

**POST CLOSURE
OPERATION & MAINTENANCE MANUAL
FOR THE CAPPING COVERAGE,
DRAINAGE & ROADWAY SYSTEMS
AT THE OLD BETHPAGE LANDFILL**



SUBMITTED TO:

**TOWN OF OYSTER BAY
DEPARTMENT OF PUBLIC WORKS**

MAY 1993

TOWN OF OYSTER BAY

OLD BETHPAGE SOLID WASTE DISPOSAL COMPLEX

POST CLOSURE
OPERATION AND MAINTENANCE MANUAL
FOR THE
CAPPING COVERAGE, DRAINAGE AND ROADWAY SYSTEMS
AT THE OLD BETHPAGE LANDFILL
CONTRACT NO. TBI 86-415

Lockwood, Kessler & Bartlett, Inc.
Syosset, N.Y.

May 1993

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LIST OF SKETCHES

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1.0 INTRODUCTION

1.1 Purpose of the Manual

The purpose of this manual is to provide instructions to operating personnel for monitoring maintenance and reporting of the landfill cap at the Old Bethpage Solid Waste Disposal Complex. In accordance with the New York State Department of Environmental Conservation Regulations (6 NYCRR Part 360-2.15 (i)(7)) these procedures will be followed for a minimum period of 30 years subsequent to the completion of the closure.

Specific subjects discussed in this manual include:

- the cover system
- the drainage system
- the access roads
- the gabion wall
- materials required for routine maintenance
- equipment required for routine maintenance.

1.2 Summary

This manual presents a protocol for the post-closure monitoring maintenance and corrective measures of the landfill. The following tables contain a schedule of the required monitoring and repairs and a report form.

TOWN OF OYSTER BAY
OLD BETHPAGE SWDC
SCHEDULE OF INSPECTION/MAINTENANCE

DESCRIPTION	ONCE/YR	TWICE/YR	QUARTERLY	AFTER MAJOR RAIN EVENTS	REMARKS
Soil pH level					Test every three years
Vegetation/grass	Mowing	Mowing along gas pipes	Inspection /repairs		
Deep Rooting/Trees	X (1)		X (2)		(1)Remove trees (2)Insp/repairs
Cracks due to Settlements	X (2)		X (1)		Inspect/Repairs (1)1st 5 years (2)after 1st 5yrs
Ponding				X	Inspect/Repairs
Leachate Seepage or ponding			X		Inspect/Repairs
Control of Burrow Animals			Inspect/Repairs		By-weekly Rodent Control or as required
Odor Control					Inspect during any other sched. maintenance
Drainage System			X	X	Inspect/Repairs Apply Herbicide quarterly as needed
Access Roads			X	X	Inspect/Repairs
Gabion Retaining Wall	Topo Survey		Inspect/Repairs		

TOWN OF OYSTER BAY

OLD BETHPAGE SWDC

INSPECTIONS AND REPAIRS REPORT FORM

DESCRIPTION/ SCHEDULE	INSPECTION DATE	IDENTIFICATION OF DEFECT 1)	DATE OF REPAIRS
Vegetation/grass (Quarterly)		V1 V2 V3	
Deep Rooting (Quarterly)		R1, R2, R3	
Cracks (Quarterly)		C1, C2, C3	
Ponding (After Rain Events)		P1, P2, P3	
Leachate Seepage (Quarterly)		L1, L2, L3	
Vector Burrowing (Quarterly)		B1, B2, B3	
Odor Control (Any other inspection)		O1, O2, O3	
Drainage (Quarterly & after Rain Events)		D1, D2, D3	
Access Roads (Quarterly & after Rain Events)		A1, A2, A3	
Gabion Retaining Wall (Quarterly)		G1, G2, G3	

NOTES:

- 1) Identify location on Sketch Nos. 1 or 2 and describe defect on separate sheet. If no defects found, enter O.K. in identification column. As required, use more than one copy of Sketch Nos. 1 and/or 2 to locate all identified defects.
- 2) Describe defects as in the following examples:
 V1 20± sq. ft.
 C1 Minor settlement crack 30" long
 D1 Swale erosion requires gabion mattress repair
 D2 Vegetation growth in the ditch

1.3 Reporting

The findings of the inspections shall be reported using copies of Sketches Nos. 1 and 2, to indicate the locations and nature of the damages. As might be necessary, brief description of the damages and recommended repairs shall be included in written reports accompanying the sketches.

