ROSE VALLEY LANDFILL

TOWN OF RUSSIA

HERKIMER COUNTY, NEW YORK

STETSON-DALE NO. 2817

CLOSURE PLAN

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JANUARY, 1984

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185 Genesee Street
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I. PURPOSE

The site addressed in this report, and shown on the attached drawings, has been used as a domestic landfill for the past two decades. Since that time, the environmental awareness of solid waste disposal has greatly increased, along with the regulations and their enforcement. The active portion of Rose Valley Landfill now consists of approximately 8-1/4 acres. The on-site soil is generally sandy above the water table. Because no natural or artifical liner exists below the refuse, and there is no leachate collection system, the site does not conform to present Environmental Regulations. The New York State Department of Environmental Conservation has ordered that the operation of this landfill be closed by December 31, 1985. The Owner of the site, Mr. Gerald Crouch, has agreed to the order.

The purpose of this report is to provide relevant information concerning the site and present the details of how closure will be accomplished. This closure plan has been developed to make optimum use of the disturbed landfill area within the time frame allowed, while providing necessary facilities to safeguard against further environmental degradation.

II. SITE ANALYSIS

A. Topography and Site Drainage

The site is located in Herkimer County, just inside the Town of Russia, near the junction of the Towns of Norway, Newport, and Russia. Although the site is approximately 3-1/2 miles outside the Adirondack Park boundary, it shares many of the characteristic features associated with that region. Site features are shown on Sheet 1, "Site Map" (Appendix "C").

Local relief differential within the 100 acre site area is about 180 feet. The highest elevation, about 1,315 feet above MSL, is located in the northwest quadrant of the site. This section is gently sloped from 1.5% to 3.5%. The southeast quadrant comprises the lowest elevation and contains several small streams, as well as some normally wet areas. The site drains generally to the south and southeast, except for the southwest quadrant which tends to slope to the southwest. The property is surrounded on three sides by non-paved roads. A sharp break in grade exists along the northeast edge of the property.

A small stream enters the site and is directed to the southeast by this ridge. Several other small drainage channels are found running from the west to the east which eventually join this stream. A second stream, from a beaver dam off the eastern edge of the property, crosses onto the site and joins the other stream just at the south boundary line. This stream is part of the headwaters of White Creek. White Creek flows to the south, approximately some 14 miles before joining the West Canada Creek below the Village of Newport.

B. Vegetation and Wildlife

The vegetation of the site is consistent with typical Adirondack trees, shrubs, and groundcovers. The changes in soil moisture content, elevation, and exposure, found on the site, account for the wide variety of plant life encountered. Evergreens, including white pine and spruce, appear by the main entrance, near the southwest corner of the site. The high plateau area, on the north and central portions, is predominantly mixed hardwoods, featuring red maple and sugar maple, in addition to a number of other trees and shrubs, such as rock elm, dogwood, staghorn sumac, red ash, white ash, white oak, poplar, striped maple, cottonwood, black locust, paper birch, black cherry, hemlock, red mulberry, alder, yellow birch, and american basswood.

Various groundcovers are found throughout the site, with a great many different growths established, particularly in the low lying region of the southwest quadrant. Typical groundcovers for this area include such growths as follows: yarrow, goldenrod, common plantain, common ragwood, stiff aster, bushy aster, small flowered white aster, violet, grasses, sedges, canada thistle, queen anne's lace, dandelion, bladder campion, black-eyed susan, chicory, virginia creeper, cinnamon fern, interrupted fern, new york fern, christmas fern, bracken fern, daisy, phragmites, cattails, wood sorrel, phlox, cinquefoil, strawberry, and daisy fleabane.

A portion of the site is generally wet most of the year. It is not contiguous to other wetland areas and is less than 12.4 acres. The area has not been designated, by DEC, as a wetlands, for environmental purposes.

The streams onsite are primarily drainage channels and are believed intermittent, according to the DEC definition of one cfs. However, various minnow species and small fish, up to about 6 inches in length, have been observed in the lower reaches of the stream near the southern boundary below the outlet from the beaver dam.

The operation of the landfill has not had a deletorious effect on area wildlife. Whitetail deer have occasionally been sighted. Signs of black bear have been seen around the landfill, although no permanent population is known to inhabit the site. Other fur bearing mammals, such as red fox, raccoon, cottontail rabbit, field mice, moles, squirrels, chipmunks, varying hare, beaver, fisher, weasel, skunk and muskrat, are known to be present on site or on adjacent areas. There have been no rats of any kind observed on the site.

During the summer months, many birds, including blue jays, starlings, woodpeckers, redwing blackbirds, various finches, robins, swallows, sparrows, crows, and other song birds inhabit the woodlands surrounding landfill. The primary upland game bird found on site is the ruffed grouse. However, woodcock may be expected to stay over for short periods in the low areas during their fall migration. Ducks and geese do not normally inhabit or pass through the site.

C. Soils Analysis

1. Subsurface Soils and Hydrogeological Study

A detailed study of this site, titled "Hydrogeologic and Geologic Evaluation of the Rose Valley Landfill", was conducted by Dunn Geoscience Corporation in September 1982. A copy of that report has previously been submitted.

