FARWELL LANDFILL
COMPREHENSIVE DOCUMENT
(WORK PLAN, OM&M MANUAL, AND EMP)
CATTARAUGUS COUNTY, NY

Prepared for

CATTARAUGUS COUNTY, NEW YORK

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

The Cattaraugus County Department of Public Works is responsible for maintaining the County's closed Farwell Landfill in the Town of Ischua, NY. This comprehensive document has been prepared to establish three separate programs that will contribute to the County's successful implementation of a long-term post-closure monitoring and maintenance strategy. Each program will contribute to the long-term effectiveness of the final site remedy, and is addressed in the following chapters of this document:

A. **Chapter 2 – Work Plan.** The work plan describes field work that will be completed in advance of developing a final site remediation design. The goal of the field work will be to fill data gaps that currently prevent the development of a final design, and also to expand monitoring capabilities, which will be part of the remedial design.

B. **Chapter 3 – Operations, Monitoring, and Maintenance (OM&M) Manual.** The OM&M Manual describes specific monitoring and maintenance activities that will occur over the long term after actual construction of the final design.

C. **Chapter 4 – Environmental Monitoring Plan (EMP).** The EMP describes the quarterly monitoring program that will take place in fulfillment of New York State Solid Waste Regulations (Part 360, 1988). This standard program will be concurrent with the special monitoring requirements described in the OM&M Manual.

The objectives of the above programs are to:

1. Provide an adequate level of monitoring and maintenance to minimize future impacts to human health and the environment.

2. Provide a consistent and well-documented procedure for completing the required monitoring and maintenance.

3. Satisfy regulatory obligations relating to New York State Solid Waste Regulations (6 NYCRR Part 360, 1988) and the 2000 Record of Decision (ROD).

1.2 BACKGROUND

The Farwell Landfill is located on Farwell Road, off of Route 16, in the Town of Ischua, Cattaraugus County, NY (Figure 1-1). The landfill occupies the northern portion of property owned by the County, located along the western wall of the Ischua Creek valley. Farwell Road passes along the southern side of the site, while the western side is bounded by a narrow strip of trees and fields. The northern and eastern sides are bounded by a bend in Ischua Creek and an active Norfolk and Southern railroad line (Figure 1-2). At its closest point, the creek is approximately 400 feet from the landfill.

The landfill was constructed in phases to form three contiguous areas. Phase I and II areas of the landfill are unlined. Active disposal of municipal solid wastes, resource recovery ash, and New York State Department of Environmental Conservation (NYSDEC) approved non-hazardous industrial wastes took place in these areas until 1984, when these areas reached capacity. The Phase III area of the landfill was constructed with a compacted soil liner and leachate collection system. This particular area accepted only commercial, permitted industrial, C&D waste, and incinerator ash. The ash was used primarily as daily cover material. The Phase III portion of the landfill was utilized until 1989.

Following closure in 1989, the entire landfill was capped with 12 to 18 inches of compacted soil followed by a 6-inch topsoil layer. The cap has an established vegetative cover consisting of mixed grasses and herbaceous plants. During closure, leachate collection piping was added to the southeastern, eastern, and western sides of the landfill in areas where leachate outbreaks had been observed. Currently, leachate is collected in two 10,000-gallon storage tanks located on the eastern portion of the site. Leachate is pumped from the tanks as needed and transported off site to a permitted wastewater treatment facility.

A number of investigations have been completed over the years at the landfill in order to determine the extent of groundwater contamination. Water quality data from the monitoring wells and Ischua Creek is available from the 1970s to the present. Groundwater monitoring undertaken prior to the remedial investigation indicated the principal contaminants of concern at the Farwell Landfill are chlorinated volatile organic compounds (VOCs). These include

trichloroethene (TCE), vinyl chloride (VC), chloroethane, 1,1-Dichloroethene (1,1-DCE), 1,1-Dichloroethane (1,1-DCA), 1,1,1-Trichloroethane (TCA), and the two isomeric forms of 1,2-Dichloroethene (1,2-DCE) (RI, Stearns & Wheler, 1999). The origin of these compounds is believed to be hazardous waste that was dumped into the landfill.

1.3 REMEDIAL INVESTIGATION

In 1997, Stearns & Wheler conducted a review of existing information on site hydrogeology and groundwater quality from the Farwell Landfill. Based on groundwater analytical data results, evidence showed that the contaminants of concern were naturally degrading in groundwater. However, to make sure that natural attenuation was occurring, several data gaps remained that needed to be studied further in order to support such a claim. The purpose of the remedial investigation was to better define the nature and extent of any contamination that resulted from previous activities at the Farwell Landfill.

The first phase of the RI was conducted between August and September 1998, while the second phase occurred during August and September 1999. For each phase, groundwater, surface water, and sediment samples were collected and analyzed for TCL volatile organics, TAL metals, and Part 360 routine parameters. In addition, samples were analyzed for dissolved gases oxygen, carbon dioxide, and methane. The following section summarizes conclusions used in the Remedial Investigation Report, submitted by Stearns & Wheler in February 1999.

Chemical evidence of landfill-related impacts in groundwater is highest in monitoring wells immediately adjacent to the waste mass (MW-9D, MW-10S/D, MW-11S/D, MW-13D, MW-14S/I). However, further downgradient of the landfill, contaminant levels decrease. Based on historic groundwater records, there has been an overall decline in concentration of the chlorinated compounds over the past several years. The concentrations of chlorinated organic compounds decline from upgradient to downgradient at a rate that exceeds the decline in the conservative tracer chloride. This indicates that the chlorinated compounds are being destroyed, in addition to being dispersed (diluted), along the groundwater flow path. In addition, geochemical indicators of natural attenuation reactions, such as dissolved oxygen, carbon dioxide, pH, and alkalinity, are present in ways that suggest biological and chemical attenuation reactions are occurring.

The chemical quality of the surface water and sediment sample locations (landfill pond, railroad pond, and Ischua Creek) showed no evidence of landfill-related impacts. In addition, both upstream and downstream samples taken from Ischua Creek displayed similar water quality characteristics. Groundwater and creek elevations support that the creek is a local groundwater discharge zone. Because groundwater contours converge towards the creek from both sides, it is clear that the creek is a hydrogeologic boundary which prevents groundwater from flowing from the landfill eastward across the creek.

1.4 RECORD OF DECISION (ROD)

The Record of Decision presents the selected remedy for the Farwell Landfill site that was chosen in accordance with the New York State Environmental Conservation Law (NYSDEC, ROD, March 2000). Based on the results of the remedial investigation/feasibility study (RI/FS) for the Farwell Landfill, the NYSDEC has selected *Alternative 3B: Repaired Cap, Institutional Controls and Natural Attenuation Monitoring* as the site remedy.

