Section 5 Preferred Plan Alternatives

5.0 Introduction

As indicated in the previous sections, the 208 Program has identified Long Island's wastewater management needs and the relevant structural and non-structural alternatives that may be used to ameliorate them. A large number of wastewater management alternatives were defined, all having as their general objective the development of a comprehensive management plan for the treatment and disposal of waste in order to protect the public health and natural resources of the Nassau-Suffolk 208 Region.

During the course of the planning process leading up to the development of the Plan, alternatives were subjected to constant evaluation in terms of engineering and economic feasibility, probable environmental effects and legal or regulatory requirements. Where any alternative or set of alternatives was found to violate environmental, economic, engineering or legal constraints, it was eliminated or modified.

It is well known that the groundwater and marine surface waters of the Bi-county Region were strongly interdependent, as far as quality and quantity were concerned, but that waste management alternatives could conveniently be defined in terms of protecting one or the other. This led to the division of the bi-county land area into a number of hydrogeologic zones distinguished by differences in groundwater flow regime and degree of development. Furthermore, the marine surface waters were divisible into segments having different physical characteristics, tidal flushing patterns, freshwater inputs, and so forth. Waste management alternatives tailored to their specific conditions and requirements were then postulated for each zone and segment.

Water quality problems in Nassau-Suffolk are generally a function of the density of residential development and of the nature of some of the industrial activity. Generally, ground and surface waters are or have been most severely impacted in those areas occupied by the greatest number of persons. Some of these areas are now sewered and groundwater quality appears to be improving.

Long Island's continued ability to meet the regional demand for potable water and for water-based recreation opportunities and commercial fisheries will depend to a great extent on the measures taken to prevent further degradation or to improve the quality of the aquifers, streams and bays.

Inasmuch as the management of domestic and industrial wastes is a primary concern, most of the recommendations for the construction of sewers, or the installation of monitoring wells, are related to existing or proposed residential densities, and to industrial areas.

However, sources of pollution other than sewage must also be controlled in order to achieve and maintain improved water quality. Sources such as stormwater runoff, fertilizers, animal wastes and landfills contribute to the overall problem, and steps must must be taken to mitigate their effects. Since these and other non-point pollution sources are not specific to any locality, measures for mitigation are identified as "Areawide Recommendations."

In 5.1, the Areawide Recommendations are presented, under eight main headings. Next, in 5.2, the array of alternatives for each of the hydrogeologic zones and surface water segments is briefly discussed. In order to provide guidance to present and future 201 Studies in the Region, the 208 Program has related the hydrogeological zone and surface water recommendations to detailed study areas. A map of the detailed study areas was overlaid on the zone and segment maps in order to identify those portions of the various zones and segments located within each study area. It was then possible to develop individual waste treatment management plans for the study areas, and these are presented in 5.3. Together, they constitute the areawide plan.

Finally, inter-jurisdictional matters are discussed in 5.4, and recommendations for future studies in 5.5.

5.1 Areawide Recommendations

The following recommendations should be regarded as applicable throughout the bi-county area wherever the pollutant problems addressed by the proposed measures or practices occur. The recommendations, which have been selected from the more extensive list presented in Section Three and in Section J of the Areawide Waste Treatment Management Plan, focus on key non-point problems: control of stormwater runoff, the functioning of on-lot disposal systems; the use of fertilizers; landfills; animal wastes; on-site industrial waste and chemical products handling, and water conservation.

For the most part, the proposed measures are non-structural in nature and call for the institution or continuation and expansion of Best Management Practices. Furthermore, certain measures require development and demonstration, in order to determine their efficacy. Measures requiring such further study, *e.g.*, marsh-pond treatment, on-lot subsurface denitrification systems, etc., are discussed in Section 6.5.2.

5.1.1 Control Stormwater Runoff. The 208 investigations have indicated that stormwater runoff is a major contributor of non-point pollution to Long Island's surface waters and groundwaters. Best Management Practices should be employed to reduce the volume and velocity of runoff and the consequent diminution of its erosive and transport capabilities. To the extent feasible, surface runoff should be intercepted and disposed of as close as possible to the source. Best Management Practices, including proper grading and the maintenance of vegetation, and/or structural systems should be employed to minimize the volume of runoff and the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. Recharge basins may need to be modified, where feasible, to improve the removal of nutrients, metals and organic chemicals in stormwater runoff that contribute to groundwater contamination. Inasmuch as the practicality and cost-effectiveness of most of the techniques for the treatment of runoff have not yet been determined, the establishment and operation of several pilot projects is recommended. Further investigation and testing of street vacuuming and the use of natural or man-made detention systems, with marsh-pond treatment and/or disinfection, are proposed.

Land clearance and development tend to accelerate runoff and erosion when the protective vegetal cover of the land is removed. The use of Best Management Practices during clearance, building construction, and site restoration should be required in order to avoid increased runoff and sediment transport from the site.

5.1.2 Ensure the Proper Functioning of On-Lot Waste Disposal Systems.

a. *Provide for Routine Maintenance of On-Site Disposal Systems.* Provision should be made for routine pumping and maintenance of the on-lot systems in order to extend the service life of the leaching facility and to ensure its continued efficacy. Local or county government should be responsible for the provision of scavenger waste treatment and disposal facilities. The numbers and locations of such facilities should be determined at a 201 level of study.

County sponsored public education to encourage voluntary implementation is recommended. The promulgation of legislation mandating routine pumping and maintenance is not proposed at this time.

b. *Prohibit the Use of Certain Chemical Cleaners in On-Lot Systems.* If organic solvents and other chemical agents contain ingredients which might reasonably be expected to impair groundwater quality, their use for cleaning or extending the service life of on-lot sewage disposal systems should be prohibited or controlled. A program to identify such products is presently being conducted by Nassau County Health Department and Suffolk County Departments of Health Services and Environmental Control, and should be continued and emphasized. This should be coupled with specific county legislation banning the local sale of these products within Nassau and Suffolk Counties.

5.1.3 Reduce the Use of Fertilizers. Since fertilizers are one of the largest sources of nitrogen applied to the land surface, they constitute a significant potential source of ground and surface water impairment. Pending further study to better define fertilizer impact on water quality, public education should, and regulation may, be employed to limit, or possibly eliminate, the use of all or specific types of fertilizers. Best Management Practices, some of which may also pertain to agriculture, include modification of application rates, discontinuance of reliance on fast-acting inorganic fertilizers, and promotion of low-maintenance lawns, which would require both less fertilizer and less consumptive use of water.

5.1.4 Minimize Pollution from Landfills.

a. *Reduce Reliance on Landfilling.* Landfills are not a viable long-term solution to Long Island's solid waste disposal problems. Resource recovery systems, at the regional or sub-regional level, are recommended. Feasible methods should be evaluated for local cost-effectiveness and ability to avoid groundwater impairment. Methods for the co-disposal of sewage sludge and solid waste should also be considered. The continued burial of wastes in landfills, with the exception of non-putrescible or non-polluting matter, should be minimized or discontinued, especially in hydrogeological zones that are particularly sensitive. It should be noted however that if land is unavailable in the less sensitive zones and safeguards can be assured that will effectively control the production of leachate and the impairment of the groundwater, landfills may be considered for the more sensitive zones.

b. *Improve Existing Landfills.* Existing and completed landfills should be upgraded in order to effectively control infiltration and direct runoff to surface waters. Methods used should include top covering with impermeable barriers, positive grading with erosion control, and other stormwater diversion systems.

5.1.5 Reduce and Control Animal Waste. In order to minimize the ad-

verse effects of animal wastes on surface waters, a number of Best Management Practices are recommended. These are the following:

1. Repeal dog curbing ordinances, and promote dog waste clean-up ordinances. Also, encourage dog population control.
2. Closely regulate the stabling of horses and other large domestic animals in residential areas. Their numbers should be limited, and the methods of storing and handling of their wastes should be strictly controlled.
3. Prohibit the sale of White Pekin ducks as pets. This practice has resulted in interbreeding with wild species, and the establishment of a semi-wild duck population on inland lakes and ponds. It is necessary that this population be gradually eliminated.

5.1.6 Strengthen and Enforce Regulations Pertaining to Industrial Wastes, Product Storage and Transportation, and Residuals.

a. *Expand Regulations and Enforcement Regarding the Disposal of Industrial Wastes.* Where industrial wastes are discharged to municipal sewer systems, strict enforcement of sewer use ordinances should be insured. Suffolk County is revising its sewer use ordinance to conform to applicable State and Federal guidelines. This revision will be implemented by October, 1978; Nassau County has already adopted such an ordinance. These County ordinances should be the model for all other municipalities or sewer districts within each respective county, and as such should be adopted by each of these entities. Each municipality or sewer district should be responsible for the enforcement of the ordinances and should maintain an adequate staff for such enforcement.

Present regulations covering the discharge of industrial wastes to the ground should be expanded to include greater coverage of specific contaminants and to prescribe allowable discharge levels. This applies primarily to organic chemicals and heavy metals.

b. *Regulate the Storage and Transportation of Chemical Products.* Permits and other controls should be required for the storage and transportation of chemical products that pose a threat to either the groundwater or surface water. The regulations should cover prescribed practices, safety requirements, inspection of equipment and contingency plans for interim storage and clean-up. The county agencies should be responsible for enforcing the permit regulations and control measures; the individual operator should be responsible for maintaining records and monitoring. In addition to industrial chemicals, these products include chemical wastes and sludges, de-icing salts and petroleum products. Salt storage facilities should be designed to prevent leachate contamination of groundwater.

Particular emphasis should be placed on the regulation of gasoline storage facilities at automobile service stations and, to a lesser degree, home heating oil storage tanks. Criteria should be developed and enforced to ensure the integrity of all storage facilities. The 208 Study has recognized these two types of facilities as major potential pollutant sources, but has not been able to define the precise magnitude of the problem.

c. *Provide for the Treatment of Hazardous Wastes.* The industries in the Nassau-Suffolk Region and the wastewater treatment processes they employ generate two kinds of hazardous wastes: small volumes of strong, toxic industrial wastes and industrial waste treatment sludges.

In view of the environmental sensitivity of the study area, continued disposal of these types of hazardous wastes outside of the area should be encouraged. However, if this disposal option is not available in the future, treatment facilities or landfills for the disposal of hazardous wastes will have to be provided in the bi-county area. The 208 recommendation is for a regional hazardous waste treatment facility for both counties. If a single facility cannot be implemented, individual county facilities are then recommended.

Treatment facilities should, wherever possible, be located at a sewage treatment plant with an ocean outfall. The effluent from the hazardous waste treatment facility should be disposed of to the outfall, not to the plant influent. The outfall disposal will provide a temporary discharge in the event of a hazardous waste facility upset.

If a hazardous waste treatment facility cannot be located at a sewage treatment plant with an ocean outfall, it can be located somewhere in the area served by the plant, and can discharge *treated* effluent to the sewer system. Effluent monitoring must then be intensive so that in the event of a plant or process upset, a slug of toxic waste can be prevented from reaching the downstream treatment plant.

If a hazardous waste treatment plant is not connected to a treatment plant ocean outfall, and is located in the deep-flow aquifer recharge area, special provisions must be made to contain any waste spillage. The wastes must not be allowed to percolate into the ground. Consequently, impermeable retention lagoons must be provided, large enough to take the entire plant inventory, in the event of a radical plant failure.

The hazardous waste treatment facilities should provide treatment for both organic and inorganic wastes where feasible. Radioactive wastes should not be handled at the facilities.

5.1.7 Promote Water Conservation. Water conservation is a matter of importance on Long Island for several reasons. First, a reduction in the amount of water use would help reduce the degree of water level declines in the bi-county area. This might also reduce losses in streamflow and underflow to the bays in some areas. Furthermore, in certain cases, lower pumpage from high yield public supply wells as a result of water conservation may help to minimize alteration of natural-flow systems and subsequent migration of contaminants to the deeper aquifer. Moreover, using less water would achieve savings in energy required to pump and heat it. It would also reduce flow to individual disposal systems, which could reduce failures. Finally, in areas requiring sewers, lower water use might permit the development of smaller sewage treatment facilities. Concerted public information programs, and the promotion of flow-reduction devices, can aid in reducing wastage. Recreational, residential and institutional lawn irrigation should be minimized by

the modification of automatic, clock-operated systems to systems that sense the moisture content in the root zone. Public education programs should discourage the use of water-intensive Bluegrass lawns and should encourage the planting of Fescue grasses, which require less water.

Agricultural irrigation water management boards should be organized in the Towns of Brookhaven, Riverhead and Southold. These boards should examine agricultural, residential and recreational irrigation water demands and uses, and should develop water priorities during periods of drought and for areas with saltwater intrusion problems. Irrigation water management plans identifying crop needs and the soil/water holding capacity should be prepared for agricultural operations and lawn areas exceeding five acres. Trickle irrigation and efficient sprinkler irrigation should be encouraged.

5.1.8 Provide Alternatives to Ocean Disposal of Municipal Treatment Plant Sludge. The major municipal treatment plant sludge processing and disposal approaches that appear viable in the Nassau-Suffolk Region include composting, landfilling, land application, incineration, co-incineration with solid waste, pyrolysis and thermal drying. (These approaches also apply to the sludge from scavenger waste treatment plants.) It has been found that any of the conventional approaches can be implemented in the Nassau-Suffolk area without significant environmental degradation if normal safeguards are taken. Final sludge disposal options should be selected after 201 level detail studies have been conducted, since the final decision should be based upon cost-effectiveness and environmental impact. The 208 study has determined that the conventional approaches are regionally acceptable.

Land based sludge disposal options (land application, composting) must be accompanied by monitoring or other control programs to insure against contamination of groundwater with heavy metals, inorganic and organic chemicals, and pathogens. This is particularly important in hydrogeologic zones I, II and III. Land-based disposal options will require strict enforcement of industrial pre-treatment requirements to minimize the amount of toxic materials in municipal treatment plant sludges.

5.2 Recommendations by Hydrogeologic Zone and Surface Water Element

5.2.1 General. Section 5.2 contains a summary table (Table 5–1) indicating the preferred alternatives for each of the eight hydrogeologic zones and the eleven bays described in Sections 3.2 and 3.5, together with brief discussions of recommended groundwater monitoring, the maintenance of groundwater levels, the siting, construction and management of landfills, and the expansion of public water supply systems.

The preferred alternatives for the hydrogeologic zones and surface water elements address public health objectives. The alternatives selected for the hydrogeologic zones characterized by a deep flow system are expected to minimize contaminant concentrations in the primary water supply aquifer, the Magothy, and in the deep Glacial aquifer in northwestern Nassau; those selected for the zones characterized by a shallow flow system are expected to protect the as yet uncontaminated portions of the Glacial aquifer and permit the restoration of previously degraded sectors. The alternatives selected for the surface water elements are expected to minimize coliform levels and maintain dissolved oxygen levels in recreational and shellfish waters.

The pollutants of greatest concern are nutrients, organic chemicals, heavy metals, coliform bacteria and viruses. Nitrogen was selected as the key pollutant for the purpose of developing and selecting alternative waste management options. It is found in most of the important pollutant sources, such as domestic sewage and fertilizers; is analyzed for routinely in all water samples (both potable and waste); and has been identified everywhere in the surface and groundwaters of the Bi-county Region. The selection of nitrogen as a key parameter does not diminish the need for the monitoring of other contaminants, nor does it preclude the possible need for additional treatment measures. A discussion of nitrogen as the key pollutant is to be found in Section 3.2.