2. Soil Conservation Service

The following information on site soils has been compiled by the Soil Conservation Service; reference "Soil Survey of Herkimer County".

Capability Unit	Soil Types Found	Description
IVs-1	HmB	Hinckley gravel loamy sand, 3 to 8 percent slope
VIIs-2	HmC	Hinckley gravel loamy sand, 8 to 15 percent slope
VIIe-1	HnF	Hinckley and Windsor soils, 25 to 70 percent slope
VIIs-2	HnD	Hinckley and Windsor soils, 15 to 25 percent slope
IIw-1	PpB	Phelps gravel fine sandy loam, 0 to 4 percent slope
IVw-1	Ha	Halsey soils
IVs-1	WnC	Windsor loamy fine sand, 8 to 15 percent slope

Land uses, to date, in the area, have included soil borrow operations, landfilling, and hunting.

"Capability units" are primarily intended as an indication of what kind of crops the soil is most suited for. However, it does give some description of the general soil drainage, texture, and optimum crop selection.

"Soil types" includes information pertaining to grade, erosion, ability to retain water, and some degree of land uses. Together, these two pieces of data provide a good view of the agricultural potential of the site. The general impression, having reviewed this data, is that the site would not support most crop production, may be suitable for tree species that tolerate dryness, and is probably a good source for sand and gravel.

See Appendix "B" for additional data and soils map.

III. LANDFILL OPERATIONS

A. Existing Conditions

Landfilling of refuse at the site has been occurring on a nearly continuous basis for two decades. Prior to the present ownership, which began in 1974, domestic solid waste was placed in shallow lifts sporadically around the higher section of the site.

This higher central portion of the site contains refuse to a depth of approximately 8 feet. This is the location of the oldest landfilling operation. Refuse here is overlain by several feet of sand and top-soil. The area has not been used in recent years, except in certain locations, as an application of septic tank sludge.

The active landfill area, as shown on Sheet 1, "Site Map", is located approximately midway along the southern portion of the site. Domestic solid wastes and approved industrial wastes are landfilled. This area has been in use for several years and is now operating under a consent order which calls for closure by the end of 1985.

B. Pre-Closure Conditions

The landfilling operations, under this plan, will meet the conditions and timetable set forth in the Consent Order.

The landfill has been surveyed and the limits established and staked, as shown on the plans. No lateral extension of the boundaries is proposed under this plan.

A monitoring program of the surface and groundwaters has been initiated and will continue through five years past closure.

The quantities of solid waste being received into the site have been estimated until closure. The landfill grading plan has been developed to meet the projected volume requirements. Also included were estimates of the quantities of daily, interim, and final covers. The final grading plan, as shown on Sheet 4 of the plans, has an amount of excess capacity which can be utilized for a slight increase in delivery rates. The grading plan, following a phased program, involves three distinct areas; Area 1, Area 2, and Area 3. The excess capacity is found in Area 3, which overlays Area 2.

All final and intermediate grades are between 10 and 33-1/3 percent to maximize runoff while minimizing erosion.

A final cover section has been selected and is shown on the plans. This includes both soil cover material and a seeding program.

Leachate generation will be minimized through capping and drainage techniques.

IV. SAMPLING PROGRAM

A. General

A sampling program was undertaken to determine the baseline water quality data at the site. Surface and groundwater samples were collected and analyzed. The sampling locations are shown on Sheet 1, "Site Map".

B. Surface Water

Surface water grab samples were taken approximately 20 feet above (S-1) and 20 feet below (S-2) the confluence with the stream from the beaver pond.

The weather was cold, 30 °F, and clear with no visible surface runoff.

The stream classifications on the site are as follows:

All branches above the confluence including the beaver pond stream	Class D
Below the confluence (White Creek to West Canada Creek)	Class CTS[1]

Table 1 contains the test results and stream standards.

The results indicate that these stream standards are not being contravened and that the results compare favorably to values obtained from the West Canada Creek downstream of the confluence with White Creek.

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[1] CTS, Class C, Trout Waters Spawning

C. Groundwater

Groundwater samples were taken at three locations on the site. A sample was taken from monitoring well B-1, located up gradient of the landfill. Sample No. 4 was collected from a down gradient well B-4. Sample No. 3 was collected from well B-3 set near the fill.

Comparison of results to drinking water (groundwater) standards indicates that well B-1 and well B-4 meet, or barely contravene, the standards. Well B-3 had higher oxygen demand and bacteria readings, as would be expected due to its close proximity to the fill. The test results of well B-3 didn't yield the expected ratio range of TOC/COD (1.75 to 6.65, Ref. Eckenfelder and Ford, 1970),and this well was retested for these two parameters. Table II contains the test results and groundwater standards.

D. Planned Testing Program

In accordance with the conditions of the Consent Order, an on-going testing program has been established. All sampling and testing will be performed semi-annually (May and November) at the three groundwater montoring wells and the two established surface water sampling points. This program will begin May 1984 and continue through November 1990. Copies of the results from each round of testing will be promptly forwarded to the Regional Office of the Department of Environmental Conservation in Watertown. The following parameters will be analyzed at the appropriate location.