In order to mitigate groundwater impact to the environment in areas near the Farwell Landfill, the following remedy will be implemented:

1. Repair damaged or settled portions of the existing landfill cover. It is estimated that one third of the landfill cap (approximately 5 acres) will need some repair, due to settling of buried waste that has occurred over the years. Cap repairs will prevent water from ponding on the landfill surface, which will reduce the potential for infiltration and production of leachate.

2. Supplement the existing perimeter fence with vegetation barriers to restrict public access to the landfill. A hedge of thorny shrubs will be planted along Farwell Road and the railroad to limit trespassers from eroding the existing low permeability soil cap.

3. Continue the ongoing collection and off-site treatment of leachate from the landfill.

4. Conduct long-term groundwater sampling to monitor the natural attenuation of contaminants in areas of groundwater impact. This will involve the installation of three new groundwater monitoring wells downgradient of the landfill site.

5. Place deed restrictions on the impacted County owned property to preclude the installation of drinking water wells.

6. Identify and decommission existing monitoring wells that are no longer needed for the future monitoring programs.

CHAPTER 2

WORK PLAN

2.1 GENERAL

This comprehensive work plan sets forth the work that will be completed as a precursor to preparing a remedial design for the Farwell Landfill, located in the Town of Ischua, NY. Cattaraugus County Department of Public Works operated the Farwell Landfill from 1975 until 1989, when the last phase of the landfill was closed pursuant to a 1984 NYSDEC consent order (84-106). This prompted the installation of several additional groundwater monitoring wells around the landfill perimeter to supplement wells that had already been in place a number of years.

In 1996, the NYSDEC classified the landfill as a Class 2 inactive hazardous waste site. Such a classification suggested that the site might represent a significant threat to the public health or environment, and that action might be required. Industrial wastes containing trichloroethene, a chlorinated hazardous waste solvent, were accepted into the landfill at some point in time during the landfill's operation. TCE and several other aliphatic hydrocarbon compounds have been identified in groundwater samples at the Farwell Landfill. Some of the hazardous waste was released or migrated with groundwater from the site toward Ischua Creek and County owned property south of the landfill.

Based on the findings of the FI/FS (Stearns & Wheler, 1997-1999), the NYSDEC, in consultation with the New York State Department of Health (NYSDOH), has selected a remedy to address the potential threat to the environment created by the presence of hazardous waste at the Farwell Landfill. The remedy is presented in the Record of Decision (ROD) for the site. This work plan sets forth the specific tasks that will be completed as the first phase of implementation of that remedy.

2.2 WORK PLAN OBJECTIVES

The work under this plan will constitute the initial phase of remedial design implementation, and will include the following tasks:

1. Decommission three existing groundwater monitoring wells that will no longer be used for future monitoring. Selected wells will be properly abandoned following NYSDEC accepted procedures.

2. Install three compliance monitoring wells south (downgradient) of the landfill in accordance with the ROD. These wells will monitor groundwater quality at the established compliance boundary, to determine that Class GA water quality standards are met.

3. Complete a site topographic survey of the existing landfill cap.

The first two of the above tasks will be completed to establish a monitoring array that is capable of meeting the post-closure requirements as set forth by the ROD, and also Part 360. The third task above will be completed to provide a basis for preparing a scoping document for the cap repairs that will occur as part of the remedial design. Each task is discussed below. Appendix A provides a site-specific health and safety plan that will be observed during the completion of the field work described in Section 2.3.

2.3 SCOPE OF WORK

A. **Well Decommissioning.** The County will identify existing wells that are to be removed from service, and have those wells decommissioned. For the purpose of this work plan, Wells MW-3, MW-4, and MW-7 are tentatively proposed. Final selection of up to three wells will be made once it can be verified that the tentatively proposed wells are still in place and suitable for decommissioning. Stearns & Wheler will negotiate with NYSDEC to allow the selected monitoring wells to be decommissioned by grouting them in place and overdrilling the top 5 feet below surface. A cement/bentonite grout will plug the overdrilled area.

B. **Compliance Well Installation.** In accordance with the site remedy described in the ROD, three compliance groundwater monitoring wells will be installed at a compliance boundary, downgradient (south) of the landfill, to assure that natural attenuation maintains landfill impacts at or below applicable water quality standards before groundwater migrates off Cattaraugus County property (Figure 2-1). The RI/FS indicated that, based on existing levels of impact and groundwater flow dynamics, natural attenuation will reduce constituent concentrations to acceptable levels within 1,500 feet of the landfill's edge. The compliance monitoring wells will therefore be installed approximately 1,500 feet south of the landfill. Stearns & Wheler will

conduct a site visit with County personnel and the NYSDEC to select suitable well locations. The three proposed monitoring wells (MW-21S, MW-22S, and MW-23S) will be installed in the overburden to an estimated total depth of 80 to 100 feet. Once completed, these wells will be incorporated into the final proposed groundwater monitoring network as required by the ROD.

Each monitoring well will be constructed of a 10-foot, 2-inch diameter PVC screen and separate riser. All Part 360 well construction materials, including sand filter pack, fine-grained "choker" pack, bentonite, grout, and protective casings will be appropriately used. Drilling can be completed by hollow-stem augers or by spun casings, depending on the difficulty of drilling conditions. Soil samples will be collected during drilling by split-spoon samplers at standard 5-foot intervals for the first 70 feet, at which point continuous sampling will begin to characterize the anticipated screened horizons. During the drilling procedure, a geologist will maintain drilling logs describing soil classifications, as well as monitoring well completion diagrams showing the depths of installation and materials used.

Following completion, when well materials have set, wells will be developed by a combination of pumping and bailing. Well development will continue until turbidity is below 50 NTU or until the turbidity approaches a stable limit to ensure that representative water samples can be collected and analyzed. County surveying personnel will establish the locations and elevations for the top of PVC for each well with respect to the existing site monitoring array.

The compliance boundary wells will be sampled on a quarterly basis as part of the post-closure monitoring and maintenance program for the landfill, as described in Chapter 3.

C. **Site Topographic Survey.** A New York State licensed surveyor will complete a site-wide survey of the existing cap to determine the areas of settlement that require remedial work. As stated previously, it is estimated that 5 acres of the landfill cap will need to be repaired. The survey will include surface topography at a minimum 2-foot interval. A Stearns & Wheler engineer will coordinate the efforts of the surveyor and participate in an on-site visit prior to the survey to meet with the surveyor and County personnel regarding the project needs. The results of the survey will be used to determine the volume of material that will be needed to regrade the landfill cover, which is necessary information for developing a remedial design scoping document.

D. **Remedial Design Document**. Once the site topographic survey is complete, Stearns & Wheler will complete a remedial design based on the effort and approach needed in repairing the landfill cap, and according to the general requirements of the ROD. The ROD acknowledges that some minor data gaps remain that need to be filled before a detailed design can be prepared. The topographic survey will help resolve existing uncertainty regarding the limits and volume of settlement. However, a conceptual design approach has been developed which includes the following basic elements.