The preferred alternatives also address natural resource objectives. These include the maintenance of adequate groundwater levels in order to preclude abnormal changes in stream levels that could affect critical environments or endanger coastal ecosystems, and to assure a sufficient potable water supply. They also include the maintenance of nutrient levels that will minimize eutrophication, and will assure conformance with dissolved oxygen standards and waste load allocations.

Collection and treatment as used in Table 5–1 refers to a variety of possible communal collection systems such as gravity lines, pressure or vacuum. The method of treatment may employ conventional secondary/tertiary, marsh-pond, spray irrigation or other method. This does not preclude the use of innovative on-site treatment systems (*e.g.*, with denitrification capability) in areas, which are candidates for sewering, as such systems are proven to be cost-effective. Note that items listed in Table 5–1 as "Non-Structural Recommendations" may, in part, have structural components. Note also that the order of presentation of recommendations in Table 5–1 does not imply any ranking or prioritization.

5.2.2 Recommended Monitoring of Groundwater Quality. In any area that depends exclusively on groundwater for its potable supply, the wastewater management alternative or alternatives should be accompanied by an extensive program of ambient water quality monitoring. The program described below can provide timely notice of existing and developing problems and of the effectiveness of various countermeasures.

This is a particularly attractive and necessary approach for assessing the effects of diffuse sources of contamination, such as on-lot sewage disposal systems, fertilizers, and stormwater, which cannot be easily monitored using a discharge permit type approach. The present monitoring of ambient shallow groundwater quality in both the unsewered and sewered areas depends on an insufficient number of widely spaced wells. Some wells are shallow, but many are deep (greater than 50 feet below the water table). In general, these deeper

Table 5—1

NASSAU-SUFFOLK 208 STUDY WASTE MANAGEMENT RECOMMENDATIONS BY HYDROGEOLOGIC ZONE AND SURFACE WATER ELEMENT

Hydrogeologic Zone/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
Zone I Deep aquifer recharge area. This zone is a primary source of public water supply.	Central and northern Nassau and portions of western Suffolk.	1. In developed areas not presently sewered or scheduled for sewering, plans for collection and treatment where the current density is nine or more persons (three dwelling units) per gross acre should be initiated. 2. At densities less than nine persons (three dwelling units) per gross acre, institute a monitoring program to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where area-average nitrate-nitrogen levels are six milligrams per liter or greater or other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, provide collection and treatment. 3. As currently vacant land is developed, provide collection and treatment at a density of approximately 6 persons or two dwelling units per gross acre. 4. Divert the sewage flow from the C. W. Post College to the Cedar Creek STP or recharge to groundwater following advanced wastewater treatment, with nitrogen removal. 5. The 208 Study has not identified a need, within the twenty year planning period, for groundwater recharge in this area for the purpose of preserving drinking water supply. However, the importance of maintaining the flow and water quality of streams may require action to mitigate the impact of reduced groundwater levels attributable to sewering with marine discharge. 6. In areas that are completely sewered, regulations mandating the hook-up of private disposal systems to district collection systems should be strictly enforced.	1. Minimize population density by encouraging large lot development (one dwelling unit/ one or more acres), where possible, to protect the groundwater from future pollutant loadings. 2. Prohibit the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. 3. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface and groundwaters. 4. Provide for routine maintenance of on-site disposal systems. 5. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 6. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals. 7. Prohibit the use of certain chemical cleaners in on-lot systems.
Zone II Deep aquifer recharge area. An area of existing water quality problems.	East central Nassau	1. This area is, or will be, essentially completely sewered. Present plans generally conform to recommended 208 guidelines.	1. Prohibit the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. 2. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 3. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals, and bacteria to surface and ground waters. 4. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals.

Table 5–1 . . . Cont'd.

Hydrogeologic Zone/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
Zone III Deep aquifer recharge area. Exceptionally high water quality and high potential yields.	East central Suffolk	1. Require collection and treatment at densities of one or more dwelling units per acre in those areas where large lot development and the preservation of existing large land holdings are infeasible due to existing or planned development. 2. Require advanced wastewater treatment with nitrogen removal for treatment plants recharging effluent to ground or surface waters.	1. Land use controls should be the primary method for protecting this valuable groundwater resource. Where residential development is allowed, require large lot development (two acre zoning or greater). Encourage the preservation of existing large land holdings, and natural vegetation. 2. Establish a groundwater monitoring program to provide early indication of water quality problems and to permit timely institution of corrective measures. 3. Prohibit the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. 4. Provide for routine maintenance of on-site disposal systems. 5. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 6. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface and ground waters. 7. Strengthen and enforce regulations pertaining to industrial waste disposal, product storage and transportation of residuals. 8. Prohibit the use of certain chemical cleaners in on-lot systems.
Zone IV Local water quality problems, but potential for groundwater development, particularly on the South Fork; significant agricultural input.	North Fork and eastern part of South Fork	1. In developed areas not presently sewered, plans for collection and treatment should be initiated where the current density is nine or more persons (three dwelling units) per gross acre. 2. At densities less than nine persons (three dwelling units) per gross acre, institute a monitoring program to determine the quality of the water-table aquifer and the efficacy of the non-point source controls. Where area-average nitrate-nitrogen levels are six milligrams per liter or greater or other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, provide collection and treatment. 3. Provide collection and treatment in those areas where on-lot systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other conditions.	1. Minimize population density by encouraging large lot development (one dwelling unit per one or more acres) where possible, to protect the groundwater and surface waters from future pollutant loadings, and to provide additional protection for existing marsh and wetland areas. 2. Control the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. In cases of extreme hardship, new landfills may be permitted if extra-ordinary measures are taken to protect surface and ground water. 3. Reduce excessive use of irrigation water, to minimize saltwater intrusion.

Table 5–1 . . . Cont'd.

Hydrogeologic Zone/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
Zone IV cont'd.		4. Provide collection and treatment in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards. 5. As currently vacant land is developed, provide collection and treatment at the present Suffolk County Department of Health Services approved density of approximately two dwelling units per acre (greater than 20,000 square foot lot size).	4. Optimize pumping patterns, to minimize saltwater upconing. 5. Optimize the timing of fertilizer application, to reduce nitrate contamination from agriculture. 6. Prohibit the use of certain chemical cleaners in on-lot systems. 7. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface and ground waters. 8. Provide for routine maintenance of on-site disposal systems.
Zone V Local water quality problems, but potential for groundwater development; little agricultural input.	Western South Fork	1. In developed areas not presently sewered, plans for collection and treatment should be initiated where the current density is nine or more persons (three dwelling units) per gross acre. 2. At densities less than nine persons (three dwelling units). per gross acre, institute a monitoring program to determine the quality of the water table equifer and the efficacy of the non-point source controls. Where area-average nitrate-nitrogen levels are six milligrams per liter or greater or other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, provide collection and treatment. 3. Provide collection and treatment in those areas where on-lot systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other conditions. 4. As currently vacant land is developed, provide collection and treatment at the present Suffolk County Department of Health Services approved density of greater than approximately two dwelling units per acre (less than 20,000 square foot lot size). 5. Provide collection and treatment in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.	1. Minimize population density by encouraging large lot development (one dwelling unit per one or more acres) where possible, to protect the groundwater and surface waters from future pollutant loadings, and to provide additional protection for existing marsh and wetland areas. 2. Control the establishment of new landfills, and the expansion of existing ones. Upgrade existing landfills, where possible, to minimize further groundwater contamination. In cases of extreme hardship, new landfills may be permitted if extraordinary measures are taken to protect surface and ground water. 3. Optimize pumping patterns to minimize saltwater upconing. 4. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface and ground waters. 5. Prohibit the use of certain chemical cleaners in on-lot systems. 6. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns.
Zone VI Generally shallow groundwater levels, with horizontal flow, which has impact on surface water.	South central Suffolk	1. Due to the impact of groundwater underflow and stream flow in this area on the sensitive eastern Great South Bay, collection and treatment is required at densities of one or more dwelling units per acre. 2. Require advanced wastewater treatment with nitrogen removal for treatment plants recharging effluent to ground or surface waters.	1. Minimize population density by encouraging large lot development (one dwelling unit per two or more acres) where possible, to protect the groundwater and surface water from future pollutant loadings, and to provide additional protection for existing marsh and wetland areas.

Table 5—1 . . . Cont'd.

Hydrogeologic Zone/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
Zone VI cont'd.		3. Provide collection and treatment in those areas where contaminated groundwater may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards. 4. Provide collection and treatment in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.	2. New landfills should be permitted under current New York State policy, provided the site is landward of the primary coastal zone and the depth to groundwater is sufficient to ensure an adequate unsaturated zone below the bottom of the landfill. (The primary coastal zone extends landward for 1,000 feet or to the ten foot elevation, whichever includes the greater distance from the shoreline or from any stream flowing into marine waters.) 3. Stress the future implementation of stormwater runoff controls, if proven feasible, in order to assist in upgrading surface water quality to increase open shellfishing areas. 4. Provide for routine maintenance of on-site disposal systems. 5. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 6. Control animal populations and animal waste disposal. 7. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources. 8. Prohibit the use of certain chemical cleaners in on-lot systems.
Zone VII Generally shallow horizontal groundwater flows.	Southern Nassau and southwestern Suffolk.	1. This area is, or will be, essentially completely sewered. Present plans generally conform to recommended 208 guidelines. 2. In developed areas not presently sewered or scheduled for sewering, plans for collection and treatment where the current density is nine or more persons (three dwelling units) per gross acre should be initiated. 3. Provide collection and treatment in those areas where on-lot systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other conditions. 4. Provide collection and treatment in those areas where contaminated groundwater may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface and ground waters. 2. New landfills should be permitted under current New York State policy, provided the site is landward of the primary coastal zone and the depth to groundwater is sufficient to ensure an adequate unsaturated zone below the bottom of the landfill. (The primary coastal zone extends landward for 1,000 feet or to the ten foot elevation, whichever includes the greater distance from the shoreline or from any stream flowing into marine waters.)

Table 5–1 . . . Cont'd.

Hydrogeologic Zone/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
Zone VII cont'd.		5. *The 208 Study has not identified a need, within the* twenty year planning period, for groundwater recharge in this area for the purpose of preserving drinking water supply. However, the importance of maintaining the flow and water quality of streams may require action to mitigate the impact of reduced groundwater levels attributable to sewering, with marine surface water discharges.	3. *Reduce the use of fertilizers on turf.* Promote the use of low-maintenance lawns.
Zone VIII Generally shallow horizontal groundwater flows.	Most of the area bordering Long Island Sound, from Hempstead Harbor to Wading River.	1. Provide collection and treatment in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations. 2. Provide collection and treatment in those areas where contaminated groundwater may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals, and bacteria to surface and ground water. 2. New landfills should be permitted under current New York State policy, provided the site is landward of the primary coastal zone and the depth to groundwater is sufficient to ensure an adequate unsaturated zone below the bottom of the landfill. (See Zone VII.) 3. Provide for routine maintenance of on-site disposal systems.

Surface Water Elements/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
A. Manhasset Bay Important recreational harbor. (Dominated by the influence of Western Long Island Sound, which has been impaired by New York City discharges.)	Northwestern Nassau	1. Based upon preliminary economic and environmental analyses, the diversion of sewage flows from GNSD, Village of Great Neck, and Port Washington, to the Cedar Creek treatment facility is the recommended alternative. 2. If the cost of flow diversion significantly outweighs environmental benefits, the next preferred option would be to consolidate the existing treatment plants into a subregional facility. 3. If (1) and (2) above are not feasible, and the present configuration remains as is, then the individual facilities will require either nitrogen removal if the present discharge location is retained, or a mid-bay discharge, if the present level of treatment is maintained. Of these two options, a mid-bay outfall is recommended due to improved dispersion characteristics of the receiving waters, and reduced costs.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Enforce existing regulations concerning waste discharge from boats. The towns and/ or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches. 3. Control animal population and animal waste disposal.

Table 5–1 . . . Cont'd.

Surface Water Elements/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
B. Hempstead Harbor Major commercial harbor, with considerable recreation. (Dominated by the influence of Western Long Island Sound, which has been impaired by New York City discharges.)	Northern Nassau	1. Based upon preliminary economic and environmental analyses, the diversion of sewage flows from Roslyn Sewage Treatment Plant to the Cedar Creek treatment facility is the recommended alternative. The Glen Cove treatment plant is excluded from this alternative because it is being reconstructed and upgraded. 2. If the cost of flow diversion significantly outweighs environmental benefits, the next preferred option would be to consolidate the existing plants into a sub-regional facility in the recommended Northwest study area. 3. If (1) and (2) above are not feasible, and the present configuration remains as is, then the individual facilities will require either nitrogen removal if the present discharge location is retained, or a mid-bay discharge, if the present level of treatment is maintained. Of these two options, a mid-harbor outfall is recommended due to improved dispersion characteristics of the receiving waters, and reduced costs.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Encourage the relocation of the solid waste handling and landfilling operations in, and adjacent to the Port Washington Sand Pits, to a site outside the coastal zone, at such time as a feasible alternative is available. 3. Control animal populations and animal waste disposal.
C. Oyster Bay Recreational harbor, and important commercial shellfishing area.	Northeastern Nassau	1. Based upon preliminary economic and environmental analyses, the diversion of sewage flows from the Oyster Bay Treatment Plant to the Cedar Creek treatment facility is the recommended alternative. 2. If it is determined that Bayville should be served by its own sewage treatment facility, then final effluent disposal should be to Long Island Sound. 3. If the cost of flow diversion significantly outweighs environmental benefits, the next preferred option would be to consolidate the existing treatment plants into a sub-regional facility in the Northeast study area. 4. Based upon water quality analysis, the Oyster Bay plant, may retain its present treatment level and discharge location without significantly impairing the receiving waters; however, this does not preclude the possibility of diversion to either the Cedar Creek treatment plant or to a sub-regional facility.	1. Due to the valuable shellfishing industry, the extensive wetlands and the excellent water quality in Oyster Bay, non-point source controls to alleviate impact on surface waters should be emphasized. 2. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources. 3. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be disignated in all areas open to shellfishing; and contiguous to bathing beaches. 4. Control animal populations and animal waste disposal.
D. Huntington Bay Complex bay system, includes natural, as well as highly developed shorefronts.	Northwestern Suffolk	1. On the basis of preliminary environmental analysis and projected flow, it is recommended that if the Huntington Sewage Treatment Plant is utilized as either a regional or sub-regional facility, secondary treatment with mid-bay effluent discharge appears preferable to AWT and effluent discharge at the present location in Huntington Harbor.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals, and bacteria to surface waters.

Table 5–1 . . . Cont'd.

