided for tires, metals, white goods, C&D materials, and MSW. In addition, compartmentalized containers should be provided for recyclable paper and commingled containers. An asphalt paved driveway and surface to place the roll-off containers on would benefit this operation. Signage should be used to direct the public in properly separating the waste (MSW, C&D, yard waste, etc.) into specific containers. We believe that this procedure will result in better separation of waste types (see Section 3.2.3.5 for waste separation discussion) as well as improve collection of recyclables. The roll-off containers can then be hauled to the working face when full or when convenient to the operator.

Since the proposed location of this operation is outside of the current permitted area, we anticipate that a permit modification will be required from the SDDENR and from the Minnehaha County Planning Department. In order to implement this project in 2004, the permitting activities should be started as soon as possible.

Figure 4-2, which follows Section 4 of this report, identifies the location of the proposed drop-off area. Estimated costs for the public drop off area, included in the Implementation Plan (Section7.0), are based on a two-acre area with crushed stone base and asphalt surface. Also included in the budget estimate is the purchase of 30 roll-off containers. A hook truck for hauling roll-offs between the drop off area and the landfill working face is included for purchase in 2003.

3.2.3 Existing Landfill (Active Area)

Waste is currently being placed in the Active Area, which includes MSW and C&D waste. The landfill is unlined and nearing its permitted capacity. The landfill received a projected 160,000 tons of MSW and 65,000 of C&D in 2002. Since 1996, the quantities of MSW received have increased approximately 2 percent to 10 percent annually. Waste filling is accomplished using the standard approach of filling in lifts, compacting the waste during placement, and minimizing the working face.

Final cover has been placed on the northeast corner of the landfill during 2002. The final cover consisted of 18-inches of compacted clay plus 6-inches of topsoil. Timing for the subsequent phases of final cover placement is tied to waste flow and the facility's closure plan. Closure of this area is further discussed in Section 2.5, Closure/Post-Closure Care Plan Evaluation.

3.2.3.1 Emergency Cells

Two unlined emergency cells have been used for MSW disposal when access to the primary working face of the Active Area landfill was too wet or inclement weather conditions such as snow storms or windy conditions prevailed. Although volume calculations have not been performed, we believe that the remaining capacity of these areas for MSW is small. If the City chooses to, we understand from SDDENR staff that these cells can continue to be used for filling of MSW, provided that they are not expanded laterally. Remaining landfill space between and on the side-slopes of the cells is designated for C&D material as provided for in the Closure Plan (HDR, 2001b).

3.2.3.2 MSW 1998 Expansion

We understand that in the year 1998, the City placed MSW waste in a 1.8 acre unlined portion of the site located between the asbestos area and the main pre-subtitle D portion of the landfill. The City informed the SDDENR of this and asked for approval to continue placement of MSW in this area in order reach more appropriate slopes (to prevent ponding) in preparation for the interim closure. It is our understanding that the SDDENR has indicated to the City that it will only allow placement of contaminated soil or C&D material in this area.

3.2.3.3 Asbestos Area

The City has a dedicated area for MSW and asbestos disposal located north of the emergency cells. The asbestos cell was originally developed to accept asbestos waste from some major building demolition projects in the City. Having a dedicated asbestos disposal area has the benefit of isolating the location of the asbestos within the landfill. Secondly, future drilling within the existing landfill for landfill gas/leachate wells can be accomplished with less concern about encountering asbestos. The asbestos area is very accessible and is located near the scale-house.

3.2.3.4 Construction and Demolition Waste Disposal

A dedicated C&D waste disposal area is provided to accommodate building construction and demolition projects. A new C&D cell was excavated in the southern portion of the Active Area in 2002. Although survey information was not available, the C&D pit appears to be at least 50 feet deep. It is our understanding during rainy conditions access to the pit is very difficult. During those times, traffic is directed to the above grade portion of the C&D area, located east of the pit.

3.2.3.5 Waste Separation and Handling

During our site visit, it was noticed that some of the loads of C&D and MSW were mixed at the working face. Based on our observations, we recommend that more effort be made to check loads and divert all "dirty" loads to the MSW fill. Any organic material that can degrade, creating leachate or landfill gas, or would attract vectors, should be placed in the MSW cell. Any construction debris or containers that would leach volatile organics should be placed in the MSW cell or managed through the HHW or Very Small Quantity Generator (VSQG) programs. The following two photographs reflect the present concern. The first photograph actually represents the MSW working face and the second photograph is the C&D fill working face. It was visually difficult to distinguish the MSW working face from the C&D fill working face during the observation period.

Photograph of MSW Working Face, January 2003

Photograph of C&D Working Face, January 2003

Based on our observations during the assessment, we recommend that the operator limit the amount of waste pushing with the compactor from the tipping area to the working face. The dozer or track loader should be used for that activity. The compactor should be used for compacting the MSW. This reflects a typical landfill operating practice that needs improvement at most landfills.

3.2.4 New Cell Development (Expansion Area)

The first cell of the Expansion Area has been constructed. The two planned remaining tasks to be accomplished prior to using the cell are to improve the access road into the cell to provide two-way traffic, and secondly install a leachate pump, storage tank, and loadout system to serve the cell. The storage tank can be integrated into the overall leachate management plan. This work is scheduled to begin in the fall of 2003 and will be completed in 2004.

In order to facilitate use of this new cell during the first few weeks of operation, we would recommend the following:

- To protect the liner, the first lift of waste (6-10 feet) should be select, non-bulky waste. Until this first lift is placed, the Active Area will need to remain open for placement of bulky material.

- Unless the access road is improved, customers may need to queue along the south perimeter road and then enter the cell road, one at a time, as a customer leaves. It would be difficult for two vehicles to pass each other on this entrance road, particularly on the curves.

- Place a granular soil pad in the northwest corner of the cell to allow customers to enter and back into the tipping area. The pad should be a minimum 150-feet north-south and 100-feet east-west. Initially, trucks would pull in pointing south. The vehicles would then back up to the east and tip at the edge of the pad. The waste lift would first move to the east and then to the south.

3.2.5 Daily Cover

The City applies Concover at the MSW working face after each day, Monday through Friday. Concover is a commercial daily cover that uses recycled paper mixed with water and is sprayed over the waste. The application of Concover takes about 20 minutes to spray over the waste. The following photograph shows the Concover material being applied to the working face.

Photograph of Concover Being Applied to Working Face

Soil cover is applied over the waste at the end of the operations on Saturday. This weekly placement of soil is not removed and usually is intermixed with the waste. The City estimates this soil volume at 70 to 100 cubic yards with a refuse to soil ratio of about 6:1. Per the industry standard, the refuse to soil ratio should be 5:1 or greater. Thus, if the actual refuse to soil ratio is 6:1 at the landfill, the City has exceeded the industry standard. The City does not apply daily cover to the C&D working face and this is consistent with similar landfill operations because there is no concern with vectors.

It is our understanding that sometimes the Concover is not used due to maintenance problems with the equipment. When that happens, soil is used for daily cover. When operations move to the Expansion Area, it will be important to minimize the amount of clay daily cover that is used. The use of too much clay daily cover will tend to limit opportunities, or reduce efficiencies for leachate recirculation or bioreactor development, should the City decide to pursue these options in the future. We recommend that the Concover be used as alternative daily cover to the extent possible. For the weekly soil cover, granular soils should be used to the extent they are available. Consideration should also be given to using wood grindings from the compost operation as alternative daily cover (refer to Section 3.2.6.3). If clay must be used (since it is the dominate on-site material), we recommend that it be used sparingly and then stripped off or mixed into the waste prior to continuing filling.

3.2.6 Miscellaneous Waste/Recyclable Storage and Treatment Areas

3.2.6.1 White Goods

White goods are stored in a designated area. Appliances containing freon have the freon removed by City staff for subsequent freon recycling. The white goods are stored until there is a sufficient quantity for a vendor to remove the goods for recycling. The City receives revenue from the recycled goods.

3.2.6.2 Tire Storage

A designated tire storage area is provided on-site. The steel belting of the tires is removed and the tires are chipped prior to being used as a fuel source at an electrical power plant located within the region. A recycling vendor is responsible for removal of the steel belting and chipping of the tires.

3.2.6.3 Composting/Wood Grinding

The City operates a 4 ½ acre compost site at the landfill to compost yard waste. During the fall, the facility receives large quantities of leaves that require temporary storage areas, not contiguous with the compost site, to be utilized. To allow for expansion of the compost site and to accommodate the seasonal fluctuations in materials, we recommend that the site be relocated from its present location in the Active Area to a location north of the Active Area (east of the scale-house). Relocating this outside of the Active Area would provide the further benefit of reducing traffic within the landfill and allow continued development of the existing area for C&D disposal.

Figure 4-2, which follows Section 4 of this report, shows the proposed relocated compost site on 10 acres north of the Active Area. Sufficient area is available to the north and east to expand the operations as necessary to meet future composting needs. Estimated costs for relocating the compost site are included in the Implementation Plan (Section 7.0) for year 2004. Costs are based on 10 acres of grading and general site preparation. Costs do not include paved surfaces.

Relocating the compost site will require a permit modification from the SDDENR and from the County Planning Department. Permitting for these activities should provide for the potential future expansion of these areas. In order to implement this project in 2004, the permitting activities should be started as soon as possible.

The tub grinder, which is shared with Brookings, is used to grind the brush to be subsequently composted. The compost and wood grindings are available to the public free of charge. Wood grindings can make suitable alternative daily cover. If the City is interested in using this material for daily cover, a modification to the solid waste permit may be necessary.

The City staff indicated the tub grinder has some limitations regarding capacity. It is our understanding that the grinder will process tree limbs no larger than 6-inches in diameter. In the past year, the City has accepted approximately 2,000 tons of material that was too large for processing by this equipment. The City obtained bids for outsourcing the grinding of this material that ranged from $10,000 to $14,000 (approximately $5 to $7 per ton, assuming 2,000 tons). A larger tub grinder capable of processing materials larger than six inches in diameter would likely cost more than $250,000 depending on size, horsepower, and other accessories. In addition, operation and maintenance costs for this equipment range from $5 to $10 per ton of material processed. Assuming that the 2,000 tons of material is a reasonable annual estimate for the City, the purchase of a larger tub grinder to process this limited amount of

material is not recommended. The City will be better served by outsourcing the processing of this larger sized material on an as-needed basis.

3.2.6.4 Petroleum Contaminated Soils Treatment

Petroleum contaminated soils (PCS) are segregated and placed in a designated area on-site. The soils are spread in a thin layer and disced to allow the volatile organic compounds in the soils to be released to the atmosphere. These soils are periodically disced until the contaminant levels in the soils are within regulatory compliance limits. These treated soils are then used for daily cover purposes in the landfill.

The current location for PCS treatment appears adequate. As the Expansion Area is developed, the future location for PCS treatment could be in various delineated sites on the Active or Expansion Areas that are accessible to the haulers.

Based on discussions with landfill staff, the disc used for the PCS is not adequate and should be replaced with a heavier disc to improve operations. Although we did not observe this operation, we believe that a heavy-duty disc would assist in these activities. The heavy soil types and quantity of material handled necessitate heavy-duty equipment. Considering the relatively low cost of a disc, we believe that replacement of the existing disc with a heavier one is a practical solution.

3.2.6.5 Deer Disposal Area

An unlined area on-site has been excavated and designated for deer carcass disposal. The concern with Chronic Wasting Disease (CWD) has resulted in meat processing plants needing to dispose of the deer carcasses. In the past, these carcasses were sent to a rendering plant. Approximately 25,000 deer carcasses were disposed in the designated area during the past hunting season in 2002. The deer disposal area has been surveyed by the City and is indicated on site activity maps. The area is located in the northwest corner of the Expansion Site, which happens to coincide with future Cell 15 (the last cell to be developed in the Expansion Area). Current projections indicate Cell 15 to be developed in 2036.

Over the past several years, a number of states have been addressing the disposal of deer due to the concern over CWD. The trend in some states, such as practiced in Wisconsin, is to dispose of the deer in a MSW landfill. Other states, such as South Dakota, prefer to dispose of carcasses separately in unlined monofills. Currently there is much unknown about CWD, but research is advancing at a rapid rate. For now, the City should continue with the disposal of carcasses within the future Cell 15 area. Between the present time and development of Cell 15, it is likely that further advances will be made in our knowledge of CWD and of the best available measures to deal with these issues.

If future research supports the disposal of carcasses by other means (i.e. disposal in MSW cell, or rendering), we recommend that use of the designated disposal site be stopped so that it can be developed as future Cell 15. At this time, we are unable to predict whether or not this will be possible.

3.2.7 Leachate Management

The existing Active Area does not have a conventional leachate collection system along its base. Although not under any State mandate, the City is proactively studying ways to pump leachate from the Active Area in order to reduce head (mounding) of leachate in the waste. Cell development in the Expansion area includes a leachate collection system designed to limit the head at the base of the cells to 12 inches or less.

A tank storage and truck loadout facility for leachate is planned for construction in 2003/2004. This facility will be used to manage leachate collected from the Expansion Area and potentially from a future extraction system in the Active Area.

Further discussion of leachate management options and recommendations are addressed in Section 4.9 of this report.

3.2.8 Landfill Gas Management

The Active Area does not have a landfill gas collection and control system nor was it required to under current air quality regulations. Based on discussions with site personnel and field observations, the landfill has not had odor problems typical of a MSW landfill. Usually landfills the size of SFRSL has active landfill gas extraction systems to control odor and gas migration, and to comply with state and federal regulations. Recent results of Teir 2 sampling (conducted in July 2003) indicate that the SFRSL is under, but very close to the trigger level of 50 Mg/yr of NMOC. Calculations indicate that SFRSL may exceed the 50 Mg/yr threshold in the year 2004, thus requiring collection and control of landfill gas. Recommendations for landfill gas management are discussed in Section 4.10 of this report.

According to site personnel, there is approximately 12.5 million cubic yards of MSW and C&D waste in the existing landfill. The approximate landfill dimensions are 40 ft. below grade and 80 to 90 ft. above grade. There are no landfill gas probes. Typically, landfill gas probes are placed at least on each side of the landfill and extending to the base of the landfill or to the water table, whichever is shallower. For larger landfills, multiple gas probes are installed along each side. The purpose of the gas probes is to monitor for gas migration. Landfill gas can migrate through the soils especially where sand or gravel seams or pockets exist. We recommend that the City install landfill gas probes and monitor them quarterly as part of the facility's landfill monitoring program.

3.2.9 Surface Water Management

Surface water on the landfill is routed around the perimeter to the south to a sedimentation pond. Although significant problems were not encountered during our site visits, it was difficult to determine if positive drainage was being provided in some areas. It is our understanding that excessive surface water run-on to the C&D area occurred during heavy rain events in 2003. It appears that the ditch system between the Active and Expansion Areas is not fully functional. We recommend that a comprehensive surface water management plan be developed for the entire site in conjunction with an updated closure plan. To accomplish this, an updated site topographic survey will be required. Additional discussion concerning this is included in Section 2.5.5, Closure Design Issues.

Water in contact with MSW when the new cell begins operation will need to be treated as leachate. Best management practices should continue to be followed for both the Active Area and the Expansion Area.

3.2.10 Litter Control

Control of blowing litter is a problem at most landfills, and SFRSL is no exception. Historically, SFRSL staff have expended significant time and effort responding to neighbor's complaints of blowing litter. Combinations of occurrences contribute to problem litter. Besides the wind, it is primarily related to size and operator control at the working face. The transition of MSW operations from the Active Area to the Expansion Area, and other operational changes should improve the landfill staff's ability to control litter.

Perhaps the biggest positive effect on litter control will be implementation of the public drop off area near the scale-house (refer to Section 3.2.2). Providing the public drop off will significantly reduce the amount of traffic at the working face. This will give the landfill operator much more control over the size of the working face and will help him to better direct the tipping of commercial loads.

Litter problems become worse when filling higher portions of the landfill. During development, it is important to dedicate more protected, generally lower, portions of the landfill for filling during very windy periods.

Temporary fencing near the working face is quite effective in controlling wind blown litter. Most common are a series of portable metal or wood framed fences similar to "backstops" at a ballfield. These are typically a minimum of 16 feet high and are moved into place as needed by the landfill heavy equipment. Other types of temporary fencing, such as construction fencing, are commonly used. However, the fence is shorter, labor intensive to set up, and is generally not as effective as the higher "backstop" type of litter fence.

As evidenced during our site visit, the perimeter chain link fence and perimeter shelterbelts are effective in preventing a large amount of litter from blowing off-site. However, picking up these areas is very labor intensive. The City has indicated their desire to purchase a litter vacuum to assist in these efforts. Our experience at other landfills is that litter-vacs work well and are cost effective. Even at facilities smaller than SFRSL, they have been a good investment. In the Implementation Plan (Section 7.0), purchase of a litter-vac is indicated on the equipment list in 2004.

3.2.11 Landfill Equipment

The City staff provided a comprehensive list of landfill equipment including heavy equipment, light equipment, trucks, and an equipment evaluation chart from the City's accountant. Also provided was a 5-year equipment replacement schedule and projected costs. Preliminary review reflects this plan appears complete and consistent with accepted replacement practices.

City staff had indicated a need for a larger compactor to improve waste density. Many similar and larger landfill operations are using larger compactors to maximize density and thereby save landfill space. The City is planning to purchase a new compactor with a 120,000-lb. rating. The compactor will provide improved waste compaction compared to the present equipment and will extend the landfill's site life through better compaction. We recommend that City proceed with the purchase of this larger compactor. Upon purchase of a new compactor, we recommend the existing compactor be retained and used for the management of construction and demolition materials in the C&D disposal area. It is our opinion that the SFRSL handles sufficient quantity of C&D and MSW, in separate areas, to warrant two compactors. It is also advantageous in that one compactor can be used as a backup in case the other compactor is down for maintenance or repair.

The other heavy equipment seems to be sufficient to operate the landfill. Maintenance service agreements are in place for the dozers, scrapers, hauler/loader to cover oil changes, 1,000-hour, 2,000-hour, etc. maintenance. Estimated equipment usage was reported to be 2,200 hours/year for the dozers and compactors and 1,500 hours/year for the scrapers. Butler Equipment (local Caterpillar dealership) located in Sioux Falls has a service agreement with the City for the landfill equipment, including preventative maintenance. This firm was reported to provide prompt service and thereby minimizes downtime of equipment.

Costs for fuel, parts, preventative maintenance, and repairs should be characterized on a per unit basis by dividing these costs by the machine hours (or miles) during a given period (e.g., year). Expenses can then be tracked to determine the cost per hour. This cost per hour should then be benchmarked to assess equipment maintenance costs, and tracked over time. The operating costs for the heavy equipment should be compared to the industry benchmarks of $25 to $35 per hour for compactors, $25 to $45 per hour for dozers, and $50 to $60 per ton for scrapers. These benchmarks are derived from the review of other heavy equipment operating costs used at landfills throughout the United States and applies to equipment of an age of three to seven years, maximum operating hours of 10,000 hours, and includes repairs and maintenance but excludes fuel and fluids.

Operating and maintenance costs for the City's compactor, dozers, and scrapers were reviewed for the time period of February 2002 through September 2003. Hourly costs were less than $10 per hour for each piece of equipment excluding fuel. All five pieces of equipment have been operated for 3 years or less by the City. Continued monitoring of costs is recommended as the total operating hours for the equipment continues to increase.

A variety of other comparatively minor equipment used at SFRSL (i.e. trucks, forklift, soil disc, etc.) are included on the City's 5-year equipment replacement schedule and/or are recommended. A listing of these and the other major equipment is included on the Implementation Plan included in Section 7.0 of this report. This listing includes a description of each piece of equipment, the proposed year for replacement, and the estimated cost. Further discussion regarding landfill equipment is included in Section 4.11, Future Manpower and Equipment.

3.2.12 Maintenance and Office Buildings

The existing buildings consist of a relatively new maintenance/office building and two older pole barns.

The maintenance/office building has heated and unheated areas for performing routine maintenance on equipment and vehicles. The truck with the Concover equipment for daily cover application is stored in the maintenance building. Sufficient office space, a break room, and a storage area for supplies are also provided. We recommend that the City consider relocating the Landfill Manager's office from the scale-house to the maintenance/office building to provide closer access between the Landfill Manager, the superintendent, and other landfill staff. The current Landfill Manager's office in the scale-house could be converted to file storage or possibly a break room.

The larger pole barn is in relatively good condition and can continue to be used for vehicle and equipment storage. The smaller pole barn could be relocated and used for compost equipment storage, if it is cost effective to relocate. The City should discuss this relocation with a local contractor to assess the cost to relocate the building. The smaller pole barn is located near the emergency cell. If the small pole barn is removed or relocated, this area could be used for other uses such as demolition waste placement or landfill support functions.

Based on discussions with City staff and a review of the City's landfill equipment, an additional Equipment/Maintenance Building would be beneficial. We recommend the design and construction of a five to six bay building to store and maintain the equipment. Figure 4-2 (following Section 4) shows the location of the proposed Equipment/Maintenance Building. A five bay facility with an area for garage, possibly office space, and loft for storage would be approximately 80 feet by 130 feet. This assumes 16-foot wide garage doors, four-foot space between doors, and a 30-foot wide garage/storage area. It is critical that the surface of the floor be designed to handle heavy equipment and facilitates the cleaning of

the equipment. The City should also consider installing an overhead crane for equipment maintenance. The extent of heavy equipment and supplies on-site justifies this new building based on similar size landfill operations. We recommend the actual building size and features be determined during final design that includes further programming of City needs. During final design, the City should consider including a conference/meeting room for staff meetings, training, and meetings with landfill managers and supervisors.

3.2.13 Hours Of Operation, Staffing, and Training

The SFRSL is open to the public from 8:00 a.m. to 4:30 p.m. during the fall, winter, and spring, and 7:30 a.m. to 5:15 p.m. Monday through Saturday during the summer months. The landfill is closed on New Year's Day, Fourth of July, Thanksgiving, and Christmas. The City is considering closing the landfill on Memorial Day and Labor Day. The commercial haulers have expressed some concerns about being closed on these holidays. However, most landfills are closed on major holidays, such as Memorial Day and Labor Day.

Six operators and four service workers report to an Operations Manager. The City also plans to add another equipment operator when the new compactor arrives. The operators work four 10-hour days, from 7:30 a.m. to 6:00 p.m. Wednesday and Thursday are overlap days. This approach is used at other similar facilities and generally results in offering an efficient staffing approach if the overlap day is generally a high volume, high traffic time period.

The service workers shift is reported to be 7 a.m. to 3:30 p.m., five days per week. Staff arrives early to fuel equipment and then do odd jobs as needed with equipment or around the landfill. They also may staff the scale-house. A part-time litter picker and part-time laborer for Freon removal reports to the Operations Manager. They work 20-30 hours per week. At the scale-house, two full time attendants, one part-time attendant, and a technical clerk, report to the Landfill Manager.

Overall, staffing appears to be appropriate for a facility of this size at this time. Additional staff may be required over the next few years as leachate and landfill gas management systems at the landfill come online and recycling efforts are improved. It is anticipated that one person will be dedicated to operate and maintain the landfill gas extraction and leachate collection systems for the Active Area. Based on projected volumes, a person half time will be needed to haul leachate to the City's water reclamation plant. When the landfill gas system is operating in the Expansion Area, staffing needs should be reviewed to determine if additional manpower will be needed. If a gas to energy project is implemented in the future, additional staffing may be necessary depending on the type and scope of the project.

The City has compiled a document of standard operating procedures and has a program in place to train staff and keep the procedures updated as necessary. Based on our observations during the operational assessment, landfill staff appeared well trained in their duties and only one specific area of additional training was identified. Scale-house staff should undergo further training to better differentiate between MSW and C&D materials (refer to Section 3.2.3.5, Waste Separation and Handling) so that these materials can be directed to the correct disposal area. If the City wishes to supplement on-site training, it could provide additional opportunity to operators and managers to attend continuing education courses such as those offered by the Solid Waste Association of North America (SWANA). Perhaps the most useful informal training for operators would be to provide opportunities for staff to visit other similar sized, well-operated landfills in order to network and observe how other facilities deal with similar issues.

3.2.14 Soil Stockpiles

A substantial soil stockpile exists on the Expansion Area. The landfill will need some soils for final cover and daily cover, but there appears to be a major soil surplus. The U.S. Army Corps of Engineers was interested in soils for the flood improvement project in Sioux Falls. It appears to provide an opportunity for the City to share the soil resources and reduce the City's future cost to relocate the stockpile as cell development occurs in the stockpile area. Additional discussion on soil needs, stockpiles, and quantities is provided in Section 4.4, Soil Storage and Usage.

3.2.15 Buffer Land

The City owns considerable acreage surrounding the landfill operations. This property serves as a buffer zone, shelter belt, future landfill area, or future related support areas. We understand that purchase of additional properties by the City is underway. Additional discussion and recommendations concerning buffer land is included in Section 4.8, Land Acquisition and Buffer Areas.

Management of the City's properties for landfill related operations and buffer zone is an important function. Some buffer area is currently rented to farmers for crops and other areas are kept in a natural state for wildlife habitat. The following discusses the advantages and disadvantages with these buffer zone management practices.

3.2.15.1 Farming the Buffer Areas

The City can farm all or some of the buffer areas through rental of the property to farmers or farming the property using City staff and equipment. The City does not appear to have the staff or farming equipment to properly farm these areas. Therefore, rental of the property appears to be the more prudent approach. The advantages with such an approach are the City receives an income from the property, the farmer maintains the property, and weeds are controlled. The disadvantages are the City loses some control over the property. Depending upon the crop, the City may have a difficult time picking windblown paper from the property, thereby creating problems with windblown paper, and straining relationships with the public and renter. Therefore, the income from the property rental must be offset by the disadvantages in controlling windblown paper.

3.2.15.2 Planting Native Vegetation

A second management option is to plant sorghum or native vegetation such as prairie grasses, flowers, or other plants that can benefit wildlife. The advantages are the City maintains full control of the buffer lands for management and control of windblown paper. The maintenance of the native species is generally low thereby minimizing the City's investment. Wildlife benefits from these areas are the providing of an important food source, nesting habitat, and provide year-round wildlife habitat.

Some landfill owners have partnered with conservation and hunting organizations to assist in the development of such habitat as a public relations and environment conservation project.

3.2.16 Surveying

Based on our site visits, discussions with City staff, and our review of documents concerning this site, it is evident that development and use of an updated site survey database has been deficient in the past. Current survey information is extremely helpful for the daily operations of a landfill and is a requirement for design drawings and site investigations.

We recommend that an aerial survey be conducted for entire site on an annual basis. The map developed from this survey should include topographic contours (2-foot maximum) as well as site features normally depicted from aerial surveys such as roads, buildings, fences, stockpiles, etc.

As the Active Area reaches final grades, it is important to provide adequate grade staking for the operator to reference during placement of waste. At a minimum, grade stakes should be placed on an established grid system that corresponds with the approved closure plan. It is our opinion that the current closure plan is not adequate for this purpose and we recommend that an updated plan be prepared. The drawings for the closure plan should be detailed enough to be used for closure construction and for staking of the final grades.

Monitoring well and soil boring locations should also become part of the survey database and should be updated as needed. It was discovered during recent fieldwork by Earth Tech staff that certain monitoring wells were not present in the field at the relative locations indicated on the site map provided for our use. Further, the recent survey of new monitoring wells installed in 2003 included elevation of the top of outer casing, not the inner casing as is required for consistent and accurate measurement of water levels. These findings raise doubt as to the validity of the existing monitoring well survey data, particularly since the data was likely gathered over a period of many years. We recommend that all monitoring points be re-surveyed during one event to assure that the survey data accurate. The northing and easting coordinates should be obtained to within typical map accuracy standards. The elevation of the monitoring wells must be determined at the top of the inner casing (with the cap removed) to an accuracy of 0.01 feet.

3.3 SUMMARY AND RECOMMENDATIONS

Overall the SFRSL and its operations appear to be operated relatively efficiently as compared to similar type and size landfills. Working face equipment operation and airspace utilization was efficiently utilized during our site visit. Moreover, it appeared based on our review of available information and data that record keeping practices for equipment and personnel had improved over the last 12 to 18 months.

To improve the facility's overall operations, the following is a summary of our key recommendations:

- Reconfigure the entrance road at the scale-house and upgrade the road from the scale-house to the working face to facilitate traffic flow.

- Develop a public drop-off area near the scale-house to minimize the need for the public to haul their waste to the landfill disposal area.

- Modify the present standard operating procedures to minimize the quantities of non-construction and demolition materials (i.e., organics) being deposited in the unlined C&D disposal area.

- Upgrade the access road by widening the road for two-way semi-truck traffic for the gravel segment to Cell 1. This improvement is being implemented in 2003. Paving the perimeter access road is recommended for 2004.

- Move the compost area from its present location to an area east of the scale-house to allow more space for composting and to allow continued development of the C&D area. Consider using wood grindings from this operation for alternative daily cover. Outsource the processing (grinding) of wood that is too big to be processed by the City's existing tub grinder.

- Move forward with the design and implementation of a leachate collection system to ensure best management practices. In particular, a leachate storage and loadout facility will be constructed for Cell 1 in 2003 and 2004.

- Install landfill gas monitoring probes around the perimeter of the landfill and monitor them as part of the facility's monitoring program.

- Develop a comprehensive surface water management plan for the entire site in conjunction with an updated closure plan.

- Move forward with the purchase of an additional, larger compactor for the MSW area to increase waste density and maximize the landfill site life.

- Proceed with the proposed equipment items identified in the Capital Improvements Program and the Implementation Plan (Section 7.0) to maintain efficient operations.

- Continue to monitor the cost effectiveness of the present landfill equipment maintenance service agreement by benchmarking the per hour operating costs for the various types of heavy equipment over the next 12 to 24 months.

- Move forward with the design and building of a new equipment/maintenance building to ensure optimal space for the maintenance and storage of all the landfill equipment.

- Consider relocating the Landfill Manager's office to the existing maintenance/office building to provide closer access between the Landfill Manager and landfill superintendent.

- Continue to communicate with the U.S. Army Corps of Engineers to have the Corps use about 1 million cubic yards of surplus soil from the landfill stockpile for the flood control project in Sioux Falls.

- Continue with the adjacent property acquisition program to ensure an adequate buffer zone for future landfill expansion and landfill support facilities.

- Contract annual aerial surveys of the site and provide adequate survey control and closure plans to site personnel. Update surveys of monitoring wells to required accuracy standards.

4.0 LANDFILL DEVELOPMENT AND LONG TERM MANAGEMENT

This section addresses landfill development and long-term management. This includes a series of drawings and descriptive narrative that address the present day through 20 years of development, at 5-year time intervals.

The development plans were prepared to show existing site conditions and proposed future development and phased closure. These are included as Figures 4-1 through 4-9, following the text of this section. An Implementation Plan, which includes a summary of recommendations contained in this section, along with estimated costs and year of implementation, is presented in Section 7.0.

4.1 EXISTING CONDITIONS

The Active Area is unlined and is currently being utilized for the disposal of MSW and C&D. The MSW disposal areas within the Active Area will soon reach the permitted grades and will, therefore, be closed in phases over the next few years. Disposal of C&D in the Active Area will continue until final grades are achieved. The estimated operating life in the Active Area for C&D disposal is at least 45 years.

Future disposal of MSW is planned to occur within the 160-acre Expansion Area located to the west of the Active Area. The Expansion Area is estimated to have capacity for an operating life of approximately 34 years. Construction of the first cell in the Expansion Area was completed in 2002, with the exception of a leachate removal and management system that is planned for fall of 2003. Landfilling operations in Cell 1 has not yet begun.

4.2 EVALUATION OF VERTICAL EXPANSION IN ACTIVE AREA

The approved final grades of the Active Area, in accordance with the City's closure plan (HDR, 2001b), are shown on Figure 2-1 in Section 2 of this report. It is our understanding the City and SDDENR agreed in principle that future waste filling would be done in the Expansion Area and no additional vertical expansion would be considered for the Active Area.

Earth Tech did evaluate the potential for additional vertical expansion of the Active Area. From an engineering standpoint, there is potential additional landfill capacity in excess of at least 1 year. Considering the City and SDDENR's understanding, it may not be politically feasible to pursue the vertical expansion. However, as outlined in Section 2.5.5.3 of this report, increasing the top slope of this area would have significant benefits with regard to cover efficiency and long term maintenance of the cap. We recommend that the City revisit this issue with the SDDENR to determine whether or not this is an option (from a regulatory standpoint) worth pursuing.

4.3 PROPOSED SITE DEVELOPMENT

Earth Tech reviewed the site development design presented by HDR in their Leachate Management Evaluation Report (HDR, 2001c). Other than closure phasing and design issues (refer to Section 2.5, Closure/Post-Closure Plan Evaluation), we concur with the cell sequencing outlined in the HDR report. The Expansion Area is 160 acres of which 122 acres will be developed as 15 different cells for MSW disposal.

The development of the facility over the next 20 years is presented in a series of sequential drawings showing various stages of development. Figures 4-1 through 4-5 show the stages of major developments

for the entire site starting in 2003 and continuing every 5 years until 2023. The cell development sequence for the Expansion Area is based site life and capacity estimates included in HDR's development plan (HDR, 2001c). Although proposed locations for landfill facilities are shown on the Development Plans, actual locations and areas required may vary and will be up to the discretion of the City.

The locations of improvements and activities shown on the development plans are for planning purposes and should be considered conceptual. Further design and programming will be required prior to implementation. As recommended in Section 3.2.16, all future design work should be based on updated, current site surveys.

Current Conditions, Year 2003

Figure 4-1 shows the current, 2003, development of the site. Locations of site activities were updated by the City in a survey on July 18, 2003. Phase I on the Active Area has received final cover. Cell 1 is constructed in the Expansion Area, but the Active Area is still being filled. A clay stockpile exists to the west of Cell 1. The petroleum contaminated soil (PCS) treatment area, tire storage, and the white goods staging area are located in the southern portion of future Cell 3.

Years 2004 Through 2008

Figure 4-2 shows the future development of the site in the year 2008. Development features notable to this drawing include the following:

- The proposed Phase II and Phase III Closures on the Active Area are shown to be completed (refer to Section 2.5). Phases II and III are planned for closure in 2004 and 2005, respectively.

- C&D will be placed in Phase IV of the Active Area (refer to Section 2.5 and Figure 2-1).

- If needed, a wetland mitigation area is proposed to be in-place on City property located east of the Phase I (Closed) Active Area (refer to Section 2.2.4).

- The compost site has been relocated to the area directly east of the entrance/scale facility (refer to Section 3.2.6.3). It has been expanded from approximately 4.5 acres to approximately 10 acres to better accommodate fall leaf volumes.

- The entrance road before the Scale Facility has been widened to improve traffic patterns approaching the incoming scales (refer to Section 3.2.1).

- Located adjacent to the relocated compost facility is a new public drop-off area where residents will be able to deposit MSW, recyclables, white goods, tires, and compostables without having to enter the landfill and mix with commercial haulers and semi-transfer trailers (refer to Section 3.2.2).

- The Landfill Gas Management System has been constructed within the Active Area (refer to Section 4.10), and the landfill gas blower and flare have been installed at the west side of the Active Area, east of the main entrance road.

- A new Equipment/Maintenance building has been constructed north of the current maintenance building (refer to Section 3.2.12).

- Cells 1, 2, and 3 are constructed in the Expansion Area. Cells 1 and 2 are filled to final grades (final outer slopes and intermediate inner slopes) with temporary or daily cover in-place. Cell 1 was constructed in 2002. Cell 2 is planned for construction in 2005 and Cell 3 in 2007.

- The perimeter landfill access road in the Expansion Area will be constructed along with each new perimeter landfill phase constructed. The perimeter access road will be asphalt, which will improve access in all weather conditions.

- The leachate storage and loadout facility has been constructed at the southwest corner of the Active Area and is collecting leachate from Cells 1, 2, and 3 in the Expansion Area. Construction of this facility is planned in 2003 and 2004. We anticipate that a leachate collection system will also be in place for the Active Area in 2004 and the leachate removal from the Active Area will be ongoing. Also, a leachate treatment strategy should be decided on and in-place (refer to Section 4.9). Although the treatment system has not been selected at this time, we recommend truck hauling to the WWTP for the next 5 years, at least. At that time, the other treatment alternatives should be re-evaluated. Currently, no other treatment option is shown on the future development plans.

- In the Expansion Area, the clay stockpile will have been removed from west of Cell 1 (see Section 4.4). Soil stockpiles resulting from the excavation of Cells 2 and 3 have been created on the City property located north of the Expansion and west of the new entrance facility. Some of the soil excavated from Cells 2 and 3 will have been used for closure construction of Phases II and III in the Active Area.

- The tire storage and white goods staging areas have been relocated east of the Maintenance Building. These areas provide reasonable access from the Maintenance Building for staff to remove freon from the white goods. Also, there is adequate space for staging both the tires and the white goods prior to them being hauled off for recycling. Although these areas are part of the landfill and will eventually be occupied by C&D waste, filling in this area should not occur for at least 20 years (refer to Section 2.5 and Figure 2-1).

- Although a specific area is not shown on the figure, petroleum contaminated soils may be treated at various delineated areas on the Active or Expansion Areas that are accessible to haulers and adequate for treatment purposes.

- It is not expected that Emergency Cells will be required in the Expansion Area and therefore, one is not shown.

Years 2009 Through 2013

Figure 4-3 shows the future development of the landfill in the year 2013. Development features notable to this drawing include the following:

- Cells 1, 2, 3, and 4 have been constructed and filled to capacity (final outer slopes and intermediate inner slopes) with temporary or daily cover in-place. Cell 5 has been constructed and will be receiving waste. As indicated in the Implementation Plan (Section 7.0), Cell 4 is planned for construction in 2009, and Cell 5 in 2011.

- Soil stockpiles remain on the City property located north of the Expansion Area.

- C&D will continue to be placed in Phase IV of the Active Area (refer to Section 2.5 and Figure 2-1).

- Although a specific area is not shown on the figure, petroleum contaminated soils may be treated at various delineated areas on the Active or Expansion Areas that are accessible to haulers and adequate for treatment purposes.

- Property to the west and south of the site will have been purchased by the City (refer to Section 4.8). The drainageway from Wall Lake that transects the southwest corner of the Expansion Area has been abandoned and relocated on the purchased property. We recommend that this work be completed prior to development of Cell 4. The relocated drainageway may provide mitigation opportunities and, therefore, will meander as much as practicable on the purchased property. As the relocated drainageway approaches the existing drainageway south of West 57th Street, we propose wide meanders and creation of a mitigation area.

- A Landfill Gas Management System will be constructed in year 2013 within portions of Cells 1, 2, 3, and 4 (refer to Section 4.10).

Years 2014 Through 2018

Figure 4-4 shows the future development of the landfill in the year 2018. Development features notable to this drawing include the following:

- Final cover Phases 1 and 2 in the Expansion Area have been placed over Cells 1, 2, and portions of Cells 4, 5, and 6. The remainder of Cells 3, 4, 5, and 6 have intermediate or daily cover in-place. Closure construction of Phases 1 and 2 are estimated to occur in the years 2014 and 2017, respectively.

- Cell 7 has been constructed and will be receiving waste. Cell 7 construction is expected in year 2017.

- Soil stockpiles remain on the City property located north of the Expansion Area. Some of the soil excavated from the cell construction will be used for closure construction of Phases 1 and 2 in the Expansion Area.

- C&D will continue to be placed in Phase IV of the Active Area (refer to Section 2.5 and Figure 2-1).

- Although a specific area is not shown on the figure, petroleum contaminated soils may be treated at various delineated areas on the Active or Expansion Areas that are accessible to haulers and adequate for treatment purposes.

Years 2019 Through 2023

Figure 4-5 shows the future development of the landfill in the year 2023. Development features notable to this drawing include the following:

- Closure construction in the Expansion Area continues with Phase 3. At this time, final cover has been placed over Cells 1, 2, and 3, and portions of Cells 4 through 7 (i.e., those portions that have reached final grades). The remainder of Cells 4 through 7 has intermediate or daily cover in-place. Closure construction for Phase 3 is expected in year 2020.

- The Landfill Gas Management System will be extended throughout closure Phases 1, 2, and 3.

- Cell 8 has been constructed and filled to final grades (final outer slopes and intermediate inner slopes) with temporary or daily cover in-place. Construction of Cell 8 is expected in year 2020.

- Cell 9 has been constructed and is receiving waste. Construction of Cell 9 is expected in year 2022.

- Soil stockpiles remain on the City property located north of the Expansion Area.

- C&D will continue to be placed in Phase IV of the Active Area (refer to Section 2.5 and Figure 2-1).

4.4 SOIL STORAGE AND USAGE

Currently, a large soil stockpile is located on the Expansion Site (as shown on Figure 4-1). The U.S. Army Corps of Engineers has committed to using 900,000 cy of that soil for a dike construction project. The project is to be completed in 2006. The remaining soil will be used for weekly cover and for closure in the Active Area. It has been estimated by others that 1,000,000 cy of soil is in the stockpile. We recommend a survey be performed on the stockpile to verify that enough soil is there to meet short-term needs.

Concurrent with cell development, excess soils will be stockpiled to the north of the Expansion Area as shown on Figure 4-2. This stockpile will be used for weekly soil cover in the Expansion Area and for closure activities in the Active Area. Table 4-1 shows estimated soil sources, uses, and surpluses for the SFRSL.

TABLE 4-1

APPROXIMATE SOIL BALANCE AT SFRSL

Source	Estimated Quantity (Cubic Yards)
Excess Soils from Existing Stockpile*	+100,000
Soils from Excavation of Expansion Area	+8,850,000
Active Area Weekly and Intermediate Cover	-770,000
Active Area Final Cover	-330,000
Expansion Area Berms	-210,000
Expansion Area Weekly and Intermediate Cover	-3,900,000
Expansion Area Final Cover	-450,000
Surplus Soils at Closure	3,290,000 cy

Notes:
* Estimated by Others. Assumes 900,000 cy of soil is used by the U.S. Army Corps of Engineers for a dike construction project and the remaining soil balance is +100,000 cy.

This shows that significant excess soils may remain at closure unless uses are found for the estimated 3.3 million cubic yards of excess soil (a stockpile this big would cover 45 acres with an average height of 45 feet). It is not intended that the designated stockpile area shown on development plans 4-2 to 4-5 accommodate the entire soil surplus. If necessary, the stockpile area can be expanded to the north to provide additional capacity. Additionally, more buffer land could be purchased to the west of the designated stockpile to provide additional area for long term soil storage (refer to Section 4.8 regarding Land Acquisition and Buffer Areas). Where possible, we recommend that other beneficial uses for the surplus soil be found as development of the landfill proceeds. Possible uses of the surplus soil include:

- Provide a thicker final cover over the waste to reduce infiltration of rainwater into the waste (refer to Section 2.5.5.2 regarding Closure Design Issues).

- Construct screening berms around the site. Specific areas or need for screening berms have not been identified. Based on the successful acquisition of buffer land, logical locations for screening berms would be just outside the north, west, and southern boundaries of the Expansion Site.

- Construct berms for leachate treatment ponds. If needed, this would not be implemented for several years (refer to Section 4.9 regarding leachate management).

4.5 UTILITY PLAN

Existing site utilities were identified and the locations were surveyed. Figure 4-6 shows existing utilities. Identified and surveyed utilities and other underground structures include:

- Electric - Electric service comes into the site from the north. It is overhead service located on utility poles on the east side of the landfill entrance road. This is single phase, 240v-service. Electric service will be extended to new buildings and facilities. Three-phase service is only available from nearly 1 mile away from the property, and we believe it would be cost-prohibitive at this time to pursue extension of 3-phase service to the site. However, this may be pursued in

the future. The new leachate loadout facility located on the south end of the site will be served by an electric line from the south based on discussions with the utility. Future electrical needs and service options will need to be evaluated by the City and the electric utility as the need arises.

- Telephone - Telephone service comes into the site from the north. Telephone service will be extended to new buildings and will likely be utilized for an automatic dialer alarm system in the future, which will automatically notify appropriate personnel in case of alarms, such as flare shutdown or leachate tank full. The dialer can call pre-programmed call lists of personnel (or consultants) who will respond to the emergency.

- Fiber Optic - Fiber optic cable is installed between the new scale-house and the maintenance/office building. This cable is used for data and communication on-site. It may be extended in the future.

- Water - Water service enters the site from the north and runs on the west side of the entrance road. Water service currently extends to the scale-house and maintenance/office building. It will be extended as needed in the future.

- Storm Sewer - Storm sewer conveys surface water from the north side of the Active Area under the entrance road and around the maintenance/office building where it discharges to an existing ditch which is routed around the north and west sides of Cell 1 in the Expansion Area.

- Septic - There are existing septic systems serving the maintenance/office building, the old scale-house, and the new scale-house facility. In the future, it may be investigated to determine if the sanitary waste can be combined with the leachate in a storage tank.

- Compressed Air - It should be noted that there exists a potential future need to install an air compressor facility to supply compressed air to power leachate extraction well pumps on the site (primarily on the Active Area). Pneumatic pumps are often the best option since electric pumps experience voltage changes due to the long distances on the landfill. Electric pumps also experience plugging at the anticipated low flow rates. A location has not been proposed since it may not be used, but it could be located near the proposed blower/flare station.

4.6 ROADWAY AND TRAFFIC PLAN

The county roads that lead to the site are paved all-weather roads. On-site roads are currently gravel and maintained by landfill staff to be as all-weather as possible. We recommend that the perimeter road that will run all the way around the Expansion Area be paved. The portion which runs from the scale to the south end of the site and around Cell 1 to the gravel access road entering Cell 1 will receive asphalt in 2004. The remainder of permanent perimeter access road will be built in increments as cell development progresses as shown on Figures 4-2 through 4-5. Access to the cells for filling will be from the south for Cells 1 and 2, and from the north for Cell 3 as shown on Figures 4-2 and 4-3. Access will be from the south for Cells 4, 5, 8, and 9, and from the north for Cells 6 and 7.

Other road related improvements include adding a lane along the west side of the entrance road to the Scale Facility. This additional lane will improve traffic flow for incoming commercial vehicles and the public (refer to Section 3.2.1 for additional discussion). The current entrance road layout can be a bottle neck by restricting the access of commercial vehicles to the incoming scales during peak traffic periods.

The proposed public drop-off area and compost site to be located east of the Scale Facility will require a short access road off of the main landfill road. The public will first proceed to the Scale Facility and then be diverted to the public drop off area. This use of the public drop off area and compost site will reduce traffic to the MSW and C&D landfill working face and will be substantially more accessible and safer for the general public.

4.7 STORMWATER CONTROL PLAN

Stormwater is currently routed around the Active Area to a sedimentation basin located south of the site across the county road. The sedimentation basin is utilized for all run-on and runoff on the site. The existing on-site storm sewer reportedly discharges to a channel which runs around the north and west sides of the newly constructed Cell 1 in the Expansion Area before entering the culverts that discharge to the sedimentation basin. Runoff and run-on on the Expansion Area are planned to be routed to the same sedimentation basin.

While enough elevation change is available to accomplish this surface water routing plan, the existing engineering documents are not detailed enough to evaluate the effectiveness of the design. We recommend that the City prepare an all-encompassing surface water management plan to study the entire system, calculate peak flows, analyze capacities of existing structures, and design additional facilities, if necessary. Further discussion of storm water management is included Sections 2.5.6 (Closure Plan Evaluation) and 3.2.9 (Operations Assessment).

4.8 LAND ACQUISITION AND BUFFER AREAS

The City has been actively acquiring property adjacent to the landfill to maintain a buffer zone. This is important to avoid conflicts with potential development, and to provide adequate area for future landfill expansion. The property serves as a buffer zone, shelterbelt, future landfill area, or future related support areas. In addition to those currently owned, we recommend the following additional purchases:

- We recommend that the City obtain the parcels located south and west of the 160-acre landfill Expansion Area. These parcels are critical to the City for long-term landfill development, support facilities and buffer area. The drainage from Wall Lake currently crosses the southwest portion of the 160-acre Expansion Area and will need to be relocated in the future to allow for the permitted landfill development. This adjacent property is important to the rerouting of this drainageway in order to maximize development of the landfill in the 160-acre Expansion Area. For planning purposes, we assume that the recommended parcels will include a total of 160 acres at a cost of $5,000 per acre. As indicated in the Implementation Plan in Section 7.0, purchase of this property is considered a priority, with purchase in 2004.

- We understand from City staff that 16 acres is being considered for purchase south of the landfill and east of the stormwater sedimentation pond. We agree that this parcel would be beneficial, but not critical, for use as a buffer zone plus for landfill support facilities.

- Although not critical to the operation of the landfill, additional property to the north of the west half of the Expansion Area would be beneficial for stockpiling of excess soils during development of the landfill. If available, the additional area would allow shorter haul distances for stockpiling of soil as development in the Expansion Area proceeds to the west.

It is our opinion that purchase of buffer area near the landfill is in the City's best interest over the long term to prevent encroachment and associated issues. The City should pursue these purchases as the opportunity arises. In addition to the critical 160-acre parcel recommended for purchase in 2004, we have included in the Implementation Plan (Section 7.0) the future acquisition of additional beneficial buffer property around the landfill. Although the acquisition of such property is generally opportunity based, the purchase of an additional 160 acres is indicated in the Implementation Plan (Section 7.0) in the years 2006 and 2008.

Management of the City's properties for landfill related operations and buffer zone is an important function. Recommendations pertaining to land management issues are included in Section 3.0.

4.9 LEACHATE CONTROL PLAN

The purpose of this section is to evaluate leachate management options and make recommendations regarding leachate management strategy for the SFRSL. Leachate management options include different methods of storing, handling, and treating leachate generated from the Active and Expansion Areas. Earth Tech has reviewed and refined evaluations from the August 2001 Leachate Management Evaluation Report by HDR Engineering, Inc (HDR, 2001c).

The criteria used in the evaluation of leachate management strategies include: system costs; technical viability; flexibility in dealing with variable leachate characteristics; ability to dispose of leachate in an environmentally acceptable manner; and reliability. This evaluation attempts to include leachate generation and treatment options from 2003 to closure of the Expansion Area (anticipated in 2036). We expect any leachate management system chosen for the active life of the site will still be the best option for post-closure. Therefore, post-closure costs are not included in the evaluations.

4.9.1 Leachate Generation

Leachate generation volume estimates are critical to evaluation of the various leachate management strategies. Leachate volume affects costs because the size of facilities needed impacts capital costs and the volume to be treated affects annual operation and maintenance costs. Leachate volume estimating techniques come with a wide margin of error, making it difficult to estimate accurately and with confidence. For reasonable assurance of our estimates, we compare various estimates including computer modeling, previous estimates by others, and comparison with other similar facilities.

The United States Environmental Protection Agency (USEPA) Hydrologic Evaluation of Landfill Performance (HELP) model was used to estimate the amount of leachate generated within the Expansion Area during open (20-foot waste thickness with 6-inch daily cover), intermediate (50-foot waste thickness with 12-inch intermediate cover), and closed (50-foot waste thickness with vegetated permitted final cover in-place) conditions. The estimated average annual leachate generation for the expansion site ranges from 350,000 gpy (HDR, 2001c) to 1,600,000 gpy (Earth Tech, 2003).

The Active Area is also a source of leachate. There is currently no leachate removal from the Active Area. There is leachate within the waste mass and there is continual infiltration from rainfall events. It has been estimated (HDR, 2001c) that 20 million gallons of leachate lie within the Active Area and of that, 8.5 million gallons is estimated to lie above the water table within the site (per letter, July 3, 2002). This volume may be removed by utilizing leachate extraction wells.

Earth Tech views the results of the Leachate Extraction Pilot Project as encouraging. The results were reported in the "Performance Evaluation" by Leggette, Brashears & Graham, Inc. (LBG), dated May 16, 2003. The study showed that in 8 months, 65,000 gallons of leachate was removed of an estimated 155,000 gallons of recoverable leachate in the area. Leachate head levels were reduced by as much as 3.5 feet. Removing 42 percent of the estimated leachate at a consistent rate of 0.19 gpm over only 8 months is a very good result for landfill conditions (especially considering that the study was performed in the Emergency Cell where greater soil content and lower permeabilities would be expected). Although we cannot calculate hydraulic properties to apply to the landfill and to use to calculate precise spacing for wells, the leachate head within the landfill can be reduced. Well spacing can be determined based upon experience at other landfills. Removal of leachate from the Active Area will be a dynamic process. As head is reduced at a given well, the pump could be utilized in a different area. Low leachate pumping rates and recharge rates are desirable because they keep suspended solids from entering the wells and fouling the pumps. Pumping rates less than 1 gpm are both expected and desired. While the use of horizontal directionally drilled (HDD) wells appear to hold promise for reducing leachate head along the site perimeter, we recommend that overall leachate head within the landfill also be reduced. Historically, HDD wells have experienced problems in landfill applications. Differential settlement inherent in the waste causes the casing to be forced up, down, and side-to-side as well as squashing. The pumps tend to get stuck in the casing, which requires abandonment of the entire well. Electric pumps are used for horizontal wells, but they do not perform well at low flow rates. The electric pumps tend to burn out. We recommend vertical wells. Vertical wells can perforate clay layers and release perched leachate. Vertical leachate extraction wells can be used effectively over time, and are especially economical when installed within a dual gas/leachate extraction system, since landfill gas extraction is expected to be necessary.

Removal of the 8,500,000 gallons of leachate estimated to be above the water table in the Active Area will take time. Assuming a 10-year pumping schedule, the extraction rate would be 850,000 gal/year, which is only 1.62 gal/min. We would expect to achieve a higher overall pumping rate utilizing many leachate extraction wells within the Active Site.

Infiltration through the waste due to rainfall is another source of leachate in the Active Area. HDR estimated leachate generation of 350,000 gal/year, while Earth Tech estimates infiltration could produce 1,685,000 gal/year during waste filling. The MSW portion of the Active Area is near closure so this leachate generation rate during filling is very short-term and the leachate generation rate at closure is estimated by Earth Tech to be 125,500 gpy. Table 4-2 contains a summary of leachate generation estimates by HDR and Earth Tech.