1. In those portions of the landfill where settlement has occurred, the existing topsoil layer will be scraped away and the depressed areas filled with compacted soils matching the low permeability characteristics of the original barrier layer. The topsoil will then be replaced and reseeded.

2. To limit site access, a hedge of thorny shrubs will be planted along the perimeter of the site to supplement the existing fence.

3. The operation of the leachate collection system will continue, with leachate being disposed of off site.

4. Property use restrictions will be placed by the County on the deed for the site to prevent future exposures to residual impacts.

Following completion of the topographic survey, detailed estimates can be made relating to the level of effort and approach for regrading the cap. A remedial design work plan will be developed for NYSDEC review and approval. The final approved remedial design will be stamped by a New York State professional engineer.

2.4 SCHEDULE

The schedule for completing the work described in this chapter is outlined as Figure 2-2.

CHAPTER 3

OPERATIONS, MONITORING, AND MAINTENANCE

The following operations, monitoring, and maintenance (OM&M) requirements are presented as guidance for the post-closure operations at the Farwell Landfill. The Part 360 monitoring program identified a number of contaminants of concern, namely chlorinated organic compounds, in several groundwater monitoring wells downgradient of the landfill. A subsequent remedial investigation generally verified the presence of the chlorinated organics, but also provided chemical evidence that natural attenuation was reducing the contaminant levels as groundwater migrates away from the landfill. The remedial investigation report recommended that monitored natural attenuation be considered as the preferred site remedy, and provided a general basis for future monitoring in order to verify that natural attenuation would continue to be effective.

Based on chemical data provided by the remedial investigation and previous Part 360 monitoring, this chapter describes the OM&M requirements for monitored natural attenuation with regular cap inspections and maintenance as the post-closure remedy at the Farwell Landfill. Appendix B includes a Field Sampling Plan (FSP) that describes the protocols that will govern much of the program described below.

3.1 MONITORING REQUIREMENTS

Cattaraugus County has assumed responsibility for post-closure operations at the Farwell Landfill. The post-closure monitoring program will satisfy two basic needs: (1) fulfill post-closure monitoring requirements pursuant to 6 NYCRR Part 360 (May 1991); and (2) provide an ongoing means for evaluating the effectiveness of natural attenuation as the selected remedial option.

Annual baseline and quarterly routine monitoring is presently being performed on groundwater samples collected at the Farwell Landfill, as required by 6 NYCRR Part 360. In addition to the sampling of groundwater, quarterly leachate samples will be collected from storage tanks, and annual surface water samples will be collected from the landfill pond and Ischua Creek locations upstream (Dutch Hill Road bridge), downstream (Kent Road bridge), and adjacent (Farwell

bridge). This monitoring program is being implemented for a period of 30 years from the date of final closure, as required by NYSDEC, with periodic review and modification as appropriate and allowable by regulation. Presently, quarterly monitoring reports are provided to NYSDEC.

In addition to the above ongoing post-closure monitoring program, Cattaraugus County will implement a supplemental groundwater monitoring program to assess the continued effectiveness of natural attenuation of groundwater impacts. The specific elements of this supplemental monitoring program are presented below.

3.2 SUPPLEMENTAL GROUNDWATER MONITORING

The existing groundwater monitoring system will be expanded, and a supplemental groundwater sampling program will be implemented and maintained during the post-closure period. The protocol used to collect, preserve, and transport the samples will be in accordance with Appendix B, Field Sampling Plan.

The existing monitoring array that is sampled under the County's current Part 360 monitoring program includes quarterly sampling of Wells MW-13D, MW-14S, MW-14I, MW-15S, MW-15I, MW-16S, MW-16D, MW-17S, and MW-17I and annual sampling of Wells MW-9S, MW-9D, MW-10S, MW-10D, MW-11S, and MW-11D. In addition, quarterly sampling of upgradient well location MW-6 will be included as a background sampling point. Wells that are sampled quarterly to fulfill Part 360 post-closure monitoring requirements include three routine and one baseline event each year. Monitoring Wells MW-14S/I, MW-15S/I, MW-16S/D, and MW-17S/I will be rolled into the supplemental monitoring program for ongoing evaluation of natural attenuation.

Table 3-1 lists monitoring wells that are to be sampled as part of the County's supplemental monitoring program. This supplemental program will be in addition to the monitoring that will take place as part of the landfill's Part 360 post-closure program.

The basic additions to the current Part 360 monitoring will be the addition of Wells MW-19S and MW-20D to the monitoring array, as well as the addition of three compliance boundary wells (MW-21S, MW-22S, MW-23S) on County property approximately 1,500 feet downgradient (south) of the edge of refuse (Figure 2-1). These five downgradient compliance wells will be sampled quarterly for 6 NYCRR Part 360 baseline parameters, as well as the dissolved gases

carbon dioxide, oxygen, and methane. Further, existing monitoring well couplets MW-14S/I, MW-15S/I, MW-16S/D, and MW-17SI will undergo quarterly baseline monitoring plus the dissolved gases.

The depths of the compliance wells will be determined based on one test boring that extends down to bedrock at a location approximately 1,500 feet from the landfill. Based on the types of soils encountered, a well will be screened in the test boring to intersect a zone where it appears that soils are most permeable. The other two wells would be screened at similar depths.

The primary objective of the above supplemental program will be to determine whether contaminant levels continue to decline with distance from the landfill, such that the compliance boundary marks the point beyond which groundwater quality returns to background conditions. Further, chemical data collected from the supplemental monitoring well network will be evaluated to determine whether there is chemical evidence that chemical and/or biological attenuation reactions are being sustained. Specific evaluation techniques will include:

1. An evaluation of the dissolved gases (CO_2, O_2, CH_4) which are consumed and produced during biological degradation reactions.

2. An evaluation of the ratios of parent compounds and their degradation products with distance along the groundwater flow path to determine whether it appears that attenuation is being sustained.

3. An evaluation of the decline in concentration for parameters in individual wells over time, and in general, the decline in concentration of individual compounds with distance from the landfill.

4. A comparison of more conservative inorganic parameters, such as chloride, with organic trends to determine whether the apparent attenuation of the organic contaminants of concern exceeds the dispersion (dilution) rate of the conservative tracer.

3.3 REPORTING

In addition to annual Part 360 monitoring reports, the County will provide NYSDEC with quarterly reports which describe the results of the supplemental monitoring program. These reports will include:

1. A discussion of the analytical results, including instances in which water quality standards are exceeded in the supplemental program wells, and a geochemical interpretation of data that provides evidence of chemical and/or biological reactions that sustain attenuation.

2. An evaluation of attenuation that describes the changes in concentrations of contaminants of concern as groundwater travels from the landfill wells (MW-14S/I, MW-15S/I, MW-16S/D) to wells further downgradient (MW-19S, MW-20D) to the compliance boundary (MW-21S, MW-22S, MW-23S).