Quarterly reports indicating the above information as well as descriptions and dates of the repairs shall be prepared and kept in the files. Annual reports to the NYSDEC will include copies of the quarterly reports.

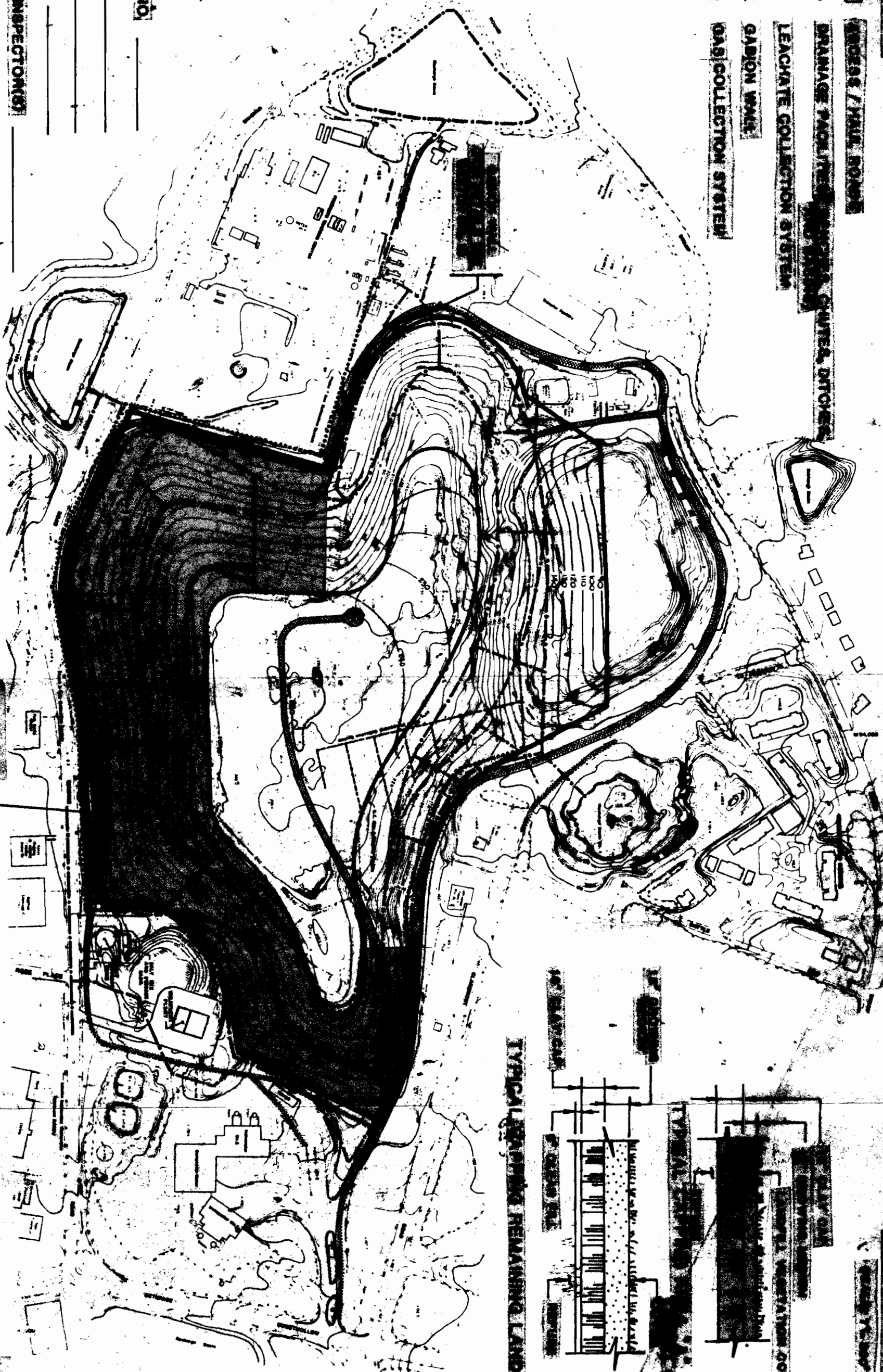
ACCESS / PAVE ROADS

DRAINAGE FACILITIES / DRAINAGE SYSTEMS / CURBS, DITCHES

LEACHATE COLLECTION SYSTEM

GASION WALL

GAS COLLECTION SYSTEM



TYPICAL REMAINING LANDFILL



REPORT NO.