TABLE 4-2

SUMMARY OF LEACHATE GENERATION ESTIMATES

	Active Area Leachate Mound Pumping Volume (gpy)	Active Area Final Cover Infiltration (Filling) (gpy)	Active Area Final Cover Infiltration (Closed) (gpy)	Expansion Area Final Cover Infiltration (Filling) (gpy)	Expansion Area Final Cover Infiltration (Closed) (gpy)
HDR Estimate[1]	2 M to 4 M[2]	350,000	N/A	350,000	N/A
Earth Tech Estimate	0.85 M[3]	1.7 M	125,500	1.7 M	125,500

Notes:
* "M" stands for "Million."
1 "HDR Estimate" refers to leachate infiltration estimates included in the Leachate Management Evaluation Report, August 2001, prepared by HDR Engineering, Inc.
2 2 Million gal/year over 10 years; 4 million gal/year over 5 years.
3 0.85 Million gal/year over 10 years to remove only the leachate which sits higher than the water table.

The Expansion Area will have a constructed leachate collection and removal system utilizing a drainage layer and perforated collection pipes on the base leading to perimeter sumps and sideslope risers with pumps for extraction.

Over the remaining life of the facility, annual leachate generation will vary from year to year, but due to specifics of the site, the variance won't be extreme. When leachate extraction wells are installed in the Active Area, and the existing "mound" of leachate is pumped, leachate volumes will be high for many years, but these will be the years of initial development in the Expansion Site when leachate volumes won't be high. As the Active Area is closed, leachate generation due to infiltration through the final cover will drop off. As the Expansion Area grows, leachate generation will increase.

For the purposes of this evaluation of alternative leachate treatment options, average annual leachate volume is assumed to be 1.6 million gallons total, from the Active and Expansion Areas. For comparison, Brown County, South Dakota, collected 1,300,000 gallons of leachate from their landfill in 2001. That site covers approximately 15 acres, with intermediate cover over about ¾ of the area and no cover over the remainder. The Active Area at SFRSL is six to seven times as big. The MSW (pre-Subtitle D) portion of the Active Site covers approximately 81 acres. Currently, approximately 25 acres has final cover and the remainder is under intermediate conditions. The Expansion Site will cover approximately 117 acres.

Based upon the above comparisons, the 1.6-million gallon volume estimate for the SFRSL may prove to be somewhat low over the life of the facility. However, it should be high enough to show which options are better economically, given higher leachate volumes.

4.9.2 Leachate Management Options

Leachate management systems consist of several components including:

- Collection
- Storage
- Treatment or pre-treatment
- Disposal

Disposal is the ultimate disposition of leachate with collection, storage, and treatment as the means to this end. These system components were analyzed to identify a viable leachate management strategy for the entire site. The following sections present each system component and leachate management strategy.

4.9.2.1 Collection

Leachate will be collected from the Active Area through wells (horizontal, vertical, or both) drilled into the waste. Pumps in the wells will extract leachate and bring it to the surface where it will go into headers which may be either forcemains or gravity pipes. Leachate will be collected at the perimeter of the base of the Expansion Area. The Expansion Area collection system includes sumps, pumps, and a header pipe or tanker truck. Once the leachate is collected in the header pipe or tanker truck, it will be conveyed to a storage system or directly to disposal. All costs presented later in this report do not include purchase or maintenance of a tanker truck for collection. Gravity pipe or forcemain leading to a central storage location is assumed.

4.9.2.2 Storage

Storage is assumed to be either one or two 20,000-gallon underground storage tanks depending on the requirements of the treatment option selected. The storage area will include pumps, controls, electrical services, access, and a truck loadout area.

4.9.2.3 Treatment or Pre-Treatment

Anticipated leachate characteristics, presented in the HDR Report (HDR 2001), are low in metals, low in VOCs, and high in BOD. Some treatment or pre-treatment will be required prior to discharge. Pre-treatment would apply to systems where further treatment would occur. Treatment would reach regulated discharge limits and allow discharge into local waterways. For purposes of this discussion, all treatment options will be referred to as pre-treatment. The technologies presented might provide full treatment if combined.

Information from POTW personnel suggests that in the future, pre-treatment would likely not be required for POTW disposal, unless characteristics change substantially. The City needs to continue to monitor these characteristics if discharge to the City's POTW is planned.

Pre-treatment options most applicable for SFRSL leachate include: biological treatment (aeration); granular activated carbon; constructed wetlands; and recirculation. Following is a description of each of these pre-treatment options.

Aeration

Aeration can be used to accelerate ambient stabilization of BOD by removing biodegradable organics if it is determined that concentrations exceed discharge or disposal limits. Aeration can also be used to reduce odors prior to on-site disposal or discharge. Stabilization occurs by introducing more oxygen into the upper layer using surface aerators. As BOD concentrations are reduced, odor associated with the biodegradable organics should also be reduced.

Aeration is not feasible during cold weather. For cost estimation, we assume collection, storage in underground storage tanks, hauling by truck, and treatment at the wastewater treatment plant (WWTP) for 5 months in winter.

Granular Activated Carbon

Granular activated carbon (GAC) is effective in removing organics by adsorption. GAC is most effective as a polishing step for those cases in which biological treatment alone cannot meet effluent requirements or in the case of a low BOD/COD ratio. Therefore, GAC alone is not appropriate as a pre-treatment option. The only treatment and disposal option that may require a GAC system is direct discharge. This would only be applicable if stringent effluent requirements had to be satisfied.

Filtration preceding GAC treatment would be required to prevent plugging, since suspended solids concentrations will most likely be more than 10 times the limit for the GAC system. In addition, the GAC system would require frequent thermal regeneration based on the estimated organic loading rates.

Constructed Wetlands

Wetlands are shallow inundated areas that support hydrophytic vegetation and hydric soils. Wetlands reduce BOD by providing plant and soil surfaces for the attachment of bacteria films. Reduction of COD also takes place via anaerobic soils. Operation of a wetland system through cold weather periods is not feasible. Therefore, hauling, storage, or another treatment mechanism is expected to be required during winter months. We will assume collection, storage in storage tanks, hauling by truck, and treatment at the WWTP for 5 months in winter.

Recirculation

A recirculation system would consist of either: 1) perforated PVC pipes, in the waste, or 2) distribution of collected leachate via a hose or spreader bar on the working face. Leachate treatment occurs within the waste fill through absorption and uncontrolled anaerobic digestion. As a result, the level of BOD/COD and metal reduction is not always predictable. Data from similar landfill projects show that recirculation reduces the organic loads COD, BOD, and TOC, as well as volatile acids, phosphate, ammonia-nitrogen, and TDS.

Recirculation could not be done until waste grades in a lined area reach a sufficient depth. Recirculation would be limited somewhat, initially, depending on field capacity (ability to absorb and hold water) of the waste. For the purposes of this evaluation, it is assumed that recirculation would be a bonus regardless of the treatment system used. Recirculation may not serve to absorb or eliminate all leachate. As such, a cost estimate is not included. It is recommended that recirculation be used in the future to the extent possible. Recirculation is not a seasonally dependent technology.

4.9.2.4 Disposal

Disposal refers to the ultimate elimination of the leachate following collection, storage, and treatment. Viable options for disposal include the following:

- Disposal at a City POTW via truck hauling.
- Evaporation on-site.
- Land application.
- Discharge to wetlands.
- Disposal at a City POTW via forcemain from the landfill to a City sewer.
- Recirculation (to be used with all options; not costed).
- Thermal evaporation (using landfill gas).

There are a number of variables that might be associated with each disposal method including treatment or pre-treatment and storage requirements. Seasonal restrictions can impact evaporation, land application, and wetlands methods and thus, require added storage capacity or seasonal transport to the POTW.

4.9.2.5 Leachate Management System Options

Leachate management system options consisting of storage, treatment, and disposal are presented below. Storage will consist of one 20,000-gallon underground storage tank installed for the opening of the Expansion Area with another tank added with construction of Cell 8, if needed. Costs are included only for those options that require the second tank since the leachate storage and loadout facility will be installed in 2003 and, therefore, it is not a factor in evaluating the various system options. The forcemain option only requires one 20,000-gallon storage tank. (The thermal evaporation option does not require the central storage and discharge area.)

To evaluate each management option, system definitions reflecting storage, treatment, and disposal components have been created. The evaluations include consideration of technical viability, flexibility in dealing with variable leachate generation rates and characteristics, and reliability. The system options are summarized in Table 4-3 and are described and evaluated further in the following sections.

TABLE 4-3

LEACHATE MANAGEMENT SYSTEM OPTIONS

Option	Description
1	Tank storage, haul to POTW
2	On-site evaporation pond with pre-treatment
3	Treatment and on-site discharge
4	Pre-treatment and land application
5	Discharge to on-site constructed wetlands
6	Thermal evaporation using landfill gas
7	Tank storage forcemain to POTW
8	Recirculation followed by disposal (not costed)

Option 1 - Tank Storage, Haul to a POTW and Dispose

It is not anticipated that treatment of leachate prior to discharge at the City's POTW will be necessary because of the relatively small contribution. This option was evaluated assuming the facility purchases three leachate hauling tanker trucks over the 36-year site life and that site personnel operate the trucks.

Storage and hauling is considered technically viable and reliable (although there is risk inherent in transporting leachate lest an accident causes a spill). The major advantage of this option is that the landfill would not be responsible for the treatment process which could be difficult considering variations in leachate quantities, concentration levels, and discharge regulations over the years. Another advantage of this option is that there would be no odors at the landfill due to treatment ponds.

Option 2 - On-Site Evaporation Pond with Pre-Treatment

Leachate collected and allowed to evaporate in a shallow composite-lined pond would eliminate the need for off-site disposal, except in winter months. To minimize potential odors from the leachate, an aeration pond (including surface aerators) was included prior to the evaporation pond(s).

In the spring, additional odor control measures may be necessary in the aeration pond (i.e., increase aeration rates, addition of hydrogen peroxide to oxidize odorous compounds, adding masking agents, or installing a physical containment structure to cover the pond). For cost estimating purposes, it was assumed that hydrogen peroxide would be utilized to control odors.

Evaporation is considered technically viable and reliable. Pre-treatment is considered essential prior to discharge to a shallow evaporation pond. Flexibility would be achieved by using several ponds to adjust for variations in leachate quantities and climate conditions. The relatively large leachate volumes expected will require a lot of land dedicated to shallow ponds. Odors are another potential disadvantage associated with the pre-treatment/storage ponds.

One advantage of this system is the elimination of POTW treatment costs and costs associated with conveying leachate to the POTW for approximately 7 months of the year.

Option 3 - Treatment and On-Site Discharge

To reach leachate characteristics suitable for on-site discharge, extensive on-site treatment would probably be required. On-site treatment includes an aeration pond (including surface aerators) and a Granular Activated Carbon (GAC) system. Due to removal inefficiencies and varied leachate generation rates and characteristics, aeration alone may not satisfy National Pollution Discharge Elimination System (NPDES) effluent requirements. Therefore, a GAC system was included in this process as one option to polish the leachate to meet effluent discharge requirements. Truck transport to the POTW was included in this process due to inefficient treatment during cold weather periods. Filtering to remove suspended solids would be needed prior to the GAC system. The GAC system would require frequent re-generation at considerable cost.

The technical viability and reliability of treatment and on-site discharge is limited by the variability of the leachate composition. If treatment objectives cannot be satisfied, because of quantity or composition variability, then alternate disposal would be required. A backup disposal system is assumed. Tank storage and haul to a POTW is assumed as a backup and as the only alternative during approximately 5 months of winter. Within a reasonable design range, the system should be flexible, but may have limitation due to odor control associated with the storage pond. A major drawback to this system is the costs associated with a GAC system.

Option 4 - Pre-Treatment and Land Application

Land application of partially treated leachate, on- or off-site is assumed to be by irrigation techniques using a center pivot system. Natural treatment of leachate using irrigation is provided by physical, chemical, and biological processes that occur in the soil and vegetation. State guidelines provided by SDDENR for land application of domestic wastewater were used by HDR Engineering, Inc., as a guideline in area sizing. The guidelines identify application rates, vegetation uptake rates, and system operation requirements. Based on the estimated leachate characteristics before and after pre-treatment HDR determined approximately 5 acres would be required for land application if average annual leachate generation is 350,000 gallons (HDR, 2001c). Since Earth Tech assumes annual leachate generation of 1.6 million gallons, potentially 23 acres could be required for land application.

Operation of a land application system during cold weather periods is not feasible. Therefore, truck transport to the POTW of peak winter month's quantities was included in this process, although other leachate management options could be used.

The technical viability and reliability of this land application option is limited by the variability of the leachate composition. Similar to Option 3, if treatment objectives cannot be satisfied, then alternate disposal would be required. This poses a risk of reliability and of added costs. Within a reasonable design range, the system should be flexible, but may have limitations due to seasonal restrictions.

Option 5 - Discharge to On-Site Constructed Wetlands

Within certain seasonal and characteristic limits, leachate can be treated on-site by a constructed wetland. To minimize potential odors, an aeration pond was included prior to wetlands treatment. Odor control measures (specifically hydrogen peroxide) were assumed to be required with this system. Truck transport to the POTW was included in this process due to inefficient treatment during cold weather periods and the potential for significant volumes of leachate during winter months.

It is anticipated that leachate will have to be sampled prior to both discharge to the wetlands and from the wetlands.

Wetlands treatment is considered technically viable, but has seasonal limits in reliability and requires a lot of land area. Additional pre-treatment is considered necessary for odor control, not process performance. The uncertainty of leachate flow rate and composition represents a risk that treatment objectives may not always be satisfied. If treatment objectives are not met, then alternate disposal would be required. Flexibility would be achieved by using several segmented ponds (areas) to adjust for variations in leachate quantities and composition.

One advantage of this system would be the (seasonal) elimination of POTW treatment costs and a portion of the costs associated with conveying leachate to the POTW. Disadvantages include the land area required for wetlands, the seasonal limits on using wetlands, and the potential for odor problems.

Option 6 - Thermal Evaporation Using Landfill Gas

A thermal evaporation system would utilize heat from combustion of generated landfill gas (methane) to evaporate leachate. In order for this option to operate in an economically feasible manner, there must be enough methane produced from the landfill.

It is expected that an active landfill gas extraction system will eventually be required SFRSLF, so the cost of the gas collection system installation is not included as a cost for this leachate management option.

Landfill gas generation is a fairly steady process whereas leachate generation is irregular. To match leachate production with gas generation, a leachate storage tank is assumed. Earth Tech estimates that 831 cfm of recoverable landfill gas is being generated in the Active Area under the current conditions. The peak quantity of recoverable landfill gas is calculated to be available in 2037. The peak quantity is estimated at 2,850 cfm.

These estimates indicate that landfill gas could be used to evaporate essentially all leachate generated. The smallest evaporator unit has a capacity of 5,000 gpd. It requires an enclosed landfill gas flare to be operational also. Vapor is directed into the flare for destruction. The flare and evaporator require approximately 1,000 cfm of landfill gas to operate. Estimation of available methane indicates there will be enough gas generated by 2008 to run the evaporator and enclosed flare. The evaporator will remove 97%+ of the liquid from the leachate as well as all volatile organic compounds (VOCs). The residual from the process is a concentrated leachate consisting of 3 percent (or less) of the original liquid. This residual would be recirculated on the landfill (in lined portions) or it can be pressed such that the solids are landfilled and the liquid goes to the POTW. For the purpose of this cost estimate, it was assumed that the residual can be recirculated (i.e., lined cells will have enough waste in them) by the time the evaporator system is up and running.

Evaporation is considered technically viable and reliable. However, the quantity of landfill gas required to evaporate all leachate is not generated at the same rate as the leachate, making large storage tanks necessary. Alternate disposal will be required from now until 2008. Tank storage and hauling to the POTW is assumed for the first 5 years until gas generation and recovery is enough to support the enclosed flare and leachate evaporator.

Option 7 - Tank Storage, Forcemain to POTW

This option is similar to Option 1 in that treatment is provided at the City's POTW. Transport to the City sewer system is proposed via a forcemain that will exit the landfill to the south and be laid within the road right-of-way. The forcemain will run east along West 57th Street until it reaches the western limit of the City sewer system (approximately 6 miles). There it will discharge into the existing City sewer system. Refer to Figure 4-7 for the proposed location of the leachate forcemain. A meter at the landfill will document leachate volume discharged to the City sewer system.

The discharge system could be operated according to the requirements of the WWTP. Controls could be added to fine tune the pumping system to some degree. The average volume of leachate is quite low, only 3.1 gpm. The discharge pump to be located in the 20,000-gallon storage tank will have a maximum capacity of approximately 100 gpm. At this rate, the pump run time will average only 44 minutes per day.

Earth Tech reviewed sewer design information provided by the City of Sioux Falls and determined that there is reserve capacity in the downstream pipes in the sanitary sewer basin such that the 100 gpm pumping rate would not overload the sewer system. Refer to sewer capacity calculations in Appendix B.

One major advantage of this option is that the landfill would not be responsible for the treatment process which could be tricky considering variations in quantities, concentration levels, and discharge regulations over the years. Other advantages of this option include no odors at the landfill due to treatment ponds, reduced liability from trucking leachate off-site, and not having to purchase and maintain tanker trucks for hauling. The main disadvantage of this option is the high up front capital costs to build the forcemain.

Option 8 - Recirculation Followed by Disposal

By recirculating the collected leachate through the expansion site, many advantages can be realized over conventional disposal techniques. Recirculation is recommended in conjunction with the selected disposal option. For cost estimating purposes, recirculation was not considered in examining alternatives because we recommend it be used with all alternatives.

Calculations show that theoretically, any infiltration and/or recirculated leachate should be absorbed in the landfill based on waste moisture contents. In reality, some of the water entering the landfill will find highly permeable pathways to the collection system and not be absorbed by the waste. As a result, recirculation does not eliminate the full need for leachate disposal.

The recirculation process increases the rate of anaerobic processes within the landfill, resulting in accelerated settlement (consolidation), additional landfill gas, and potentially significant odors from uncapped areas. The accelerated settling process within the landfill has both advantages and disadvantages. This settling can damage or diminish the effectiveness of the recirculation piping if utilized.

The recirculation process is considered technically viable, both as a pre-treatment process and for limited disposal. The concept of a wet landfill (bioreactor) is an emerging technology with promising results, but somewhat limited history and data. The system is also considered flexible in responding to changes in quantity and characteristics of the leachate. Potential limitations include odors in uncapped areas.

Major advantages of this system are reductions in quantities of leachate requiring disposal, effectiveness as a pre-treatment system, and lack of seasonal restrictions on a properly designed and operated system. Disadvantages of this system are that recirculation may not absorb all leachate, there will probably be a limit to the volume that can be discharged on an area on a daily basis and recirculation can only be done in lined landfill areas.

4.9.3 Conclusions and Recommendations

Estimated capital and long-term operating costs for the leachate management system options are summarized in Table 4-4.

TABLE 4-4

LEACHATE TREATMENT ECONOMIC SUMMARY (2003)

Technology Option	Costs	Rank
1. Tank Collection, Truck Haul, POTW Disposal		1
Present Worth Capital	$439,600	
Present Worth Annual O&M (2003$)	$708,400	
Total (Present Worth)	$1,148,000	
2. On-Site Evaporation		2
Present Worth Capital	$1,042,090	
Present Worth Annual O&M (2003$)	$460,910	
Total (Present Worth)	$1,503,000	
3. Treatment and On-Site Discharge		5
Present Worth Capital	$1,711,860	
Present Worth Annual O&M (2003$)	$1,166,730	
Total (Present Worth)	$2,878,590	
4. Pre-Treatment and Land Application		6
Present Worth Capital	$2,882,180	
Present Worth Annual O&M (2003$)	$531,000	
Total (Present Worth)	$3,413,180	
5. Discharge to Wetlands		7
Present Worth Capital	$3,288,750	
Present Worth Annual O&M (2003$)	$344,860	
Total (Present Worth)	$3,633,610	
6. Thermal Evaporation		4
Present Worth Capital	$2,060,880	
Present Worth Annual O&M (2003$)	$363,900	
Total (Present Worth)	$2,424,780	
7. Forcemain to City Sewer		3
Present Worth Capital	$1,618,700	
Present Worth Annual O&M (2003$)	$125,870	
Total (Present Worth)	$1,744,600	

These costs are based on estimated leachate generation rates, projected leachate characteristics, and effluent requirements for each treatment and disposal option. The closure period was not considered in the system costs since leachate generated from closed areas is minimal compared to the active life of the facility.

Table 4-4 presents management system costs for long-term with an emphasis on total costs. The economic analysis attempts to include all capital and operations costs from pre-treatment and disposal components of each system option. All options assume the site closes in the year 2036 and subsequent leachate management costs are minimal. Operating costs over the life of the facility are totaled based on present worth in 2003 to compare total cost of each option.

The economic analysis suggests that hauling leachate to the WWTP by landfill personnel in landfill-owned trucks is the most economically viable option. The next most viable option appears to be on-site evaporation followed by the force main to the City sewer operation. It is expected that recirculation will be utilized, to the extent possible, along with the chosen alternative, due to its low cost and effectiveness at treating leachate and reducing leachate volumes.

Our recommendation is to proceed with the least costly and most easily implemented option which is collection of leachate in a tank, and hauling it by truck to the City's water reclamation plant for treatment. Plans for installation of the leachate removal system for Cell 1 are currently underway. The tank and loadout system will be constructed in the spring of 2004. Purchase of a 5,000-gallon semi-tanker for leachate hauling is included in the Implementation Plan (Section 7.0) in 2004.

We also recommend initiating removal of existing leachate from the Active Area by installing approximately 10 gas/leachate extraction wells in the Active Area along with a compressed air system in 2004. Initially, the 10 wells will only be utilized as leachate extraction wells. They will be connected to the Active Gas Collection System when it is constructed in 2006. It is our understanding that the City wishes to implement the leachate extraction system in the Active Area as soon as possible. However, since the proposed leachate and landfill gas systems will function together as a combined system, it is our opinion that construction will be more economical if the systems were installed at the same time. To accomplish this, the leachate extraction system would either have to be delayed until 2006, or the landfill gas system would have to be installed sooner to coincide with the leachate extraction. In the Implementation Plan (Section 7.0), it is assumed that the construction will occur in two separate phases to allow the immediate implementation of the leachate extraction system.

To reduce leachate volumes that must be hauled away, we recommend that recirculation be part of the leachate management plan. To facilitate this, we recommend that the City purchase another tanker truck for the purpose of hauling leachate to the working face or to recirculation piping within the cell. Leachate recirculation is expected to begin with the development of Cell 2. We recommend that recirculation only occur in cells that have a fully engineered liner system. The Implementation Plan (Section 7.0) provides for the purchase of a leachate/multi purpose truck in year 2007.

We recommend the City re-evaluate continued truck hauling of the leachate after approximately 5 years. Based upon actual leachate volumes, hauling costs, and treatment costs, truck hauling would be compared to constructing leachate evaporation ponds or constructing a 5.5-mile forcemain to the City.

4.10 LANDFILL GAS MANAGEMENT PLAN

4.10.1 Implementation Overview

Implementation of the landfill gas system depends on several factors as follows:

- Regulatory Requirements.
- Leachate Extraction for the Active Landfill.
- City's Proactive Measures.

Regulatory Requirements

As discussed in Section 2.2.5 of this report, the landfill is subject to NSPS. Tier 2 testing was performed in July 2003. Average NMOC concentrations were used to calculate NMOC emissions for the landfill. The 2003 results show NMOC emissions of 49.6 Mg/yr. The NSPS requires gas collection and control for landfill emissions of 50.0 Mg/yr or greater. Additional municipal solid waste accepted at SFRSL will likely put the facility over the 50.0 Mg/yr threshold in 2004. If in 2004, Tier 2 and/or Tier 3 sampling and analysis confirm that the level has reached or exceeded 50 Mg/yr, the following events will take place:

- A NSPS gas system collection and control design plan must be prepared within 1 year of reaching 50.0 Mg/yr.
- Construction of a gas collection and control system is to be completed within 30 months of submittal of the first annual report showing NMOC emissions equal to or exceeding 50 Mg/yr. Thus, the system would be running in 2007.
- Monitoring of the system including air emissions will be required after the system is in operation. The federal regulations WWW Part 63, Subpart AAAA contain the requirements for monitoring the gas system.

Leachate Extraction for the Active Landfill

If the City implements leachate extraction using vertical wells, a portion of the landfill gas system could be constructed to provide dual gas and leachate extraction. Approximately 10 vertical wells will be installed for dual gas/leachate extraction. The leachate would be extracted from the wells to reduce the leachate mound within the Active Landfill (refer to Section 4.9).

The balance of the landfill gas system for the Active Landfill would be phased in as the landfill is closed. There will be an estimated 53 gas extraction wells to serve the entire MSW area of the Active Landfill including the Emergency Cell.

City's Proactive Measures

The City has initiated a variety of proactive measures to provide landfill planning and environmental protection at the landfill. The City could initiate the leachate extraction in the Active Landfill and gas collection if it so desires. Under a voluntary program, the City could develop the gas and leachate extraction in phases to explore the effectiveness of the system and expand the network based on the success of the initial development. Phased development would also reduce the City's initial capital cost allowing the investment to be paid off gradually. Phased development of the gas system could be integrated with the landfill closure phases. Most landfills that are the size of the Active Landfill do have an active landfill gas system in place to control air emissions and landfill gas migration.

4.10.2 Landfill Gas Collection and Control

This section describes the proposed landfill gas collection and control system for the SFRSL. Due to NSPS requirements for collection and control of NMOC emissions, passive venting systems will not be adequate at SFRSL. Active extraction and destruction of the gas, either by flare or by beneficial use, will be required.

Vertical gas extraction wells will be utilized for gas collection throughout the MSW areas of the landfill. Each gas well will be connected to a series of horizontal pipes called the "header line." A vacuum will be induced on this header line from a blower at the flare station, which will be located west of the Active Area. The applied vacuum will pull landfill gas from each well into the header line, which conveys gas to a utility flare station for combustion and/or other potential gas processing equipment that would provide a beneficial use for the landfill gas. The projected maximum gas generation rate for the MSW portion of the Active Area plus the 160-acre Expansion Area is 2,850 cfm (see Appendix B for gas generation calculations).

The gas system should be designed to accommodate the existing and future areas of the landfill. For C&D areas, no active gas collection system is proposed at this time. If the C&D areas warrant gas control in the future, options such as gas extraction vents or horizontal gas collection trenches may be used. These components may also be connected to the active gas collection system in the future. A projected maximum gas generation rate for the C&D portion of the Active Area is estimated to be 705 cfm (see Appendix B for gas generation calculations).

4.10.3 Implementation of Landfill Gas Extraction System

Depending on next year's Tier 2 or Tier 3 testing results, a gas extraction system could be required to be operational in the Active Area as soon as 2007. In the Implementation Plan (Section 7.0), costs for design and construction of the gas extraction system are included for year 2006. This system is intended to expand, and become part of, the leachate extraction system that would be installed in 2004. A concept drawing showing the gas wells (including gas/leachate combination wells), header layout, and proposed blower/flare station is included as Figure 4-8.

Gas extraction would not be necessary in the Expansion Area for some time. We assume that the gas system will be phased in as cells are filled and brought up to final grade. As indicated in the Implementation Plan (Section 7.0), gas wells and header will be extended to portions of Cells 1, 2, 3, and 4 in year 2013. A concept drawing showing the extraction system for the entire Expansion Area is included as Figure 4-9.

4.10.4 Beneficial Use for Landfill Gas

Based on Earth Tech's experience with similar alternative energy projects as well as a review of the latest technical literature, the following options are being presented as possible beneficial use projects for the landfill gas at SFRSL. If interested, an expanded study comparing each of these options could be performed in the future to determine the optimum option for the facility, based on feasibility and cost.

- On-site gas to electricity power plant utilizing landfill gas engines to produce electric power.
- On-site Microturbines for electric power generation.
- Dual fuel boiler system for heating facility buildings.
- Leachate evaporation system fueled by landfill gas.

4.10.4.1 Landfill Gas Engines

This option includes the development of a landfill gas to electricity facility, which will incorporate landfill gas fired engine generators. Most landfills collect landfill gas and send it to a flare for combustion, wasting a valuable energy source. Landfill gas is delivered to a gas plant by a fuel gas compressor and it is fed to reciprocating engines. The engines use the gas as a fuel and turn power generators that produce the electricity. Power generated would be delivered to the local electrical utility grid and also provide electricity to the facility. This option is the most commonly used technology for utilizing landfill gas.

The limitations to this system are the upfront capital costs and the cost for electricity tie-in to the utility grid. The electrical utility typically charges approximately $0.04 to $0.12/kw-hr to customers for service.

Often a third party firm gets involved in these types of projects. The firm would purchase the landfill gas rights from the City to develop a gas to energy plant. In the past, tax credits were available to a third party for such development. The tax credits provided financial incentives for development of these systems. Based on similar projects, the third party would need to receive about $0.04 to $0.05/kw-hr from the utility for the project to be cost-effective.

The City could further explore opportunities with third party firms to further assess the cost benefits. The benefits to the City could be very significant. The City could obtain revenue from the gas sale, control landfill gas emissions, and potentially reduce the investment in a landfill gas collection system for the Active Area as well as for a future system in the Expansion Area. The City and third party could negotiate the cost sharing of the design and construction of the landfill gas collection system.

4.10.4.2 Microturbines

This option includes delivering landfill gas to a microturbine system for generating electrical power. Power generated would be delivered to the local electrical utility grid and also provide electricity to the facility. Microturbines are ideally suited for landfills since they can convert biogas methane into electricity without the heat and noise of reciprocating engines. Essentially, microturbines are scaled down turbine engines with integrated generators and power electronics. Microturbines can operate on a wide variety of gaseous and liquid fuels, and have extremely low emissions of nitrogen oxides.

The main drawback to this technology is that microturbines require a minimum of 30 percent methane concentration in order to operate effectively. Since landfill gas methane concentrations tend to vary over time, the microturbine may need to be supplemented with other fuels. Another drawback is that the cost of operating and maintaining the microturbines has been a significant issue at other landfills.

Similar to the engine generators, the limitations to implementing this system are the upfront capital costs and the cost for electricity tie-in to the utility grid.

4.10.4.3 Dual Fuel Boiler Systems

This option includes delivering landfill gas to a dual fuel gas boiler system. The boiler system will heat the existing landfill maintenance building and/or the proposed maintenance building. In order to accomplish this, the HVAC system must be designed to have a hydronic (hot water) heating system to carry heat energy (in the form of 190^{o}F hot water) from the boilers out to the air handling units. The boilers must be capable of carrying the peak heating loads. The boilers will use landfill gas and/or propane as the fuel. That way, if the landfill gas system is down for any reason, the facility can rely on the natural gas (propane) source.

The cost considerations include modifying or replacing the existing HVAC system to accommodate a dual fuel gas boiler system and added costs for running the landfill gas pipeline to the boiler system. The other cost issues revolve around the current heating costs. These cost considerations will need to be evaluated for the feasibility of using this option.

4.10.4.4 Leachate Evaporation Systems

A leachate evaporation system consists of a process where leachate is evaporated using landfill gas as a fuel. VOCs and other odorous compounds found in the leachate feed are stripped into the exhaust vapor of the evaporation process and thermally treated within an enclosed flare. The leachate evaporator reduces the volume of typical leachate by about 97 percent. Trace metals and salts remain with the residual that is continuously removed from the bottom of the evaporator. This non-hazardous residue, similar to a brine, can be recirculated to the landfill or solidified for landfill disposal. The process includes tankage for the residual, evaporator, vapor demister, enclosed flare, leachate feed pump, and related support equipment. In general, about 1,000 cfm of landfill gas is necessary to treat 1 gpm of leachate.

Typically, this type of system is cost effective if the current leachate treatment costs are $0.06 per gallon or greater (not including transportation costs).

4.10.5 Conclusions and Recommendations

A landfill gas collection and control system will be needed for SFRSL in the near future. The timeframe for this is dependent on regulatory requirements outlined in Sections 2.2.5 and 4.10.1 of this report. Potentially, a gas collection system could be required to be operational as soon as 2007.

Vertical gas extraction wells should be utilized for gas collection throughout the MSW areas of the landfill. A utility flare station will be used for combustion of the gas over the near term. A study could be performed in the future to determine which, if any, of the beneficial uses identified in Section 4.10.4 would be the most cost-effective at SFRSL.

4.11 FUTURE MANPOWER AND EQUIPMENT

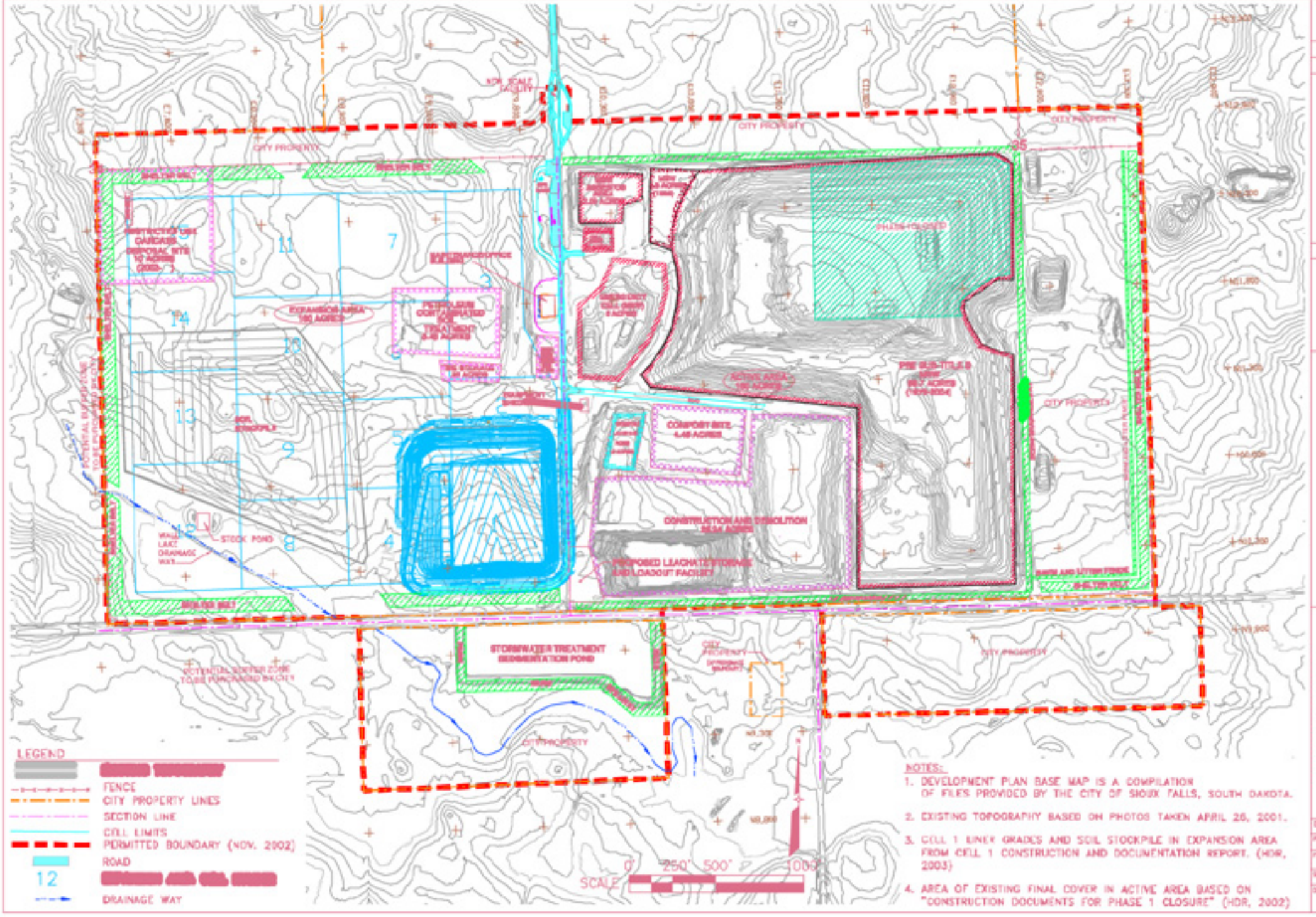
The City has appropriate manpower for the size and activities at the landfill. Additional staff will be required as flow of waste and recyclables increase, and as additional activities at the landfill are implemented. These activities include:

- An additional compactor is placed on-line.
- Leachate extraction in the Active Area.
- Landfill gas collection in the Active Area.
- Leachate hauling to the City's water reclamation plant.
- Leachate extraction and recirculation in the Expansion Area.
- Potential gas to energy development.
- Increase handling and storage of recyclables including white goods, tires, and metals.

Additional discussion of staffing is provided in Section 3.2.13, Hours of Operation, Staffing, and Training.

The City has been proactive in keeping the equipment functional, efficient, and current. An equipment replacement program is instituted whereby major pieces of equipment have a projected life, and a system is in place to budget a replacement unit when the equipment's life expectancy is reached. Landfill staff monitor the equipment performance to ensure the equipment is functioning correctly, and they budget for replacements according to the five year Capital Improvement Program.

During the next five years, most major pieces of equipment are planned for replacement. These items include compactors, scrapers, dozers, a semi-tanker truck for leachate hauling, a replacement for the Concover truck, and a number of other trucks and specialized equipment. Operating hours should be monitored for each piece of equipment and 10,000 operating hours should be used as a threshold for determining the timeframe for equipment replacement. The Implementation Plan, included in Section 7.0, provides a detailed listing of major equipment, approximate cost, and the year planned for purchase.



LEGEND

- FENCE
- CITY PROPERTY LINES
- SECTION LINE
- CELL LIMITS
- PERMITTED BOUNDARY (NOV. 2002)
- ROAD
- 12
- DRAINAGE WAY

NOTES:

1. DEVELOPMENT PLAN BASE MAP IS A COMPILATION OF FILES PROVIDED BY THE CITY OF SIOUX FALLS, SOUTH DAKOTA.
2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 26, 2001.
3. CELL 1 LINER GRADES AND SOIL STOCKPILE IN EXPANSION AREA FROM CELL 1 CONSTRUCTION AND DOCUMENTATION REPORT. (HDR, 2003)
4. AREA OF EXISTING FINAL COVER IN ACTIVE AREA BASED ON "CONSTRUCTION DOCUMENTS FOR PHASE 1 CLOSURE" (HDR, 2002)

EARTH TECH

SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL

DEVELOPMENT PLAN
INITIAL CONDITIONS

DATE: OCTOBER 2003
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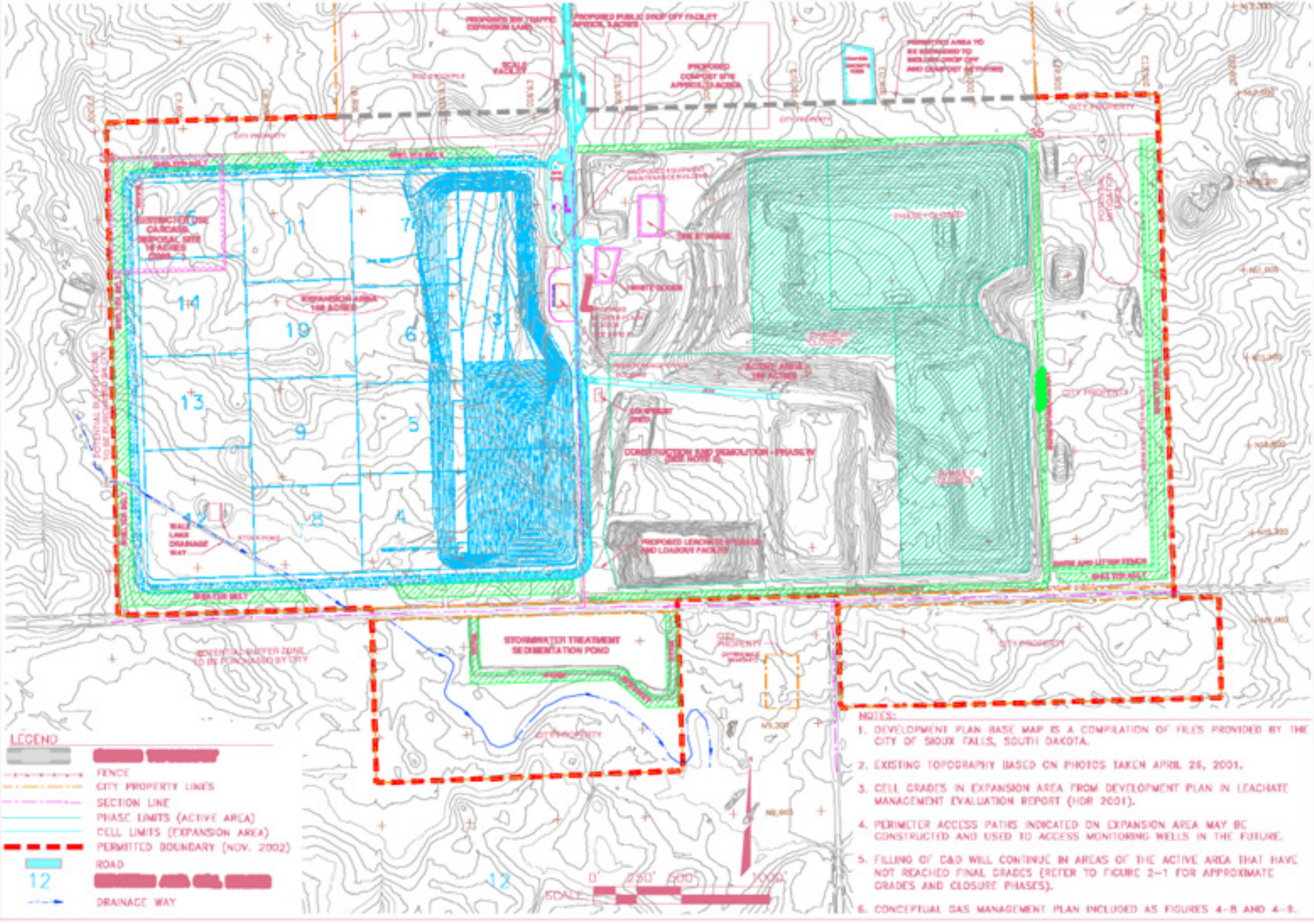
SHEET NO:
DRAWING NO: 4-1



LEGEND

- FENCE
- CITY PROPERTY LINES
- SECTION LINE
- PHASE LIMITS (ACTIVE AREA)
- CELL LIMITS (EXPANSION AREA)
- PERMITTED BOUNDARY (NOV. 2002)
- ROAD
- 12
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NOTES:

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2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 26, 2001.
3. CELL GRADES IN EXPANSION AREA FROM DEVELOPMENT PLAN IN LEACHATE MANAGEMENT EVALUATION REPORT (HDR 2001).
4. PERIMETER ACCESS PATHS INDICATED ON EXPANSION AREA MAY BE CONSTRUCTED AND USED TO ACCESS MONITORING WELLS IN THE FUTURE.
5. FILLING OF C&D WILL CONTINUE IN AREAS OF THE ACTIVE AREA THAT HAVE NOT REACHED FINAL GRADES (REFER TO FIGURE 2-1 FOR APPROXIMATE GRADES AND CLOSURE PHASES).
6. CONCEPTUAL GAS MANAGEMENT PLAN INCLUDED AS FIGURES 4-8 AND 4-9.

EARTH TECH

SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL

DEVELOPMENT PLAN YEAR 2008

DATE: OCTOBER 2002
PROJECT NO: 53053
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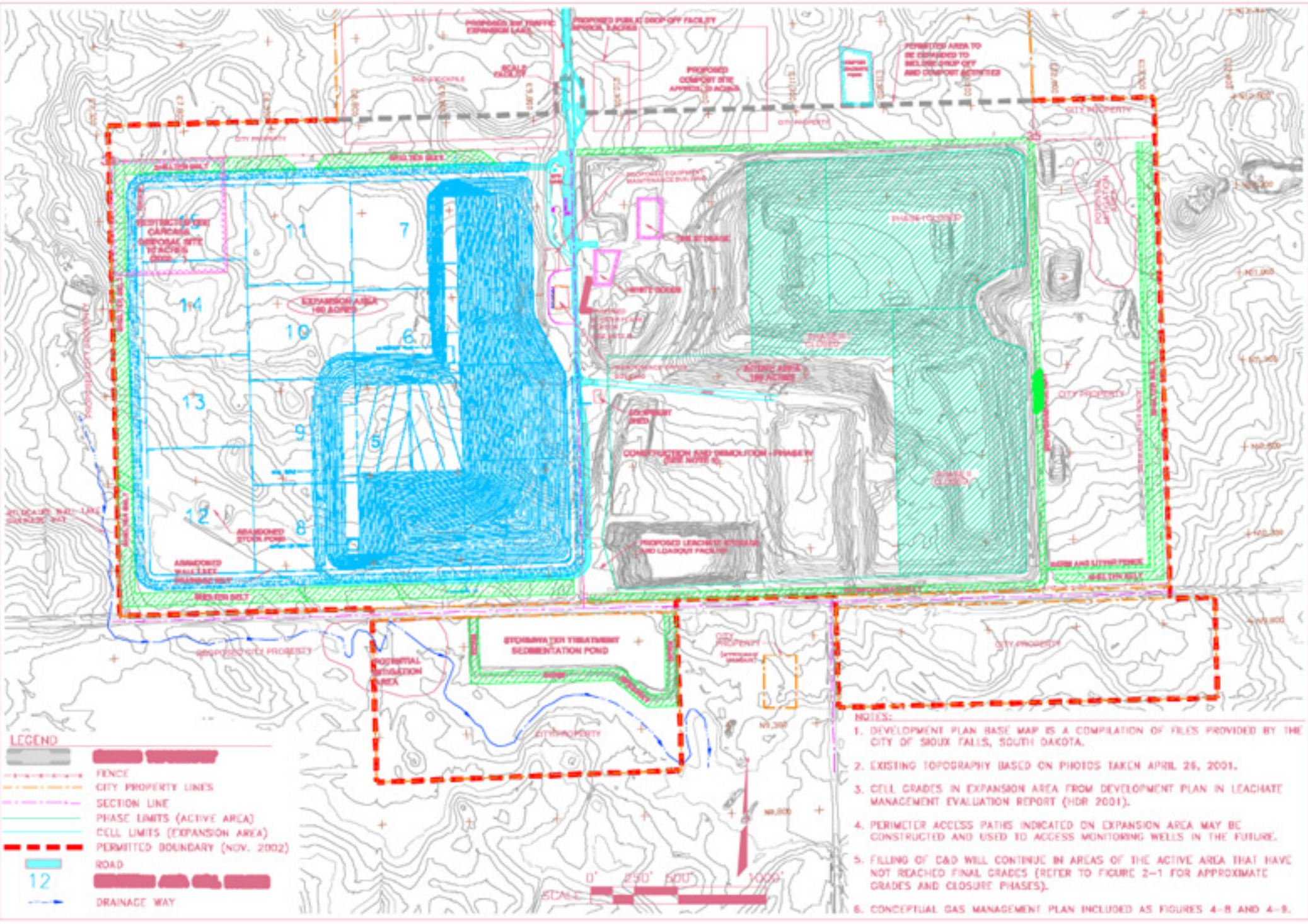

LEGEND

- FENCE
- CITY PROPERTY LINES
- SECTION LINE
- PHASE LIMITS (ACTIVE AREA)
- CELL LIMITS (EXPANSION AREA)
- PERMITTED BOUNDARY (NOV. 2002)
- ROAD
- 12
- DRAINAGE WAY

NOTES:

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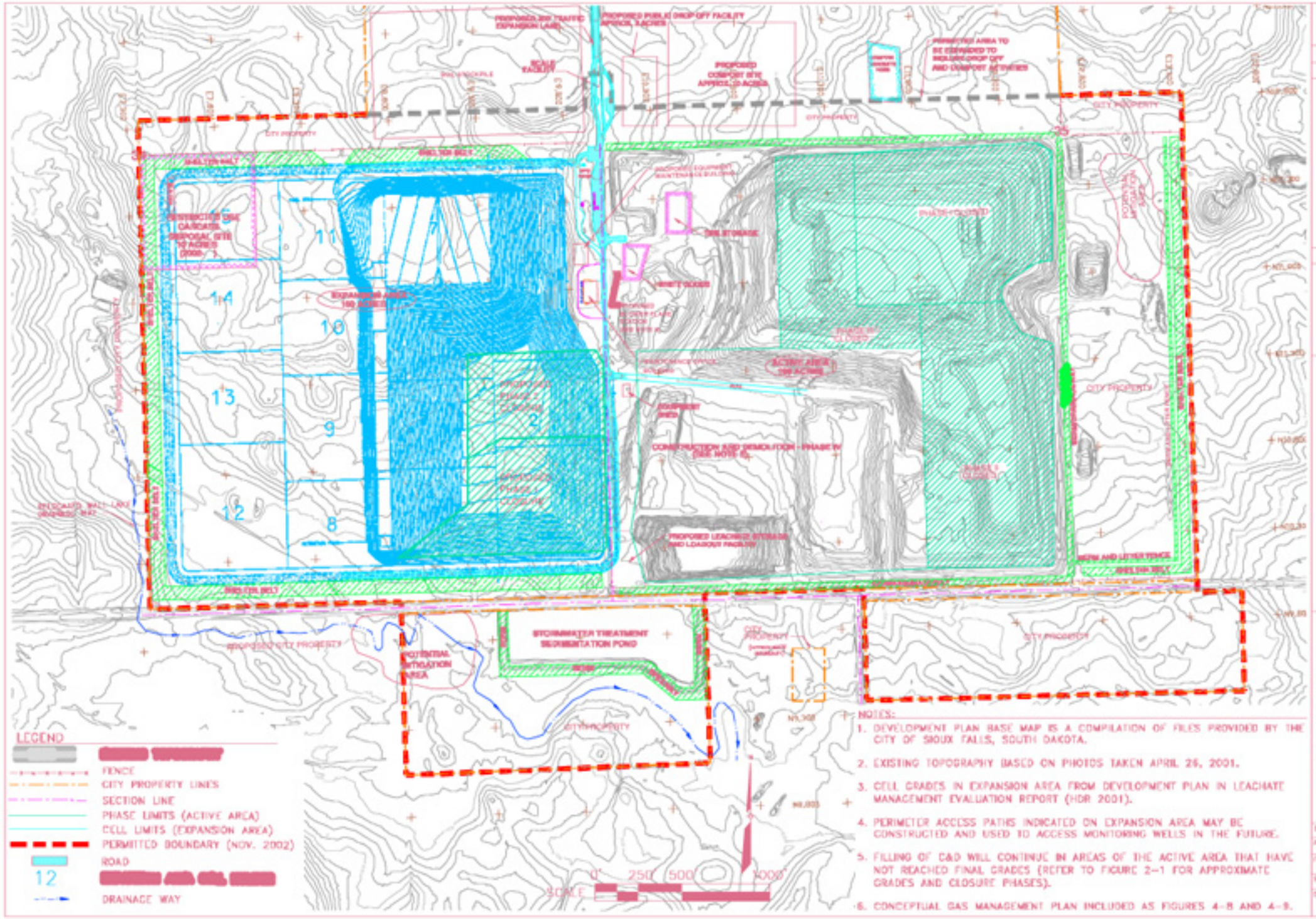
2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 26, 2001.
3. CELL GRADES IN EXPANSION AREA FROM DEVELOPMENT PLAN IN LEACHATE MANAGEMENT EVALUATION REPORT (HDR 2001).
4. PERIMETER ACCESS PATHS INDICATED ON EXPANSION AREA MAY BE CONSTRUCTED AND USED TO ACCESS MONITORING WELLS IN THE FUTURE.
5. FILLING OF C&D WILL CONTINUE IN AREAS OF THE ACTIVE AREA THAT HAVE NOT REACHED FINAL GRADES (REFER TO FIGURE 2-1 FOR APPROXIMATE GRADES AND CLOSURE PHASES).
6. CONCEPTUAL GAS MANAGEMENT PLAN INCLUDED AS FIGURES 4-8 AND 4-9.