3. Based on the above presentations, an overall assessment of whether natural attenuation continues to mitigate groundwater impacts in a way that is protective of human health and the environment.

The quarterly report for each year's fourth-quarter event will also include a Part 360 annual summary, as described in Chapter 4.

It is recommended that this supplemental monitoring program be reviewed by the County and NYSDEC after the first two years to determine whether the program needs to be modified, and again after another three years (i.e., five years after implementation).

3.4 MAINTENANCE REQUIREMENTS

The existing landfill cap was constructed in accordance with the requirements of a 1984 consent order and consists of a gas venting layer that extends 18 inches into refuse, covered by a barrier layer of 18 inches (at 10^{-7} cm/sec), covered by 6 inches of topsoil. The topsoil supports a variety of grasses and small non-woody vegetation. The Farwell Landfill will have reduced utility in the future, as inactive landfills generally are unsuitable for agricultural usage or construction. Because a shallow root zone is necessary to maintain the integrity of the compacted soil cover

material, the landfill cannot be reforested. Vegetation should therefore be maintained as it presently exists, as grasses and small non-woody plants. The County intends to maintain both the landfill and the surrounding area within its ownership as open space. Further, the landfill will be surrounded by multi-floral rose shrubbery, which is a hardy, shallow-rooted, spiney, dense shrub that will restrict unauthorized access.

As part of the selected site remedy, the County will implement a formal landfill inspection and maintenance program. This program will occur for the 30-year post-closure monitoring period, or as subsequently amended as appropriate. An initial inspection will occur, and general cap repairs will take place based on that inspection. Repairs may include backfilling depressed areas to promote drainage and minimize infiltration, reseeding bare spots, mowing vegetation, removing trees and wood-stemmed vegetation, repairing drainage conveyances, and generally replacing cover material in damaged areas. The objective of these types of repairs will be to minimize erosion of the cap, enhance drainage of surface water away from the landfill, and minimize infiltration of water into the wastes. The combined effect will be to minimize the future production of leachate, which will reduce the level of groundwater impact over time.

Following the initial inspection and repair, routine maintenance and inspection checks will be conducted monthly from April through November when the surface is free of snow cover, and post-closure inspection reports (Appendix C) will be completed for each inspection. Copies of the monthly inspection reports will be maintained on the site and also in the County's Public Works office. Annual summary reports of the inspection program will be submitted to NYSDEC.

A. **Drainage Ditches and Retention Basins.** Existing drainage features will be checked for failure or obstructions once in the spring and once in the fall, as well as after the occurrence of severe storms (greater than 1 inch of rain per hour). Drainage conveyances will be maintained free of obstructions, damaged or failed sections will be repaired, and sediment build-up removed. Areas on site which are frequently eroded by drainage will be repaired, and riprap or erosion blankets will be placed on them.

B. **Cover and Vegetation.** Post-closure cover maintenance will include:

1. Mowing the vegetation as required to maintain a healthy cover. In general, it is anticipated that mowing will be performed once during the early spring (June) and again in early fall (September) to discourage the growth of woody plants.

2. Revegetating areas as needed; clearing trees and brush.

3. Repairing eroded or settled areas by adding compacted soil and/or topsoil and then reseeding. Heavy equipment and vehicular traffic should be limited to the access road to prevent damage to the cap. In areas with more than 6 inches of settlement, compacted clay fill would be used to fill the depression to within 6 inches below grade, then 6 inches of topsoil would be added and reseeded.

C. **Access Control.** Access control is to be maintained such that unauthorized entrance to the facility is prevented. There is presently no need for public access to the site, and the County owns the majority of lands immediately surrounding the landfill. These facts by themselves will naturally limit public access to the site. However, control will be expanded to include the planting and maintenance of multi-floral rose shrubbery around the landfill perimeter. This plant is shallow rooted, hardy and spiney, requires little maintenance, and will form a dense hedge wall to restrict unauthorized access. This vegetation will be inspected, repaired, and replaced as needed as part of the cover and vegetation check. Further, the landfill's existing supply well has been posted as being unsuitable for drinking. This warning sign will be maintained.

D. **Gas Venting System.** The gas venting system will be inspected for plugging and damage of the vent risers and return bends. If damage has occurred, the vent risers will be replaced from the connecting union. In addition, post-closure maintenance will include regular inspection of the landfill final cover for cracks or stressed vegetation that might signal the release of landfill gas. Areas where there are cracks or where vegetation appears to be stressed will be tested with a portable explosive gas detector. Areas of the final cover which may have been damaged will be repaired and steps taken to prevent future damage, such as the installation of additional vents.

E. **Groundwater Monitoring Wells.** During the monthly routine inspections, the groundwater monitoring wells will be checked to assure that the locks, risers, and caps are in

good condition. Any evidence of damage or tampering will be noted on the inspection forms and repaired.

3.5 CONTINGENCY PLANS

The following contingency plans have been developed to address the possibility that contaminants may be detected within the established compliance boundary wells at some time in the future. The final closure and maintenance plan should minimize the amount of precipitation and overland flows that could infiltrate into landfill wastes. This should reduce the leachate impacts to surface water and groundwater over time. Continued monitoring according to the standard Part 360 monitoring program and supplemental monitoring for natural attenuation will enable the County to determine whether contaminants are migrating beyond the compliance boundary.

The standard Part 360 and supplemental attenuation monitoring programs will continue as described above, and quarterly reports will be submitted to NYSDEC. Requirements for additional analysis or further action will be determined following the first two years of supplemental monitoring, with further review of the program after five years. At these review milestones, the requirements of the supplemental monitoring and maintenance programs will be reviewed and revised. If this strategy determines that significant migration of contaminants is potentially occurring beyond the compliance boundary, or if site contaminants are detected in water supply wells, then the following contingency plans can be implemented.

If impacts, in the form of a water quality exceedance, are detected in the compliance monitoring wells included in the supplemental monitoring program the County will notify NYSDEC within 24 hours of receiving the analytical results. A confirmatory sampling round of the affected compliance wells would occur within 30 days of the initial finding. A written report would be prepared and submitted to NYSDEC within 14 days of receiving the analytical results of the confirmatory round.

If the confirmatory sampling refutes the initial finding, then the quarterly monitoring program would resume for all wells involved in the supplemental monitoring program. If confirmatory sampling verifies the initial finding that a particular well is affected, the following steps would be taken:

1. The County will notify NYSDEC within 24 hours of confirmation of results. If the data indicate a specific residential well is affected, the County would also notify that resident within 24 hours and immediately provide the resident with an alternate water supply, including bottled water and/or the installation of a new well.

2. The County would prepare a field investigation program (FIP) plan, and submit it to NYSDEC within 30 days. The FIP will describe the County's plan for investigating and mitigating the groundwater impacts.

Following the execution of the FIP, if it is determined that corrective action is needed, the County will begin a remedial action contingency plan, which will include the following steps:

1. Complete the approved FIP.

2. Prepare a report which describes the activities of the FIP, including conclusions and recommendations, within 60 days of completing the field investigation.