Groundwater Sample Points	Surface Water Sample Points
Chlorides	Chlorides
Specific Conductance	Specific Conductance
Total Organic Cargon	pH
pH	Chemical Oxygen Demand
Total Iron	Total Dissolved Solids
Total Dissolved Solids	

V. OPERATIONAL PLAN

A. General

The operational plan is the specific physical activities leading to final closure of the site. Items addressed here include daily application of refuse; daily, interim, and final cover; leachate control measures; monitoring program; and landscaping.

B. Materials

The materials required to operate the landfill, under this plan, include earth of various qualities for cover materials and seed to establish the cover crop.

The material specifications for the particular cover requirements are:

1. Daily and Intermediate Cover

Any clean soil material, such as bank run gravel or sand.

It is anticipated that on-site sand will be utilized for the daily and intermediate cover.

2. Final Cover

The final cover will be comprised of several layers of materials.

The bottom layer will be 12 inches of a soil material similar to that for the daily and intermediate cover from on-site sources.

The middle layer shall be 6 inches of a soil with a maximum permeability of 3.33×10^{-6}cm/sec. Materials generally attaining this level of permeability include clays or mixtures of clays and silts, with or without larger sands and gravels. This material is expected to be obtained off-site. By itself, this layer will be equivalent to 5 feet of a 10^{-5}cm/sec soil, as required by the regulations.

The uppermost layer shall be 6 inches of a topsoil suitable for the establishment of the cover crop. It is anticipated this will be a mixture of on-site topsoil and sand along with treatment plant sludge or septage used as a soil conditioner.

3. Cover Crop

The cover crop shall consist of a mix of grasses selected for their combination of properties.

Crown Vetch.....Low maintenance; excellent drought tolerance; grows in shallow, low fertility, acid, clayey, loamy and sandy soils; used in disturbed areas of steep slopes.

Red Fescue.....Fast growing; fair drought tolerance; grows in medium fertility, slightly acid, clayey and loamy soils; used to stabilize slopes.

Perennial Ryegrass...Rapid growing; fair drought tolerance; growns in medium fertility, slightly acid, clayey, loamy soils; short-term stabilizing cover.

These seeds shall be applied in equal portions of 1 lb./1000 SF. In addition, other surface dressings and constituents including innoculars, lime, fertilizer, and mulch shall be applied at the specified rates, as given on Drawing 5.

C. Refuse Application Sequence

The application of refuse, cover, and surface grading shall follow the plans, as shown on Sheets 2, 3, and 4.

The intent of the plan is to allow the Owner flexibility in filling operations in each of the three areas while ultimately attaining the final grading plan.

All refuse shall be applied in 2 foot thick cells, as shown on the plans. The landfill face should be managed in a downhill manner to provide adequate drainage. All daily cover shall be 6 inches thick. Intermediate cover shall be 12 inches. Final cover shall be as shown on the plans.

In general, the application of refuse and cover will follow these steps:

1. Check existing grades. Set grade stakes for Area 1 as shown on Sheet 2.

2. Work Area 1 from south to north. As final elevations are attained, final cover shall be applied.

   The estimated duration of this phase is 10 to 13 months.

3. Set grade control for Area 2 as shown on Sheet 3. Apply refuse on the southwesterly portion to attain a working face. Complete the intermediate contours on the westerly portion and apply

intermediate cover. Complete the development of Area 2 from west to east. Apply final cover on those portions not underlaying Area 3. The estimated duration of this phase is 9 to 11 months.

4. Set grade control for Area 3. This area will be worked from the center, establishing a working face, and proceeding concentrically to the limits of the area. Apply final cover.

   The estimated duration of this phase is 1 to 3 months.

5. A chart of these duration periods is included in the "Closure Schedule", attached as Figure 1.

D. Leachate Control

The most important technique in controlling the volume of leachate generation is to minimize infiltration. This will be accomplished through grading and cover.

The sequential grading plan, shown on Sheets 2, 3, and 4, establishes two drainage swales and a minimum surface slope of approximately 10%. This slope is intended to maximize sheet drainage off the cover material without causing excessive erosion.

Final cover will consist of 12 inches of sand over the fill with 6 inches of a material, having a maximum permeability of 3.33×10^{-6}cm/sec, applied over this layer. A minimum of 6 inches of topsoil, suitable for the growth of cover crops, will comprise the top layer of the final cover.

A typical section of final cover is shown on Sheet 5 of the plans.

Erosion of the final cover zone will be minimized through grading, applying, and maintaining the cover crop.

E. Landscaping and Ultimate Land Use

The final landscaping plan is shown on Sheet 4.

The cover crops shall be planted within four months of placement of final cover, or season, as permitting. The mix of grasses described in Paragraph B of this section shall be applied at a rate of 3 lb./1,000 SF. Soil cover, slopes, and vegetation shall be maintained for five years beyond the date of placement of final cover. This will permit adequate time for full development of the seeding system plus infiltration by natural grasses and larger shrubs and trees.