DATE

TEMP.

WEATHER

NAME OF INSPECTOR(S)

SIGNATURE OF INSPECTOR(S)



LOCKWOOD, KESSLER & BARTLETT, INC.
1000 PARKWAY DRIVE, SUITE 1000
STROBERT, MISSISSIPPI 39285

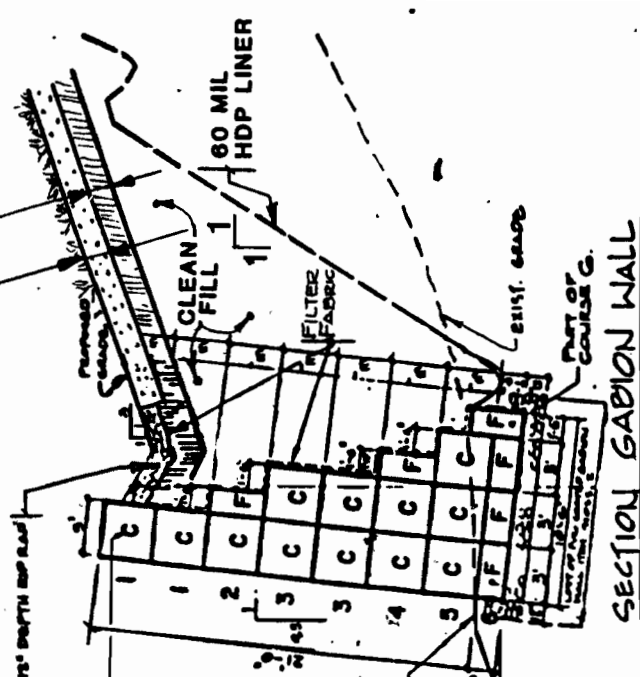
TOWN OF OSTEE

DEPARTMENT OF HEALTH

OLD SITE

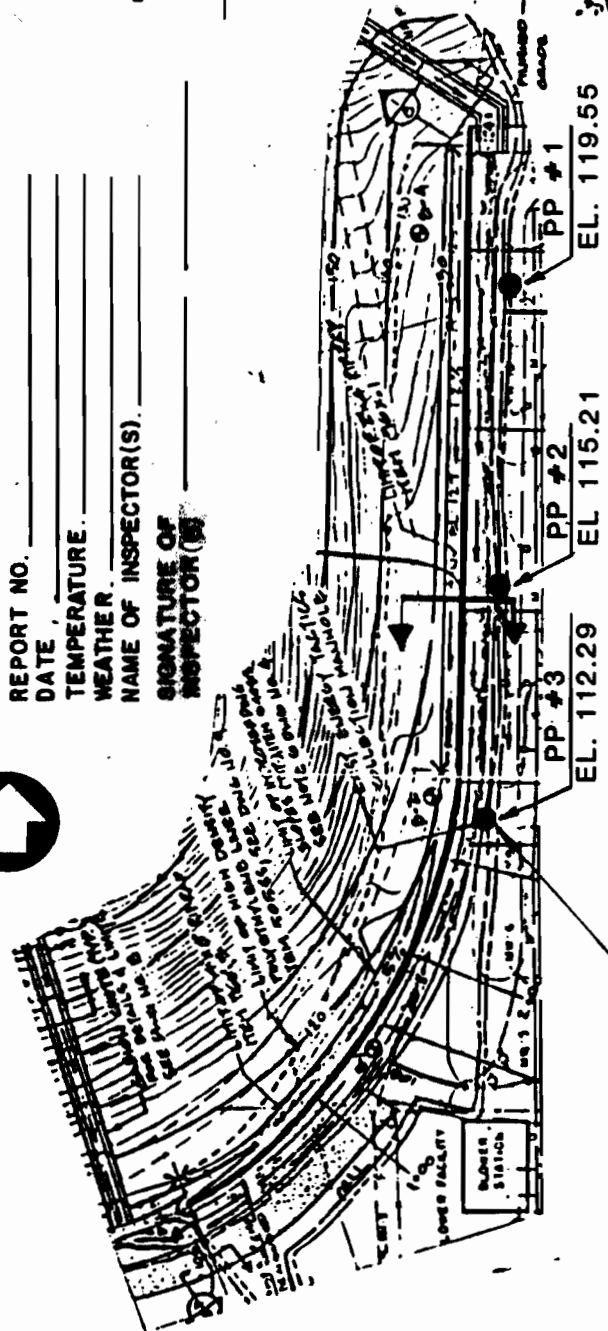
LANDFILL CAP

18" CLAY GAP
18" GROWING MEDIUM



BM NO.	ELEV. JAN. 93	ELEV.
1	117.73	
2	120.40	
3	126.88	
4	129.55	
5	129.56	
6	130.13	
7	130.09	
8	130.29	

REPORT NO. _____
DATE _____
TEMPERATURE _____
WEATHER _____
NAME OF INSPECTOR(S) _____
SIGNATURE OF INSPECTOR _____



CONTROL BENCH MARK P.K. NAILS IN POWER POLES. (TYP)

BM NO.	ELEV. JAN. 93	ELEV.
1	117.73	
2	120.40	
3	126.88	
4	129.55	
5	129.56	
6	130.13	
7	130.09	
8	130.29	

FRONT ELEVATION: GABION WALL



2.0 COVER SYSTEM

2.1 General

The purpose of the cover system is threefold: to minimize water infiltration to prevent the emanation of landfill gases and to provide an aesthetically pleasing appearance to the landfill. Since the cap is a long term structural system, its integrity must be assured for many years. Current New York State regulations require a maintenance period of at least 30 years following closure.

There are several outside factors that may adversely alter the structural integrity of the cap. They are:

1. Erosion by Water. With adequate slope design and proper vegetation and cover soil, the detrimental effects of runoff water can be alleviated.
2. Erosion by wind. It becomes a problem if vegetation is not properly utilized and maintained.
3. Root Penetration. With some types of vegetation, deep root penetration into the cover materials might occur. This vegetation appears and generates naturally and is mostly represented by locust trees. Please refer to Subsection 2.3.

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4. Burrowing Animals. Damage to the cap caused by animals can be prevented by proper maintenance consisting of a sound vector control. Please refer to Sub section 2-7 for details.