Surface Water Elements/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
D. Huntington Bay cont'd.		2. If the sub-regional alternative is selected, utilize the Huntington and Northport Village STPs.	2. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches. 3. Control animal populations and animal waste disposal.
E. Port Jefferson Harbor Major industrial, commercial and recreational harbor. Ferry terminal.	Central Suffolk, North Shore	1. There is a 201 study currently underway in this area and the 208 has not selected a recommended alternative for sewage treatment and disposal. It is required that the 201 study select the number and location of facilities by evaluating combinations of existing facilities and other suitable sites. 2. Surface water discharge shall not exceed the waste load allocations established by the 208 study.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches. 3. Control animal populations and animal waste disposal.
F. Flanders Bay—Peconic Estuary Drains agricultural and natural areas. Hamlet of Riverhead located on the Estuary.	Riverhead—Brookhaven—Southampton Towns	1. Move the Riverhead STP discharge to a location outside the Estuary. 2. The 201 study currently underway should evaluate the regional, sub-regional and small plants alternatives discussed in Section 3.5. Provide for further monitoring, specifically for dissolved oxygen nutrients and chlorophyll a to better define and select one of the point source control alternatives. 3. Require that duck farms' treatment facilities conform to compliance schedules which will call for zero discharge by 1983. 4. No additional loading should be allowed from the Brookhaven National Laboratory Sewage Treatment Plant or from the Grumman Sewage Treatment Plant.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources. 3. Determine the impact of duck sludges as a source of nutrients and bacteria, and the feasibility of their removal. 4. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches.

Table 5–1 . . . Cont'd.

Surface Water Elements/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
G. Mecox Bay Small bay, with ephemeral connection to the Atlantic Ocean.	Atlantic shore, Town of Southampton	1. Prohibit new point source discharge to the bay. 2. Provide nitrogen removal, or complete effluent recycling, for duck farm discharges located in the drainage area.	1. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources. 2. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 3. Determine the impact of duck sludges as a source of nutrients and bacteria and the feasibility of their removal. 4. Determine the desirability of stabilizing the inlet from the Atlantic Ocean to provide adequate flushing and dispersion.
H. Shinnecock Bay Shallow bar-built estuary, important commercial and sport fishing facilities.	Between Shinnecock Inlet and Shinnecock Canal, Town of Southampton.	1. Prohibit new point source discharges to the bay. 2. Maintain the ocean inlet to provide adequate flushing and dispersion.	1. Prohibit, or severely restrict, all further development in shoreline areas. Establish adequate buffer zones around wetlands. Assign priority to public acquisition, based on the protection of groundwater quality and natural resources. 2. Provide for the routine maintenance of on-site disposal systems. 3. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 4. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches.
I. Moriches Bay Shallow bar-built estuary, with unstable ocean inlet. Extremely sensitive to groundwater inflow quality.	South shore, between Shinnecock ahd Great South Bays.	1. Prohibit new point source discharges to the bay. 2. Provide nitrogen or complete effluent removal from duck farms located in the drainage area. 3. Maintain the ocean inlet to provide adequate flushing and dispersion. 4. Determine the impact of duck sludge on bay water quality.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Determine the impact of duck sludges as a source of nutrients and bacteria and the feasibility of their removal.

Table 5–1 . . . Cont'd.

Surface Water Elements/ Characteristics	Location	Structural Recommendations	Non-Structural Recommendations (Can have structural elements)
I. Moriches Bay cont'd.		5. If duck sludge is *not* the controlling influence on bay water quality, and if the maintenance of the ocean inlet does *not* provide the desired improvement, then collect and treat at one or more D.U./acre in presently developed areas. 6. In order to maintain groundwater nitrogen at or below 2 milligrams per liter, collection and treatment should be provided when densities reach 1 or more D.U./gross acre.	3. Control animal populations and animal waste disposal. 4. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches.
J. Great South Bay Shallow bay, western portion generally well flushed, eastern portion poorly flushed. Major commercial shellfishing area.	Between the Barrier Beach and the Towns of Babylon, Islip and Brookhaven.	1. Prohibit new point source discharges into Eastern Great South Bay and recharge tertiary treated effluent. 2. Provide nitrogen removal for the Patchogue Sewage Treatment Plant.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Control animal populations and animal waste disposal. 3. Reduce the use of fertilizers on turf. Promote the use of low-maintenance lawns. 4. Require nitrogen removal for treatment plants recharging effluent. 5. Prohibit any new development along streams and shorelines. Create buffer zones where possible along all water bodies and protect all remaining marine wetlands. 6. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches.
K. Western South Shore Bays Relatively well-flushed but sensitive to high pollutant loads.	Between the Barrier Beach and the Towns of Hempstead and Oyster Bay.	1. Locate the Bay Park sewage plant outfall offshore. 2. Divert the Long Beach sewage treatment plant effluent to the proposed Bay Park ocean outfall. 3. Initiate a study to determine whether the Lawrence treatment facility discharge violates water quality standards in Bannister Creek. If so, the discharge options should be as follows: a. Institute AWT with effluent discharge at the present location. b. Continue present treatment with effluent discharge to Reynolds Channel, and c. Divert sewage to the Bay Park treatment facility. 4. Terminate the operation of the Freeport treatment plant and divert the flow to the Cedar Creek facility by December 31, 1979, as presently scheduled.	1. Control stormwater runoff to minimize the transport of sediments, nutrients, metals, organic chemicals and bacteria to surface waters. 2. Institute legislation to control animal populations and animal waste disposal. 3. Enforce existing regulations concerning waste discharge from boats. The towns and/or counties should provide pumpout stations at all facilities owned and/or operated by them. In addition, "no-discharge" zones should be designated in all areas open to shellfishing and contiguous to bathing beaches.

wells are not designed to answer specific types of wastewater management questions.

Present wastewater management decisions concerning non-point sources are based primarily on population density. This is a very easy criterion to use because the distribution of population is readily ascertainable. However, the problem of trying to predict concentrations of various chemicals in groundwater on the basis of present population densities or land uses is a multi-variate one that is not easily solved in a region of varied, changing land use. The application of lawn fertilizer, for instance, is a major source of nitrogen and may be related not only to population density but to other factors such as homeowner income in a particular neighborhood. Predictions of the concentrations of constituents other than nitrate on the basis of population density is even more tenuous because of a general lack of data, particularly for organic chemicals. For instance, the input of organic chemicals may be partially related to certain types of industrial discharges, the use of organic solvents in cesspools, or to the traffic volume in a given area. In fact, because of the complexity of sources over space and time, and because of differences in the soil media, a strictly deterministic basis for wastewater management decisions may not be feasible. There must be some mechanism that allows for the actual monitoring of the groundwater system. Such a program may well result in the discovery of new water quality relationships or trends that were not previously anticipated.

One alternative is to install a number of shallow water table monitor wells throughout the two counties. These wells would provide data on any constituent desired, and permit the making of decisions on the basis of actual data, rather than on the basis of predicted or assumed values. Samples from wells screened in the upper ten feet of the saturated sediments will generally represent water that has recently percolated from the land surface. In addition, this water usually originates in the area immediately upgradient from the well and consequently reflects conditions in that area. Groundwater quality near the water table often represents a worst case situation, since, as the water travels further within the system, contaminants may be diluted and may be attenuated by adsorption on soil particles. For these reasons, adverse water quality conditions measured in these wells can be related to recent land use and/or wastewater disposal practices in the vicinity of the well, and appropriate abatement measures can be taken.

In its simplest form, a grid system would be established throughout the water management zone of interest. A coarse grid, with relatively large spacings between wells, would be established in those areas that appear to be least affected by human activities. Areas of dense residential development, agricultural use, or industrial development would be covered with a fine grid of relatively closely spaced wells. In planning this initial set of wells, sources of nitrate and organic chemicals should be given primary consideration. As water quality data is obtained from these wells it may become apparent that a particular area is receiving contaminants even though it may be located in a coarser section of the grid. This area would then be investigated and additional monitor wells would be drilled. In this way, new information gathered from the wells would be used to refine the monitoring system. As the program continues, the correlation between the presence of certain contaminants in groundwater and different types of land use or population density might become clear. Initially, the present knowledge of contaminant loading from various sources would be used in establishing the location and spacing of the wells. A model can be used to predict a mean concentration of nitrogen in soil water, below the root zone, for each of the land use grid cells used by the NSRPB. This information, along with water quality data from exising wells, would help determine the number of wells needed in any one area. Results of the monitoring could, in turn, help to refine the assumptions made in this model. Thus, two approaches, modeling and the collection of data indicating actual water quality conditions, could be used conjunctively to assess the groundwater quality on a continuing basis.

The number of wells in any particular land use area should be determined with statistical inference in mind. For example, there is usually considerable spatial variability of nitrate in contaminated groundwater, and therefore a sufficient number of samples and wells are necessary before significance can be established. Variation of nitrate in uncontaminated areas is low and fewer samples may be necessary to satisfy the monitoring objectives there. It is expected that many of the approximately 190 Suffolk County DEC and USGS wells, and perhaps a few Nassau County wells could be utilized in this program. Additional wells, perhaps between 50 and 100 wells per county, would be necessary to complete the new system. In addition to the installation of the wells, it will be necessary to carefully describe and catalog the land use in the vicinity, especially upgradient of each well. In this way, water quality data could be related back to these land uses.

Of equal importance to the design of the system is the continuing evaluation and review of the data. In addition to an assessment of existing conditions, shallow monitoring wells can be used to determine trends of a variety of constituents over time. This would be particularly important in areas of changing land use where trends would give an indication of effects of recent development. These wells could also be used to monitor the results of recent large scale sewering, such as that in Sewage Disposal District Three in Nassau, or to supplement the existing monitoring well system of the Southwest Sewer District in Suffolk.

5.2.3 Maintenance of Stream Base Flow and Surface Water Elevations. Fluctuations in groundwater levels (and potentiometric surfaces), stream base flow and surface water elevations have been observed over the past 40 years. These fluctuations result from natural dry/wet year precipitation cycles, and also from groundwater pumping and operation of non-recharging sewage collection systems.

The 208 Study has not identified a need for areawide groundwater recharge of wastewater treatment plant effluent for the purpose of maintaining

drinking water supply. On a regional basis, adequate quantity can be sustained over the entire planning period of twenty years by implementing recommended wastewater and water supply management practices. However, the maintenance of groundwater levels is important and should be addressed. The decline in water levels, which will occur by applying the 208 sewering criteria, and recharge limitations must be analyzed on an individual basis.

While a decline in groundwater level is generally not detrimental to water supply, it can significantly reduce stream base flow and surface waterbody elevations. These reductions can adversely impact water dependent vegetation and ecosystems. In eastern Great South Bay, the limited tidal exchange causes stream base flow to be extremely important in maintaining the bay salinity patterns. Other Long Island bays are not as sensitive to stream base flow or groundwater underflow.

In order to thoroughly ascertain the effects of proper maintenance of streamflow levels, it is recommended that streamflow augmentation studies be conducted by both Nassau and Suffolk Counties, as presently planned. The studies should continue to be comprehensive in nature and deal with the need for augmentation, beneficial impacts, available methods and cost-effectiveness.

It may be feasible to mitigate the effects of groundwater level decline on surface waters without maintaining present average groundwater levels. Information gained from the streamflow augmentation needs studies for the Nassau Sewage Disposal Districts Two and Three and the Suffolk County Southwest Sewer District should be incorporated into the 208 Plan when the studies are completed.

A major concern of the 208 is the potential contamination of the groundwater supply by organic chemicals and other pollutants in the event of system failure, poor operation or other, unforeseen occurrences. It is the recommendation of the 208 to carefully evaluate the results of the Cedar Creek recharge project in terms of process performance, reliability and effluent quality, and then decide if a decision on recharge safety can be reached. It is a further recommendation to continue the sampling and analytical program started under 208, of the impact on groundwater quality of effluent recharge from a secondary treatment plant. The program should be expanded in terms of the number and depth of sampling wells and frequency of sampling.

5.2.4 Recommendations for the Siting, Construction and Management of Landfills. Over the long term, the primary emphasis should be on resource recovery methods for the disposition of most residual wastes. Because of the inherent public health and environmental hazards, especially groundwater pollution, the continued burial of residual wastes in landfills can no longer serve as the Region's primary disposal method. However, some landfills will still be required for (1) the disposal of the relatively small amounts of inert residues remaining after the resource recovery process, (2) non-recoverable and non-putrescible wastes, such as concrete rubble and demolition wastes, and (3) the untreated solid wastes that are generated in rural or resort areas located too far from the resource recovery plants to justify shipment, and in quantities that are too small to warrant the establishment of a resource recovery facility. Various other methods, among them separation, leaf composting, electrical or steam generation, must be evaluated by local and regional agencies for applicability. Smaller political jurisdictions should combine to optimize cost-effectiveness.

The New York State Department of Environmental Conservation's regional policy based in part on the conclusions of the Oyster Bay—Plainview Landfill hearings strongly favors resource recovery for the Region and will require "a thorough examination of alternatives before approving new landfills on Long Island, particularly when they are to be located in areas where the groundwater situation is especially sensitive." (NYSDEC, 1977, Proceedings for the TOB Solid Waste Management Facility, Plainview, N.Y.)

The conclusion does not eliminate landfilling as a means of disposal in the Region, nor rule out the possibility that fail-safe leachate containment systems may be devised, which could allow for the future landfilling in all zones. In the interim, however, DEC's policy will (1) deter the development of large scale landfill sites, issuing only short term permits (three years or less); (2) strictly enforce the newly revised Rules and Regulations of Part 360; and (3) aggressively persuade refuse collecting jurisdictions to evaluate and implement, where justified, resource recovery alternatives.

In considering the following residual waste disposal recommendations for each of the hydrogeological zones, the reader should be aware that the zone boundaries as depicted in Figure 3—2 are merely approximations, and that further investigation is required before their precise location can be determined. It would, therefore, be prudent for any jurisdiction considering the siting of a new landfill to first carefully study the hydrogeology of the area to determine the applicable zone recommendations before proceeding further. Recommendations:

Zone I

1. Existing or abandoned landfills should be covered with impermeable barriers and properly graded to prevent stormwater infiltration, where feasible. Venting or methane recovery should also be considered to prevent lateral subsoil movement of decomposition gases, which will occur subsequent to capping.

2 a. New sanitary landfills, with the exception of landfills used for the disposal of inert wastes under proper management, should be prohibited. Likewise, any other solid waste treatment or disposal facility that might discharge process water to the ground, treated or untreated, should be discouraged from siting in this zone.

2 b. If, however, authorization for the establishment of the landfill was obtained prior to the adoption of the 208 plan, site preparation may proceed, provided that the leachate containment and monitoring systems (double liner—dual leachate collection piping) are designed to prevent all possible exfiltration of leachate and infiltration of stormwater. If leachate

is detected within the monitoring pipes, that area of the site must be immediately surface-sealed with an impermeable barrier, vented and discontinued.

2c. Leachates collected at new or existing sanitary landfills should be pretreated to conform with applicable sewer use ordinances and disposed of at a treatment plant. It has been demonstrated that leachate is not effectively attenuated in typical Long Island glacial tills. Therefore, recharge of even the pretreated effluent is to be prohibited.

Zone II

Even though the groundwaters in this zone have been impaired by past activities, the following recommendations should be implemented to prevent continued degradation, since the zone is within the Magothy recharge area:

1. All existing solid waste facilities, with the exception of controlled composting sites and landfills that dispose of inert wastes, should be graded and top-lined with an impervious barrier to prevent stormwater infiltration. Gas venting or methane recovery systems should also be installed to prevent lateral distribution to areas off site.

2. Whenever an existing landfill is extended into a previously unused area, that area should be double-lined and provided with dual leachate piping systems. Provision should be made for (a) the removal of leachate from the primary liner and (b) monitoring and removal of any leachate that might penetrate the primary liner and accumulate on the secondary liner.