Continued use of an above area of a closed portion of the property is planned for development as a sanitary landfill and/or other solid waste management uses. No plans are presently being made for any kind of commercial, industrial or private development on this section of the property. It is intended to allow these areas to turn back to their natural state to support whatever wildlife and vegetation that occurs in the area.

F. Monitoring Program

A surface and groundwater monitoring program shall be conducted semi-annually during the remaining operational life of the landfill. Additional monitoring after closure will be done in the same manner for a period of 5 years, at which time further regulatory requirements may be imposed. Samples shall be taken at the established sample points at regular 6 month intervals and the results submitted to Regional Office of the Department of Environmental Conservation in Watertown for review. The specific parameters to be tested are listed for each sample point in Section IV.D.

G. Special Controls

1. Gas Venting

The anaerobic production of potentially explosive gases, such as methane, will be minimized by reducing infiltration into the fill. Methane fixing bacteria prefer a warm, moist environment. Vent pipes shall be provided, as shown on the plans, to release the gas that is produced before it reaches dangerous concentrations.

2. Vector, Odor, and Litter Control

There have been no known incidents of viral or other human parasitic diseases occurring from the operation of this site. This may, in part, be due to the droughty nature of the site which does not afford good breeding or hatching areas for the host insects which carry the micro-organisms. Also, refuse delivered to the site is primarily collected in small quantities by hand. There is limited use of dumpsters which may conceal mice and rats. To date, there have never been rats sited at this landfill. These factors, coupled with prompt burial of incoming refuse and maintaining good drainage of the fill, should keep such problems from occurring.

Some nuisance odors are inescapable with any landfill operation. However, odors can be minimized with good management. Daily cover will help in this effort. The sandy material used at this site is very porous which permits the passage of air into the upper layer of refuse, thereby helping to maintain an aerobic condition. The gases which do escape are dispersed eastward away from the nearest populated area by the prevailing westerly winds.

On-site litter is a manageable condition at this site. Incoming refuse is restricted to a single access entry which is equipped with a lockable gate. No traffic is permitted on-site after hours or without special approval under supervision by the Owner. The front of the property is maintained neat and orderly with separate piles of scrap metals and other recyclable materials sorted out. No dumping is permitted along the access road to the landfill. The fill itself is generally maintained in an orderly manner. Once dumped, the waste is immediately placed by a tracked vehicle which compacts the refuse to prevent the scattering of litter. Daily cover is then applied to stabilize loose surface material. Some blowing during the unloading does occur from time to time, which has caused paper and other light material to drift outside the immediate operation. However, since most of the area surrounding the site is wooded, these materials are generally prevented from blowing on-site. Occasional policing of the lower fringe shall be conducted to maintain an orderly appearance.

VI. CLOSURE COST ESTIMATE

Closure actions will proceed in a continuous manner, in accordance with the schedule provided as Figure 1. Those actions, where final cover is to be applied, have been separated into three phases. The following cost estimate is, therefore, broken down into the same phases. These figures represent a best estimate, given that some of the work will be done by the Owner. In these cases, labor and material costs are eliminated or reduced below the typical Contractor's rate.

Phase I

ITEM	QUANTITY	UNIT COST	COST
12 inches Sand	4,330 CY	$1.50	$ 6,495
6 inches Clayey Loam	2,165 CY	8.00	17,320
6 inches Topsoil	2,165 CY	6.00	12,990
Seeding	13,000 SY	0.10	1,300
Lime,Fertilizer, Mulch	13,000 SY	0.10	1,300
Grade Control	L.S.		300
Ditching & Miscellaneous	L.S.		295
TOTAL COST			$40,000

Phase II

ITEM	QUANTITY	UNIT COST	COST
12 inches Sand	4,330 CY	$1.50	$ 6,495
6 inches Clayey Loam	2,165 CY	8.00	17,320
6 inches Topsoil	2,165 CY	6.00	12,990
Seeding	13,000 SY	0.10	1,300
Lime, Fertilizer, Mulch	13,000 SY	0.10	1,300
Grade Control	L.S.		300
Ditching & Miscellaneous	L.S.		295
TOTAL COST			$40,000

Phase III

ITEM	QUANTITY	UNIT COST	COST
12 inches Sand	4,980 CY	$1.50	$ 7,470
6 inches Clayey Loam	2,490 CY	8.00	19,920
6 inches Topsoil	2,490 CY	6.00	14,940
Seeding	15,000 SY	0.10	1,500
Lime, Fertilizer, Mulch	15,000 SY	0.10	1,500
Grade Control	L.S.		300
Ditching & Miscellaneous	L.S.		370
TOTAL COST			$46,000

Laboratory Testing

Sampling Cost	$ 130
Transportation	30
3 Groundwater Analyses @ $50 each	150
Surface Water Analyses @ $45 each	90
SUB-TOTAL	$ 400
Twice Annually	x 2
TOTAL COST	$ 800/year

Summary

Phase I	-	$ 40,000
Phase II	-	40,000
Phase III	-	46,000
ESTIMATED TOTAL COST	-	$126,000

A T T A C H M E N T S

TABLE I

SURFACE WATER RESULTS AND STANDARDS

Parameter	Above Confluence S-1	Below Confluence S-2	West Canada Creek*	Stream Standard
PH	7.7	7.3	8.1	6.5 - 8.5
TDS	350.0	180.0	148.0	500.0
Conductance† uhmos/cm	640.0	350.0	124.5	---
COD	37.0	15.0	2.0	---
Iron	0.54	0.37	0.35	---

All units mg/l, unless otherwise indicated.