EARTH TECH

SOLID WASTE MASTER PLAN
CITY OF SOUX FALLS SOUTH DAKOTA
SOUX FALLS REGIONAL LANDFILL

DEVELOPMENT PLAN YEAR 2013

DATE: OCTOBER 2003
PROJECT NO: 53053
FILE NAME: F304-3A2W2
SHEET NO:
DRAWING NO: 4-3



NOTES:

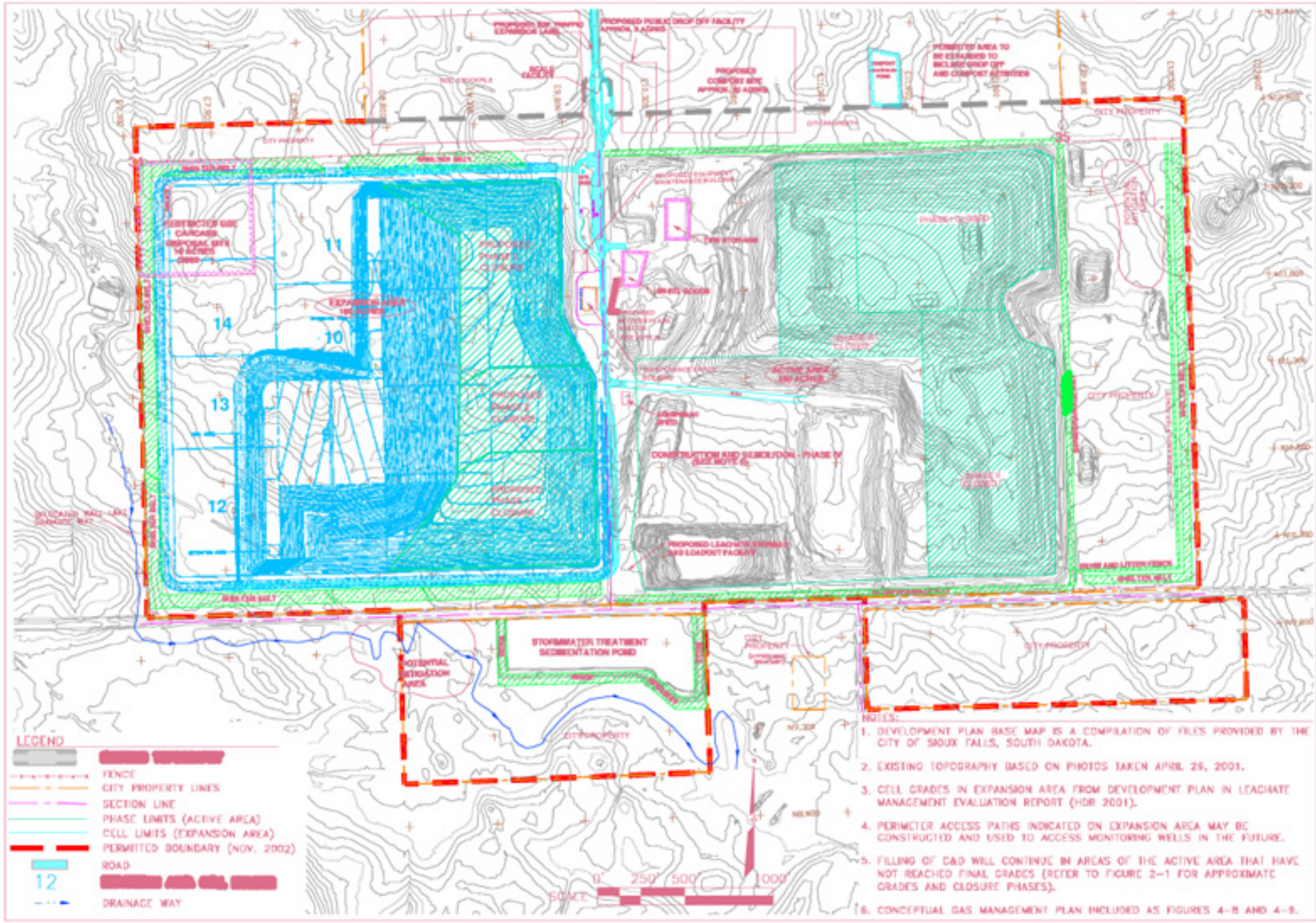
1. DEVELOPMENT PLAN BASE MAP IS A COMPILATION OF FILES PROVIDED BY THE CITY OF SIOUX FALLS, SOUTH DAKOTA.
2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 26, 2001.
3. CELL GRADES IN EXPANSION AREA FROM DEVELOPMENT PLAN IN LEACHATE MANAGEMENT EVALUATION REPORT (HDR 2001).
4. PERIMETER ACCESS PATHS INDICATED ON EXPANSION AREA MAY BE CONSTRUCTED AND USED TO ACCESS MONITORING WELLS IN THE FUTURE.
5. FILLING OF C&D WILL CONTINUE IN AREAS OF THE ACTIVE AREA THAT HAVE NOT REACHED FINAL GRADES (REFER TO FIGURE 2-1 FOR APPROXIMATE GRADES AND CLOSURE PHASES).
6. CONCEPTUAL GAS MANAGEMENT PLAN INCLUDED AS FIGURES 4-8 AND 4-9.

EARTH TECH

SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL

DEVELOPMENT PLAN YEAR 2018

DATE: OCTOBER 2002
PROJECT NO: 53053
FILE NAME: F304-1A2R0
SHEET NO:
DRAWING NO: 4-4



LEGEND

- FENCE
- CITY PROPERTY LINES
- SECTION LINE
- PHASE LIMITS (ACTIVE AREA)
- CELL LIMITS (EXPANSION AREA)
- PERMITTED BOUNDARY (NOV. 2002)
- ROAD
- 12
- DRAINAGE WAY

NOTES:

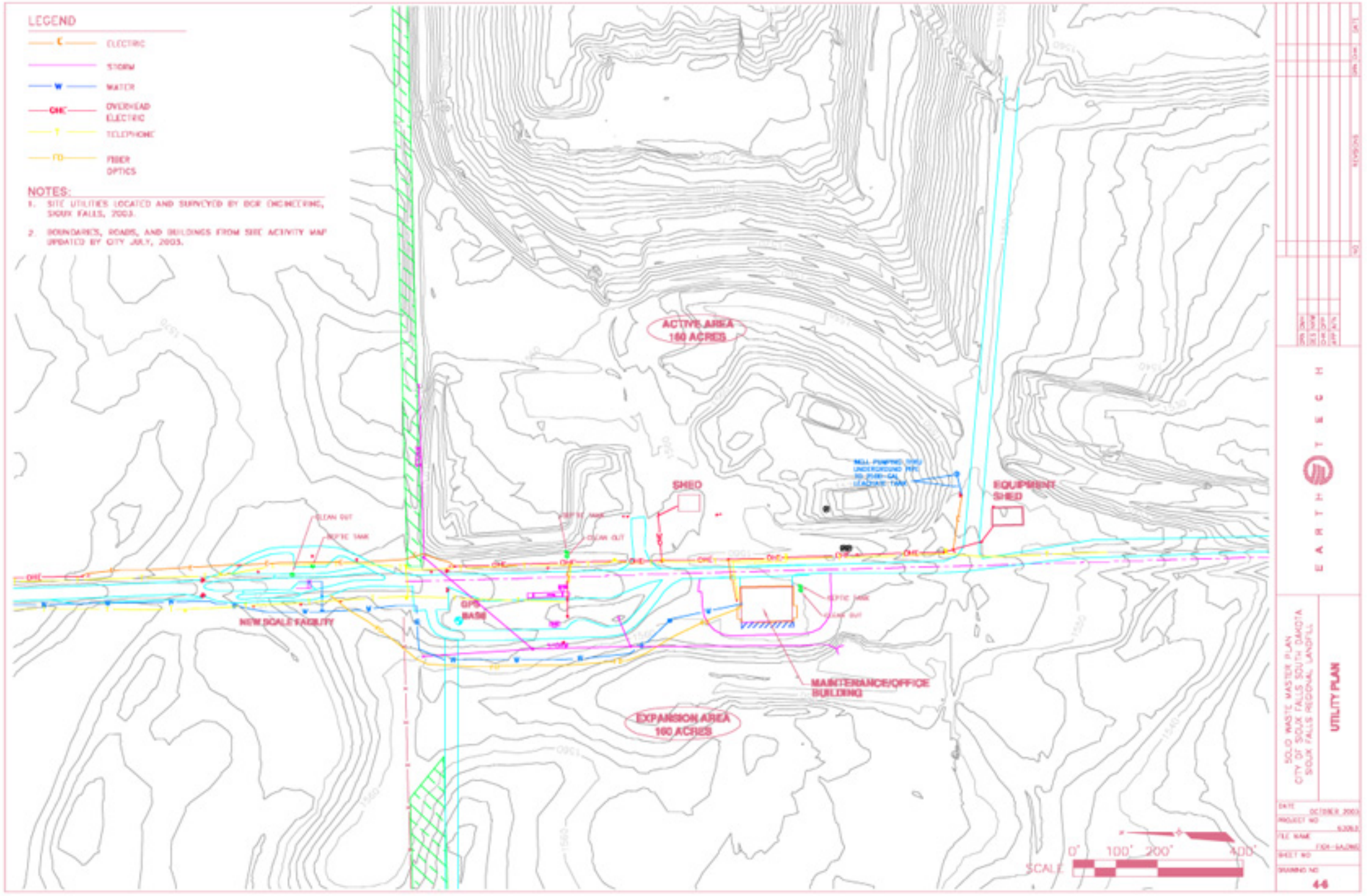
1. DEVELOPMENT PLAN BASE MAP IS A COMPILATION OF FILES PROVIDED BY THE CITY OF SIOUX FALLS, SOUTH DAKOTA.
2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 26, 2001.
3. CELL GRADES IN EXPANSION AREA FROM DEVELOPMENT PLAN IN LEACHATE MANAGEMENT EVALUATION REPORT (HDR 2001).
4. PERIMETER ACCESS PATHS INDICATED ON EXPANSION AREA MAY BE CONSTRUCTED AND USED TO ACCESS MONITORING WELLS IN THE FUTURE.
5. FILLING OF C&D WILL CONTINUE IN AREAS OF THE ACTIVE AREA THAT HAVE NOT REACHED FINAL GRADES (REFER TO FIGURE 2-1 FOR APPROXIMATE GRADES AND CLOSURE PHASES).
6. CONCEPTUAL GAS MANAGEMENT PLAN INCLUDED AS FIGURES 4-8 AND 4-9.

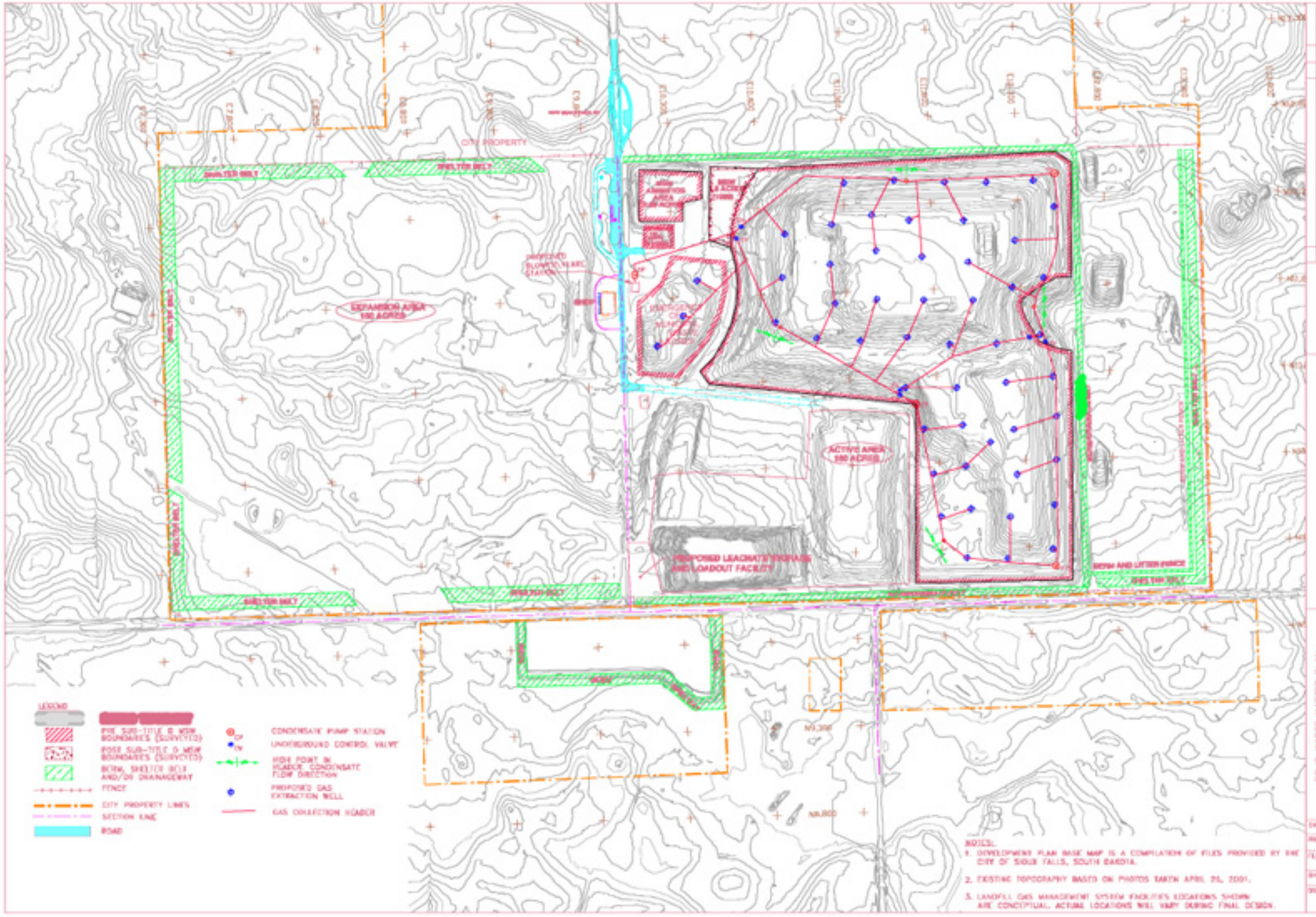
EARTH TECH

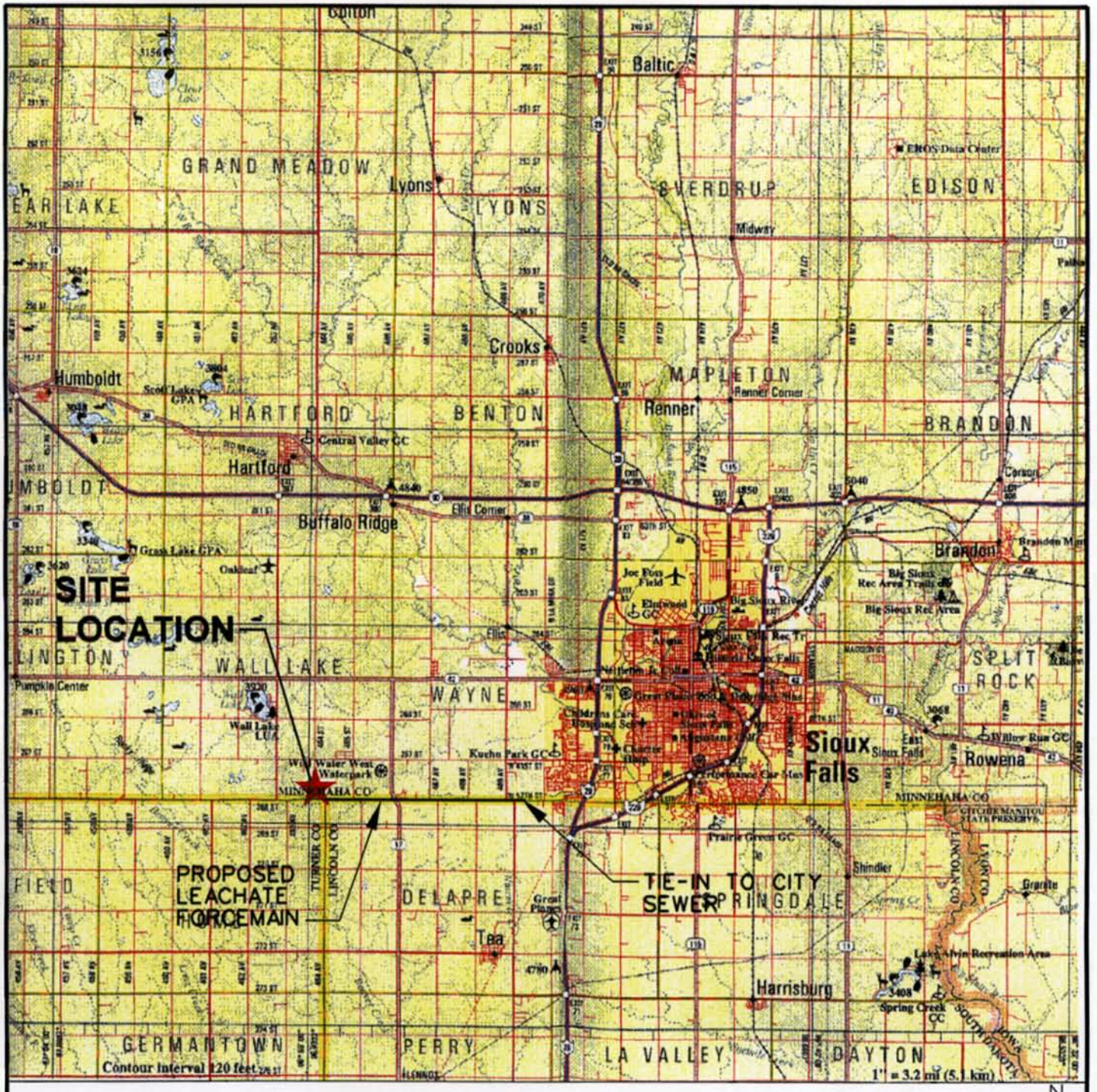
SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS, SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL

DEVELOPMENT PLAN YEAR 2023

DATE: OCTOBER 2002
PROJECT NO: 52053
FILE NAME: F304-54J06
SHEET NO:
DRAWING NO: 4-8


LEGEND
E ELECTRIC
STORM
W WATER
OHE OVERHEAD ELECTRIC
T TELEPHONE
FO FIBER OPTICS
NOTES:
1. SITE UTILITIES LOCATED AND SURVEYED BY BOB ENGINEERING, SIOUX FALLS, 2003.
2. BOUNDARIES, ROADS, AND BUILDINGS FROM SDEC ACTIVITY MAP UPDATED BY CITY JULY, 2003.
ACTIVE AREA 160 ACRES
SHED
EQUIPMENT SHED
NEW SCALE FACILITY
GPS BASE
MAINTENANCE/OFFICE BUILDING
EXPANSION AREA 160 ACRES
SEPTIC TANK
CLEAN OUT
SCALE
0'
100'
200'
400'
EARTH TECH
SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL
UTILITY PLAN
DATE
OCTOBER 2003
PROJECT NO
53053
FILE NAME
FIGR-SA2MS
SHEET NO
DRAWING NO
4-6


CITY PROPERTY
EXPANSION AREA
100 ACRES
ACTIVE AREA
100 ACRES
PROPOSED LEACHATE STORAGE AND LOADOUT FACILITY
LEGEND
CONDENSATE PUMP STATION
UNDERGROUND CONTROL VALVE
HIGH POINT IN HEADER CONDENSATE FLOW DIRECTION
PROPOSED GAS EXTRACTION WELL
GAS COLLECTION HEADER
CITY PROPERTY LINES
SECTION LINE
ROAD
NOTES:
1. DEVELOPMENT PLAN BASE MAP IS A COMPILATION OF FILES PROVIDED BY THE CITY OF SIOUX FALLS, SOUTH DAKOTA.
2. EXISTING TOPOGRAPHY BASED ON PHOTOS TAKEN APRIL 25, 2001.
3. LANDFILL GAS MANAGEMENT SYSTEM FACILITIES LOCATIONS SHOWN ARE CONCEPTUAL. ACTUAL LOCATIONS WILL VARY DURING FINAL DESIGN.
SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL
LANDFILL GAS MANAGEMENT PLAN-ACTIVE AREA
EARTH TECH
DATE OCTOBER 2001
PROJECT NO 53263
FILE NAME FGR-BASE
SHEET NO
DRAWING NO 4-8



SOURCE:

SOUTH DAKOTA ATLAS & GAZETEER
SECOND EDITION, 2001.

APPROXIMATE SCALE: 1" = 3.8 MILES

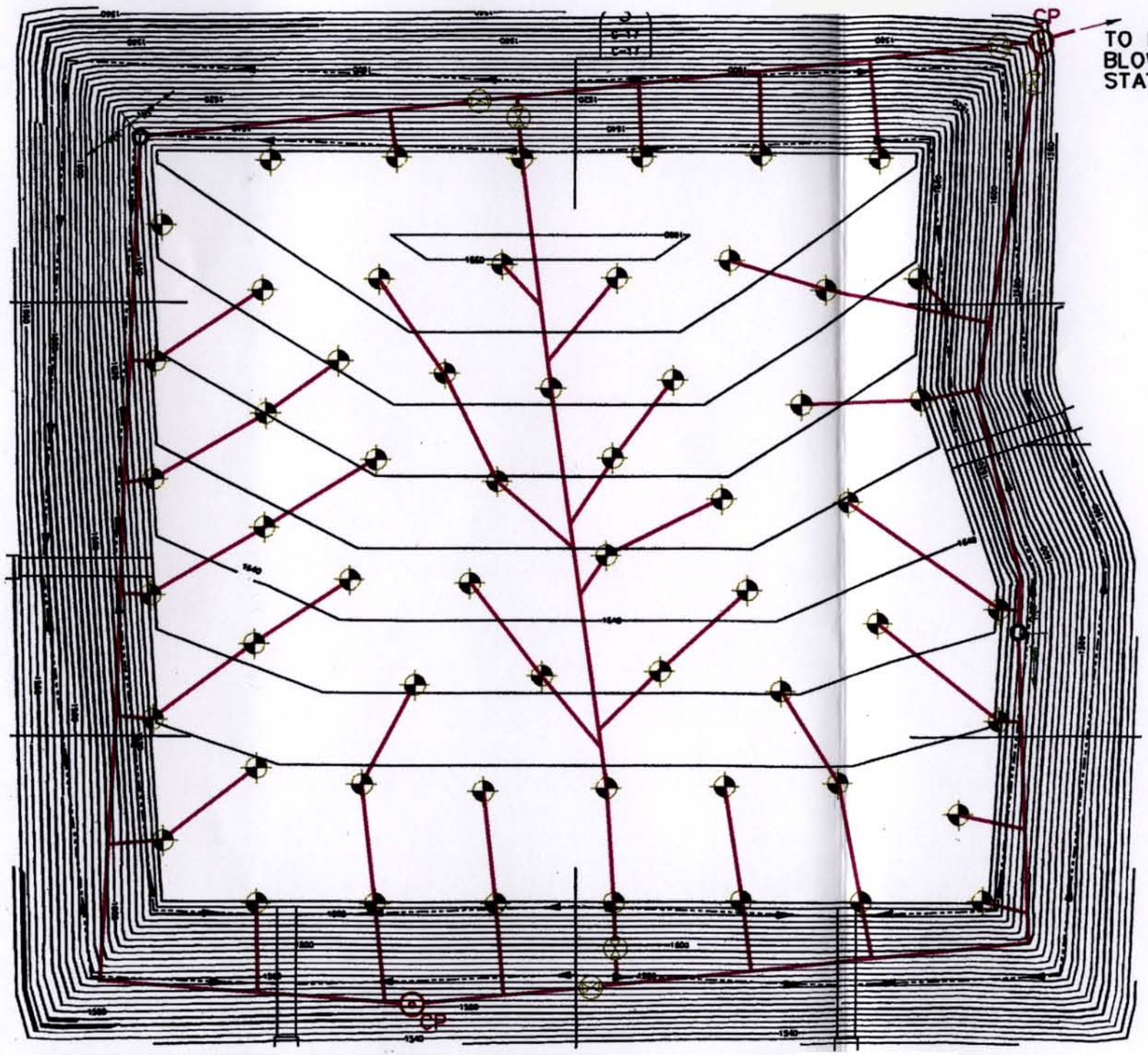
EARTH TECH

FIGURE 4-7
LEACHATE FORCEMAIN LOCATION MAP

SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS, SOUTH DAKOTA
SIOUX FALLS REGIONAL LANDFILL

OCTOBER 2003 63063

DGN =l:\work\sioux_falls\63063\cadd\sheb-ob\030811\fig4-7a.dgn



LEGEND

- 1570 — PROPOSED GRADES
- GAS EXTRACTION WELL
- GAS COLLECTION HEADER
- HEADER ACCESS RISER
- CP — CONDENSATE PUMP STATION
- HIGHPOINT IN HEADER- CONDENSATE FLOW DIRECTION
- UNDERGROUND CONTROL VALVE

NOTE:

1. LANDFILL GAS MANAGEMENT SYSTEM FACILITIES LOCATION SHOWN ARE APPROXIMATE. ACTUAL LOCATIONS WILL VARY DURING CONSTRUCTION.
2. CLOSURE PLAN BASE MAP IS FROM "SIOUX FALLS REGIONAL LANDFILL LATERAL EXPANSION DISPOSAL AREA FILLING PLAN" BY HDR, 2001.

N

APPROXIMATE SCALE: 1" = 300'

EARTH TECH

FIGURE - 4-9
LANDFILL GAS MANAGEMENT PLAN-EXPANSION AREA
SOLID WASTE MASTER PLAN
CITY OF SIOUX FALLS, SOUTH DAKOTA
OCTOBER 2003 SIOUX FALLS REGIONAL LANDFILL 63063

DATE = Mon Oct 20 11:43:40 2003

5.0 FINANCIAL ANALYSIS

5.1 LANDFILL FINANCIAL ASSURANCE REVIEW

5.1.1 Overview

The objective of this task is to review the City financial assurance calculation and determine the adequacy of the annual payments to meet regulatory and physical closure and post-closure requirements. To initiate this task we reviewed the following:

- Memorandum and attachment dated February 21, 2002, from Doug Johnson, Environmental Analyst, to Duane Hatch, Senior Accountant, describing the approach taken by the City to calculate closure and postclosure costs for meeting the financial assurance requirements.

- Closure/post-closure plan (HDR, 2001b) for the Active Site dated August 2001 developed by HDR (Plan) for the City of Sioux Falls Regional Sanitary Landfill (SFRSL).

- Solid Waste Permit Renewal Application dated August 2001 (LBG, 2001).

- Administrative Rules of South Dakota (ARSD) Chapter 74:27:15, Closure and Post-Closure, and Chapter 74:27:16, Financial Assurance.

- E-mail dated June 3, 2003, from Bob Kappel providing additional background on the City's approach for calculating financial assurance.

5.1.2 Closure Costs Calculation

The closure costs are estimated in the Plan per the requirements specified in ARSD Chapter 74:27:15:04. The estimated costs are based on historical bid pricing to complete similar work as referenced in the applicable rule. The Plan states the estimated cost per acre of the Active Site is $35,960 with total closure costs of $5,214,200 for closure of 145 acres.

Per our review of the detailed calculations in the Plan, it appears the method used to determine closure costs for the active site are consistent with the applicable ARSD. To determine the closure costs component of the financial assurance, the total closure costs expended to date for the Active Area need to be subtracted from the adjusted total closure costs calculation.

5.1.3 Post-Closure Costs Calculation

The post-closure costs are estimated in the Plan per the requirements set out in ARSD Chapter 74:27:15:09. This calculation includes estimated costs for post-closure care as defined in ARSD Chapter 74:27:15:09 including, but not limited to, costs associated with final cover, leachate management, groundwater monitoring, and LFG management. The Plan states the estimated annual post-closure costs for the Active Site to be $75,690 in 2001 dollars with a total of $2,270,700 for the 30-year post-closure period.

Per our review of the detailed calculations in the Plan, it appears the scope of the post-closure costs for the Active Site are consistent with the applicable ARSD. However, we would recommend that the 30-year post-closure costs be discounted to develop a present value calculation to more accurately represent the post-closure costs.

5.1.4 Financial Assurance Mechanism and Fund Balance

The City presently uses a Cash Reserve Account as its assurance mechanism. Per the ARSD, the components of financial assurance shall be closure, postclosure, corrective action and may include environmental remediation. Based on our review, the rules as drafted appear to provide broad discretion to the South Dakota Department of Environment and Natural Resources (SDDENR) in defining the scope of the required financial assurance.

Based on review of the City Public Works Department information addressing SFRSL financial assurance, the closure and post-closure costs as of December 31, 2001, were calculated to be $2,570,639 and $1,000,000 for corrective action for a total of $3,570,639. Per City staff, the City's current financial assurance calculations are based on a closure/post closure study completed in 1994 (LBG) and the Plan was not used to modify or update the City's financial assurance requirements. Thus, the financial assurance calculation was based on volumetric capacity as opposed to total acreage needing to be closed.

Provided below is a summary of the City's financial assurance and calculations as provided by the Health Department. The closure costs were projected based upon estimated costs to close one 6-acre cell. Additions to the financial assurance fund balance were determined using volumetric estimates and in accordance with Governmental Accounting Standards.

Initial Estimate

$1,350,000	Closure/Post Closure Care
$750,000	Environmental Remediation
$2,100,000	Initial Total (Approximately nine years ago)

1994 - 2002 Additions

$1,035,528	Closure/Post Closure Care
$250,000	Environmental Remediation
$1,285,528	Total Increase to Financial Assurance Cash Account

Present Total

$2,385,528	Closure/Post Closure Care
$1,000,000	Environmental Remediation
$3,385,528	Current Financial Assurance Account Balance

The total annual payment for the Active Site for 2001 was estimated by City to be $325,421.20.

5.1.5 Alternative Calculations

Based on the above information, R.W. Beck, with input from City staff, contacted representatives of the SDDENR to discuss the applicable ARSD as applied to the City's landfill and its financial assurance. The primary objective was to clarify the scope of the financial assurance requirements. Per discussions with SDDENR representatives, the Project Team concluded the following:

- Restricted use areas designated for construction and demolition disposal are not subject to financial assurance calculations.

- Environmental remediation costs do not need to be designated as part of the financial assurance set-aside requirements.

- Financial assurance calculations should be periodically updated and should be adequate for closure and post-closure throughout the life of the facility. It appears some flexibility exists as to the financial assurance set aside standard. An alternative to the standard requiring adequate set aside for closure of the "largest area of the landfill open at any time during the operations of the facility" may be acceptable.

As a result, R.W. Beck recalculated the City's financial assurance requirements and developed two sets of calculations. The first set of calculations, *Scenario A: All Planned Cells*, represents the projected closure and post-closure obligation assuming closure and post-closure obligations begin at the end of projected life of the landfill in 2038. The second set of calculations, *Scenario B: Largest Expansion Area (Cell 6)* represent the projected closure and post-closure obligations assuming closure and post-closure obligations would begin if the largest segment of the Expansion Area to be open at any one time needed to be closed. Per the phasing plan, under this scenario we are assuming closure of the landfill in 2014 with an expected life of 11 years per the phasing plan.

Key assumptions included in both analyses are as follows:

- Final cover area for active site of approximately 145 acres.

- Post-closure period of 30 years.

- Discount rate of 1.25 percent.

- Final post-closure cover area for Expansion Area is approximately 50 acres.

- Current estimated 2003 end of year financial assurance fund balance of $3,455,608.

- No specific set aside required for the environmental remediation component,

- Closure and post-closure unit cost estimates developed previously for the city were used and not updated.

The following tables provide the present values for closure and post-closure costs, total financial obligation, and projected monthly payment under the two scenarios.

TABLE 5-1

SCENARIO A: ALL PLANNED CELLS
Calculation of Financial Assurance Obligation
30 Year Post-Closure: 2039 to 2069

Present Value of:		
Closure Costs	$2,311,471	Closure of Cells 1-6
Post-Closure Costs	$2,107,470	Active Site
Post-Closure Costs	$2,124,915	Expansion Area
Contingency Action	$0	
Total Obligation	$6,543,856	
Current Balance of Fund	$3,455,608	(Estimate, 2003 year end)
Expected Life	35 years	(2004 to 2038)
Projected Monthly Payment	$9,082.11	
Total Lump Sum for Remainder of Life	$3,088,247	

TABLE 5-2

SCENARIO B: LARGEST EXPANSION AREA (CELL 6)
Calculation of Financial Assurance Obligation
30 Year Post-Closure: 2015 to 2044

Present Value of:		
Closure Costs	$2,311,471	Closure of Cells 1-6
Post-Closure Costs	$2,220,412	Active Site
Post-Closure Costs	$2,238,793	Expansion Area
Contingency Action	$0	
Total Obligation	$6,770,676	
Current Balance of Fund	$3,455,608	(estimate, 2003 year end)
Expected Life	11 years	(2004 to 2014)
Projected Monthly Payment	$26,893.36	
Total Lump Sum for Remainder of Life	$3,315,067	

5.1.6 Financial Assurance Recommendations

Both above analyses suggest total additional financial assurance obligations of more than $3,000,000. However, Scenario A financial requirements are approximately $109,000 per year, as opposed to approximately $322,000 per year for Scenario B. Scenario A offers an annual payment substantially less than the total annual set aside of $325,421 reported by the City in 2001. Per our review and discussions with the SDDENR staff, the annual set aside of approximately $109,000 per year identified in Scenario A may be adequate to meet the requirements. We recommend presenting this alternative calculation to the SDDENR for consideration. At minimum, we recommend the existing closure and post-closure per unit

cost estimates be updated so financial assurance calculations can be more reliably updated during the future operating life of the landfill.

5.2 TIP FEE ANALYSIS

5.2.1 Overview

This task involved review of current SFRSL operational costs and planned facility and equipment upgrades in conjunction with the total landfill revenue. The objective is to identify a potential tip fee level needed to generate adequate revenue to meet future program needs through the next 5 years. The spreadsheets included with this evaluation provide a summary of the overall analysis.

The key assumptions in our analysis include the following:

- Projected revenues based on average annual growth rates using historical landfill receipts from 1996-2002 (excluding C&D).
- C&D disposal growth rate peaks at an average historical rate in 2003 and is gradually reduced to 4 percent or the estimated MSW growth rate through the planning period to reflect a more conservative estimate in the intermediate term.
- Revenues from hauler licenses increased at the present rate of inflation.
- All operating expenses are projected to increase at the assumed rate of inflation unless otherwise designated.
- Capital improvement expenses for 2004-2008 are based on the Project Team's recommendations with input from City staff.
- Annual financial assurance expenses are comparable to estimates developed by the Project Team using the alternative analysis developed in Section 5.1 identifying a reduced annual set aside.
- An applicable portion of the City's solid waste restricted reserves fund has been used to cover costs of the closure and post-closure care for the Active Area.
- Three million dollars from the unrestricted reserves fund balance of approximately $6.9 million has been used over the five year planning period to reduce the net expenses. The total dollars used annually from the unrestricted fund are proportional to the annual capital expenses for each of the years of 2004 to 2008 over the total capital expenses for the five year time frame. As a result, approximately $3.9 million was retained in the unrestricted fund because it represents, on average, approximately one year of operating expenses, excluding planned capital expenses.
- Capital improvement costs are assumed to be paid in full during year incurred, no cost levelizing has been undertaken, and no debt service incurred.
- The MSW and C&D tip fees for 2004 through 2008 represent the recommended tip fees.

The following three tables depict the projected revenues and expenses for years 2003 to 2008. Table 5-3 identifies the annual net income/loss based on the differential between the annual revenues and expenses. Table 5-4 provides revenue detail while Table 5-5 provides expense detail.

TABLE 5-3

SUMMARY SANITARY LANDFILL TIP FEE ANALYSIS

	Actual		Budget	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
ESTIMATED ANNUAL REVENUES								
Tip Fee Revenues								
MSW	1,983,797	2,062,302	2,224,371	4,199,994,	4,366,910	4,540,460	4,720,907	4,908,525
Yard Waste	49,976	55,521	32,493	37,661	43,652	50,595	58,643	67,971
Tire Disposal	17,774	13,479	15,627	16,095	16,578	17,075	17,588	18,115
C&D (Rubble)	1,140,669	1,104,823	837,792	1,698,886	1,815,945	1,923,418	2,018,555	2,098,777
Petroleum Contaminated Soil	11,544	49,388	50,823	52,300	53,820	55,384	56,994	58,650
Asbestos	3,123	5,355	25,524	23,930	22,435	21,034	19,720	18,488
Appliances	11,643	19,665	15,654	16,124	16,607	17,106	17,619	18,147
Total Tipping Revenues	**3,218,526**	**3,310,533**	**3,202,284**	**6,044,990**	**6,335,948**	**6,625,072**	**6,910,025**	**7,188,674**
Miscellaneous Revenues								
Interest Earned	556,835	418,216	421,055	330,701	281,884	253,687	227,747	217,440
Hauler Licenses and Permits	29,600	19,250	30,488	31,403	32,345	33,315	34,315	35,344
Other	1,968	31,415	2,027	2,088	2,150	2,215	2,281	2,350
Total Miscellaneous Revenues	**586,435**	**437,466**	**453,570**	**364,192**	**316,379**	**289,217**	**264,343**	**255,134**
Reserve Withdrawal								
Restricted Reserves	-	-	-	**1,178,000**	**608,000**	**80,000**	**80,000**	**80,000**
Unrestricted Reserves	-	-	-	**1,070,538**	**607,357**	**574,639**	**570,017**	**177,449**
TOTAL ANNUAL REVENUES	**3,804,961**	**3,747,999**	**3,655,854**	**8,657,720**	**7,867,684**	**7,568,928**	**7,824,385**	**7,701,257**

TABLE 5-3

SUMMARY SANITARY LANDFILL TIP FEE ANALYSIS

	Actual		Budget	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
ESTIMATED ANNUAL EXPENSES								
Wages	643,965	718,043	753,334	775,934	799,212	823,188	847,884	873,321
Social Security & Medicare	45,926	51,591	54,885	56,532	58,227	59,974	61,774	63,627
Fringe Benefits	121,131	154,584	201,416	207,458	213,682	220,093	226,695	233,496
Insurance (Property, Liability)	19,466	9,398	8,602	8,860	9,126	9,400	9,682	9,972
Professional Services	509,368	479,846	1,041,566	1,072,813	1,104,997	1,138,147	1,172,292	1,207,460
Publishing	-	-	-	-	-	-	-	-
Rentals	23,841	23,561	24,040	24,761	25,504	26,269	27,057	27,869
Repair & Maintenance	129,452	196,952	258,459	266,213	274,199	282,425	290,898	299,625
Supplies & Materials	211,469	174,840	289,780	298,475	307,427	316,650	326,149	335,934
Job Performance	14,587	14,318	14,145	14,569	15,006	15,457	15,920	16,398
Recycling and Reuse	-	-	25,000	100,000	50,000	50,000	50,000	50,000
Utilities	19,728	21,437	39,617	40,806	42,030	43,291	44,589	45,927
Household Haz Mat Ops Costs	-	-	-	328,229	338,076	348,218	358,665	369,425
Aerial Site Surveys	-	-	10,000	10,000	10,000	10,000	10,000	10,000
Other Current Expenses	123,699	129,541	-	128,000	131,840	135,795	139,869	144,065
Capital Expenses	1,756,281	2,429,106	-	-	-	-	-	-
Capital Planning Needs	-	-	3,115,930	7,527,304	4,270,530	4,406,480	4,007,980	1,247,700
Financial Assurance	-	-	98,316	98,316	98,316	98,316	98,316	98,316
Transfers	-	-	95,026	-	-	-	-	-
Misc. Expenses	(1,430,303)	360,114	360,114	360,114	360,114	360,114	360,114	360,114
TOTAL ANNUAL EXPENSES	**2,188,610**	**4,763,331**	**6,390,230**	**11,318,385**	**8,108,287**	**8,343,817**	**8,047,884**	**5,393,249**
DEBT SERVICE	-	-	-	-	-	-	-	-
NET INCOME (LOSS)	**1,616,351**	**(1,015,332)**	**(2,734,376)**	**(2,660,665)**	**(240,603)**	**(774,889)**	**(223,499)**	**2,308,008**

TABLE 5-4

SANITARY LANDFILL TIP FEE ANALYSIS - REVENUES

		Actual		Budgeted	Projected				
		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
OPERATING REVENUES									
Tipping Fees									
MSW	($/ton)	13.75	13.75	13.75	24.97	24.97	24.97	24.97	24.97
Yard Waste	($/ton)	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Tire Disposal	($/ton)	NA	NA	NA	NA	NA	NA	NA	NA
C&D (Rubble)	($/ton)	12.75	12.75	12.75	23.97	23.97	23.97	23.97	23.97
Petroleum Contaminated Soil	($/ton)	8.62	7.63	7.63	7.63	7.63	7.63	7.63	7.63
Asbestos	($/ton)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Appliances	($/ton)	NA	NA	NA	NA	NA	NA	NA	NA
Tipping Quantities									
MSW	(tons/year)	153,562	155,589	161,772	168,202	174,886	181,837	189,063	196,577
Yard Waste	(tons/year)	5,054	5,097	5,908	6,847	7,937	9,199	10,662	12,358
Tire Disposal	(tons/year)	NA	NA	NA	NA	NA	NA	NA	NA
C&D (Rubble)	(tons/year)	65,156	59,448	65,709	70,876	75,759	80,243	84,212	87,558
Petroleum Contaminated Soil	(tons/year)	1,340	6,471	6,660	6,853	7,052	7,257	7,468	7,685
Asbestos	(tons/year)	571	605	567	532	499	467	438	411
Appliances	(tons/year)	NA	NA	NA	NA	NA	NA	NA	NA
Total Tipping Tonnage	(tons/year)	**225,683**	**227,210**	**240,616**	**253,309**	**266,133**	**279,003**	**291,843**	**304,590**

TABLE 5-4

SANITARY LANDFILL TIP FEE ANALYSIS - REVENUES

		Actual		Budgeted	Projected				
		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Tipping Revenues									
MSW	($)	1,983,797	2,062,302	2,224,371	4,199,994	4,366,910	4,540,460	4,720,907	4,908,525
Yard Waste	($)	49,976	55,521	32,493	37,661	43,652	50,595	58,643	67,971
Tire Disposal	($)	17,774	13,479	15,627	16,095	16,578	17,075	17,588	18,115
C&D (Rubble)	($)	1,140,669	1,104,823	837,792	1,698,886	1,815,945	1,923,418	2,018,555	2,098,777
Petroleum Contaminated Soil	($)	11,544	49,388	50,823	52,300	53,820	55,384	56,994	58,650
Asbestos	($)	3,123	5,355	25,524	23,930	22,435	21,034	19,720	18,488
Appliances	($)	11,643	19,665	15,654	16,124	16,607	17,106	17,619	18,147
Total Tipping Revenues	($)	**3,218,526**	**3,310,533**	**3,202,284**	**6,044,990**	**6,335,948**	**6,625,072**	**6,910,025**	**7,188,674**
Miscellaneous Revenues									
Interest Earned	($)	556,835	418,216	421,055	330,701	281,884	253,687	227,747	217,440
Hauler Licenses and Permits	($)	29,600	19,250	30,488	31,403	32,345	33,315	34,315	35,344
Other	($)	1,968	31,415	2,027	2,088	2,150	2,215	2,281	2,350
Total Misc. Revenues	($)	**586,435**	**437,466**	**453,570**	**364,192**	**316,379**	**289,217**	**264,343**	**255,134**
Reserve Withdrawal									
Restricted Reserves					**1,178,000**	**608,000**	**80,000**	**80,000**	**80,000**
Unrestricted Reserves					**1,070,538**	**607,357**	**574,639**	**570,017**	**177,449**
TOTAL REVENUES	($)	**3,804,961**	**3,747,999**	**3,655,854**	**8,657,720**	**7,867,684**	**7,568,928**	**7,824,385**	**7,701,257**

TABLE 5-4

SANITARY LANDFILL TIP FEE ANALYSIS - REVENUES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Restricted Reserves Account Activity								
Beginning Balance				3,455,608	2,277,608	1,669,608	1,589,608	1,509,608
Phase II Closure Costs				1,178,000	-	-	-	-
Phase III Closure Costs				-	608,000	-	-	-
Active Area Post-Closure Care				-	-	80,000	80,000	80,000
Ending Balance		**3,385,528**	**3,455,608**	**2,277,608**	**1,669,608**	**1,589,608**	**1,509,608**	**1,429,608**

Unrestricted Reserves Parameters	
Approximate Balance	6,937,620
Average Expenses 2004-2008	3,950,326
Available Proceeds	2,987,294
Rounded Available Proceeds	3,000,000

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Wages								
Full-Time	571,784	606,529	666,703	686,704	707,305	728,524	750,380	772,892
Overtime	26,226	32,131	24,000	24,720	25,462	26,225	27,012	27,823
Standby	504	156	-	-	-	-	-	-
Part-time	31,317	69,227	45,820	47,195	48,610	50,069	51,571	53,118
Sick Leave & Benefits	5,962	1,677	5,807	5,981	6,161	6,345	6,536	6,732
Deferred Compensation	8,172	8,323	11,004	11,334	11,674	12,024	12,385	12,757
Total Wages	**643,965**	**718,043**	**753,334**	**775,934**	**799,212**	**823,188**	**847,884**	**873,321**
Social Security & Medicare	**45,926**	**51,591**	**54,885**	**56,532**	**58,227**	**59,974**	**61,774**	**63,627**
Fringe Benefits								
Retirement Contribution	54,861	57,695	67,851	69,887	71,983	74,143	76,367	78,658
Worker's Compensation	9,317	9,219	7,061	7,273	7,491	7,716	7,947	8,186
Group Insurance	55,715	85,434	124,141	127,865	131,701	135,652	139,722	143,913
Life Insurance	1,238	2,236	2,363	2,434	2,507	2,582	2,660	2,739
Total Fringe Benefits	**121,131**	**154,584**	**201,416**	**207,458**	**213,682**	**220,093**	**226,695**	**233,496**
Insurance (Property, Liability)	**19,466**	**9,398**	**8,602**	**8,860**	**9,126**	**9,400**	**9,682**	**9,972**
Professional Services								
Independent Contractor	416,303	373,466	608,308	626,557	645,354	664,715	684,656	705,196
From Other Departments	82,470	92,827	1,680	1,730	1,782	1,836	1,891	1,948
Other	10,595	11,580	406,578	418,775	431,339	444,279	457,607	471,335
Hazardous Waste	-	-	10,000	10,300	10,609	10,927	11,255	11,593
Information Technology	-	-	-	-	-	-	-	-
Publishing	-	1,973	15,000	15,450	15,914	16,391	16,883	17,389
Total Professional Services	**509,368**	**479,846**	**1,041,566**	**1,072,813**	**1,104,997**	**1,138,147**	**1,172,292**	**1,207,460**

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Publishing	-	-	-	-	-	-	-	-
Rentals								
Property	18,719	18,436	17,825	18,360	18,911	19,478	20,062	20,664
Technology Equipment	5,122	5,125	6,215	6,401	6,593	6,791	6,995	7,205
Total Rentals	**23,841**	**23,561**	**24,040**	**24,761**	**25,504**	**26,269**	**27,057**	**27,869**
Repair & Maintenance								
Licensed Vehicles	4,552	17,758	9,950	10,249	10,556	10,873	11,199	11,535
Unlicensed Vehicles	71,744	137,441	167,519	172,545	177,721	183,053	188,544	194,200
Other Equipment	8,304	11,241	6,315	6,504	6,700	6,901	7,108	7,321
Buildings & Structures	3,385	5,538	8,250	8,498	8,752	9,015	9,285	9,564
Street, Curb & Sidewalk	27,842	15,915	47,400	48,822	50,287	51,795	53,349	54,950
Utilities	11,712	1,492	1,625	1,674	1,724	1,776	1,829	1,884
Grounds	1,913	7,567	17,400	17,922	18,460	19,013	19,584	20,171
Total Repair & Maintenance	**129,452**	**196,952**	**258,459**	**266,213**	**274,199**	**282,425**	**290,898**	**299,625**
Supplies & Materials								
Office	45,266	49,472	44,330	45,660	47,030	48,441	49,894	51,391
Fuel	92,210	93,730	103,125	106,219	109,405	112,687	116,068	119,550
Clothing & Protective Equip	6,654	2,421	10,250	10,558	10,874	11,200	11,536	11,883
Small Tools & Minor Equip	3,645	921	7,930	8,168	8,413	8,665	8,925	9,193
Chemical / Lab	1,050	-	1,165	1,200	1,236	1,273	1,311	1,351
Janitorial / Shop	2,281	1,622	2,995	3,085	3,177	3,273	3,371	3,472
Other	53,979	13,587	69,750	71,843	73,998	76,218	78,504	80,859
Traffic Materials & Signs	133	1,906	12,365	12,736	13,118	13,512	13,917	14,334
Non-Capital Inventory	6,251	9,632	34,170	35,195	36,251	37,338	38,459	39,612

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Cmptr Hdw (-500) & Software	-	-	3,700	3,811	3,925	4,043	4,164	4,289
Cmptr Hdw (500 to 7,500)	-	-	-	-	-	-	-	-
Inventory Adjustment	-	1,549	-	-	-	-	-	-
Total Supplies & Materials	**211,469**	**174,840**	**289,780**	**298,475**	**307,427**	**316,650**	**326,149**	**335,934**
Job Performance								
Travel, Education & Training	7,833	7,419	8,150	8,395	8,646	8,906	9,173	9,448
Memberships & Dues	1,751	2,292	1,990	2,050	2,111	2,175	2,240	2,307
Subscriptions & Publications	31	-	705	726	748	770	793	817
Mileage / Motor Pool	4,972	4,607	3,300	3,399	3,501	3,606	3,714	3,826
Total Job Performance	**14,587**	**14,318**	**14,145**	**14,569**	**15,006**	**15,457**	**15,920**	**16,398**
Recycling & Reuse								
Expand Website	-	-	-	10,000	-	-	-	-
Update Recycling Plan	-	-	25,000	-	-	-	-	-
Recycling Coordinator	-	-	-	40,000	40,000	40,000	40,000	40,000
Educational Materials	-	-	-	50,000	10,000	10,000	10,000	10,000
Total Recycling & Reuse	**-**	**-**	**25,000**	**100,000**	**50,000**	**50,000**	**50,000**	**50,000**
Utilities								
Telephone	9,261	7,980	10,374	10,685	11,006	11,336	11,676	12,026
Natural Gas	2,110	819	7,150	7,365	7,585	7,813	8,047	8,289
Electricity	7,850	10,911	9,350	9,631	9,919	10,217	10,524	10,839
Water	507	1,727	4,743	4,885	5,032	5,183	5,338	5,498
Sanitation	-	-	8,000	8,240	8,487	8,742	9,004	9,274
Total Utilities	**19,728**	**21,437**	**39,617**	**40,806**	**42,030**	**43,291**	**44,589**	**45,927**
Household Haz Mat Ops Costs	**-**	**-**	**-**	**328,229**	**338,076**	**348,218**	**358,665**	**369,425**
Aerial Site Surveys	**-**	**-**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
Other Current Expenses	**123,699**	**129,541**	**-**	**128,000**	**131,840**	**135,795**	**139,869**	**144,065**

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Capital Expenses								
Land	246,123	2,000	-	-	-	-	-	-
Buildings	-	722,079	-	-	-	-	-	-
Improvements Other than Bldgs	1,182,001	941,313	-	-	-	-	-	-
Equipment	77,941	303,262	-	-	-	-	-	-
Engineering/Geotechnical	250,216	460,452	-	-	-	-	-	-
Total Capital Expenses	**1,756,281**	**2,429,106**	-	-	-	-	-	-
Capital Planning Needs								
Active Area								
Leachate Extraction System			-	699,600	-	-	-	-
Gas Extraction System					-	-	-	1,028,200
Phase II Closure			-	1,178,000	-	-	-	-
Phase III Closure			-	-	608,000	-	-	-
Post-Closure Care					-	80,000	80,000	80,000
Expansion Area								
Cell 1 leachate system			350,000	-	-	-	-	-
Cell 2 (Eng & Const)			-	122,300	2,286,600	-	-	-
Cell 3 (Eng & Const)			-	-	-	170,400	3,185,300	-
Cell 4 (Eng & Const)			-	-	-	-	-	140,700
Land Acquisition			-	800,000	-	400,000	-	400,000
Wetlands								
Engineering			8,000	6,000	5,250	-	-	-
Construction			114,240	-	75,000	-	-	-
Leachate Management System								
Engineering			259,590	-	-	-	-	-
Construction			2,345,730	-	-	-	-	-
Semi Tanker Truck			-	137,000	-	-	-	-

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
HHW Center (Eng. & Const)			-	1,500,000	-	-	-	-
Compost Pad (Eng. & Const)			-	60,000	-	-	-	-
Equipment Bldg (Eng & Const)			-	-	-	1,250,000	-	-
Landfill Compactor - Repl			-	-	450,000	-	-	-
Landfill Compactor - New			-	700,000	-	-	-	-
Leachate Extraction System								
Engineering			-	47,000	-	-	-	-
Construction					-	260,000	-	-
Landfill Gas Extraction System								
Engineering			-	57,000	-	143,000	-	-
Construction					-	335,600	-	885,200
Roads, Grading and Surfacing								
Access Road to Cell 1			-	200,000	-	-	-	-
Reconfig Entrance Rd			-	100,000	-	-	-	-
Lockers			-	-	-	30,000	-	-
Radio Network			-	21,244	-	-	-	-
Pickup ¾ Ton 4××4			-	-	27,000	-	-	27,000
Pickup ½ Ton 4×4			-	-	-	-	-	25,000
Leachate Recirculator Truck			-	-	-	-	120,000	-
Dump Truck			-	60,200	-	-	-	-
Dust Control Tanker			-	17,000	-	-	-	-
Litter Vacuum			-	20,000	-	-	-	-
ATV (Gator type)			-	-	10,000	-	-	-
Hook Truck			120,000	-	-	-	-	-
5,000 gal semi-tanker			-	137,000	-	-	-	-
Vehicle Attachments - Disc			-	15,000	-	-	-	-
Mower Attachment			-	-	-	-	15,000	-

TABLE 5-5

SANITARY LANDFILL TIP FEE ANALYSIS – EXPENSES

	Actual		Budgeted	Projected				
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Scraper			-	-	-	-	550,000	575,000
Dozer			-	-	330,000	340,000	-	-
Fork Lift			-	-	-	22,000	-	-
Landfill Compactor			-	-	425,000	-	-	-
Public Drop-off (Eng & Const)			-	446,000	-	-	-	-
Recycling Bins			-	525,000	-	-	-	-
Total Capital Planning Needs			**3,115,930**	**7,527,304**	**4,270,530**	**4,406,480**	**4,007,980**	**1,247,700**
Financial Assurance	**-**	**-**	**98,316**	**98,316**	**98,316**	**98,316**	**98,316**	**98,316**
Transfers	**-**	**-**	**95,026**	**-**	**-**	**-**	**-**	**-**
Miscellaneous Expenses								
Depreciation	325,884	360,114	360,114	360,114	360,114	360,114	360,114	360,114
Uncollectible Receivables	94	12,672	-	-	-	-	-	-
Capitalized Purchases	(1,756,281)	(2,429,106)	-	-	-	-	-	-
Total Misc. Expenses	**(1,430,303)**	**(2,056,320)**	**360,114**	**360,114**	**360,114**	**360,114**	**360,114**	**360,114**
Debt Service								
TOTAL EXPENSES	**2,188,610**	**2,346,897**	**6,390,230**	**11,318,385**	**8,108,287**	**8,343,817**	**8,047,884**	**5,393,249**

5.2.2 Results

Based upon the above analysis, we have calculated the MSW and C&D tip fees needed for the total nominal revenues to approximately equal the total nominal expenses for the 2004-2008 time frame. For purposes of our analysis, we have considered three scenarios with varying tip fees for MSW and construction and demolition materials. These scenarios reflect different options to generate adequate revenues to cover the projected expenses. The calculated tip fees have been rounded to the nearest dollar. The table below depicts the results.