5. Accidental Intrusion. Damage to the cap may be caused by large pieces of equipment that will be used for the maintenance/repairs extensions of the gas extraction and/or leachate collection systems, or other construction and maintenance projects.

In addition to the intrusions described above, the performance of the capping system could be adversely affected by uneven settlements that might cause pondings and/or cracks. Routine visual inspections (particularly following rainstorms) and adequate remedial measures of the damages observed, is part of normal maintenance procedures.

2.2 Vegetation/Grass

Permanent deep-rooted grasses are the first line of defense against erosion and constitute the only soil protection of the cap. Routine inspections followed up by repairs as necessary shall be made on a regular basis at least four (4) times a year. Intensive storms, long periods of drought and landfill settlement may exacerbate the need for maintenance.

In areas where vegetation has not become established or is sparse, reseeding will be necessary. If large areas require reseeding, hydroseeding can be used to apply the seed mix, along with lime, fertilizer, legume inoculant, and mulch in a water mix.

For smaller areas, seed can be broadcast. In this case, the topsoil should be prepared with fertilizer and lime, the seed spread over the area and covered by an application of clean straw or hay mulch.. A tackifier should be used on steep slopes to hold mulch in place.

For best results, seeding should be done in the early spring from late March to early May or in early September. However, in no case are eroded areas to be left unprotected at any time. During the summer and late fall months, oats may be seeded; these will usually suffer winter kill but will protect soil. The following spring, these areas should be reseeded with the permanent seed mix. During the winter, the damaged areas shall be temporarily protected by utilizing mulch and/or broken stone.