3. New sanitary landfills for the disposal of garbage should be prohibited.

4. Waste and quench waters from other solid waste facilities should be pretreated to conform to sewer use ordinances and then discharged to a municipal facility.

Zone III

The groundwater in this zone is of excellent quality and must be retained for future public water supply.

1. There should be an immediate discontinuance of obsolete operational practices in existing landfills. Older sections of the site should be graded and covered with an impermeable liner to prevent stormwater infiltration and generation of leachate.

The landfill should be redesigned to incorporate the latest techniques for the prevention of groundwater contamination (*i.e.,* double liner—dual leachate collection piping).

2. New sanitary landfills with the exception of those used for the disposal of inert wastes under proper management, should be prohibited. Likewise, any other solid waste treatment or disposal facility that might discharge process water to the ground, treated or untreated, should be discouraged from siting in this zone.

3. Solid wastes generated within this zone should be transported to established waste disposal facilities or landfills located in zones where future sources of drinking water will not be jeopardized.

Zone IV

Heavy agricultural land use in this zone has contaminated the groundwaters with excessive levels of nitrates, and the zone is underlain at various depths with saltwater. The following recommendations should be considered:

1. Where it can be demonstrated that groundwater movement is away from existing or future public water supply resources, the operation of existing landfills should be allowed, in accordance with Part 360. Where leachate might be expected to impact the zone's water resources, existing landfills should be modified, as indicated for Zone II.

2. Where the establishment of new landfills or the expansion of existing landfills cannot be avoided, they should be so sited as to impact already degraded areas. Thus new landfills could be sited downflow of existing landfills where groundwater may already be contaminated and favorable groundwater flow conditions exist, and away from drinking water supply wells. However, proper grading should be incorporated to minimize stormwater infiltration. The establishment of new landfills in a groundwater resource area or immediately adjacent to surface waters should be prohibited.

3. Other types of solid waste facilities that discharge wastewaters may be permitted, provided that they have treatment facilities capable of meeting New York State's groundwater discharge criteria. No type of solid waste facility that requires a wastewater discharge should be permitted in a water resource area.

4. Inasmuch as Shelter Island is isolated and therefore dependent on the local groundwater supply, protection of that supply is particularly important. It should be noted that the cost of importing water may exceed the cost of exporting degradable domestic and commercial solid wastes.

It is recommended that on Shelter Island all landfilling of degradable solid waste be immediately discontinued and the waste exported to a suitable facility elsewhere in Zone IV or Zone V. Unless there are stringent on-site controls, liners may be required even where landfills are designated for the exclusive disposal of inert materials. In addition, the site should be graded to minimize stormwater infiltration.

Zone V

The recommendations for Zone IV also apply throughout all of Zone V.

Zone VI

The recommendations for a zone that provides recharge into the shallow groundwater system may place additional constraints on existing landfilling operations beyond those provided in NYSDEC Rules and Regulations Part 360. New facilities should not be sited in the primary coastal zone or in areas with high groundwater levels. Surface runoff and leachate should be contained and treated to prevent contravention of groundwater standards.

Zone VII

The recommendations for this zone, which also recharges to the shallow groundwater system, are the same as for Zone VI.

Zone VIII

This zone, located on the North Shore, is hydrogeologically similar to Zones VI and VII. Therefore, the recommendations that apply to those

zones also apply to Zone VIII.

5.2.5 Expansion of Public Water Supply Systems. In those hydrogeologic zones where population densities are presently very low and groundwater is near pristine (*e.g., Zone III*), the concept of "monitoring ambient groundwater quality . . . as a basis for wastewater management decisions," has been adopted as an integral part of the policy of maintaining low population density. In those areas, residences are usually served by individual or private wells. It is also generally true that groundwater quality measured in observation wells screened in the upper ten or twenty feet of the water table aquifer would represent a worse case situation, and most likely reflect the most recent land use and waste disposal practices.

Since it is axiomatic that the major premise for making wastewater mangement decisions, whether they be structural or non-structural controls or monitoring programs, is the protection of the public health, it appears that one of the first responses to a measured degradation in groundwater quality in the water table aquifer should be the extension of public water supply facilities. The rigidly controlled construction standards, and the frequency of quality control monitoring by the public water purveyors, are substantial public heath protective measures in themselves.

5.3 Recommendations by Detailed Study Areas

5.3.1 Detailed Study Areas. The Bi-county Region has been divided into a number of detailed study areas, largely on the basis of surface drainage basins. (See Figure 2–3). Nine of these areas have already been designated in whole or in part as 201 study areas, one is awaiting designation, and the remainder are potential 201 areas.

201 study areas were designated pursuant to Title II of the Federal Water Pollution Control Act (FWPCA), which provides assistance to localities for the development and implementation of waste treatment works. In general, Section 201 has provided financial assistance through a three-tiered program, consisting of alternatives evaluation, detailed project plans and actual construction. Recent amendments (1977) to the FWPCA require applicants for 201 assistance to consider a broad range of alternatives, which may provide for water reclamation and reuse, the need for sewers, improved techniques for waste treatment and various land disposal methods.

Since the hydrogeologic zones are distinguished from each other by their groundwater flow regimes, their boundaries do not coincide with those of the detailed study areas. However, the Areawide Waste Treatment Management Plan has to be based on the latter, rather than the hydrogeologic zones, because the 201 Programs represent the most practical means whereby the management recommendations arising from the 208 Program can be implemented.

5.3.2 Integration of Hydrogeologic Zones and Detailed Study Areas. Figure 5–1 provides a graphic display of the relationship between (1) the detailed study areas and 201 Areas where so designated (each is defined in detail in Section H of the Plan; (2) the potential sewer service areas based on a density of two or more dwelling units per acre and (3) the hydrogeologic zones. The wastewater planning districts are shown as they appear in other 208 outputs, and detailed summary information has been presented for them. The boundaries shown represent the currently anticipated geographic implementation boundaries. It is recommended that the currently designated 201 Programs be implemented according to the boundaries shown in Figure 5–1. An implementation schedule is given in Section Seven. (See Section M of the Areawide Waste Treatment Management Plan.)

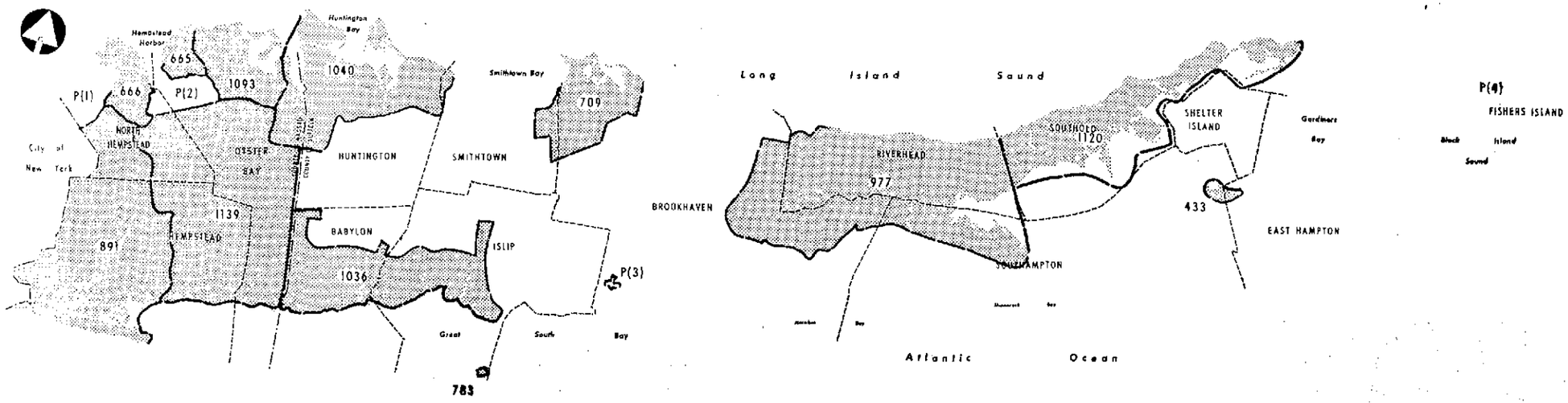
Figure 5–1 illustrates the relationships for one of several sewering options that may be adopted in the future. (See Sections 3.3 and 3.5 for a discussion of the various options.) As previously indicated, sewering at densities of one or more dwelling units per gross acre represents a maximum sewering approach. Sewering at densities of two or more dwelling units per gross acre in areas of high groundwater or low soil permeability and of three or more dwelling units per gross acre elsewhere represents a minimal sewering approach. Sewering at densities of approximately two dwelling units per gross acre, or lot sizes of less than 20,000 square feet for new developments, represents an intermediate approach and reflects current sewering policy in Suffolk County. The three pieces of information have been graphically combined to demonstrate how they should be analyzed and interpreted at a more detailed 201 level of study. The 201 Studies should take cognizance of the regional implications identified at the 208 level of study and interpret and apply the implications at the more detailed level of study.

Within each 201 level study, the hydrogeologic zone boundaries should first be defined in more detail, applying the criteria that were developed in the 208 Program. A similar approach should be taken in mapping areas of different population densities for possible definition as sewer service areas. Areas of high water table and low soil permeability should also be mapped.

For each hydrogeologic zone, the 208 has recommended a specific action or set of options that may be implemented to affect regional waste management goals. These are the alternatives that each 201 Study should develop and evaluate in detail. Each 201 area overlies at least one (and usually more) hydrogeologic zones, and the zone recommendations should be applied individually to the various parts of the 201 study area.

The proposed Yaphank study area in Suffolk provides a good example of the integration procedure. The northern portion is a part of Zone VIII, the central portion includes parts of Zones I and III, and the southern portion is part of Zone VI. Therefore, a 201 Study should be guided by the recommendations provided for the appropriate zones, when selecting alternatives for the various portions of the Yaphank study area.

The North Shore planning area in Nassau County can be similarly analyzed. Those southerly portions of the area that lie in hydrogeologic Zone I should be guided by Zone I recommendations. The northern parts of the area, which lie in Zone VIII, should incorporate the recommendations made, and study the various options listed herein for Zone VIII at a 201 level of detail. The regional, sub-regional or small plants approaches as presented in



(a) Existing and Pending 201 Study Areas

Existing 201 Study Areas

433 – Sag Harbor (V)
665 – Glen Cove (C)
666 – Port Washington
709 – Port Jefferson
783 – Ocean Beach (V)
891 – Nassau County SD No. 2
977 – Riverhead (T)
1036 – Suffolk County SWSD
1040 – Huntington (T)/Northport (V)
1093 – Oyster Bay
1120 – Southold (T)/Greenport (V)
1139 – Nassau County SD No. 3

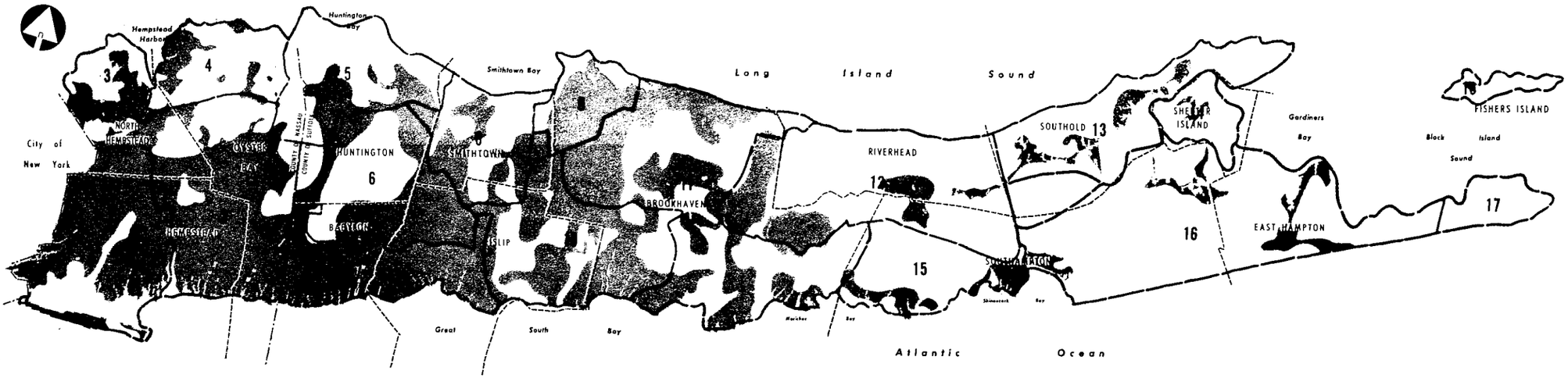
Pending 201 Study Areas

P (1) – Great Neck peninsula
P (2) – north shore undesignated
P (3) – Patchogue SD
P (4) – Fishers Island

Proposed Detailed Study Areas

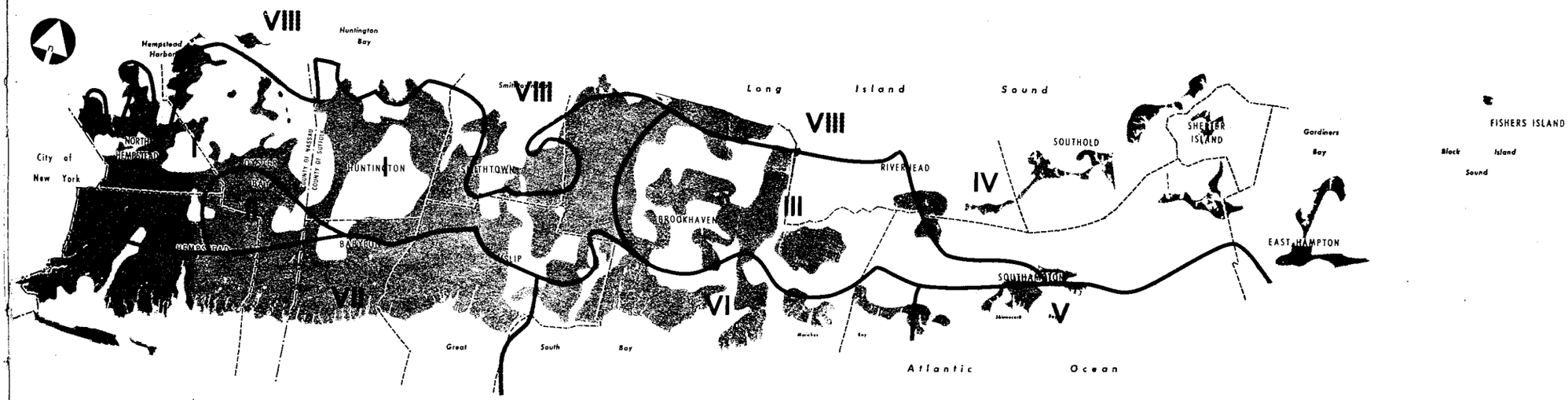
1. Southwestern NC
2. Cedar Creek
3. Northwest NC
4. Northeast NC
5. Huntington/Northport
6. West Central SC
7. Southwest SC
8. Kings Park
9. Port Jefferson
10. South Central SC
11. Yaphank
12. Riverhead
13. Southold/Greenport
14. Shelter Island DD No. 14
15. Southampton DD No. 12
16. South Fork DD No. 15
17. Montauk DD No. 16
18. Fishers Island DD No. 17

FIGURE 5–1 *201 Areas, Detailed Study Areas and Hydrogeologic Zones in Relation to Development of Two or More D.U./Acre*



(b) Proposed Detailed Study Areas

All hydrogeologic zone boundaries are approximate. Further definition of groundwater flow systems at a sub-regional level is required.