Table 5-6

RECOMMENDED TIP FEE ADJUSTMENT ANALYSIS

Tip Fees	Scenario 1	Scenario 2	Scenario 3
MSW	$32.00	$26.00	$28.00
C&D	$13.00	$25.00	$22.00
Other Materials	Present rates	Present rates	Present rates

Because of concerns associated with creating incentives for haulers to mix MSW with C&D, the above analysis offers options as related to the fee differential between the MSW and C&D rates. Until the City's C&D recovery program evolves and these materials are primarily landfilled, we recommend that the differential between the two rates be minimal. Thus, an MSW tip fee of $26.00 and C&D tip fee of $25.00 is recommended for implementation in 2004.

To put the recommended tip fees in context, provided below is a table depicting the reported tip fees for other landfills in the region.

TABLE 5-7

LANDFILL TIP FEES[1]
Benchmark Analysis

Landfill	Annual Quantities Received (in Tons)	Public or Privately Owned	Tip Fees per Ton	
			MSW	C&D
Brookings Regional Landfill Brookings, South Dakota	32,000 (2002)	Public	$33	$16.50
Brown County Landfill Aberdeen, South Dakota	34,000 MSW 6,000 C&D (2002)	Public	$35	$16.00 $10 for heavy debris (i.e., concrete, rocks, and dirt)
Vermillion Landfill Vermillion, South Dakota	26,500 (2002)	Public	Resid: $39.00 Comm: $36.00	$36.00

TABLE 5-7

LANDFILL TIP FEES[1]
Benchmark Analysis

Landfill	Annual Quantities Received (in Tons)	Public or Privately Owned	Tip Fees per Ton	
			MSW	C&D
Mitchell Landfill[2] Mitchell, South Dakota	33,000 (2002)	Public	$30.00	$20.00
Nobles County Sanitary Landfill Rushmore, Minnesota	13,000 (2002)	Private	$37.00 ($11.00/cubic yd)	$32.00 ($9.60/cubic yd)
Sioux City Landfill Sioux City, Iowa	39,872 (2001)	Public	Resid: $26.13 Comm: $33.25	Same as MSW
LP Gill Landfill Jackson, Nebraska	177,339 (2002)	Private	$27.00	$27.00

Notes:
[1] Based on discussions with facility representatives or reported directly by entity.
[2] The City of Mitchell is building a new landfill to be open in January 2004. At that time tip fees for MSW and C&D will both be $36.00.

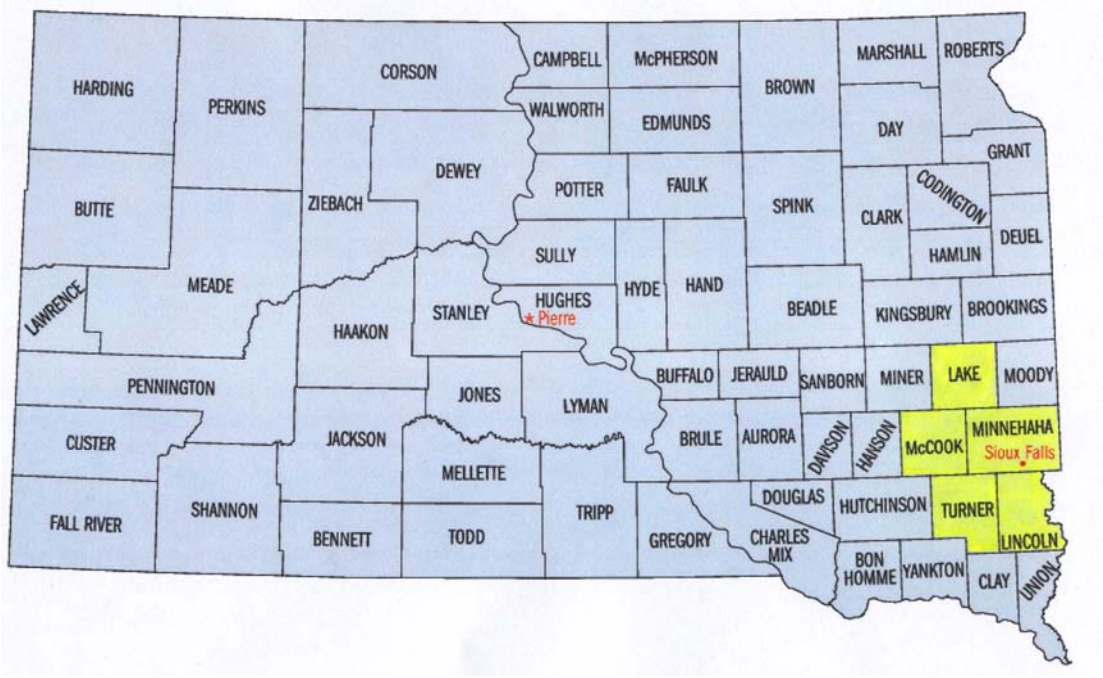
As reflected above, increasing the tipping fee for MSW to $26.00 per ton would place the Sioux Falls MSW tipping fee in the reported range of $26 to $39 per ton of MSW for other landfills in the region.

6.0 WASTE DIVERSION

For this Section of the Regional Solid Waste Master Plan, R. W. Beck, Inc. (Beck), carried out the following tasks:

- Assessment of Regional Opportunities to Share Diversion Facilities and Equipment.
- Materials Recovery Processing and Reuse Evaluation.
- Evaluation of the Waste Reduction, Reuse, and Recycling Public Education and Information Program.

Through meetings with City staff, the Solid Waste Planning Board, the local haulers, and local recyclable materials processors, Beck has characterized the current programs and offers recommendations for improving waste diversion in the Sioux Empire Region (Region). This Region is made up of five counties: Lake, McCook, Minnehaha, Turner, and Lincoln. Communities within these counties sign an annual Solid Waste Disposal Agreement with the City of Sioux Falls to use the Sioux Falls Regional Sanitary Landfill (SFRSL).



6.1 ASSESSMENT OF REGIONAL OPPORTUNITIES TO SHARE DIVERSION FACILITIES AND EQUIPMENT

The City of Sioux Falls and the City of Brookings entered into an agreement in March of 1997 "for the purpose of providing for joint ownership and administration of solid waste management equipment." Together the two communities applied for a grant to partially fund a tub grinder and a trommel screen, to be used at both landfills. The remaining funding was provided by each city: Sioux Falls contributed 80 percent and Brookings contributed 20 percent. The City of Sioux Falls also jointly owns, with the City of Brookings, the tractor used to pull the tub grinder and trommel screen.

The tub grinder is used to chip brush and other tree debris and the trommel screen is used to screen the material to remove undesirable items. The City leases the trommel screen to other municipalities for $20 per hour. The cities of Watertown, Aberdeen, and Huron have leased the screen in the past. The tub grinder is not leased because of its high maintenance.

In addition to access to the SFRSL and compost site, the City will also make available to communities within the five-county Region access to their new Household Hazardous Materials (HHM) collection facility. The building is scheduled to be constructed this year and is anticipated to be operational in 2004.

Another diversion activity at the SFRSL is the collection of tires and appliances. These items are banned from the landfill, but are accepted for a fee and placed into separate piles on the landfill property. The City contracts with a local tire recycler and an appliance processor to remove these two waste streams throughout the year.

Recommendations

The City should continue to make the municipalities in the region aware of the opportunity to use the above mentioned equipment and the HHM facility. Also, if other municipalities are interested, they could possibly contract with the same vendors for the proper disposal of tires and appliances. Language could be added to the Solid Waste Disposal Agreement that is signed each year by the municipalities and the City, that references these sharing opportunities.

6.2 MATERIALS RECOVERY PROCESSING AND REUSE EVALUATION

The State of South Dakota set a goal to reduce the waste stream disposed in landfills by 50 percent by July 1, 2001. The base year for establishing the amount of materials in the waste stream is the calendar year 1990. The State estimates that the waste stream has been reduced by approximately 37 percent. There are no penalties for not meeting this goal.

Table 6-1 shows the amount of MSW disposed at the Landfill since 1995 and the percent increase or decrease from the previous year.

TABLE 6-1

ANNUAL MSW TONNAGE DISPOSED AT THE SIOUX FALLS REGIONAL LANDFILL

Year	1995	1996	1997	1998	1999	2000	2001
Tonnage	139,297	125,504	128,266	132,686	137,717	140,582	155,563
Percent increase or decrease from previous year	n/a	-11.0%	2.2%	3.4%	3.8%	2.1%	10.7%

The increase in tonnage over the years can be attributed to any number of variables such as an increase in population, an increase in MSW generation per capita, or an increase in the customer base using the SFRSL.

In the 1998 Sioux Empire Region Comprehensive Solid Waste Source Reduction and Recycling Plan, it states that since 1992, the Region has been eliminating yard waste, waste oil, tires, appliances, and lead acid batteries, as well as post-consumer recyclables (i.e., office paper, OCC, plastics, metal containers).

6.2.1 Characterization of Existing Recycling Program

The City of Sioux Falls has an open collection system for municipal solid waste (MSW) and recycling. Haulers must apply annually for a permit. Currently there are 27 licensed haulers in the City. The number of licenses issued by the City was 24, but the Ordinance was revised in 2003 and now there is no limit to the number of haulers licensed.

All haulers collect both MSW and recyclable materials, and most haulers provide residential collection of yard waste materials. Per the City's Ordinance, garbage and yard waste must be collected at least once per week and recyclables must be collected at least once per month (garbage must be collected at least three times per week from the business districts). MSW containers must be kept at the rear of the premises accessible to the garbage collector and yard waste containers must be kept in an inconspicuous place except when placed for collection (no cans are allowed at the curb). Recycling containers must be "placed at a location clearly visible, other than curbside". Per City staff input, this has been interpreted by the haulers and customers as placing the container between the house and the sidewalk, but not on the street side of the sidewalk.

The haulers set their own collection schedules – some collect recyclables weekly, bi-weekly, or monthly. Some haulers may collect certain items on certain weeks (e.g., collection of plastic and metals the first full week of the month and newspaper and cardboard the second full week of the month).

Per the City's Ordinance definitions, "residential recyclables means separation at the source of the following materials into separate recycling containers for collection:

1. Office paper other than junk mail
2. Corrugated Cardboard
3. Plastic and metal containers
4. Newspaper".

Multi-family dwelling recycling is addressed in Section 18-23 of the City's Ordinance. The ordinance states "every owner of an apartment shall do the following to facilitate recycling in each such building:

1. Provide adequate recycling containers for recyclable material. Containers shall be stored on the premises in a screened location that is convenient for the deposit and collection of recyclables.
2. Provide for the separation of all residential recyclables generated by or accruing to such establishment.
3. Distribute written information to the building tenants at the time of leasing and as least annually thereafter regarding the established recycling program.
4. Post a copy of the recycling information in a conspicuous place available to all residents.
5. Provide a copy of the recycling information that is annually provided to the apartment tenants by filing the same before January 1 of each year with the city public works department."

The recyclable materials collected from residents' homes are delivered to one of two materials recovery facilities (MRFs) in Sioux Falls: Millennium Recycling and Advanced Recycling. These facilities process residential and commercial recyclables and market the materials to various end-users throughout the United States and Canada.

Millennium Recycling has a drop-off site located inside their facility that is open during business hours for residents of the City and surrounding communities to drop off recyclable materials. They also offer redemption opportunities for residents to receive revenue for their aluminum cans. They do charge a fee of one dollar per load to drop off recyclable materials, but the fee is waived if five pounds or more of aluminum cans are redeemed. Items accepted for drop-off at Millennium include cardboard, newspaper (including inserts), magazines, office paper, junk mail, phone books, soft cover books, aluminum and tin food cans, and plastics numbered 1 through 7.

Advanced Recycling allows residents to drop off recyclable materials at no charge. They accept newspaper (including inserts), office paper, junk mail, cardboard, aluminum and tin cans, and plastic bottles numbered 1 and 2. Advanced pays for aluminum cans in quantities of twenty-five pounds or more.

The City also has a drop-off area at the SFRSL for residents and businesses to use free of charge. Items accepted at SFRSL include cardboard, newspaper (including inserts), aluminum and tin cans, and plastic bottles.

The estimated annual quantity of recyclable materials processed in the Sioux Falls area is 23,281 tons[1]. Of that total, approximately 12,143 tons come from residents. This calculates to approximately 30 pounds of recyclables per household per month, or 7.5 pounds per household per week. The national average is 9.8 pounds per week[2], or approximately 30 percent more than the City's current per household recycling rate.

The City has a variable rate pricing system for MSW, which in effect, encourages recycling. Per the City Ordinance, "All licensed garbage haulers shall file, as a part of their application for a business license, a general statement of their use rate structures and billing systems consistent with the City's comprehensive plan of solid waste reduction and recycling program which shall include the following elements:

[1] Source: 2002 Tonnages reported to the City by the two largest MRFs.
[2] Source: U.S. Environmental Protection Agency report "Municipal Solid Waste in the United States: 2000 Facts and Figures."

1. A rate to reward people who reduce their level of solid waste collection service based either upon volume or weight.

2. A rate to provide customers with adequate options and incentives to reduce their weekly level of solid waste collection service and the amount of solid waste collected as a result of their participation in waste reduction and recycling programs.

3. A rate that includes the combined cost of solid waste, using the above elements, and recycling collection services."

From the haulers' License and Permit Renewal Applications, the average and range of monthly solid waste collection fees, *including recycling*, is depicted in Table 6-2.

TABLE 6-2

MSW AND RECYCLING COLLECTION FEES
City of Sioux Falls, South Dakota

Service Level	Average	Range
1-can	$10.56	$10.50 - $14.00
2-cans	$12.37	$12.25 - $16.50
3-cans	$16.55	$13.00 - $19.00
4-cans	$17.25	$17.00 - $17.50
Extra can or bag	$1.23	$ .50 - $2.00

Table 6-3 depicts the average monthly collection fees for Dakota County, Minnesota (just south of the Twin Cities), which also has an open hauling system. Compared to monthly rates in Dakota County, the rates in Sioux Falls are approximately 20 percent lower for the one- and two-can service level. The City's three can rate is similar in price to Dakota County's 90-gallon rate. Note that Dakota County uses cart sizes rather than number of cans.

TABLE 6-3

MSW AND RECYCLING COLLECTION FEES
Dakota County, Minnesota

Container Size	Average Monthly Rate
30 gallons	$12.56
60 gallons	$15.12
90 gallons	$16.87

Note: This does not account for differences of house-side vs. curbside collection and the difference in disposal costs.

Recently, Beck completed a Recycling Program Analysis for Washington County, Minnesota, located east of St. Paul. When analyzing variable rate pricing, the data showed that the cities with the highest increment between the small and medium MSW container size collection fees had the highest recovery rate of recyclable materials. Table 6-4 shows the monthly fees and the percent difference in price

between container sizes for various communities in the Minneapolis-St. Paul area, as well as their recovery rates per household. Sioux Falls and Dakota County, Minnesota, were added for comparison. When comparing fees, it is assumed the size of the containers used in Sioux Falls are comparable to the 30-, 60-, and 90-gallon sizes used in automated systems elsewhere.

TABLE 6-4

AVERAGE MONTHLY MSW AND RECYCLING COLLECTION FEES, THE PERCENT DIFFERENCE BETWEEN MSW CONTAINER SIZES, AND ANNUAL RECOVERY AMOUNTS

Community	SMALL (at 30 gallon)	*Percent Difference in Price Between Small & Medium*	MEDIUM (at 60 gallon)	*Percent Difference in Price Between Medium & Large*	LARGE (at 90 gallon)	2001 Per Household Recovery in Pounds
Oak Park Heights	$10.20	*12.0%*	$11.42	*14.3%*	$13.05	278
Woodbury	$12.34	*14.1%*	$14.08	*12.2%*	$15.80	580
Oakdale	$13.57	*14.7%*	$15.56	*13.6%*	$17.68	396
Stillwater	$12.25	*15.5%*	$14.15	*13.9%*	$16.12	564
Sioux Falls	$10.56	*17.1%*	$12.37	*33.8%*	$16.55	390
Afton	$10.98	*19.9%*	$13.17	*16.6%*	$15.36	1,037
Dakota County	$12.56	*20.4%*	$15.12	*11.6%*	$16.87	420[1]

[1] 2000 data.

The percent difference between collection fees for the various container levels in Sioux Falls appears to be at a level that promotes a comparable quantity of recyclable materials being set out for recovery.

Per the City's Garbage and Trash Ordinance, (Chapter 18), the following materials are excluded from the solid waste deposited at the Sioux Falls Landfill:

1. Office Paper
2. Corrugated cardboard (OCC)
3. Plastic containers #1 and #2
4. Metal containers
5. Automobile bodies or other bulky articles
6. Trees and tree limbs, unless they are cut to less than 8 feet in length
7. Oils, gasoline, and other petroleum products*

8. Hazardous materials*
9. Yard waste*
10. Lead acid batteries*
11. Waste tires*
12. White good appliances*
13. Regulated medical waste*
14. Radioactive materials*

The items with an asterisk indicate materials banned from all landfills by the State of South Dakota.

City staff conducts random load inspections at the SFRSL (approximately 6 per week). The staff look for banned items such as appliances, tires, used motor oil, yard waste, and hazardous waste. If a small amount of post-consumer recyclables (i.e., office paper, OCC, plastics, metal containers) are found in a resident's garbage, there is no penalty, but if a hauler attempts to dispose of source-separated recyclables that are mixed in with a truckload of MSW, the City may issue a fine. The Ordinance states that if excluded materials are discovered during the inspection, the director of the department may refuse the entire load and charge the person attempting to deposit the materials the cost of the inspection.

6.2.2 Regional Recycling Programs

As part of this study, Beck surveyed the Solid Waste Planning Board members to better understand the regional recycling efforts. Each community that uses the SFRSL has signed an agreement with the City that states they will implement volume-based collection rates to promote solid waste reduction and recycling, and they will provide recycling opportunities for their residents. Table 6-5 lists the five counties that use the SFRSL and describes their current recycling program. Information for individual cities within the counties was provided by the "Solid Waste Reduction and Recycling Plan 2003 Update Worksheets" that were completed by each local government and returned to the City.

TABLE 6-5

REGIONAL RECYCLING ACTIVITIES

Municipality	Program Description
Lake County  	The County currently has three licensed haulers that operate outside of the City of Madison. The County does not report designating a budget for recycling or waste diversion activities. In the City of Madison, municipal crews collect residential recyclables at the curb. The City requires residents to place recyclables into 3 clear plastic bags, separated as follows: 1. Newspaper. 2. Other paper including office paper and computer paper. 3. Tin, steel and aluminum cans, #1 and #2 plastic bottles. Cardboard is collected loose. The materials are taken to the City-owned MRF where they are sorted and baled. (The MRF was built in 1997, funded in part by a State grant.) Residents may also drop off recyclables at the MRF. Other items accepted for drop off include: glass, magazines, catalogs, and phone books. The City accepts recyclables from all of Lake County. Five part-time, developmentally disabled staff are used to sort the materials. The City's garbage and recycling collection staff come to the MRF at the end of their routes each day to bale the materials. The City crushes the glass and uses it in various public works projects such as road base, utility trenches, and swimming pool filters.
Lincoln County	The County licenses haulers. Haulers provide curbside recycling service in the cities of Lennox, Canton, and Beresford City. Some haulers also provide drop-off recycling services.
McCook County	The County licenses recycling haulers and currently there are two licensed in McCook County and both provide curbside recycling service. The following cities have curbside recycling service: Bridgewater, Salem, and Canistota. The County does not report designating a budget for recycling or waste diversion activities.

TABLE 6-5

REGIONAL RECYCLING ACTIVITIES

Municipality	Program Description
Minnehaha County	The County currently licenses ten haulers. The haulers are required to provide recycling opportunities for the unincorporated areas of the County. The following cities have curbside recycling service: Hartford, Humboldt, Garretson, Valley Springs, and Crooks. The materials collected are the same as those collected in Sioux Falls and are processed in Sioux Falls. The County does not report designating a budget for recycling or waste diversion activities.
Turner County	The County currently has six licensed haulers. Haulers provide curbside and/or drop-off recycling services. The following cities have curbside recycling service: Viborg, Chancellor, Parker, and Monroe. The County does not report designating a budget for recycling or waste diversion activities, but does provide a site and equipment for an annual collection of tires and appliances.

6.2.3 Recommendations for the City of Sioux Falls Recycling Program

- Create an ad-hoc committee made up of City staff and representatives from most of the licensed Sioux Falls haulers, to discuss these recommendations, discuss the feasibility of making changes to the current program, and implement changes. The Solid Waste Planning Board (made up of regional representatives) offers an opportunity for solid waste management policy, but the ad-hoc committee would provide an opportunity to implement specific program changes. Representation from most of the hauling community is critical to formulating and developing support for program change.

- Consider standardizing the recycling program to ensure consistency in the following areas:

  - Bin type - the City may want to consider purchasing recycling bins for all residents, so all haulers are using the same type of collection container. Bin prices vary depending on size and quantity, but $5.00 - $7.00 per bin is an average cost.
  - Material type - require haulers collect the same types of materials, (i.e., all haulers must collect the same types of recyclables, and they must all collect yard waste and bulk items).
  - Collection schedule - to make collection of recyclables consistent, require that all haulers collect recyclables on the same schedule such as: all materials, every other week, same day as garbage collection. This would allow the City to create more detailed education pieces that would be relevant to all residents, regardless which hauler they use. However, it is likely the haulers will be impacted differently by such a request.

- Enforce the landfill ban by conducting more frequent and consistent load inspections, and consider charging a fee above and beyond the current tip fee when a hauler violates the ban by transporting loads of materials to the landfill containing large amounts of recyclable materials. Section 18-21 of the City Ordinance states, "Residential recyclables collected shall not be deposited at the sanitary landfill. The separation of glass, paper products, and other recyclable materials shall be on a voluntary basis." Section 18-32 lists the fourteen materials that "shall be excluded from the solid wastes deposited at the landfill site". It appears that residents may choose not to recycle, but once recyclable materials have been set out and collected by the haulers, those materials cannot be deposited at the landfill. The Ordinance language seems to suggest that no recyclable materials should be deposited at the landfill whether they are commingled with MSW or collected separately. The City's intent needs to be clarified with revisions to the Ordinance.

- Consider mandating that commercially generated cardboard (OCC) be recycled. The City could decide if ALL commercial cardboard should be recycled, or target businesses that meet City-defined criteria. In a recent benchmarking study conducted by Beck, it was noted that the City of Austin, Texas, mandates that certain businesses, depending on size, must provide on-site recycling service[3]. Also, the Bluestem Solid Waste Agency in Cedar Rapids, Iowa, retained Beck to help implement a cardboard ban at their landfills. Bluestem held focus groups and included the haulers in the process of implementing the ban. A 6-month transition period provided time to educate the waste generators. After 6 months, fines were issued to violators. This approach was successful by reducing the quantity of OCC being landfilled and increasing the quality of OCC being recycled.

- Consider an ordinance that requires the separation of Construction and Demolition (C&D) debris at construction sites. C&D debris includes bricks, concrete, lumber, paving materials, electrical materials, plumbing fixtures, vinyl siding, etc. These materials are considered inert and could be disposed in the City's C&D landfill, instead of with the MSW. By separating

[3] Commercial and multi-family buildings must provide on-site recycling service per the City Ordinance. The following must provide recycling service: 1) a business with 100 or more employees; 2) a building housing businesses with an aggregate of at least 100 employees if the building owner or manager provides a single garbage collection service; and 3) a multi-family complex with 100 or more units. Said businesses must provide recycling of at least two recyclable materials outlined in another Ordinance, and multi-family complexes must provide recycling for at least four items. Recycling service must be provided at least twice per month. Recycling information and instructions must be provided to employees and tenants. A recycling plan must be filed with the Department of Solid Waste Services and a quarterly volume report must be submitted to the Department.

C&D debris, construction companies could pay substantially less per ton to landfill separated loads of C&D as opposed to the per ton fees to dispose of MSW.

- To increase waste diversion, the City could promote the reuse and recycling of C&D materials. The quantities of C&D material generated is likely to increase at a rate greater than MSW, thus addressing this component of the solid waste stream is critical to promoting diversion. In order for these items to be reusable, contractors must remove them intact (windows, doors, fixtures, etc.) or in large pieces (lumber, drywall, etc.). Some communities have reuse stores or non-profit agencies that will accept used building materials. In Moorhead, Minnesota, Clay County staff separate reusable C&D materials at their landfill and make them available to their residents at no charge. More information is available on their website at:

  http://www.co.clay.mn.us/Depts/PlanEnvi/SWResRec.htm.

  The City may want to research local options for recycling C&D materials such as lumber, asphalt, concrete, roofing material, and wallboard. More information on reducing C&D debris is available from the U.S. Environmental Protection Agency at:

  http://www.epa.gov/epaoswer/non-hw/debris/index.htm

  Also included is a document titled "Building Savings: Strategies for Waste Reduction of Construction and Demolition Debris from Buildings" available at:

  http://www.ilsr.org/recycling/buildingdebris.pdf

- As part of the hauler licensing/renewal requirements, require that the haulers submit a monthly or quarterly recycling tonnage report that lists the tonnages by material type and customer type (residential and commercial). The City should develop a standard form for the haulers to complete. The form would make it easy for City staff to tally the tonnages and make it easy for the haulers to complete. Currently, the only recycling tonnages the City receives are from the two processors in Sioux Falls. One processor reports just residential quantities, the other reports a combination of commercial and residential tonnage. By requiring hauler tonnage reports, the City could better monitor residential and commercial recycling and track its recycling/diversion rate.

- Require the haulers add separate line items on their collection bills indicating what the fee is for recycling collection and yard waste collection. This would increase the visibility as related to these services.

- Strengthen efforts to increase recycling at multi-unit dwellings. Some suggested recommendations include:

  - Develop an education campaign targeted specifically to multi-family dwellers. Send a brochure or distribute door hangers to each apartment resident in the City encouraging recycling and informing them what items are recyclable and where they can drop-off recyclable materials within the City. Provide extra brochures or door hangers to apartment managers to distribute to new tenants. Apply for a grant or use Enterprise Funds to purchase small bins or 5-gallon buckets for each apartment, or sturdy nylon bags with

handles (like Burnsville has) to give to apartment building managers to distribute to their tenants (for those buildings that have collection bins for recyclables).

- Work with several willing haulers to conduct a pilot study of various size apartment buildings, to learn what type of containers work best, how to overcome space issues, the importance of signage to prevent contamination, frequency of collection, etc. If possible, require that the haulers collect tonnage data to determine approximately how many pounds per HH is being collected from the multi-family dwellings that are participating in the pilot. Another recommendation for consideration is to have the City conduct (or hire a firm to conduct) a waste sort of the apartment buildings participating in the pilot before and after the pilot to determine the effect that recycling had on their waste streams.
- After completion of a pilot study and evaluation of results, recommend that the City revise its apartment recycling ordinance to be more specific as to how many items, at a minimum, should be recycled at multi-family dwellings, such as "at least ONP, aluminum and tin cans, and plastic bottles".

- Consider partnering with the private sector to organize an annual or semi-annual electronics collection event. The City could go out for bids for pricing to have a company collect, transport, and recycle computers, monitors, televisions, and other electronic items. Appendix D includes a contact list of companies that offer recycling services and a list of references of municipalities that have held electronics collection events in the past. The City should also contact the local processors of recyclables and inquire of their interest in offering this service. In 2000, the North Dakota Solid Waste Management Association received a grant from the U.S. Environmental Protection Agency (EPA) for the collection and recycling of electronics. The following link describes the events: http://www.ndswma.org/grants.htm. The City may want to approach the South Dakota Solid Waste Management Association to see if there is interest in providing collection events throughout the state.

To determine if other recyclable materials should be added to the City's recycling program, the City should consider conducting a waste characterization study to determine the types and quantities of recyclable materials that are being disposed along with the MSW. For planning purposes, we have included waste characterization information. Beck was retained by the Solid Waste Management Coordinating Board and Minnesota Pollution Control Agency to conduct a waste characterization study in 1999. Figure 6-1 and Table 6-6 on the following pages depict the composition of the waste stream in Greater Minnesota. This waste stream is likely to be similar to the City of Sioux Falls and the region.

FIGURE 6-1

GREATER MINNESOTA WASTE COMPOSITION RESULTS

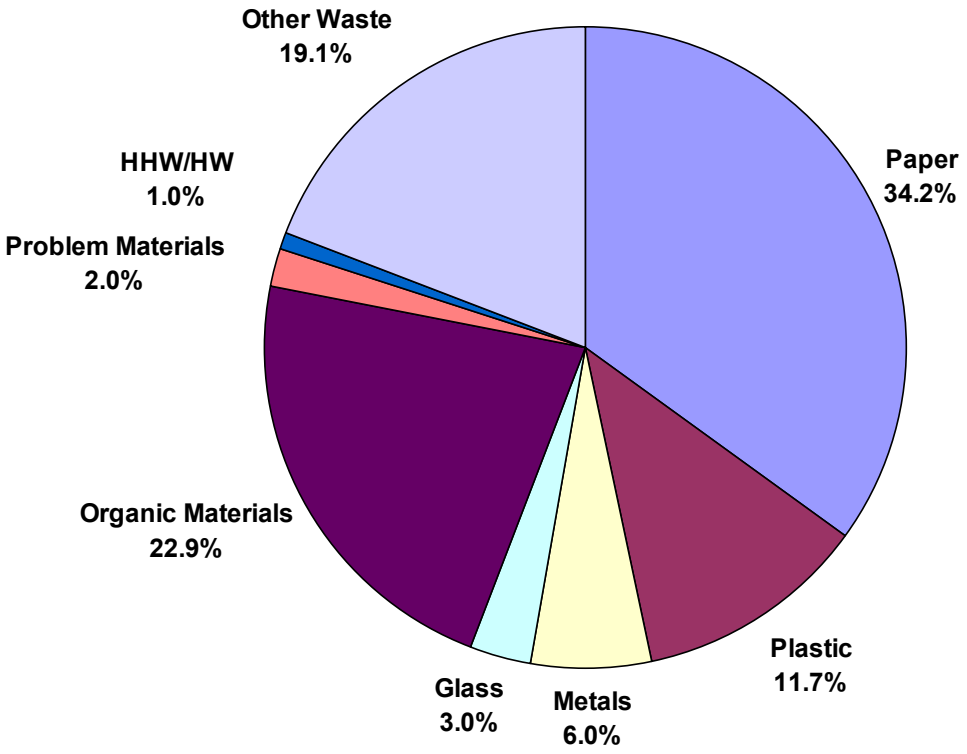


TABLE 6-6

GREATER MINNESOTA AGGREGATE COMPOSITION SUMMARY (BY WEIGHT)

Material Categories	Mean	Material Categories	Mean
PAPER		**ORGANIC MATERIALS**	
Newsprint (ONP)	4.3%	Yard Waste - Grass and Leaves	1.7%
High Grade Office	3.1%	Yard Waste - woody material	0.1%
Magazines/Catalogs	2.7%	Food Waste	14.5%
Uncoated OCC - recyclable	4.6%	Wood Pallets	0.4%
Uncoated OCC - nonrecyclable	0.5%	Treated Wood	1.6%
Coated OCC	0.3%	Untreated Wood	1.1%
Boxboard	2.8%	Diapers	2.7%
Mixed Paper - recyclable	5.3%	Other Organic Material	0.9%
Mixed Paper - nonrecyclable	10.8%	*Subtotal Organic Materials*	*22.9%*
Subtotal Paper	*34.2%*	**PROBLEM MATERIALS**	
PLASTIC		Televisions	<0.1%
PET Bottles/Jars - clear	0.5%	Computer Monitors	<0.1%
PET Bottles/Jars - colored	0.4%	Computer Equipment/Peripherals	<0.1%
Other PET	<0.1%	Electric and Electronic Products	1.9%
HDPE Bottles - natural	0.3%	Batteries	0.1%
HDPE Bottles - colored	0.3%	Other	<0.1%
PVC	0.1%	*Subtotal Problem Materials*	*2.0%*
Polystyrene	0.9%	**HHW/HW**	
Film - transport packaging	0.2%	Latex Paint	<0.1%
Other Film	4.4%	Oil Paint	0.1%
Other Containers	0.5%	Unused Pesti/Fungi/Herbi-cides	<0.1%
Other non-containers	4.2%	Unused Cleaners and Solvents	<0.1%
Subtotal Plastic	*11.7%*	Compressed Fuel Containers	0.0%
METALS		Automotive - Antifreeze	<0.1%
Aluminum Bev. Containers	0.9%	Automotive - Used oil filters	0.1%
Other Aluminum	0.5%	Other	0.6%
Ferrous Containers	1.3%	*Subtotal HHW/HW*	*1.0%*
Other Ferrous	3.3%	**OTHER WASTE**	
Other Non-Ferrous	0.1%	Textiles	3.4%
Subtotal Metals	*6.0%*	Carpet	1.5%
GLASS		Sharps and Infectious Waste	<0.1%
Clear Containers	1.6%	Rubber	0.7%
Green Containers	0.4%	Construction and Demo. Debris	3.2%
Brown Containers	0.5%	Household Bulky Items	2.9%
Other Glass	0.5%	Empty HHW/HW Containers	0.7%
Subtotal Glass	*3.0%*	Miscellaneous	6.7%
		Subtotal Other Waste	*19.1%*
GRAND TOTAL			**100%**

Note:
The total/subtotal may not equal the sum of the material categories due to rounding.

The percentage of paper (other than newspaper, office paper, and non-recyclable paper) that could potentially be recycled totaled 15.7 percent. The amount of glass in the waste stream totaled 3 percent. Therefore, additional diversion opportunities exist.

The City may want to discuss with the haulers and Millennium Recycling and Advanced Recycling the possibility of adding residential mixed paper (magazines, household office paper and mail, and/or boxboard) to the list of recyclable materials collected from residents by the haulers. Also, discuss with the local haulers and processors the feasibility of adding clear and brown glass to the recycling program, as a way to increase diversion.

Anchor Glass in Shakopee, Minnesota (just southwest of Minneapolis), is a large end user of recycled glass in the region. Minnkota Recycling in Fargo, North Dakota, transports clear and brown glass to Anchor. The green glass collected in Fargo's recycling program is crushed and used by a local manufacturer of sandblast material and sandpaper products. Per a telephone conversation with Anchor Glass, market prices as of May 12, 2003, were $50.00 per ton for clear, $35.00 per ton for amber, and $15.00 per ton for green glass, delivered. Another option for glass is crushing it and using it as part of the aggregate mix for roadbed construction. The Minnesota Department of Transportation, in conjunction with the Minnesota Office of Environmental Assistance (MOEA), published the "Reclaimed Glass Information Kit" in March of 2001. This document provides information on reclaiming glass, provides case studies of Minnesota counties that have successfully used glass in aggregate mix, and provides references and resources. The kit may be downloaded from the MOEA's website at:

http://www.moea.state.mn.us/lc/purchasing/glassaggregate.cfm#toolkit

The City should consider contacting the City of Madison, SD to discuss their uses of crushed glass and investigate the feasibility of Sioux Falls using crushed glass similarly in City public works projects such as road base or as a filter medium. If the haulers and/or processors do not want to handle glass, the City could provide drop-off sites for residents to dispose of glass bottles and jars. The City may be eligible to receive funding for a glass crusher and screener through the State of South Dakota's Department of Environment & Natural Resources. Their funding requirements are outlined further in this section under "Funding and In-kind Support for Public Education and Information Efforts". In the past, the State has awarded grants to fund capital costs related to solid waste and recycling projects.

6.2.4 Characterization of Existing Yard Waste Collection and Composting Programs

In 1995, the State of South Dakota banned yard waste from all landfills in the state.

City of Sioux Falls

The City operates a 5-acre compost site at the SFRSL. Lawn waste is accepted for $5.50 per ton, $5.00 per pickup truck, $2.50 per car, and $.50 per bag (grass and leaves only). Most licensed haulers provide yard waste collection to residents. Per City Ordinance, haulers must collect yard waste from residents at a minimum of once per week.

At a hauler meeting held on March 27, 2003, most haulers stated they have an additional charge beyond their MSW base fee for residential yard waste collection. On the Hauler License and Renewal Applications, most haulers provided MSW collection rates only, so it is not clear what is charged for yard

waste collection. Three haulers did give rates for yard waste collection: $1.00 per bag, $1.50 per bag, and one stated it depends on the quantity.

The annual quantities of yard waste materials collected in recent years, as reported by the City, are shown in Table 6-7. The increase in tonnage may be attributed to several variables including more participation by residents, or it may be directly related to the weather, (i.e., if more precipitation was received in the last few years, that could have contributed to more yard waste collected).

TABLE 6-7

ANNUAL YARD WASTE AMOUNTS BROUGHT TO THE SIOUX FALLS COMPOST SITE

Year	1997	1998	1999	2000	2001
Tonnage	2,473	3,292	3,842	4,559	5,054
Percent Increase From Previous Year	2%	33%	17%	19%	11%

The City actively composts the yard waste during the spring, summer, and fall months. The finished compost is given away to residents free of charge (residents must load it themselves at the Landfill compost site) and the City Parks Department is allowed two dump trucks per year. The City does not sell the compost, and is able to get rid of it all through the giveaway program.

The City has created public education pieces in the past to educate residents about yard waste disposal options. On the City's website, on the Landfill/Recycling page, there is a Yard Waste section with three links:

- "A Guide to Recycling," which offers yard waste information such as:

  - Why Bag Your Grass Clippings?
  - How to Recycle Grass Clippings?
  - Mulching Tips.

- "The Essentials of Composting," which explains the composting process and gives directions for making a compost bin.

- "The Benefits of Reusing Yard Wastes."

In April 1991, the City published a tri-fold brochure titled "Cut it High – Let it Lie" which encouraged residents to leave grass clippings on their lawn. An undated brochure titled "A Homeowners Guide to Recycling" is very thorough. It has most of the same information that is currently on the website such as how to recycle grass clippings, mulching tips, how to build a compost bin, and the benefits of reusing yard wastes. The flyer that the City sent out in utility bills in the spring of 2003 did not address yard waste.

Recommendations

- Include yard waste disposal information on all solid waste and recycling public education pieces.

- Conduct a survey of customers to assess who sets out yard waste for collection and other related data.

- The City may want to consider selling finished compost for a fee. Or perhaps offer one load for free to residents, and charge a per load or per cubic yard fee for additional amounts.

- Per discussions with State Department of Agriculture staff, whether the City sells or gives away finished compost, it must obtain a Commercial Fertilizer Distribution License from the Department of Agriculture, per South Dakota Statute Title 38 - Agriculture and Horticulture, Chapter 19 – Commercial Fertilizer. The license is biennial and the fee is $25. In addition to the license fee, the City would be required to pay an inspection fee of ten cents per ton for each ton of compost distributed during the previous calendar year. A guaranteed analysis of the finished compost is required to determine total nitrogen (N), available phosphoric acid (P2O5), and soluble potash (K2O). A label for the compost is required regardless if it is distributed in containers or in bulk. The City must make the labels (or photocopies of the label) available upon request for customers. The label must contain the following information:

  1. Net weight.
  2. Brand and grade.
  3. Guaranteed analysis.
  4. The source or sources from which the nitrogen phosphorus and potassium are derived (specialty fertilizers only).
  5. Name and address of licensee or registrant.

  If the finished product is adulterated or misbranded, there may be consequences, as either act may be considered a misdemeanor.

6.2.5 Regional Yard Waste Programs

Turner County

- Cities in the County deposit yard waste at rubble sites. (Rubble sites are inert landfills that accept yard waste, concrete, wood, etc. Yard waste must be composted, C&D materials can be buried, and brush can be burned.)

City of Madison

- Per City Ordinance, yard waste is collected by the City on a subscription basis. Collection is every Wednesday from April through November. Yard waste containers must be approved by the City. Residents pay an annual subscription fee plus a per bag fee which is collected through the purchase of the bags.

- Yard waste is taken to the City's restricted use site (old landfill) where it is composted and used as cover for the C&D materials.

Lake County

- See City of Madison.

McCook County

- The County does not have a management plan for yard waste. The City of Salem has a restricted use site for the disposal of yard waste for Salem residents.

Minnehaha County

- No yard waste program.

6.2.6 Characterization of Existing Community Reuse Programs

On the City of Sioux Falls' website, under Tips for Recycling, waste reduction ideas are listed as well as organizations that take used clothing.

Recommendations

The City should post addresses and phone numbers on the website of the organizations that accept reuse items. Also, expand the website to include information on disposing of bulk materials such as furniture and "problem" materials such as computers, electronics, and cellular phones (many national companies have take-back programs). Investigate the feasibility of creating a reuse website, such as the City of Fargo's "Freebee" website or the "Twin Cities Free Market" website:

http://www.cityoffargo.com/solidwaste/freebee/default.asp

http://www.twincitiesfreemarket.org/resources.cfm

6.3 EVALUATION OF THE WASTE REDUCTION, REUSE, AND RECYCLING PUBLIC EDUCATION AND INFORMATION PROGRAM

Beck staff met with City staff on March 6, 2003, to discuss current waste diversion programs. Beck staff then attended a Solid Waste Planning Board meeting in Sioux Falls on March 12, 2003. The Board is made up of representatives from each of the five counties that have agreements with the City of Sioux Falls to use the Sioux Falls Regional Landfill. During the meeting, the Board provided feedback and background information on current diversion activities in the five-county Region. Each Board member was given a written survey with questions regarding their local waste diversion activities. A copy of the survey is included in Appendix D.

On March 27, 2003, Beck staff met with local haulers to discuss recycling-related issues. A written survey was given to all haulers in attendance. Those not in attendance were mailed a survey. A copy of the hauler survey is attached in Appendix D. On May 28, 2003, Beck staff observed residential recycling collection in Sioux Falls, met with City staff, toured Millennium Recycling, Inc., in Sioux Falls, and toured the City of Madison's recycling center and restricted use site.

6.3.1 Current Public Education Program and Marketing Strategies

The City of Sioux Falls has published many brochures on the topics of waste reduction, reuse, and recycling. Some of the titles include:

- Sioux Empire Guide to Recycling.
- 2002 Make Sioux Falls Glitter.
- Pick up Your Litter.
- Home Healthcare Needle Disposal Program.
- Household Hazardous Material 2002 collection notices.

- Cut it High – Let it Lie (Yard Waste).

- A Homeowners Guide to Recycling (Yard Waste).

- In the Spring of 2003, the City included a flyer in the utility bills that outlined how to prepare trash and recyclables for collection.

The Public Works Department has a "Landfill/Recycling" webpage. The page has four links: Recycling, Landfill, Special Wastes, and Yard Wastes.

The Recycling page offers the following four pages of information:

- Vendor List. Provides the names of local businesses that accept recyclable materials.

- Tips for Recycling. Lists the items that are banned from the Sioux Falls Landfill and describes how to prepare these items for recycling and explains which materials to discard. This page also offers a few waste reduction ideas.

- Household Hazardous Waste Program. Describes the City's annual Household Hazardous Materials (HHM) collection day.

- Projects N.I.C.E. (Neighborhood Improvement Complaint Easement) and K.E.E.P. (Keep Environmental Enhancement Permanent). Explains these neighborhood cleanup programs.

The Yard Waste page offers the following three pages of information:

- "A Guide to Recycling" offers yard waste information such as:

    - Why Bag Your Grass Clippings?
    - How to Recycle Grass Clippings.
    - Mulching Tips.

- "The Essentials of Composting" explains the composting process and gives directions for making a compost bin.

- "The Benefits of Reusing Yard Wastes" explains the benefits of composting and mulching.

Other public education programs in the five-county Region include:

- The City of Madison – The City publishes solid waste and recycling reminders in the local paper, includes information in utility bills, makes presentations to schools and scout groups, and organizes an annual Earth Day event.

- Lake County – The Solid Waste Advisory Board published public education ads and pamphlets several years ago. The Board has since disbanded, but the pamphlets are still distributed to new customers by the City of Madison.

- McCook County – The County does not provide any recycling public education information.

- Minnehaha County – The County does not provide any recycling public education information.

- Turner County – The County does not provide any recycling public education information. The haulers send information to their customers.

- Lincoln County did not respond to the Solid Waste Planning Board Waste Diversion, Recycling, and Reuse Survey, distributed by R. W. Beck.

- Millennium Recycling, Inc., the largest materials recovery facility in Sioux Falls, has a web page that provides recycling information for businesses and residents. Millennium also has a public drop-off/redemption center located inside their facility.

6.3.2 Funding and In-kind Support for Public Education and Information Efforts

The State of South Dakota's Department of Environment and Natural Resources provides grants, loans, or a combination of grants and loans for solid waste disposal, recycling, and waste tire projects. Last year the legislature approved $750,000 for this fund. The program is funded through a $1.00 per ton surcharge at all landfills and a $.25 per tire or a maximum of $1.00 per vehicle, paid during vehicle registration. To apply for a loan and/or grant, the applicant must complete an application as well as submit a 3-year business plan.

To be eligible for funding consideration an application must:

1. Clearly show how the project will advance the state's solid waste management hierarchy.

   - Volume reduction at the source.
   - Recycling and reuse.
   - Use for energy production.
   - Disposal in landfill or combustion for volume reduction.

2. Show potential cost savings, public health, or environmental benefits in solid waste management, waste tire management, or waste tire processing for energy production.

3. Develop a detailed workplan, time schedule, budget, and provisions for a final report.

In the past, the grants have typically been awarded to fund capital costs related to solid waste and recycling projects.

In 2003 the City budgeted $44,450 for Landfill Printing and Advertising. This money is allocated for television and radio advertising, waste reduction education, information on Landfill bans, HHM information, public service announcements, and Earth Day promotions. This equates to approximately $.67 per household for public education, using the 2000 Census Data household count of 66,778.

As a reference, Dakota County, Minnesota, budgets approximately $150,000 for public education, which equals approximately $1.10 per household (135,846 households). Anoka County, Minnesota, budgets approximately $139,200 or $1.31 per household (106,428 households). These counties were used as a reference because they both have open hauling systems.

Recommendations

- Update the Comprehensive Solid Waste Source Reduction and Recycling Plan (Plan). The State requires local governments to update this Plan every 5 years. The Sioux Empire Regional Plan was last updated in December of 1998. The City and regional municipalities should follow their own Waste Reduction "Recommended Actions" outlined in the Plan:

  - Pursue grants for the purpose of expanding and enhancing waste reduction and reuse programs in the Region.

  - Promote waste reduction activities through educational materials. Investigate grant opportunities for funding the development, printing, and circulation of regional public education materials such as PSAs, a business recycling guide, C&D recycling education, etc.

  - Develop a group of resource persons from communities in the Region who will promote and help implement waste reduction programs.

  - Work to develop and implement a waste exchange program for the Region's industry and businesses.

As mentioned earlier in the Recycling Recommendations:

- Standardize the method of residential recyclables collection by requiring all haulers to collect recyclables in the same manner (i.e., recyclables should be placed in an 18-gallon bin, and materials should be in paper bags, not plastic bags). Standardized educational materials should be developed to educate residents on how to prepare items for recycling, regardless which hauler collects their materials.

- Consider purchasing 18-gallon recycling bins, or some agreed upon alternative, for all City residents. This would help standardize the program, and give the City a more uniform "look." (Currently, some haulers allow residents to use their own bin, box, can, or container for recycling.) Also the distribution of bins would serve as an opportunity to distribute recycling literature.

- Require the haulers add separate line items on their collection bills indicating what the fees are for recycling collection and yard waste collection. This would ensure the residents realize that recycling is a separate component of their MSW collection service. The City should also revise their annual license fee application form by asking for these costs to be itemized instead of combined with MSW collection fees.

- Hire a staff person or redefine an existing City position to dedicate to recycling program management. If possible, research grant opportunities to pay for part or all of this person's salary. Also, consider hiring a college intern to help with recycling-related tasks. Develop a plan to educate school children through school presentations.

- Enforce proper recycling setouts, to reduce contamination and amount of unacceptable materials. Work with haulers to educate the residents by leaving reminder tags. Repeat offenders should be reported to the City. The City should add language to the annual hauler license applications defining their role and the haulers' role regarding improper recycling setouts.

- When feasible, the City should identify disposal options for other materials such as tires, appliances, scrap metal, electronics, etc. in their printed materials. This information should also be added to the City's website.

- Ensure that the language in the public education pieces is consistent with the language in the Ordinance.

- When designing public education brochures and information pieces, consider using a consistent "look" in all pieces (i.e., use the same font, colors, logo, mascot, etc.). Residents will eventually recognize these as waste reduction and recycling information pieces and will hopefully save them and reference them when needed.

- Update and re-publish the Business Recycling Guide that was developed in the mid-1990s as part of the Region's Comprehensive Solid Waste Source Reduction and Recycling Plan. Form a committee to oversee the design and content of the guide and develop a distribution plan. Follow-up with businesses to gauge the effectiveness of the guide.

- The City should increase the public education budget and expand its efforts to increase the visibility of the recycling and waste diversion programs. It is recommended that at least $1.00 per household per year be budgeted for public education.

- To further promote recycling and waste diversion activities, the City should consider expanding its public education efforts. Provided below is a discussion on public education initiatives that may provide the City with ideas for increasing awareness.

Public Education Initiatives

The City has created an awareness about solid waste management issues, such as waste reduction, recycling, composting, and anti-littering, and played a significant role in reducing the amount of waste annually disposed of in the Sioux Falls Landfill.

To further enhance the performance and cost effectiveness of the City's outreach programs, the City may want to develop public education initiatives. Fortune 500 companies throughout the United States have begun to realize that many programs are developed and implemented without *measurable goals, identification of specific target audiences, strategies to meet the goals, and monitoring mechanisms*. In response, program managers are often required to develop plans which include these components, before a recommended program is even considered. The City may want to apply this process to education/outreach initiatives and solid waste programs that either have been or will be implemented. Provided below are recommendations to help the City increase waste reduction and recycling awareness.

- **Target Community Recycling Efforts.** The City has successfully promoted recycling and these efforts have contributed to a portion of the residents participating in recycling. However, if the City is going to increase these participation rates, the City will need to:

  - Document participation rates.
  - Determine areas with low participation rates.
  - Target individual neighborhoods or communities.
  - Determine why residents within these neighborhoods or communities do or do not recycle.
  - Develop specific strategies for increasing recycling within these neighborhoods or communities.

  To accomplish this, the City could use the following process:

  1. Identify up to two neighborhoods or communities per year to conduct a targeted and comprehensive recycling campaign.
  2. Once identified, conduct focus groups within the neighborhood or community or conduct a survey to identify individual recycling habits and concerns.
  3. Establish a solid waste steering committee or even just one individual that can serve as the district liaison with the neighborhood or community.
  4. Make school presentations and educator workshops a priority in that neighborhood or community.
  5. Make waste reduction efforts and development of recycling programs for businesses a priority in that neighborhood or community.
  6. Work with government officials to establish recycling and programs at government offices.
  7. Develop an outreach campaign specific to that neighborhood or community.
  8. Work with local haulers to be able to benchmark changes in recycling.
  9. Have a special promotional recycling event within that neighborhood or community.
  10. Recognize the neighborhood or community at the end of the year for implementation of recycling programs and increasing recycling.
  11. Highlight the success of this neighborhood or community on a Regional basis.

- **Focus on Annual Outreach Campaigns.** Currently, the City is conducting numerous outreach campaigns for yard waste management, waste reduction, household hazardous waste, recycling, and littering. To increase the effectiveness of each campaign, the City may want to limit its outreach campaigns to one or two per year. For each of these campaigns, the City could use the

continual improvement process to develop a yearlong campaign that includes specific timelines. Additionally, the City could promote that particular campaign to all waste generators. For example, if the campaign is going to be about waste reduction, then the business, residential, and education community outreach efforts should all address waste reduction.

Marketing studies have reported that a message needs to be seen at least seven times to have any impact, and at least 20 times to change a consumer habit. For many of these campaigns, such as "Buy Recycled," the City is trying to change a consumer habit, and just one or two exposures will not accomplish this goal. After the intense campaign, the City could continue to reinforce the campaign through periodic exposures to the issue.

- **Re-Establish the Business Recycling Program.** To increase recycling in the business community, the City may want to work with other regional business and recycling organizations to implement a business waste reduction program during the planning period that could include:

  1. Targeting businesses by the type of waste they generate.

  2. Designing specific workshops for specific generator types.

  3. Following up with workshop attendees.

  Each of these is discussed in detail below:

  A. Target Businesses by the Type of Waste They Generate

  Industries within the same Standard Industrial Code (SIC) classification exhibit similarities in the composition of their disposed waste stream. For example, businesses in SIC Code 25 (Furniture and Fixtures) generate large quantities of wood by-products, whereas businesses in SIC Code 27 (Publishing and Printing) generate large quantities of paper by-products. By targeting business outreach efforts to just one or two SIC codes per year, the County will be able to:

  - Identify key decision-makers.
  - Coordinate face-to-face meetings with key decision-makers.
  - Design educational and promotional materials that are specific to that particular business category and waste stream.
  - Determine motivators and barriers to waste reduction that are specific to that particular business category and waste stream.
  - Focus research on material markets to just one or two waste streams.
  - Facilitate alliances among similar waste generators.
  - Conduct timely follow-up.