The permanent seed mix for the landfill, areas adjacent to drainage ditches and recharge basin should be:

<u>Species Common Name</u>	<u>Pure Live Seed Rate (lbs/acre)</u>
Tall fescue	40
'Empire' Birdfoot Trefoil*	12

Redtop	10
Perennial Rye	25
Total Pure Live Seed	87 lbs/Acre

* The 'Empire' Birdfoot Trefoil must be inoculated immediately prior to seeding.

The year following seeding, top dress with additional fertilizer. Fertilizer in a slow release form is to be applied to the cover vegetation to maintain health and vigor without over stimulation of growth. It should be a 5-10-10 mix of nitrogen, phosphorus and potassium applied at a rate of one pound per 1,000 square feet. After this period, fertilizer will be applied only as vegetative cover is thinning out or new stands of vegetation are being established.

Lime is to be applied to maintain a pH level between 6.0 to 7.0. The soil will be tested every third year to check lime requirements and application rate. Application of lime should be made in the spring or fall only.

In order to reduce fire hazards, the areas along the perimeter gas collection system shall be mowed at least twice a year. To promote growth, the balance of the landfill shall be mowed once a year, preferably in the fall.

Grasses may brown up during the hot, dry periods. These areas, though not presenting any serious problems should be watched for

visible soil erosion. As moisture and cooler temperatures, occur, the grass will start to green up again. Since weeds enhance the protective effect of the vegetation, herbicides are not recommended to be used. No insecticides are recommended to be used on a routine basis because resistant strains of insects might develop. In addition, both the herbicides and insecticides may contaminate the stormwater runoff.

Except for ticks which are usually associated with the presence of rats and mice, no other insects create problems at the landfill. By eliminating these rodents, ticks will also likely disappear (See Section 2.7 for discussion of rodent control measures). In exceptional situations when areas of the landfill are infested with ticks, as a last resort, the Town should contract a commercial applicator for an insect control program.

2.3 Vegetation/Deep Rooting Trees

Saplings exceeding 1 1/2 to 2 inches in diameter (with possible deep roots) are evident mostly within the areas of the landfill that were capped prior to 1988, specifically the section of the landfill designated as Area A in Sketch No. 1. All trees with diameters of more than 1 inch shall be cut at grade. During the annual mowing of the landfill, as described in the previous section, all other trees/shrubs with stem diameters of less than 1 inch should be cut and removed.

After the initial removal of all trees, any reestablished trees or shrubs should be removed during the subsequent annual mowings.

Inspection of the areas where trees were removed should be made every three months. If either during the quarterly inspection specifically related to tree removal, or during any other routine inspection of the landfill, cracks or holes caused by rotting roots are observed, they should be repaired as soon as possible, weather permitting. The repair consists of digging a hole by shovel around the root to a depth equal to the depth of the root, and refining the hole with clay to within 6 inches of the surface. The clay shall be as specified in Subsection 2.4. The last 6 inches should be filled with growing medium. The materials should be as specified in Subsection 2.4.

Any dead tree regardless of its size shall be pulled out (including the root) and the capping repaired. In no case shall trees be cut and the roots left in the ground. The field inspection and the removal as described above should be performed once a year, if possible at the same time the annual mowing is done.

2.4 Cracks Caused by Uneven Settlements

Approximately 90 percent of the anticipated land settlement is likely to occur within five years after the landfilling operation was completed. The site is to be inspected visually for the

presence of major (greater than 12 inches in depth) or minor (less than 12 inches in depth) settlement cracks a minimum of four times per year for five years and once a year thereafter.

Areas where major settlements occur are to be repaired as soon as weather conditions permit to insure the integrity of the cap. Since clay is difficult to work with when wet or frozen, major repairs should generally be avoided during the spring and winter months. Repair of major settlement cracks are to be accomplished by removing the final cover strata and replacing the growing medium, clay barrier and clean fill Type A layer materials to obtain at least the same thickness as the original layers, but not less than the thicknesses indicated in the typical sections shown on Sketch No. 1. The growing medium material, shall consist of 30-60 percent sand, 20-60 percent silt and 5-25 percent clay and a pH value between 6.0 and 7.0. The clay material shall hve a permeability of 1×10^{-7} cm/sec or less and a plasticity index of 10 percent or greater. The clean fill Type A shall be sound hard durable stone, run-of-bank gravel, sand or other granular materials. The affected areas shall be regraded to the original slope and reseeded as described in Sub-section 2.2

Minor settlement cracks or areas where the final cap has not been seriously impaired should be top dressed with barrier protection material which is the uppermost 12 or 18 inches of the cap as indicated in Sketch No. 1. Reseeding the affected area should be

done as soon as the weather conditions permit, following the other corrective measures.