(c) Hydrogeologic Zones

— Development at 2 or more D.U.'s/Acre.

Plan Section H, and summarized previously in Section 3.2, should be analyzed in a 201 Study once zone options have been identified. However, the sewage flows and cost estimates presented earlier in this Summary Report (Section 3.3), were presented for detailed study areas and not hydrogeologic zones. Therefore, they are not directly transferrable since study area and zone boundaries do not coincide. Flows, loads and cost estimates will have to be finalized at a 201 level once zone options have been selected and detailed development of alternatives has occurred. In addition, in those 201 facilities planning areas where marine surface water effluent disposal has been recommended, additional detailed study should be conducted to determine the optimal discharge locations.

Groundwater quality monitoring is an integral part of detailed study area planning, and should be routinely employed in situations where there is uncertainty as to the existing quality of the shallow groundwater, or where there is uncertainty as to trends in pollutant concentration. The use of actual groundwater quality data in making wastewater management decisions is an approach that has not been widely used on Long Island. It is a concept that recognizes the limitations of any predictive model, whether it be theoretical or empirical. The planning guidelines recommended for the hydrogeologic zones and surface water elements should be applied in developing plans for relevant portions of the detailed study areas. For example, for those portions of the detailed study areas that are characterized by deep flow recharge regimes, the following planning guidelines should be applied:

1. Guidelines for Determining the Need for Structural and Non-Structural Controls.

a. *Developed Areas.* Since existing data is not sufficient to delineate the spatial extent of needed sewering, and since the effectiveness of selected non-point source controls is not known, the initial minimum density for sewering in developed areas should be nine persons per gross acre (approximately three dwelling units per gross acre). This will provide current 201 facilities planning areas with a threshold density at which to initiate their planning. Statistically, at this density, a nitrate-nitrogen groundwater concentration of ten milligrams per liter may be exceeded in 40 percent of samples drawn from shallow monitoring wells in that locality.

In areas where the density is less than nine persons per gross acre, monitoring should be undertaken during the initial phase of a 201 Study. This effort should be undertaken to define the hydrogeologic system beneath the area and to determine the need for further sewering.

The detection of an average nitrate-nitrogen concentration of six milligrams per liter or greater for the individual analysis of the shallow aquifer monitoring wells during the observation period would indicate the need for control measures to reduce the nitrogen loading.

Statistically, an average value of six milligrams per liter means that a nitrate-nitrogen groundwater concentration of ten milligrams per liter may be exceeded in ten percent of the samples drawn from shallow monitoring wells in that locality.

If it is determined, following analysis, that the source of nitrogen contamination is on-lot disposal systems, the spatial extent of needed sewering will be delineated by the extent of the area where the average nitrate-nitrogen concentrations are six milligrams per liter or greater.

b. *Undeveloped Areas.* For planning purposes, it is desirable to take a more conservative approach regarding the utilization of structural controls because of uncertainty concerning the absolute effectiveness of best management alternatives and the added expense of installing sewers after developments are established. It is recommended that, in undeveloped areas, sewering should be implemented at a population density of six persons per gross acre, which would yield values of nitrate-nitrogen in excess of ten milligrams per liter in approximately twenty percent of the observations in shallow wells. It is assumed that, at six person per gross acre, a large percentage of the violations can be eliminated through Best Management Practices, primarily fertilizer controls. Conversely, it may be assumed that, if non-structural controls are ineffective, or are not stringently applied, sewering may be necessary at lower population densities. At densities less than six persons per gross acre, monitoring of the water table would be undertaken to determine groundwater quality trends and to determine the future need for improved non-structural and structural controls.

At the population density of six persons per gross acre, if one were to assume a household size of 3.5 persons per dwelling unit, this would result in a density of 1.7 dwelling units per acre. Since this recommended sewering criterion for undeveloped areas is very close to the present Suffolk County standard for requiring sewers in new developments at lot sizes less than 20,000 square feet, or 1.6 dwelling units per acre, it is recommended that for planning purposes, the Suffolk County policy remain in effect for undeveloped areas. The additional groundwater quality data, which would be gathered in both 201 and other recommended Studies on the basis of varying geological conditions and population densities as discussed in the recommendations for developed areas, would possibly modify the criterion for structural pollution controls, as recommended herein, in the future.

2. Guidelines for Comprehensive Groundwater Monitoring

Comprehensive monitoring programs to provide data to be used in making wastewater management decisions for both structural and non-structural controls should be initiated or expanded.

The observation well drilling sequence, and the monitoring program should be carefully designed to provide data on representative ambient conditions in previously developed areas, and base data to evaluate trends in concentrations of contaminants in newly developed areas.

The number of wells, locations and depths, and frequency of sampling cannot be determined in a regional study. However, it appears evident that at least monthly samplings must be made for a period sufficient to characterize levels of nitrate-nitrogen and other contaminants with full consideration to the variability imposed by differences in geology, initial conditions, population density and thickness of the unsaturated zone. It

is estimated that sampling would be necessary over a period of six to twelve months. The details of these programs should be based on the demonstration project described in Section 5.5.2.5.

Shallow observation wells, screened in the upper portion of the water table aquifer, would reflect, in the shortest time period, changes in water quality due to activities at the land surface, and the impact on drinking water quality in the area may be predicted, and help to assist in decision-making, especially in areas where 201 Studies are underway or planned.

5.3.3 Structural Recommendations for Nassau County Detailed Study Areas. The following are only structural recommendations for Nassau County 201 study areas. Many of the pollutants that impact groundwater and surface waters can be expected to persist regardless of the structural recommendations that are selected. For this reason, non-structural alternatives must be regarded as an essential part of any comprehensive waste water management plan. For brevity, non-structural and non-point source recommendations have not been reiterated. However, it is necessary to review Table 5—1, in Section 5.2.1, and the Areawide Recommendations in Section 5.1, and apply those recommendations listed for a particular zone to the same zone or zones included in the detailed study area.

5.3.3.1 Southwestern Nassau County Planning Area (Districts No. 1 and No. 2, and the Cedarhurst, Lawrence, Long Beach and West Long Beach Sewer Districts)

Hydrogeologic Zones

Zone I

This area is completely sewered and no further sewering options exist. Regulations mandating the hook-up of private disposal systems to the district collection system should be more strictly enforced.

Zone VII

This area is essentially completely sewered and only one additional sewering option is recommended; that is, to sewer Point Lookout and the unsewered section of Lido Beach. These locations are in areas where on-lot sewage disposal systems are subject to failure and where it may reasonably be expected that these systems contribute pollutants to the surface waters.

Surface Water Elements

1. Relocate the Bay Park Treatment Plant outfall offshore to significantly reduce the nutrient and bacteria loadings to the present receiving waters, which include Hempstead Bay and Reynolds Channel.

2. Reroute the Long Beach Treatment Plant effluent to the proposed Bay Park outfall for ocean disposal. Although the background water quality at the present Long Beach outfall location is marginal, and the impact of the Long Beach discharge on the water quality is relatively minor when compared to that of Bay Park, in the long term, the most environmentally beneficial option is to divert the effluent offshore.

3. Initiate a study to determine whether the Lawrence treatment facility discharge violates water quality standards in Bannister Creek. If so, the discharge options should be as follows:

a. upgrade treatment with effluent discharge at the present location,
b. continue present treatment with effluent discharge to Reynolds Channel, and
c. divert sewage to the Bay Park treatment facility.

5.3.3.2 Cedar Creek Facilities Planning Area (Sewage Disposal District No. 3)

Hydrogeologic Zones

Zone I

1. Continue present plans for sewering this area. These plans generally conform to the recommended 208 guidelines.

2. In developed areas not presently sewered or scheduled for sewering, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

3. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

4. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

Zone II

The desired goal in this zone is to upgrade groundwater quality and to ensure the continued viability of the aquifer as a source of drinking water.

1. This area is, or will be, essentially completely sewered, and no further sewering options exist. Present plans generally conform to recommended 208 guidelines.

Zone VII

1. This area is completely sewered and no further sewering options exist.

2. It is also recommended that, if sewage flow diversion from the North Shore to the South Shore is determined to be the most cost-effective option, then it should be diverted to the Cedar Creek treatment facility, since land is available at this site.

Surface Water Elements

1. Terminate the operation of the Freeport Treatment Plant and divert the flow to the Cedar Creek facility by December 31, 1979, as presently scheduled.

2. Stress the implementation of those non-point source and stormwater runoff controls proven feasible, to upgrade marine surface water quality to meet shellfishing standards.

5.3.3.3 North Shore Facilities Planning Area. It should be noted that the prioritizing of the wastewater treatment, routing and effluent disposal

alternatives here in this section is not meant to exclude any of these options from further study. The ranking of the treatment alternatives under "Surface Water Elements" is based upon preliminary engineering, environmental and economic analysis, and therefore, it is recommended that all of these wastewater management options discussed below be considered viable and evaluated in greater detail in a "201" level of study.

It is recommended that the northern drainage basin of Nassau County be divided into two 201 level study areas due to drainage patterns, economies of scale, diversion potential, land use characteristics and potential for subregional treatment plants.

1. *The Northwest Study Area* would include the Great Neck peninsula, and the Port Washington peninsula. This would include the following sewer districts and unsewered areas: Belgrave, Great Neck, Great Neck Village, Port Washington, Roslyn, Plandome-Sands Point and Kings Point-Manhasset.

2. *The Northeast Study Area* would comprise the Oyster Bay drainage area and the eastern drainage basin of Hempstead Harbor, including Glen Cove. The study area would include the following sewer districts and unsewered areas: Glen Cove, Oyster Bay, Sea Cliff-Roslyn Harbor, Centre Island, East Norwich, Bayville and Locust Valley.

A 201 facilities planning study has recently been undertaken for Port Washington, and one for Oyster Bay will begin during 1978.

Hydrogeologic Zone

Zone I

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. Sewage flow from C. W. Post College should be diverted to the Cedar Creek treatment facility for final disposal. If the cost of diversion, however, significantly outweighs the cost of nitrogen removal, as determined in a 201 Study, then this treatment plant may continue to discharge to the ground providing it is upgraded to include nitrogen removal and to meet other applicable groundwater quality standards. This recommendation is consistent with proposed NYSDEC regulations to provide nitrogen removal where the flow exceeds 30,000 gallons per day.

5. All treatment plants discharging to the ground will be required to employ AWT (nitrogen removal).

Zone VIII

1. Sewer in those areas where on-lot sewage disposal systems are subject to failure and cannot be upgraded due to high groundwater table, low soil permeability, small lot size, etc.

2. Sewer in those areas where contaminated groundwater may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards. This recommendation refers specifically to parts of Plandome-Sands Point, Kings Point-Manhasset, Sea Cliff-Roslyn Harbor, Bayville and Centre Island, which existing and future studies may indicate are critical areas controlling nearby surface water quality.

Surface Water Elements

1. Based upon preliminary economic and environmental analyses, the diversion of sewage flows from the North Shore areas to the Cedar Creek treatment facility is the recommended alternative. The Glen Cove Treatment Plant, however, is excluded from this alternative because it is presently being reconstructed and upgraded.

2. If the cost of flow diversion significantly outweighs environmental benefits, the next preferred option would be to consolidate the existing treatment plants into a sub-regional facility in each recommended Northeast and Northwest study area. The reliance on a number of small treatment plants in this area may fail to capture all the economies of scale available to a larger sub-regional facility.

3. If the benefits of the preferred alternatives cannot be realized due to cost, and the present configuration remains as is, then the individual facilities will require either nitrogen removal if the present discharge location is retained, or a mid-bay discharge, if the present level of treatment is maintained. Of these two options, a mid-bay outfall is recommended due to improved dispersion characteristics of the receiving waters , and reduced costs.

4. Based upon water quality analysis, the Oyster Bay plant may retain its present treatment level and discharge location without significantly impairing the receiving water; however, this does not preclude the possibility of diversion to either the Cedar Creek Treatment Plant or to a sub-regional facility to assure minimal impact on the ecosystem in the area due to the present discharge of both nutrients and bacteria. The potential environmental benefits, achieved through diversion, make this the recommended alternative.

5. If it is determined that Bayville should be served by its own sewage treatment facility, then final effluent disposal should be to Long Island Sound.

6. The presently planned treatment level for the Glen Cove treatment facility will not achieve water quality standards in Glen Cove Creek. To insure compliance with the standards, nitrogen removal or a mid-harbor discharge is required. However, if the removal of a significant source of bacteria in the vicinity of a number of bathing beaches, and the maximum dispersion of effluent is to affected, then a mid-harbor outfall is the preferred alternative.

7. Due to the valuable shellfishing industry, the extensive wetlands and

the excellent water quality in Oyster Bay, non-point source controls to alleviate impacts on surface waters should be emphasized, if proven cost-effective.

5.3.4 Structural Recommendations for Suffolk County Detailed Study Areas. The following are only structural recommendations for Suffolk County 201 study areas. Many of the pollutants that impact groundwater and surface waters can be expected to persist regardless of the structural recommendations that are selected. For this reason, non-structural alternatives must be regarded as an essential part of any comprehensive waste water management plan. For brevity, non-structural and non-point source recommendations have not been reiterated. However, it is necessary to review Table 5–1, in Section 5.2.1, and the Areawide Recommendations in Section 5.1, and apply those recommendations listed for a particular zone to the same zone or zones included in the detailed study area.

5.3.4.1 Huntington/Northport Study Area. A 201 facilities planning study has recently been undertaken for this area, which includes a small portion of northeastern Nassau County. Parts of the area are presently sewered and there are three existing facilities in Suffolk and one in Nassau.

Hydrogeologic Zones

Zone I

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Zone VIII

1. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

2. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

3. A need for groundwater recharge for the purpose of maintaining water supply self-sufficiency in the Region has not been identifed by the 208 Study. This does not preclude recharge as an option in any investigation of effluent disposal methods.

Surface Water Elements

1. The following sewage treatment options require further evaluation as part of the 201 plan.

a. Regional Alternative Site
   i. Huntington Sewage Treatment Plant or
   ii. Crab Meadow

b. Sites for the Sub-Regional Alternative
   i. Huntington Sewage Treatment Plant and
   ii. Northport Village Sewage Treatment Plant

c. Small Treatment Plants—All inland treatment plants will be required to employ AWT (nitrogen removal).

2. On the basis of preliminary environmental analysis and projected flow, it is recommended that, should the Huntington Sewage Treatment Plant be utilized as either a regional or sub-regional facility, secondary treatment with mid-bay effluent discharge would be preferable to AWT and effluent discharge at the present location in Huntington Harbor.

5.3.4.2 West Central 201 Study Area. For the purposes of future investigation, this study area may be divided by the Long Island Expressway into a northern and a southern segment, due primarily to the provisions for diversion of flow of the southern portion of this 201 study area to the Southwest Sewer District (Suffolk County Sewer District No. Three).

A. *Northern Area.* This portion of the 201 area north of the L.I.E., which is largely unsewered, has five existing sewage treatment facilities.

Hydrogeologic Zones

Zone I

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Further evaluation of the following options is required as part of the 201 plan for selection of the preferred sewage treatment alternative.

a. Sites for the Sub-Regional Alternative
   i. Suffolk State School and
   ii. Facility located in the eastern portion of this area.

b. Small Treatment Plants Alternative—All sewage treatment plants will be required to provide AWT (nitrogen removal).

c. Diversion to the Suffolk County Sewer District No. Three Water Pollution Control Plant (Bergen Point).