The City could work with businesses to develop a business outreach plan. This plan could include information such as:

- Names of key decision-makers within the targeted firms.
- A schedule for the first round of meetings.
- Identification of materials these businesses currently dispose that could be recycled.
- Case studies from similar businesses that have successfully implemented a recycling program.
- List of trade publications and conferences, including trade shows, with exhibit information that target similar businesses.
- Meeting dates and contact names for trade associations that serve these types of businesses.

B. Design Specific Workshops for Specific Generator Types

As with the business program, workshops can be designed to target specific generator types. For example, the City could design a workshop just for printers (SIC code 27) rather than all businesses. By narrowing the intended audience, the workshop could include both environmental and non-environmental information that may be of interest to printers, such as new printing digital technologies, scanning equipment, soy-based ink products, recycled-content paper stocks, etc. By making the topics specific to their business rather than generic waste reduction information, interest in the workshop will most likely increase.

C. Follow-up with Workshop Attendees

The measure of success for a business workshop is not only the number of firms attending, but also the changes in behavior that result from the information provided. To facilitate the successful implementation of diversion programs after workshops, follow up is often conducted at least once with each of the attendees.

When conducting follow-up with workshop attendees, the City may:

- Provide additional information on how to institute a waste reduction program for that particular type of business.
- Distribute a list of local companies that would accept their recyclable materials.
- Identify opportunities for the attendee to purchase recycled-content products.

Table 6-8 provides a summary of the Waste Diversion recommendations.

TABLE 6-8

SUMMARY OF WASTE DIVERSION RECOMMENDATIONS

Recycling	Yard Waste	Reuse	Public Information/Education
Create an ad-hoc committee to develop recommendations	Require haulers to list yard waste fees on license applications	Expand current website to identify locations accepting items; include options for problem materials such as computers, electronics, cell phones, etc.	Update the Comprehensive Solid Waste Source Reduction and Recycling Plan.
Standardize bin type, material type, and collection schedule	Include yard waste information on all public education pieces	Consider developing a reuse website	Pursue grants for education funding.
Enforce landfill ban by conducting more frequent and consistent load inspections and charging additional fees above and beyond current tip fee for loads in violation of Ordinance	Via Ordinance, require all haulers to collect yard waste, and list collection fee on their bills as a separate line item		Standardize education materials.
Mandate recycling of commercially generated OCC	Conduct a survey of customers to assess yard waste collection participation		Retain staff person with some recycling responsibilities.
Consider mandating the separation of C&D material for either reuse and/or recycling	Consider selling finished compost		Enforce recycling setouts.
Request tonnage reports from haulers	Obtain a license from the State to distribute finishes compost		Ensure language in public education pieces is consistent with that in Ordinance.
Request that haulers itemize customer bills showing diversion fees.			Publish a Business Recycling Guide
Consider a waste composition study and the feasibility of adding mixed paper, glass, and/or other items to program			Develop Public Education Initiatives
Consider adding glass to the recycling program either via curbside collection or through a drop-off program			

7.0 IMPLEMENTATION PLAN

Table 7-1 includes a listing of capital improvements, projects, and recommendations made in this Master Plan that may be implemented over the next 10 years. Also included is a listing of new, recommended or replacement equipment over a five-year schedule. Refer to the applicable sections of this Master Plan for further detail pertaining to the items listed.

Each entry on this table was rated in accordance with its priority for implementation. A particular entry was assigned a "1" if implementation is required for continued operation, regulatory compliance, or critical for program effectiveness. The entry was assigned a "2" if implementation will simply improve operations, resolve questionable compliance, or improve a program. The entry was assigned a "3" if it was believed that implementation was entirely optional and would provide only marginal improvement or upgrade.

Most, but not all, of the recommendations on Table 7-1 have a cost associated with its implementation. Planning level cost estimates were based on similar work or were determined from conceptual design. Conceptual cost estimates for major items are included in Appendix C. The estimated cost and year of implementation shown in this Implementation Plan provides the basis for the tipping fee analysis included in Section 5.0 of this Master Plan.

8.0 REFERENCES

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APPENDICES

APPENDIX A

GEOLOGIC AND HYDROGEOLOGIC DATA

TABLE A-1
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SUMMARY OF SOIL BORINGS
Sioux Falls Sanitary Landfill

Soil Boring	Date Drilled	Drilling Contractor [1]	Ground Elevation (feet NGVD)	Depth (feet)	Bottom Elevation (feet NGVD)
Active Landfill					
MW-1			1556.2		
SDGS-6	7/10/1984	SDGS	1552.0	52.0	1500.0
SDGS-7	7/10/1984	SDGS	1552.0	22.0	1530.0
SDGS-2	7/11/1984	SDGS	1560.0	20.0	1540.0
SDGS-17	7/11/1984	SDGS	1550.0	22.0	1528.0
SDGS-24	7/11/1984	SDGS	1549.0	47.0	1502.0
SDGS-25	7/11/1984	SDGS	1549.0	20.0	1529.0
SDGS-26	7/11/1984	SDGS	1566.0	17.0	1549.0
SDGS-56	7/11/1984	SDGS	1541.0	47.0	1494.0
SDGS-62	7/11/1984	SDGS	1531.6	47.0	1484.6
SDGS-10	7/12/1984	SDGS	1554.9	27.0	1527.9
SDGS-11	7/12/1984	SDGS	1554.0	32.0	1522.0
SDGS-12	7/12/1984	SDGS	1554.0	18.0	1536.0
SDGS-34	7/12/1984	SDGS	1540.7	47.0	1493.7
SDGS-35	7/12/1984	SDGS	1550.0	27.0	1523.0
SDGS-36	7/12/1984	SDGS	1550.0	17.0	1533.0
SDGS-40	7/12/1984	SDGS	1551.2	47.0	1504.2
SDGS-41	7/16/1984	SDGS	1551.2	38.0	1513.2
SDGS-16	7/17/1984	SDGS	1551.0	17.0	1534.0
SDGS-48	7/17/1984	SDGS	1526.0	48.0	1478.0
SDGS-49	7/17/1984	SDGS	1523.0	48.0	1475.0
SDGS-52	7/17/1984	SDGS	1529.0	48.0	1481.0
SDGS-53	7/17/1984	SDGS	1530.0	48.0	1482.0
SDGS-54	7/17/1984	SDGS	1530.0	17.0	1513.0
SDGS-57	7/17/1984	SDGS	1541.0	17.0	1524.0
SDGS-63	7/17/1984	SDGS	1532.0	48.0	1484.0
SDGS-66	7/17/1984	SDGS	1533.0	17.0	1516.0
SDGS-8	7/18/1984	SDGS	1553.0	10.0	1543.0
SDGS-9	7/18/1984	SDGS	1552.0	15.0	1537.0
SDGS-13	7/18/1984	SDGS	1555.0	8.0	1547.0
SDGS-14	7/18/1984	SDGS	1554.0	12.0	1542.0
SDGS-18	7/18/1984	SDGS	1549.0	6.0	1543.0
SDGS-19	7/18/1984	SDGS	1548.0	15.0	1533.0
SDGS-20	7/18/1984	SDGS	1548.0	11.0	1537.0
SDGS-45	7/18/1984	SDGS	1544.0	17.0	1527.0
SDGS-50	7/18/1984	SDGS	1523.0	17.0	1506.0
SDGS-51	7/18/1984	SDGS	1538.0	48.0	1490.0
SDGS-58	7/18/1984	SDGS	1541.0	48.0	1493.0
SDGS-59	7/18/1984	SDGS	1544.0	48.0	1496.0
SDGS-61	7/18/1984	SDGS	1537.0	48.0	1489.0
SDGS-64	7/18/1984	SDGS	1535.0	48.0	1487.0
SDGS-65	7/18/1984	SDGS	1539.0	48.0	1491.0
SDGS-15	7/19/1984	SDGS	1554.0	16.0	1538.0

TABLE A-1
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SUMMARY OF SOIL BORINGS
Sioux Falls Sanitary Landfill

Soil Boring	Date Drilled	Drilling Contractor [1]	Ground Elevation (feet NGVD)	Depth (feet)	Bottom Elevation (feet NGVD)
SDGS-27	7/19/1984	SDGS	1565.0	17.0	1548.0
SDGS-28	7/19/1984	SDGS	1560.0	17.0	1543.0
SDGS-32	7/19/1984	SDGS	1559.0	48.0	1511.0
SDGS-33	7/19/1984	SDGS	1559.0	17.0	1542.0
SDGS-37	7/19/1984	SDGS	1549.0	12.0	1537.0
SDGS-38	7/19/1984	SDGS	1549.0	16.0	1533.0
SDGS-42	7/19/1984	SDGS	1550.0	48.0	1502.0
SDGS-43	7/19/1984	SDGS	1550.0	48.0	1502.0
SDGS-44	7/19/1984	SDGS	1550.0	48.0	1502.0
SDGS-46	7/19/1984	SDGS	1544.0	48.0	1496.0
SDGS-47	7/19/1984	SDGS	1537.0	48.0	1489.0
SDGS-55	7/19/1984	SDGS	1545.0	48.0	1497.0
SDGS-60	7/19/1984	SDGS	1544.0	17.0	1527.0
SDGS-29	7/23/1984	SDGS	1560.0	48.0	1512.0
SDGS-30	7/23/1984	SDGS	1552.0	48.0	1504.0
SDGS-31	7/23/1984	SDGS	1552.0	18.0	1534.0
SDGS-3	7/24/1984	SDGS	1560.0	19.0	1541.0
SDGS-4	7/24/1984	SDGS	1560.0	14.0	1546.0
SDGS-5	7/24/1984	SDGS	1559.0	9.0	1550.0
SDGS-21	7/24/1984	SDGS	1555.0	48.0	1507.0
SDGS-22	7/24/1984	SDGS	1553.0	23.0	1530.0
SDGS-23	7/24/1984	SDGS	1555.0	48.0	1507.0
SDGS-39	7/24/1984	SDGS	1550.0	48.0	1502.0
SDGS-67	7/25/1984	SDGS	1552.0	48.0	1504.0
SDGS-68	7/25/1984	SDGS	1552.0	18.0	1534.0
SDGS-69	7/25/1984	SDGS	1556.0	48.0	1508.0
SDGS-70	7/25/1984	SDGS	1551.0	19.0	1532.0
SDGS-71	7/25/1984	SDGS	1559.0	19.0	1540.0
SDGS-76	7/25/1984	SDGS	1543.0	48.0	1495.0
SDGS-77	7/25/1984	SDGS	1543.0	18.0	1525.0
SDGS-78	7/25/1984	SDGS	1550.0	14.0	1536.0
SDGS-79	7/25/1984	SDGS	1550.0	18.0	1532.0
SDGS-80	7/25/1984	SDGS	1550.0	48.0	1502.0
SDGS-72	7/26/1984	SDGS	1551.0	48.0	1503.0
SDGS-73	7/26/1984	SDGS	1559.0	48.0	1511.0
SDGS-74	7/26/1984	SDGS	1547.0	48.0	1499.0
SDGS-75	7/26/1984	SDGS	1546.0	48.0	1498.0
TCT-1 (SB)	10/14/1991	TCT	1554.0	56.0	1498.0
TCT-2/3 (TCT-1)	10/14/1991	TCT	1554.0	59.5	1494.5
MW-4	11/7/1991	TCT	1531.0	48.5	1482.5
MW-8	11/11/1991	TCT	1560.0	65.0	1495.0
MW-10	11/12/1991	TCT	1565.0	65.0	1500.0
MW-14	1/29/1992	TCT	1548.0	34.5	1513.5
MW-16	1/30/1992	TCT	1560.0	40.0	1520.0

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SUMMARY OF SOIL BORINGS
Sioux Falls Sanitary Landfill

Soil Boring	Date Drilled	Drilling Contractor [1]	Ground Elevation (feet NGVD)	Depth (feet)	Bottom Elevation (feet NGVD)
R20-93-01	5/25/1993	SDGS	1541.0	50.0	1491.0
R20-93-02	5/26/1993	SDGS	1544.5	74.0	1470.5
R20-93-03	5/27/1993	SDGS	1544.3	52.0	1492.3
R20-93-04	6/1/1993	SDGS	1542.2	30.0	1512.2
R20-93-05	6/2/1993	SDGS	1543.4	34.0	1509.4
R20-93-06	6/2/1993	SDGS	1543.0	28.3	1514.7
R20-93-07	6/3/1993	SDGS	1543.5	17.0	1526.5
R20-93-08	6/3/1993	SDGS	1543.8	22.0	1521.8
R20-93-09	6/3/1993	SDGS	1544.8	16.8	1528.0
R20-93-10	6/3/1993	SDGS	1542.5	29.0	1513.5
R20-93-11	6/7/1993	SDGS	1545.0	29.0	1516.0
R20-93-12	6/7/1993	SDGS	1537.9	33.0	1504.9
R20-93-13	6/7/1993	SDGS	1538.2	17.3	1520.9
R20-93-14	6/8/1993	SDGS	1538.6	74.0	1464.6
R20-93-15	6/9/1993	SDGS	1539.9	51.0	1488.9
R20-93-16	6/10/1993	SDGS	1537.2	29.0	1508.2
R20-93-17	6/10/1993	SDGS	1537.6	28.0	1509.6
R20-93-18	6/13/1993	SDGS	1538.0	22.0	1516.0
R20-93-19	6/13/1993	SDGS	1538.8	17.0	1521.8
R20-93-20	6/13/1993	SDGS	1540.3	19.5	1520.8
R20-93-21	6/15/1993	SDGS	1541.0	23.5	1517.5
R20-93-22	6/15/1993	SDGS	1543.7	19.1	1524.6
R20-93-23	6/15/1993	SDGS	1544.3	23.0	1521.3
MW-18	6/6/1994	TCT/H	1547.7	45.0	1502.7
MW-19	6/10/1994	TCT/H	1555.8	55.0	1500.8
MW-20	6/10/1994	TCT/H	1558.0	55.0	1503.0
H-401	6/29/1994	TCT/H	1553.1	25.0	1528.1
H-411	6/29/1994	TCT/H	1556.3	25.0	1531.3
MW-42ox	6/19/1995	TCT/H	1530.6	20.0	1510.6
MW-43ox	7/19/1995	TCT/H	1532.0	25.0	1507.0
MW-12R	9/8/1997	ATS	1532.7	50.0	1482.7
MW-6R	12/16/1997	ATS	1526.5	50.0	1476.5
MW-44ox	10/6/1999	ATS	1529.0	20.0	1509.0
MW-45ox	10/6/1999	ATS	1531.5	25.0	1506.5
MW-46ox	7/12/2001	ATS	1548.1	30.0	1518.1
MW-47ox	12/16/2002	Maxim	1545.0	20.0	1525.0
MW-48ox	12/16/2002	Maxim	1558.4	25.0	1533.4
Expansion Area					
MW-21un	6/14/1994	TCT/H	1557.6	35.0	1522.6
MW-22un	6/15/1994	TCT/H	1524.5	35.0	1489.5
MW-23un	6/16/1994	TCT/H	1538.1	55.0	1483.1
MW-24un	6/17/1994	TCT/H	1547.1	35.0	1512.1
MW-25ox	6/17/1994	TCT/H	1560.7	20.0	1540.7

TABLE A-1
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SUMMARY OF SOIL BORINGS
Sioux Falls Sanitary Landfill

Soil Boring	Date Drilled	Drilling Contractor [1]	Ground Elevation (feet NGVD)	Depth (feet)	Bottom Elevation (feet NGVD)
MW-26ox	6/20/1994	TCT/H	1549.3	20.0	1529.3
MW-27ox	6/20/1994	TCT/H	1545.2	20.0	1525.2
H-28un	6/20/1994	TCT/H	1557.6	40.0	1517.6
MW-29un	6/21/1994	TCT/H	1532.4	55.0	1477.4
H-30UN	6/21/1994	TCT/H	1528.6	30.0	1498.6
H-31UN	6/22/1994	TCT/H	1543.0	61.0	1482.0
H-32UN	6/24/1994	TCT/H	1535.6	35.0	1500.6
H-33UN	6/24/1994	TCT/H	1536.2	30.0	1506.2
H-34UN	6/27/1994	TCT/H	1552.0	40.0	1512.0
H-35UN	6/27/1994	TCT/H	1555.8	43.5	1512.3
H-36UN	6/28/1994	TCT/H	1538.5	40.0	1498.5
H-37UN	6/28/1994	TCT/H	1549.6	42.5	1507.1
H-38UN	6/28/1994	TCT/H	1547.6	50.0	1497.6
MW-39ox	6/27/1994	TCT/H	1524.7	15.0	1509.7
SB-44	11/28/1995	ATS	1550.7	80.0	1470.7
SB-45	11/29/1995	ATS	1557.1	70.0	1487.1
SB-46	12/1/1995	ATS	1529.3	85.0	1444.3
SB-47	12/4/1995	ATS	1531.6	85.0	1446.6
MW-49un	5/27/2003	Maxim		60.0	
MW-50un	5/28/2003	Maxim		55.0	
MW-51un	5/29/2003	Maxim	1550.2	75.0	1425.2
P-1D	10/5/1989	TCT	1550.6	26.5	1524.1
P-2D	10/5/1989	TCT	1530.5	25.5	1505.0
P-4	10/5/1989	TCT	1536.4	16.5	1519.9
P-5	10/4/1989	TCT	1551.2	16.5	1534.7
SB-1	11/28/1988	TCT	1568.0	41.0	1527.0
SB-2	11/28/1988	TCT	1525.0	41.0	1484.0
SB-3	11/28/1988	TCT	1538.0	51.0	1487.0
SB-4	11/28/1988	TCT	1558.0	36.0	1522.0
SB-5	11/29/1988	TCT	1552.0	26.0	1526.0
SB-6	11/29/1988	TCT	1542.0	46.0	1496.0
SB-7	11/29/1988	TCT	1530.0	16.0	1514.0
SB-8	11/29/1988	TCT	1544.0	21.0	1523.0
SB-9	9/28/1989	TCT	1532.0	81.0	1451.0
SB-10	9/29/1989	TCT	1555.0	81.0	1474.0

Notes:

(1) Drilling contractors:

TCT	Twin City Testing, Souix Falls, South Dakota
TCT/H	Twin City Testing/Huntingdon, Souix Falls, South Dakota
ATS	American Technical Services, Souix Falls, South Dakota
Maxim	Maxim Technologies, Souix Falls, South Dakota
SDGS	South Dakota Geological Survey, Vermillion, South Dakota

TABLE A-2
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SUMMARY OF GEOTECHNICAL DATA

Sioux Falls Sanitary Landfill

Soil Boring	Reference	Ground Elevation (feet NGVD)	Sample Depth (feet)	Sample Elevation (feet NGVD)	Grain-Size Distribution				Atterberg Limits			Hydraulic Conductivity (cm/sec)[2]
					Percent Gravel	Percent Sand	Percent Silt	Percent Clay[1]	Liquid Limit	Plastic Limit	Plasticity Index	
Active Area												
Trench core	Davis et al (1997)	NA	NA	1534.5	0.0	31.0	41.0	28.0	38.0	19.4	18.6	
Trench core	Davis et al (1997)	NA	NA	1533.0	8.0	28.0	39.0	25.0	43.6	17.0	26.6	
Trench core	Davis et al (1997)	NA	NA	1527.0	1.0	32.0	40.0	27.0	36.2	18.2	18.0	
Trench core	Davis et al (1997)	1543.9	18.9	1525.0								2.5×10^{-6}
Trench core	Davis et al (1997)	1543.9	20.6	1523.3	3.0	35.0	41.0	21.0	41.7	19.8	21.9	4.3×10^{-6}
Trench core	Davis et al (1997)	1543.9	24.7	1519.2	3.0	33.0	41.0	23.0	31.9	17.9	14.0	4.9×10^{-7}
Trench core	Davis et al (1997)	1543.9	26.9	1517.0								5.4×10^{-5}
Trench core	Davis et al (1997)	1543.9	29.1	1514.8	6.0	35.0	37.0	22.0	35.4	20.5	14.9	5.0×10^{-7}
Trench core	Davis et al (1997)	1543.9	31.2	1512.7	2.0	39.0	36.0	23.0	37.2	17.7	19.5	4.8×10^{-7}
Trench core	Davis et al (1997)	1543.9	33.3	1510.6	2.0	39.0	39.0	20.0	39.9	19.7	20.2	3.2×10^{-4}
Trench core	Davis et al (1997)	1543.9	35.2	1508.7								2.0×10^{-4}
Trench core	Davis et al (1997)	1543.9	38.4	1505.5	2.0	39.0	39.0	20.0	40.0	20.3	19.7	5.0×10^{-8}
R20-93-02	Davis et al (1997)	1544.5	71.2	1473.3								7.0×10^{-9}
R20-93-02	Davis et al (1997)	1544.5	71.7	1472.8								7.3×10^{-9}
R20-93-02	Davis et al (1997)	1544.5	73.5	1471.0								9.3×10^{-9}
R20-93-02	Davis et al (1997)	1544.5	73.8	1470.7								8.0×10^{-9}
R20-93-03	Davis et al (1997)	1544.3	49.0	1495.3								6.5×10^{-9}
R20-93-03	Davis et al (1997)	1544.3	49.8	1494.5								9.5×10^{-9}
R20-93-03	Davis et al (1997)	1544.3	51.5	1492.8								9.5×10^{-9}
R20-93-03	Davis et al (1997)	1544.3	51.8	1492.5								6.0×10^{-9}
R20-93-05	Davis et al (1997)	1543.4	26.2	1517.2								4.5×10^{-8}
R20-93-05	Davis et al (1997)	1543.4	26.7	1516.7								6.0×10^{-9}
R20-93-05	Davis et al (1997)	1543.4	28.5	1514.9								2.5×10^{-9}
R20-93-05	Davis et al (1997)	1543.4	28.8	1514.6								9.5×10^{-8}
R20-93-05	Davis et al (1997)	1543.4	30.5	1512.9								6.5×10^{-9}
R20-93-05	Davis et al (1997)	1543.4	30.8	1512.6								9.0×10^{-9}
R20-93-07	Davis et al (1997)	1543.5	15.5	1528.0								7.8×10^{-9}
R20-93-07	Davis et al (1997)	1543.5	15.8	1527.7								7.0×10^{-9}
R20-93-08	Davis et al (1997)	1543.8	15.5	1528.3								3.9×10^{-8}
R20-93-08	Davis et al (1997)	1543.8	15.7	1528.1								3.8×10^{-9}
R20-93-08	Davis et al (1997)	1543.8	17.2	1526.6								3.5×10^{-8}
R20-93-08	Davis et al (1997)	1543.8	17.7	1526.1								1.7×10^{-8}
R20-93-08	Davis et al (1997)	1543.8	19.4	1524.4								6.0×10^{-9}
R20-93-08	Davis et al (1997)	1543.8	19.7	1524.1								5.2×10^{-9}
R20-93-11	Davis et al (1997)	1545.0	25.3	1519.7								1.3×10^{-3}
R20-93-11	Davis et al (1997)	1545.0	25.8	1519.2								9.6×10^{-9}
R20-93-12	Davis et al (1997)	1537.9	26.5	1511.4								1.6×10^{-8}
R20-93-12	Davis et al (1997)	1537.9	26.8	1511.1								3.3×10^{-8}
R20-93-12	Davis et al (1997)	1537.9	28.3	1509.6								1.0×10^{-8}
R20-93-12	Davis et al (1997)	1537.9	28.8	1509.1								5.7×10^{-9}
R20-93-12	Davis et al (1997)	1537.9	30.5	1507.4								1.1×10^{-8}
R20-93-12	Davis et al (1997)	1537.9	30.8	1507.1								1.1×10^{-8}
R20-93-14	Davis et al (1997)	1538.6	71.3	1467.3								2.8×10^{-8}
R20-93-14	Davis et al (1997)	1538.6	71.8	1466.8								4.6×10^{-9}
R20-93-15	Davis et al (1997)	1539.9	50.3	1489.6								4.5×10^{-9}
R20-93-15	Davis et al (1997)	1539.9	50.8	1489.1								4.3×10^{-9}
R20-93-16	Davis et al (1997)	1537.2	27.3	1509.9								8.1×10^{-9}
R20-93-16	Davis et al (1997)	1537.2	28.0	1509.2								4.8×10^{-9}
R20-93-18	Davis et al (1997)	1538.0	14.9	1523.1								9.0×10^{-9}
R20-93-18	Davis et al (1997)	1538.0	15.5	1522.5								1.6×10^{-8}
R20-93-18	Davis et al (1997)	1538.0	19.5	1518.5								1.8×10^{-8}
R20-93-18	Davis et al (1997)	1538.0	19.8	1518.2								9.0×10^{-9}
R20-93-19	Davis et al (1997)	1538.8	15.3	1523.5								3.8×10^{-8}

TABLE A-2
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SUMMARY OF GEOTECHNICAL DATA

Sioux Falls Sanitary Landfill

Soil Boring	Reference	Ground Elevation (feet NGVD)	Sample Depth (feet)	Sample Elevation (feet NGVD)	Grain-Size Distribution				Atterberg Limits			Hydraulic Conductivity (cm/sec)[2]
					Percent Gravel	Percent Sand	Percent Silt	Percent Clay[1]	Liquid Limit	Plastic Limit	Plasticity Index	
R20-93-19	Davis et al (1997)	1538.8	15.8	1523.0								2.0×10^{-8}
R20-93-20	Davis et al (1997)	1540.3	19.0	1521.3								5.5×10^{-9}
R20-93-20	Davis et al (1997)	1540.3	19.3	1521.0								5.5×10^{-9}
R20-93-21	Davis et al (1997)	1541.0	20.7	1520.3								7.0×10^{-9}
R20-93-21	Davis et al (1997)	1541.0	20.9	1520.1								5.9×10^{-9}
R20-93-22	Davis et al (1997)	1543.7	18.7	1525.0								1.9×10^{-7}
R20-93-23	Davis et al (1997)	1544.3	18.8	1525.5								8.5×10^{-9}
R20-93-23	Davis et al (1997)	1544.3	19.0	1525.3								8.5×10^{-9}
Expansion Area												
H-23un	LBG (January 23, 1996)	1538.1	55.0	1483.1	7.0	30.0	41.0	22.0	41.0	18.0	23.0	2.9×10^{-8}
H-23ox	LBG (January 23, 1996)	1538.1	20.0	1518.1	2.0	31.0	47.0	20.0	41.0	19.0	22.0	3.7×10^{-8}
H-24un	LBG (January 23, 1996)	1547.1	35.0	1512.1	2.0	33.0	38.0	27.0	39.0	16.0	23.0	2.6×10^{-8}
H-31un	LBG (January 23, 1996)	1543.0	57.0	1486.0	4.0	40.0	38.0	18.0	43.0	19.0	24.0	2.4×10^{-8}
MW-49un	Earth Tech (7/22/03)		1 - 5		2.0	22.0	39.0	37.0	42.0	20.0	22.0	
MW-49un	Earth Tech (7/22/03)		18 - 19		0.0	18.0	52.0	30.0	32.0	22.0	10.0	
MW-49un	Earth Tech (7/22/03)		19 - 20		1.0	32.0	39.0	28.0	40.0	22.0	18.0	
MW-49un	Earth Tech (7/22/03)		35 - 40		1.0	34.0	41.0	24.0	36.0	15.0	21.0	
MW-49un	Earth Tech (7/22/03)		50 - 60		1.0	33.0	37.0	29.0	41.0	19.0	22.0	
MW-50un	Earth Tech (7/22/03)		7.5 - 8		0.0	9.0	52.0	39.0	46.0	22.0	24.0	
MW-50un	Earth Tech (7/22/03)		11 - 12		25.0	70.9	4.1[3]		NA	NA	NA	
MW-50un	Earth Tech (7/22/03)		35 - 37		0.0	34.0	32.0	34.0	40.0	20.0	20.0	
MW-50un	Earth Tech (7/22/03)		45 - 46		1.0	32.0	41.0	26.0	38.0	17.0	21.0	
MW-50un	Earth Tech (7/22/03)		50 - 55		1.0	33.0	35.0	31.0	42.0	18.0	24.0	
MW-51un	Earth Tech (7/22/03)	1552.8	11 - 12	1541.8-1540.8	0.0	33.0	33.0	33.0	21.0	20.0	21.0	
MW-51un	Earth Tech (7/22/03)	1552.8	17 - 18	1535.8-1534.8	0.0	32.0	43.0	25.0	43.0	20.0	23.0	
MW-51un	Earth Tech (7/22/03)	1552.8	56 - 57	1496.8-1495.8	1.0	32.0	42.0	25.0	41.0	19.0	22.0	
MW-51un	Earth Tech (7/22/03)	1552.8	70 - 75	1482.8-1481.8	1.0	30.0	37.0	32.0	40.0	19.0	21.0	

Note:

(1) Particle size criteria not defined for test results published by Davis et al (1997).
Remaining results applies ASTM D420 with clay particles defined as less than 0.005 mm in diameter.
(2) Hydraulic conductivity by Davis determined following methods outlined in Kortran (1995).
Remaining results applied ASTM 5087.
(3) Particle size for sand and silt not differentiated.

TABLE A-3
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SUMMARY OF EXISTING WELL DATA
Sonix Falls Regional Sanitary Landfill

Monitoring Well	Date Installed	Driller [1]	Soil Boring Log Preparer [2]	Top of Casing Elevation (feet NGVD)	Ground Elevation (feet NGVD)	Screen Length (feet)	Well Depth [3] (feet)	Screened Elevation [4] (feet NGVD)	Condition Monitored			In-situ [8] Hydraulic Conductivity (cm/sec)	Static Water Elevation (feet NGVD)				
									Soil Condition [5]	Screened Soil Type [6]	Ground Water [7]		2/12/2001	5/15/2001	9/12/2001	11/19/2001	7/31/2003
Active Area																	
SDGS-2	7/11/1984	SDGS	SDGS	1562.91	1560.0	2.1	20.0	1540-1542	Unoxidized	Clay Till	P			1558.95	1554.02	1552.88	
SDGS-3	7/24/1984	SDGS	SDGS	1562.82	1560.0	4.6	18.0	1542-1547	Oxidized	Clay Till	Near WT			1558.46	1553.53	1552.77	
SDGS-4	7/24/1984	SDGS	SDGS	1562.64	1560.0	4.6	13.5	1546-1551	Oxidized	Clay Till	WT			1558.46	1553.42	1552.65	
SDGS-5	7/24/1984	SDGS	SDGS	1562.43	1559.0	4.6	8.5	1550-1555	Oxidized	Clay Till	WT			1558.29	1553.30	1552.56	
SDGS-7	7/10/1984	SDGS	SDGS	1558.21	1552.0	2.1	17.0	1535-1537	Oxidized	Sand	Near WT		1544.45	1555.72	1544.04	1543.84	
SDGS-8	7/18/1984	SDGS	SDGS	1558.13	1553.0	4.6	9.5	1544-1548	Oxidized	Clay Till	WT		1544.59	1547.12	1544.14	1543.99	
SDGS-9	7/18/1984	SDGS	SDGS	1558.07	1552.0	4.6	14.5	1538-1542	Oxidized	Clay Till	WT		1544.60	1547.21	1544.16	1548.03	
SDGS-17	7/11/1984	SDGS	SDGS	1551.63	1550.0	2.1	17.5	1532-1533	Oxidized	Sand	Near WT		1542.98	1546.66	1543.47	1542.65	
SDGS-19	7/18/1984	SDGS	SDGS	1551.26	1548.0	4.6	15.0	1533-1538	Oxidized	Clay Till	WT		1543.05	1546.62	1543.42	1542.32	
SDGS-20	7/18/1984	SDGS	SDGS	1550.92	1548.0	4.6	10.5	1536-1541	Oxidized	Clay Till	WT		1543.09	1546.61	1543.42	1542.59	
SDGS-25	7/11/1984	SDGS	SDGS	1551.80	1549.0	2.1	20.0	1529-1531	Oxidized	Clay Till	Near WT		1541.56	1544.44	1541.26	1540.72	
SDGS-27	7/19/1984	SDGS	SDGS	1567.58	1565.0	2	16.0	1549-1551	Oxidized	Clay Till	WT		1554.54	1561.46	1555.38	1553.94	
SDGS-28	7/19/1984	SDGS	SDGS	1562.54	1560.0	2	16.5	1544-1546	Oxidized	Clay Till	P		1551.17	1554.87	1552.14	1551.44	1552.77
SDGS-31	7/23/1984	SDGS	SDGS	1552.41	1552.0	1.9	18.0	1534-1536	Oxidized	Clay Till	P		1549.90				1537.06
SDGS-33	7/19/1984	SDGS	SDGS	1561.71	1559.0	2.1	16.5	1542-1545	Oxidized	Clay Till	WT		1546.79	1548.41	1545.68	1545.06	
SDGS-37	7/19/1984	SDGS	SDGS	1550.15	1549.0	4.6	11.5	1538-1542	Oxidized	Clay Till/Sand/Gravel	WT			1545.46			
SDGS-45	7/18/1984	SDGS	SDGS	1547.16	1544.0	2	17.0	1527-1529	Oxidized	Clay Till	WT		1532.42	1537.73	1532.32	1530.93	1534.35
SDGS-54	7/17/1984	SDGS	SDGS	1532.93	1530.0	2	17.0	1513-1515	Oxidized	Clay Till	Near WT		1523.57	1527.90	1523.58	1522.66	
SDGS-57	7/17/1984	SDGS	SDGS	1543.58	1541.0	2	17.0	1524-1526	Oxidized	Clay Till	Near WT		1531.27	1537.50	1532.85	1531.04	1532.60
SDGS-66	7/17/1984	SDGS	SDGS	1535.30	1533.0	2	17.0	1516-1818	Oxidized	Clay Till	Near WT		1524.99	1529.54	1525.38	1524.32	
SDGS-68	7/25/1984	SDGS	SDGS	1554.01	1552.0	2.1	18.0	1534-1536	Oxidized	Clay Till	Near WT		1542.60		1542.91	1542.32	1545.68
SDGS-70	7/25/1984	SDGS	SDGS	1560.54	1551.0	2	18.5	1532-1534	Unoxidized	Clay Till	P					1546.48	
SDGS-77	7/25/1984	SDGS	SDGS	1545.29	1543.0	2.1	12.5	1530-1533	Oxidized	Clay Till	Near WT		1539.83		1538.75	1538.95	
MW-1				1558.53	1556.2								1544.55	1546.90	1544.04	1544.00	
MW-4	11/7/1991	TCT	TCT	1532.82	1531.0	10	48.5	1482-1492	Unoxidized	CL	P		1523.38	1528.21	1523.67	1522.68	1524.93
MW-5	11/7/1991	TCT	TCT	1532.76	1531.0	10	30.0	1501-1511	Oxidized	CL	P		1523.53	1528.11	1523.81	1522.84	1525.15
MW-6R	12/16/1997	ATS	LBG	1529.02	1526.5	5	50.0	1476-1482	Unoxidized	Clay	P		1508.60	1510.12	1509.95	1509.61	1512.35
MW-7R	12/16/1997	ATS	LBG	1528.88	1526.4	15	25.0	1501-1516	Unoxidized	Clay w/sand seams	Near WT		1516.96	1522.35	1517.52	1516.89	1520.18
MW-8	11/11/1991	TCT	TCT	1562.11	1560.0	10	65.0	1495-1505	Unoxidized	CL	P		1545.68	1546.63	1543.93	1543.82	1545.33
MW-9	11/11/1991	TCT	TCT	1562.04	1559.5	10	35.0	1524-1534	Oxidized	CL w/sand seams	Near WT		1546.47	1547.79	1545.00	1544.62	1546.15
MW-10	11/12/1991	TCT	TCT	1567.97	1565.0	5	65.0	1500-1505	Unoxidized	CL	P		1553.31	1558.45	1554.49	1553.91	1554.37
MW-11	11/12/1991	TCT	TCT	1567.78	1565.0	10	35.0	1530-1540	Oxidized	CL w/sand seams	P		1553.67	1558.45	1554.49	1553.91	1554.90
MW-12R	9/8/1997	ATS	LBG	1536.47	1532.7	5	50.0	1482-1488	Unoxidized	Clay w/sand seams	P		1520.66	1526.19	1523.15	1522.06	1522.11
MW-13R	9/9/1997	ATS	LBG	1536.46	1533.7	15	25.0	1509-1524	Oxidized	Clay	WT		1524.97	1531.38	1526.63	1525.03	1527.60
MW-14	1/29/1992	TCT	TCT	1550.60	1548.0	10	34.5	1514-1524	Unoxidized	CL	P		1542.57	1545.74	1542.52	1541.95	1543.61
MW-15	1/29/1992	TCT	TCT	1550.09	1548.0	10	15.0	1533-1543	Oxidized	CL	WT		1542.32	1544.98	1542.06	1541.58	1542.94
MW-16	1/30/1992	TCT	TCT	1562.95	1560.0	10	40.0	1520-1530	Unoxidized	CL	P			1558.26	1553.83	1553.06	1554.93
MW-17	1/30/1992	TCT	TCT	1562.71	1560.0	10	19.5	1540-1550	Oxidized	CL	WT			1558.59	1553.74	1553.00	1554.59
MW-18	6/6/1994	TCT/H	TCT/H	1550.15	1547.7	10	45.0	1503-1513	Unoxidized	CL w/sand seams	P	6.1×10^{-7}	1536.83	1537.05	1535.42	1535.84	1534.10
MW 19	6/10/1994	TCT/H	TCT/H	1558.28	1555.8	10	55.0	1501-1511	Unoxidized	CL	P	5.0×10^{-7}	1541.94	1542.55	1536.60	1540.50	1540.53
MW-19i	6/29/1994	TCT/H	TCT/H	1558.20	1555.8	10	16.0	1540-1550	Oxidized	Cl and SM	WT	5.6×10^{-3}		1552.25	1547.65	1546.75	1548.70
MW-20	6/10/1994	TCT/H	TCT/H	1560.52	1558.0	10	55.0	1503-1513	Unoxidized	CL	P	1.3×10^{-6}	1542.98	1546.36	1543.31	1542.62	1544.60
MW-42ox	6/19/1995	TCT/H	TCT/H	1533.18	1530.6	10	20.0	1511-1521	Oxidized	CL	WT		1525.00	1529.02	1523.05	1522.08	1525.21
MW-43ox	7/19/1995	TCT/H	TCT/H	1534.46	1532.0	10	25.0	1507-1517	Oxidized	CL	WT		1522.39	1529.71	1525.33	1524.05	1526.22

SUMMARY OF EXISTING WELL DATA
Souix Falls Regional Sanitary Landfill

Monitoring Well	Date Installed	Driller [1]	Soil Boring Log Preparer [2]	Top of Casing Elevation (feet NGVD)	Ground Elevation (feet NGVD)	Screen Length (feet)	Well Depth [3] (feet)	Screened Elevation [4] (feet NGVD)	Condition Monitored: Soil Condition [5]	Condition Monitored: Screened Soil Type [6]	Condition Monitored: Ground Water [7]	In-situ [8] Hydraulic Conductivity (cm/sec)	Static Water Elevation (feet NGVD): 2/12/2001	5/15/2001	9/12/2001	11/19/2001	7/31/2003
MW-44ox	10/6/1999	ATS	LBG	1532.16	1529.0	15	20.0	1509-1524	Oxidized	Clay w/sand seams	WT		1521.87	1528.68	1524.21	1523.49	1524.87
MW-45ox	10/6/1999	ATS	LBG	1534.60	1531.5	20	25.0	1506-1526	Oxidized	Clay and Silt	WT		1522.46	1529.11	1523.67	1522.96	1523.93
MW-46ox	7/12/2001	ATS	LBG	1551.00	1548.1	20	30.0	1518-1538	Oxidized	Clay w/sand seams	WT						1546.09
MW-47ox	12/16/2002	Maxim	Maxim	1545.99	1544.0	10	20.0	1524-1534	Oxidized	Clay w/sand seams	Near WT						1539.00
MW-48ox	12/16/2002	Maxim	Maxim	1560.44	1558.4	10	25.0	1533-1543	Oxidized	Clay and Silt	Near WT						1549.40
Expansion Area																	
P-1S	10/4/1989	TCT	TCT	1553.09	1550.6	5	15.0	1536-1541	Oxidized	CL	WT	3.0×10^{-6}	1547.73	1551.44	1546.07	1546.41	1550.62
P-5	10/4/1989	TCT	TCT	1553.54	1551.2	5	15.0	1536-1541	Oxidized	Cl and SM	WT	1.2×10^{-7}					1553.54
P-1D	10/5/1989	TCT	TCT	1553.17	1550.6	10	25.0	1526-1536	Oxidized	CL	Near WT	1.2×10^{-7}	1547.65	1551.34	1545.96	1546.28	1550.56
P-2D	10/5/1989	TCT	TCT	1532.63	1530.5	10	25.0	1506-1516	Oxidized	CL	Near WT	2.9×10^{-6}	1521.67	1526.77			
P-2S	10/5/1989	TCT	TCT	1532.70	1530.5	5	12.5	1518-1523	Oxidized	CL	WT	3.5×10^{-7}	1522.62	1527.42			
P-4	10/5/1989	TCT	TCT	1538.81	1536.4	5	14.5	1522-1527	Oxidized	CL	WT	3.5×10^{-6}	1528.63	1534.68			
MW-21ox	6/14/1994	TCT/H	TCT/H	1560.23	1557.6	10	20.0	1538-1548	Oxidized	CL w/sand seams	WT	2.0×10^{-5}	1546.25	1554.01	1549.54	1548.79	1548.69
MW-21un	6/14/1994	TCT/H	TCT/H	1559.99	1557.6	5	35.0	1523-1528	Unoxidized	CL	P	7.6×10^{-7}	1545.43	1551.72	1546.45	1547.85	1548.50
MW-22ox	6/15/1994	TCT/H	TCT/H	1527.23	1524.7	10	20.0	1505-1515	Oxidized	CL w/sand seams	WT			1522.91	1518.74	1518.43	1521.54
MW-22un	6/15/1994	TCT/H	TCT/H	1526.73	1524.5	5	35.0	1490-1495	Unoxidized	CL	P			1517.05	1513.77	1515.16	1515.97
MW-23ox	6/16/1994	TCT/H	TCT/H	1540.64	1538.1	10	20.0	1518-1528	Oxidized	CL	WT	4.5×10^{-5}		1535.48	1528.43	1527.18	1531.17
MW-23-un	6/16/1994	TCT/H	TCT/H	1540.28	1538.1	5	55.0	1483-1488	Unoxidized	CL w/sand seams	P	2.4×10^{-7}		1535.28	1530.09	1528.62	1532.42
MW-24ox	6/17/1994	TCT/H	TCT/H	1549.69	1547.1	10	20.0	1527-1537	Oxidized	CL w/sand seams	WT	1.8×10^{-6} [9]	1539.34	1545.14			1541.58
MW-24un	6/17/1994	TCT/H	TCT/H	1549.48	1547.1	5	35.0	1512-1517	Unoxidized	CL	P	2.3×10^{-6}	1538.72	1538.55			1540.77
MW-25ox	6/17/1994	TCT/H	TCT/H	1563.25	1560.7	10	20.0	1541-1551	Oxidized	CL	WT		1553.44	1557.10	1552.42	1552.42	1557.54
MW-26ox	6/20/1994	TCT/H	TCT/H	1551.79	1549.3	10	20.0	1529-1539	Oxidized	CL							
MW-27ox	6/20/1994	TCT/H	TCT/H	1547.75	1545.2	10	20.0	1525-1535	Oxidized	CL w/sand seams	WT		1536.50	1541.52			
MW-29un	6/21/1994	TCT/H	TCT/H	1534.88	1532.4	10	55.0	1477-1487	Unoxidized	CL	P		1515.85	1517.08	1516.11	1515.43	1516.00
MW-39ox	6/27/1994	TCT/H	TCT/H	1527.41	1524.7	10	15.0	1510-1520	Oxidized	CL w/sand seams	WT		1521.41	1524.37	1520.98	1521.79	1521.87
MW-49P	5/27/2003	Maxim	Maxim	1539.09*		15	35.0	1517-1502	Unoxidized	CL w/sand seams	WT	Pending					1517.38
MW-49un	5/27/2003	Maxim	Maxim	1539.09*		10	60.0	1487-1477	Unoxidized	CL w/sand seams	P	Pending					1489.47
MW-50P	5/28/2003	Maxim	Maxim	1532.02*		15	25.0	1520-1505	Oxidized	SP, CL w/sand lenses	WT	Pending					1521.13
MW-50un	5/28/2003	Maxim	Maxim	1531.90*		10	55.0	1487-1477	Unoxidized	CL w/sand lenses	P	Pending					1511.86
MW-51P	5/29/2003	Maxim	Maxim	1552.74	1550.2	15	30.0	1520-1535	Unoxidized	CL w/cobbles	WT	Pending					1526.03
MW-51un	5/29/2003	Maxim	Maxim	1552.88	1550.5	10	75.0	1485-1475	Unoxidized	CL w/cobbles	P	Pending					1481.12

Notes:

(1) Drilling contractors:
- TCT Twin City Testing, Souix Falls, South Dakota
- TCT/H Twin City Testing/Huntingdon, Souix Falls, South Dakota
- ATS American Technical Services, Souix Falls, South Dakota
- Maxim Maxim Technologies, Souix Falls, South Dakota
- SDGS South Dakota Geological Survey, Vermillion, South Dakota

(2) Soil boring log preparers:
- TCT Twin City Testing, Souix Falls, South Dakota
- TCT/H Twin City Testing/Huntingdon, Souix Falls, South Dakota
- LBG Leggette, Brashears & Graham, Inc., Souix Falls, South Dakota
- Maxim Maxim Technologies, Souix Falls, South Dakota
- SDGS South Dakota Geological Survey, Vermillion, South Dakota

(3) Depth to bottom of well screen from ground surface; depth to bottom of borehole may be different.

(4) Elevation rounded to the nearest foot.

(5) Based on color description on the soil boring log.

(6) ASTM D2488 Soil Classification:
- CL
- SM Sandy lean clay or lean clay

(7) Ground water conditio Silty sand
- WT
- Near WT Water level falls within the screened interval or within 5 feet above the top of screen.
- P Water level is within 10 feet above the top of screen.

(8) Based on in-situ rate-o Piezometeric conditions; water levels are greater than 10 feet above the top of screen.

(9) Based on in-situ rate-of-recovery rising head test.

(10) Elevations shot at top of steel protective casing; remaining elevations are assumed at top of inner casing.

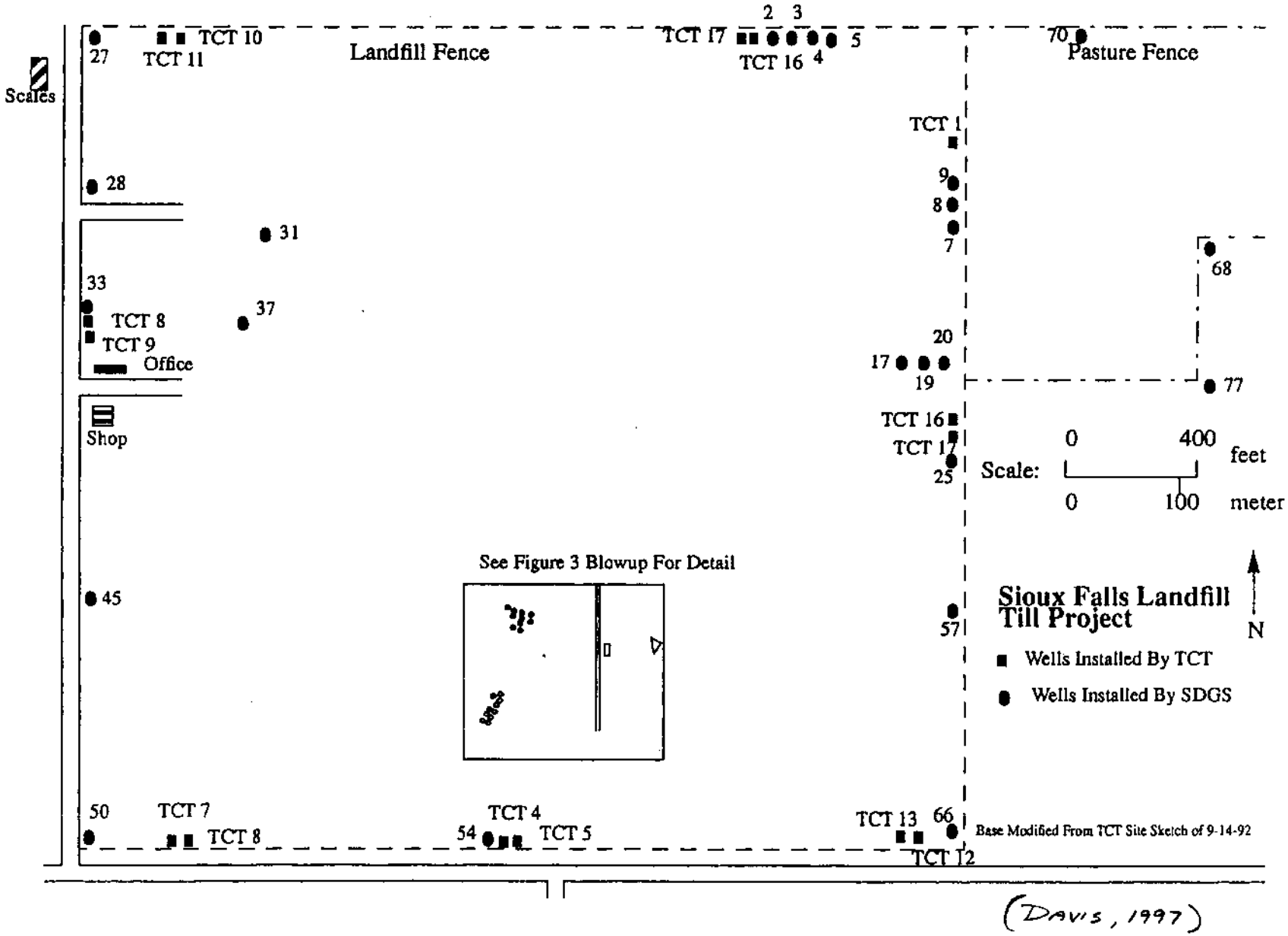


Figure 2 - Sioux Falls Landfill Till Project, Sioux Falls, South Dakota - Site Map

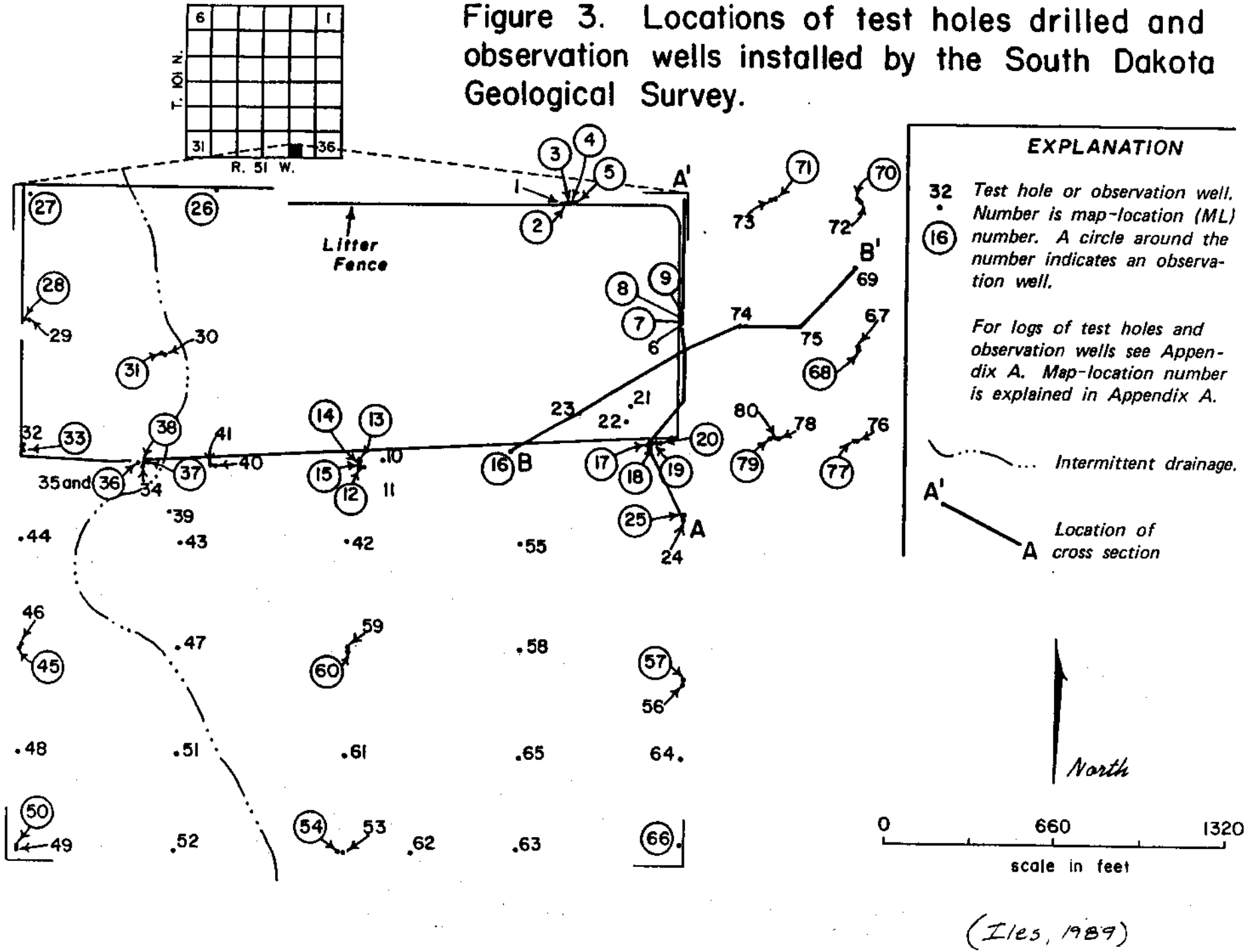
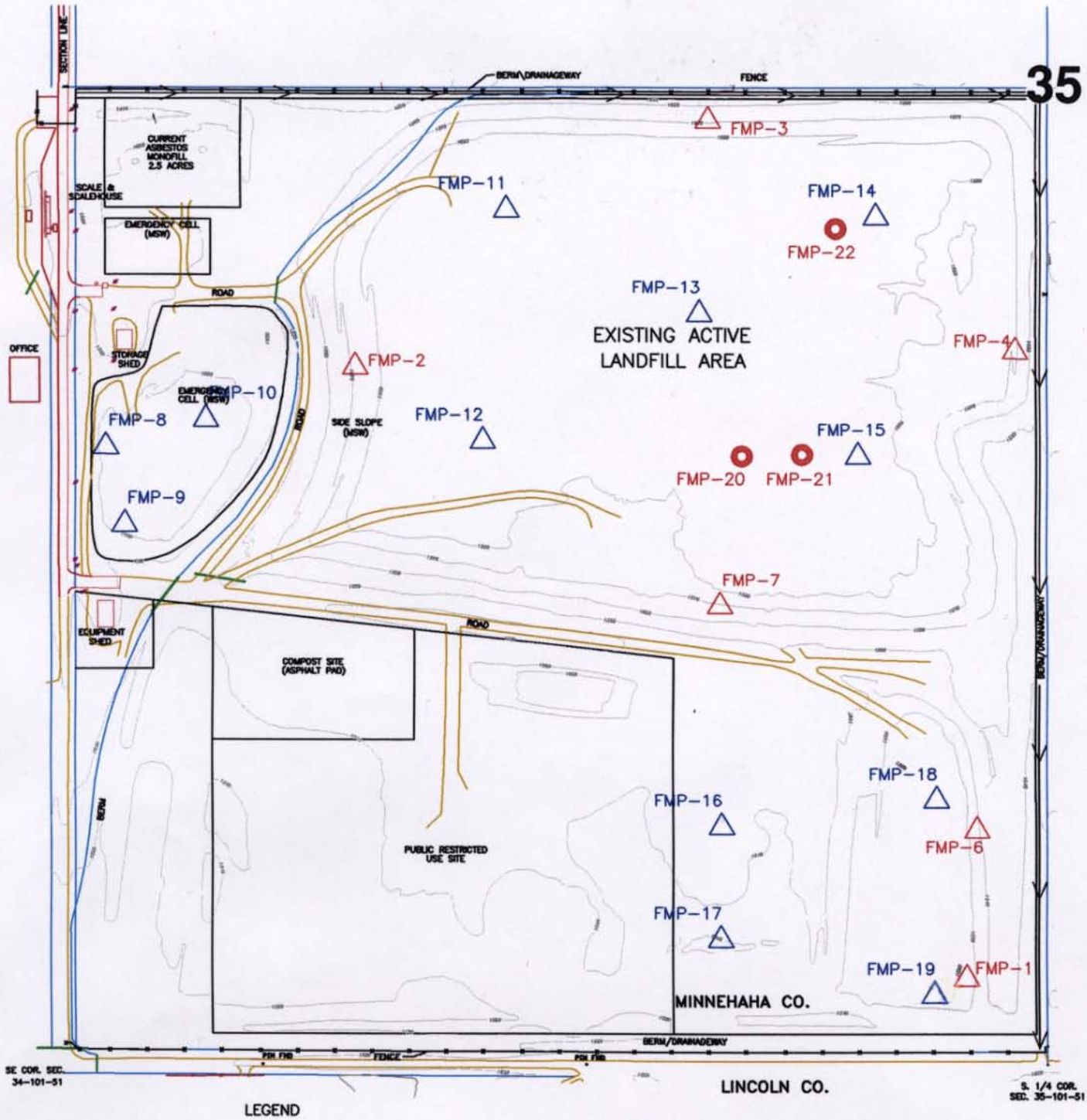


Figure 3. Locations of test holes drilled and observation wells installed by the South Dakota Geological Survey.