3. Complete a corrective measures assessment, as needed based on the findings of the FIP, which proposes a preferred remedial alternative (within 60 days of NYSDEC acceptance of FIP report).

4. Begin remediation as outlined in the corrective measures assessment within 30 days of NYSDEC approval of plans and specifications relating to the preferred alternative.

The selected corrective measure would satisfy the following criteria:

1. Protect public health, safety, and the environment.

2. Attain an established groundwater protection standard.

3. Control the source of release to the maximum extent practical so as to reduce or eliminate future releases.

4. Comply with applicable state and federal regulations.

In addition, the County will consider the following six additional criteria when selecting the corrective measure:

1. The long-term and short-term effectiveness and protectiveness of the measure.

2. The probability of success of the corrective measure.

3. The corrective action's effectiveness in preventing the release of additional contaminants.

4. The ease or difficulty of implementation.

5. The technical and economic resources available for implementation.

6. The degree to which community concerns are addressed by the measure.

Remedial actions may include:

1. Additional drainage controls to divert flows away from the landfill to further reduce leachate production.

2. Providing a permanent potable water source to residents with affected water supplies.

3. Renovation of existing leachate collection system to further control/minimize leachate release to groundwater.

4. Implementation of groundwater control and/or recovery by extraction or cut-off wall.

CHAPTER 4

ENVIRONMENTAL MONITORING PLAN (EMP)

The Environmental Monitoring Plan for the Farwell Landfill has been prepared to document the procedures and techniques for collecting groundwater, surface water, and leachate samples. The plan provides a long-term monitoring strategy for the site that fulfills the requirements of 6 NYCRR Part 360 (December 1988). Part 360 monitoring will be completed in concurrence with the other monitoring requirements set forth in previous chapters of this comprehensive document.

4.1 SITE SETTING

The Farwell Landfill is located in a remote, rural setting in the Town of Ischua, NY (Figures 1-1 and 1-2). Farwell Road passes along the south side of the site, and the north and east sides are bounded by a bend in Ischua Creek. The land surface rises steeply to the west, where elevations of greater than 2,000 feet above sea level are common at the hilltops. Regional relief is high, with numerous hills and valleys. The landfill itself is situated on the western wall of the Ischua Creek valley.

A detailed assessment of area hydrogeology and groundwater flow can be found in previous site investigation reports. The following is a brief summary of major points from those previous studies.

Site geology consists of a variable sequence of glacial deposits, including till, glaciofluvial, and glaciolacustrine sediments. Ablation till is the uppermost stratigraphic unit and is underlain by glaciofluvial sediments. Groundwater flow is primarily through the coarser-grained glaciofluvial (sand and gravel) deposits. This shallow water-bearing zone has been determined to be roughly 30 to 40 feet thick (Malcolm Pirnie 1990). The upper till serves to confine groundwater in the glaciofluvial unit, resulting in an upward flow potential from glaciofluvial to till. Underlying the shallow water-bearing zone is a series of brown and grey ablation and grey lodgement till units that comprise a lower confining layer. The till consists of a variable assortment of clay, silt, sand, gravel, and cobbles, with some occasional boulders. Eastward towards the creek, the upper ablation till is overlain by alluvial deposits.

Bedrock occurs below the overburden sequence at depths that range from roughly 70 to 100 feet below grade. The bedrock is primarily shale from the Chautauquan series, comprised primarily of silts and shales. The head differential between the bedrock and the overlying till suggests an upward flow potential (Malcolm Pirnie 1986).

The prevailing groundwater flow direction across the landfill site is from west to east, from the highlands towards the creek (Figure 4-1). Topographic features and groundwater elevation measurements indicate that Ischua Creek is a groundwater discharge area for site groundwater.

4.2 MONITORING PROGRAM

A. **Groundwater.** Groundwater monitoring wells have been installed around the landfill in various phases since the 1970s, as illustrated on Figure 1-2. Water quality data from site groundwater monitoring wells and the creek go back to the early 1970s. Records indicate that eight monitoring wells were in place by the early 1980s. In 1984, the County was issued an Order on Consent to bring the then-active landfill into compliance with 6 NYCRR Part 360 solid waste regulations. As part of the County's landfill closure strategy, seven additional monitoring wells were installed in 1987, followed by four more in 1989 and another four in 1990. Four additional wells were installed between 1998 and 1999 as part of the recent RI.

The monitoring wells that have been sampled under the County's current Part 360 monitoring program includes quarterly sampling of Wells MW-13D, MW-14S, MW-14I, MW-15S, MW-15I, MW-16S, MW-16D, MW-17S, and MW-17I; and annual sampling of Wells MW-9S, MW-9D, MW-10S, MW-10D, MW-11S, and MW-11D. In addition, annual sampling of upgradient well location MW-6 will be included as a background sampling point.

Wells MW-14S/I, MW-15S/I, MW-16S/D, and MW-17S/I will be sampled as part of the supplemental monitoring requirements of the ROD, as described in Chapter 3. Wells MW-6 -9D, -10S, -10D, -11S, -11D, and 13D will remain in the Part 360 monitoring program, and be sampled annually for routine parameters, and once every third year for baseline parameters. The annual sampling events will occur in the second sampling quarter each year, at the same time as the second quarter of special monitoring described in Chapter 3. Table 4-1 summarizes the Part 360 program. Appendix B (FSP) presents the detailed methods for completing the Part 360 field sampling program.

B. **Surface Water.** In addition to the sampling of groundwater, annual surface water samples will be collected from the landfill pond and Ischua creek locations upstream (Dutch Hill Road bridge), downstream (Kent Road bridge), and adjacent (Farwell bridge). This monitoring program will be implemented for a period of 30 years from the date of final closure in 1989, as required by NYSDEC, with periodic review and modification as appropriate and allowable by regulation. Concurrent with the groundwater program, the surface water samples will be analyzed for routine parameters, and once every third year for baseline parameters. Sampling will occur in the second quarter of each year.

C. **Leachate.** Leachate samples will be collected each quarter from the on-site leachate storage tank, including three routine events and one baseline event. Baseline sampling will be rotated forward by one quarter each year in order to determine any seasonal variation in leachate composition.

4.3 DATA EVALUATION AND CONTINGENCY MONITORING

Existing site water quality has been extensively studied in previous site investigations, including the RI and past quarterly Part 360 monitoring events. The existing understanding of site water quality can be used as a baseline against which future water quality data can be compared.

In the event that a downgradient monitoring well or downstream surface water location from the Part 360 program experiences a change in water quality, as evidenced by three consecutive sampling events in which the concentration of one or more parameters at a particular location increases above applicable water quality standards, the location will be sampled for baseline parameters within 90 days of that determination. If the baseline sampling verifies an immediate threat to public health or the environment, a corrective action plan will be prepared by the County and submitted to NYSDEC within 60 days. Additional or more frequent sampling may be required, as determined by NYSDEC.