B. *Southern Area.* The portion of the 201 area south of the L.I.E. is again predominantly unsewered. There are eight existing sewage treatment facilities.

Hydrogeologic Zones

Zone I

1. In developed areas not presently sewered, plans for sewering where the current density of nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

5. This area is included in the study area of the recently initiated Flow Augmentation Needs Study, which will determine the need and, if necessary, the method of mitigating the impact of possible reduced groundwater levels and streamflow resulting from sewering at the Southwest Sewer District (S.W.S.D.). The impact of sewering in this portion of the West Central 201 study area will require further investigation.

6. Interceptor sewers of the S.W.S.D. are sized to accept sewage flow from this area north of the S.W.S.D. Therefore, the recommended means for providing sewer service to this area is to extend those interceptor sewers from the S.W.S.D. which would serve areas of Zone I in accordance with the 208 sewering criteria as substantiated by the prescribed groundwater sampling program. Furthermore, it should be noted that extensions of interceptor sewers from the S.W.S.D. to serve Zone I of the study area must pass through Zone VII. Therefore, service would also be made available to those areas of Zone VII tributary to the interceptors required for Zone I. This recommendation will require further evaluation to assess the impact of effluent disposal alternatives.

Zone VII

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. Sewer in those areas where on-lot sewage disposal systems are subject to failure and cannot be upgraded due to high groundwater table, low soil permeability, small lot size, etc.

3. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

Pilgrim State Hospital.

A priority has been established for the sub-drainage area that includes Pilgrim State Hospital and AIL (Cutler Hammer) Corporation. Both of these facilities are in violation of their SPDES permits, and require upgrading. In additon, Pilgrim State provides sewage treatment services for Suffolk Community College, West Campus, and the planned Multi-Town Solid Waste Facility, which will also require extensive sewage service. Therefore, a modified 201 Study for this drainage area should begin immediately, with the results required to be consistent with the 208 recommendations for Zones I and VII of the entire West Central 201 study area.

If the 201 Study for the West Central area is begun prior to approval of the 201 facilities plan for the modified area, then the information developed should be used as input for the more comprehensive study area and further work on the modified 201 should terminate.

On the other hand, if 201 planning has not been initiated for the entire area, then the modified area should be considered eligible for necessary funding required for Step II and Step III activities. Also, this procedure would serve as a model for initiating studies for other identified problem areas.

5.3.4.3 Southwest Sewer District (Suffolk County Sewer District No. 3).

Hydrogeologic Zones

Zone VII

1. This area is, or will be, essentially completely sewered, and no further sewering options exist. Present plans generally conform to recommended 208 guidelines.

Surface Water Elements

1. Construction has begun for an ocean outfall for effluent disposal from the Bergen Point Water Pollution Control Plant. The 208 Study has verified that, at design flow, a bay discharge of secondary effluent from this facility would have resulted in unacceptable bay water quality.

2. Stress the future implementation of non-point source controls, if proven feasible, in order to assist in upgrading surface water quality to increase open shellfishing areas.

3. The recently initiated Flow Augmentation Study will determine the need and, if necessary, the method for mitigating the impact of possible reduced stream flow resulting from sewering in the S.W.S.D.

5.3.4.4 Kings Park 201 Study Area. Portions of the study area are

sewered, and there are eight existing treatment facilities.

Hydrogeologic Zones

Zone I

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 foot lot size).

5. The 208 Program has not identified a need for groundwater recharge in this area for the purpose of preserving the drinking water supply. However, the importance of maintaining the flow and water quality of the Nissequogue River will require the investigation of possible streamflow augmentation needs.

Zone VIII

1. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

2. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

Surface Water Elements

1. The following sewage treatment options require further evaluation as part of the 201 facilities plan:

a. Site for Regional Alternative
   i. Kings Park Sewage Treatment Plant

b. Sites for Sub-Regional Alternative
   i. Kings Park Sewage Treatment Plant
   ii. Suffolk County Center Sewage Treatment Plant

c. Small Plants—(1) maintain and upgrade existing treatment facilities to AWT. (2) Investigate cost-effective combinations of sewage treatment plants. (3) Provide additional facilities in accordance with sewering criteria.

2. Investigate the need for streamflow augmentation for the Nissequogue River.

5.3.4.5 Port Jefferson 201 Study Area. Significant portions of this study area are presently sewered, and there are two existing treatment facilities.

Hydrogeologic Zones

Zone I

1. Due to the advanced state of 201 facilities planning for this study area, the time schedule does not allow for a substantial groundwater monitoring program. Therefore, additional sewer service beyond that provided by the existing facilities should be based on the minimum sewering guideline, except where existing groundwater data is sufficient to identify a problem area that requires sewering.

2. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

3. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

4. In any detailed study area, a monitoring program should be instituted and continued beyond the completion of Phase I of the 201 Facilities Plan in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

5. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Zone VIII

1. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

2. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

Surface Water Elements

1. The 208 has not selected a recommended alternative for sewage treatment and disposal. It is required that the 201 Study select the number and location of facilities by evaluating combinations of existing facilities and other suitable sites.

2. Surface water discharge shall not exceed the waste load allocations established by the 208 Study.

5.3.4.6 South Central 201 Study Area. In this study area there are numerous pockets of development that are presently sewered, and there are

thirty-one existing treatment facilities.

Hydrogeologic Zones

Zone 1

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

5. The 208 Study has not identified a need for groundwater recharge in this area for the purpose of preserving drinking water supply. However, the importance of maintaining the flow and water quality of streams in this area, especially of the Connetquot River, and the water level of Lake Ronkonkoma, will require the investigation of possible streamflow augmentation and lake level maintenance needs.

Zone III

1. Land use controls should be the primary method for protecting this valuable groundwater resource. Where residential development is allowed, large lot development (two acre zoning or greater) should be required. Encourage the preservation of existing large land holdings and natural vegetation. A groundwater monitoring program should be employed to ensure timeliness of mitigation if degradation is discerned.

2. In the areas of this zone where it is infeasible to implement the preceding recommendation due to existing development of land allocation of planned development, the following actions are recommended:

a. Require sewering at densities of one or more dwelling units per acre.

b. Stress implementation of those non-point source controls proven feasible, in order to protect groundwater quality.

3. The 208 Program has not identified a need for groundwater recharge in this area for the purpose of preserving the drinking water supply. However, the importance of maintaining the flow and water quality of the Carmans River will require the investigation of possible streamflow augmentation needs.

Zone VI

1. Due to the impact of this area on the sensitive eastern Great South Bay, sewering is required at densities of one or more dwelling units per acre.

2. Stress the implementation of those non-point source controls proven feasible, in order to assist in upgrading surface water quality to protect shellfishing areas.

3. The 208 Study has not identified a need for groundwater recharge in this area for the purpose of preserving drinking water supply. However, the importance of maintaining the flow and water quality of streams in this area, especially of the Connetquot River, will require the investigation of possible streamflow augmentation needs.

Surface Water Elements

1. Duck farms are to conform to compliance schedules which require zero discharge by 1983.

2. The following sewage treatment options require further evaluation as part of the 201 facilities plan.

a. Regional Alternative Site
(To be selected)

b. Sites for the Sub-Regional Alternative
i. West of Lake Ronkonkoma
ii. Oakdale vicinity
iii. Sayville vicinity
iv. The Parkland III and S.C.S.D. No. 7 (Medford) facilities would be maintained.

c. Small Plants—(1) Maintain and upgrade existing treatment facilities to AWT (nitrogen removal). (2) Investigate cost-effective combinations of sewage treatment plants. (3) Provide additional facilities in accordance with sewering criteria for the various zones.

Village of Patchogue

A priority has been identified for the Patchogue Village Sewage Treatment Plant, which is presently in violation of its SPDES permit. The following is the recommended course of action to address this immediate need.

1. The "first-stage" 201 Study presently being conducted by the Village should consider the following:

a. Sewering those areas where on-lot sewage disposal systems are subject to failure.

b. Sewering those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters, which results in a contravention of the standards.

c. Upgrading the sewage treatment plant according to the recommendations in this Plan.

d. Implementing the recommendations for Zone VI of the South Central study area, where applicable.

2. If a 201 Study is begun for an area similar to the South Central Study Area before approval of the village's "first-stage" 201 facility report

(estimated for April 1979), the information developed by the village should be fully incorporated into such study so as to avoid duplication of effort and the village's "first-stage" 201 Study should cease.

3. If no 201 Study is begun before approval of the village's "first-stage" 201 facility report, the village should be considered eligible for Section 201 funding for subsequent Step II and Step III work, to carry out its approved 201 facility report.

5.3.4.7 Yaphank 201 Study Area. There are numerous pockets of development in this study area that are presently sewered, and there are twenty-five existing treatment facilities.

Hydrogeologic Zones

Zone I

1. In developed areas not presently sewered, (three dwelling units per gross acre) plans for sewering where the current density is nine persons per gross acre should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Zone III

1. Land use controls should be the primary method for protecting this valuable groundwater resource. Where residential development is allowed, large lot development (two acre zoning or greater) should be required. Encourage the preservation of existing large land holdings and natural vegetation. A groundwater monitoring program should be employed to ensure timeliness of mitigation if degradation is discerned.

2. In the areas of this zone where it is infeasible to implement the preceding recommendation due to existing development of land allocation of planned development, the following actions are recommended:

a. Require sewering at densities of one or more dwelling units per acre.

b. Stress implementation of those non-point source controls proven feasible, in order to protect groundwater quality.

3. The 208 Program has not identified a need for groundwater recharge in this area for the purpose of preserving the drinking water supply. However, the importance of maintaining the flow and water quality of the Carmans River will require the investigation of possible streamflow augmentation needs.

Zone VI

1. Due to the impact of this area on the sensitive eastern Great South Bay, sewering is required at densities of one or more dwelling units per acre. In order to maintain groundwater Nitrogen at or below two milligrams per liter, collection and treatment should be provided when densities reach one or more D.U./gross acre.

2. Stress the implementation of those non-point source controls proven feasible in order to assist in upgrading surface water quality to protect shellfishing areas.

3. The 208 Program has not identified a need for groundwater recharge in this area for the purpose of preserving the drinking water supply. However, the importance of maintaining the flow and water quality of the Carmans River will require the investigation of possible streamflow augmentation needs.

Zone VIII

1. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

2. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

Surface Water Element

1. Stabilize or upgrade the ocean inlet of Moriches Bay.

2. Duck farms are to conform to compliance schedules, which require zero discharge by 1983.

3. The following sewage treatment options require further evaluation as part of the 201 facilities plan.

a. Sites for the Sub-Regional Alternative
   - i. Three sites:
     - (a) Selden Sanitary
     - (b) Suffolk County property at Horse Block Road
     - (c) Mastic Beach east of William Floyd Parkway
   - ii. Six sites:
     - (a) utilize the three sites of No.1
     - (b) Rocky Point vicinity
     - (c) Artist Lake vicinity
     - (d) Center Moriches east of Forge River

b. Small Plants
   - i. Maintain and upgrade existing treatment facilities to AWT.
   - ii. Investigate cost-effective combinations of sewage treatment plants.
   - iii. Provide additional facilities in accordance with sewering criteria for the various zones.

5.2.4.8 Riverhead 201 Study Area. The 201 facilities plan for the

study is presently underway. There are currently four treatment facilities in this area including the Town of Riverhead Sewage Treatment Plant.

Hydrogeologic Zones

Zone III

1. Land use controls should be the primary method for protecting this valuable groundwater resource. Where residential development is allowed, large lot development (two acre zoning or greater) should be required. Encourage the preservation of existing large land holdings. A groundwater monitoring program should be employed to ensure timeliness of mitigation if degradation is discerned.

2. In the areas of this zone where it is infeasible to implement recommendation (1) due to existing development or land allocation of planned development, the following actions are recommended:

a. Require sewering at densities of one or more dwelling units per acre.

b. Stress implementation of those non-point source controls proven feasible, in order to protect groundwater quality.

3. The 208 Program has not identified a need for groundwater recharge in this area for the purpose of preserving the drinking water supply. However, the importance of maintaining the flow and water quality of the Peconic River will require the investigation of possible streamflow augmentation needs.

Zone IV

The desired goal is self-sufficiency in respect to water supply, therefore, recommended measures are directed towards obviating the need for importation of drinking water while maintaining the quality and quantity of the groundwater.

1. Due to the advanced state of 201 facilities planning in this study area, the time schedule does not allow for a substantial groundwater monitoring program. Therefore, additional sewer service beyond that provided by the existing facilities should be based on the minimum sewering guideline, except where existing groundwater data is sufficient to identify a problem area that requires sewering.

2. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

3. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Zone VIII

1. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

2. Sewer in those areas where contaminated underflow may reasonably be expected to contribute pollutants to the surface waters and to result in a contravention of the standards.

Surface Water Element

1. Duck farm treatment facilities are to conform to compliance schedules, which will require zero discharge by 1983.

2. No additional waste loading should be allowed from the Brookhaven National Laboratory or Grumman Sewage Treatment Plants.

3. The Riverhead Sewage Treatment Plant discharge should be relocated out of the Peconic Estuary. Monitoring should be conducted to determine when relocation will become necessary.

4. The following treatment options are to be evaluated as part of the 201 facilities plan:

a. Site for Regional Alternative

i. Riverhead Sewage Treatment Plant—expand service area in accordance with sewering criteria

b. Sites for Sub-Regional Alternative

i. Riverhead Sewage Treatment Plant

ii. Manorville

c. Small Plants—Provide facilities as needed in accordance with sewering criteria. All sewage treatment plants with inland disposal will require AWT (nitrogen removal).

5.3.4.9 Village of Greenport/Town of Southold 201 Study Area. A 201 facilities plan is currently being initiated for this study area. There are two existing facilities.

Hydrogeologic Zones

Zone IV

The desired goal is self-sufficiency in respect to water supply; therefore, recommended measures are directed towards obviating the need for importation of drinking water while maintaining the quality and quantity of the groundwater.

1. In developed areas not presently sewered, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. Sewer in those areas where on-lot sewage systems are subject to

failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

5. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Surface Water Elements

1. The following sewage treatment options require further evaluation as part of the 201 facilities plan:

a. Small Treatment Plants

i. Village of Greenport Sewage Treatment Plant—expand service area in accordance with sewering criteria. Investigate the need for recharge to preclude saltwater intrusions. Recharge would require AWT (nitrogen removal).

ii. Additional sites to be selected as needed for areas which satisfy sewering criteria. All sewage treatment plants with inland disposal will require AWT (nitrogen removal).

5.3.4.10 Disposal District Fourteen—Shelter Island. There is currently one primary treatment plant serving Shelter Island Heights.

1. In developed areas not presently sewered or scheduled for sewering, plans for sewering, where the current density is nine or more persons per gross acre (three dwelling units per gross acre), should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Surface Water Elements

1. Shelter Island Heights Sewage Treatment Plant—expand service area in accordance with sewering criteria. Upgrade facility to secondary treatment with discharge to Shelter Island Sound.

5.3.4.11 Disposal District Twelve (Western Portion of the Town of Southampton). There are two existing treatment plants in this study area.