(Iles, 1989)



DATE	REVISED
3/16/98	BJP

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
1113 East 14th Street
Sioux Falls, South Dakota 57104
(605) 334-6000

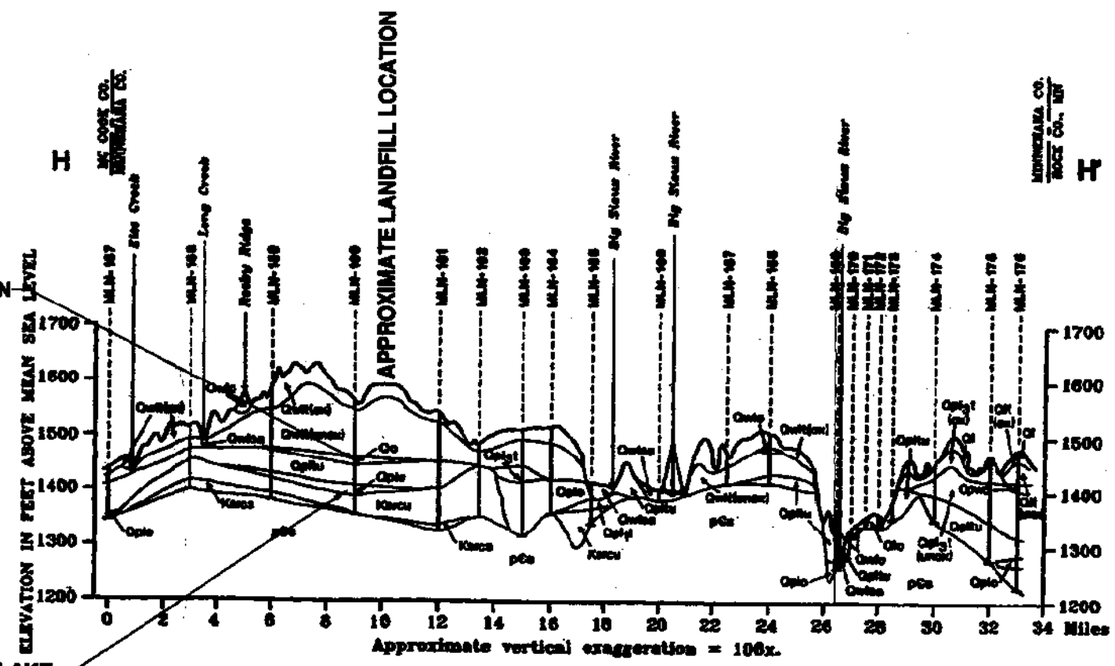
CITY OF SIOUX FALLS
REGIONAL SANITARY LANDFILL
SIOUX FALLS, SOUTH DAKOTA

Conceptual Location of Vertical Leachate Extraction Wells

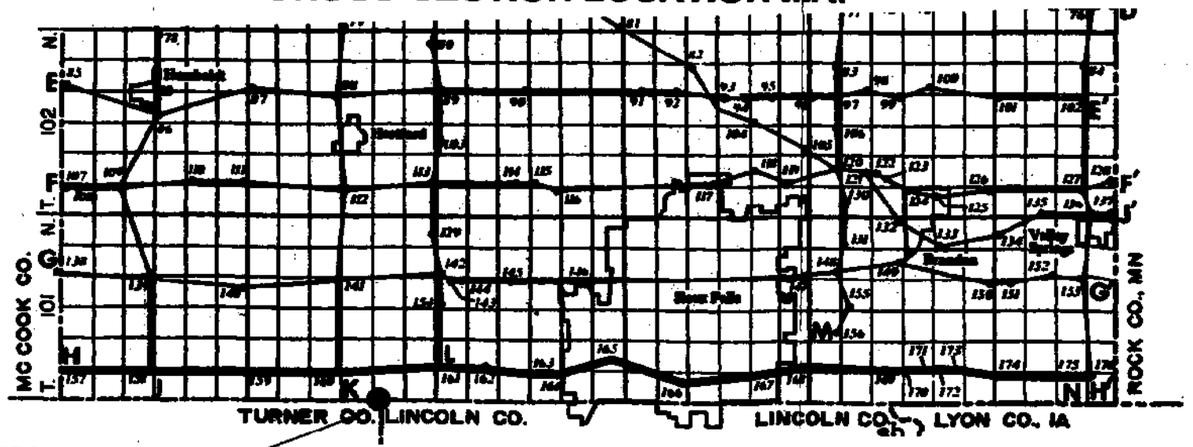
FILE:	leachate.dwg	DATE:	May 2001	FIGURE:	1

Geologic cross section H-H'.

West ← → East



CROSS-SECTION LOCATION MAP



QUATERNARY

- Ql ..... Holocene through pre-Illinoian 3 loess, undifferentiated
- Qwll ..... late Wisconsin lacustrine sediments
- Qwloa ..... late Wisconsin outwash and/or Holocene alluvium, undifferentiated
- Qwlo ..... late Wisconsin outwash
- Qwlt(ox) ..... late Wisconsin till (oxidized)
- Qwlt(unox) ..... late Wisconsin till (unoxidized)
- Qo ..... late Wisconsin and/or pre-Illinoian outwash, undifferentiated
- Qit(ox) ..... Illinoian(?) till (oxidized)
- Qit(unox) ..... Illinoian(?) till (unoxidized)
- Qio ..... Illinoian(?) outwash
- Qpwo ..... pre-Wisconsin outwash, undifferentiated
- Qpitu ..... pre-Illinoian till, undifferentiated
- Qpill ..... pre-Illinoian lacustrine sediments, undifferentiated
- Qpio ..... pre-Illinoian outwash, undifferentiated
- Qpi_3l ..... pre-Illinoian 3 loess
- $Qpi_3t(ox)$ ..... pre-Illinoian 3 till (oxidized)
- $Qpi_3t(unox)$ ..... pre-Illinoian 3 till (unoxidized)
- Qpi_3o ..... pre-Illinoian 3 outwash
- Qpi_2l ..... pre-Illinoian 2 loess
- $Qpi_2t(ox)$ ..... pre-Illinoian 2 till (oxidized)
- $Qpi_2t(unox)$ ..... pre-Illinoian 2 till (unoxidized)
- Qpi_2o ..... pre-Illinoian 2 outwash
- Qpi_1l ..... pre-Illinoian 1 loess
- Qpi_1t ..... pre-Illinoian 1 till
- Qpi_1o ..... pre-Illinoian 1 outwash

c-

- Q-Kus ..... undifferentiated silts

PRECAMBRIAN CRETACEOUS

- Ksrcu ..... Split Rock Creek Formation, undifferentiated
- Ksrcc ..... Split Rock Creek Formation, clay and shale
- Ksrco ..... Split Rock Creek Formation, opaline spiculite, etc.
- Ksrcs ..... Split Rock Creek Formation, sand

- pCc ..... Corson Diabase
- pCs ..... Sioux Quartzite

Test hole. Number is map location number (MLN). See appendix for explanation. See figure 3 for test-hole location.

Lithologic contact. Dashed where approximate.

ADAPTED FROM TOMHAVE (1994)

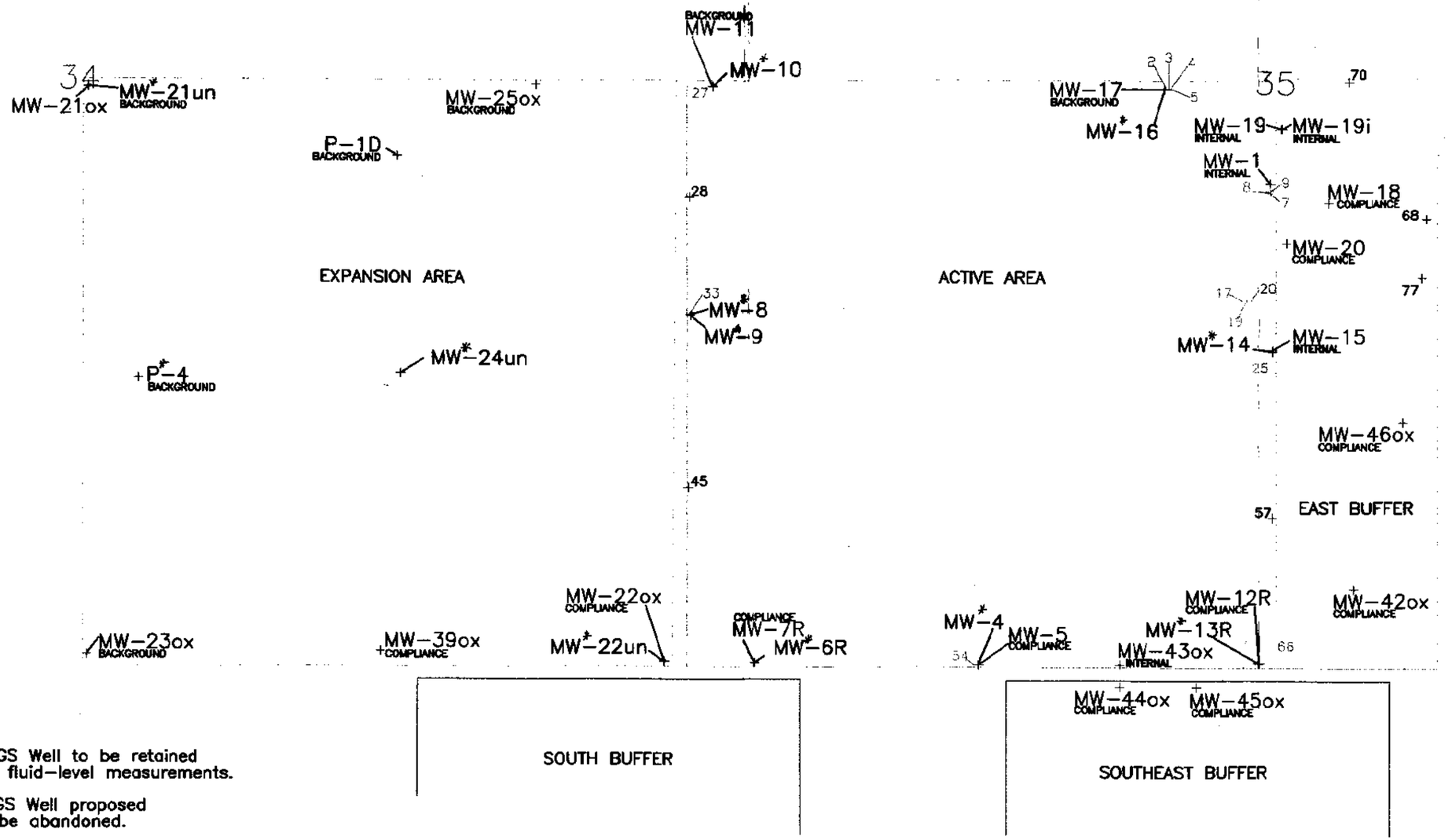
EARTH TECH

APPENDIX A
REGIONAL GEOLOGIC CROSS-SECTION

SOLID WASTE MASTER PLAN
SIOUX FALLS, SOUTH DAKOTA

AUGUST 2003

63063



77+ SDGS Well to be retained for fluid-level measurements.

54 SDGS Well proposed to be abandoned.

MW-4+ Monitor well to be removed from sampling program but retained for possible future use.

MW-5+ Monitor well to be utilized for sampling and fluid-level measurements.

BACKGROUND
COMPLIANCE
INTERNAL
Regulatory status of well.

DATE	REVISED

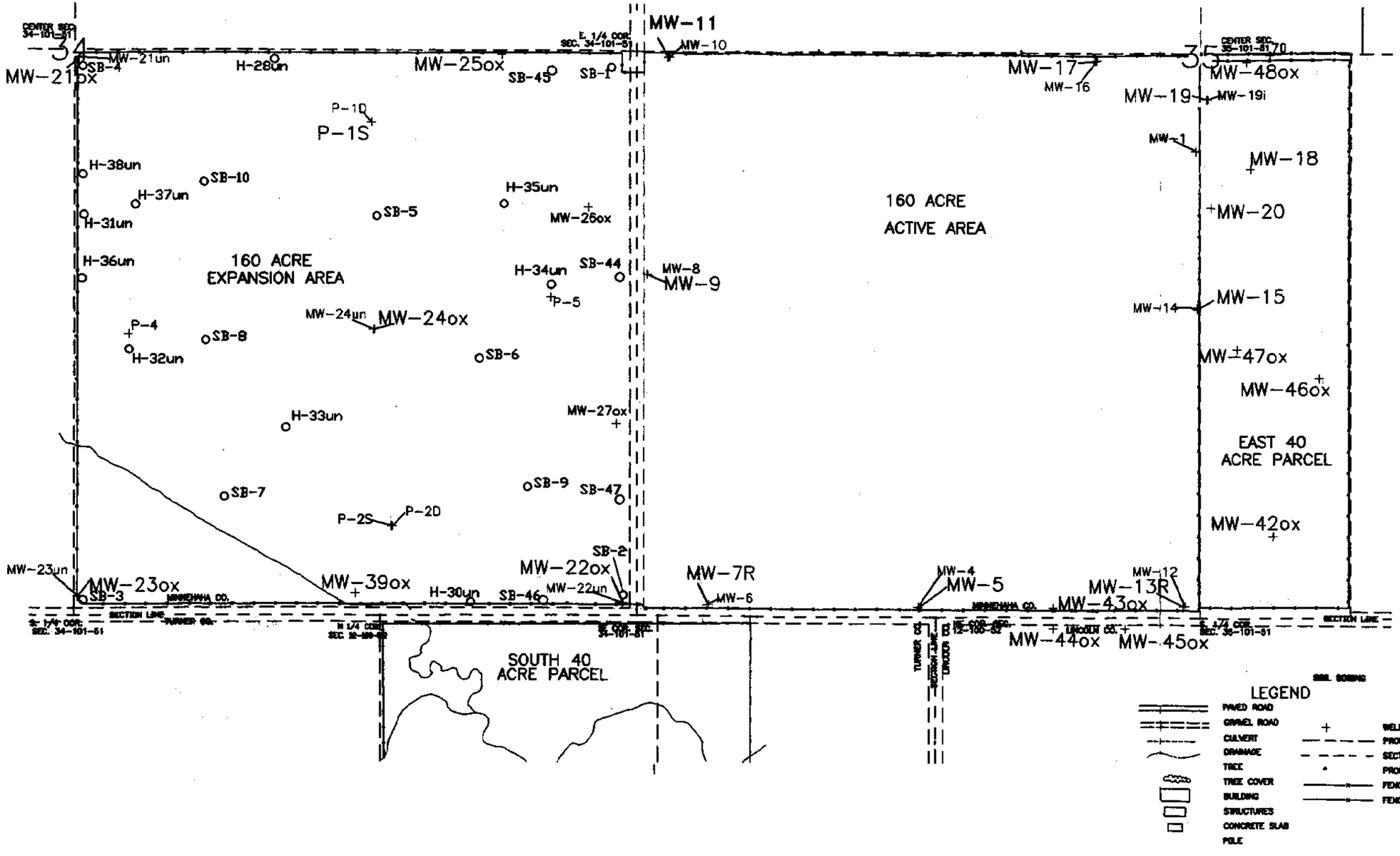
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water and Environmental Services
1113 East 14th Street
Sioux Falls, South Dakota 57104
(605) 334-6000

CITY OF SIOUX FALLS
HEALTH DEPARTMENT
REGIONAL SANITARY LANDFILL

Monitor Well Locations
Revised Ground-Water Monitoring Plan

FILE: mon modifications.dwg | DATE: April 2002 | FIGURE: 1

(LBG, 2002 b)



DATE	REVISED

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Ground-Water
and Environmental Services
1115 East 14th Street
Sioux Falls, South Dakota 57104
(605) 334-6000

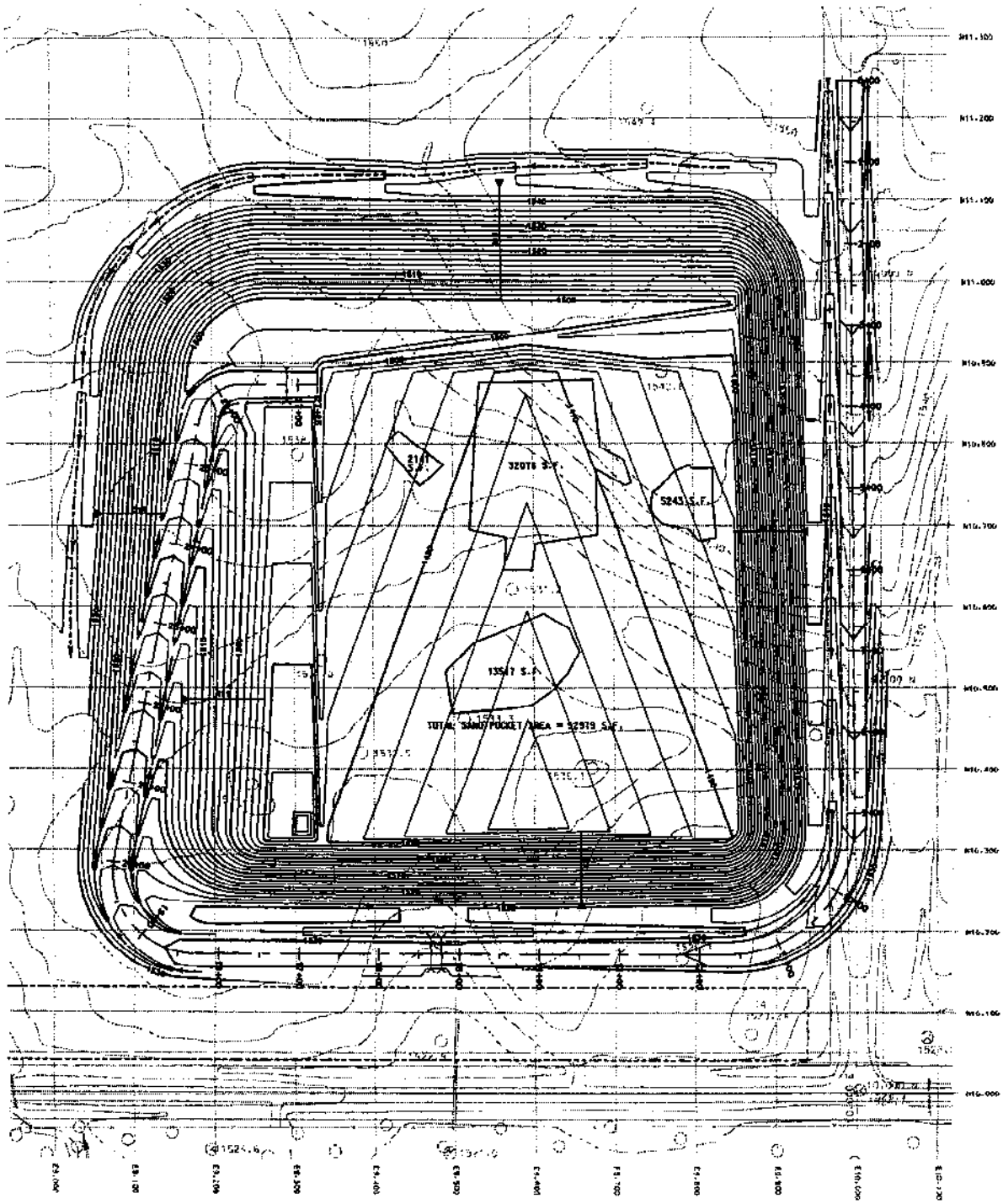
SIOUX FALLS REGIONAL SANITARY LANDFILL

Department of Public Works
Sioux Falls, South Dakota

SOIL BORING AND MONITORING WELL LOCATIONS

FILE:	DATE:	FIGURE:
slsf-new.dwg	October 2002	

(LBG, 2002b)



HDR

HDR Engineering, Inc.

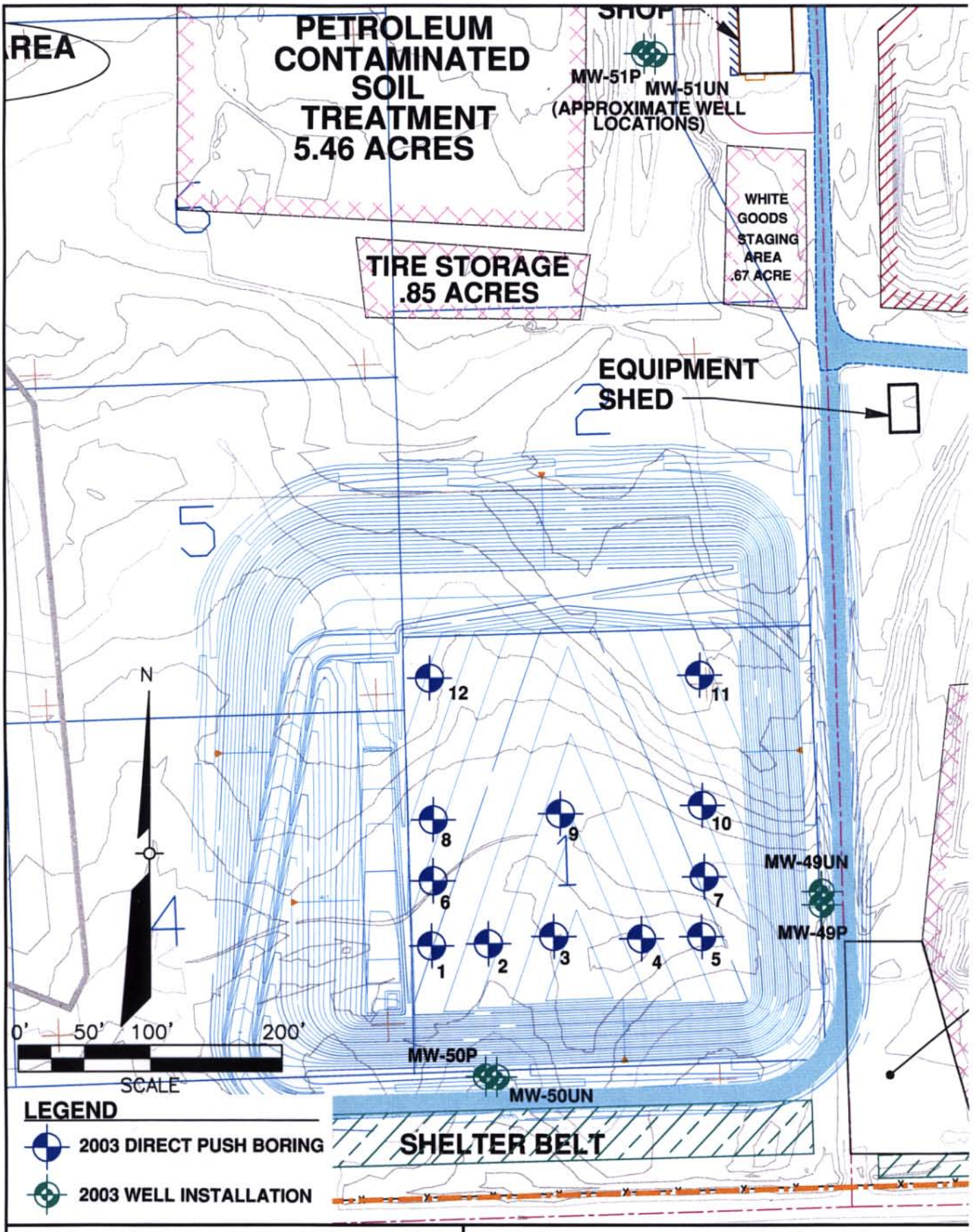
GRANULAR MATERIAL REMOVAL AREAS

SIOUX FALLS SANITARY LANDFILL

Date
JULY 2002

Sheet
A

FROM: LANDFILL EXPANSION CELL I CONSTRUCTION, HDR, JANUARY 200



EARTH TECH

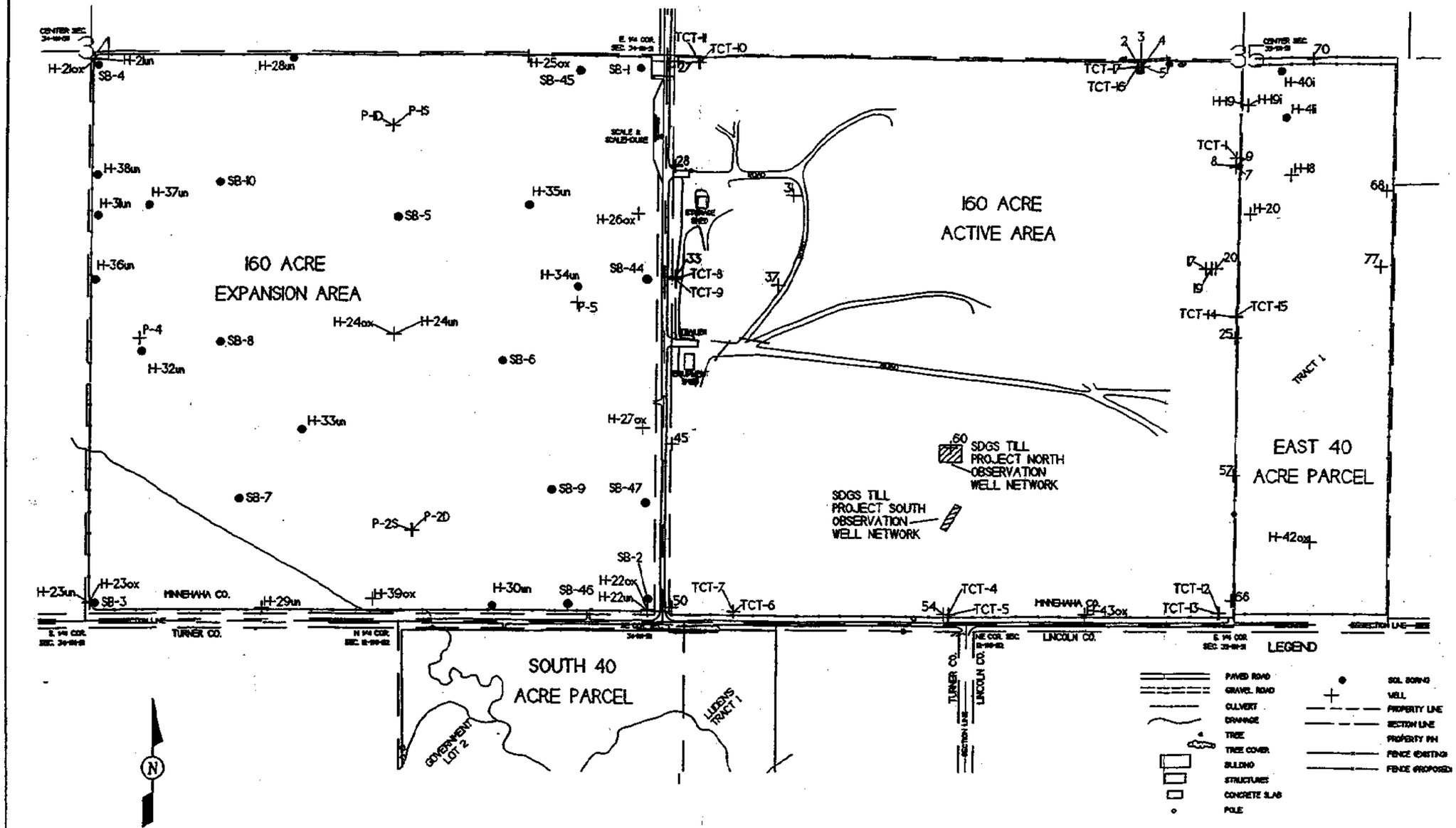
APPENDIX A

2003 WELL INSTALLATIONS

SOLID WASTE MASTER PLAN
SIOUX FALLS, SOUTH DAKOTA

AUGUST 2003

63063



DATE	REVISED

LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater Consultants
1400 West Russell Street
Sioux Falls, SD 57104
(605) 334-6000

SIOUX FALLS SANITARY LANDFILL

SITE PLAN MAP

FILE: SFSL | DATE: 11/19/95 | FIGURE: 3

(LGG, 1996a)

APPENDIX B

ENGINEERING DOCUMENTATION

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 63063

CLIENT Sioux Falls, South Dakota
PROJECT Master Plan

SUBJECT Capacity of Existing City Sewers to Accept Landfill Leachate Flow

Prepared By TKW Date 08/14/2003
Reviewed By DFP Date 8/20/03
Approved By JES Date 8/27/03

OBJECTIVE

Determine whether existing sewers downstream of the forcemain discharge point have sufficient capacity to accept leachate flow.

ASSUMPTIONS

1. We expect to pump 80 to 100 gpm.

2. Pipe capacities and reserve capacities downstream of the landfill leachate discharge point are shown on the attached table provided by the City of Sioux Falls Engineering Department.

CALCULATIONS

If 100 gpm, then:

$$\frac{100 \text{ gallons}}{\text{minute}} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \times \frac{1 \text{ cf}}{7.48 \text{ gallons}} = 0.223 \text{ cfs}$$

Reserve capacity in all pipes in the sanitary sewer basin (except for the 10-inch pipe at Rolling Hills, which is scheduled to be replaced) is more than .223 cfs.

CONCLUSIONS

∴A 100 gpm pump (or less) would not overload the existing sewer system.

SUMMARY OF FLOWS
BASIN 7R
CITY OF SIOUX FALLS

LAND AREA	Peak Flow cfs	Pipe Size inches	Pipe Capacity cfs	Reserve Capacity cfs	Factor of Safety %
1. Area	4.87	21	7.99	3.12	164%
2. Area (RH & Cry Sprgs)	4.59	18	8.22	3.63	179%
3. Area (Rolling Hills)	4.56	10	1.67	-2.89	37%
4. Pana Tracts	4.29	18	7.15	2.86	167%
5. Sunset Ridge*	4.02	16	8.42	4.40	210%
6. S. of Sunset Ridge	3.61	16	8.42	4.81	233%
7. Sertoma Hills*	3.19	16	8.42	5.23	264%
8. Misty Glen*	2.74	15	3.61	0.87	132%
9. Sundown Estates*	2.40	15	3.61	1.21	150%
10. Candlelight Acres*	2.27	15	3.61	1.34	159%
11. Undeveloped	1.96	12	2.42	0.46	124%
13. Galway Park*	1.29	12	1.80	0.51	139%
14. Jim Jackson	0.77	10	1.25	0.48	163%
15. SW1/4 Sec 34	0.74	10	1.25	0.51	168%

Reserve Capacity = Pipe Capacity - Peak Flow
Factor of Safety = Pipe Capacity/Peak Flow

EXHIBIT B

EARTH TECH
A TYCO INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

Job ID 63063
Cost Code .03

CLIENT City of Sioux Falls SUBJECT Gas Generation Rate Prepared By DB Date 8/06/03
PROJECT Sioux Falls Landfill Calculation Reviewed By TLW Date 8/14/03
Approved By DFP Date 8/20/03

MSW ACTIVE AREA AND EXPANSION AREA

PURPOSE: To estimate the maximum recoverable volume of landfill gas generated by the Active Landfill in the year after closure 2037 and current year 2003. The areas include the MSW Active Area and 160 Ac. Expansion Area.

METHODS AND ASSUMPTIONS:

- A landfill gas production model developed by Earth Tech, was used to determine the maximum gas generation rate. The model is utilizes waste intake rates in tons per year.
- The site started receiving waste in 1979 and will closed in 2036.
- The waste intake rates are based on scale data from historical data for years through 1999 and projected waste intake rates through year 2036.
- The gas generation rate of the waste = 0.100 cf / lb waste - year. This measurement is based on an average of gas generation rates for several western landfills with similar climate factors.

CALCULATION:

The parameters described under methods and assumptions will be used to calculate gas generation of the landfill.

The Landfill Gas Production Data Sheet (Attachment 1) requires as input the annual refuse intake rate (ton/year), gas generation rate, LFG theoretical production, recoverable gas percentage and methane concentration. Given these inputs the spreadsheet calculates the gas production rate on an annual basis.

When analyzing the landfill, we will consider the gas generation rate in the current year of 2037, since this is the year after the landfill has closed and will yield the maximum gas generation rate for the facility. Furthermore to be conservative, the recoverable gas produced will be used to size any future landfill equipment.

CONCLUSION:

An estimated maximum recoverable volume of **2,850 cfm** of landfill gas will be produced in 2037, based on the Landfill Gas Production Data sheet (See Attachment 1). While current landfill gas recoverable volume for year 2003 is **831 cfm**. This gas flow estimate pertains to the MSW Active Area plus the 160 Ac. Expansion Area.

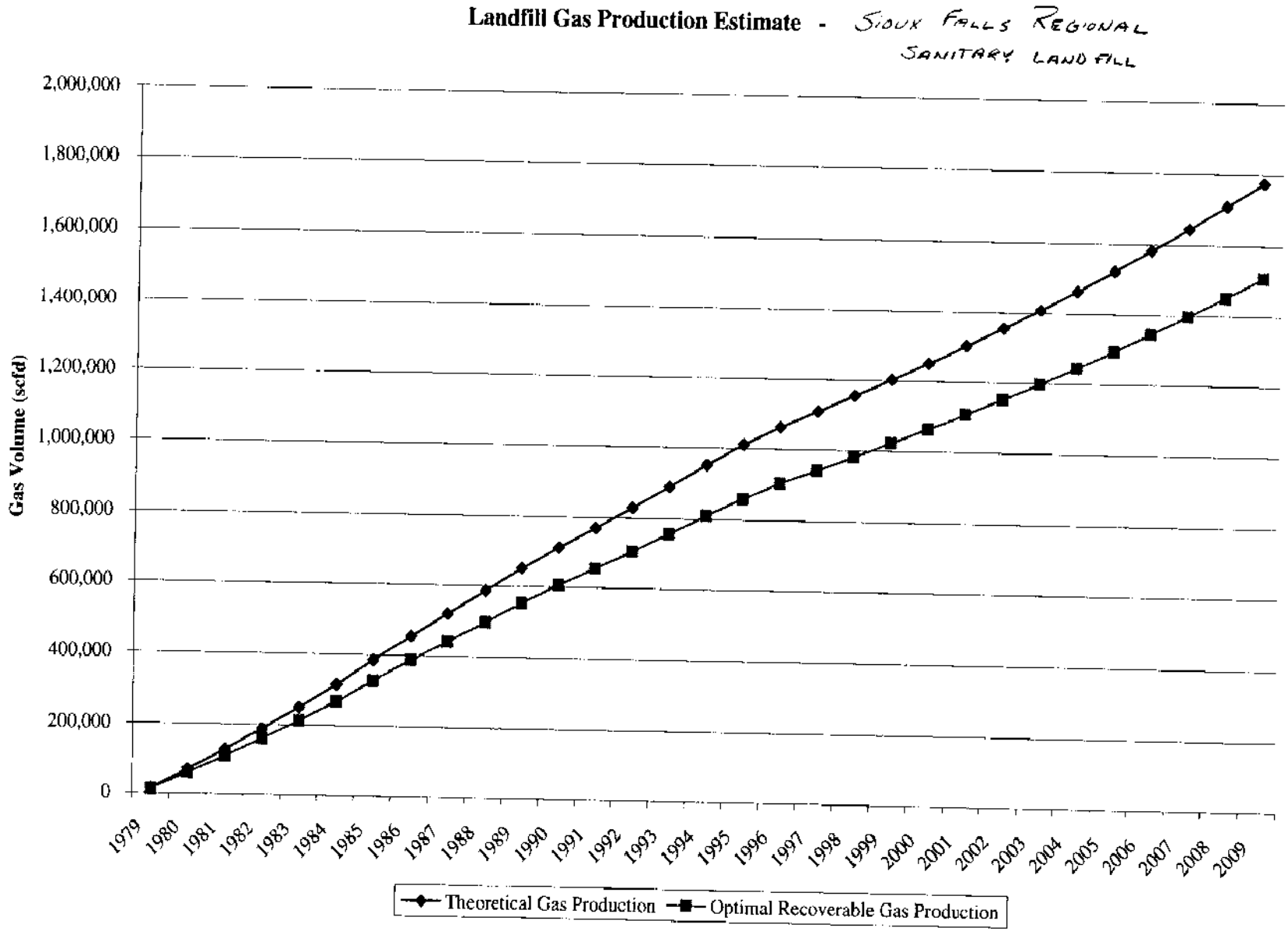
Devloped by: EARTH TECH Version: 1.01

LANDFILL GAS GENERATION MODEL

SITE: Sioux Falls Landfill

Options

- [ ] Standard Gas Volume Curve
- [ ] NMOC Emissions Curve
- [ ] NMOC / VOC Emissions Curve
- [ ] Engine Usage Curve
- [ ] Turbine Usage Curve
- [ ] MSDS Inventory Curve


Landfill Gas Production Estimate - Sioux Falls Regional Sanitary Land Fill
Gas Volume (scfd)
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1979
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1981
1982
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1984
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2003
2004
2005
2006
2007
2008
2009
Theoretical Gas Production
Optimal Recoverable Gas Production

LANDFILL GAS PRODUCTION DATASHEET

SITE: Sioux Falls Landfill

LFG Generation Rate:	0.1 CU FT/LB-YR	
LFG Theoretical Production:	4.5 CU FT/LB	
Optimal Recoverable LFG:	85 %	
Methane Concentration:	54 %	
Total Disposal Tonnage:	13,300,001 Tons of refuse	@68°F and 14.7 psia

YEAR	ANNUAL REFUSE (tons)	LFG PRODUCED (THEORETICAL) (scfd)	LFG RECOVERABLE (OPTIMAL) (scfd)	LFG PRODUCED (THEORETICAL) Excluding Delay Factor) (scfy)	Available Decomposable Waste (lbs)
1979	101,027	13,839	11,763	2.02E+07	1.98E+08
1980	106,671	69,662	59,213	4.11E+07	4.02E+08
1981	113,774	127,537	108,406	6.29E+07	6.15E+08
1982	120,194	187,924	159,736	8.56E+07	8.37E+08
1983	126,778	250,510	212,933	1.09E+08	1.07E+09
1984	136,889	315,795	268,426	1.34E+08	1.31E+09
1985	148,390	385,361	327,557	1.61E+08	1.57E+09
1986	131,850	455,841	387,465	1.83E+08	1.79E+09
1987	141,940	519,340	441,439	2.08E+08	2.03E+09
1988	142,390	585,636	497,791	2.32E+08	2.27E+09
1989	141,180	650,478	552,906	2.55E+08	2.49E+09
1990	132,019	712,127	605,308	2.75E+08	2.69E+09
1991	140,000	769,735	654,274	2.97E+08	2.91E+09
1992	140,000	829,342	704,940	3.19E+08	3.12E+09
1993	154,470	889,606	756,165	3.43E+08	3.35E+09
1994	146,259	953,354	810,351	3.64E+08	3.56E+09
1995	139,297	1,011,356	859,653	3.84E+08	3.75E+09
1996	125,504	1,063,319	903,821	4.01E+08	3.92E+09
1997	128,266	1,108,838	942,512	4.17E+08	4.08E+09
1998	132,686	1,155,085	981,822	4.35E+08	4.25E+09
1999	137,717	1,202,810	1,022,389	4.52E+08	4.42E+09
2000	142,100	1,252,143	1,064,322	4.71E+08	4.60E+09
2001	146,500	1,302,783	1,107,366	4.90E+08	4.79E+09
2002	151,100	1,354,737	1,151,526	5.09E+08	4.98E+09
2003	158,000	1,408,371	1,197,115	5.29E+08	5.18E+09
2004	164,000	1,464,471	1,244,801	5.50E+08	5.38E+09
2005	170,000	1,522,612	1,294,221	5.72E+08	5.59E+09
2006	176,000	1,582,749	1,345,337	5.95E+08	5.81E+09
2007	182,000	1,644,837	1,398,112	6.18E+08	6.04E+09
2008	188,000	1,708,833	1,452,508	6.42E+08	6.27E+09
2009	195,000	1,774,832	1,508,607	6.66E+08	6.52E+09
2010	202,000	1,843,199	1,566,719	6.92E+08	6.77E+09
2011	209,000	1,913,883	1,626,801	7.18E+08	7.02E+09
2012	216,000	1,986,832	1,688,807	7.46E+08	7.29E+09
2013	224,000	2,062,132	1,752,812	7.74E+08	7.57E+09
2014	232,000	2,140,143	1,819,121	8.03E+08	7.85E+09
2015	240,000	2,220,803	1,887,683	8.33E+08	8.15E+09
2016	248,000	2,304,055	1,958,446	8.64E+08	8.45E+09
2017	257,000	2,389,977	2,031,480	8.96E+08	8.77E+09
2018	266,000	2,478,921	2,107,083	9.30E+08	9.09E+09
2019	275,000	2,570,820	2,185,197	9.64E+08	9.43E+09
2020	285,000	2,665,745	2,265,884	1.00E+09	9.77E+09
2021	295,000	2,764,041	2,349,435	1.04E+09	1.01E+10
2022	305,000	2,865,632	2,435,787	1.07E+09	1.05E+10
2023	316,000	2,970,581	2,524,994	1.11E+09	1.09E+10
2024	327,000	3,079,226	2,617,342	1.15E+09	1.13E+10
2025	338,000	3,191,483	2,712,761	1.20E+09	1.17E+10
2026	350,000	3,307,411	2,811,299	1.24E+09	1.21E+10
2027	362,000	3,427,337	2,913,237	1.28E+09	1.26E+10
2028	375,000	3,551,311	3,018,615	1.33E+09	1.30E+10
2029	388,000	3,679,654	3,127,706	1.38E+09	1.35E+10
2030	402,000	3,812,404	3,240,543	1.43E+09	1.40E+10
2031	416,000	3,949,876	3,357,394	1.48E+09	1.45E+10
2032	431,000	4,092,101	3,478,286	1.53E+09	1.50E+10
2033	446,000	4,239,384	3,603,477	1.59E+09	1.55E+10
2034	462,000	4,391,751	3,732,988	1.65E+09	1.61E+10
2035	478,000	4,549,499	3,867,074	1.70E+09	1.67E+10
2036	495,000	4,712,646	4,005,749	1.77E+09	1.73E+10

LANDFILL GAS PRODUCTION DATASHEET

SITE: Sioux Falls Landfill

LFG Generation Rate:	0.1 CU FT/LB-YR	
LFG Theoretical Production:	4.5 CU FT/LB	
Optimal Recoverable LFG:	85 %	
Methane Concentration:	54 %	
Total Disposal Tonnage:	13,300,001 Tons of refuse	@68°F and 14.7 psia

YEAR	ANNUAL REFUSE (tons)	LFG PRODUCED (THEORETICAL) (scfd)	LFG RECOVERABLE (OPTIMAL) (scfd)	LFG PRODUCED (THEORETICAL) Excluding Delay Factor) (scfy)	Available Decomposable Waste (lbs)
2037	0	4,811,345	4,089,643	1.73E+09	1.69E+10
2038	0	4,704,426	3,998,762	1.69E+09	1.65E+10
2039	0	4,599,883	3,909,901	1.65E+09	1.61E+10
2040	0	4,497,664	3,823,014	1.61E+09	1.58E+10
2041	0	4,397,716	3,738,058	1.58E+09	1.54E+10
2042	0	4,299,989	3,654,990	1.54E+09	1.51E+10
2043	0	4,204,433	3,573,768	1.51E+09	1.48E+10
2044	0	4,111,001	3,494,351	1.48E+09	1.44E+10
2045	0	4,019,646	3,416,699	1.44E+09	1.41E+10
2046	0	3,930,320	3,340,772	1.41E+09	1.38E+10
2047	0	3,842,980	3,266,533	1.38E+09	1.35E+10
2048	0	3,757,580	3,193,943	1.35E+09	1.32E+10
2049	0	3,674,079	3,122,967	1.32E+09	1.29E+10
2050	0	3,592,432	3,053,568	1.29E+09	1.26E+10
2051	0	3,512,601	2,985,710	1.26E+09	1.23E+10
2052	0	3,434,543	2,919,361	1.23E+09	1.21E+10
2053	0	3,358,220	2,854,487	1.21E+09	1.18E+10
2054	0	3,283,593	2,791,054	1.18E+09	1.15E+10
2055	0	3,210,624	2,729,030	1.15E+09	1.13E+10
2056	0	3,139,277	2,668,385	1.13E+09	1.10E+10
2057	0	3,069,515	2,609,088	1.10E+09	1.08E+10
2058	0	3,001,303	2,551,108	1.08E+09	1.05E+10
2059	0	2,934,608	2,494,417	1.05E+09	1.03E+10
2060	0	2,869,394	2,438,985	1.03E+09	1.01E+10
2061	0	2,805,630	2,384,785	1.01E+09	9.85E+09
2062	0	2,743,283	2,331,790	9.85E+08	9.63E+09
2063	0	2,682,321	2,279,973	9.63E+08	9.41E+09
2064	0	2,622,714	2,229,307	9.41E+08	9.20E+09
2065	0	2,564,431	2,179,766	9.20E+08	9.00E+09
2066	0	2,507,444	2,131,327	9.00E+08	8.80E+09

Year	Tonnage
1979	101,027
1980	106,671
1981	113,774
1982	120,194
1983	126,778
1984	136,889
1985	148,390
1986	131,850
1987	141,940
1988	142,390
1989	141,180
1990	132,019
1991	140,000
1992	140,000
1993	154,470
1994	146,259
1995	139,297
1996	125,504
1997	128,266
1998	132,686
1999	137,717
2000	142,100
2001	146,500
2002	151,100
2003	158,000
2004	164,000
2005	170,000
2006	176,000
2007	182,000
2008	188,000
2009	195,000
2010	202,000
2011	209,000
2012	216,000
2013	224,000
2014	232,000
2015	240,000
2016	248,000
2017	257,000
2018	266,000
2019	275,000
2020	285,000
2021	295,000
2022	305,000
2023	316,000
2024	327,000
2025	338,000
2026	350,000
2027	362,000
2028	375,000
2029	388,000

2030	402,000
2031	416,000
2032	431,000
2033	446,000
2034	462,000
2035	478,000
2036	495,000
2037	
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2081	

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CALCULATION SHEET

Job ID 63063
Cost Code .03

CLIENT City of Sioux Falls **SUBJECT** Gas Generation Rate **Prepared By** DB **Date** 8/06/03
PROJECT Sioux Falls Landfill Calculation for C&D Areas **Reviewed By** TKW **Date** 8/14/03
Approved By DFP **Date** 8/20/03

PURPOSE: To estimate the maximum recoverable volume of landfill gas generated by the C&D Areas of the landfill in the year after closure 2049.

METHODS AND ASSUMPTIONS:

- A landfill gas production model developed by Earth Tech, was used to determine the maximum gas generation rate. The model is utilizes waste intake rates in tons per year.
- The site started receiving C&D waste in 2001 and will closed in 2048.
- The waste intake rates are based on projected Construction/Demolition and Rubble Fill Areas waste intake rates from year 2001 through year 2048.
- A gas generation rate of the waste = 0.075 cf / lb waste – year is assumed. This measurement is based on an average of gas generation rates for C&D landfills with similar climate factors.
- A LFG Theoretical Yield of 1.0 cf/lb waste is assumed.

CALCULATION:

The parameters described under methods and assumptions will be used to calculate gas generation of the C&D landfill Areas.

The Landfill Gas Production Data Sheet (Attachment 1) requires as input the annual refuse intake rate (ton/year), gas generation rate, LFG theoretical production, recoverable gas percentage and methane concentration. Given these inputs the spreadsheet calculates the gas production rate on an annual basis.

When analyzing the landfill, we will consider the gas generation rate in the year of 2049, since this is the year after the landfill has closed and will yield the maximum gas generation rate for the facility. Furthermore to be conservative, the recoverable gas produced will be used to size any future landfill equiptement.

CONCLUSION:

An estimated maximum recoverable volume of **705 cfm** of landfill gas will be produced in 2049, based on the Landfill Gas Production Data sheet (See Attachment 1).