For sample point location refer to Drawing 1, Site Map.

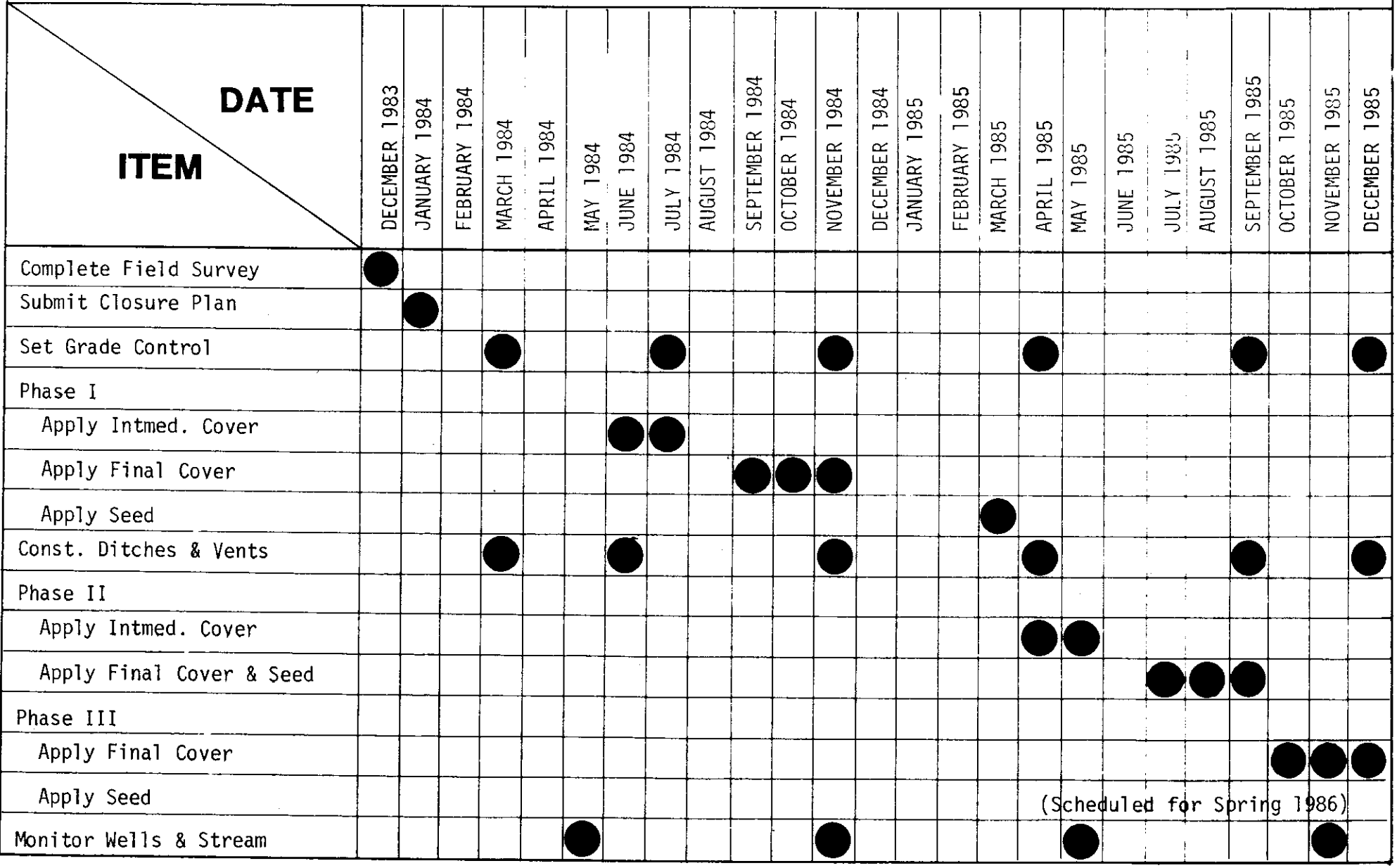
*Source, "Water Quality Management Plan for Mohawk River Planning, Areas 12-01 and 12-02, NYS DEC, 1976. Sample taken below confluence with White Creek.

†The conductivity of potable waters in the United States ranges from 50 to to 1,500 uhmos/cm. Source, "Standard Methods For Examination of Wastewater", 14th Edition, 1975.