2.5 Ponding Caused by Settlements

Although, because of the age of the landfill, no significant ponding caused by settlements is expected to occur for the next few years, routine inspection of the plateau should be made following any rainstorm in excess of 1 1/2 inches over a 24 hour period or comparable snow melting. Corrective measures are to be implemented immediately following the detection of ponding. Ponding areas that show no evidence of cracks shall be restored to the original slopes by filling the depressions with growing medium material as described in Subsection 2.4, and seeding as described in Section 2.2.

2.6 Leachate Seep Management

The landfill is to be visually inspected for the presence of leachate seeps or leachate ponding areas a minimum of four times per year. The presence of leachate indicates a defect of the clay barrier. Corrective measures shall be taken immediately following the detection of any seepage and/or ponding areas. Repairs of leachate seepage areas consist of restoring the clay layer, placing the growing medium compacting, and seeding, similar to the recommendations made for crack repairs and/or ponding areas. Please refer to Sections 2.4 and 2.5 as

applicable. Ponded leachate shall be pumped into a tank truck and delivered to the Leachate Treatment Plant.

The final slopes of the restored area should be the same as the adjacent areas.

2.7 Control of Burrowing Animals

Burrowing animals may penetrate the full depth of the cap. This would allow rainwater to percolate into the landfilled materials and lead to the production of additional leachate and the possibility of leachate seepage.

Burrowing animals indigenous to Long Island include shrews, moles, voles, rats, mice, chipmunks, rabbits, fox and woodchuck. Because of the type of vegetation in the landfill, open grassland, it is expected that rodents occupying the landfill will be of the shallow burrowers type, such as voles and mice. At this time it is not expected that rodent population will burrow through the clay layer due to the underlying presence of landfill gas. However, in the future, as the gas generation diminishes, burrowing may become a problem.

With respect to rodent control, the Town is currently under contract with a commercial pest control company. Under the contract that is being renewed periodically, bait is placed at selected locations determined by routine monitoring. Currently,

the baits are being placed in selected areas along the perimeter of the landfill, in the vicinity of certain structures that may become "active areas" as well as in any other location where recent activity is observed. The baits are being placed in tamper proof rodent stations located 10 to 30 feet apart as determined by the Contractor. The commercial name of the poison used is Contact Blox, EPA No. DI-Blox, manufactured by Bell Laboratory. Since this procedure appears to be adequate, it shall continue on a bi-weekly basis with future modifications of the schedule as may be required.

If for six consecutive months, no rodent activity is observed, the above described procedure may be discontinued, but as a minimum requirement, quarterly inspection for burrows will be performed and a preventive rodent control program by placing bait along the perimeter of the landfill, across the observed passage routes of rodents should be implemented throughout the 30 year period. If the rodent activity increases, the bi-weekly procedure should be reinstated.

Since foxes can to some extent control the rodent activity, their sporadic presence within the landfill should be of no concern. However, if they become a nuisance for the maintenance personnel or for inhabitants of the surrounding areas, the Town should contact a commercial wildlife trapper and implement a control program.

When a burrow is found, it will be immediately plugged using growing medium, clay and/or clean fill materials as necessary depending upon the depth of the hole and the cap restored in a manner similar to that described in Sub Section 2.4.

2.8 Odor Control

Presence of odor within a capped landfill could indicate a malfunction of one of the components of the closure such as:

- breakage of a pipe or other component of the landfill gas collection and/or extraction system;
- deterioration of the clay barrier layer that allows landfill gases to emanate into the atmosphere; or
- leachate ponding or leachate seepage.

If during any routine inspection of the landfill or any other time odor is detected, the inspector should locate, identify and report the source of odor and repairs shall be made immediately, in accordance with the applicable procedures described in other sections of this manual or in accordance with the methods recommended for pipe repairs in the O&M Manual pertaining to the gas control system.