Devloped by: EARTH TECH

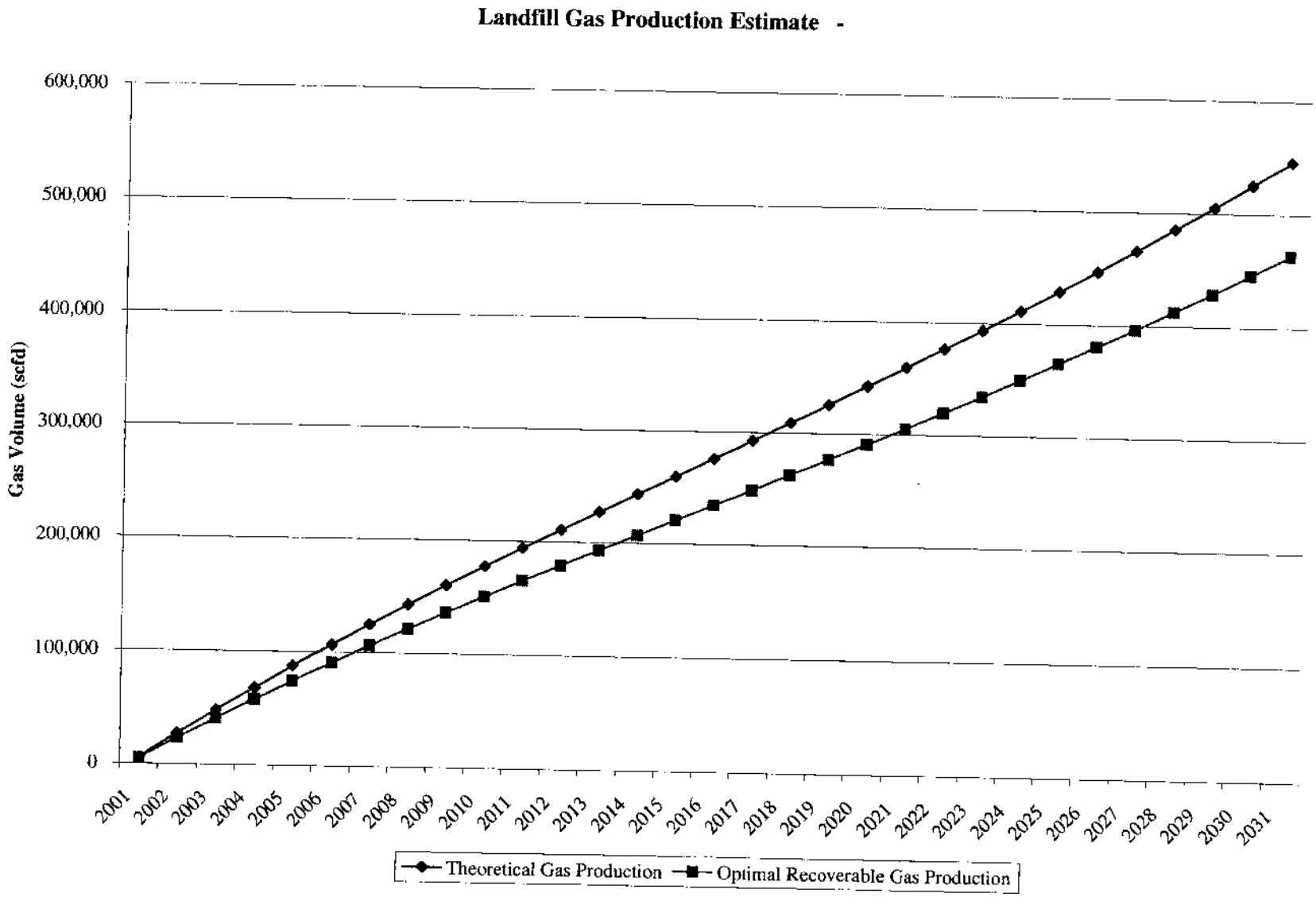
Version: 1.01

LANDFILL GAS GENERATION MODEL

SITE: Sioux Falls Landfill (C&D Areas)

Options

- [x] Standard Gas Volume Curve
- [ ] NMOC Emissions Curve
- [ ] NMOC/ VOC Emissions Curve
- [ ] Engine Usage Curve
- [ ] Turbine Usage Curve
- [ ] MSDS Inventory Curve


Landfill Gas Production Estimate -
Gas Volume (scfd)
600,000
500,000
400,000
300,000
200,000
100,000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
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2031
Theoretical Gas Production
Optimal Recoverable Gas Production

LANDFILL GAS PRODUCTION DATASHEET

SITE: Sioux Falls Landfill (C&D Areas)

LFG Generation Rate:	0.075	CU FT/LB-YR
LFG Theoretical Production:	1	CU FT/LB
Optimal Recoverable LFG:	85	%
Methane Concentration:	54	%
Total Disposal Tonnage:	6,428,148	Tons of refuse

@68°F and 14.7 psia

YEAR	ANNUAL REFUSE (tons)	LFG PRODUCED (THEORETICAL) (scfd)	LFG RECOVERABLE (OPTIMAL) (scfd)	LFG PRODUCED (THEORETICAL) Excluding Delay Factor) (scfy)	Available Decomposable Waste (lbs)
2001	53,266	5,473	4,652	7.99E+06	9.85E+07
2002	55,198	27,151	23,078	1.57E+07	1.93E+08
2003	57,200	48,004	40,804	2.31E+07	2.85E+08
2004	59,202	68,116	57,899	3.02E+07	3.73E+08
2005	61,274	87,550	74,418	3.71E+07	4.58E+08
2006	63,419	106,385	90,428	4.39E+07	5.41E+08
2007	65,638	124,697	105,992	5.04E+07	6.22E+08
2008	67,936	142,555	121,172	5.68E+07	7.01E+08
2009	70,313	160,027	136,023	6.31E+07	7.79E+08
2010	72,774	177,173	150,597	6.93E+07	8.55E+08
2011	75,321	194,054	164,946	7.54E+07	9.30E+08
2012	77,958	210,725	179,116	8.14E+07	1.00E+09
2013	80,686	227,238	193,153	8.74E+07	1.08E+09
2014	83,510	243,644	207,098	9.34E+07	1.15E+09
2015	86,433	259,990	220,992	9.94E+07	1.23E+09
2016	89,458	276,322	234,874	1.05E+08	1.30E+09
2017	92,589	292,683	248,781	1.11E+08	1.37E+09
2018	95,830	309,115	262,748	1.17E+08	1.45E+09
2019	99,184	325,659	276,810	1.23E+08	1.52E+09
2020	102,655	342,351	290,999	1.30E+08	1.60E+09
2021	106,248	359,231	305,346	1.36E+08	1.67E+09
2022	109,967	376,334	319,884	1.42E+08	1.75E+09
2023	113,816	393,697	334,642	1.49E+08	1.83E+09
2024	117,799	411,352	349,649	1.55E+08	1.91E+09
2025	121,922	429,335	364,935	1.62E+08	1.99E+09
2026	126,190	447,678	380,527	1.69E+08	2.08E+09
2027	130,606	466,415	396,453	1.75E+08	2.16E+09
2028	135,178	485,577	412,741	1.83E+08	2.25E+09
2029	139,909	505,198	429,418	1.90E+08	2.34E+09
2030	144,806	525,308	446,512	1.97E+08	2.43E+09
2031	149,874	545,940	464,049	2.05E+08	2.53E+09
2032	155,119	567,125	482,056	2.13E+08	2.63E+09
2033	160,549	588,896	500,562	2.21E+08	2.73E+09
2034	166,168	611,285	519,593	2.29E+08	2.83E+09
2035	171,984	634,325	539,176	2.38E+08	2.94E+09
2036	178,003	658,047	559,340	2.47E+08	3.04E+09
2037	184,233	682,486	580,113	2.56E+08	3.16E+09
2038	190,681	707,674	601,523	2.65E+08	3.27E+09
2039	197,355	733,646	623,599	2.75E+08	3.39E+09
2040	204,263	760,437	646,372	2.85E+08	3.52E+09
2041	211,412	788,082	669,870	2.95E+08	3.64E+09
2042	218,811	816,618	694,125	3.06E+08	3.77E+09
2043	226,470	846,081	719,169	3.17E+08	3.91E+09
2044	234,396	876,509	745,033	3.28E+08	4.05E+09
2045	242,600	907,941	771,750	3.40E+08	4.20E+09
2046	251,091	940,416	799,354	3.52E+08	4.35E+09
2047	259,879	973,976	827,880	3.65E+08	4.50E+09
2048	268,975	1,008,662	857,363	3.78E+08	4.66E+09
2049	0	1,015,916	863,528	3.50E+08	4.31E+09
2050	0	939,722	798,764	3.23E+08	3.99E+09
2051	0	869,243	738,856	2.99E+08	3.69E+09
2052	0	804,050	683,442	2.77E+08	3.41E+09
2053	0	743,746	632,184	2.56E+08	3.16E+09
2054	0	687,965	584,770	2.37E+08	2.92E+09
2055	0	636,368	540,912	2.19E+08	2.70E+09
2056	0	588,640	500,344	2.03E+08	2.50E+09
2057	0	544,492	462,818	1.87E+08	2.31E+09
2058	0	503,655	428,107	1.73E+08	2.14E+09

LANDFILL GAS PRODUCTION DATASHEET

SITE: Sioux Falls Landfill (C&D Areas)

LFG Generation Rate:	0.075 CU FT/LB-YR	@68°F and 14.7 psia
LFG Theoretical Production:	1 CU FT/LB	
Optimal Recoverable LFG:	85 %	
Methane Concentration:	54 %	
Total Disposal Tonnage:	6,428,148 Tons of refuse	

YEAR	ANNUAL REFUSE (tons)	LFG PRODUCED (THEORETICAL) (scfd)	LFG RECOVERABLE (OPTIMAL) (scfd)	LFG PRODUCED (THEORETICAL) Excluding Delay Factor) (scfy)	Available Decomposable Waste (lbs)
2059	0	465,881	395,999	1.60E+08	1.98E+09
2060	0	430,940	366,299	1.48E+08	1.83E+09
2061	0	398,619	338,826	1.37E+08	1.69E+09
2062	0	368,723	313,414	1.27E+08	1.56E+09
2063	0	341,069	289,908	1.17E+08	1.45E+09
2064	0	315,489	268,165	1.09E+08	1.34E+09
2065	0	291,827	248,053	1.00E+08	1.24E+09
2066	0	269,940	229,449	9.29E+07	1.15E+09
2067	0	249,694	212,240	8.59E+07	1.06E+09
2068	0	230,967	196,322	7.95E+07	9.80E+08
2069	0	213,645	181,598	7.35E+07	9.07E+08
2070	0	197,621	167,978	6.80E+07	8.39E+08
2071	0	182,800	155,380	6.29E+07	7.76E+08
2072	0	169,090	143,726	5.82E+07	7.18E+08
2073	0	156,408	132,947	5.38E+07	6.64E+08
2074	0	144,677	122,976	4.98E+07	6.14E+08
2075	0	133,827	113,753	4.60E+07	5.68E+08
2076	0	123,790	105,221	4.26E+07	5.25E+08
2077	0	114,505	97,330	3.94E+07	4.86E+08
2078	0	105,918	90,030	3.64E+07	4.49E+08
2079	0	97,974	83,278	3.37E+07	4.16E+08
2080	0	90,626	77,032	3.12E+07	3.85E+08
2081	0	83,829	71,254	2.88E+07	3.56E+08
2082	0	77,542	65,910	2.67E+07	3.29E+08
2083	0	71,726	60,967	2.47E+07	3.04E+08
2084	0	66,347	56,395	2.28E+07	2.82E+08
2085	0	61,371	52,165	2.11E+07	2.60E+08
2086	0	56,768	48,253	1.95E+07	2.41E+08
2087	0	52,510	44,634	1.81E+07	2.23E+08
2088	0	48,572	41,286	1.67E+07	2.06E+08

Year	Tonnage
2001	53,266
2002	55,198
2003	57,200
2004	59,202
2005	61,274
2006	63,419
2007	65,638
2008	67,936
2009	70,313
2010	72,774
2011	75,321
2012	77,958
2013	80,686
2014	83,510
2015	86,433
2016	89,458
2017	92,589
2018	95,830
2019	99,184
2020	102,655
2021	106,248
2022	109,967
2023	113,816
2024	117,799
2025	121,922
2026	126,190
2027	130,606
2028	135,178
2029	139,909
2030	144,806
2031	149,874
2032	155,119
2033	160,549
2034	166,168
2035	171,984
2036	178,003
2037	184,233
2038	190,681
2039	197,355
2040	204,263
2041	211,412
2042	218,811
2043	226,470
2044	234,396
2045	242,600
2046	251,091
2047	259,879
2048	268,975
2049	-
2050	-
2051	-

APPENDIX C

FINANCIAL DATA

CAPITAL IMPROVEMENTS PROGRAM
LANDFILL CLOSURE - ACTIVE SITE
PROJECT COSTS

Reference: Closure/Post-Closure Plan for Active Site, August 2001 by HDR
Attachment 2

1. Closure Costs - Active Site, as prepared by HDR
   a. Final Cover ..... $9,170 per acre
   b. Seeding, Fertilizing & Mulching ..... $1,140 per acre
   c. Surface Water Control Structures ..... $1,480 per acre
   d. Gas Management System ..... $0 per acre
   e. Leachate Management ..... $13,940 per acre
   f. Miscellaneous ..... $930 per acre

   Subtotal Closure Costs ..... $26,660 per acre

   g. Engineering of Closure ..... $5,300 per acre
   h. Legal and Administration ..... $1,300 per acre
   i. Contingency ..... $2,700 per acre

   TOTAL CLOSURE COSTS ..... $35,960 per acre

Note: Above information is from the 2001 HDR Report.

2. Update 2001 cost estimate to reflect current conditions
   a. Engineering News Record
      Inflation adjustment from 2001 to 2003 is 5.5%.

   b. Total Closure Cost of $35,960 per acre
      in 2001 x 1.055 = ... $38,000 per acre in 2003

   c. Capital Improvements Program identifies engineering costs separately, so adjust costs for inflation, and identify costs separately for engineering.
      Engineering of Closure = ... $5,300 per acre (Year 2001)
      x 1.055 = ... $5,600 per acre (Year 2003)

   d. Total Closure Cost - Engineering Cost (Year 2003)
      $38,000 per acre - $5,600 per acre = ... $32,400 per acre

3. Active Site
   Phase I Closed in 2002
   Phase II Close in 2004 - 31 Acres
   Phase III Close in 2005 - 16 Acres

   Closure of Phases II and III will be based on completion of waste filling to final grades.
   Final grades are expected to be reached in 2004, and will be verified by the City's survey.
   For Capital Improvements Program budgeting the following is proposed:

a. Phase II Closure in 2004
Engineering Cost = 31 Acres x $5,600 per acre..$173,600
Construction Cost = 31 Acres x $32,400 per acre $1,004,400

b. Phase III Closure in 2005
Engineering Cost = 16 Acres x $5,600 per acre..$89,600
Construction Cost = 16 Acres x $32,400 per acre $518,400

Sioux Falls Regional Landfill
Cell 2, 3 - Cost Estimate
Proj. No. 68433
13-Aug-03

CELL 2

Area of Cell Floor:	250,000 sf	Area of Sideslope:	50,000 sf
Cross Section of Excavation:	39,460 sf	Additional excavation for 2' of clay on	
Length of Excavation:	500 ft	base liner (2' x area of cell floor):	500,000 cf

Total Volume of Excavation = 20,230,000 cf = 749,259 cy

Item	Quantity	Units	Unit Price	Cost
Excavation	749,259	CY	$2.00	$1,498,519
2' Compacted Clay Liner	18,519	CY	$3.81	$70,556
60-mil Geomembrane- smooth	27,778	SY	$4.05	$112,500
60-mil Geomembrane-textured	5,556	SY	$4.32	$24,000
Geocomposite (sideslopes)	5,556	SY	$3.78	$21,000
Geogrid (sideslopes)	5,556	SY	$3.40	$18,889
GCL (sideslopes)	5,556	SY	$4.50	$25,000
4" Forcemain from Cell 2 to Leachate Loadout	750	LF	$30.00	$22,500
Sump and Leachate Extraction System	1	LS	$50,000	$50,000
Mobilization	1	LS	$10,000	$10,000
			Subtotal =	$1,852,963
			Engineering (Design/CQA) (20%)	$370,593
			Contingency (10%)	$185,296
			Total =	$2,408,852

Notes:

1. Previous city budgets were ammended to reflect current prices and include additional construction items. Additional construction items include 60 mil HDPE liner in cells 2 and 3, 2 ft. of recompacted clay on the cell base, forcemain from Cell 2 to the leachate loadout, and associated engineering and contingencies. If these features are not incorporated into the cell construction, the costs are identified and can be deleted from the project budget.
2. GCL price based on GSE products, reinforced GCL for sideslopes is $0.50/sf.
3. Geocomposite price based on GSE products, use a 6 oz. Double sided priced at $0.42/sf. (8oz. Double sided is $0.45/sf)
4. 60-mil geomembrane price based on GSE products, $0.48/sf for textured, $0.45/sf for smooth.
5. Geogrid price based on discussion with May Zin, Earth Tech, Geogrid material $2.5/sy and general geotextile or geocomposite material installation $0.10/sf. Use geogrid total = $3.40/sy.
6. Compacted clay price based on 2003 RS Means Sitework and Landscape Cost Data, compacting 6" lifts $0.80/cy (02315.300.5620), excavation from stockpile to cell $2.0/cy (provided by city) and spreading with a dozer $1.52/cy (02315.505.0010). The city location factor is 80.6. Total cost = (0.80 + 1.52) x 0.806 +2.0 =$3.81/cy
7. Excavation unit price provided by the City, $2.00/cy.
8. GSE prices as stated by Roger Krabel, GSE- (402) 463-0857, in a phone call. Prices based on a 10 acre cell, material supplied and installed.

Sioux Falls Regional Landfill
Cell 2, 3 - Cost Estimate
Proj. No. 63063.01
13-Aug-03

CELL 3

Area of Cell Floor:	297,600 sf	Area of Sideslope:	77,350 sf
Cross Section of Excavation:	25,500 sf	Additional excavation for 2' of clay on	
Length of Excavation:	1,100 ft	base liner (2' x area of cell floor):	595,200 cf

Total Volume of Excavation = 28,645,200 cf = 1,060,933 cy

Item	Quantity	Units	Unit Price	Cost
Excavation	1,060,933	CY	$2.00	$2,121,867
2' Compacted Clay Liner	22,044	CY	$3.81	$83,989
60-mil Geomembrane- Smooth	33,067	SY	$4.05	$133,920
60-mil Geomembrane- Textured	8,594	SY	$4.32	$37,128
Geocomposite (sideslopes)	8,594	SY	$3.78	$32,487
Geogrid (sideslopes)	8,594	SY	$3.40	$29,221
GCL (sideslopes)	8,594	SY	$4.50	$38,675
Access Road	1	LS	$94,000	$94,000
Mobilization	1	LS	$10,000	$10,000
			Total =	$2,581,287
			Engineering (Design/CQA) (20%)	$516,257
			Contingency (10%)	$258,129
			Total =	$3,355,673

Notes:

1. Previous city budgets were ammended to reflect current prices and include additional construction items. Additional construction items include 60 mil HDPE liner in cells 2 and 3, 2 ft. of recompacted clay on the cell base, forcemain from Cell 2 to the leachate loadout, and associated engineering and contingencies. If these features are not incorporated into the cell construction, the costs are identified and can be deleted from the project budget.
2. GCL price based on GSE products, reinforced GCL for sideslopes is $0.50/sf.
3. Geocomposite price based on GSE products, use a 6 oz. Double sided priced at $0.42/sf. (8oz. Double sided is $0.45/sf)
4. 60-mil geomembrane price based on GSE products, $0.48/sf for textured, $0.45/sf for smooth.
5. Geogrid price based on discussion with May Zin, Earth Tech, Geogrid material $2.5/sy and general geotextile
6. Compacted clay price based on 2003 RS Means Sitework and Landscape Cost Data, compacting 6" lifts $0.80/cy (02315.300.5620), excavation from stockpile to cell $2.0/cy (provided by city) and spreading with a dozer $1.52/cy (02315.505.0010). The city location factor is 80.6. Total cost = (0.80 + 1.52) x 0.806 +2.0 =$3.81/cy
7. Excavation unit price provided by the City, $2.00/cy.
8. GSE prices as stated by Roger Krabel, GSE- (402) 463-0857, in a phone call. Prices based on a 10 acre cell, material supplied and installed.

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 63063

CLIENT Sioux Falls, South Dakota
PROJECT Master Plan
SUBJECT Compare Costs for City Haul vs. Contract Hauler

Prepared By JKW Date 8/14/2003
Reviewed By DFP Date 8/20/03
Approved By JES Date 8/27/03

OBJECTIVE

Determine whether it is more economical for the City to purchase tanker trucks and use City personnel to haul leachate to the POTW or for the City to hire a local hauler to do the leachate hauling.

DESIGN CRITERIA AND ASSUMPTIONS

1. Annual leachate flow (extracted from Active and Expansion Landfills) will be 1,600,000 gallons.

2. A leachate hauling truck would cost the City $137,150.

3. Each leachate hauling truck would need to be replaced after 12 years in service.

4. Average annual maintenance on City leachate trucks would be $5,000.

5. Each load would be 5,000 gallons.

6. Gasoline costs per trip would be:

$$\frac{\text{30-mile round trip}}{\text{6 miles/gallon}} \times \frac{\$1.70}{\text{gallon}} = \frac{\$8.50}{\text{trip}}$$

7. Unit price cost for hauler, based upon the leachate hauler used for the leachate pilot study, is $128.50/1,000 gallons based upon an estimated 500,000-gallon contract total. Assuming a contract for 1,600,000 gallons per year, and a multi-year contract (but remaining conservative), assume $127/1,000 gallons. Assume the hauler included the treatment cost in this rate.

8. Cost for City personnel to do hauling (assuming an existing employee could take time to haul):

1 hour to prepare and fill truck
+ 1 hour to haul round-trip
+ 0.5 hour to empty truck
+ 0.5 hour to cleanup-up and store truck
1 hour misc. maintenance of truck and equipment

4-hour trip x $25/hr = $100/trip

9. Treatment costs for landfill leachate at the WWTP = $1.94 per 1,000 gallons. (Refer to calculation entitled, "Leachate Treatment Costs at POTW" in this appendix).

10. This calculation will assume a 12-year period, since the life of one City-owned truck is assumed to be 12 years.

11. Annual interest rate = 5% = 0.05.

12. Intangibles which affect the decision of which option to use for hauling include: maintenance of required permit(s), personnel training, liability, insurance, possibility of weekend and holiday hauling requirement, etc.

CALCULATIONS

Cost for City to haul and treat:

Capital $137,150 in Year 1

Annual costs (1,600,000 gallons ÷ 5,000 gallons/trip = 320 trips/year)

Treat at POTW	$1.94 x 1,600 gal = $3,110
Maintenance	$5,000
Gasoline	$8.50 x 320 = $2,720
Labor	$100 x 320 = $32,000

Total Annual O&M = $42,830

Total Present Worth O&M (12 years) = $42,830 x $\frac{(1+i)^n - 1}{i(1+i)^n}$

= $42,830 x $\frac{(1.05)^{12} - 1}{.05(1.05)^{12}}$

= $42,830 x $\frac{(1.7959 - 1)}{0.0898}$

= $42,830 x 8.8633

Total Present Worth O&M (12 years) = $379,615

Total Present Worth Capital and O&M = $137,150 + $379,615

Total Present Worth Capital and O&M = $516,765

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 63063

CLIENT Sioux Falls, South Dakota
PROJECT Master Plan

SUBJECT Compare Costs for City Haul vs. Contract Hauler

Prepared By [illegible] Date 8/14/2003
Reviewed By DFP Date 8/20/03
Approved By JES Date 8/27/03

Cost for City to use a hauler for 12 years:

Annual cost: $127/1,000 gallons x 1,600,000 gallons/year = $203,200
Total Present Worth = $203,200 x 8.8633
= $1,801,000

CONCLUSIONS

Using City personnel and trucks to haul leachate to the POTW has a present worth cost over 12 years (including treatment) of $516,765.

Using a commercial hauler to haul leachate to the POTW has a present worth cost of $1,801,000.

Therefore, it is nearly 3.5 times as expensive to hire a commercial hauler unless the hauler significantly reduces the rate charged for the leachate pilot project.

EARTH TECH
A TYCO INTERNATIONAL LTD. COMPANY

CALCULATION SHEET

PROJECT NO. 63063

CLIENT Sioux Falls, South Dakota
PROJECT Master Plan
SUBJECT Leachate Treatment Costs at POTW

Prepared By NW Date 08/14/2003
Reviewed By DFP Date 9/20/03
Approved By JES Date 9/27/03

OBJECTIVE

Determine average annual leachate treatment costs at the Sioux Falls WWTP for leachate from the Site.

DESIGN CRITERIA AND ASSUMPTIONS

1. Annual leachate flow (extracted from Active and Expansion Landfills) will be 1,600,000 gallons.

2. Assumed leachate quality is per the HDR Leachate Report (2001) from Table 6, "Projected Leachate Characteristics." We will use the "Average Concentrations" which are historic averages from Bluff Road Landfill in Lincoln, Nebraska, which are:

BOD	1,600 mg/l
TSS	100 mg/l
TKN	60 mg/l

3. Treatment rates (costs), as provided by the City of Sioux Falls*, are as follows:

Flow -	$0.50 per 1,000 gallons
BOD (surcharge) -	$0.09 per pound
TSS (surcharge) -	$0.09 per pound
TKN (surcharge) -	$0.33 per pound

*Lyle Johnson's memo dated June 13. 2003 (attached), and verified by telephone by Rod Harms on July 3, 2003.

4. Conservatively assume surcharge rates are applied on the total BOD, TSS, and TKN in the leachate, not just the portion that exceeds certain thresholds.

CALCULATIONS

Cost for basic service at WWTP:

$$\frac{\$0.50}{1{,}000\ \text{gal}} \times \frac{1{,}600{,}000\ \text{gal}}{\text{year}} = \$800/\text{year}$$

Cost for BOD surcharge:

$$\$0.09/\text{lb} \times 1{,}600\ \text{mg/l} \times 8.345\ \text{lb/Mgal} \times 1.6\text{Mgal/year} = \$1{,}923/\text{yr}$$

CLIENT Sioux Falls, South Dakota
PROJECT Master Plan
SUBJECT Leachate Treatment Costs at POTW

Prepared By TAW Date 08/14/2003
Reviewed By DFP Date 8/20/03
Approved By JKS Date 8/27/03

Cost for TSS surcharge:

$0.09/lb x 100 mg/l x 8.345 lb/Mgal x 1.6Mgal/year = $120/yr

Cost for TKN surcharge:

$0.33/lb x 60 mg/l x 8.345 lb/Mgal x 1.6Mgal/year = $265/yr

Total Annual Treatment Costs (Estimated)

$800 + $1,923 + $120 + $265 = $3,110/year

Unit Treatment Cost = $\frac{\$3,110}{1,600,000 \text{ gal}}$ = $1.94/1,000 gal

CONCLUSIONS

Projected treatment costs are expected to average $3,110 per year over the life of the site, assuming flow, leachate characteristics, and treatment rates do not change.

Wright, Nancy
From: Pirrung, Don
Sent: Friday, June 13, 2003 3:19 PM
To: Wright, Nancy
Subject: FW: SF - 75% meeting followup

-----Original Message-----

From: **Johnson, Lyle [mailto:ljohnson@SIOUXFALLS.org]**
Sent: Friday, June 13, 2003 3:08 PM
To: Scharf, Jon
Cc: Pirrung, Don; Robert Craggs (E-mail); Chan, Jason; Harms, Rod; Smith, Kevin
Subject: RE: SF - 75% meeting followup

Jon,

1. Bob Kappel is assembling the documentation on the County permit and will be forwarding the materials to you. It does appear we will need to bring a consultant on board to update the stormwater management plan,
2. Bob Kappel is checking on this and it appears that the application for the stormwater permit was submitted and the permit issuance is on administrative extension,
3. Rod Harms will be providing unit price information from recent projects to refine your estimate. The wastewater rates are flow, $.50 per 1000 gallons; BOD, $0.09 per pound; TSS, $0.09 per pound; TKN, $0.33 per pound. You will need to work with Bob on any idustrial pretreatment issues.
4. Jason is flexible on the leachate storage tank. We ask that you provide a recommendation based on cost, delivery time, space issues, etc. 20,000 gallons is ok with us.
5. Unless there are delivery time issues, we would prefer that you include the tank in the project.
6. Power will need to be run from the equipment storage building to the leachate pump. We would be interested in a stationary gen set that could power the leachate system and the scale house in an emergency. I am not sure on the availability of 3 phase power.
7. We are contracting with JSA to do the survey work at the landfill. If you need any assistance with our bid procedures or documents, work with Rod.

Lyle

Rates are per City Ordinance. Rates verified by Rod Harms during telephone conversation on 7/03/03. Also by Water Reclamation Manager ~ 8/11/03.

-----Original Message-----

From: **Scharf, Jon [mailto:Jon.Scharf@earthtech.com]**
Sent: Thursday, June 12, 2003 10:54 AM
To: Johnson, Lyle
Cc: Pirrung, Don; Robert Craggs (E-mail)
Subject: SF - 75% meeting followup

Hi Lyle,

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 1 - TANK STORAGE, HAUL TO A POTW AND DISPOSE				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Trucks (3 required. - 2nd in year 12; 3rd in year 24)	1	Each	137,150	$137,150
Subtotal				$137,150
FUTURE CAPITAL				
2nd Storage Tank PW (F=$40,000; i=5%; n=18) = 0.4155*F				$16,620
2nd Submersible Pump PW (F=$5,000; i=5%; n=18) = 0.4155*F				$2,080
2nd Truck PW (F=$137,150; i=5%; n=12) = 0.5568*F				$76,370
3rd Truck PW (F=$137,150; i=5%; n=24) = .3101*F				$42,530
Subtotal				$137,600
Total Capital Subtotal				$274,750
Contractors Overhead and Profit (20%)				$54,950
Engineering and Construction Monitoring (20%)				$54,950
Contingency (20%)				$54,950
Total Capital				$439,600
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Haul to POTW	1,600	1,000 GAL	24.825	$39,720
Treatment at POTW	1,600	1,000 GAL	1.944	$3,110
Total Annual O&M				$42,830
Total Present Worth O&M (36 Years)				$708,400
Total Present Worth Capital and O&M				**$1,148,000**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 2 - ON-SITE EVAPORATION POND WITH PRE-TREATMENT				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Aeration Lagoon (0.09 acre)	1	LS	45,150	$45,150
- hydrogen peroxide distribution	1	LS	57,500	$57,500
- aerator	6	Each	5,275	$31,650
Electrical Service Hookup	1	LS	13,720	$13,720
Mobilization	1	LS	10,000	$10,000
Evaporation Pond (7 acres)	1	LS	175,000	$175,000
- test pad construction	600	CY	5.28	$3,170
- liner protection	3	LS	2,310	$6,930
Site Preparation	1	LS	10,000	$10,000
Pump for transporting leachate from aeration to evap. pond	1	Each	15,830	$15,830
Piping from aeration to evap. pond				
- valves, fittings	1	LS	5,280	$5,280
- pipe (10 inch PVC Sch. 80)	75	LF	26.38	$1,980
Trucks (3 required. - 2nd in year 12; 3rd in year 24)	1	Each	137,150	$137,150
Subtotal				$513,710
FUTURE CAPITAL				
2nd Storage Tank PW (F=$40,000; i=5%; n=18) = 0.4155*F				$16,620
2nd Submersible Pump PW (F=$5,000; i=5%; n=18) = 0.4155*F				$2,080
2nd Truck PW (F=$137,150; i=5%; n=12) = 0.5568*F				$76,370
3rd Truck PW (F=$137,150; i=5%; n=24) = .3101*F				$42,530
Subtotal				$137,600
Total Capital Subtotal				$651,310
Contractors Overhead and Profit (20%)				$130,262
Engineering and Construction Monitoring (20%)				$130,262
Contingency (20%)				$130,262
Total Capital				$1,042,096
OPERATIONS AND MAINTENANCE (annual)	**Quantity**	**Units**	**Unit Prices**	**Total**
Maintenance (aerators, pumps, hydrogen peroxide)	1	LS	7,500	$7,500
Testing	8	Each	844	$6,750
Electrical Supply	1	LS	3,165	$3,165
42% of O&M from Option 1 for Winter Disposal	1	LS	10,450	$10,450
Total Annual O&M				$27,865
Total Present Worth O&M (36 Years)				$460,920
Total Present Worth Capital and O&M				**$1,503,000**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 3 - TREATMENT AND ON-SITE DISCHARGE				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Aerated Pond (.09 acres)	1	LS	45,150	$45,150
- test pad construction	200	CY	5.28	$1,060
- 60-mil FML (smooth)	4,500	SF	0.47	$2,120
- liner protection	1	LS	2,380	$2,380
- aerator	6	Each	5,275	$31,650
- hydrogen peroxide distribution	1	LS	57,500	$57,500
- electrical service hookup	1	LS	13,720	$13,720
Mobilization	1	LS	10,000	$10,000
Site Preparation	1	LS	10,000	$10,000
Pump for discharging leachate from remote storage pond	1	Each	15,820	$15,820
Piping (excavation, backfill, manholes, piping)	2,500	LF	47.50	$118,750
Valves	1	LS	12,660	$12,660
GAC (material and installation)	3	LS	158,000	$474,000
Trucks (3 required. - 2nd in year 12; 3rd in year 24)	1	Each	137,150	$137,150
Subtotal				$932,310
FUTURE CAPITAL				
2nd Storage Tank PW (F=$40,000; i=5%; n=18) = 0.4155*F				$16,620
2nd Submersible Pump PW (F=$5,000; i=5%; n=18) = 0.4155*F				$2,080
2nd Truck PW (F=$137,150; i=5%; n=12) = 0.5568*F				$76,370
3rd Truck PW (F=$137,150; i=5%; n=24) = .3101*F				$42,530
Subtotal				$137,600
Total Capital Subtotal				$1,069,910
Contractors Overhead and Profit (20%)				$213,982
Engineering and Construction Monitoring (20%)				$213,982
Contingency (20%)				$213,982
Total Capital				$1,711,856
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Maintenance (aerators, pumps, hydrogen peroxide)	1	LS	7,500	$7,500
Testing	8	Each	845	$6,760
GAC regeneration	4	Each	10,550	$42,200
Electrical supply	1	LS	3,630	$3,630
42% of O&M from Option 1 for Winter Disposal	1	LS	10,450	$10,450
Total Annual O&M			70,540	$70,540
Total Present Worth O&M (36 Years)			1,166,730	$1,166,730
Total Present Worth Capital and O&M				**$2,878,590**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 4 - PRE-TREATMENT AND LAND APPLICATION				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Aeration Lagoon (0.09 acre)	1	LS	45,150	$45,150
- hydrogen peroxide distribution	1	LS	57,500	$57,500
- test pad construction	200	CY	5.28	$1,060
- 60-mil FML (smooth)	4,500	SF	0.47	$2,120
- liner protection	1	LS	2,380	$2,380
- aerator	6	Each	5,275	$31,650
Mobilization	1	LS	10,000	$10,000
Site Preparation	1	LS	10,000	$10,000
Pump House (10'x10')				
- bottom slab (15 inches)	7	CY	211	$1,480
- suspended floor slab (9 inches)	4	CY	422	$1,690
- concrete walls (9 inches)	14	CY	422	$5,910
- split-face CMU	450	SF	21.10	$9,500
- built-up roof system	150	SF	36.93	$5,540
- access hatches, door, window, paint/coat	1	LS	3,170	$3,170
Pumps	5	LS	10,550	$52,750
Electrical hookup for pumps	1	LS	13,720	$13,720
Piping				
- header	18,000	LF	47.48	$854,640
- check valve	4	LS	9,500	$38,000
Center Pivot Irrigator	4	LS	95,000	$380,000
Trucks (3 required. - 2nd in year 12; 3rd in year 24)	1	Each	137,150	$137,150
Subtotal				$1,663,760
FUTURE CAPITAL				
2nd Storage Tank PW (F=$40,000; i=5%; n=18) = 0.4155*F				$16,620
2nd Submersible Pump PW (F=$5,000; i=5%; n=18) = 0.4155*F				$2,080
2nd Truck PW (F=$137,150; i=5%; n=12) = 0.5568*F				$76,370
3rd Truck PW (F=$137,150; i=5%; n=24) = .3101*F				$42,530
Subtotal				$137,600
Total Capital Subtotal				$1,801,360
Contractors Overhead and Profit (20%)				$360,272
Engineering and Construction Monitoring (20%)				$360,272
Contingency (20%)				$360,272
Total Capital				$2,882,180
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Maintenance (aerators and pumps)	1	LS	2,110	$2,110
Maintenance (center pivot irrigator)	1	LS	6,000	$6,000
Testing	8	Each	844	$6,750
Electrical supply	1	LS	2,110	$2,110
Mowing	1	LS	4,690	$4,690
42% of O&M from Option 1 for Winter Disposal	1	LS	10,450	$10,450
Total Annual O&M	1	LS	32,110	$32,110
Total Present Worth O&M (36 Years)			531,100	$531,100
Total Present Worth Capital and O&M				**$3,413,180**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 5 - DISCHARGE TO ON-SITE CONSTRUCTED WETLANDS				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Mobilization	1	LS	10,000	$10,000
Discharge Piping	600	LF	10.55	$6,330
Electrical service hookup	1	LS	27,430	$27,430
Site Preparation	1	LS	10,000	$10,000
Valves	1	LS	12,700	$12,700
Constructed Wetland (21 acres)	1	LS	1,582,500	$1,582,500
Piping (excavation, backfill, manholes, piping)	2,500	LF	47.50	$118,750
Valves	1	LS	12,660	$12,660
Trucks (3 required. - 2nd in year 12; 3rd in year 24)	1	Each	137,150	$137,150
Subtotal				$1,917,870
FUTURE CAPITAL				
Storage Tank PW (F=$40,000; i=5%; n=18) = 0.4155*F				$16,620
Submersible Pump PW (F=$5,000); i=5%; n=18) = 0.4155*F				$2,080
Truck PW (F=$137,150; i=5%; n=12) = 0.5568*F				$76,370
Truck PW (F=$137,150; i=5%; n=24) = .3101*F				$42,530
Subtotal				$137,600
Total Capital Subtotal				$2,055,470
Contractors Overhead and Profit (20%)				$411,094
Engineering and Construction Monitoring (20%)				$411,094
Contingency (20%)				$411,094
Total Capital				$3,288,750
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Maintenance (mowing, planting and monitoring)	1	LS	2,000	$2,000
Testing	8	Each	800	$6,400
Electrical supply	1	LS	2,000	$2,000
42% of O&M from Option 1 for Winter Disposal	1	LS	10,450	$10,450
Total Annual O&M				$20,850
Total Present Worth (36 Years)				$344,860
Total Present Worth Capital and O&M				**$3,633,610**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 6 - THERMAL EVAPORATION USING LANDFILL GAS - (Will utilize Option 1 until enough L.F. gas is available and captured - approximately 5 years?)				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Truck (only one needed)	1	Each	137,150	$137,150
Subtotal				$137,150
FUTURE CAPITAL				
Storage Tank (Present Worth if purchased in Year 18)				$16,620
Submersible Pump (Present Worth if purchased in Year 18)				$2,080
Leachate Evaporator PW (F=$750,000; i=5%; n=5)		LS	587,700	$587,700
2nd Leachate Evaporator (n=16) PW =.4581F		LS	343,600	$343,600
3rd Leachate Evaporator (n=27) PW=.2678F		LS	200,900	$200,900
Subtotal				$1,150,900
Total Capital Subtotal				$1,288,050
Contractors Overhead and Profit (20%)				$257,610
Engineering and Construction Monitoring (20%)				$257,610
Contingency (20%)				$257,610
Total Capital				$2,060,880
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Leachate Terminator (operating costs)	1	LS	20,000	$20,000
Landfill Gas Collection System	1	LS	2,000	$2,000
Total Annual O&M				$22,000
Total Present Worth Annual O&M				$363,900
Total Present Worth Capital & O&M				**$2,424,780**

LEACHATE MANAGEMENT OPTIONS
COST ESTIMATE

OPTION 7 - TANK STORAGE, FORCEMAIN TO CITY SANITARY SEWER AND DISPOSE				
CAPITAL	**Quantity**	**Units**	**Unit Prices**	**Total**
Mobilization	1	LS	10,000	$10,000
Forcemain	31,680	LF	31.00	$982,080
Air/Vacuum Release Manholes (7 @ $2,800)	7	Each	2,800	$19,600
Subtotal				$1,011,680
Contractors Overhead and Profit (20%)				$202,340
Engineering and Construction Monitoring (20%)				$202,340
Contingency (20%)				$202,340
Total Capital				$1,618,700
OPERATIONS AND MAINTENANCE (ANNUAL)	**Quantity**	**Units**	**Unit Prices**	**Total**
Forcemain	1	LS	2,500	$2,500
Treatment	1,600	1,000 GAL	1.944	$3,110
Electrical	1	LS	2,000	$2,000
Total Annual O&M				$7,610
Total Present Worth (36 Years)				$125,870
Total Present Worth Capital and O&M				**$1,744,600**

NOTES:

1. Cost estimate is based upon cost estimate prepared by HDR Engineering, Inc., and included in the Leachate Management Evaluation Report, dated August 2001. Generally, costs were increased by 5.5 percent to bring them up to date for 2003 dollars from 2001 dollars. 5.5 percent is per ENR inflation rates from 2001 to 2003.
2. In some cases, costs were reduced or increased if the HDR estimate appeared unrealistic.
3. In some cases, capital costs were split between immediate and future cost to be more realistic for present worth analysis.
4. Some items have been added to the cost estimate.

SIOUX FALLS LANDFILL
PHASE I
SUMMARY/LANDFILL GAS SYSTEM
AND LEACHATE EXTRACTION ACTIVE SITE
PROJECT COST ESTIMATE

A. Leachate Extraction System
Engineering and Construction Related Services $47,000
Construction 260,000

B. Phase I Landfill Gas System
Engineering and Construction Related Services $57,000
Construction 335,600

Notes:

1. Phase I Landfill Gas System consists of 10 vertical wells, and landfill gas header to connect the wells to allow for leachate extraction from the Active Site.

2. If the City wishes to include the blower/flare station into Phase I, refer to the cost table for the landfill gas system for these related additional cost items.

3. If the City prefers to hold off constructing the landfill gas header system, the investment can be postponed and the 10 vertical wells can be connected with temporary piping located above ground. In this case, the pneumatic pumps would operate from spring through fall and shut down during the cold weather period. Year round operation would be implemented after the permanent landfill gas header is constructed in subsequent years.

4. Landfill Gas System Active Site Cost Estimate Summary:

   a. Phase I
   Engineering $57,000
   Construction 335,600

   b. Balance of Gas System
   Engineering $143,000
   Construction 885,200

   c. Total Gas System
   Engineering $200,000
   Construction 1,220,800

SIOUX FALLS LANDFILL
LEACHATE EXTRACTION CONSTRUCTION
COST ESTIMATE

Pneumatic Pump/Airline System

2,500 ft. 2" HDPE Piping in Gas Header, Trench	$10,000
500 ft. 2" HDPE Piping buried separately	5,000
Pipe Fittings	10,000
10 Pneumatic Pumps	32,000
Air Compressor System	40,000
20,000 gal. Leachate/Condensate Tank *	47,000
Leachate Loadout, Pump & Controls *	28,000
Electrical	40,000
Site Restoration	20,000
Subtotal	**$231,000**

Miscellaneous

Design	$22,000
Permitting	5,000
Construction Quality Assurance	20,000
Mobilization	5,000
Contingency (10%)	23,000
TOTAL Estimated Cost	**$307,000**

Assumptions

- Air header is installed in gas header trench.
- Ten pneumatic pumps required.
- Project is constructed concurrently with gas header system.
- Dual gas/leachate vertical wells are used.
- Vertical well costs are part of gas system cost and not included in the pump cost estimate.

* Note, for budgeting purposes, a leachate tank, pump and loadout facility is included. The cost for a pipeline to route the leachate south to the Cell 1 leachate tank would have a comparable cost. If the City plans to install a forcemain from the landfill to the City in the future, a leachate pipeline from the Active Site to the Cell 1 Storage Tank is recommended.

Sioux Falls Landfill

Date: 6/22/03

PHASE I LANDFILL GAS COLLECTION SYSTEM (Existing MSW Active Area)
COST ESTIMATE

** Assume : Gas system cost estimate for Phase I of MSW Active Area Only
** Assume : 10 vertical gas wells will be installed. Average Well Depth will be 70 feet.
** Assume : Phase I includes 10 gas wells and header for leachate extraction but not the blower/flare station.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
GAS COLLECTION WELL					
WELLHEAD ASSEMBLY(Installed)	$1,200.00	ea.	10	$12,000	
GAS WELL 8"sch 80 PVC PIPE	$7.00	/lf	700 ft	$4,900	
GAS WELL 8"sch 40 PVC CAPS	$18.00	ea.	10	$180	
GAS WELL 8"sch 80 PVC COUPLINGS	$19.50	ea.	20	$390	
GAS WELL INSTALLATION	$65.00	ft	700 ft	$45,500	
GAS VENT ABANDONMENT	$800.00	ea.	0	$0	
			total	$62,970	$62,970
SYSTEM MATERIAL					
20" DIAMETER	$18.00	/lf	0 ft	$0	
18" DIAMETER	$16.00	/lf	620 ft	$9,920	
16" DIAMETER	$14.00	/lf	0 ft	$0	
14" DIAMETER	$12.00	/lf	0 ft	$0	
12" DIAMETER	$10.00	/lf	1980 ft	$19,800	
10" DIAMETER	$8.00	/lf	0 ft	$0	
8" DIAMETER	$5.00	/lf	0 ft	$0	
6" DIAMETER	$3.00	/lf	1200 ft	$3,600	
4" DIAMETER	$2.00	/lf	300 ft	$600	
2" DIAMETER	$1.00	/lf	0 ft	$0	
HDPE FITTINGS				$10,000	
UNDERGROUND CV	$1,000.00	ea.	2	$2,000	
CONDENSATE MGMNT.					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$10,000.00	ea.	2	$20,000	
Knockout/Dripleg	$5,000.00	ea.	0	$0	
	total		4100 ft	$71,920	$134,890
SYSTEM INSTALLATION					
20" DIAMETER	$41.00	/lf	0 ft	$0	
18" DIAMETER	$39.00	/lf	620 ft	$24,180	
16" DIAMETER	$36.00	/lf	0 ft	$0	
14" DIAMETER	$33.00	/lf	0 ft	$0	
12" DIAMETER	$30.00	/lf	1980 ft	$59,400	
10" DIAMETER	$27.00	/lf	0 ft	$0	
8" DIAMETER	$20.00	/lf	0 ft	$0	
6" DIAMETER	$18.00	/lf	1200 ft	$21,600	
4" DIAMETER	$16.00	/lf	300 ft	$4,800	
2" DIAMETER	$5.00	/lf	0 ft	$0	
UNDERGROUND CONTROL VALVE INST/	$2,000.00	ea.	6	$12,000	
CONDENSATE MANAGEMENT					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$3,500.00	ea.	2	$7,000	
Knockout/Dripleg	$2,500.00	ea.	0	$0	
			total	$134,980	$269,870

Sioux Falls Landfill

Date: 6/22/03

PHASE I LANDFILL GAS COLLECTION SYSTEM (Existing MSW Active Area)

COST ESTIMATE

** Assume : Gas system cost estimate for Phase I of MSW Active Area Only

** Assume : 10 vertical gas wells will be installed. Average Well Depth will be 70 feet.

** Assume : Phase I includes 10 gas wells and header for leachate extraction but not the blower/flare station.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
UTILITY FLARE	$50,000	ea.	0	$0	
FLARE INSTALLATION	$8,000	ea.	0	$0	
BLOWER	$5,000	ea.	0	$0	
BLOWER INSTALLATION	$4,000	ea.	0	$0	
ELECTRICAL	$15,000	ea.	1	$15,000	
			total	$15,000	$284,870
MISCELLANEOUS					
DESIGN	$25,000			$25,000	
PERMITTING	$5,000			$5,000	
AS-BUILT DOCUMENTATION	$5,000			$5,000	
ROUTE SURVEY	$5,000			$5,000	
QA/QC	$17,000			$17,000	
MOBILIZATION	$15,000			$15,000	
			total	$72,000	$356,870
SUB TOTAL					$356,870
CONTINGENCY (10%)					$35,730
GRAND TOTAL					$392,600

Notes:

1. Phase I Landfill Gas System consists of 10 vertical wells, and landfill gas header to connect the wells to allow for leachate extraction from the Active Site.
2. If the City wishes to include the blower/flare station into Phase I, refer to the cost table for the landfill gas system for these related additional cost items.
3. If the City prefers to hold off constructing the landfill gas header system, the investment can be postponed and the 10 vertical wells can be connected with temporary piping located above ground. In this case, the pneumatic pumps would operate from spring through fall and shut down during the cold weather period. Year round operation would be implemented after the permanent landfill gas header is constructed in subsequent years.