Hydrogeologic Zones

Zone V

1. In developed areas not presently sewered or scheduled for sewering, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be initiated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. Sewer in those areas where on-lot sewage systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

5. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Zone VI

1. If duck sludge is *not* the controlling influence on bay water quality, and if the maintenance of the ocean inlet does *not* provide the desired improvement, then collect and treat at one or more D.U./acre in presently developed areas.

2. In order to maintain groundwater Nitrogen at or below two milligrams per liter, collection and treatment should be provided when densities reach one or more D.U./gross acre.

3. Stress the implementation of those non-point source controls proven feasible, in order to assist in upgrading surface water quality to protect shellfishing areas.

Surface Water Elements

1. Stabilize or upgrade the existing ocean inlet to Moriches Bay.

2. If recommendation number one is ineffective, then despite the low population density projected for much of this area, the desire to maintain or upgrade the water quality of the Moriches Bay will require the evaluation of the possible need for small treatment facilities. Sites are to be selected as needed for area that satisfy sewering criteria. All sewage treatment plants with inland disposal will require AWT (nitrogen removal).

5.3.4.12 Disposal District Fifteen (Eastern Portion of the Town of Southampton and the Town of East Hampton). There are currently two treatment facilities in this study area.

Hydrogeologic Zones

Zones IV and V

1. In developed areas not presently sewered or scheduled for sewering, plans for sewering where the current density is nine or more persons per gross acre (three dwelling units per gross acre) should be inititated.

2. In addition to the planning for sewering at nine or more persons per gross acre, the implementation of non-structural controls should be initiated

immediately.

3. In any detailed study area, a monitoring program should be instituted in order to determine the quality of the water table aquifer and the efficacy of the non-point source controls. Where it is found that area-average nitrate-nitrogen levels are six milligrams per liter or greater, or when other contaminants are in excess of groundwater standards, and where the pollution may reasonably be expected to result from on-lot systems, sewering should be initiated at densities less than nine persons per gross acre (three dwelling units per gross acre).

4. Sewer in those areas where on-lot systems are subject to failure and cannot be upgraded due to soil conditions, high groundwater, small lot size and other considerations.

5. As currently vacant land is developed, sewer at the present SCDHS designated density of approximately two dwelling units per acre (less than 20,000 square foot lot size).

Surface Water Elements

1. Mecox Bay—restrict the development of shoreline areas abutting the bay.

2. The following small sewage treatment plant options should be evaluated:

a. Maintain existing facilities.

b. Extend Sag Harbor service area in accordance with sewering criteria.

c. Provide new facilities in accordance with sewering criteria.

5.3.4.13 Disposal District 16—(Montauk Area). There is one treatment facility servicing the Air Force base. Due to the low population density projected for this area, no additional sewering appears to be necessary.

5.3.4.14 Disposal District 17—Fishers Island. The collection system discharges raw sewage to Long Island Sound. Therefore, it is recommended that secondary treatment be provided with Long Island Sound discharge.

5.4 Inter-Jurisdictional Recommendations

5.4.1 Western Long Island Sound. Long Island Sound conditions exert a dominant influence on water quality within Manhasset Bay and Hempstead Harbor. Western Long Island Sound waters are characterized by high levels of solids, nitrogen and bacteria. Since most of the high levels of suspended solids, nitrogen and coliform bacteria in western Long Island Sound can be traced to discharges within New York City, Long Island Sound conditions are largely beyond the control of the Nassau-Suffolk 208 Program. It is therefore the responsibility of the USEPA and NYSDEC to require the implementation of waste controls necessary to improve water quality to meet the standards specified for this surface water segment. These controls may include nitrogen removal for existing sewage treatment plants and the retention and treatment of combined sewer overflows. Pretreatment for metals and/or organic chemicals may be in order if it can be shown that toxic contaminants move from New York City into the Sound.

5.4.2 Nearshore Atlantic Ocean. It is the responsibility of the USEPA and NYSDEC to insure that necessary wastewater controls are implemented to prevent the discharge of contaminants and floatable material into the New York Bight. Such contaminants and floatables have particularly impaired the use of regional ocean bathing beaches. These regulations should apply to the control and treatment of raw or inadequately treated sewage discharges, industrial discharges and combined sewer overflows from sites located in New York City and New Jersey.

5.4.3 Western Nassau County. Jamaica Water Company is currently creating significant groundwater movement from western Nassau County to Queens. The company's heavy pumping in Queens has resulted in a significant reduction in the water levels in western Nassau. It is the responsibility of the NYSDEC to implement whatever pumping controls are necessary to prevent the continued underflow to Queens to permit the recovery of water levels and to prevent accelerated saltwater intrusion in western Nassau County.

5.5 The Need for Further Regional Studies, Demonstration Projects and Research

The 208 Program has raised numerous wastewater management questions that are of importance to Long Island and, in many cases, to the Nation as well.

The continuation of studies initiated as part of the 208 Program, including further monitoring and data analysis, is needed to provide essential information in several general areas, including hydrogeologic relationships, correlation between population density and groundwater quality, organic chemical and other contamination of groundwater, and viruses in aquatic systems.

The establishment of demonstration projects is needed to test promising pollution control techniques and to permit the further refinement and development of cost-effective, environmentally acceptable recommendations for incorporation in 208 plans as they are updated in the future. Among these are the water quality impacts associated with street vacuuming and subsurface denitrification.

Research is needed to identify the intermedia impacts of air pollution on wastewater management options and of wastewater management options on air quality, and to permit an evaluation of the nitrate standard for drinking water.

The following brief descriptions indicate the general nature of the proposed studies or projects, the agency or level of government capable of undertaking responsibility for or actually performing the work, and estimated costs, where appropriate.

5.5.1 Continuation of Regional Studies

5.5.1.1 Further Definition of Groundwater Management Zones. The boundaries of the groundwater management zones shown in Figure 3—2 depend, in many cases, on a distinction between areas where recharge from

the land surface generally enters either a shallow or deep flow system. In many areas, recharge to the deep flow system implies recharge to the Magothy aquifer. In the so-called shallow flow systems, the depth of flow is generally restricted to a depth of one to two hundred feet. The zone boundaries as mapped are based on existing data and are only approximate. In many cases, the distinctions between these systems is often not clear and distinct. Since a number of important wastewater management decisions may be based on these flow relationships, it is recommended that further investigations be initiated. The studies of the groundwater flow systems in and around the zone boundary lines should be conducted first on a sub-regional basis in areas where a major wastewater decision is expected in the near future. For example, it would be desirable to investigate those regions where large-scale sewering or development is proposed.

In southwest Suffolk County, it is expected that many of the questions regarding depth, direction and rates of groundwater flow will be answered as part of the proposed stream augmentation feasibility study. In order to answer the critical questions in any area, it will be necessary to drill and construct a series of wells and piezometers screened at different depths. These would be designed to (1) locate and define the extent of any confining clay layers such as the Gardiners Clay, which separate the shallow and deep aquifers; (2) map the direction of groundwater flow under existing conditions by measuring water levels at various depths; and (3) obtain water samples from various depths to see if hydrogeologic factors are providing any protection to the deeper aquifer. In addition, a number of pumping tests would be conducted at various depths to evaluate the hydraulic connection between the shallow and deep aquifer systems and to examine the effect of any confining clay layers.

This approach to the definition of groundwater flow is similar to that attempted in many of the USGS Water Supply Papers of past years. However, the USGS was forced to rely on existing data that, generally, was adequate only to define gross directions of flow. Data from such an investigation could provide considerable insight as to the possible benefits or adverse effects associated with a particular wastewater decision. For instance, it would be very useful to know if groundwater contamination resulting from large-scale development of an area would be likely to affect drinking water supplies or shallow groundwater discharges to streams and bays. In addition, it would be useful to have a clear picture of what portions of the groundwater reservoir might benefit from sewering or non-point source controls.

The regional digital model developed as part of the 208 can be modified, updated and calibrated using the new information developed from the sub-regional investigations. In this way, the model may be used to aid in evaluating 201 wastewater management decisions, especially in relation to overall options for the bi-county area. The extent and cost of such an investigation would vary considerably, depending on the size and location of the area to be studied. It is estimated that for a large sub-region such as the Smithtown-Port Jefferson area, perhaps a dozen or so piezometers or well clusters would be necessary. The cost of such a program, including drilling, testing and hydrogeologic investigation would probably be about $400,000 for a single sub-region. This is a small fraction of the cost of any large sewering or development program. Digital modeling, where necessary, may cost an additional $200,000. The Regional Planning Board and/or the counties should be responsible for this work.

5.5.1.2 Application of the Regional Digital Models to Evaluate Region-Wide Effects of Man-Induced Changes in Groundwater Elevations. Groundwater elevations fluctuate due to natural and man-induced changes in recharge and groundwater pumpage. Declines in groundwater levels can adversely impact water supply, fresh surface waters and groundwater level dependent ecosystems. Some research is currently planned to evaluate these impacts in selected 201 areas. However, evaluations of these impacts is needed on a regional basis.

Specific research needs include utilization of the regional digital groundwater model to determine the regional response of groundwater levels to (1) groundwater pumping alternatives, (2) changes in stormwater recharge, and (3) sewering alternatives. The results of this work should lead to recommendations for groundwater elevations. The estimated cost is $300,000. The Regional Planning Board and/or the counties should be responsible for this work.

5.5.1.3 Detailed Mapping of Land Uses, Natural Resources and Environmental Constraints for the Deep Flow Aquifer Recharge Area. Existing land use maps and tabulations for the deep flow areas, although adequate for general planning purposes, do not provide the detailed resolution most appropriate for local as opposed to areawide wastewater management. Natural resources and environmental constraints maps are currently unavailable. Maps similar to the detailed land use, natural resources and environmental constraints maps already prepared for the coastal zone are needed for further implementation of the chosen wastewater management strategies, particularly those relying on non-structural approaches to the prevention or mitigation of non-point pollution. Data collection, interpretation and mapping should be undertaken by the Nassau-Suffolk Regional Planning Board. The task is expected to take one and one half years. The estimated cost is $400,000.

5.5.1.4 Extent and Causes of Organic Chemical Contamination

a. *Inventory of Organic Chemical Sources.* Organic chemicals are an important contaminant of the Long Island aquifers. Efforts to formulate a control strategy are hampered by a lack of data concerning sources. Thus, a complete inventory is required. This inventory should cover (a) industrial point sources, (b) waste water treatment plant effluents, (c) runoff recharge, (d) landfills and hazardous waste facilities, (e) domestic non-point sources and (f) industrial non-point sources. The inventory must present estimates of mass loading per unit time for all of the contaminants occurring in groundwater at ten micrograms per liter. Nassau and Suffolk Counties should undertake this work. The counties should also continue their sampling for organic

chemicals in the Magothy aquifer. The estimated cost of this work is $350,000.

b. *Organic Chemical Sources—Landfills, Waste Water Treatment Plant Outfalls, Runoff Recharge Basins.* On the basis of preliminary findings, all three of the above listed pollutant sources appear to be significant with respect to organics. The three should be similarly characterized if identified by the organics source inventory. Characterization of sources will require collection of a number of samples, defined by a source-specific sampling plan, with several replicates for each sample. The effort should be undertaken by Nassau and Suffolk Counties. For each source studied, $50,000 is required.

5.5.1.5 Evaluation and Monitoring of the Movement of Heavy Metals and Organic Chemicals in the Aquifer System.

The discharge of untreated and treated industrial and domestic liquid wastes to septic tanks, cesspools and recharge basins has been an accepted disposal practice in Nassau and Suffolk Counties. Many of these waste streams contain small concentrations of heavy metals and organic chemicals that are considered hazardous. In addition, studies undertaken as part of the Long Island 208 investigation have shown that other sources of hazardous substances also exist in the area. Some spills and incidental discharges at industrial and commercial facilities and along transportation routes also contain heavy metals and organic chemicals.

Significant discharge of such pollutants to the ground has been occurring on Long Island for decades. Because of heavy groundwater withdrawals and the resulting pumping patterns, the migration of pollutants from the surface into the deeper aquifers presently used for public water supply may be accelerating. Monitoring to date has already shown their presence in deeper aquifers, and this has led to restriction of the use of some wells in various parts of the two counties.

There is a definite need for more complete evaluation and monitoring of the movement of heavy metals and organic chemicals throughout the aquifer system underlying the Island so that an assessment can be made of the long-term threat to continued use of groundwater in critical water supply areas. At the present time, monitoring programs are incomplete from the standpoint of serving as a warning mechanism on the vertical and lateral migration of hazardous chemicals. It is not known, for example, whether shallow untapped aquifers contain high concentrations of heavy metals and organic chemicals that may in the future move into the deeper, heavily pumped, aquifers. If this were to occur on a broad scale, the results would be a significant reduction in the availability of potable groundwater in the Region.

The Nassau-Suffolk Regional Planning Board and the two counties should be responsible for the work, which is expected to take one and one-half years. The estimated cost is $750,000.

5.5.1.6 Assimilative Capacity of Subsoils. Measure and determine the saturation capacity, and whether a substantial difference exists between assimilative or absorptive capacity of different soils in various formations, and determine the limits of these natural treatment processes. The ability to predict saturation levels of various subsoils would aid greatly in the planning of recharge facilities and water supply systems. The information gathered could become an integral part of the groundwater quality model developed in the 208 Program. The soil columns findings could be used in conjunction with viral, organic chemicals, heavy metal studies, etc. The Suffolk County Department of Health Services should undertake a two year study. The estimated cost is $75,000.

5.5.1.7 Determination of the Impact of Leakage and Spills from Hazardous Materials Storage and Transport, and Identification of Best Means of Control. Sufficient evidence already exists to indicate that leakage of materials such as gasoline, fuel oil, solvents and chemicals into the groundwater from storage and transport facilities constitutes a major pollution problem that must be controlled. A study is needed to further define the problem and to provide the information necessary to develop legislation for control. Once regulations exist, enforcement will proceed involving extensive testing and inspection of tanks and pipelines with repair, improvement or replacement as needed. This will also lead to the discovery of existing pockets of contamination and subsequent clean-up operations. This study and the resulting regulating activities can be carried out by the Nassau County Department of Health in Nassau and by the Suffolk County Department of Environmental Control in Suffolk, with the addition of adequate personnel and equipment. The study will take two to three years. Estimated cost is $320,000.

5.5.1.8 Measurement of Groundwater Underflow Quantity and Quality and Impacts of Duck Sludge Deposits. Groundwater has been shown to be a major source of nitrogen to systems such as Great South Bay and Flanders Bay, where long residence times allow buildup of the nutrients to signifianct levels. Due to the typically good flushing of the North Shore bays, groundwater sources are fairly insignifiant there, compared with the boundary water quality effects of Long Island Sound. Presently, there are no data on actual quantity or quality of groundwater underflow through the bay bottoms. Values for flow quantities used in model calculations were based indirectly on estimates from the USGS groundwater analog modeling efforts, whereas quality was estimated indirectly through historical well sampling landward along the shoreline.

Millions of cubic yards of duck sludge have accumulated in portions of Moriches and Flanders Bays as a result of decades of duck farm operations. Virtually no data exist, however, to establish whether or not the old sludge represents a bacterial or nutrient source. Waste management alternatives currently being formulated for Flanders Bay assume zero discharge from duck farms by 1981. The question of residual loadings from the old sludge deposits remains, however, and cannot be factored into waste load allocations to the bay. In Moriches Bay, where the deposits are most extensive, it has not been possible to estimate nutrient loadings from the sludge deposits.