4.4 REPORTING

Annual Part 360 monitoring reports will be prepared and submitted to NYSDEC. The annual reports will be included within the fourth quarter report for the supplemental monitoring program described in Chapter 3. Part 360 data will be presented in a table that shows the sample collection date, the analytical results, and applicable water quality standards. Results that exceed

standards will be flagged. A written summary will also be provided which will discuss contraventions of water quality standards, as well as a comparison of current results with previous results, noting any water quality changes.

TABLE 1

SAMPLING SUMMARY

PART 360 PROGRAM

DESIGNATION	LOCATION RATIONALE	AQUIFER SCREENED	APPROXIMATE BORING DEPTH (FEET)	ESTIMATED SCREEN LENGTH (FEET)
Groundwater				
MW-6	Upgradient	Overburden	160	10
MW-9S	Downgradient	Overburden	42	10
MW-9D	Downgradient	Overburden	76	10
MW-10S	Downgradient	Overburden	33	10
MW-10D	Downgradient	Overburden	87	10
MW-11S	Downgradient	Overburden	45	10
MW-11D	Downgradient	Overburden	92	5
MW-13D	Downgradient	OB/BR	99	10
Surface Water				
SW-1	Upstream			
SW-2	Adjacent			
SW-3	Downstream			
SW-4	Landfill pond			
Leachate				
L-1	-- From leachate collection system --			

OM&M PROGRAM

DESIGNATION	LOCATION RATIONALE	AQUIFER SCREENED	APPROXIMATE BORING DEPTH (FEET)	ESTIMATED SCREEN LENGTH (FEET)
Groundwater				
MW-14S	Downgradient	Overburden	56	5
MW-14I	Downgradient	OB/BR	84	10
MW-15S	Downgradient	Overburden	47	5
MW-15I	Downgradient	OB/BR	81	10
MW-16S	Downgradient	Overburden	42	5
MW-16I	Downgradient	OB/BR	87	10
MW-17S	Cross-gradient	Overburden	40	5
MW-17I	Cross-gradient	OB/BR	97	10
MW-19	Downgradient	Overburden	45	10
MW-20	Downgradient	Bedrock	135	10
MW-21	Compliance	Overburden	TBD	10
MW-22	Compliance	Overburden	TBD	10
MW-23	Compliance	Overburden	TBD	10

OB/BR = Cross overburden-shale contact.
TBD = To be determined

TABLE 2

ANALYTICAL AND QA/QC REQUIREMENTS

PART 360 PROGRAM

MATRIX	NO. OF SAMPLING POINTS	FIELD QC NO. OF SAMPLES	NO. OF SAMPLES, BY MATRIX	ANALYSIS
Groundwater	8	1 field duplicate; 1 trip blank for organic compounds (baseline only)	9	Part 360 routine (annual) Part 360 baseline (every third year)
Surface water	4	Included in groundwater QC	4	Part 360 routine (annual) Part 360 baseline (every third year)
Leachate	1	Included in groundwater QC	1	Quarterly Part 360 routine, annual baseline

OM&M PROGRAM

MATRIX	NO. OF SAMPLING POINTS	FIELD QC NO. OF SAMPLES	NO. OF SAMPLES, BY MATRIX	ANALYSIS
Groundwater	13	1 field duplicate; 1 trip blank for organic compounds	14	Quarterly Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)

TABLE 1

SAMPLING SUMMARY

PART 360 PROGRAM

DESIGNATION	LOCATION RATIONALE	AQUIFER SCREENED	APPROXIMATE BORING DEPTH (FEET)	ESTIMATED SCREEN LENGTH (FEET)
Groundwater				
MW-6	Upgradient	Overburden	160	10
MW-9S	Downgradient	Overburden	42	10
MW-9D	Downgradient	Overburden	76	10
MW-10S	Downgradient	Overburden	33	10
MW-10D	Downgradient	Overburden	87	10
MW-11S	Downgradient	Overburden	45	10
MW-11D	Downgradient	Overburden	92	5
MW-13D	Downgradient	OB/BR	99	10
Surface Water				
SW-1	Upstream			
SW-2	Adjacent			
SW-3	Downstream			
SW-4	Landfill pond			
Leachate				
L-1	-- From leachate collection system --			

OM&M PROGRAM

DESIGNATION	LOCATION RATIONALE	AQUIFER SCREENED	APPROXIMATE BORING DEPTH (FEET)	ESTIMATED SCREEN LENGTH (FEET)
Groundwater				
MW-14S	Downgradient	Overburden	56	5
MW-14I	Downgradient	OB/BR	84	10
MW-15S	Downgradient	Overburden	47	5
MW-15I	Downgradient	OB/BR	81	10
MW-16S	Downgradient	Overburden	42	5
MW-16I	Downgradient	OB/BR	87	10
MW-17S	Cross-gradient	Overburden	40	5
MW-17I	Cross-gradient	OB/BR	97	10
MW-19	Downgradient	Overburden	45	10
MW-20	Downgradient	Bedrock	135	10
MW-21	Compliance	Overburden	TBD	10
MW-22	Compliance	Overburden	TBD	10
MW-23	Compliance	Overburden	TBD	10