Sioux Falls Landfill

Date: 8/5/03

LANDFILL GAS / LEACHATE COLLECTION SYSTEM (Existing Area)

COST ESTIMATE

** Assume : Gas and Leachate system cost estimate for Existing Permitted Area Only

** Assume : 53 vertical gas wells will be installed. Average Well Depth will be 70 feet.

** Assume : 10 pnuematic pumps to be installed at wells containing liquids for leachate collection system

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
GAS COLLECTION WELL					
WELLHEAD ASSEMBLY(Installed)	$1,200.00	ea.	53	$63,600	
GAS WELL 8"sch 80 PVC PIPE	$7.00	/lf	3710 ft	$25,970	
GAS WELL 8"sch 40 PVC CAPS	$18.00	ea.	53	$954	
GAS WELL 8"sch 80 PVC COUPLINGS	$19.50	ea.	106	$2,067	
GAS WELL INSTALLATION	$65.00	ft	3710 ft	$241,150	
GAS VENT ABANDONMENT	$800.00	ea.	0	$0	
			total	$333,741	$333,741
SYSTEM MATERIAL					
20" DIAMETER	$18.00	/lf	0 ft	$0	
18" DIAMETER	$16.00	/lf	620 ft	$9,920	
16" DIAMETER	$14.00	/lf	0 ft	$0	
14" DIAMETER	$12.00	/lf	0 ft	$0	
12" DIAMETER	$10.00	/lf	7320 ft	$73,200	
10" DIAMETER	$8.00	/lf	0 ft	$0	
8" DIAMETER	$5.00	/lf	1700 ft	$8,500	
6" DIAMETER	$3.00	/lf	6630 ft	$19,890	
4" DIAMETER	$2.00	/lf	424 ft	$848	
2" DIAMETER	$1.00	/lf	0 ft	$0	
HDPE FITTINGS				$44,943	
UNDERGROUND CV	$1,000.00	ea.	6	$6,000	
CONDENSATE MGMNT.					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$10,000.00	ea.	4	$40,000	
Knockout/Dripleg	$5,000.00	ea.	0	$0	
	total		16694 ft	$209,301	$543,042
SYSTEM INSTALLATION					
20" DIAMETER	$41.00	/lf	0 ft	$0	
18" DIAMETER	$39.00	/lf	620 ft	$24,180	
16" DIAMETER	$36.00	/lf	0 ft	$0	
14" DIAMETER	$33.00	/lf	0 ft	$0	
12" DIAMETER	$30.00	/lf	7320 ft	$219,600	
10" DIAMETER	$27.00	/lf	0 ft	$0	
8" DIAMETER	$20.00	/lf	1700 ft	$34,000	
6" DIAMETER	$18.00	/lf	6630 ft	$119,340	
4" DIAMETER	$16.00	/lf	424 ft	$6,784	
2" DIAMETER	$5.00	/lf	0 ft	$0	
UNDERGROUND CONTROL VALVE INSTALL	$2,000.00	ea.	6	$12,000	
CONDENSATE MANAGEMENT					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$3,500.00	ea.	4	$14,000	
Knockout/Dripleg	$2,500.00	ea.	0	$0	
			total	$435,904	$978,946

Sioux Falls Landfill

Date: 8/5/03

LANDFILL GAS / LEACHATE COLLECTION SYSTEM (Existing Area)

COST ESTIMATE

** Assume : Gas and Leachate system cost estimate for Existing Permitted Area Only

** Assume : 53 vertical gas wells will be installed. Average Well Depth will be 70 feet.

** Assume : 10 pnuematic pumps to be installed at wells containing liquids for leachate collection system

DESCRIPTION	UNIT PRICE	QUANTITY	TOTAL COST	RUNNING TOTAL
UTILITY FLARE	$50,000 ea.	1	$50,000	
FLARE INSTALLATION	$8,000 ea.	1	$8,000	
BLOWER	$4,000 ea.	1	$4,000	
BLOWER INSTALLATION	$3,000 ea.	1	$3,000	
LEACHATE COLLECTION SYSTEM	$50,000 ea.	1	$50,000	
		total	$118,000	$1,096,946
MISCELLANEOUS				
DESIGN	$20,000		$20,000	
PERMITTING	$10,000		$10,000	
AS-BUILT DOCUMENTATION	$5,000		$5,000	
ROUTE SURVEY	$5,000		$5,000	
QA/QC	$25,000		$25,000	
MOBILIZATION	$15,000		$15,000	
		total	$80,000	$1,176,946
SUB TOTAL				$1,176,946
CONTINGENCY (10%)				$117,695
GRAND TOTAL				$1,294,641

Sioux Falls Landfill

Date: 6/22/03

LANDFILL GAS COLLECTION SYSTEM (Existing MSW Active Area)

COST ESTIMATE

** Assume : Gas system cost estimate for MSW Active Area Only

** Assume : 53 vertical gas wells will be installed. Average Well Depth will be 70 feet.

** Assume : Project costs are for total system including Phase I Gas System.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
GAS COLLECTION WELL					
WELLHEAD ASSEMBLY(Installed)	$1,200.00	ea.	53	$63,600	
GAS WELL 8"sch 80 PVC PIPE	$7.00	/lf	3710 ft	$25,970	
GAS WELL 8"sch 40 PVC CAPS	$18.00	ea.	53	$954	
GAS WELL 8"sch 80 PVC COUPLINGS	$19.50	ea.	106	$2,067	
GAS WELL INSTALLATION	$65.00	ft	3710 ft	$241,150	
GAS VENT ABANDONMENT	$800.00	ea.	0	$0	
			total	$333,741	$333,741
SYSTEM MATERIAL					
20" DIAMETER	$18.00	/lf	0 ft	$0	
18" DIAMETER	$16.00	/lf	620 ft	$9,920	
16" DIAMETER	$14.00	/lf	0 ft	$0	
14" DIAMETER	$12.00	/lf	0 ft	$0	
12" DIAMETER	$10.00	/lf	7320 ft	$73,200	
10" DIAMETER	$8.00	/lf	0 ft	$0	
8" DIAMETER	$5.00	/lf	1700 ft	$8,500	
6" DIAMETER	$3.00	/lf	6630 ft	$19,890	
4" DIAMETER	$2.00	/lf	424 ft	$848	
2" DIAMETER	$1.00	/lf	0 ft	$0	
HDPE FITTINGS				$44,943	
UNDERGROUND CV	$1,000.00	ea.	6	$6,000	
CONDENSATE MGMNT.					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$10,000.00	ea.	4	$40,000	
Knockout/Dripleg	$5,000.00	ea.	0	$0	
	total		16694 ft	$209,301	$543,042
SYSTEM INSTALLATION					
20" DIAMETER	$41.00	/lf	0 ft	$0	
18" DIAMETER	$39.00	/lf	620 ft	$24,180	
16" DIAMETER	$36.00	/lf	0 ft	$0	
14" DIAMETER	$33.00	/lf	0 ft	$0	
12" DIAMETER	$30.00	/lf	7320 ft	$219,600	
10" DIAMETER	$27.00	/lf	0 ft	$0	
8" DIAMETER	$20.00	/lf	1700 ft	$34,000	
6" DIAMETER	$18.00	/lf	6630 ft	$119,340	
4" DIAMETER	$16.00	/lf	424 ft	$6,784	
2" DIAMETER	$5.00	/lf	0 ft	$0	
UNDERGROUND CONTROL VALVE INST/	$2,000.00	ea.	6	$12,000	
CONDENSATE MANAGEMENT					
-Header Access Riser	$1,500.00	ea.	4	$6,000	
-Knockout/Pump station	$3,500.00	ea.	4	$14,000	
Knockout/Dripleg	$2,500.00	ea.	0	$0	
			total	$435,904	$978,946

Sioux Falls Landfill

Date: 6/22/03

LANDFILL GAS COLLECTION SYSTEM (Existing MSW Active Area)

COST ESTIMATE

** Assume : Gas system cost estimate for MSW Active Area Only

** Assume : 53 vertical gas wells will be installed. Average Well Depth will be 70 feet.

** Assume : Project costs are for total system including Phase I Gas System.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
UTILITY FLARE	$50,000	ea.	1	$50,000	
FLARE INSTALLATION	$8,000	ea.	1	$8,000	
BLOWER	$5,000	ea.	1	$5,000	
BLOWER INSTALLATION	$4,000	ea.	1	$4,000	
ELECTRICAL	$30,000	ea.	1	$30,000	
			total	$97,000	$1,075,946
MISCELLANEOUS					
DESIGN	$60,000			$60,000	
PERMITTING	$10,000			$10,000	
AS-BUILT DOCUMENTATION	$20,000			$20,000	
ROUTE SURVEY	$15,000			$15,000	
QA/QC	$95,000			$95,000	
MOBILIZATION	$15,000			$15,000	
			total	$215,000	$1,290,946
SUB TOTAL					$1,290,946
CONTINGENCY (10%)					$129,854
GRAND TOTAL					$1,420,800

Sioux Falls Landfill

Date: 6/22/03

LANDFILL GAS COLLECTION SYSTEM (Expansion Area)

COST ESTIMATE

** Assume : Gas system cost estimate for Expansion Area Only

** Assume : 53 vertical gas wells will be installed. Average Well Depth will be 70 feet.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
GAS COLLECTION WELL					
WELLHEAD ASSEMBLY(Installed)	$1,200.00	ea.	56	$67,200	
GAS WELL 8"sch 80 PVC PIPE	$7.00	/lf	3920 ft	$27,440	
GAS WELL 8"sch 40 PVC CAPS	$18.00	ea.	56	$1,008	
GAS WELL 8"sch 80 PVC COUPLINGS	$19.50	ea.	112	$2,184	
GAS WELL INSTALLATION	$65.00	ft	3920 ft	$254,800	
GAS VENT ABANDONMENT	$800.00	ea.	0	$0	
			total	$352,632	$352,632
SYSTEM MATERIAL					
20" DIAMETER	$18.00	/lf	0 ft	$0	
18" DIAMETER	$16.00	/lf	700 ft	$11,200	
16" DIAMETER	$14.00	/lf	0 ft	$0	
14" DIAMETER	$12.00	/lf	0 ft	$0	
12" DIAMETER	$10.00	/lf	7800 ft	$78,000	
10" DIAMETER	$8.00	/lf	0 ft	$0	
8" DIAMETER	$5.00	/lf	1950 ft	$9,750	
6" DIAMETER	$3.00	/lf	10665 ft	$31,995	
4" DIAMETER	$2.00	/lf	448 ft	$896	
2" DIAMETER	$1.00	/lf	0 ft	$0	
HDPE FITTINGS				$52,736	
UNDERGROUND CV	$1,000.00	ea.	6	$6,000	
CONDENSATE MGMNT.					
-Header Access Riser	$1,500.00	ea.	2	$3,000	
-Knockout/Pump station	$10,000.00	ea.	2	$20,000	
Knockout/Dripleg	$5,000.00	ea.	0	$0	
	total		21563 ft	$213,577	$566,209
SYSTEM INSTALLATION					
20" DIAMETER	$41.00	/lf	0 ft	$0	
18" DIAMETER	$39.00	/lf	700 ft	$27,300	
16" DIAMETER	$36.00	/lf	0 ft	$0	
14" DIAMETER	$33.00	/lf	0 ft	$0	
12" DIAMETER	$30.00	/lf	7800 ft	$234,000	
10" DIAMETER	$27.00	/lf	0 ft	$0	
8" DIAMETER	$20.00	/lf	1950 ft	$39,000	
6" DIAMETER	$18.00	/lf	10665 ft	$191,970	
4" DIAMETER	$16.00	/lf	448 ft	$7,168	
2" DIAMETER	$5.00	/lf	0 ft	$0	
UNDERGROUND CONTROL VALVE INST/	$2,000.00	ea.	6	$12,000	
CONDENSATE MANAGEMENT					
-Header Access Riser	$1,500.00	ea.	2	$3,000	
-Knockout/Pump station	$3,500.00	ea.	2	$7,000	
Knockout/Dripleg	$2,500.00	ea.	0	$0	
			total	$521,438	$1,087,647

Sioux Falls Landfill

Date: 6/22/03

LANDFILL GAS COLLECTION SYSTEM (Expansion Area)

COST ESTIMATE

** Assume : Gas system cost estimate for Expansion Area Only

** Assume : 53 vertical gas wells will be installed. Average Woll Depth will be 70 feet.

DESCRIPTION	UNIT PRICE		QUANTITY	TOTAL COST	RUNNING TOTAL
UTILITY FLARE	$50,000	ea.	1	$50,000	
FLARE INSTALLATION	$8,000	ea.	1	$8,000	
BLOWER	$4,000	ea.	1	$4,000	
BLOWER INSTALLATION	$3,000	ea.	1	$3,000	
			total	$65,000	$1,152,647
MISCELLANEOUS					
DESIGN	$20,000			$20,000	
PERMITTING	$10,000			$10,000	
AS-BUILT DOCUMENTATION	$5,000			$5,000	
ROUTE SURVEY	$5,000			$5,000	
QA/QC	$25,000			$25,000	
MOBILIZATION	$15,000			$15,000	
			total	$80,000	$1,232,647
SUB TOTAL					$1,232,647
CONTINGENCY (10%)					$123,265
GRAND TOTAL					$1,355,912

APPENDIX D

WASTE DIVERSION INFORMATION

Regional Electronics Recyclers:

Asset Recovery
150 State Street
St. Paul, MN 55107
(800) 472-2081

Clean Harbors
211 Holiday Avenue
Cannon Falls, MN 55009
(507) 263-0200

Electronic Recovery Inc.
124 12th Ave. S.
Minneapolis, MN 55415
(612) 338-2466

Green Lights Recycling
10040 Davenport St. NE
Blaine, MN 55449
(800) 208-8340

Materials Processing Corporation
2805 West Service Road
Eagan, MN 55121
(651) 681-8099

Onyx Environmental Services
3230 101st Avenue NE
Blaine, MN 55449
(888) 887-9457

Retrofit Recycling
2960 Yorkton Blvd.
St. Paul, MN 55117
(800) 274-1309

References:

City of Fargo
Angela Schneider
2301 8th Avenue North
Fargo, ND 58102
(701) 298-6944

City of Bismarck
Galen Bren
601 South 26th Street
Bismarck, ND 58504
(701) 222-6431

Jackson County
Arlene Vee
405 4th Street
Jackson, MN 56143
(507) 847-2240

City of Blaine
Roark Haver
1801 – 101st Avenue NE
Blaine, MN
(763) 785-6192

City of Fridley
Julie Jones
6431 University Avenue NE
Fridley, MN 55432
(763) 572-3594

Scott County (businesses only)
Greg Boe
200 4th Ave. West, Rm. A104
Shakopee, MN 55379
(952) 496-8652

City of Sioux Falls Solid Waste Planning Board
Waste Diversion, Recycling, and Reuse Survey

County or Municipality: _____

Address: _____

City, State and Zip Code: _____

Contact Name: _____

Phone Number: _____

Fax Number: _____

E-mail Address: _____

Please provide the following information regarding waste diversion, recycling, and reuse in the County or municipality you represent.

1. Does the County (or its municipalities) have ordinances regarding solid waste management and/or recycling? If so, could you provide a copy of the ordinance(s) to us via e-mail, fax or regular mail?

2. Does the County (or its municipalities) have a recycling program?
   If so, what materials are collected?

   Are recyclable materials collected from residents at the curb or via drop-off locations?

   Where are the recyclable materials from your County or municipality taken for processing?

3. Does the County (or its municipalities) license their recycling haulers? If so, how many are currently licensed? Is there a limit to the number of licensed haulers allowed?

4. Does the County (or its municipalities) have a management plan for yard waste materials?
   If so, how is it collected?

   Where is the yard waste taken for processing/composting?

5. Does the County (or its municipalities) have a budget specifically for recycling and waste diversion activities?
   If so, what is the annual budget amount?

   What programs/services are funded?

   Has the County/municipality received grant money in the past? If so, please provide the dollar amount, source of funding, and describe what the money was used for.

6. Does the County (or its municipalities) currently share any recycling programs, facilities, or equipment with other local governments? If so, please explain.

7. What types of recycling public education does the County (or its municipalities) provide to residents? Is there a staff person appointed to handle public education? If possible, please provide copies of brochures, flyers, newspaper articles, etc. as examples of public education pieces.

8. Please provide any other relevant recycling information.

Thank you for answering these questions. Please fax completed survey to R. W. Beck, attention Mary Chamberlain at (651) 994-8396. Any questions can be directed to Mary via phone at (651) 994-8415 or via e-mail at mchamberlain@rwbeck.com.

If you have information (ordinances, public education materials) to send via regular mail, please send to the following address: R. W. Beck, Inc., Attn: Mary Chamberlain, 1380 Corporate Center Curve, Ste. 305, St. Paul, MN 55121

City of Sioux Falls Licensed Haulers
Waste Diversion, Recycling, and Reuse Survey

The contact information in italics below is optional. You may complete the survey anonymously if you prefer.

Name of Company: _____

Address: _____

City, State and Zip Code: _____

Contact Name: _____

Phone Number: _____

Fax Number: _____

E-mail Address: _____

Please provide the following information regarding waste diversion, recycling, and reuse in the Sioux Empire Region (communities that use the Sioux Falls Sanitary Landfill):

9. a. Please identify the types of recyclable materials (i.e., old newspapers, #1 & #2 plastic bottles, etc.) that you collect from your customers at their residence.

   b. Do you collect materials from residents only, or do you also provide recyclable materials collection service to businesses?

10. How often do you collect recyclable materials from your residential customers?
    - ☐ Once a week
    - ☐ Once every two weeks
    - ☐ Once a month
    - ☐ Other: _____

11. a. What are your monthly charges to residents for solid waste collection service?

    b. Is recyclable materials collection included in this rate? If not, what is the monthly charge to residents for recyclable materials collection?

12. Do you collect the recyclable materials in two streams or sort the materials at the curb into individual material compartments on your collection vehicles?

13. Do you offer any drop-off locations for recyclable materials? Where are they located? How often are they serviced?

14. a. Where are the recyclable materials taken for processing?

    b. Are you charged by the processor(s) for acceptance of these materials? If so, how much?

    c. Are you paid by the processor(s) for these materials? If so, how much?

15. a. Do you collect yard waste materials from residents? If so, how is it collected? (i.e., bags, cans, automated carts, other.)

    b. What is the rate charged customers for this service?

    c. Do you collect yard waste from drop-off locations?

16. a. Where is the yard waste taken for processing/composting?

    b. Are you charged for this service? If so, how much?

17. Do you collect problem materials (i.e., appliances, tires, etc.) from your residential customers? If so, what materials are collected and what rate is charged to customers?

18. Do you share any recycling programs, facilities, or equipment with other haulers or local governments? If so, please explain.

19. What types of recycling public education do you provide to residents? If possible, please provide copies of brochures, flyers, reminder tags, etc. as examples of public education pieces.

20. Would you be interested in working with the City of Sioux Falls to conduct a pilot study to determine recycling participation and set-out rates of Sioux Falls' residents?

21. What specific changes to the City of Sioux Falls' program would you recommend as an improvement to its recycling collection program or public education program?

Thank you for answering these questions. Please fax completed survey to R. W. Beck, attention Mary Chamberlain at (651) 994-8396. Any questions can be directed to Mary via phone at (651) 994-8415 or via e-mail at mchamberlain@rwbeck.com.

If you have public education materials to send via regular mail, please send to the following address: R. W. Beck, Inc., Attn: Mary Chamberlain, 1380 Corporate Center Curve, Ste. 305, St. Paul, MN 55121

APPENDIX E

CITY ORDINANCE, CHAPTER 18, GARBAGE AND TRASH

Chapter 18
GARBAGE AND TRASH*

Cross references: Administration, ch. 2; food and food handlers, ch. 17; disposal of garbage and waste food by food establishments, § 17-8; health and sanitation, ch. 19; examples of nuisances, § 19-50; garbage disposal in mobile home parks, § 24-17; littering in parks, § 27-8; plumbing, ch. 33; utilities, ch. 41.

State law references: Municipal garbage disposal systems, SDCL 9-32-11.

Article I. In General

Article II. Collection Regulations

Article III. Sanitary Landfill

Article IV. Commercial Haulers

ARTICLE I.
IN GENERAL

Sec. 18-1. Definitions.

The following words, terms and phrases, when used in this chapter, shall mean except where the context clearly indicates a different meaning:

Animal waste means any accumulation of waste manure or straw resulting from the transportation, housing or penning of animals.

Apartment means any building with two or more rental dwelling units.

Catch basin means a formed holding area for sludges, sediments, screenings, or grit which may include the cleanout and settling tank areas.

Commercial garbage collector or commercial garbage hauler means any person who hauls or transports any garbage, rubbish or livestock waste through or upon the streets or alleys of this city for a consideration or a fee.

Corrugated cardboard means heavy paper with alternating ridges and grooves.

Garbage means all refuse, containers or accumulation of animal or vegetable matter which attends the processing, preparation, transportation, cooking, eating, sale, or storage of meat, fish, vegetables, fruit and all other food or food products found within the city which has been condemned by the health department as a nuisance or is likely to cause or transmit disease, or which may be a hazard to health.

Garbage collector or garbage hauler means any person who hauls or transports any garbage through or upon the streets or alleys of this city.

Litter means garbage, rubbish, waste material or animal waste improperly disposed of by discarding, abandoning, allowing to accumulate, scattering or depositing outside an approved

container.

Metal containers means any container made from aluminum, tin or steel which contained a product for consumption.

Newspaper means printed ground wood paper commonly referred to as newsprint, including glossy advertisements delivered with the newspaper.

Office paper means high grade office paper, newsprint, offset paper, bond paper, xerographic bond paper, mimeo paper, duplicator paper, computer paper, and envelopes.

Paper products means magazines, catalogs, advertising supplements, books and junk mail. It does not include chip board, items such as juice boxes, milk cartons, cereal boxes, mix boxes, tissue boxes, shoe boxes, soda and beer cartons, etc.

Plastic containers means any formed or molded container having a neck that is smaller than the body of the container, composed predominately of plastic resin #1 and #2.

Recyclable collector means any person who collects or receives recyclable materials from another person or persons for a consideration or a fee and/or for the purpose of resale.

Recycling collection facility means an established facility where recyclable materials are collected for shipment offsite with no processing. Fully enclosed automated self-serve aluminum collection machines are considered recycling collection facilities. Facilities which handle recyclable hazardous materials or waste petroleum products are considered recycling collection facilities.

Recycling container means a container which will securely hold recyclable materials for collection and will prevent recyclables from falling or being blown from the container.

Recyclable materials means materials or products that may be readily separated from the solid waste stream and may be used or reused as a substitute for raw materials or other items, including but not limited to aluminum, glass, paper, plastic, tin and steel.

Recycling processing facility means an established facility where recyclable materials are collected and/or processed by sorting, volume reduction, containment or other preparation for shipment offsite.

Regulated medical waste means medical waste as defined by section 15.03.020(533).

Residential means a dwelling having accommodation for and occupied by one or more families.

Residential recyclables means separation at the source of the following materials into separate recycling containers for collection:

(1) Office paper other than junk mail.

(2) Corrugated cardboard.

(3) Plastic and metal containers.

(4) Newspaper.

Rubbish means all combustible refuse matter such as paper, sweepings, rags, magazines, cardboard and similar materials.

Salvaging means the controlled removal of waste materials for reuse.

Sanitary landfill means the area provided by the city for the dumping or depositing of garbage, rubbish, animal waste, litter and waste materials not prohibited by city ordinance.

Scavenging means the uncontrolled and unauthorized removal of waste materials.

Sludges means any solid, semisolid, or liquid waste encountered, collected, and/or concentrated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, catch basins, or air pollution control facility exclusive of the treated effluent from a wastewater treatment plant.

Solid waste means garbage, rubbish, waste materials, special wastes, tree branches and garden waste, yard waste, and sludges as defined in this section.

Solid waste generated from the treatment of regulated medical waste means waste generated from the treatment of regulated medical waste in conformance with city, state, and federal rules and regulations so it no longer poses a threat to public health.

Solid waste transfer facility means a fixed facility where solid waste from collection vehicles is consolidated and temporarily stored for subsequent transport to a permanent disposal site.

Special waste means asbestos; gasoline, fuel oil or waste oil, contaminated soils, materials, sediments, etc.; co-mingled gasoline and fuel oil and/or waste oil contaminated soils, materials, sediments, etc.; and anti-freeze contaminated soils, materials, sediments, etc.

Tree, brush and garden waste means trees, tree branches, brush, wood, wood shavings and garden waste.

Waste material means all noncombustible inorganic matter such as ashes, glass, sand, earth, stones, concrete, mortar, metals, tin cans, and similar material.

Yard waste means grass clippings and leaves.

(1957 Rev. Ords., § 7.901; Ord. No. 2308, 12-14-64; Ord. No. 73-75, § 1, 11-17-75; Ord. No. 88-81, § 1, 11-2-81; Ord. No. 93-88, § 1, 10-24-88; Ord. No. 60-92, § 1, 6-22-92; Ord. No. 43-93, § 1, 5-17-93; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 1, 8, 6-2-97; Ord. No. 75-01, § 1, 8-6-01)

Cross references: Definitions and rules of construction generally, § 1-2; distributing handbills in public places, § 3-19.

Sec. 18-2. Littering prohibited– Generally.

It shall be unlawful for any person to throw, drop, cast or deposit upon any street, alley, sidewalk, lake, stream, river, pond, body of water or any yard or premises, public or private, any filth of any kind, or cans, paper, trash, paper containers, rubbish, bottles, or any form of litter or waste matter.

(1957 Rev. Ords., §§ 9.802, 9.809; Ord. No. 149-95, § 1, 11-20-95)

State law references: Refuse in public places and streams, SDCL 9-32-10; littering prohibited, SDCL 34A-7-6 et seq.; ordinances to regulate litter, SDCL 34A-7-14.

Sec. 18-3. Same– Duty of business owners, occupants.

(a) Generally. The owner or occupant of any store or other place of business situated within the city shall exercise reasonable diligence at all times to keep his premises clean of wastepaper, wrapping paper, paper napkins, cartons, package containers, and other used or waste materials thrown or left on such premises by his customers, and to take reasonable measures to prevent the materials from drifting or blowing to adjoining premises.

(b) Receptacles. Receptacles of sufficient size and number shall be placed on the premises accessible to the customers of such business where such articles of waste may be disposed of.

(c) Signs. Each and every business establishment shall place upon its premises in a conspicuous place, in close proximity to the receptacle referred to in subsection (b) of this section, a sign which shall, in essence, convey to its customers a request that they use such receptacles for the disposal of waste material.

(Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-4. Same– Duty of customer.

It shall be unlawful for any customer going upon the premises of another to in any manner dispose of wastepaper, wrapping paper, paper napkins, cartons, package containers, and other used or waste materials except in receptacles provided for such purposes.

Sec. 18-5. Littering on premises of another.

It shall be unlawful for any person going upon the premises of another to in any manner dispose of litter except in receptacles provided for such purposes and except with the permission of the person in possession of the premises.

(Ord. No. 73-75, § 2, 11-17-75; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-6. Removal of litter by city.

If the occupant, person in charge or owner of any real property fails to remove litter from real property after notice from the city, the city may cause such litter to be removed and for such

purpose may enter upon any such real property.

(Ord. No. 73-75, § 3, 11-17-75; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 1, 2-10-03)

Secs. 18-7– 18-14. Reserved.

ARTICLE II.
COLLECTION REGULATIONS

Sec. 18-15. Rubbish on sidewalk.

The owner or occupant of any lot or private ground abutting upon any public sidewalk shall not allow rubbish, debris or obstruction of any kind to be or remain on such sidewalk along such abutting property.

(1957 Rev. Ords., § 7.907; Ord. No. 2308, 12-14-64; Ord. No. 19-72, 4-10-72; Ord. No. 35-73, § 1, 4-30-73; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-16. Preparation for deposit.

All household and commercially generated garbage, animal waste, rubbish, and other materials shall be placed in a securely tied bag. Recyclable materials shall be separated into their respective categories. Animal waste from commercial operations may be transported and deposited in covered leakproof hauling units.

(Ord. No. 73-75, § 4, 11-17-75; Ord. No. 88-81, § 3, 11-2-81; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-17. Garbage containers.

The occupant, owner or manager of every dwelling, house, apartment or construction site and of every place of business and building shall provide a suitable, rigid watertight container in which the occupants shall cause to be deposited all garbage, animal waste and rubbish, except yard waste, accumulating upon the premises. The garbage container shall be kept at the rear of the premises accessible to the garbage collector. There shall be provided a tightly-fitted cover for each container which shall be removed only for the purpose of depositing or removing garbage, rubbish, animal waste or cleaning. The vicinity of the garbage container shall be kept free from garbage, rubbish, animal waste, litter, yard waste or any putrescible matter that attracts flies and rats.

(Ord. No. 73-75, § 5, 11-17-75; Ord. No. 88-81, § 4, 11-2-81; Ord. No. 60-92, § 2, 6-22-92; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-17.1. Rental units; garbage and recyclable service.

The owner or manager of any dwelling who rents, leases, or lets dwelling unit(s) for human habitation shall provide in a location accessible to all dwelling units at least one 30-gallon receptacle for each dwelling unit, or receptacles with a capacity sufficient to prevent the

overflow of garbage and rubbish from occurring, and receptacles for recycling, into which garbage, rubbish, and recyclable materials from the dwelling units may be emptied between days of collection. The owner or manager of the units shall subscribe to and pay or provide for garbage removal and recyclable service as required by ordinance.

(Ord. No. 71-99, § 1, 7-6-99)

Sec. 18-18. Maintenance of containers.

Every container required by this article shall be maintained in as sanitary condition as possible in view of the use to which it is put, and shall be thoroughly cleansed as needed by washing, sanitizing or otherwise.

(Ord. No. 73-75, § 6, 11-17-75; Ord. No. 88-81, § 5, 11-2-81; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-19. Garbage disposal required.

The occupant, owner or manager of every dwelling, house, apartment or construction site shall remove or have removed all garbage from the premises at least once each week and deposit it in a permitted solid waste facility. The occupant, owner or manager of every place of business and building shall remove or have removed all garbage from the premises at least three times each week and deposit it in a permitted solid waste facility.

(Ord. No. 73-75, § 7, 11-17-75; Ord. No. 43-93, § 2, 5-17-93; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 2, 6-2-97)

Sec. 18-20. Yard waste collection.

Yard waste shall be collected by licensed garbage haulers. Yard waste shall be deposited in a proper container, a Kraft-type paper bag designated for yard waste, or a 32-gallon rigid watertight container with a tightly fitted cover, and placed at the location clearly visible other than curbside, designated for collection by the licensed hauler contracted to remove the same. All yard waste and containers therefore shall be kept in an inconspicuous place except when placed for collection. Yard waste shall be collected or removed at a minimum of once a week.

(Ord. No. 60-92, § 3, 6-22-92; Ord. No. 72-92, § 1, 8-3-92; Ord. No. 43-93, § 4, 5-17-93; Ord. No. 70-93, § 1, 9-20-93; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-21. Residential recyclable collection and containers.

Residential recyclables shall be collected at least once a month by a licensed garbage hauler. Recyclables shall be separated from household garbage and rubbish and deposited in a proper recycling container and placed at a location clearly visible, other than curbside as directed by the licensed hauler contracted to remove the same. All recyclables and containers therefore shall be kept in an inconspicuous place except when placed for collection. Residential recyclables collected shall not be deposited at the sanitary landfill. The separation of glass, paper products, and other recyclable materials shall be on a voluntary basis.

(Ord. No. 43-93, § 5, 5-17-93; Ord. No. 70-93, § 2, 9-20-93; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 3, 6-2-97)

Sec. 18-22. Commercial and business recyclable collection.

Commercial and business establishments, except apartments, shall separate recyclable materials except glass and plastics other than #1 and #2 generated by or accruing to such establishment prior to removal. Commercial and business recyclable materials shall not be deposited at the sanitary landfill. Commercial and business recyclables shall be removed from the premises at a minimum of once a month.

(Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 4, 6-2-97)

Sec. 18-23. Apartment recyclables.

Every owner of an apartment shall do the following to facilitate recycling in each such building:

(1) Provide adequate recycling containers for recyclable material. Containers shall be stored on the premises in a screened location that is convenient for the deposit and collection of recyclables.

(2) Provide for the separation of all residential recyclables generated by or accruing to such establishment.

(3) Distribute written information to the building tenants at the time of leasing and at least annually thereafter regarding the established recycling program.

(4) Post a copy of the recycling information in a conspicuous place available to all residents.

(5) Provide a copy of the recycling information that is annually provided to the apartment tenants by filing the same before January 1 of each year with the city public works department.

(Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 5, 6-2-97; Ord. No. 15-03, § 2, 2-10-03)

Secs. 18-24– 18-27. Reserved.

ARTICLE III.
SANITARY LANDFILL

Sec. 18-28. Designation.

The city council shall designate an area to be known as the sanitary landfill which shall be for the depositing of garbage, litter, animal waste, rubbish and waste materials.

(Ord. No. 73-75, § 8, 11-17-75; Ord. No. 88-81, § 6, 11-2-81; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 6, 6-2-97)

Sec. 18-29. Unlawful deposits.

It shall be unlawful for any person to deposit or cause to be deposited any garbage, rubbish, animal waste or other waste material in or upon any park, street, alley, gutter or in or upon any other private or public property within this city or upon any other property on the route between this city and the sanitary landfill area.

(1957 Rev. Ords., § 7.908; Ord. No. 2308, 12-14-64; Ord. No. 88-81, § 7, 11-2-81; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-30. Rates for use.

(a) Garbage, rubbish, or other waste material generated in Minnehaha, McCook, Lincoln, Turner, and Lake Counties, South Dakota, deposited at Sioux Falls landfill:

(1) Passenger car: $5.00 to include surcharge.

(2) Pickup trucks, panel trucks and two-wheel trailers not to exceed three cubic yards: $10.00 to include surcharge.

(3) Four-wheel trailers and trucks: $12.75 per ton, plus surcharge.

(b) Garbage, rubbish, or other waste material generated outside of Minnehaha, McCook, Lincoln, Turner, and Lake Counties, South Dakota, but still generated within the borders of the state: $63.00 per ton.

(c) Garbage, rubbish, or other waste material generated outside the state: $135.00 per ton.

(d) In addition to the above rates for solid waste, there will be added thereto a surcharge of $1.00 per ton collected pursuant to statute for the state.

(e) Yard waste:

(1) Commercial haulers: Yard waste generated in Minnehaha, McCook, Lincoln, Turner and Lake Counties, South Dakota: $5.50 per ton.

(2) Individuals: Yard waste generated in Minnehaha, McCook, Lincoln, Turner and Lake Counties, South Dakota: $5.50 per ton, or $0.50 per bag.

(3) Yard waste generated outside Minnehaha, McCook, Lincoln, Turner and Lake Counties, South Dakota, but still generated within the borders of the state: $11.00 per ton or $2.20 per bag.

(4) Yard waste generated outside of the state: $16.50 per ton.

(5) Leaves generated in the City of Sioux Falls: $0.50 per bag, $1.00 per passenger car, $2.00 per pickup truck or two-wheel trailer.

(f) Tires:

(1) Motorcycle, bicycle and smaller tires not listed smaller than passenger car and light truck tires: $0.50 each or $110.00 per ton.

(2) Passenger car and light truck tires 16.5 inches or less in diameter: $1.00 each or $110.00 per ton.

(3) Semitruck, truck and bus tires larger than 16.5 inches in diameter: $5.00 each or $110.00 per ton.

(4) Agricultural: $10.00 each or $110.00 per ton.

(5) Heavy equipment tires: $250.00 per ton.

(g) Special waste generated in Minnehaha, McCook, Lincoln, Turner and Lake Counties, South Dakota:

(1) Asbestos: $9.00 per cubic yard based on the manufacturer's box rating or on box capacity as determined through measurement by the city.

(2) Gasoline or fuel oil contaminated soils, materials, sediments, etc.: $8.25 per ton.

(3) Co-mingled gasoline and fuel oil and/or waste oil contaminated soils, materials, sediments, etc.: $10.50 per ton.

(4) Anti-freeze contaminated soils, materials, sediments, etc.: $6.25 per ton.

(5) The minimum charge under this section is a three cubic yard or three ton charge.

(h) Special waste generated outside Minnehaha, McCook, Lincoln, Turner and Lake Counties, South Dakota, but still generated within the borders of the state:

(1) Asbestos: $45.00 per cubic yard based on the manufacturer's box rating or on box capacity as determined through measurement by the city.

(2) Gasoline or fuel oil contaminated soils, materials, sediments, etc.: $41.00 per ton.

(3) Co-mingled gasoline and fuel oil and/or waste oil contaminated soils, materials, sediments, etc.: $52.00 per ton.

(4) Anti-freeze contaminated soils, materials, sediments, etc.: $30.00 per ton.

(5) The minimum charge under this section is a three cubic yard or three ton charge.

(i) Special waste generated outside the state:

(1) Asbestos: $95.00 per cubic yard based on the manufacturer's box rating or on box capacity

as determined through measurement by the city.

(2) Gasoline or fuel oil contaminated soils, materials, sediments, etc.: $87.00 per ton.

(3) Co-mingled gasoline and fuel oil and/or waste oil contaminated soils, materials, sediments, etc.: $111.00 per ton.

(4) Anti-freeze contaminated soils, materials, sediments, etc.: $66.00 per ton.

(5) The minimum charge under this section is a three cubic yard or three ton charge.

(j) Solid waste generated in Minnehaha, McCook, Lincoln, Turner, and Lake Counties, South Dakota, from the treatment of regulated medical waste: $12.75 per ton.

(k) Solid waste generated outside Minnehaha, McCook, Lincoln, Turner, and Lake Counties, South Dakota, but still within the borders of the state, from the treatment of regulated medical waste: $63.00 per ton.

(l) Solid waste generated outside of the state, from the treatment of regulated medical waste: $135.00 per ton.

(m) In addition to the above rates for solid waste, generated from the treatment of regulated medical waste, there will be added thereto a surcharge of $1.00 per ton collected pursuant to statute for the state.

(n) Untarped loads: $10.00.

(1) Exceptions from the tarping ordinance shall include the following: asphalt, concrete, steel, white goods, or tires if loaded in a manner such that the items are not likely to fall or be blown from the vehicle.

(o) The city may charge patrons of the sanitary landfill, compost site, or the rubble site any and all costs associated with the patrons' failure to follow sanitary landfill, compost site, or rubble site rules and procedures for any class of waste.

(p) Deer or elk carcasses generated within the state: private individuals, no charge up to ten carcasses; businesses, $50.00 per ton.

(q) Deer or elk carcasses generated outside the state: $500.00 per ton.

(1957 Rev. Ords., § 7.909; Ord. No. 2308, 12-14-64; Ord. No. 2655, 12-8-69; Ord. No. 21-72, 4-17-72; Ord. No. 44-73, § 1, 5-14-73; Ord. No. 50-75, § 1, 9-2-75; Ord. No. 56-76, § 1, 6-28-76; Ord. No. 18-79, § 1, 3-12-79; Ord. No. 107-86, 12-8-86; Ord. No. 127-89, §§ 1, 2, 12-11-89; Ord. No. 36-90, §§ 1, 2, 4-16-90; Ord. No. 125-90, § 1, 12-24-90; Ord. No. 35-91, § 1, 4-8-91; Ord. No. 71-91, § 1, 9-23-91; Ord. No. 5-92, § 1, 1-21-92; Ord. No. 28-92, §§ 1, 2, 3-9-92; Ord. No. 60-92, § 4, 6-22-92; Ord. No. 105-92, § 1, 12-7-92; Ord. No. 70-93, § 3, 9-20-93; Ord. No. 95-93, § 1, 12-6-93; Ord. No. 73-94, §§ 1, 2, 8-15-94; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 2, 8-6-01; Ord. No. 99-02, § 1, 11-25-02; Ord. No. 15-03, § 3, 2-10-03)

Sec. 18-31. Reserved.

Editor's note: Ord. No. 149-95, § 1, adopted Nov. 20, 1995, repealed former § 18-31, which pertained to manner of payment of charges.

Sec. 18-32. Certain materials excluded.

The following materials shall be excluded from the solid wastes deposited at the landfill site:

(1) Office paper.

(2) Corrugated cardboard.

(3) Plastic containers #1 and #2.

(4) Metal containers.

(5) Automobile bodies or other bulky articles.

(6) Trees and tree limbs, unless they have been cut into pieces not exceeding eight feet in length.

(7) Oils, gasoline and other petroleum products.

(8) Hazardous materials.

(9) Yard waste.

(10) Lead acid batteries.

(11) Waste tires.

(12) White good appliances.

(13) Regulated medical waste.

(14) Radioactive materials.

Any person bringing material for deposit at the landfill, upon entry onto the landfill premises, authorizes the city to inspect the material before deposit. If excluded materials are discovered during the inspection, the city may refuse the entire load and charge the person attempting to deposit the materials the cost of the inspection.

(1957 Rev. Ords., § 7.910; Ord. No. 2308, 12-14-64; Ord. No. 19-72, 4-10-72; Ord. No. 56-74, § 1, 10-21-74; Ord. No. 73-75, § 9, 11-17-75; Ord. No. 88-81, § 8, 11-2-81; Ord. No. 60-92, § 5, 6-22-92; Ord. No. 56-94, § 1, 6-20-94; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 43-97, § 7, 6-2-97; Ord. No. 75-01, § 3, 8-6-01; Ord. No. 15-03, § 4, 2-10-03)

Sec. 18-33. Removal restricted.

It shall be unlawful for any person to remove or cause to be removed from the rubble sites or sanitary landfills of this city any articles or material of any kind after the articles or materials have been deposited there, with the exception of the following:

(1) The city reserves the right to enter into a contract with a person for the right of resource recovery at rubble sites.

(2) The city reserves the right to allow the cutting and removal of firewood from city rubble sites; provided, that persons cutting and removing firewood wear protective clothing and abide by safety regulations posted at the sites.

(3) The city reserves the right to allow removal of finished compost and wood chips.

(1957 Rev. Ords., § 7.911; Ord. No. 2308, 12-14-64; Ord. No. 25-88, § 1, 4-11-88; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-34. Private landfill unlawful.

No person shall operate or permit the operation of a disposal site in the city for the disposal of garbage, litter, rubbish or animal waste.

(Ord. No. 19-72, 4-10-72; Ord. No. 73-75, § 10, 11-17-75; Ord. No. 82-79, § 1, 9-4-79; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-35. Refusal to admit certain vehicles.

The city may refuse the admittance or the unloading at the sanitary landfill of the following vehicles:

(1) Those so loaded or uncovered so that material may fall or be blown off the vehicle while in transit.

(2) Those not having a permit displayed as required by section 18-52.

(3) Those containing special wastes not having received prior approval of the director or his designee or not having provided the landfill a minimum of 24 hours notice of intent to deliver said special wastes.

(4) Those containing materials in a form which when unloaded at the landfill will blow or is prone to blow from the face of the landfill.

(5) Those containing solid waste from the treatment of regulated medical waste not having documentation of waste sources and third party testing.

(Ord. No. 55-74, § 1, 10-21-74; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 4, 8-6-01; Ord. No. 15-03, § 5, 2-10-03)

Cross references: Traffic, ch. 40.

Secs. 18-36– 18-43. Reserved.

ARTICLE IV.
COMMERCIAL HAULERS

Sec. 18-44. License required.

No commercial garbage hauler shall use the streets for the collection, removal or disposal of any garbage, animal waste, rubbish or recyclable materials without first having obtained a garbage hauler's business license from the city.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 98-02, § 1, 11-18-02)

Sec. 18-45. Chapter 23 applicable.

The provisions of chapter 23, insofar as the chapter may be applicable and not in conflict, shall apply to and govern the issuance of any license under the provisions of this article.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-46. Reserved.

Editor's note: Ord. No. 15-03, § 6, adopted Feb. 10, 2003, repealed § 18-46, which pertained to application for business license. See the Code Comparative Table.

Sec. 18-47. Reserved.

Editor's note: Ord. No. 39-95, § 1, adopted Mar. 6, 1995, repealed former § 18-47, which pertained to approval required.

Sec. 18-48. Transfer.

A business license issued under the provisions of this article may be transferred after paying the city a transfer fee as set out in section 23-25(4). The transfer will be approved only to a business operation meeting the minimum start-up requirements for garbage hauling. Individuals or businesses having a controlling interest in an existing garbage hauling operation cannot have a monetary interest in other licensed garbage hauling operations in the city. Business licenses transferred upon sale of a business to a new owner may be reissued in the name of the previous owner upon payment of a reissuance fee, compliance with the provisions of this article and proof that the business has been returned.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-49. Expiration.

Every business license issued under the provisions of this article, unless renewed, shall expire on December 31 following its date of issuance. Sale of a licensed garbage hauling business to an existing licensed garbage hauling business will cause the seller's license to expire upon consummation of the sale.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 7, 2-10-03)

Sec. 18-50. Hauling unit permits.

A permit fee as set out in section 23-25(4) shall be charged for each hauling unit used by the licensee to transport garbage.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-51. Unit inspection required.

All hauling units permitted under this article shall be subject to random inspections by the city. Random inspections include inspections of vehicles, equipment, and contents delivered to the landfill for deposit.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 8, 2-10-03)

Sec. 18-52. Display of permit.

The permits issued for the hauling units under this article shall be permanently displayed on each unit permitted to carry garbage.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-53. Minimum design and capacity requirements for vehicles and containers.

All garbage haulers are required to have watertight vehicles or containers which shall be permanently covered with no openings on top that would allow the contents to escape. All metal boxes are required and shall be equipped with metal doors which shall be in a closed position when the truck is in motion. Containers must be attached to the frame when in transport. Vehicles and containers must be manufactured or designed for garbage hauling. Pickup trucks containing dumpsters, open-framed boxes and wood-framed trucks are prohibited. Such vehicles or containers shall be thoroughly washed at such times as may be directed by the city or as may be necessary to keep the vehicles or containers in proper sanitary condition. Such vehicles or containers transporting garbage and rubbish or animal waste shall be so loaded that all the material shall be carried within the metal containers.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 9, 2-10-03)

Cross references: Motor vehicles, ch. 25.

Sec. 18-54. Loading of vehicles.

Vehicles used for transporting rubbish, animal waste and waste materials shall be loaded so that no materials shall fall off or be blown off the vehicle while in transit. Loosely loaded vehicles with open boxes must be tarped.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-55. Reserved.

Editor's note: Ord. No. 39-95, § 2, adopted Mar. 6, 1995, repealed former § 18-55, which pertained to revocation.

Sec. 18-56. Frequency of collection.

Every licensed and unlicensed garbage collector or hauler shall collect the garbage, rubbish and animal waste from the residential districts at least once each week and from the business districts at least three times in each week. The collections in the business district shall be made as early in the day as convenient. Garbage, rubbish and animal waste loaded in a hauling unit must be in transport to a proper disposal site within 48 hours after pickup.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 43-93, § 3, 5-17-93; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-57. Minimum vehicle requirements.

Individuals or businesses seeking a garbage hauler's business license shall provide proof of ownership of a minimum of one packer truck in good working condition. This requirement shall not apply to businesses using roll-off containers exclusively.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-58. Proof of insurance required for license.

No license shall be issued to any garbage hauler until proof of insurance is furnished to the city, showing such insurance to be in full force and effect during the entire term of the business license. The licensee shall furnish proof of liability insurance for public liability and property damage and for bodily injury/death growing out of any one accident or any other cause in the minimum sum of $250,000.00 for one person, with an annual aggregate limit of $500,000.00 for two or more persons; and in addition shall provide damage liability insurance in the minimum of $100,000.00 for property damage growing out of any one accident or other cause, or as an alternative, provide combined limit for bodily injury/death or property damage in the sum of $500,000.00. Such public liability and property damage insurance shall protect against loss from liability imposed by law for damages on account of bodily injury, including death resulting therefrom, suffered or alleged to have been suffered by any person resulting directly or indirectly from any act or activity of the licensee or any person acting for the licensee or under the licensee or under the licensee's control or direction and also to protect against loss from liability imposed by law for damages to property of any person caused

directly or indirectly by acts or activities of the licensee or any person acting for the licensee or under the licensee's control or direction.

(Ord. No. 111-89, § 1, 10-16-89; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-59. Solid waste collection rates.

All licensed garbage haulers shall file, as a part of their application for a business license, a general statement of their use rate structures and billing systems consistent with the city's comprehensive plan of solid waste reduction and recycling program which shall include the following elements:

(1) A rate to reward people who reduce their level of solid waste collection service based either upon volume or weight.

(2) A rate to provide customers with adequate options and incentives to reduce their weekly level of solid waste collection service and the amount of solid waste collected as a result of their participation in waste reduction and recycling programs.

(3) A rate that includes the combined cost of solid waste, using the above elements, and recycling collection services.

(Ord. No. 43-93, § 6, 5-17-93; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-60. Garbage haulers licensed recyclable collectors.

Licensed garbage haulers shall be licensed recyclable collectors.

(Ord. No. 43-93, § 7, 5-17-93; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-61. Licensed recyclable collectors.

It shall be unlawful to purchase or use the streets for the collection of recyclables without first having obtained a recyclable collectors' license from the city. Only licensed garbage haulers may collect residential recyclables.

(Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-62. Reserved.

Editor's note: Ord. No. 15-03, § 10, adopted Feb. 10, 2003, repealed § 18-62, which pertained to application for recycable collectors' license; expiration. See the Code Comparative Table.

Sec. 18-63. Filing of reports.

Every licensed recyclable collector shall file an annual report before January 30 with the city on forms provided by the city showing the total weight by type of recyclables collected during the prior year and delivered to a recycling collection and/or processing facility not licensed by

the city. Records relating to recycling activities shall be kept confidential upon request, to the extent necessary, to protect proprietary information.

(Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 11, 2-10-03)

Sec. 18-64. Recycling collection and/or processor; license required.

It shall be unlawful to purchase recycled materials or operate a recycling collection facility or a recycling processing facility without first obtaining a recycling collection and/or processing facility license from the city.

(Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-65. Reserved.

Editor's note: Ord. No. 15-03, § 12, adopted Feb. 10, 2003, repealed § 18-65, which pertained to application for recycling and collection and/or processors' license; expiration. See the Code Comparative Table.

Sec. 18-66. Filing of reports.

Every licensed recycling collection and/or processing facility shall file a monthly report before the 15th of the following month with the city on forms provided by the city, showing the total weight by type of recyclables purchased and/or processed during the reporting period. Records relating to recycling activities shall be kept confidential upon request, to the extent necessary, to protect proprietary information.

(Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 13, 2-10-03)

Sec. 18-67. Confidentiality of information.

The information disclosed under sections 18-59, 18-63 and 18-66 of this article may be disclosed only to the following:

(1) The licensee who is required to submit the information to the department, or his designee appointed in writing;

(2) Officers, employees, or legal representatives of the department for the purposes of, and only to the extent necessary in, the administration of this section;

(3) Any agency, body, commission, or legal representative of the United States or the State of South Dakota charged with the administration of solid waste management, and only to the extent necessary in, the administration of such laws and regulations; and

(4) To the extend required by a proper judicial or administrative order.

(Ord. No. 28-96, § 1, 3-4-96)

Secs. 18-68– 18-69. Reserved.

ARTICLE V.
SOLID WASTE, REGULATED MEDICAL WASTE, TRANSFER AND RECYCLING FACILITIES*

Editor's note: Ord. No. 75-01, § 5, adopted Aug. 6, 2001, amended the title of Article V to read as herein set out. See the Code Comparative Table.

Sec. 18-70. License required.

No person shall operate a solid waste or regulated medical waste, transfer or treatment facility without first having obtained a license to perform such service from the city.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 6, 8-6-01; Ord. No. 15-03, § 14, 2-10-03)

Sec. 18-71. Application for license.

A written application for a license required by this chapter, if not provided for otherwise shall be filed with the city and shall set forth the following information:

(1) The true name and address of the owner or operator of the facility or site.

(2) Legal description of the place where the facility or site will be located.

(3) A schematic drawing of buildings and other structures, showing layout and general dimensions for unloading, storage, compacting, processing, parking and loading areas.

(4) The description of equipment including type, capacity and number of units.

(5) A description of the fire-control equipment and additional emergency firefighting equipment that will be located at the facility or site.

(6) An estimate of the design capacity and current daily capacity of the facility in tons.

(7) Anticipated amount and planned method for final disposal of authorized collections.

(8) Insurance requirements:

a. Workers' compensation insurance providing the statutory limits required by South Dakota law. In addition, it shall provide coverage B, employer's liability coverage, of not less than $1,000,000.00 each accident, $1,000,000.00 disease– Policy limits. The required limit may be met by excess liability (umbrella) coverage.

b. Commercial general liability insurance providing occurrence form contractual, personal

injury, bodily injury, and a property damage and liability coverage with limits of at least $1,000,000.00 per occurrence, $2,000,000.00 general aggregate, and $2,000,000.00 aggregate products and completed operations. The required limit may include excess liability (umbrella) coverage. If "occurrence form" insurance is not available, "claims made" insurance will be acceptable.

c. Automobile liability insurance covering all owned, nonowned, and hired automobiles, trucks, and trailers. The coverage shall be as broad as that found in the standard comprehensive automobile liability policy with limits of not less than $1,000,000.00 combined single limit each occurrence. The required limit may include excess liability (umbrella) coverage.

The city's approval or acceptance of certificates of insurance does not constitute city assumption of responsibility for the validity of any insurance policies nor does the city represent that the above coverages and limits are adequate to protect any individual/group or business, and assumes no liability therefor.

(9) A bond shall be filed with the city finance office in an amount of at least $25,000.00, indemnifying the public against damages sustained because of any spill, dump or discharge occurring at the transfer, collection or processing facility or during transport from the facility to a permanent disposal site.

(10) A written emergency operational plan to provide for an alternative waste-handling system during periods of in operation, if applicable.

(11) A statement of the proposed days and hours of operation.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 7, 8-6-01; Ord. No. 15-03, § 15, 2-10-03)

Sec. 18-72. Transfer.

Licenses issued pursuant to this chapter are not transferable.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-73. Renewal.

The city may, upon reapplication, renew a license issued under this article.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 16, 2-10-03)

Sec. 18-74. License fees.

On filing an original application or a renewal application for a license to operate a solid waste or regulated medical waste transfer or treatment facility, or a solid waste transfer site, the applicant shall pay a fee as provided for in Chapter 23.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 9, 8-6-01)

Sec. 18-75. Denial or revocation.

The license required by this chapter may be denied or revoked by the city if one or more of the following facts or circumstances are found to exist:

(1) The applicant is not able to obtain the necessary bonding and insurance.

(2) The facility is permitted to operate in such a manner as to create air, land or water pollution, public health hazards or nuisances.

(3) The facility or site is not maintained in a clean and sanitary condition.

(4) Violation by the licensee of applicable noise and fire ordinances.

(5) Violation by the licensee of any applicable provision of this Code, state law, rule or regulation.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 17, 2-10-03)

Sec. 18-76. Operating requirements.

General requirements and operation procedures for solid waste transfer facilities are listed as follows:

(1) Storage of salvage. Salvaging and volume reduction operations shall be restricted to a specified, clearly identified area of the transfer facility. Salvage materials generated onsite or imported shall be stored away from other activity areas and be limited to a volume as approved by the health department. Stored materials salvaged from solid wastes shall be ancillary to the operation of the facility, unless such storage is planned as an integral part of the operation.

(2) Drainage control. Surface drainage shall be handled as specified in the facility design. Storm water drainage leaving the facility shall not contain pollutants, solids, washwater or leachate emanating from solid wastes or any other process wastewater.

(3) Housekeeping. A high standard of housekeeping is required in the maintenance of station equipment. Accumulation of fuel drums, parts, inoperable equipment, tires, scrap and similar items must be minimized unless reasonably screened from outside the station boundary.

(4) Odor control. The facility shall not be a source of odor nuisances.

(5) Equipment construction. All equipment used for the collection and transportation of solid wastes shall be durable, easily cleanable and designed for safe handling and constructed to prevent loss of waste from the equipment during collection or transportation. All equipment shall be maintained in a good condition and cleaned in a frequency and in a manner to prevent

the propagation or attraction of flies, mosquitoes, rodents, birds and other vectors.

(6) Frequency of removal. Waste can be stored at the transfer facility or site for no longer than 48 hours. A weekly removal of salvaged waste material is required. Other frequencies may be acceptable, so long as they do not result in health or safety problems and are authorized by the health department.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 15-03, § 18, 2-10-03)

Sec. 18-77. Volume reduction permitted.

Volume reduction operations, such as baling, shredding, compacting or salvaging, are permitted at a solid waste transfer facility, provided they are conducted in a controlled manner as an integral part of the operation and in conformance with conditions established by the health department. Volume reduction activities shall not interfere with other aspects of the station operation and shall be controlled to minimize health, safety or nuisance problems.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95)

Sec. 18-78. Conduct prohibited.

The following conduct is prohibited, unless the applicable permit to allow such activity has been obtained and the operation is in accordance with the appropriate federal, state and local laws, rules and regulations:

(1) Scavenging.

(2) Acceptance of hazardous substances.

(3) Acceptance of regulated medical wastes.

(4) Acceptance of liquid wastes.

(Ord. No. 93-88, § 2, 10-24-88; Ord. No. 149-95, § 1, 11-20-95; Ord. No. 75-01, § 8, 8-6-01)

Sec. 18-79. Requirements for disposal of solid waste generated from the treatment of regulated medical waste.

Any person that brings solid waste generated from the treatment of regulated medical waste to the landfill shall meet the following requirements:

(1) Provide documentation that the waste has been properly treated. Sampling and testing of the solid waste generated from the treatment of regulated medical waste shall be performed by a method and frequency approved by the city.

(2) Maintain waste manifests containing information regarding the waste generators and quantities of materials treated from each source.

(3) Allow the city to inspect the treatment facility and required records.

(4) The facility shall maintain all records for a minimum of three years.

(Ord. No. 75-01, § 10, 8-6-01; Ord. No. 15-03, § 19, 2-10-03)

ARTICLE VI.
SOLID WASTE PLANNING BOARD

Sec. 18-80. Creation.

There is hereby created a solid waste planning board.

(Ord. No. 61-98, § 1, 6-15-98)

Sec. 18-81. Composition of board.

The solid waste planning board shall be composed of 13 members appointed by the mayor with the advice and consent of the council:

(1) Eight members shall be voting members and selected as follows:

a. Three members shall be city employees who shall serve at the pleasure of the mayor.

b. One member shall be a representative of the garbage/recycling industry.

c. One member shall be from the Minnehaha County Planning Office.

d. Three members shall be citizens of Sioux Falls who have no financial interest in the garbage/recycling industry.

(2) Five members shall be nonvoting members and selected as follows:

a. One representing Lake County.

b. One representing Lincoln County.

c. One representing McCook County.

d. One representing Turner County.

e. One representing the City of Madison.

(3) The terms of members, except the three city employees, shall be for a period of three years.

(Ord. No. 61-98, § 1, 6-15-98)

Sec. 18-82. Purpose.

(a) Review the current waste stream of the users of the Sioux Falls landfill and investigate how the waste stream may vary in the future and analyze how current and future recycling efforts may impact on the waste stream.

(b) Assess the availability of markets and potential markets for recyclable materials on the local, regional, and national scale, including collection sites, actual recycling operations, prices, and any related matters.

(c) Develop plans for public education programs for waste reduction and recycling.

(d) Develop plans and pilot projects to achieve waste reduction and recycling goals and provide economic, environmental, and social cost-benefit analysis for each project.

(e) Assess current ordinances and statutes and recommend appropriate changes.

(f) Review and analyze alternative methods (other than landfilling) for disposal of "special wastes," i.e., hazardous wastes generated by households and small quantity generators, waste oil, tires, batteries, pesticides, and any other problem wastes.

(g) Make ongoing reports to the mayor of its findings and recommendations.

(Ord. No. 61-98, § 1, 6-15-98)

Sec. 18-83. Staff.

The city employee member from the public works department shall act as chairman and secretary for the board. The city attorney shall appoint a staff member of the attorney's office to advise the board.

(Ord. No. 61-98, § 1, 6-15-98; Ord. No. 15-03, § 20, 2-10-03)

APPENDIX A

GEOLOGIC AND HYDROGEOLOGIC DATA

APPENDIX B

ENGINEERING DOCUMENTATION

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FINANCIAL DATA

APPENDIX D

WASTE DIVERSION INFORMATION

APPENDIX E

CITY ORDINANCE, CHAPTER 18, GARBAGE AND TRASH