3.0 DRAINAGE SYSTEM

The drainage system consists of a network of swale, gabion chutes, open ditches, pipes and other appurtenances all collecting and conveying the runoff into recharge basins. The primary collection system consists of a series of swales, spaced approximately 40 to 50 vertical feet apart, generally running parallel to the slopes and being in many instances part of a bench used also as an access road. The swales/benches are formed over the clay barrier and lined with 3/4 inch stone. The gabion chutes running down the slopes intercept the swells. They consist of gabion mattresses filled with 3 to 6 inch stone to withstand high velocity and scour effects caused by the steep slopes of 1 on 3.

The gabion chutes discharge the collected runoff into a network of open ditches and pipes located generally along and outside the perimeter of the landfill (toe of slope). Most of the runoff is conveyed by the open ditches and pipes into three recharge basins under the jurisdiction and maintenance of the Town of Oyster Bay. Under the final drainage plan of the landfill, a portion of the runoff, generated over an area of approximately 24 acres will be discharged into an old, abandoned pit known as the Phase 2 Pit. This depression is in the process of being filled with selected clean fill. A collection well will be constructed within this area so that stored water can be extracted and used for various operation and maintenance purposes within the landfill.

Stormwater conveyance facilities within the landfill require maintenance to ensure that the system as a whole functions properly. In general, this involves regular quarterly inspections of all swales, ditches, pipes and other drainage structures for signs of debris build up, sediment deposits, excessive vegetation growth in the open ditches, erosion, and other structural failures caused by settlement. Visual inspections should also be made following any significant rainstorm event in excess of 1 1/2 inches over 24 hours.

Signs of erosion and other structural failures of the swales and chutes are to be addressed promptly to insure the integrity of the capping system and to protect the adjacent areas of the site from flooding. Areas subject to high velocity or turbulence such as those located in the vicinity of chutes, pipe and chute/swale/access roadway intersections are particularly susceptible to erosion and shall be maintained on an as-needed basis. Eroded areas adjacent to the chutes should be restored by filling with applicable materials as shown in the typical sections on Sketch No. 1, addition of rip-rap, repairing or replacing portions of the gabion mattresses, replacing filter fabric or other appropriate measures to correct the problem and prevent further erosion. The rip-rap should be dry rip-rap 3"-6" with percentages passing 3", 5" and 6" sieves of 0, 25-75 and 100, respectively.

The polyester filter fabric shall be No. 700 as manufactured by Polyfelt and distributed by Gundle or equal. The growing medium, clay and clean fill materials, and the seeding should conform with the requirements of Sub-sections 2.2 and 2.4.

Vegetation within the chutes and drainage ditches should be eliminated by using the herbicide Round-Up manufactured by Monsanto. The treatment should be made during or following the quarterly inspections as required in accordance with the manufacturer's recommendations.

4.0 ACCESS ROADS

The landfill is encircled by a system of roadways that follows in general, its perimeter and is known as the Patrol Road and Haul Road. Access to the side slopes and the plateau of the landfill is provided by a network of one way access roads and/or multipurpose benches. The multipurpose benches also accomodate drainage collection facilities as described in the previous section of this manual.

The access road system shall be inspected for damages quarterly, and also following any major storm events, similarly and at the same time as the drainage facilities are inspected. However by virtue of implementing other inspection/monitoring requirements, described in this manual, the access roads will be used and could be inspected much more often.

All access roads should be maintained in a safe passable condition. It is of uppermost importance to repair promptly any damage of the benches in order to maintain the integrity of the impermeable barrier of the landfill as well as the integrity of the drainage system.

The repairs will consist in general of regrading, filling with suitable materials, compaction, and reseeding of the areas adjacent to the roads as applicable.

The materials to be used for the access roads within the landfill (benches) should be 3/4" crushed stone Type A, B, or C as defined by the Nassau County DPW, 1964 Standard Specifications.