CLOSURE SCHEDULE

ROSE VALLEY LANDFILL

HERKIMER COUNTY, NEW YORK



PHASED VOLUME SUMMARY

AREA	VOLUMES					LIFE EXPECTANCY MONTHS
	TOTAL AVAILABLE X 1000 C.Y.	REFUSE X 1000 C.Y.	DAILY COVER X 1000 C.Y.	INTERIM COVER (ALLOWANCE) X 1000 C.Y.	FINAL COVER X 1000 C.Y.	
1	83.9	52.2	14.1	2.2	15.4	13±
2	63.9	39.7	10.7	1.8	11.7	10±
3	22.2	13.8	3.7	0.6	4.1	3±
TOTAL LANDFILL	170.0	105.7	28.5	4.6	31.2	

TABLE II

GROUNDWATER TEST RESULTS AND STANDARDS

Parameter	B-1	B-3	B-4	B-3*	Drinking/Surface Water† Standard
pH	7.6	6.8	7.3		6.5 - 8.5
Total Dissolved Solids	500	1100	960		---
Conductance (uhmos/cm)	340	2800	1100		---
Chloride	0.75	2.6	140		250
Phenol	0.002	0.030	0.018		0.001
COD	15	46000	41	1000	---
Total Hardness	240	400	500		---
Total Organic Carbon	20	300	40	185	---
Total Coli(col/100mls)	<1	<10*	<1		1
Aluminum	<0.1	0.2	0.1		---
Arsenic	0.003	0.031	0.005		0.025
Cadmium	<0.005	<0.005	<0.005		0.01
Chromium	<0.05	<0.05	<0.05		---
Hexavalent Chromium	<0.01	<0.01	<0.01		0.05
Copper	0.03	<0.02	<0.02		1.0
Iron	0.10	4.0	0.28		0.3
Manganese	0.02	0.86	1.0		0.3
Lead	<0.05	<0.05	<0.05		0.025
Mercury	<0.0002	0.0006	0.0003		0.002
Zinc	0.01	<0.01	<0.01		5.0
Selenium	0.005	0.014	0.005		0.01

All units mg/l, unless otherwise indicated.

For sample point location refer to Drawing 1, Site Map.

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*Retest of well B-3.

†NYS DEC Groundwater Quality Standard or EPA Interim Primary Drinking Water Standard, whichever is most stringent.

APPENDIX "B" - SOILS CONSERVATION SERVICE

CAPABILITY UNITS

A. Capability Unit IIw-1

This unit consists of deep, level to very gently sloping, moderately well drained soils of the Herkimer, Lima, Phelps, and Williamson series. All of these soils are medium textured except Phelps, which is moderately coarse in texture. The Herkimer and Phelps soils formed in gravelly outwash. The Lima soils are on till uplands. The Williamson soils formed in deposits of wind- or water-sorted silt and very fine sand. They have a fragipan 15 to 27 inches below the surface that restricts water movement and rooting.

The Herkimer and Phelps soils in this unit are medium to high in content of lime and moderate to low in natural fertility. Available water capacity is moderate to low. The Lima soils are high in content to lime and moderate to high in natural fertility. Available water capacity is moderate. The Williamson soils are very low to medium in content of lime and moderate to low in natural fertility. Available water capacity is moderate to high.

If properly managed, the soils of this unit are well suited to all crops grown in the county. The soils are easy to work. Slight wetness in places delays planting briefly in spring. Gravelly and cobbly fragments in the Herkimer and Phelps soils may interfere with the machinery used to till truck crops in places. Crops respond to nitrogen fertilizer applied early in spring, when these soils tend to be cold and wet. More lime is needed on the Williamson soils than on the other soils in this unit.

These soils can be intensively cultivated if supported by a high level of management. Keeping tillage to a minimum and planting a sod crop every 4 to 5 years help preserve soil structure. Returning crop residue to the soil and growing cover crops are also good supporting practices. On the fields that erode, contouring and terracing permit more intensive use of the soils.

Random surface drainage and random tile in wet spots improve fields for more efficient production of high quality crops.

B. Capability Unit IVw-1

This unit consists of deep, poorly drained and very poorly drained, level and nearly level soils of the Halsey, Ilion, Lamson, Lyons, and Sun series. These soils are in depressed areas where runoff water accumulates and remains for long periods. The Ilion, Lyons, and Sun soils formed in till on uplands. The Halsey soils formed in gravelly glacial outwash, and the Lamson soils in sandy lacustrine sediment.

The soils of this unit are medium and high in content of lime. All the soils of this unit except Ilion and Lyones are moderate to low in natural fertility. The Ilion and Lyons soils are moderate to high in natural fertility. Available water capacity of the normal root zone in these soils is low to moderate, but the water table persists at or near the surface for such long periods that there is more than enough water available for plant growth.

Unless drained, these soils are too wet for cultivation. Response to tile drainage is generally excellent in areas where outlets are available. Open ditches, surface drainage, land shaping, or some combination of these, with tile to remove water held in pockets, is needed. Special care is needed when tile is installed to prevent plugging with silt and fine sand. If adequately drained, these soils are suited to all crops grown in

the county. Row crops can be grown continuously. Supporting practices, such as growing cover crops, keeping tillage to a minimum, and returning all crop residue to the soil, help maintain organic-matter content and a friable surface soil.