OB/BR = Cross overburden-shale contact.
TBD = To be determined

TABLE 2

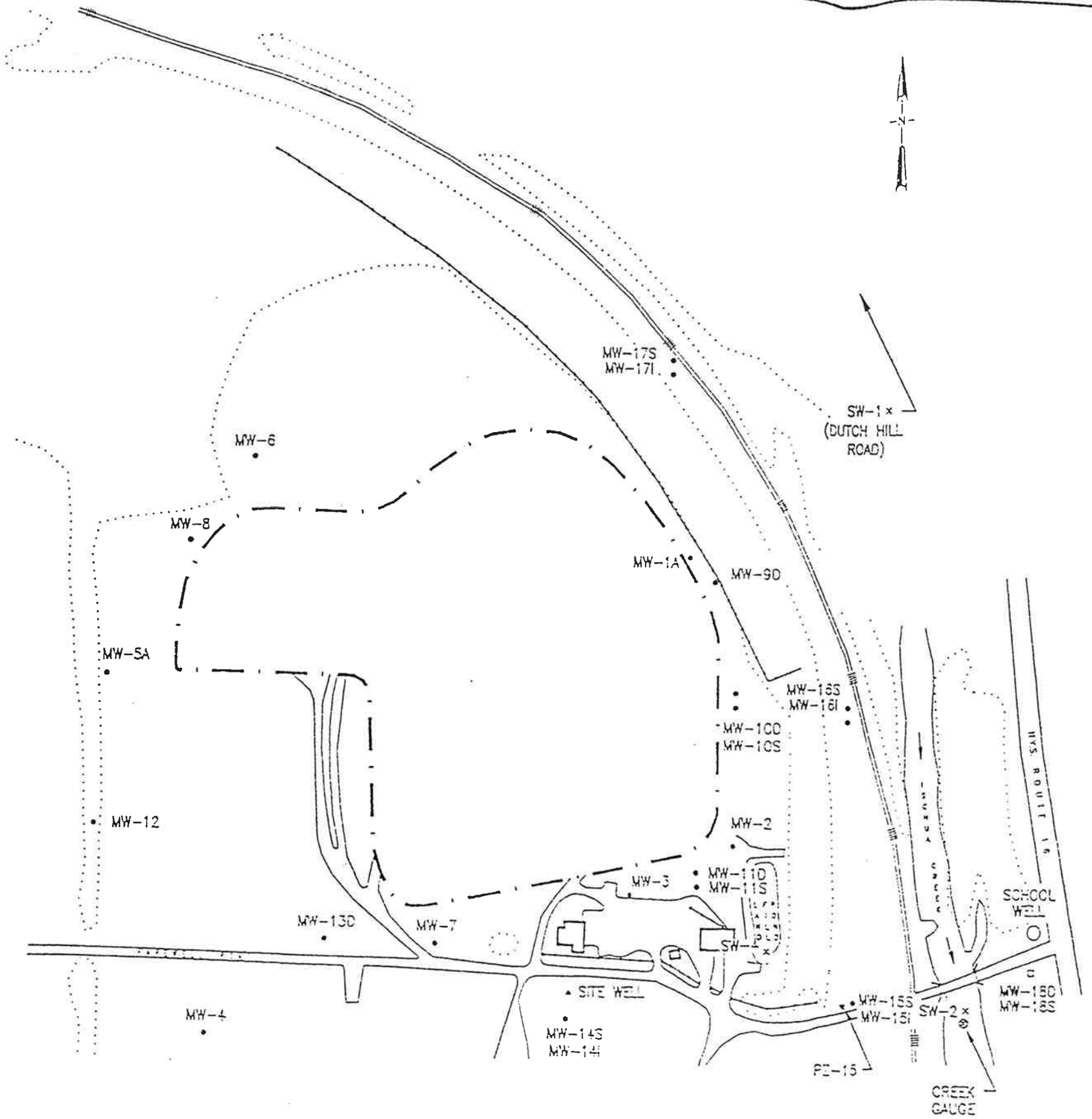
ANALYTICAL AND QA/QC REQUIREMENTS

PART 360 PROGRAM

MATRIX	NO. OF SAMPLING POINTS	FIELD QC NO. OF SAMPLES	NO. OF SAMPLES, BY MATRIX	ANALYSIS
Groundwater	8	1 field duplicate; 1 trip blank for organic compounds (baseline only)	9	Part 360 routine (annual) Part 360 baseline (every third year)
Surface water	4	Included in groundwater QC	4	Part 360 routine (annual) Part 360 baseline (every third year)
Leachate	1	Included in groundwater QC	1	Quarterly Part 360 routine, annual baseline

OM&M PROGRAM

MATRIX	NO. OF SAMPLING POINTS	FIELD QC NO. OF SAMPLES	NO. OF SAMPLES, BY MATRIX	ANALYSIS
Groundwater	13	1 field duplicate; 1 trip blank for organic compounds	14	Quarterly Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)



LEGEND

- SW-1× – SURFACE WATER SAMPLING POINT
- MW-19S □ – NEW MONITORING WELL LOCATION
- ▲ – SITE WELL LOCATION
- ● – MONITORING WELL LOCATION
- ▼ – PIEZOMETER LOCATION
- —— · —— – LIMIT OF LANDFILL
- ..... – TREE LINE
- ——— – FENCE
- ═══ – RAILROAD TRACKS
- ⊏ – BUILDING

1"=200'-0" 100 0 100 200

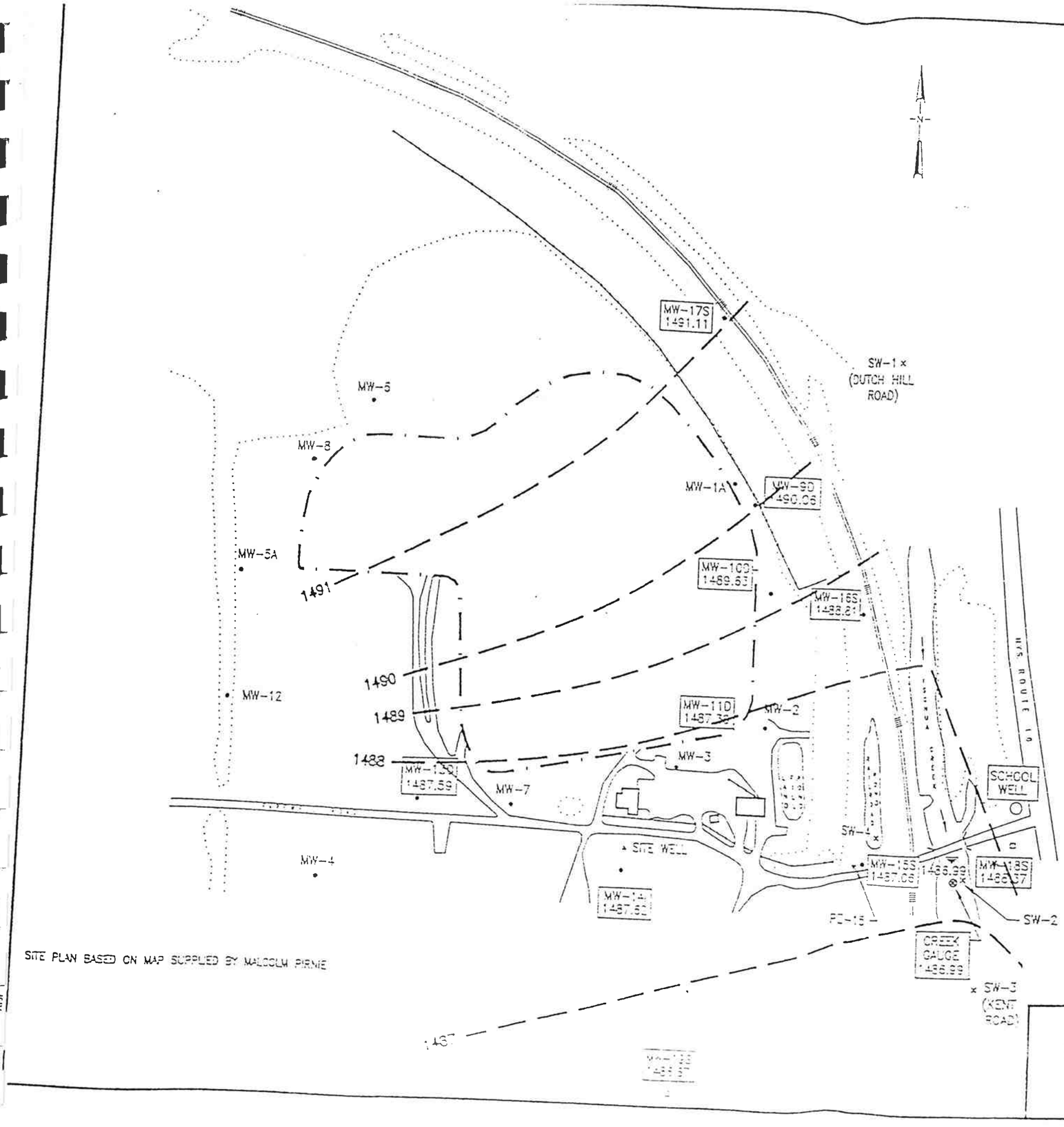
NOTE: UPSTREAM SURFACE WATER SAMPLE (SW-1) AND DOWNSTREAM SURFACE WATER SAMPLE (SW-3) WILL BE COLLECTED AT DUTCH HILL ROAD BRIDGE, AND KENT ROAD BRIDGE, RESPECTIVELY.