The materials used for the patrol road should be blended crushed stone, conforming to the following gradation:

<u>Passing Sieve</u>	<u>Percent Passing by Weight</u>
1 1/2"	100
1"	90 - 100
1/2"	65 - 85
3/8"	55 - 75
#4	40 - 55
#8	30 - 45
#30	16 - 27
#200	0 - 20

The repairs of the perimeter roads will consist in general of patching or repairing of the damaged sections of the roadways. The repair work shall be performed in a manner that will provide a passageway for vehicles at all times.

Crushed stone shall consist of clean, durable sharp angled fragments of rock of uniform quality throughout. Gravel hardness retained on a four inch screen and then crushed, is acceptable.

5.0 GABION RETAINING WALL

The gabion retaining wall is installed along the southeastern perimeter of the landfill in the vicinity of the Nassau County Firemen's Training Center. It has a length of approximately 670 feet and its height varies from 22.5 feet to 1.5 feet. By its structural nature, in accordance with the purpose for which it is used, the gabion wall has the ability to deform so that the structure can withstand unpredictable settlements without loss of stability.

Because extraneous settlements and/or pressures normally occur at landfills, a monitoring program of the gabions should be implemented.

Five (5) level benchmarks have been placed along the top of the gabion wall. In addition, two (2) control benchmarks located outside of the landfill area were established. The two control benchmarks are located in areas where settlements are not expected to occur.

The locations and current elevations of the benchmarks are shown on Sketch No.2. Yearly topographic surveys should be made to check settlement.

Quarterly visual inspections of the gabion wall should be made to check for possible deteriorations such as:

- stability (leaning, sliding);
- major settlements of the fill behind the wall could indicate deterioration of the filter fabric and washouts;
- deterioration of the swale and/or the clay cap behind the wall; and
- check the integrity of the benchmarks.

Depending upon the type of damage observed, the repairs could consist of replacement of gabion baskets, restoration of foundation, repairs of damaged baskets by using wire ties and/or wire meshes, placement of rip-rap, in the upper ditch and in the gabion baskets, replacement of the filter fabric, backfilling and capping behind the wall in accordance with the details shown on Sketch No. 2; restoration of the rip rap and reshaping of the swales. The rip-rap for the gabion wall shall be of the dry type 4"-8" size, with gradation that meets the following specifications:

<u>Sieve Size</u>	<u>Percentage Passing (Range)</u>
4 In.	0
5 In.	50 - 80
8 In.	100

All repairs are to be made as soon as weather conditions permit, after the damages are observed.

The rip-rap for the upper ditch should be dry type 3"-6" size as described in Section 3.

The filter fabric shall be as specified in Section 3.

Any benchmark that cannot be recovered should be replaced during the subsequent round of survey.

6.0 MATERIALS REQUIRED FOR ROUTINE MAINTENANCE

The following materials should be stored at the site:

1. Clay, as specified (Sub section 2.4)	80 CY
2. Rip-rap 3"-6" (Section 3.0)	160 CY
3. Blended crushed stone surface (Section 4.0)	160 CY
4. 3/4" crushed stone (Section 4.0)	80 CY
5. Selected fill - growing medium (Sub section 2.4)	200 CY
6. Clean Fill Type A (Sub section 2.4)	80 CY
7. Gabion mesh, 3 1/4 x 4 1/2" opening, PVC coated	One Roll (12'W x 100'L)
8. Wire, galvanized 2.2 m.m.	One Roll (50 lbs.600±LF)
9. *Filter fabric (Section 3.0)	One Roll (15'W x 360'L)

Other materials such as lime, seeds and herbicide should be purchased on an as needed basis.

NOTE: *Protect from exposure to sunlight.

7.0 EQUIPMENT REQUIRED FOR ROUTINE MAINTENANCE

The following major pieces of equipment are required at the site:

1. One mower (the Town is purchasing a mower).
2. One payloader International Equipment, Model 555.
3. One truck, 10 wheel carrier, 16-18 CY capacity.
4. One bulldozer, low ground pressure, low flotation Model TD10, as manufactured by International Equipment. The bulldozer should be used for compaction of soil materials related to the repairs of cracks caused by uneven settlements, ponding leachate, seep management, drainage and roadway work. For compaction of roadway work, a roller weighing 8-10 tons should be used.
5. One backhoe Case, Model 580.
6. One water truck, 2,000 gallon capacity.
7. Two chain saws required during the initial removal of trees.