In undrained areas of these soils, annual applications of complete fertilizer on grass sods that are tolerant of wetness and ponding result in good forage production. Forage crops can be better managed if water from higher land can be diverted away from these soils. Plowing, preparation of seedbeds, and seeding should be done during the dry periods of summer months. High-value crops on these soils need supplemental irrigation in places for maximum returns.

C. Capability Unit IVs-1

This unit consists of deep, excessively drained soils of the Hinckley and Windsor series. They formed in gravelly and sandy glacial water deposits. The Hinckley soils are nearly level and gently sloping, and the Windsor soils are moderately sloping. These soils are on glacial outwash terraces, kames, and deltas.

Content of lime in the Hinckley soils is very low or low, and in the Windsor soils very low. Both soils are low in natural fertility. Available water capacity is very low or low in the Hinckley soils and very low to moderate in the Windsor soils. These soils are droughty. Erosion is a hazard on the more sloping areas. These soils, especially the Windsor soils, are subject to soil blowing if left unprotected.

D. Capability Unit VIIe-1

This unit consists of deep, steep and very steep soils of the Palmyra, Howard, Hinckley, and Windsor series. These soils formed in gravelly and sandy glacial outwash on terraces, kames, and deltas.

Lime content ranges from high in the Palmyra soils to very low in the Windsor soils. The soils of this unit are moderate to low in natural fertility. Available water capacity is low to moderate, but much of the rainfall is lost through runoff and little is retained for use by plants. The hazard of erosion is severe if these soils are left unprotected.

These soils are too steep to permit the use of machinery for liming, fertilizing, or mowing. These soils are best suited to wooded areas or wildlife habitat.

Grazing should not be permitted on the soils of this unit, in order to allow the maximum protective vegetative cover to develop.

E. Capability Unit VIIs-2

This unit consists of deep, excessively drained soils of the Hinckley and Windsor series. These soils formed in gravelly and sandy glacial deposits. The Hinckley soils are moderately sloping and moderately steep, and the Windsor soils are moderately steep. These soils are on glacial outwash terraces, kames, and deltas.

The Hinckley soils of this unit are very low or low in content of lime, and the Windsor soils are very low in content of lime. These soils are low in natural fertility. Available water capacity is very low or low in the Hinckley soils and very low to moderate in the Windsor soils. Runoff is rapid, and very little rainfall is retained for use by plants. These soils are droughty. If they are left unprotected, erosion is a hazard, and the Windsor soils especially are subject to soil blowing.

These soils are best suited to selected woodland species. They are not suited to crops, and production of pasture forage is low. Response to lime and fertilizer is low because of droughtiness, slope, and low natural fertility.

Grazing should not be permitted on the soils of this unit. All natural vegetative ground cover produced should be left in place and maintained for erosion control.

SOIL TYPES

A. Halsey Soils (Ha)

These level to nearly level soils include areas with similar profiles that have loam or fine sandy loam surface and subsoil layers and are gravelly in places. They are in depressions and drainage channels on glacial outwash terraces. Individual areas are round or elliptical in depressions, long and narrow along drainageways, and from 3 to 20 acres in size.

Included with these soils in mapping were small areas of better drained Fredon soils on slight rises, and small spots of less gravelly Cohoctah soils along drainageways that are subject to flooding.

Unless drained, wetness prohibits the use of these soils for crops. They provide some pasture during dry periods, and are suited to water-tolerant trees. With adequate drainage, they are suited to many of the crops grown in the county. Drainage outlets are generally very difficult to locate. Capability unit IVw-1; woodland suitability group 5w2.

B. Hinckley Series

The Hinckley series consists of deep, excessively drained, coarse-textured soils that formed in very gravelly and cobbly glacial outwash derived mainly from granitic rocks and some sandstone and limestone. These soils are nearly level to very steep and are on glacial outwash terraces, deltas, and kames. They are very low and low in line.

In a representative profile (fig. 8) the surface layer is very dark grayish-brown gravelly loamy sand about 9 inches thick. The subsoil, between depths of 9 and 28 inches, is brown to dark-brown, very friable gravelly loamy sand that is medium acid in the upper part and slightly acid in the lower part. The substratum is dark grayish-brown to very dark grayish-brown, very friable very gravelly loamy sand that extends to a depth of 40 inches. Below this, to a depth of 70 or more inches, the substratum consists of loose, slightly acid, stratified sand and gravel that is grayish-brown to dark grayish-brown.

The water table in Hinckley soils is normally several feet below the surface, but locally it may be encountered at a depth of 40 inches. Permeability is rapid. Maximum rooting depth is mainly 30 inches. Available water capacity is low or very low. Available phosphorus and potassium are low. Available nitrogen is medium. Reaction in the surface layer is strongly acid to medium acid in unlimed areas. Aside from slope, droughtiness and low fertility are the principal limitations to use of these soils for farming. The soils are a good source of sand and gravel.