Recently, a method utilizing enclosed chambers has been devised for directly measuring groundwater seepage rates through the bay bottom and the quality of that groundwater. It is now felt that, since a method for direct measurement is available, such a study would be feasible and practical in assessing groundwater influence and duck sludge influence on bay water quality. Since this type of study should be handled on a regional basis throughout the South Shore bays and in the Peconic Estuary, it is recommended that the Nassau-Suffolk Regional Planning Board and the two counties be responsible. The cost of one summer's field effort for this study would be apporximately $75,000.

5.5.1.9 Determination of the Effects of Inlet Closure on the Water Quality of Moriches, Shinnecock and Mecox Bays and of Inlet Creation on the Water Quality of Eastern Great South Bay. Historically, Moriches, Shinnecock and Mecox Inlets have had a significant impact on water quality within these bays. At present, Moriches Inlet is reported to be closing up, which means that ocean flushing of contaminants will become greatly retarded in Moriches Bay. Considering that water quality conditions are already stressed in Moriches Bay with an open inlet, and in the interest of preserving the high quality of Shinnecock Bay waters, modeling of the two bay systems to allow selection of alternative solutions (such as maintaining the inlets) is recommended. Similar studies should be conducted for Mecox Bay, to determine the water quality benefits of maintaining a permanent inlet.

This modeling study would follow much the same procedure as for the South Shore bays west of Moriches Bay under the Nassau-Suffolk Regional Planning Board 208 Program.

An additional item of interest to wastewater management in this area is the alternative of creating a new inlet through the Fire Island barrier beach in eastern Great South Bay. Such an inlet, if determined feasible, would relax restrictions on point source waste loads within eastern Great South Bay by increasing the ocean flushing of this area. An integral part of this study would include an environmental assessment of the resulting changes in salinity.

Ideally, all of the above problems should be studied simultaneously, since there is considerable hydraulic interface between eastern Great South Bay, Moriches Bay and Shinnecock Bay. A modeling study to address these problems would involve design of monitoring programs, waste source inventory and load estimates, model set up, calibration, verification and calculation of alternatives. Most of this work is completed for the area west of Moriches Bay and could be adapted directly to the study. Such a program could be carried out by the Nassau-Suffolk Regional Planning Board and the two counties. An estimate of the cost for such a program is $300,000.

5.5.1.10 Fertilizer Research. Fertilizers have been identified as significant contributors to Long Island water quality problems. Two research projects should be initiated in order to resolve questions relating to fertilizer use and water quality.

a. *Fertilizer-Nutrient Balance.* The fate of fertilizer nutrients applied to Long Island's agricultural crops (potato, vegetable, nursery, orchard and sod) is understood to some degree. However, there are many variables that influence the movement and ultimate disposition of the nitrogen and phosphorus during and after the growing season. Crop uptake of nutrients varies with the life cycle of the plant. Precipitation patterns during the growing season influence the extent to which nutrients are washed from the surface and leach through the soil profile. Precipitation after the harvest, especially during periods of high runoff when the ground is frozen, may transport the residual nutrients to surface waters. Soil characteristics such as texture, depth and slope also affect the washing and leaching of fertilizers. The timing and method of fertilizer application (broadcast or sub-surface bonding) with respect to the crop requirements, root system and climatic conditions, influences the paths of nutrient transport. Extensive studies to assess the influence of such characteristics on potato crops have already been completed. Further research is now required for other crops and turf to develop a nutrient balance model identifying the nutrient uptake by type of crop, the nutrient leaching through the soil and the nutrient loss associated with stormwater runoff. Investigations using replicate plots to permit evaluation of variations in fertilizer application should be continued year-round for a period of at least three years.

b. *Fertilizer Formulations.* The control of fertilizer-related pollution of ground and surface waters in urban and suburban areas, especially in western Long Island, is largely dependent upon the success of educational efforts since the regulation of lawn fertilizer application practices is not considered feasible at this time. Identification of a relatively non-polluting fertilizer formulation would be a useful adjunct to an educational program.

Organic fertilizers are known to release nitrogen more slowly than inorganic fertilizers. However, local field testing is required to determine whether, and to what extent, the use of organic based nitrogen fertilizers can reduce water pollution on Long Island.

A research program should be developed in which various formulations of fertilizer would be applied to replicate plots of turf. Leachate and stormwater runoff nitrate concentrations, and crop uptake of nitrates, should be determined in order to evaluate the pathways of nitrogen transport and the availability of nitrogen throughout the growing season. Also, the feasibility of recycling existing sources of nitrogen, such as sludge from domestic sewage treatment, should be rigorously explored.

Cornell University should act as lead agency for the above studies, which could be carried out in cooperation with the U. S. Geological Survey and the Suffolk County Department of Environmental Control. Total estimated cost is $100,000.

5.5.1.11 Groundwater Screening for Aldicarb. Aldicarb has been identified as a potential groundwater contaminant. A separate program to look specifically for Aldicarb in groundwater underlying farm areas should be undertaken. New York State should assume responsibility for this work,

which could be carried out by Cornell University-Cooperative Extension Service. Estimated cost is $25,000.

5.5.1.12 Heavy Metals in Sediments. Generally, metals in marine, fresh and groundwater are rapidly adsorbed onto sediments. Major metal pollutant problems have tended to arise from accumulation of metals in the food chain where there is a high metal level concentrated in sediment or water column. Such a situation may occur when sediment metal levels are high and members of the food chain are detritus feeders. Thus, sediment metal levels should be monitored. Such data is lacking for the Long Island bays, and a program should be instituted to obtain it. The work should be undertaken by Nassau County Department of Health, and the Suffolk County Departments of Health Services and Environmental Control, and is expected to cost $125,000.

5.5.2 Demonstration Projects

5.5.2.1 Marsh-Pond Treatment of Sewage. The marsh-pond approach to sewage treatment should be tested at a full-scale installation where it will receive the normal amount of operational attention. The proposed program at Greenport should be encouraged and supported and a similar program instituted elsewhere if the Greenport program is not implemented. The Nassau County Department of Public Works and the Suffolk County Department of Environmental Control should have the responsibility for a two year study. Estimated costs are $100,000.

5.5.2.2 Marsh-Pond Treatment of Runoff. The Nassau-Suffolk 208 Study has identified a number of point sources and non-point source stormwater runoff as significant contributors of pollutants to both surface and groundwaters. The main problem in treating these pollutants arises from the facts that:

a. small point sources are widely dispersed and may involve effluent volumes too small to justify transportation to and disposal at a large regional or subregional wastewater treatment plant; and,

b. stormwater runoff is characterized by highly variable frequencies, volumes, duration and pollutant loadings.

The solution to these problems would be a system that could be scaled for various effluents and volumes, which would be relatively inexpensive to install, have low maintenance and allow discharge of the polished effluents to either ground or surface waters.

Systems such as the marsh-pond form are presently being evaluated on a small scale, primarily for wastewater renovation. However, it appears that they may also provide satisfactory treatment for stormwater runoff prior to recharge or disposal to surface waters. Therefore, projects utilizing the marsh-pond approach should be set up at two existing recharge basins in order to ascertain the degree to which this treatment can improve the efficiency of the basins. Treatment efficiency should be compared to that of two other existing basins that do not employ marsh-pond treatment. Efficiency, in each case, should be determined on the basis of the quality of the recharge water leaving the basin. Particular emphasis should be placed on the removal of heavy metals and organic chemicals. The Nassau County Departments of Health and Public Works, and the Suffolk County Department of Environmental Control should be responsible for the project. Estimated cost is $200,000.

5.5.2.3 Street Cleaning. Two projects should be established to determine the costs and identify the effects of street sweeping/vacuuming programs. A North Shore and South Shore area should be selected in order to permit observation of the effect of topographic influences. Various street sweeping and street vacuuming programs at different frequencies should be studied. The magnitudes of reduction of total annual loads as well as load reductions for individual storm events should be determined. The Nassau County Departments of Health and Public Works and the Suffolk County Department of Environmental Control should be responsible for the project. Estimated cost is $200,000.

5.5.2.4 Structural Treatment of Stormwater Runoff. Structural treatment, employing settling and the swirl-concentrator type of approach, should be evaluated. In addition, the efficiency of treatment by natural impoundments should be analyzed and compared to that of settling basins constructed specifically for the purpose. The Nassau County Departments of Health and Public Works, and the Suffolk County Departments of Environmental Control and Public Works should be responsible for the project. Estimated cost is $2,500,000.

5.5.2.5 Comprehensive Monitoring as an Aid in Making Wastewater Management Decisions. It is recommended that, prior to general implementation of comprehensive monitoring systems, immediate steps be undertaken, in coordination with ongoing 201 investigations, to develop a monitoring system in an area where a decision is pending on sewering and/or non-point source controls. This should be in an unsewered area that has been developed for at least ten years and has a population density of between five and nine persons per acre. The objective of such a demonstration monitoring system would be to establish the sampling frequency, number and spacing of wells and data reduction techniques that could be used as guidelines for subsequent 201 Studies, and for newly developing areas.

In the initial planning of this prototype, considerable attention would be paid to planning the system according to the statistical objectives of the study; that is, to obtain a good estimate of the average shallow groundwater quality and to define the time and spatial variability of selected constituents, particularly nitrates. Analyses have already been conducted within the 208 Program that could aid in planning those systems. The planning, drilling, sampling and analytical techniques developed during this demonstration study could then be used in future programs.

It is estimated that a study of this type would take about one year to complete. Assuming about twenty-five shallow wells were needed, the cost of the total program, including planning, drilling, sampling, analytical work and

data reduction, would probably be about $150,000, and should be conducted by the Nassau County Departments of Health and Public Works, and the Suffolk County Departments of Health Services and Environmental Control.

5.5.2.6 Denitrification of Individual Subsurface Sewage Disposal Facilities. One of the major causes of the increases of nitrate-nitrogen concentrations in groundwater has been attributable to the leaching and subsequent oxidation of ammonium laden wastewaters from the many thousands of cesspools. The Suffolk County Department of Health Services is currently investigating nitrate removal in a subsurface individual sewage disposal system. This program is designed to eliminate nitrates from this source. The experimental unit that has been installed uses methanol in the denitrification phase. The Department is interested in denitrification methods that would not require the homeowner to replenish the methanol, as is required by the present system.

Since it has been demonstrated by the Suffolk County Department of Health Services that denitrification of nitrified septic tank effluent can be achieved under controlled conditions in the ground below a conventional leaching field, steps should now be taken to set up demonstration installations in various parts of the county. Upon the successful completion of these demonstration projects, these systems could be installed as needed throughout the Region. Suffolk County Department of Health Services should undertake a two year project. Estimated cost is $110,000.

5.5.2.7 Removal of Nitrates from Drinking Water Supplies. A number of our public water supplies are experiencing problems as a result of increasing nitrate-nitrogen concentrations in the groundwater supply. The primary cause of these contaminants in some areas has been attributed to the leaching of nitrate fertilizers applied to farms and, possibly, lawns. The Suffolk County Department of Health Services has undertaken a project to perfect means for removal of nitrate contaminants from groundwater to be used for public water supplies. This would be accomplished by a biological denitrification anaerobic filter using methanols or sugar for bacterial activities. This would be treated at the wellhead, followed by rapid sand filters for removal of solids carried over, then followed by disinfection.

The study has progressed to the point of developing laboratory scale systems to investigate various parameters for design. The correlation in the laboratory findings will allow for the development of a pilot scale operating denitrification plant. The construction of a pilot scale operation for denitrification at the wellhead should be continued and, if successful, should provide solutions in areas affected by high nitrates. The Suffolk County Department of Health Services should undertake this project. Estimated cost is $450,000.

5.5.3 Research

5.5.3.1 Viruses in Aquatic Systems. There are no established standards for viral pollution levels in aquatic systems. Reasons for this include sampling difficulty, the lack of a standard method for enumeration and identification of species, and the lack of epidemiological data concerning waterborne transmission of the many viral groups. The study recently undertaken as part of the 208 Program just touched upon the Enterovirus group as it was found in various aquatic systems. However, no information was gathered on non-Enterovirus species, which may also be found in sewage polluted systems.

The following viral studies are needed in order to establish the magnitude of the problem and to permit formulation of appropriate control programs:

a. *Determination of the Significance of Non-Enterovirus Groups such as Adenovirus, Reovirus, Rotavirus and Norwalk Agents in Long Island Aquatic Systems and Wastewaters.* This study will help to quantify non-enterovirus groups, and to identify their sources, in order to assist in the development of control programs.

b. *Determination of the Epidemiological Significance of Human Viral Carriage by Shellfish Taken From Long Island Waters.* Such a study could help to define the problem, identify specific sources and sectors, and permit the formulation of control programs. It might also help to determine whether public health would be better served by the use of shellfish standards, related to the presence of viral agents or other types of indicators, rather than to coliform bacteria.

c. *Determination of the Movement of Virus Particles through Long Island Sub-Soils.* This would assist in the evaluation of standards for the location of wells, recharge basins, etc. and would confirm or refute the current belief that viruses emanating from sewage treatment plants and recharged would not have impact on groundwaters.

These studies should be the responsibility of the Nassau County Department of Health and the Suffolk County Department of Health Services. The cost is estimated to be $450,000.

5.5.3.2 Air Pollution and Wastewater Management (Intermedia Study). Wastewater management is affected by and affects air quality. The following studies can be expected to improve understanding of these relationships and to permit more informed, cost-effective and environmentally acceptable choices among waste management alternatives.

a. *Effects of Air Pollution on Water Quality.* Air pollutants can contaminate rainwater, and thus add non-point pollutant loads to bays and groundwater. To evaluate this problem, a rainwater sampling program is required. A series of samples of rainwater for various recharge areas on Long Island should be studied. These samples should be analyzed for nutrients, metals and organic chemicals.

b. *Effects of Wastewater Treatment on Air Quality.* Incineration, co-incineration, pyrolysis and land application of sludges all have the potential to introduce air pollutants. Standard loading coefficients exist to evaluate expected load per year per quality of sludge. An air quality dispersion model and loading coefficients for other air pollutant sources are both required as

task inputs. The air quality model can then be run for various water quality management and sludge disposal scenarios.

These studies should be undertaken by the Nassau County Department of Health and the Suffolk County Department of Health Services. Total cost is estimated to be $300,000, of which task a. will require $60,000 and task b. $240,000.

5.5.3.3 Evaluation of the Nitrate Standard for Drinking Water. The United States Public Health Services' drinking water standards established in 1962, set a maximum of 45 milligrams per liter nitrate as NO_3 (equivalent ten milligrams per liter as nitrogen). This has been questioned by a great number of eminent scientists. E. F. Winston in 1970 reported that much data did not support the low standards and recommended additional research. In the last five years several studies have been performed which show that relatively high nitrate concentrations in drinking water do not constitute a health hazard. There has not been a reported fatality due to methemoglobinemia in the past seventeen years. Few, if any, cases of methemoglobinemia have been reported in the United States where the water comes from community water supplies. The World Health Organization recommends eleven parts per million nitrate-nitrogen with a maximum of 22 parts per million nitrate-nitrogen. Since a number of researchers have questioned the existing standards and since the World Health Organization has taken steps to change these standards and because of their serious implication on our groundwater supply, we recommend that the EPA systematically review this entire question, taking advantage of all the most recent studies, and update their current standards.