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

DATE: 3-01 JOB No: 10010

FARWELL LANDFILL
REMEDIAL DESIGN DOCUMENT
CATTARAUGUS COUNTY, NY

FIGURE 1-2
SITE PLAN



SITE PLAN BASED ON MAP SUPPLIED BY MALCOLM PIRNIE

LEGEND

- SW-1 × – SURFACE WATER SAMPLING POINT
- MW-19S □ – NEW MONITORING WELL LOCATION
- ▲ – SITE WELL LOCATION
- • – MONITORING WELL LOCATION
- ▼ – PIEZOMETER LOCATION
- ——·—— – LIMIT OF LANDFILL
- ····· – TREE LINE
- ——— – FENCE
- ═══ – RAILROAD TRACKS
- – BUILDING
- MW-19 – GROUNDWATER SAMPLING POINTS
- 1486.99 – WATER LEVEL

1"=200'-0" 100 0 100 200

NOTE: UPSTREAM SURFACE WATER SAMPLE (SW-1) AND DOWNSTREAM SURFACE WATER SAMPLE (SW-3) WERE COLLECTED AT DUTCH HILL ROAD BRIDGE, AND KENT ROAD BRIDGE, RESPECTIVELY.

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

FARWELL LANDFILL
REMEDIAL DESIGN DOCUMENT
CATTARAUGUS COUNTY, NY

FIGURE 4-1
GROUNDWATER FLOW

TABLE 3-1

SUPPLEMENTAL MONITORING WELL NETWORK
FOR MONITORED NATURAL ATTENUATION
Farwell Landfill Post-Closure Program
Cattaraugus County, NY

WELL I.D.	SCREENED UNIT	ANALYSES	SAMPLING FREQUENCY
MW-14S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-14I	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-15S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-15I	OB/BR	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-16S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-16D	OB/BR	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-19S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-20D	Bedrock	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-21S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-22S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly
MW-23S	Overburden	Part 360 baseline, dissolved gases (CO_2, O_2, CH_4)	Quarterly

Italicized wells are those already included in the ongoing post-closure monitoring program per 6 NYCRR Part 360.

Bold wells will be installed at the established compliance boundary, downgradient of the landfill, but on County owned property.

TABLE 4-1

ENVIRONMENTAL MONITORING PROGRAM SUMMARY
Farwell Landfill Post-Closure Program
Cattaraugus County, NY

WELL I.D.	UNIT SCREENED	BOTTOM DEPTH (FEET)	MONITORING PROGRAM	MONITORING SCREEN LENGTH (FEET)	ANALYTICAL REQUIREMENTS
MW 6	Bedrock	160	Part 360	10	Annual routine, baseline every third year
MW 9S	Overburden	42	Part 360	10	Annual routine, baseline every third year
MW 9D	Overburden	76.42	Part 360	10	Annual routine, baseline every third year
MW 10S	Overburden	33.77	Part 360	10	Annual routine, baseline every third year
MW 10D	Overburden	87.05	Part 360	10	Annual routine, baseline every third year
MW 11S	Overburden	45.45	Part 360	10	Annual routine, baseline every third year
MW 11D	Overburden	92.8	Part 360	5	Annual routine, baseline every third year
MW 13D	OB/BR[1]	99.65	Part 360	10	Annual routine, baseline every third year
MW 14S	Overburden	56	OM&M[2]	5	Quarterly baseline, plus dissolved gases[3]
MW 14I	Overburden	84	OM&M	10	Quarterly baseline, plus dissolved gases
MW 15S	Overburden	47	OM&M	5	Quarterly baseline, plus dissolved gases
MW 15I	OB/BR	81	OM&M	10	Quarterly baseline, plus dissolved gases
MW 16S	Overburden	42	OM&M	5	Quarterly baseline, plus dissolved gases
MW 16I	OB/BR	87	OM&M	10	Quarterly baseline, plus dissolved gases
MW 17S	Overburden	40	OM&M	5	Quarterly baseline, plus dissolved gases
MW 17I	OB/BR	97	OM&M	10	Quarterly baseline, plus dissolved gases
MW-19	Overburden		OM&M	10	Quarterly baseline, plus dissolved gases

TABLE 4-1 (continued)

WELL I.D.	UNIT SCREENED	BOTTOM DEPTH (FEET)	MONITORING PROGRAM	MONITORING SCREEN LENGTH (FEET)	ANALYTICAL REQUIREMENTS
MW-20	Bedrock		OM&M	10	Quarterly baseline, plus dissolved gases
MW-21	Overburden	TBD[4]	OM&M	10	Quarterly baseline, plus dissolved gases
MW-22	Overburden	TBD	OM&M	10	Quarterly baseline, plus dissolved gases
MW-23	Overburden	TBD	OM&M	10	Quarterly baseline, plus dissolved gases

(1) Overburden/bedrock interface.
(2) OM&M = Operation, Maintenance & Monitoring Plan.
(3) Dissolved gases include carbon dioxide, oxygen, and methane.
(4) To be determined.

APPENDIX C

POST-CLOSURE INSPECTION FORM
Farwell Landfill, Cattaraugus County, New York

INSPECTOR (PRINT)	
INSPECTOR (SIGNATURE)	
DATE OF INSPECTION	

1. Fencing, Gates, and Access	
Fence intact	
Gates working	
Locks operable	
Access road condition	
2. Landfill Cover	
Visible refuse	
Signs of vector activity	
Signs of erosion	
Signs of stressed vegetation	
Leachate seeps	
Detectable odor	
Areas of subsidence	
3. Waterways and Ditches	
Signs of erosion	
Blockage of drainage pathway	
Culverts clear of obstructions	
Ponded water areas	
4. Monitoring Wells (well casing, cap, and locks in place and in good condition)	

Action Required:

Review by Public Works Commissioner:	
Signature	Date