1. Hinckley gravelly loamy sand, 3 to 8 percent slopes (HmB)

This gently sloping soil is on smoothly sloping or undulating areas of glacial outwash terraces and deltas. Individual areas are irregular in shape, and range from 5 to 100 acres.

Included with this soil in mapping were small areas of sandy Windsor soils, spots of wetter Fredon and Halsey soils in depressions and along drainageways, and small areas of finer textured Howard soils. Other inclusions, mainly in the northern part of the town of Russia, were small areas of soils that have a fine sandy loam surface layer.

This soil is poorly suited to farming because of droughtiness and low fertility. The hazard of erosion is slight in cultivated areas that are unprotected. The soil provides some early pasture, and is fair for trees. Capability unit IVs-1; woodland suitability group 5s1.

2. Hinckley gravelly loamy sand, 8 to 15 percent slopes (HmC)

This moderately sloping soil has a profile similar to the one described as representative for the series except that the subsoil is thinner in places. It is on escarpments and rolling kamy areas of glacial outwash terraces and deltas. Individual areas are irregular in shape, and range from 5 to 100 acres.

Included with this soil in mapping were small areas of sandy Windsor soils and finer textured Howard soils, and small spots of Fredon and Halsey soils in some depressions and along drainageways. In the northern part of the town of Russia, some areas of soils that have a fine sandy loam surface layer were included.

Droughtiness prohibits the use of this soil for farming. The soil is poorly suited to pasture. It is suited to tree species that will tolerate dryness. Capability unit VIIs-2; woodland suitability group 5s1.

3. Hinckley and Windsor soils, 15 to 25 percent slopes (HnD)

The soils in this group are moderately steep. Some of the areas consist only of the Hinckley soil or the Windsor soil, and other areas are made up of both soils. Both have profiles similar to the ones described as representative for their respective series except that the sub-soil is thinner in places. Also, they have sand surface layers in some areas. These soils are on escarpments and kamy areas of glacial outwash terraces and kames and sandy deltas in old glacial lake areas. Individual areas are irregular in shape or are long and narrow along terrace escarpments, and range from 5 to 60 acres.

Included with this unit in mapping were small areas of finer textured Howard soils and areas of wetter Fredon and Halsey soils in some depressions and along drainageways.

Droughtiness and slope prohibit the use of these soils for farming. The soils are poorly suited to pasture. They are suited to tree species that will tolerate dryness. If these soils are left without cover, they are susceptible to water erosion and a severe hazard of soil blowing. Capability unit VIIs-2; woodland suitability group 5s2.

4. Hinckley and Windsor soils, 25 to 70 percent slopes (HnF)

The soils in this group are steep to very steep. Some areas are made up only of the Hinckley soil or the Windsor soil, and other areas are made up of both soils. Both soils have profiles similar to those described as representative for their respective series except that the sub-soil is thinner places. Also, areas with a sand or gravelly sand surface layer are common. These soils are on escarpments and kamy areas of glacial outwash terraces, and sandy deltas in old glacial lakes. Individual areas are long and narrow on terrace escarpments or irregularly shaped in other landscapes, and range from 5 to 50 acres.

Included with this unit in mapping were small areas of wetter Fredon and Halsey soils in some depressions and along drainageways.

Droughtiness and slope prohibit the use of these soils for farming or pasture. They are suited to tree species that are tolerant of dryness, and to some types of recreational use. If these soils are left without cover, they are susceptible to severe hazards of water erosion and soil blowing. Capability unit VIIe-1; woodland suitability group 5s3.

5. Phelps gravelly fine sandy loam, 0 to 4 percent slopes (PpB)

This nearly level to very gently sloping soil is on low or slightly depressed areas of glacial outwash terraces where runoff or internal drainage is somewhat slow. Individual areas are irregularly shaped, and range from 5 to 20 acres.

Included with this soil in mapping were small areas of similar but wetter Fredon and Halsey soils in lower areas and along drainageways, spots of drier Howard and Palmyra soils on knolls, and small areas that have gravelly silt loam and gravelly loam surface layers.

This soil is suited to most crops grown in the county and to hay, pasture, or trees. Slight wetness in places delays planting briefly in spring. Random drainage of included wetter soils is desirable in places. Capability unit IIw-1; woodland suitability group 2o1.

6. Windsor loamy fine sand, 8 to 15 percent slopes (WnC)

This moderately sloping soil has a profile similar to the one described as representative for the series except that the subsoil is thinner. It is on rolling and smoothly sloping areas, on glacial outwash terraces and deltas. Individual areas are irregularly shaped, and range from 5 to 30 acres.

Included with this soil in mapping were small areas of gravelly Hinckley soils and finer textured Hartland and Agawam soils, and a few spots of wetter Fredon and Halsey soils in depressions.

This soil is poorly suited to farming because it is extremely droughty. Contour measures to conserve moisture are not feasible in many places, because of the complex short slopes. The soil is suited to hay, early pasture, and trees. The hazard of water erosion is moderate and the hazard of soil blowing is severe if this soil is left without protective cover. Capability unit IVs-1; woodland suitability group 5s1.

APPENDIX B: SOILS MAP